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An Experimental Investigation of the Relationship between Hoarding and Stress

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AN EXPERIMENTAL INVESTIGATION OF THE RELATIONSHIP BETWEEN HOARDING AND STRESS

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Hoarding is an impairing disorder characterized by difficulties with discarding one's belongings and often excessive acquisition, which lead to extreme clutter. Of the hypothesized risk and maintenance factors for hoarding, stress has emerged as an important risk construct. Traumatic and stressful life events have been associated with greater hoarding symptoms and possibly the onset of symptoms; yet, past research is marked by methodological limitations. Using experimental methodology and multi-method assessments, the current study investigated the direct effect of a stress manipulation on subsequent hoarding behaviors; the associations of biological and subjective stress response with hoarding behaviors, symptoms, and cognitions; and the interactive role of stress in predicting hoarding behaviors. Results revealed that subjective stress response was associated with specific hoarding cognitions and acquiring tendencies. Findings also indicated that stress interacted with distress tolerance and negative urgency to predict difficulties discarding. However, due to complex, unexpected findings from the experimental manipulation, no causal conclusions can be drawn at this time. Explanations and suggestions for future research are discussed in order to expand our comprehension of the multi-faceted, complex relationship between hoarding and stress.

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Chapter 1 - Introduction

Overview of Hoarding

Hoarding Disorder (HD) is a severe clinical syndrome (Frost, Steketee, & Williams, 2000; Tolin, Frost, Steketee, & Fitch, 2008; Tolin, Frost, Steketee, Gray, & Fitch, 2008), which affects between three to six percent of the population (Timpano, Exner, et al., 2011). The two core features of hoarding consist of extreme difficulty with discarding one's possessions and severely cluttered living spaces. Another key symptom of hoarding includes excessive acquiring, most often via compulsive buying or the collection of free items (Frost, Tolin, Steketee, Fitch, & Selbo-Bruns, 2009; Timpano, Exner, et al., 2011). Two of these main symptoms--acquiring and saving behaviors--are actually relatively common among the general population, and are usually not considered pathological (Frost & Steketee, 2008). In contrast, in individuals with HD, these features can be so extreme that they lead to substantial distress and impairment.

Research over the last decade has begun to document the significant ways in which HD can present problems for the sufferer, their family, and the community within which they live (Frost, Steketee, & Williams, 2000; Tolin, Frost, Steketee, & Fitch, 2008; Tolin, Frost, Steketee, Gray, et al., 2008). First and foremost, HD has a negative impact on the individual, which includes marked financial, work or social impairment (Tolin, Frost, Steketee, & Fitch, 2008; Tolin, Frost, Steketee, Gray, et al., 2008). HD is also associated with high rates of psychiatric comorbidity, most notably with major depressive disorder (MDD) and generalized anxiety disorder (GAD), and greater levels of physical health

problems, including obesity, arthritis, and fibromyalgia (Frost, Steketee, & Tolin, 2011; Frost, Steketee, & Williams, 2000; Tolin, Frost, Steketee, Gray, et al., 2008). There are also reports of extreme cases of HD, in which clutter directly led to the individual's death by fire or by being crushed under piles of belongings (Frost, Steketee, & Williams, 2000). In addition, family members report high rates of frustration, hostility, and distress due to the hoarding behaviors (Tolin, Frost, Steketee, & Fitch, 2008). Finally, HD represents a tremendous burden on the community, by potentially jeopardizing the health of neighbors and resulting in substantial costs to the public via the involvement of social services and the high rates of healthcare utilization (Frost, Steketee, & Williams, 2000; Tolin, Frost, Steketee, Gray, et al., 2008). The marked impairment associated with HD underscores the need to better understand the etiological and maintenance factors involved in hoarding.

Further investigating the factors involved in the etiology and maintenance of hoarding also has implications for HD's classification within *the Diagnostic and Statistical Manual of Mental Disorders* (DSM-V). Historically hoarding behaviors have been described as a symptom dimension of obsessive-compulsive disorder (OCD) or as a criterion of obsessive-compulsive personality disorder (American Psychiatric Association, 2000; Mataix-Cols et al., 2010). Yet mounting evidence suggests that HD may be better conceptualized as a separate and discrete disorder (Mataix-Cols et al., 2010; Pertusa et al., 2010; Pertusa, Fullana, Singh, Alonso, Menchon, & Mataix-Cols, 2008; Rachman, Elliott, Shafran, & Radomsky, 2009). For instance, HD has exhibited different patterns of comorbidity than

OCD, such as higher rates of MDD, impulse control disorders, and the inattentive subtype of attention deficit hyperactivity disorder (ADHD) (Frost, Steketee, et al., 2011). Furthermore, Frost and colleagues (2011) found that HD was more commonly comorbid with MDD, GAD, and social phobia than with OCD. Another difference emerges when one considers patients' responses to their symptoms. Whereas individuals with OCD view their obsessions and compulsions as fairly ego-dystonic, patients with HD often view their acquiring and saving behaviors as ego-syntonic (Pertusa et al., 2008; Steketee & Frost, 2003). In addition, individuals who hoard show more executive functioning deficits in the areas of categorization (Luchian, McNally, & Hooley, 2007; Wincze, Steketee, & Frost, 2007), attention (Hartl, Duffany, Allen, Steketee, & Frost, 2005), and decision-making (Samuels et al., 2007) than OCD patients. Lastly, recent research also suggests that HD is neurobiologically different from OCD (Saxena, 2008; Saxena et al., 2004). The data gathered thus far have substantiated the efforts to identify HD in DSM-V; nevertheless, many questions about its classification within the DSM remain (e.g., within which category HD should be placed).

Considering the distress and impairment associated with HD, it is regrettable that it has been acknowledged as a challenging syndrome to treat. Hoarding symptoms are a known predictor of treatment drop-out and failure in studies of pharmacological and behavioral interventions typically used to treat OCD (Abramowitz, Franklin, Schwartz, & Furr, 2003; Mataix-Cols, Marks, Greist, Kobak, & Baer, 2002). Although newer, potentially more effective treatments are being developed specifically for HD, the level of response is still relatively low

and the treatments are extremely labor intensive with an average of 22 sessions (e.g., Frost, Pekareva-Kochergina, & Maxner, 2011; Steketee & Tolin, 2011). Given that the majority of individuals with HD report a chronic, unremitting course, the low rates of response to these interventions are especially concerning (Tolin, Meunier, Frost, & Steketee, 2010).

In summary, the extant literature on HD reveals that it is a severe and impairing disorder, which negatively impacts the sufferer and those around them. The current paucity of knowledge regarding vulnerabilities for hoarding understandably limits efforts focused on treatment development and prevention. There is therefore a pressing clinical and public health need to better understand factors involved in the etiology and maintenance of hoarding.

Cognitive-Behavioral Model of Hoarding

The cognitive-behavioral (CBT) model of hoarding (see Figure 1) posits that several different components, including erroneous beliefs about possessions, information-processing deficits, and emotionally reinforced avoidance patterns, interact to invoke the primary features (i.e., clutter, difficulty discarding, and acquiring) of hoarding (Frost & Hartl, 1996; Tolin, 2011). Common hoarding beliefs that are closely tied to saving behaviors include feelings of emotional attachment to, and an excessive sense of responsibility for belongings, as well as a strong desire to maintain control over these items (Steketee, Frost, & Kyrios, 2003). Individuals with hoarding also tend to have distinctive beliefs about memory. For instance, a lack of confidence in their ability to remember valuable information often makes these individuals hesitant to

discard items that may serve as memory aids (Frost & Hartl, 1996). With respect to actual memory deficits, although some research indicates that individuals with hoarding do recall less information on memory tasks than community controls (Blom et al., 2011; Hartl et al., 2004) and also use less effective strategies to organize memory (Hartl et al., 2004; Tolin, Villavicencio, Umbach, & Kurtz, 2011), findings in support of a definitive memory deficit have largely been inconsistent (Tolin et al., 2011).

In addition to potential memory impairments, individuals with hoarding appear to have other information processing deficits as well (see Figure 1) (Steketee & Frost, 2003). For example, individuals who hoard exhibit more attention problems, such as impairments in response inhibition and selective attention compared to other clinical groups (Grisham, Brown, Savage, Steketee, & Barlow, 2007). Individuals with hoarding often present with symptoms of the inattentive subtype of ADHD, which contribute to difficulties with organizing possessions (Frost, Steketee, et al., 2011; Hartl et al., 2005; Tolin & Villavicencio, 2011b). Categorization deficits, another executive functioning impairment, can further intensify problems with organizing, and exacerbate clutter (Frost & Hartl, 1996). Decision-making also appears to be a challenging and painful process for individuals who hoard (Steketee & Frost, 2003). Indecisiveness has been consistently linked with hoarding symptoms on self-report measures (Frost & Gross, 1993; Preston, Muroff, & Wengrovitz, 2009) and on some behavioral measures (Lawrence, Wooderson, Mataix-Cols, David, Speckens, & Phillips, 2006). Yet, although many researchers have found

evidence for these decision-making and categorization deficits, other studies have found null or mixed findings (Grisham et al., 2007; Grisham, Norberg, Williams, Certoma, & Kadib, 2010; Luchian et al., 2007; Tolin & Villavicencio, 2011a; Wincze et al., 2007). Thus, although future research needs to clarify the extent of impairments in information processing, these deficits appear to play an integral role in the cycles that maintain the core symptoms of hoarding.

The CBT model of hoarding also highlights intense emotional reactions that are often driven by the information processing deficits and beliefs about possessions described above. Both negative and positive emotions influence subsequent positive and negative reinforcement cycles, which directly promote saving and acquiring behaviors (see Figure 1). Hoarding behaviors can be motivated by a variety of positive and negative emotions. For instance, sadness, anger, guilt, and distress can occur at the threat of losing a belonging, and thus can lead to chronic saving (Frost & Hartl, 1996), whereas feelings of pleasure, safety, and comfort may occur when acquiring new possessions (Grisham & Barlow, 2005). Emotionally-laden beliefs about the value and importance of belongings, and strong emotional attachments to one's items, can provoke these intense feelings when an individual with hoarding is faced with an opportunity for acquisition or an obligation to discard (Steketee et al., 2003). Saving behavior can thus be conceptualized as the behavioral avoidance of the negative sentiments associated with making decisions or losing a valued possessions (Frost & Hartl, 1996).

Researchers have also begun to investigate how individual difference and history variables (see Figure 1) might play a role in the etiology and maintenance of hoarding. Of these vulnerabilities, life stress—conceptualized both as general stress and traumatic life events (TLEs)—has emerged as an important and intriguing risk construct (Hartl et al., 2005). The relationship between stress and hoarding was first studied by Hartl and colleagues (2005), who found that hoarding was associated with greater rates of TLEs. The authors theorized that the tendency for individuals who hoard to imbue possessions with a sense of comfort and safety might be the direct result of stressful and/or traumatic experiences. Subsequent investigations have provided further credence to the hypothesis that stress may be an important risk factor for hoarding, yet the exact nature of the connection is still unclear and underlying mechanisms are unknown. It therefore remains an empirical question whether or not stress is a vulnerability factor for hoarding, and if so, in what manner the relationship is formed. Below I will first provide a discussion of general issues relevant to the study of life stress, followed by a review of the extant literature focused on stress and/or trauma and hoarding.

The Study of Stressful Life Events and Stress Reactions

Despite stress being implicated as a risk factor for a broad array of physical and mental illnesses, the best way to define and capture “stress” has been long debated in the literature (Monroe, 2008). Although there is no widely accepted definition of stress, it generally involves an individual’s ability to acclimate to challenging situations over time (Monroe, 2008). One common

conceptualization explains stress as a negative, unspecified affective response that occurs whenever a demand surpasses the regulatory capability of a person, especially in unpredictable and uncontrollable situations (Dickerson & Kemeny, 2004). Selye (1956) defined a “stressor” as an environmental condition, which presents an actual or perceived threat to an individual and the response to such a stressor as the “stress response.” Thus, stress is a negative emotional and physiological response that occurs in reaction to a difficult situation, called a stressor.

Considering the wide variety of conceptualizations of stress, not surprisingly, there are also numerous ways to measure stress, many of which are plagued by methodological limitations (Cohen, Kessler, & Gordon, 1995). Research on stress typically assesses one or more of the following: (1) the presence and/or frequency of stressful life events (SLEs) or TLEs, (2) one’s level of perceived stress, or (3) one’s biological stress response (Monroe, 2008). SLEs and TLEs are typically assessed with self-report checklists, but can also be evaluated with interview methodology (Monroe, 2008). Such checklists or interviews may ask about more general “SLEs” (e.g., divorce or death of a loved one), or the often rare and disturbing “TLEs” (e.g., sexual assault or automobile accident). Unfortunately, self-report checklists are characterized by low reliability and validity, since they can be biased by an individual’s subjective judgments and current emotional state, tend to lead to an overestimation of life events, and are generally inaccurate at distinguishing between truly stressful versus trivial events (Cohen, Towbes, & Flocco, 1988; Cohen et al., 1995; Gorman, 1993;

Kessler, Davis, & Kendler, 1997; Monroe, 2008). Although interview methods are preferred over self-report indices because they can better distinguish between truly stressful as opposed to minor life events (Gorman, 1993), the use of retrospective reporting can still be problematic given that one's memory of events can be biased or inaccurate. Thus, although interview approaches provide a good alternative to self-report assessments of TLEs and SLEs, the measurement of life events has some serious shortcomings.

Instead of collecting data on SLEs, researchers can also assess one's immediate response to stress, using perceived stress measures or biological indices. Perceived stress measures, such as the Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983), are frequently used, but are limited by self-report biases and high correlations with measures of psychological symptoms (Monroe, 2008). In contrast, the biological measurement of stress response, which typically involves measuring cortisol levels, provides an objective measure of stress reactions, that avoids the methodological issues inherent to self-report, retrospective, and perceived stress measures (Starcke & Brand, 2012). An individual's stress response is characterized by a rapid activation of the sympathetic nervous system, which invokes physiological symptoms and behaviors aimed at re-establishing homeostasis (de Kloet, Joëls, & Holsboer, 2005). Uncontrollable psychological stressors, which are characterized by social-evaluative threat, such as the Trier Social Stress Test (TSST; Kirschbaum, Pirke, & Hellhammer, 1993), are capable of eliciting such biological stress responses, and thus are often used to provoke stress in psychological research (Dickerson &

Kemeny, 2004). Thus, the biological measurement of stress via cortisol samples, appears to be a promising alternative for assessing stress reactions and has recently emerged as the most commonly used indicator of stress response (Starcke & Brand, 2012).

Connection between Stress and Hoarding

In considering the relationship between hoarding and stress, the issue of specificity first deserves comment. TLEs/SLEs and greater stress reactivity have been associated with a range of psychiatric disorders, including depression, borderline personality disorder, GAD, and post-traumatic stress disorder (Hammen, 2005; Heim, Ehlert, & Hellhammer, 2000). Therefore, one might ask why a non-specific, plausible risk factor would be of interest to investigate. We would argue that there are four such reasons. First, it is important to understand the role of stress in hoarding since so little is known about the etiology of hoarding. It is imperative to contemplate the full model of how hoarding develops, even if a factor is not unique to hoarding. Second, beyond its potential as a discrete risk factor for hoarding, stress may interact with or exacerbate other vulnerabilities, to create a “perfect storm” of factors that contribute to hoarding behaviors. It is therefore important to comprehend how stress may interact with various facets (e.g., information processing vulnerabilities) of the CBT model of hoarding. Third, MDD, which is highly comorbid with hoarding (Frost, Steketee, et al., 2011), has a well-established relationship with stress, which may suggest that stress would be especially problematic for individuals with comorbid depression and hoarding. The study of the relationship between stress and hoarding should

thus take into account comorbidity, to discover if stress has a unique relationship with hoarding. Fourth and finally, investigating the link between stress and hoarding might be especially important from a public health perspective given that both hoarding and stress have been associated with increased risk for medical problems. Though the relationship is complex, chronic stress is thought to increase the risk for cardiovascular disease, and can encourage unhealthy eating (Schneiderman, Ironson, & Siegel, 2005). Hoarding is similarly associated with obesity and a wide range of chronic and severe medical concerns (Tolin, Frost, Steketee, Gray, et al., 2008). Therefore, although stress may be a non-specific factor, the co-occurrence of stress and hoarding may be especially important for better understanding hoarding's full etiological model, including its associated psychological and physical health problems.

Although research on the relationship between stress and hoarding is only in its nascent stages, the literature thus far has focused on the general association between SLEs/TLEs and hoarding severity, as well as the role stress may have in the onset of hoarding (see Table 1 for a summary of major findings). Findings have indicated that individuals with hoarding have a significantly greater frequency of TLEs compared to individuals with OCD and controls (Hartl et al., 2005; Landau, Iervolino, Pertusa, Santo, Singh, & Mataix-Cols, 2011), and greater hoarding severity is associated with a higher frequency of SLEs/TLEs in both clinical and non-clinical samples (Cromer, Schmidt, & Murphy, 2007; Landau et al., 2011; Timpano, Keough, Traeger, & Schmidt, 2011; Tolin et al., 2010). SLEs, particularly negative interpersonal experiences, appear to be

important in the onset and maintenance of hoarding symptoms (Timpano, Keough, et al., 2011; Tolin et al., 2010). About half of individuals with hoarding report experiencing a SLE around the onset of hoarding, and these individuals tend to have a later age of onset compared to those who did not report such an event (Grisham, Frost, Steketee, Kim, & Hood, 2006; Landau et al., 2011). Individuals with hoarding also describe a greater variety of TLEs than non-hoarding controls (Hartl et al., 2005). The most commonly reported TLEs are having something taken by threat or force, as well as sexual and physical assault (Hartl et al., 2005).

Considered as a whole, the extant literature has consistently found a relationship between hoarding and both SLEs and TLEs. Yet in reflecting upon the general methodological considerations relevant to the study of stress, four key limitations inherent in this past research emerge. First, all studies have relied on self-report and retrospective data to capture the construct of “stress” (see Table 1). Given that biological assays represent the most ideal measure of the stress response, it seems remarkable that no studies have examined whether hoarding symptoms are also linked to biological stress responses. Second, all previous research has also used cross-sectional and retrospective indices of hoarding, which thwarts the ability to determine the temporal precedence of stress and hoarding. Past studies have therefore not allowed us to definitively determine whether stress is associated with a direct increase in hoarding behaviors. Third, past research has not been able to adequately address various risk models, which are relevant to the relationship between hoarding and stress.

Specifically, we have not been able to determine whether stress is a factor that gives rise to hoarding behaviors, or whether hoarding symptoms themselves impact the stress-response system. Finally, as a fourth limitation, research to date has not been able to adequately address any hypothesized factors that might interact with stress to predict hoarding. It therefore remains unclear whether, and in what manner, stress truly functions as a risk or maintenance factor for hoarding.

Current Study

The proposed investigation aimed to directly address the limitations of past research by conducting the first experimental investigation of the multifaceted association between stress and hoarding. In contrast to past investigations, the current study involved an experimental manipulation of stress, whereby participants were randomly assigned to either a psychosocial stress task based on the TSST (Kirschbaum et al., 1993) or a non-stressful control task. This allowed for the examination of the immediate impact of stress on hoarding behavior, as well as the general stress-reactivity associated with high hoarding symptoms. To improve upon past research, the proposed investigation relied on a multi-method assessment of both stress and hoarding, which allowed for more objective measures of the key constructs. A multi-method approach to stress measurement is strongly encouraged to reduce the memory biases inherent to self-report and retrospective reporting (Cerdá, DiGangi, Galea, & Koenen, 2012), and therefore, the current study measured the response to the stressor with both biological (cortisol levels) and momentary self-report indices. Similarly, hoarding

was measured using both self-report and objective behavioral measures of hoarding, which assessed acquiring tendencies and difficulties discarding following exposure to a stressor. Acquiring and difficulties discarding, rather than clutter, were measured since clutter tends to be a result of years of chronic saving and excessive acquisition, whereas one might avoid discarding (i.e., save) and acquire (i.e., shop) immediately in response to a stressful situation. Furthermore, acquiring and saving, which are common behaviors in the general population (Frost & Steketee, 2008), would be expected to occur more frequently than clutter in a younger, non-clinical population. The current study also expanded on past literature by investigating specific factors that might interact with stress to lead to increased hoarding behaviors.

This research study is vital for clarifying whether stress serves as a risk or maintenance factor for hoarding. Insight into the nature of the relationship between hoarding and stress may have far-reaching implications for treatment, classification, and prevention efforts. For instance, finding that individuals high in hoarding symptoms are particularly sensitive to stress would have important implications for treatment, since stress can influence treatment response and lead to relapse. Finding a strong link between hoarding and stress may suggest the need to incorporate stress management and coping interventions into hoarding treatment approaches.

The Relationship between Stress and Hoarding Severity and Cognitions

Research has consistently found that stress is linked with hoarding symptom severity (see Table 1), but it is unclear whether this relationship is

unidirectional or bidirectional. The current study sought to better understand the direction of this relationship. Specifically, the current study explored whether a stressor could lead to increased hoarding behaviors and/or whether initial baseline hoarding symptom severity would predict stress response. This investigation was the first experimental examination of the effect of stress on hoarding, which allowed for greater control and manipulation of the stressor. Our investigation was also the first to examine the direct effects on hoarding *behaviors* rather than self-report indices of hoarding, and was also the first study to examine the effect of initial hoarding symptom severity on cortisol response following a stressor.

The study also explored how different types of hoarding cognitions may influence one's stress response. As described previously, emotional attachment to and desire for control over possessions are common core beliefs of individuals with hoarding. Both emotional attachment to objects and desire for control may play a role in the tendency for individuals with hoarding to rely on belongings for safety in the aftermath of stress (Cromer et al., 2007; Hartl et al., 2005). In addition, stress may lead individuals to see the world as unpredictable and uncontrollable, which would lead them to seek emotional comfort in possessions, over which they can actually exert control (Hartl et al., 2005). Research suggests that individuals with a high desire for control exhibit higher stress responses, as evidenced by high systolic blood pressure following an uncontrollable stressor task (Watanabe, Iwanaga, & Ozeki, 2002). Pilot research (N = 22) collected by our group revealed that self-reported stress following a psychosocial stress task

was significantly correlated with total hoarding cognitions (r = .65, p < .01), including emotional attachment (r = .58 p < .01), memory beliefs (r = .51 p < .05), and responsibility for possessions (r = .51 p < .05). We furthermore found that hoarding cognitions, controlling for task condition, predict self-reported stress response following the psychosocial stress task (β = .09, p < .001). Considered collectively, these data provide support for not just considering baseline hoarding symptom severity as a predictor of stress response, but also whether hoarding beliefs might be linked with greater reactivity to a stressor.

Interaction between Stress and Other Risk Factors in Predicting Hoarding

Apart from the role stress may play as a distinct risk factor for hoarding, it may also act together with other variables that have previously been implicated in hoarding and/or stress responses. Within such a model, a combination of vulnerabilities may create a maladaptive interaction, which, in turn, results in pathological behaviors, such as excessive acquiring and chronic saving. Thus, it could be that an individual, who has high levels of one factor involved in hoarding, may be at an increased risk for developing hoarding, following a stressful experience.

The first factor we considered was attentional control (AC). AC is the ability to purposely focus and shift attention between tasks (Derryberry & Reed, 2002). Individuals with deficits in AC may have difficulties coping with threat and disengaging from negative material in working memory (Derryberry & Reed, 2002; Zetsche, D'Avanzato, & Joormann, 2011). Although research has yet to be published on the relationship between AC and hoarding, attention deficits and

other executive functioning difficulties have been consistently linked with hoarding (Grisham et al., 2007; Tolin & Villavicencio, 2011b). Stress appears to have a negative impact on AC (Liston, McEwen, & Casey, 2009), as evidenced by an association between greater cortisol levels and reductions in the ability to inhibit attention following mild psychological stress (Skosnik, Chatterton, Swisher, & Park, 2000). A larger set of pilot data (N = 88) from our laboratory demonstrated a relationship between AC and both hoarding (r = -.45, p < .001) and perceived stress (r = -.43, p < .001), such that lower AC is associated with greater hoarding severity and higher ratings of perceived stress. By being linked to both hoarding and stress separately, impaired AC may act synergistically with stress to influence hoarding behaviors.

We also examined how components of emotional intolerance, including negative urgency, anxiety sensitivity (AS), and distress tolerance (DT), might interact with stress in predicting hoarding behaviors. Negative urgency involves the tendency to react impulsively in situations accompanied by negative emotions (Lynam & Miller, 2004). Urgency appears to be an important factor in hoarding since negative affective states can lead individuals to acquire and save in order to quickly distract themselves from distressing feelings. In fact, greater urgency has been associated with greater hoarding severity (Timpano, Rasmussen, Exner, Rief, Schmidt, & Wilhelm, 2013). Negative urgency has also been linked to stress. In a four-week follow-up study, negative urgency was found to predict more occurrences of dependent negative life events, indicating that urgency may contribute to the generation of stress (Liu & Kleiman, 2012).

Furthermore, in an archival database from our group (*N* = 113), negative urgency was highly correlated with perceived stress (*r* = .38, *p* < .001). Thus, given the relationship of negative urgency to both SLEs and hoarding, high levels of negative urgency in the context of stress might be linked with the greatest hoarding symptoms.

Two other components of emotional intolerance, AS and DT, may similarly act synergistically with stress in predicting hoarding. AS can be conceptualized as the "fear of fear" and is characterized by beliefs that anxiety-related sensations are deleterious and carry negative consequences (Schmidt & Cook, 1999), whereas DT is the ability to tolerate any type of negative emotional state (including anxiety) (Simons & Gaher, 2005; Timpano, Buckner, Richey, Murphy, & Schmidt, 2009). Research has revealed that high AS and low DT are both associated with greater hoarding symptoms (Timpano et al., 2009). AS and DT may also influence how one responds to stress, as greater emotional intolerance has been linked to experiencing more SLEs (Timpano, Keough, et al., 2011). Furthermore, research has indicated that SLEs are correlated with greater AS and changes in AS over time (Zavos et al., 2012). Pilot data from our lab (N = 118) indicated that lower DT was correlated with higher levels of perceived stress (*r* = -.47, *p* < .001). Since AS and DT have been found to be associated with both hoarding and stress, individuals who have high AS or low DT may be at increased risk for engaging in hoarding behaviors, following exposure to stress.

Aims and Hypotheses

The current study aimed to conduct the first experimental investigation of the relationship between stress and hoarding, using a multi-measure approach. Both biological and subjective assessments of stress and behavioral and self-report indices of hoarding were considered.

Aim 1 was to examine the direct effect of a stress manipulation on subsequent hoarding behaviors.

Hypothesis 1.1: Stress task condition will predict higher rates of subsequent hoarding behaviors (difficulty discarding and acquiring).

Hypothesis 1.2: We predicted that the relationship between stress task condition and hoarding behaviors would hold controlling for depression (DASS depression scores) and social anxiety (SIAS scores). These covariates were chosen because hoarding is highly comorbid with both depression and social anxiety (Frost, Steketee, et al., 2011), depression has been associated with SLEs (Hammen, 2005), and social anxiety is relevant given the social nature of the stress manipulation.

Aim 2 was to examine the association between stress response and subsequent hoarding behaviors in the stress condition.

Hypothesis 2.1: Greater stress response (as measured by change in biological and subjective stress response from baseline to post-stressor) will predict higher rates of subsequent hoarding behaviors (difficulty discarding and acquiring).

Hypothesis 2.2: Similar to Hypothesis 1.2, we predicted that the relationship between stress response and hoarding behaviors would remain significant while

controlling for depression (DASS depression scores) and social anxiety (SIAS scores).

Aim 3 was to investigate whether baseline self-reported hoarding symptoms and cognitions predict stress response in the stress condition.

Hypothesis 3.1: Greater baseline self-reported hoarding symptom severity (SIR scores) will be associated with greater stress response (as measured by change in biological and subjective stress response).

Hypothesis 3.2: Greater hoarding cognitions (SCI scores) will predict greater stress response (as measured by change in biological and subjective stress response).

Aim 4 was to explore the potential moderating role of stress task condition in the relationship between hoarding behaviors and attentional control and emotional intolerance variables.

Hypothesis 4.1: Lower levels of attentional control (ACS scores), in light of exposure to stress, will be associated with greater subsequent hoarding behaviors (difficulty discarding and acquiring).

Hypothesis 4.2: Increased levels of negative urgency (UPPS *urgency* scores), in light of exposure to stress, will be associated with greater subsequent hoarding behaviors (difficulty discarding and acquiring).

Hypothesis 4.3: Increased levels of anxiety sensitivity (ASI scores), in light of exposure to stress, will be associated with greater subsequent hoarding behaviors (difficulty discarding and acquiring).

Hypothesis 4.4: Lower levels of distress tolerance (DTS scores), in light of exposure to stress, will be associated with greater subsequent hoarding behaviors (difficulty discarding and acquiring).

Chapter 2 - Method

Participants

The sample consisted of 80 undergraduate students with ages ranging from 17 to 23 (M=18.95, SD=1.47), enrolled in Introductory Psychology courses during the fall of 2012 and the spring of 2013. The use of an undergraduate sample is justified given the fact that hoarding symptomatology is dimensionally distributed (Timpano, Broman-Fulks, et al., 2013) and often onsets before age 20 (Tolin et al., 2010). Table 2 summarizes the demographic characteristics of the participants, who were primarily non-Hispanic (76.3%) white (67.5%) and predominantly female (63.7%).

Two-thirds of the sample (51 participants) were over-selected for having high hoarding symptoms (1 SD above the pre-screening mean on the Saving Inventory-Revised (SIR; see below; Frost, Steketee, & Grisham, 2004)), to ensure an adequate distribution of hoarding behaviors. A similar approach has been used in extant studies (e.g., Timpano & Schmidt, 2013). Specifically, eligible participants from the pre-screening were invited to participate via email. Flyers were also posted to notify students of the study and enrollment was continually monitored to ensure the desired proportion of non-selected and high-hoarding participants.

Students who wished to take part in the investigation signed up using the departmental online research participation pool (rePr), and received research familiarization credits for participating. At baseline, participants completed the SIR for a second time; only one-third of the total sample fell into the high

hoarding group. Although this may reflect a general regression to the mean, 57.5% of the sample still scored above or equal to the pre-screening mean (>21.48). This resulted in an overall mean SIR score (M=25.93, SD=14.07, Range=2-69) that is higher than typical non-clinical samples (M=23.7, SD=13.2; Frost et al., 2004). That being said, it should be noted that a previous investigation by our group using the same recruitment technique with a similar sample reported a higher overall mean SIR score (M=33.25, SD=15.02; Timpano & Schmidt, 2013). Means, standard deviations, and ranges for the SIR and other primary variables used in regression analyses are included in Table 3.

Procedure

Please refer to Figure 2 for a schematic of the study procedures. Following screening, but prior to coming to the laboratory to complete the experimental session, participants consented to participate online and then completed a brief battery of self-report questionnaires at home (see below for a detailed description). Upon arrival at the experimental session, additional written informed consent was obtained from participants. Subjects were told that the study was looking at different behaviors and thought patterns, to determine how these factors may influence information processing. This deception was used so as not to unduly bias participants with respect to the study aims. Throughout the experiment and across conditions, all study personnel were female and acted in a neutral manner towards subjects. These procedures are in line with guidelines

established by Harmon-Jones and colleagues (2007), which ensure that a participant's affective state is not unduly influenced prior to the stress manipulation (described in detail below).

Participants first completed Phase one of the Behavioral Discarding Task (BDT). Next, participants watched a nature video, in preparation for the collection of the baseline cortisol sample. Thirty minutes after arriving in the laboratory, baseline stress response was recorded (via salivary cortisol samples and self-report). Participants were then randomly assigned to one of two conditions for the experimental stress manipulation: either a psychosocial stress task or a non-stressful control task. Both sets of tasks lasted approximately 15 minutes including experimenter instructions and stress assessment.

Following completion of the psychosocial stress or non-stressful control task, all remaining procedures were the same between groups. Stress response was collected at various time points following the stress induction (see Figure 2). Directly following the post-stressor cortisol sample, participants completed Phase two of the BDT, along with the Behavioral Acquiring Task (BAT), which were presented in a counter-balanced order. At the end of the experiment, study personnel conducted a post-experimental interview to assess suspicion about study hypotheses and debriefed the participant about the actual purposes of the investigation (Harmon-Jones et al., 2007). The debriefing script is included in Appendix A. The entire study session took approximately 2 hours to complete.

Chapter 3 - Measures

Self-Report Assessments

Attentional Control Scale (ACS). The ACS (Derryberry & Reed, 2002) is a 20-item self-report questionnaire, which assesses individual differences in attentional control. Participants rate how often each item is true for them on a 4-point Likert scale from *1 (almost never)* to *4 (always)*. In addition to a total score, the ACS includes two subscales, *attention focusing*, which measures one's ability to focus attention, and *attention shifting*, which measures one's ability to shift attention between tasks. The total score has demonstrated good convergent and discriminant validity as well as internal consistency in nonclinical samples (Fajkowska & Derryberry, 2010; Ólafsson, Smári, Guðmundsdóttir, Ólafsdóttir, Harðardóttir, & Einarsson, 2011). In the current sample, the total score demonstrated good internal consistency (α = .83).

Anxiety Sensitivity Index-3 (ASI-3). The ASI-3 (Taylor et al., 2007) is an 18-item self-report measure of anxiety sensitivity. Participants rate items about potential negative consequences of anxiety symptoms on a 5-point Likert scale from *0 (very little)* to *4 (very much)*. The ASI-3 includes a total score and three factor analytically validated subscales: *physical, cognitive*, and *social concerns*. The scale has demonstrated improved psychometric properties over the original version of the ASI (Peterson & Reiss, 1987), including good internal consistency as well as content, factorial, convergent and discriminant validity across clinical and nonclinical samples (Taylor et al., 2007). The ASI-3 demonstrated excellent internal consistency in the current sample (α = .94).

Cortisol Questionnaire. The Cortisol Questionnaire is a 19-item self-report questionnaire developed for the current investigation, which asks participants questions about their medical history, medication usage, sleep and exercise patterns, caffeine usage, smoker status, and menstrual cycle. This questionnaire was used to probe any irregular patterns in cortisol data.

Demographics Questionnaire. The Demographics Questionnaire is an 11-item questionnaire, developed for the current study, which asks participants questions about their general demographic information (e.g., age, gender, and ethnic/racial background) and about their psychiatric history (i.e., previous diagnoses and family history of anxiety, OCD, and depression).

Depression Anxiety Stress Scale-21 (DASS-21). The DASS-21 (Henry & Crawford, 2005) is a condensed version of the 42-item self-report DASS scale. It includes 21 items, which measure depression, anxiety, and stress symptoms. Respondents rate how much each item has applied to them over the past week on a 4-point scale from *0 (did not apply to me at all)* to *3 (applied to me very much).* Although the DASS-21 includes three subscales, *depression, anxiety,* and *stress*, the current investigation only used the *depression* subscale. The short-form has been found to demonstrate excellent internal consistency and concurrent validity in both clinical (Antony, Bieling, Cox, Enns, & Swinson, 1998) and nonclinical samples (Henry & Crawford, 2005). The depression subscale demonstrated evidence of good internal consistency in the current sample (α = .88).

Distress Tolerance Scale (DTS). The DTS (Simons & Gaher, 2005) is a 15-item self-report questionnaire, which measures one's capacity to tolerate psychological distress. Participants are asked to consider times when they felt distressed or upset, and then rate items based on their beliefs about feeling distressed, using a 5-point Likert scale, from *1 (strongly agree)* to *5 (strongly disagree)*. While high total scores reflect high tolerance for distress, low total scores represent low tolerance for distress, or distress intolerance. The DTS includes four subscales: *tolerance, absorption, appraisal,* and *regulation*. It has demonstrated good psychometric properties, including internal consistency (Buckner, Keough, & Schmidt, 2007), test-retest reliability, and discriminant validity (Simons & Gaher, 2005). Currently, the DTS exhibited excellent internal consistency (α = .91).

The Positive and Negative Affect Scale (PANAS). The PANAS (Watson, Clark, & Tellegen, 1988) is a self-report measure, which assesses current levels of *positive* and *negative* affect, although only the *negative* affect subscale was utilized in the current study. Participants rate how much they feel each of 20 different emotions "right now" on a 5-point Likert scale from *1 (very slightly or not at all)* to *5 (extremely).* The subscales have demonstrated evidence of good internal consistency as well as convergent and discriminant validity (Watson et al., 1988). In the current study, the *negative* affect subscale exhibited good internal consistency (α = .83 - .89).

Social Interaction Anxiety Scale (SIAS). The SIAS (Mattick & Clarke, 1998) is a 20-item self-report measure of anxiety about social interactions, one of

the core components of social anxiety. Respondents rate items on a 5-point Likert scale, which ranges from *0 (not at all characteristic or true of me)* to *4 (extremely characteristic or true of me)*. Across both clinical and nonclinical samples, the SIAS has demonstrated high internal consistency and test-retest reliability (Heimberg, Mueller, Holt, Hope, & Liebowitz, 1992; Mattick & Clarke, 1998; Osman, Gutierrez, Barrios, Kopper, & Chiros, 1998). In addition, the SIAS has been found to differentiate social phobia from symptoms of agoraphobia, specific phobia, and normal levels of social anxiety (Mattick & Clarke, 1998). The SIAS exhibited excellent internal consistency in the current investigation (α = .90).

Saving Cognitions Inventory (SCI). The SCI (Steketee et al., 2003) is a self-report questionnaire, composed of 24-items that measure beliefs and thoughts experienced when faced with a decision about saving or discarding an item. Items are rated on a 7-point Likert scale, from *1 (not at all)* to *7 (very much)*. The SCI includes a total score, as well as four subscales derived through factor analysis: *emotional attachment, memory, control*, and *responsibility*. It has demonstrated good psychometric properties, including internal consistency as well as convergent and discriminant validity (Steketee et al., 2003). Currently, the SCI demonstrated excellent internal consistency (α = .95).

Saving Inventory Revised (SIR). The SIR (Frost et al., 2004) is a 23-item self-report measure of the three core symptoms of hoarding. Participants respond to items using a 5-point Likert scale, with higher scores reflecting elevated symptoms of hoarding. In addition to a total score, the measure includes

three factor analytically derived subscales: *acquisitioning*, *clutter*, and *difficulty discarding*. The SIR has demonstrated excellent internal consistency (Frost et al., 2004), good test-retest reliability, and adequate convergent validity (Coles, Frost, Heimberg, & Steketee, 2003). In the current study, the SIR demonstrated excellent internal consistency (α = .94).

UPPS Impulsive Behavior Scale (UPPS). The UPPS (Whiteside & Lynam, 2001) is a self-report questionnaire, composed of 45-items that assess four different dimensions of impulsivity, which correspond to the following subscales: *urgency, lack of perseverance, lack of premeditation,* and *sensation-seeking.* The current investigation will only use the *urgency* subscale, which includes 12 items, which assess one's tendency to act in an impulsive manner when experiencing negative affect. Participants rate items on a 4-point Likert scale, from *1 (agree strongly)* to *4 (disagree strongly)*. All subscales have demonstrated excellent internal consistency and construct validity (Whiteside & Lynam, 2001). The UPPS urgency subscale demonstrated excellent internal consistency in the current investigation (α = .91).

Psychosocial Stress Task

Participants who were randomized to the psychosocial stress task completed a task that is based on the TSST (Kirschbaum et al., 1993), a valid and established procedure to provoke stress in a laboratory setting (Dickerson & Kemeny, 2004). The task, which consists of preparing for and performing a speech and a mental arithmetic task, has been found consistently to induce significant endocrine responses in 70-80% of participants (Kirschbaum et al.,

1993). The task aims to create a realistic, stress-inducing situation, that provokes a state of social evaluative threat, by capturing participants' performance on camera and informing participants that the speech will be evaluated by the examiner (Dickerson & Kemeny, 2004).

The current study has slightly altered the following aspects of the TSST procedures. First, due to time constraints and to lessen participant burden, the anticipation period lasted two rather than ten minutes. Second, due to logistical constraints, the participant performed the speech in front of one examiner rather than a panel of people. In an unpublished study, LeMoult found that these altered procedures still elicited a significant cortisol response, in line with the current investigation (see Chapter 5 - Results). Finally, the topic of the speech was altered given the study population. Although the original TSST employs a mock job interview, the current study had participants give a speech on the death penalty, which elicited significant cortisol responses in previous studies (Yoon & Joormann, 2012) as well as in the current investigation (See Chapter 5 - Results). These procedures were modified to increase the salience of the experience, given that young undergraduates may be more likely to give speeches in class than to attend job interviews.

For the speech preparation and performance task, participants were told a cover story aimed to provoke social-evaluative threat. First, they were told that they would complete a speech that would be evaluated according to its flow, eloquence, and sophistication of word choice. During the speech, the examiner pretended to take notes on a Speech Evaluation Form to ensure the credibility of

the cover story. Second, they were informed that the speech would be videotaped so that a panel of their peers could rate the strength of their argument. They were given two minutes to prepare a speech on their position on the death penalty. They were instructed to give a scientific rather than an emotional argument for their position. After two minutes of preparation, they were given five minutes to complete the speech in front of the examiner and the camera. If they failed to fill up the entire five minutes, the examiner asked them a series of questions about the death penalty, until the five minutes had passed.

The second portion of the task consisted of a mental arithmetic task. For five minutes, participants were asked to count aloud backwards from 2083 to zero in 13-step sequences. Participants were informed that if they miscalculated, they would be corrected by the experimenter, who would say “Error, 2083” and make them start over. See Appendix A for a full description of task instructions for participants in the stress condition.

Non-stressful Control Task

Participants, who were randomized to the non-stressful control task, completed a short writing task and played a non-stressful computerized card game. This condition was designed to be as similar to the psychosocial stress task as possible, without actually being stressful. It took the same amount of time as the psychosocial stress task, but did not involve any instances of social-evaluative threat, which could provoke stress. For the first two minutes, participants sat quietly in anticipation of the first task. Second, participants completed a five-minute writing task, during which they wrote as many details as

possible about their favorite movie or book. Third, they played the game of solitaire on the computer. See Appendix A for a full description of task instructions for participants in the control condition.

Behavioral Measures of Hoarding

Two behavioral measures of hoarding, developed for the current investigation, were used as the dependent variable of the stress manipulation, given that behavioral measures are less biased than self-report measures following an emotion induction (Harmon-Jones et al., 2007). The behavioral measures directly assessed difficulties with discarding and acquiring objects.

Behavioral Discarding Task (BDT). At the beginning of the laboratory visit, participants completed Phase one of the BDT. Specifically, they were asked to provide descriptions of ten belongings, which represented items they save and would have difficulty throwing away, such as mementos of trips and family events, a card from a significant other, or notes from a class they were no longer taking. Detailed descriptions of these possessions were then written down on a set of index cards, such that one index card represented each item. Full instructions for this task are provided in Appendix A. Other studies (e.g.,Wincze et al., 2007) have used index cards as “proxies” for personal items, and effects were still found. Next, participants completed a short questionnaire about each belonging, which asked about their urge to save the item, using a scale from *0 (no urge)* to *10 (extreme urge)*, as well as how much they value each object and their hoarding-related beliefs about the possession, using a scale from *0 (not at all)* to *10 (extremely)*. These item ratings were adapted for the current

investigation from measures used in previous studies (Timpano & Schmidt, 2013; Tolin, Kiehl, Worhunsky, Book, & Maltby, 2009).

Following the stress manipulation, participants completed Phase two of the BDT, adapted from a validated symptom provocation task designed by Tolin and colleagues (2009). The task asked participants to imagine a hypothetical situation, in which there was a fire in their dorm or apartment building. They were informed that they could only take with them what they can carry, and that they should leave behind as many items as possible. They were also told that whatever they left behind may be destroyed and very certainly damaged by the fire. It was explained that any items not saved would be destroyed in the hypothetical scenario. The experimenter asked them a series of questions about each belonging listed on the ten index cards, including their urge to save the item and their final decision about saving or discarding the item. If the participant chose to discard a belonging, the experimenter then shredded the index card in front of the participant, in order to make the hypothetical situation seem more salient. See Appendix A for full instructions of the task. The primary dependent variable for this task was the number of items saved, with higher scores indicating increased difficulties with discarding. In a more exploratory vein, the experimenter ascertained at the conclusion of the task levels of distress, indecision, and grief (scale ranging from not at all (0) to extremely (10)). Thus, secondary dependent variables for the BDT included total urge to save the items, distress during the task, indecisiveness about the decisions, and grief about discarding.

Behavioral Acquiring Task (BAT). To measure an individual's inclination to acquire objects, participants completed a hypothetical computer simulation of an online shopping spree. Participants were told that they had $500 to spend on items for an upcoming vacation; however, they were encouraged to spend as little money as possible, since the remainder would go towards their savings and the bill would be sent to their parents. See Appendix A for the full instructions for the task. Participants were shown pictures and prices of 25 gender-neutral items that they had the option to "purchase." Items were selected to be valuable to University of Miami (UM) students, and examples included UM clothing, cameras, headphones, beach gear, sandals, books, and sports gear. The primary dependent variable was the number of items purchased, with higher scores indicating increased rates of acquiring tendencies. However, a secondary dependent variable included the amount of money spent, with higher scores also reflecting increased rates of acquiring tendencies.

Stress Response

Stress response was measured objectively (with salivary cortisol) and subjectively (with a one-item measure of perceived stress). Cortisol was used to measure the effect of the stress induction, given that physiological measures are preferred to self-reports for measuring the effects of emotion elicitations (Harmon-Jones et al., 2007). Although cortisol can be measured in blood, urine, and saliva, salivary cortisol samples were collected in order to limit participant burden and because salivary cortisol is considered a reliable and valid reflection of stress response, that correlates with measures of blood cortisol (Kirschbaum &

Hellhammer, 1994). For the subjective measure of perceived stress, the examiner asked the participant the following question: “Right now, on a scale of *0 (not at all)* to *10 (the most extreme level)*, how much stress do you feel right now?” Using both self-report and physiological measures of stress response allowed for a superior multi-method approach to stress measurement (Cerdá et al., 2012).

Physiological and self-report assessments of stress response were collected at six time points (See Figure 2): (T1) a baseline measure prior to the stress manipulation, (T2) in the midst of the stressor, and at four time points (T3-6) following the stress manipulation (t = 0, 10, 20, and 30 minutes after completion of tasks). This allowed for a more complete examination of stress reactivity. Stress response was expressed as the change from baseline to the completion of the stress manipulation, a technique employed by Yoon and Joormann (2012), who used a similar design. The baseline measurement of stress took place 30 minutes after participants arrived in the laboratory, to account for any anxiety they may have felt upon arrival. Stress response was measured both in the midst of the stressor and immediately following the stressor because physiological stress reactions occur immediately following stress onset and can return to baseline as soon as 10 minutes after the stressor stops (Het, Rohleder, Schoofs, Kirschbaum, & Wolf, 2009; Kirschbaum et al., 1993). The current study also measured stress at 10, 20, and 30 minutes after cessation of the stressor, given that the peak cortisol response occurs about 21-40 minutes after the onset of the stressor (Dickerson & Kemeny, 2004). During this period

(10-30 minutes after stressor cessation), participants were seated alone viewing a calming nature video, and were periodically approached for stress response assessments, which is a commonly used method for assessing stress response after a stressor (see Yoon & Joormann, 2012). Cortisol levels typically return to pre-stressor levels, and thus typically have lower effect sizes, within 41-60 minutes after cessation of the stressor (Starcke & Brand, 2012), and thus, the current study did not investigate cortisol levels during this recovery phase.

For hypotheses 2 and 3, change scores were computed for both subjective and biological stress response. Specifically, subjective stress ratings and cortisol levels at baseline (Figure 2: T1) were subtracted from subjective stress ratings and cortisol levels following the stress manipulation (Figure 2: T3), which is similar to procedures used by Yoon and Joormann (2012).

Many variables can confound the effects of cortisol response, and thus some of these variables have been controlled either during the investigation or in data analyses. For example, gender, age, oral contraceptive use, and chronic nicotine consumption can influence stress reactivity and should thus be controlled for in stress research (Starcke & Brand, 2012). These variables were measured using the Demographics and Cortisol Questionnaires. In addition, cortisol levels are based on a circadian rhythm, meaning that they increase dramatically as one awakens, gradually lessen throughout the day, and are at the lowest levels late in the evening (Dickerson & Kemeny, 2004). Therefore, the current study conducted all sessions in the afternoon, to control for time of day.

Chapter 4 – Planned Statistical Analyses

Power Analyses

A projected sample size of 70 participants (35 per cell) was identified as a suitable N, based on power analyses for the proposed statistical approach (G-power; Faul & Erdfelder, 1992). Dickerson and Kemeny (2004) found that stressor tasks that resemble the TSST tend to elicit large effects (d = .85) on cortisol levels. The relationship between hoarding and SLEs/TLEs has ranged from modest to large effect sizes (Cromer et al., 2007; Hartl et al., 2005; Landau et al., 2011; Tolin et al., 2010). As such, we powered our investigation for a moderate effect size, and the proposed sample size should therefore be adequate to test the main study hypotheses (Aim 1) at a power greater than 80% with a Type 1 error (α) < .05. With the actual sample size of 80 participants, the main study hypothesis was powered at 86.98% with a Type 1 error (α) < .05.

Preliminary Analyses

All data was screened prior to primary data analyses. The majority of questionnaires were completed by participants using the electronic data capture tool, LimeSurvey, which prevented against missing data and data-entry errors. Descriptive statistics were also examined for potential data-entry errors. Following data screening, the data were examined for potential outliers, influential observations, and possible violations of the assumptions of the linear model. Scatterplots were used to ensure that the assumptions of the linear model were met. Internal-consistency was examined by calculating Cronbach's alpha for all self-report measures.

T-tests (for continuous variables) and chi-square analyses (for dichotomous variables) were conducted to assess for any differences between conditions in relevant demographic variables (gender, ethnicity, race, and baseline self-reported hoarding severity), health variables (medication use, smoker status, and caffeine use, which are known to impact cortisol levels), and baseline value ratings of items. If any of these variables were found to differ significantly between conditions, and were also correlated with the outcome variable (i.e., hoarding behaviors), they were controlled for in subsequent analyses, by being added as predictors in the first step of regression analyses.

Manipulation Check

To ensure that the psychosocial stress task elicited stress, the PANAS was used to assess current levels of negative affect directly before and immediately following the stressor (Figure 2). A repeated measures ANOVA was conducted with time as the within subjects factor and condition as the between subjects factor. Similar sets of analyses were conducted for cortisol and subjective stress. These procedures are in-line with those reported in previous investigations using stress-manipulations (Starcke & Brand, 2012; Watson et al., 1988).

Hypothesis 1: Effects of the Stress Manipulation on Hoarding Behaviors

It was expected that the stress task condition would influence subsequent hoarding behaviors, such that participants in the psychosocial stress task condition, as compared to the non-stressful control task condition, would demonstrate increased acquiring tendencies and difficulties discarding. To test

these hypotheses, a series of multiple regression analyses were used. For Hypothesis 1.1, two separate linear regression equations were constructed with difficulties discarding and acquiring tendencies as the dependent variables, and stress task condition as the predictor.

For Hypothesis 1.2, the regression analyses outlined in Hypothesis 1.1 were repeated for any significant or marginally significant findings, including depression (DASS depression scores) and social anxiety (SIAS scores) as covariates.

Hypothesis 2: Effects of Stress Response on Hoarding Behaviors

It was hypothesized that stress response (as measured by change in biological and subjective stress) would predict higher rates of acquiring tendencies and difficulties discarding in participants in the stress condition. To examine these hypotheses, the regression analyses employed in Hypothesis 1 were repeated first using subjective stress response as the predictor, and then using biological stress response as the predictor. For Hypothesis 2.2, these regression analyses were repeated for any significant or marginally significant findings, including DASS depression and SIAS scores as covariates.

Hypothesis 3: Effects of Hoarding Symptoms and Cognitions on Stress Response

It was predicted that higher baseline self-reported hoarding symptoms (SIR scores) and cognitions (SCI scores) would be associated with greater stress response (as measured by change in biological and subjective stress) in the stress condition. For Hypothesis 3.1, two multiple regression equations were used. First, a multiple regression equation was constructed with subjective stress

response as the dependent variable and SIR scores entered as a predictor. Second, this multiple regression equation was repeated with biological stress response as the dependent variable. Two similar multiple regression analyses were conducted for Hypothesis 3.2, except that SCI scores rather than SIR scores were entered as the predictor.

Hypothesis 4: Moderating Role of Stress in the Prediction of Hoarding Behaviors

In line with the guidelines provided by Holmbeck (2002), linear regression models were used to test moderation hypotheses. For each set of analyses, scores for continuous variables (i.e., AC, negative urgency, AS, and DT) were centered to reduce multicollinearity. For all subsequent analyses, similar equations were constructed for each set of moderator hypotheses (i.e., Hypotheses 4.1-4.4), with the exception that the predictor differed (i.e., AC, negative urgency, AS, and DT).

First, an interaction term was computed between the centered predictor variable and stress task condition (dummy-coded as control = 0 and stress = 1). Second, to determine if there was a significant interaction effect in the prediction of hoarding behaviors (acquiring tendencies and difficulties discarding), the centered predictor variable, stress task condition, and the interaction term were entered simultaneously as independent variables into a multiple regression equation. This model ensured that any observed effects for the interaction were not due to shared variance with the main effects (Cohen, Cohen, West, & Aiken, 2002). In the event that a significant interaction emerged, the simple effects of

the predictor variable on hoarding behaviors among low (non-stressful control task condition) and high (psychosocial stress task condition) levels of stress were examined using procedures outlined by Holmbeck (2002).

Chapter 5 - Results

Preliminary Analyses

Data screening indicated that missing data was minimal. Imputation methods were used for one participant's baseline cortisol data. In this case, the participant's mid-stressor cortisol value was imputed as the baseline cortisol value, given that mid-stressor cortisol levels have been used as a proxy for baseline cortisol levels in previous research (e.g., Yoon & Joormann, 2012). Three other participants had missing cortisol data, but imputation methods were not considered because these participants were missing more than 10% of their cortisol data. Outliers were discovered on several variables (including cortisol, subjective stress, and the SCI), and thus the accuracy of these data-points were examined. No data entry errors were found, and regression analyses indicated that the outliers were not particularly influential based on the investigation of Studentized residuals and Cook's distance, and thus all outliers were included in subsequent analyses. Finally, scatterplots did not demonstrate skewness or kurtosis, and as such, no data transformations were executed.

Baseline Differences Between Conditions

Conditions did not differ significantly on any demographic or general baseline characteristics, except for smoker status, which was significantly different between groups (Table 2). Specifically, more participants in the stress condition were smokers than participants in the control condition. Follow-up

analyses indicated that smoker status was not significantly correlated with the outcome variables (data available upon request; all *p's* > .05), and thus was not controlled for in subsequent analyses.

Although conditions did not differ on baseline SIR scores, conditions did differ on several variables from the baseline item ratings (BIR), including urge to save the items, perceived value of the items, and feelings of responsibility for the items (Table 2). Participants in the control condition reported these ratings as significantly higher than those in the stress condition. All three of these variables were significantly associated with greater difficulties discarding, but not with acquiring tendencies (Table 4). The three BIR ratings were highly correlated with one another (*r's* = .77-.87, all *p's* < .001), and we therefore elected to calculate a composite BIR variable in order to address issues of multi-collinearity in the subsequent regression analyses. Thus, the composite measure of BIR—rather than the three individual items—was used in any subsequent relevant analyses.

Correlations between covariates and acquiring tendencies and difficulties discarding are shown in Table 5. SIAS scores were not significantly associated with difficulties discarding and acquiring tendencies. However, higher DASS depression scores were significantly associated with greater difficulties discarding (total items saved and feelings of grief about discarding items) as well as greater acquiring tendencies.

Manipulation Check

To ensure that the stressor elicited a stress reaction, we evaluated the effect of stress task condition on ratings of negative affect on the PANAS. The

repeated measures ANOVA with time (2) X condition (2) yielded a significant main effect of time, $F(1, 78) = 37.15$, $p < .001$, multivariate $\eta^2 = .32$, indicating that across groups, negative affect increased over time. This significant main effect was qualified by a significant time X condition interaction, $F(1, 78) = 24.04$, $p < .001$, multivariate $\eta^2 = .24$ (Figure 3). Between-groups analyses indicated that individuals in the two conditions exhibited similar levels of negative affect at baseline (T1). Yet, those in the stress condition displayed significantly greater levels of negative affect than the control condition following the stress manipulation (T3). Descriptive statistics and between-groups analyses for negative affect are presented in Table 6. These results indicated that the stress manipulation successfully increased negative affect.

A similar analysis was conducted to evaluate the effect of stress task condition on subjective stress, using a repeated measures ANOVA with time (6) x condition (2). Results indicated a significant effect for time, $F(5, 390) = 27.07$, $p < .001$, multivariate $\eta^2 = .26$. This significant main effect was qualified by a significant time X condition interaction, $F(5, 390) = 27.39$, $p < .001$, multivariate $\eta^2 = .26$ (Figure 4). Between-group analyses revealed that individuals from each condition reported similar levels of stress at baseline (T1), and also at 10 (T4), 20 (T5), and 30 (T6) minutes following the stressor. As predicted, individuals in the stress condition reported significantly more stress at mid-stressor (T2) and at post-stressor (T3). Descriptive statistics and between-groups analyses for subjective stress are presented in Table 6. These results further support the effectiveness of the manipulation of stress.

Finally, a parallel set of analyses was conducted to evaluate the effect of stress task condition on cortisol levels, using a repeated measures ANOVA with time (6) x condition (2). Results indicated a significant effect for time, $F(5, 370) = 16.55$, $p < .001$, multivariate $\eta^2 = .18$. The effect of time was further explored within the stress condition, in order to determine whether participants exhibited a typical pattern of stress reactivity. Results indicated that participants in the stress condition did not demonstrate a significant increase in cortisol levels from T1 to either T2 ($t(38) = -.32$, $p = .75$) or T3 ($t(38) = -.27$, $p = .79$). In addition, compared to their baseline cortisol levels, participants in the stress condition experienced decreased cortisol levels at T5 ($t(38) = 2.04$, $p > .05$) and at T6 ($t(38) = 3.78$, $p = .001$). The significant main effect of time was qualified by a significant time X condition interaction, $F(5, 370) = 13.94$, $p < .05$, multivariate $\eta^2 = .04$ (Figure 5). Between-group analyses indicated that individuals from both conditions exhibited similar cortisol levels at T1 and T6. However, participants in the stress condition experienced significantly higher cortisol levels at T2, T3, T4, and T5. Descriptive statistics and between-groups analyses for cortisol are presented in Table 7. Compared to normal values for healthy subjects (Kirschbaum & Hellhammer, 2000), participants in both conditions exhibited elevated cortisol levels at baseline, indicating that these values may not have represented a true baseline. Consequently, within the stress condition, cortisol levels did not significantly increase over the course of the stressor, perhaps, due to the timing of the

baseline sample. Yet, the time X condition interaction provides evidence that the stress manipulation elicited more stress in the stress condition than the control condition.

In a more exploratory vein, we also wanted to more carefully examine the effect of time on subjective and biological stress for each condition separately. Specifically, we were interested in the effect of the behavioral hoarding measures on stress levels, and thus we investigated the difference in stress levels in each condition between T3 (post-stressor) and T4 (post-behavioral hoarding tasks). In the stress condition, participants reported a significant decrease in subjective stress between T3 and T4, $t(39) = 4.93$, $p < .001$, which suggests that these participants found the behavioral measures of hoarding to be less stressful than the stress manipulation tasks. There was no significant decrease in cortisol levels between T3 and T4, $t(38) = .61$, $p = .54$. In contrast, participants in the control condition reported a significant increase in subjective stress between T3 and T4, $t(39) = -2.43$, $p < .05$, which suggests that these participants may have experienced the behavioral measures of hoarding as stressful. However, similar to the stress condition, there was no significant change in cortisol levels between T3 and T4, $t(38) = .96$, $p = .34$. Thus, participants in the stress condition reported a subjective decrease in stress, whereas those in the control condition reported a subjective increase in stress following completion of the behavioral measures of hoarding.

Testing Aim 1: Effects of the Stress Manipulation on Hoarding Behaviors

For hypothesis 1.1, a series of regression analyses were conducted with stress task condition as the predictor and difficulties discarding and acquiring tendencies as separate outcome variables. In the first regression analysis, with total items saved as the dependent variable, the composite BIR variable was entered as a covariate in step 1, and stress task condition was entered in step 2. After controlling for the covariate, stress task condition significantly predicted total items saved, $\beta = -.28$, $t(77) = -3.00$, $p < .01$. Contrary to the original hypothesis, individuals in the control condition, compared to those in the stress condition, saved significantly more items during the BDT. Follow-up analyses using secondary outcome variables for the BDT are summarized in Table 8. A similar pattern emerged for urge to save, such that individuals in the control condition reported a greater urge to save items than individuals in the stress condition. Stress task condition, however, did not predict the other secondary outcome variables for the BDT.

The second set of regression analyses for Hypothesis 1.1 examined whether stress task condition predicted acquiring tendencies (i.e., total items purchased). The relationship between stress task condition and total items purchased was marginally significant, but, again, in the opposite direction as predicted, $\beta = -.19$, $t(77) = -1.73$, $p = .09$, such that individuals in the control condition purchased more items during the BAT than those in the stress condition. As seen in Table 8, stress task condition, however, was not a significant predictor of money spent during the BAT.

For hypothesis 1.2, significant and marginally significant analyses described above were repeated with DASS depression and SIAS scores included as covariates in step 1 of the equation. Controlling for the covariates, stress task condition remained a significant predictor of saving less items, β = -.32, $t(75) = -3.53$, $p = .001$, and a lower urge to save items, β = -.21, $t(75) = -2.47$, $p < .05$. Controlling for DASS depression and SIAS scores, the trending relationship between stress task condition and purchasing less items became significant, β = -.23, $t(75) = -2.11$, $p < .05$. This suggests a suppressor effect (Cohen & Cohen, 1983), given that the zero-order association between stress task condition and total items purchased was only marginally significant. It seems that the variance shared between total items purchased and DASS depression masked the negative association between stress task condition and total items purchased.

Given that the above results were in the opposite direction as predicted, follow-up analyses were conducted. In particular, we sought to investigate whether the negative association between stress and items saved would differ in individuals high and low on hoarding symptoms. Participants were classified as either being above (SIR discarding > 9; N = 38) or below (SIR discarding < 9; N = 42) the SIR discarding mean. The SIR discarding subscale, rather than SIR total score, was used for analyses given that difficulties discarding is considered the most central indicator of hoarding symptoms (Mataix-Cols, de la Cruz, Nakao, & Pertusa, 2011). Next, we conducted a factorial ANOVA with this SIR grouping variable and stress task condition as the predictors, and total items saved as the dependent variable. There was a significant main effect of the stress task

condition, $F(1, 76) = 15.82$, $p < .001$, partial $\eta^2 = .17$, as described above. Results did not, however, reveal a significant main effect of the SIR grouping variable, $F(1, 76) = .13$, $p = .72$, partial $\eta^2 = .00$. There was a marginally significant interaction between stress task condition and the SIR grouping variable, $F(1, 76) = 2.80$, $p = .10$, partial $\eta^2 = .04$, indicating that the high and low SIR groups may have been affected differently by the stress manipulation (Figure 6). It should be noted that these analyses were underpowered. Because there was a marginally significant interaction, we split the file by the SIR grouping variable and ran an independent samples t-test to examine the simple effects of stress condition at each level of the SIR grouping variable. For individuals high in hoarding symptoms, participants in the control condition saved significantly more items than participants in the stress condition, $t(36) = 3.61$, $p = .001$. Yet, for individuals low in hoarding symptoms, the relationship between stress task condition and total items saved was only marginally significant, $t(40) = 1.81$, $p = .08$. This suggests that the effect of stress on saving less items was stronger for individuals high in hoarding symptoms.

Testing Aim 2: Effects of Stress Response on Hoarding Behaviors

Hypotheses 2.1 and 2.2 were examined only for participants assigned to the stress condition, given that participants in the control condition did not experience significant increases in biological (cortisol levels) and subjective (self-reported) stress over the course of the stress manipulation (Figures 4 and 5).

For hypothesis 2.1, controlling for the composite BIR variable, subjective stress response did not significantly predict total items saved, $\beta = -.15$, $t(38) = -$

1.19, p = .29. Follow-up analyses on secondary outcome variables for difficulties discarding also revealed non-significant findings (Table 9). The same analyses were repeated to determine if biological stress response was a significant predictor of difficulties discarding (Table 10).

Similarly, change in cortisol levels did not significantly predict total items saved, β = .21, t(36) = 1.52, p = .14, although the results were in the predicted direction, with individuals with a heightened biological stress response saving more items. Biological stress response did not significantly predict the secondary outcome measures for difficulties discarding (Table 10).

As hypothesized, greater subjective stress response predicted purchasing more items, β = .34, t(38) = 2.19, p < .05, as well as spending more money on the BAT. However, greater biological stress response did not significantly predict either total items purchased, β = .11, t(37) = .67, p = .51, or amount of money spent. Analyses using money spent on the BAT as the outcome variable are summarized in Tables 9 and 10.

For hypothesis 2.2, the significant analyses above, with subjective stress response as the predictor and acquiring tendencies as the dependent variable, were repeated adjusting for DASS depression and SIAS scores. After controlling for the covariates, the relationships between subjective stress response and total items purchased, β = .30, t(36) = 2.02, p = .05, as well as amount of money spent, β = .30, t(36) = 2.00, p = .05, became marginally significant.

Exploratory analyses were conducted within the control condition given that individuals in the control condition experienced an increased subjective

stress response following the behavioral measures of hoarding. Thus, we sought to investigate the relationship between subjective stress at T4 and hoarding behaviors. Within the control condition, higher subjective stress levels following the behavioral measures of hoarding were significantly associated with urge to save items (r = .47, p < .01), but not total items saved (r = .22, p = .18), total items purchased (r = .10, p = .54), or total money spent (r = .05, p = .75).

Testing Aim 3: *Effects of Hoarding Symptoms and Cognitions on Stress Response*

As with Aim 2, analyses for Aim 3 were only examined for participants assigned to the stress condition. In examining hypothesis 3.1, SIR total scores were not a significant predictor of subjective stress response, β = -.14, t(38) = -.89, p = .38, or biological stress response, β = .06, t(37) = .37, p = .71. The same pattern emerged for the SIR subscales, none of which were significant predictors of stress response (Table 11).

Similarly, SCI total scores were not significantly associated with subjective stress response, β = .13, t(38) = .83, p = .41, or biological stress response, β = -.10, t(37) = -.61, p = .54. However, more fine-grained subscale analyses indicated that ratings of *less* feelings of responsibility for items, *more* beliefs about control, and *more* concerns about memory were associated with an increased subjective stress response (Table 12). Biological stress response, however, was not significantly associated with the SCI subscales (Table 12).

Testing Aim 4: Moderating Role of Stress in the Prediction of Hoarding Behaviors

Zero-order correlations between risk variables (AC, negative urgency, AS, and DT) and difficulties discarding and acquiring tendencies are included in

Table 13. Most of the risk variables were not associated with difficulties discarding and acquiring tendencies. However, low DT was associated with saving more items.

Hypothesis 4.1: The Interaction between Stress and AC in Predicting Hoarding Behaviors

Stress task condition did not interact with levels of AC in predicting total items purchased, β = .05, $t(75) = .31$, $p = .76$. In addition, controlling for the composite BIR variable, stress task condition did not moderate the relationship between AC and total items saved, β = -.14, $t(75) = -.99$, $p = .33$.

Hypothesis 4.2: The Interaction between Stress and Negative Urgency in Predicting Hoarding Behaviors

Stress task condition did not interact with levels of negative urgency in predicting total items purchased, β = .03, $t(75) = .17$, $p = .86$. When controlling for the composite BIR variable, stress task condition did, however, interact with levels of negative urgency in predicting total items saved, although the interaction term was marginally significant, β = .23, $t(75) = 1.76$, $p = .08$. The simple effects were investigated, despite the marginally significant interaction term, given that a moderation effect was hypothesized *a priori*. The effect of negative urgency on total items saved for individuals in the control condition was not significant, β = -.10, $t(75) = -.78$, $p = .44$. In contrast, the effect of negative urgency on total items saved for individuals in the stress condition was marginally significant, β = .21, $t(76) = 1.73$, $p = .09$. As predicted, in light of exposure to stress, increased levels of negative urgency were associated with saving more items. This interaction is depicted in Figure 7.

Hypothesis 4.3: The Interaction between Stress and AS in Predicting Hoarding Behaviors

Results revealed that stress task condition did not interact with levels of AS in predicting total items purchased, β = -.12, *t*(75) = -.79, *p* = .43. Similarly, controlling for the composite BIR variable, stress task condition did not interact with levels of AS in predicting total items saved, β = -.03, *t*(76) = -.20, *p* = .85.

Hypothesis 4.4: The Interaction between Stress and DT in Predicting Hoarding Behaviors

Regression analyses indicated that stress task condition did not interact with levels of DT in predicting total items purchased, β = .21, *t*(75) = 1.32, *p* = .19. However, controlling for the composite BIR variable, stress task condition did interact significantly with DT in predicting total items saved, β = -.26, *t*(75) = -2.13, *p* < .05. Testing the simple effects revealed that, for participants in the control condition, the effect of DT on total items saved was not significant, β = -.05, *t*(75) = -.40, *p* = .69, that is, individuals high and low on DT did not differ from one another. However, within light of exposure to stress, lower DT was associated with saving significantly more items, β = -.41, *t*(75) = -3.05, *p* = .001. This interaction is depicted in Figure 8.

Chapter 6 – Discussion

Although research has generally supported a relationship between hoarding and stress, no research to date has examined the effect of stress on hoarding behaviors using an experimental paradigm. This investigation further expanded on the literature by exploring the relationship between various aspects of hoarding and both biological and subjective stress reactivity. Additionally, our study was the first to investigate the interaction between stress and relevant risk variables in predicting hoarding behaviors. Although some study hypotheses were not supported, several results are consistent with our predictions and suggest a complex relationship between hoarding and stress. Findings generally highlight the importance of conducting future research on the potentially far-reaching, in addition to immediate, impact of stress on hoarding behaviors.

The Association between Stress and Fewer Hoarding Behaviors

Our first and primary aim was to examine whether stress leads to immediate increases in hoarding behaviors. Contrary to expectations, individuals in the control condition, compared to those in the stress condition, exhibited greater discarding difficulties and acquiring tendencies, controlling for depression and social anxiety. Depression appeared to function as a suppressor variable in the analysis predicting acquiring tendencies (Tabachnick & Fidell, 2007); this effect may be due to a unique relationship between depressed mood and acquiring behaviors.

There are several explanations for these unexpected findings. First, it is plausible that executive functioning (EF) faculties were strained and/or depleted

to a greater degree in the stress condition. Research has demonstrated that tasks that require high intensity engagement, such as the stress manipulation, can temporarily reduce EF (Lavie, Hirst, de Fockert, & Viding, 2004). Although we did not directly assess EF in the current investigation, the stress condition was found to have greater cortisol levels before (T3) and after (T4) the behavioral measures of hoarding compared to the control condition. As such, it is possible that participants who underwent the stress manipulation experienced impaired EF (see Compton, Robinson, Ode, Quandt, Fineman, & Carp, 2008; Skosnik et al., 2000), which may have made them more susceptible to the demand characteristics of the tasks. Exploratory analyses further revealed that the relationship between stress and greater discarding was more pronounced in individuals with high hoarding symptoms. This opens the possibility that participants high on hoarding symptoms were more strongly impacted by the stress manipulation, which may have led to greater comparative deficits in EF and subsequently more pronounced susceptibility to the demands of the tasks. This possibility is consistent with research that hoarding is linked with deficits in self-control (Timpano & Schmidt, 2013), a construct closely related to EF (Hofmann, Schmeichel, & Baddeley, 2012).

A second explanation considers the differential patterns of subjective stress in response to the behavioral hoarding measures depending on stress task condition. During the period between T3 and T4, participants in the control condition reported an *increase* in subjective stress, indicating that they perceived the behavioral measures of hoarding as *more* stressful than the previously

completed tasks (see Figure 4). It is not surprising that these participants found the BDT stressful, given the fast-paced nature of the task, the hypothetical situation involving a fire, and the act of hypothetically shredding their belongings. Indeed, control participants who reported the greatest subjective stress at T4 reported the greatest urge to save during the BDT, suggesting that increased stress over the course of the task impacted their saving behavior. Participants in the stress condition, in contrast experienced a significant *decrease* in subjective stress from T3 to T4, signifying that they found the behavioral measures of hoarding to be *less* stressful than the stress manipulation tasks. This implies that the process of completing the behavioral measures of hoarding, and particularly the BDT due to its stressful nature, was qualitatively different between the two conditions. If we extrapolate from this interpretation, it may be that the group that experienced an increased subjective stress response during the behavioral hoarding tasks (i.e., the control condition), but not the group with elevated subjective stress prior to starting the tasks (i.e., the stress condition), exhibited greater levels of hoarding behaviors.

A third possible consideration is the temporal span between stress-exposure and the expression of hoarding symptoms. Our investigation considered hoarding behaviors immediately following a stressor, which was designed to examine the existence of a powerful and direct effect of stress on saving and acquiring behaviors. An alternative perspective is that stress may have a more long-term and indirect impact on hoarding behaviors. Within this conceptualization, one's immediate reaction to stress may not be as critical for

predicting hoarding behaviors as one's long-term adjustment to SLEs or TLEs. This possibility is in line with some patients' reports that chronic saving is not an immediate reaction to a death in the family, but rather a long-term avoidance of discarding that leads to increased clutter over time. Thus, the current study may have examined too narrow of a time-frame to observe the expected effects.

In light of these alternative explanations for why we may have found a negative relationship between stress and hoarding behaviors, future research is called for. Longitudinal designs would be helpful for discerning the temporal relationship between different types of stress and hoarding. Investigations should also be focused on a clinical population. The results of the current study using a nonclinical sample were unexpected in light of clinical observations, which suggest that individuals with hoarding have more difficulties discarding under states of stress. For instance, Hartl et al. (2005) theorized that hoarding patients, who have experienced a TLE, associate possessions with safety, which leads them to feel anxious about discarding belongings. To study the effects of stress in a clinical population, it is helpful to consider tasks that provoke stress in hoarding patients. For instance, individuals who hoard may find the BDT more stressful than the TSST. Research indicates that patients who hoard find it more stressful to make decisions about their own possessions compared to other's belongings (Grisham et al., 2010; Tolin et al., 2009). Accordingly, future studies could examine stress reactivity following completion of the original BDT, compared to a similar version of the BDT, which would require participants to make decisions about lab items.

The Association between Depressed Mood and Greater Hoarding Behaviors

Another interesting finding was that depressed mood was associated with greater hoarding behaviors. The relationship between depressed mood and acquiring tendencies is in line with previous research on compulsive buying (Claes et al., 2010; Frost, Steketee, Williams, & Warren, 2000). Furthermore, given that depressed individuals tend to be less hopeful and future-oriented, the threat of having the bill sent to their parents may not have been an adequate deterrent to purchasing for individuals with greater depressed mood. There are also several explanations for the association between depressed mood and difficulties discarding. The relationship between depressed mood and saving behavior is consistent with the CBT model of hoarding, in which individuals who hoard save to avoid negative emotions such as sadness. Consequently, chronic saving may be more pronounced in individuals with depressed mood. Future research should consider investigating what mechanisms, such as emotion regulation (e.g., Faber & Christenson, 1996), might explain the relationship between depressed mood and hoarding behaviors. For example, future studies could induce a negative mood prior to having participants complete the behavioral measures of hoarding, which would lend empirical support to the idea that negative affect drives hoarding behaviors.

The Effect of Stress Response on Subsequent Hoarding Behaviors

The current study also examined how one's stress response affects hoarding behaviors. In line with study hypotheses, a greater subjective stress response was associated with more acquiring tendencies, although the

relationship became marginally significant when controlling for depression and social anxiety. Given the limited sample size, it is not surprising that this association attenuated when taking into account depression. Biological stress response, however, was not associated with acquiring tendencies. No significant findings emerged for the relationship between subjective stress response and difficulties discarding. Although the correlation between biological stress response and difficulties discarding was also non-significant, the effect was in the predicted direction, with individuals with more pronounced cortisol levels saving more items. Given the small sample size, power was likely too low to detect an effect. With the actual sample size of 38 participants, this analysis was only powered at 52.29% with a Type 1 error (α) < .05. Future research should use larger samples to generate more power to detect an effect.

The discovery that acquiring, but not difficulties discarding, was linked to subjective stress response, is consistent with research by Timpano, Keough, et al. (2011) who found that self-reported acquiring, but not difficulties discarding, had a robust association with greater self-reported general life stress. Subjective stress may be an important impetus for shopping behavior, since shopping may be used as a strategy to increase positive emotions and avoid negative emotions (e.g., Faber & Christenson, 1996). Despite nonsignificant findings within the stress condition, exploratory analyses gave some indication that subjective stress is linked to difficulties discarding. In the control condition, higher subjective stress levels following the behavioral measures of hoarding were significantly associated with a greater urge to save items.

The nonsignificant findings of biological stress response may be explained by the artificially blunted cortisol response, due to elevated baseline cortisol, which appeared to mask significant changes in cortisol over the course of the stressor. Future research should use multiple baseline measures of cortisol: an initial sample to help participants acclimate to the novelty of the situation, and a subsequent sample which would serve as the actual baseline measure (e.g., Ellenbogen, Carson, & Pishva, 2010; Yoon & Joormann, 2012). Nevertheless, the findings provide some indication that biological stress reactivity may be more predictive of difficulties discarding than acquiring tendencies. Physiological symptoms of stress, which can deplete EF, may lead individuals with hoarding tendencies to avoid doing aversive, cognitively demanding tasks like sorting and discarding. In contrast, shopping does not appear to put a similar demand on cognitive resources, and therefore may not be as affected by physical symptoms of stress. In fact, Frost and Steketee (2010) have described shopping as a "flow state," in which individuals who hoard are so absorbed by the activity that they hardly think. Future research with larger samples and/or clinical populations should be conducted to further examine the relative impact of both subjective and biological stress on hoarding behaviors.

Effects of Hoarding Symptoms and Specific Cognitions on Stress Response

The study also sought to understand whether baseline hoarding symptoms and cognitions could impact the stress response system, via heightened stress reactivity. Analyses revealed that hoarding symptom severity was not significantly associated with either biological or subjective stress

response, but that several types of hoarding cognitions were associated with subjective stress response. Specifically, more beliefs about control and memory, but fewer beliefs about responsibility were correlated with an increased subjective stress response. These findings did not hold with biological stress response. The results suggest that hoarding symptoms and cognitions may not impact the biological stress response system. However, given the small sample size and the artificially blunted pattern of stress reactivity in the sample, these findings need to be replicated.

In the current study, hoarding cognitions, rather than hoarding symptoms, appeared to impact one's experience of stress. The fact that subjective stress response was associated with more beliefs about control and memory, but less concerns about responsibility, is thought-provoking. The relationship between subjective stress response and beliefs about control is consistent with previous research on hoarding (Cromer et al., 2007; Hartl et al., 2005) and stress (Watanabe et al., 2002). The association between subjective stress response and beliefs about memory is interesting to contemplate in terms of studies that has found deficits in working memory under states of stress (Oei, Everaerd, Elzinga, Van Well, & Bermond, 2006; Qin, Hermans, van Marle, Luo, & Fernández, 2009; Schoofs, Pabst, Brand, & Wolf, 2013; Schoofs, Wolf, & Smeets, 2009). Since stress impacts working memory, having pre-existing concerns about forgetting items might make individuals particularly reactive to stress, which would place further demands on their working memory. The finding regarding the negative relationship between levels of responsibility cognitions

and stress response was surprising; future research should be conducted to replicate this finding and subsequently investigate mechanisms underlying this relationship.

Synergistic Relationship between Stress, Negative Urgency, and Distress Tolerance

The current study also investigated the synergistic effect of stress and other risk variables in predicting hoarding behaviors. Higher levels of negative urgency and lower levels of DT interacted with stress to predict greater difficulties discarding, but not acquiring tendencies. Contrary to predictions, stress did not interact with AC or AS in predicting hoarding behaviors. Statistically, the moderation analyses for predicting acquiring tendencies were limited by the fact that stress task condition did not strongly predict acquiring tendencies; future research is warranted.

The finding that negative urgency and DT interacted with stress to predict difficulties discarding but not acquiring tendencies is particularly interesting. Despite being previously linked with self-reported acquiring (Timpano et al., 2009; Timpano, Rasmussen, et al., 2013), negative urgency and DT were not associated with acquiring tendencies on the BAT (Table 13). It could be that difficulties discarding are more influenced by these risk variables, in consideration of the proposed diagnostic criteria for hoarding in DSM-V, which will list difficulties discarding as a central symptom, but excessive acquisition as a specifier not necessary for diagnosis (Mataix-Cols et al., 2011). Alternatively, given that stress reactivity was not directly linked with difficulties discarding, it may be that a “perfect storm” of factors must interact with stress to lead to

difficulties discarding. Stress reactivity may, however, have a more direct impact on acquiring tendencies. Or, perhaps, there are other factors that were overlooked, such as beliefs about the psychological benefits of buying (see Kyrios, Frost, & Steketee, 2004), that may interact with stress to predict increased acquiring tendencies.

Furthermore, the nonsignificant findings for the synergistic role of stress in the relationship between DT and negative urgency and acquiring tendencies may be explained by the constructs investigated. For instance, it may be that other facets of impulsivity, such as motor impulsiveness (e.g., “I make up my mind quickly”) (Patton, Stanford, & Barratt, 1995), which is associated with acquisition (Timpano, Rasmussen, et al., 2013), are more relevant for predicting acquiring tendencies. It could be that stress, coupled with motor impulsivity, would lead individuals to make quick, rash decisions about purchasing. In consideration of the construct of DT examined, the DTS measures one’s perceived ability to endure a negative emotional state, whereas behavioral measures of DT assess the behavioral act of enduring distressing internal states (Leyro, Zvolensky, & Bernstein, 2010). It could be that actual, rather than perceived, DT would be relevant to acquiring tendencies. Thus, future investigations should use a behavioral measure of DT such as the Mirror Tracing Persistence Task (Quinn, Brandon, & Copeland, 1996) or the Paced Auditory Serial Addition Task (Lejuez, Kahler, & Brown, 2003) and examine additional facets of impulsivity to expand upon these findings.

In terms of the nonsignificant interactive role of stress in the relationship between AS and hoarding behaviors, it could be that a general intolerance of distress, rather than sensitivity to anxiety, is more important in predicting hoarding behaviors in the context of stress. As the CBT model of hoarding describes, hoarding behaviors can be motivated by an avoidance of a wide range of negative emotions, not just anxiety (Frost & Hartl, 1996). Currently, AS was not associated with performance on the BDT or on the BAT (Table 13), which could imply that AS is more relevant to one's perceptions of hoarding difficulties rather than actual hoarding behaviors.

The nonsignificant interaction between stress and AC in predicting hoarding behaviors may be explained by the use of a self-report measure of AC; different results might have emerged if a cognitive task had been utilized. AC furthermore did not have a main effect on BDT and BAT performance (Table 13). Since AC is conceptualized as an aspect of EF and self-control, these findings are somewhat surprising in light of recent work linking saving behaviors to decreased self-control (Timpano and Schmidt (2013). Similarly, a study by Vohs and Faber (2007) found that decreasing participants' self-control resulted in greater urge to purchase and increased spending on a shopping opportunity. That being said, self-control is a broad construct that encapsulates a number of difference facets (Hofmann et al., 2012). It may be that another cognitive factor of self-control, rather than AC, moderates the relationship between stress and hoarding.

Limitations & Future Directions

The results of the current study should be interpreted in light of several statistical and methodological limitations. First, the power to detect a significant effect for Aims 2 and 3 was limited. Second, the current study used a sample of young adults, who may have been too young to have acquired enough belongings to experience clutter, distress, or impairment from hoarding symptoms. In addition, research has indicated that hoarding patients with a later, compared to an earlier, age of onset, tend to report a SLE at the onset of hoarding (Grisham et al., 2006), which suggests the importance of examining the study hypotheses in older adults as well. Furthermore, despite over-selecting for individuals high on hoarding symptoms, the current sample had a lower mean SIR score than expected, which may have limited the range on the behavioral measures of hoarding. Third, the current study only assessed one's immediate response to stress. Yet, it may be that hoarding behaviors are brought on by states of chronic stress or TLEs (e.g., Cromer et al., 2007). Fourth, although the baseline cortisol measurement was taken 30 minutes after arrival, which has been suggested as standard in the literature (e.g., Ellenbogen et al., 2010), baseline cortisol levels were higher than would be expected. The unusual pattern of cortisol reactivity likely limited the ability to detect effects for cortisol response.

Although the study was novel in its use of two behavioral measures of hoarding, the tasks used in the current investigation may also represent a limitation, as they may not actually capture true, momentary hoarding behavior. Measuring hoarding behavior in an analogue sample comes with challenges,

such as creating tasks that are both ecologically valid (i.e., relevant for college students) and elicit variable responses (Tolin et al., 2009). The behavioral measures of hoarding may have been limited by their hypothetical nature, and future investigations should use real-life objects to increase the salience of the tasks. The BDT similarly may not have allowed for a sufficient variety of decisions, such as giving items to a third party or waiting to make a decision. Furthermore, we restricted our investigation to difficulties discarding and acquiring tendencies. It would be interesting to examine the association between stress and other hoarding-related behaviors, such as decision-making difficulties and organization/categorization problems. Finally, the BAT only tapped one aspect of acquiring behavior (i.e., compulsive shopping), and did not assess the effect of stress on collecting free items. Thus, future research should consider modifying the behavioral hoarding tasks or measuring different facets of hoarding to expand on the results of this study.

Implications

The current study has implications for the etiology and treatment of hoarding. From an etiological perspective, stress may represent an underlying vulnerability, which interacts with other risk variables, such as negative urgency and DT, to increase difficulties discarding. The results also indicate that hoarding cognitions may make individuals more reactive to stress. The finding that subjective stress response was linked to subsequent acquiring tendencies has implications for the pathoplasty model, which posits that some condition impacts the maintenance or presentation of a disorder, without necessarily directly

causing the disorder (Clark, Watson, & Mineka, 1994; Klein, Wonderlich, & Shea, 1993). Unfortunately, it is difficult to draw causal conclusions about whether stress truly functions as a risk factor for hoarding, given the nature of the sample and the complex findings from the experimental manipulation.

This investigation also has important implications for treatment. The finding that negative urgency and DT interacted with stress to predict difficulties discarding may implicate emotional intolerance in the maintenance of saving behavior. Currently, it is unclear whether DT and negative urgency are malleable (e.g., Leyro et al., 2010), but given that AS, a closely related construct, is relatively modifiable (Keough & Schmidt, 2012), future investigations should examine whether these factors can be ameliorated through treatment. Hoarding patients, especially those experiencing stress, may benefit from treatments incorporating emotion regulation strategies (e.g., Linehan, 1993). In addition, several of the findings suggest the incorporation of stress management techniques into treatments for hoarding; this may be especially warranted given that stress has been shown to influence treatment response and lead to relapse in a range of clinical disorders (Francis, Moitra, Dyck, & Keller, 2012; Gershuny, Baer, Jenike, Minichiello, & Wilhelm, 2002; Kim et al., 2011). Lastly, the discovery that hoarding cognitions were linked to increased stress reactivity highlights the importance of cognitive interventions for hoarding.

Conclusion

Despite its limitations, the current investigation represented the first experimental investigation of the multi-faceted relationship between hoarding and

stress. The results indicated that an increased subjective stress response is linked to both hoarding cognitions and acquiring tendencies. However, the discrepant findings between biological and subjective stress response suggest the importance of further research on this topic in larger samples. The study also found that stress plays an interactive role in the relationship between emotional intolerance and difficulties discarding. The current investigation provides interesting avenues for future research, such as longitudinal investigations, and further supports and clarifies the role of stress in hoarding. Overall, stress appears to have a complex and interactive relationship with the thoughts and behaviors that characterize hoarding as well as associated vulnerability factors.

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Figures

Figure 1

The Cognitive-Behavioral Model of Hoarding.

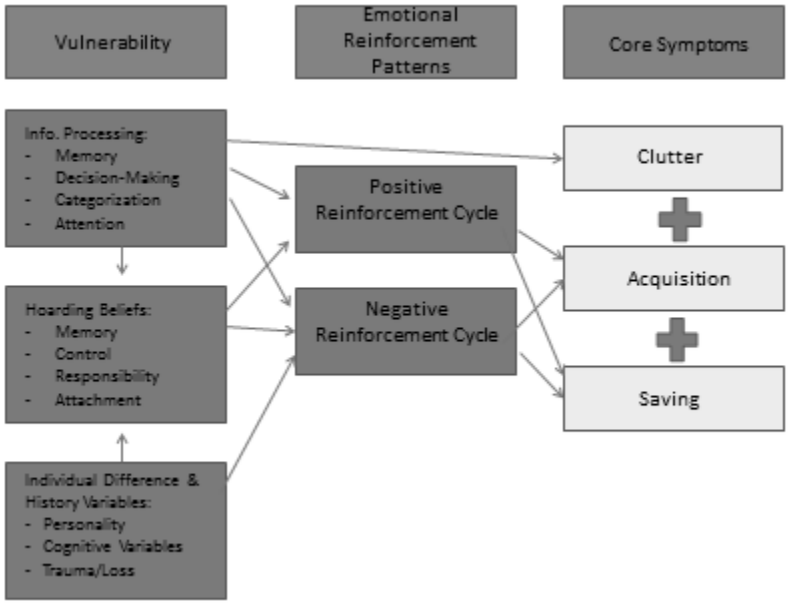
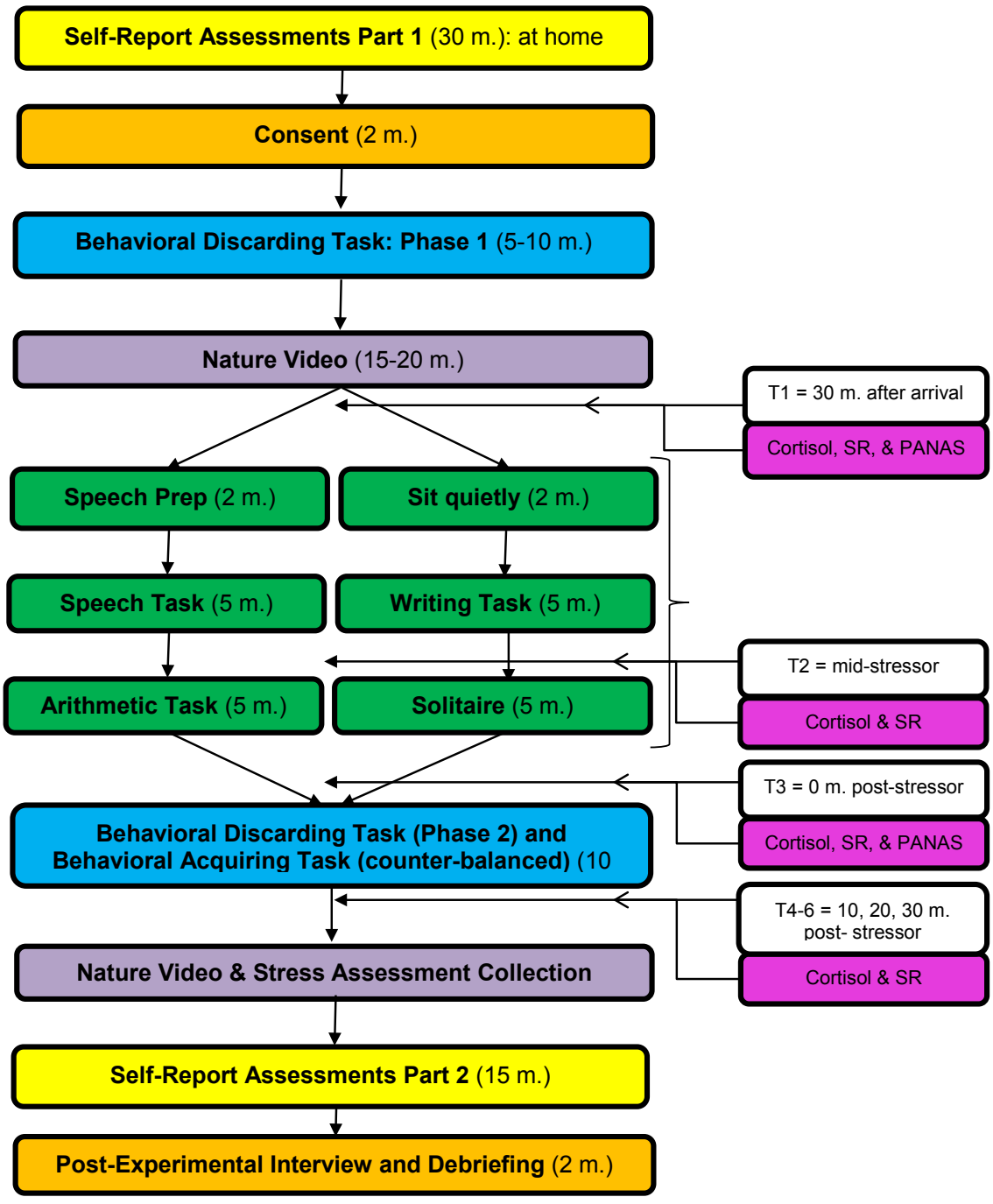


Figure 2

Study Schemata.



Note. SR = Subjective (Self-reported) Stress assessment; PANAS = Positive and Negative Affect Scale.

Figure 3

Mean PANAS Negative Affect Ratings in the Two Conditions at Baseline and Following the Stress-Manipulation.

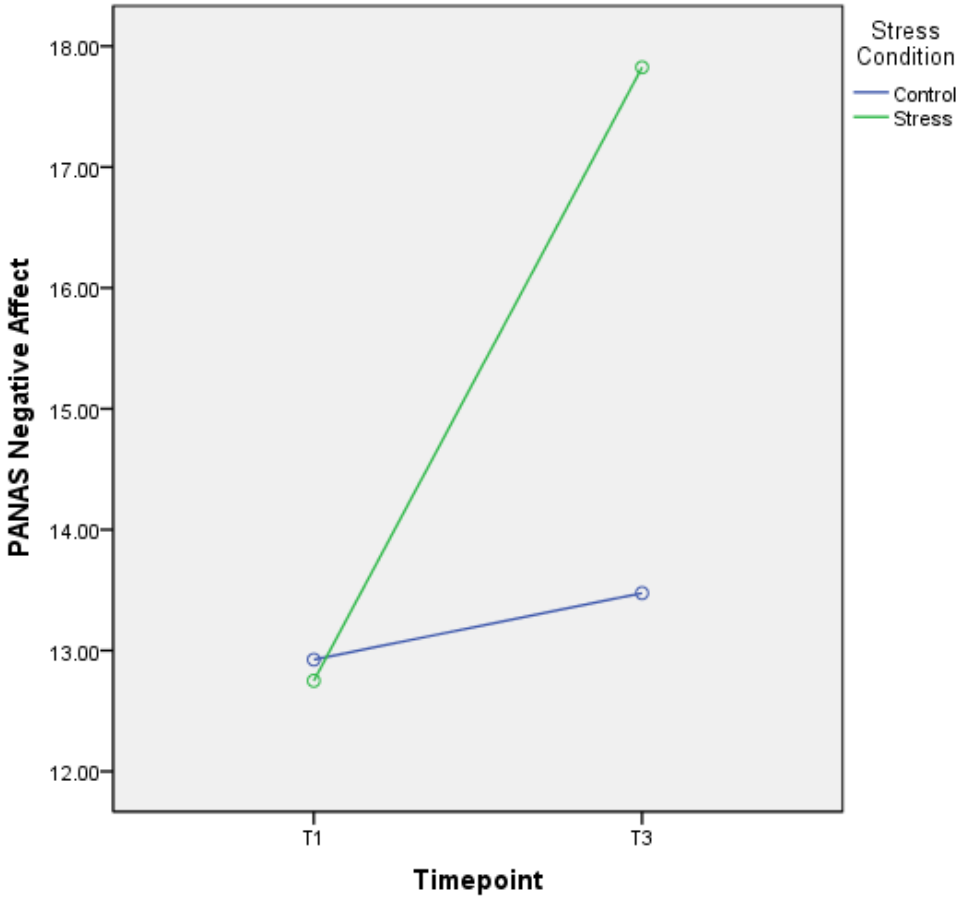
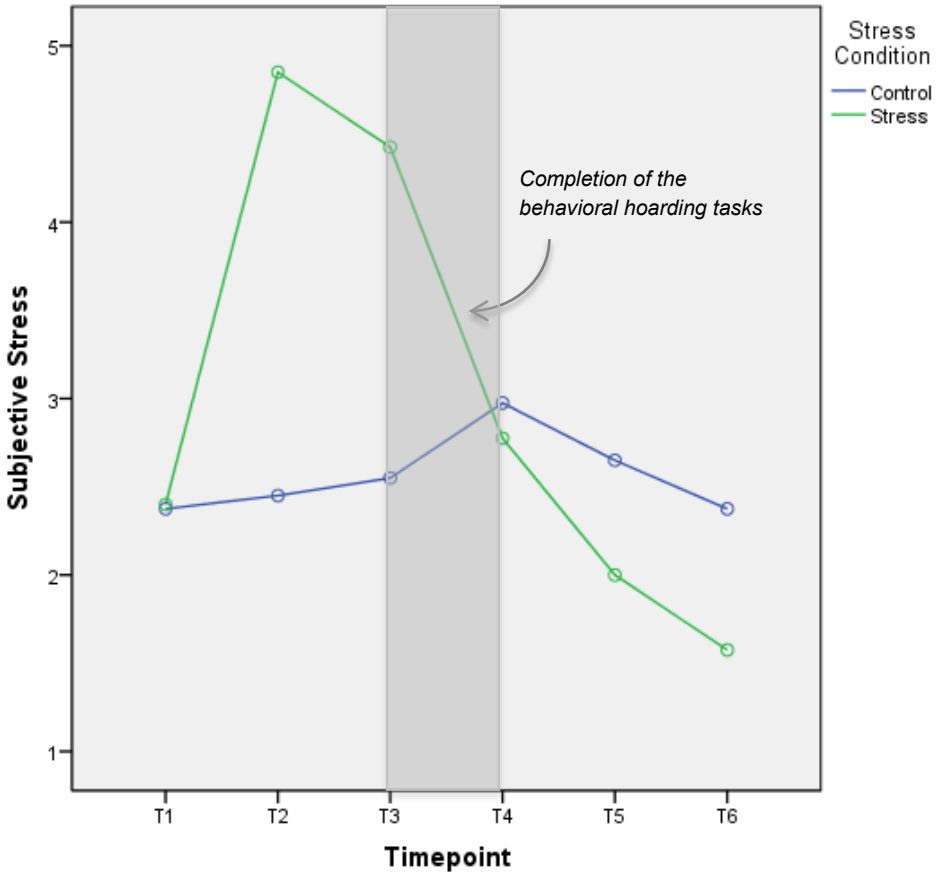


Figure 4

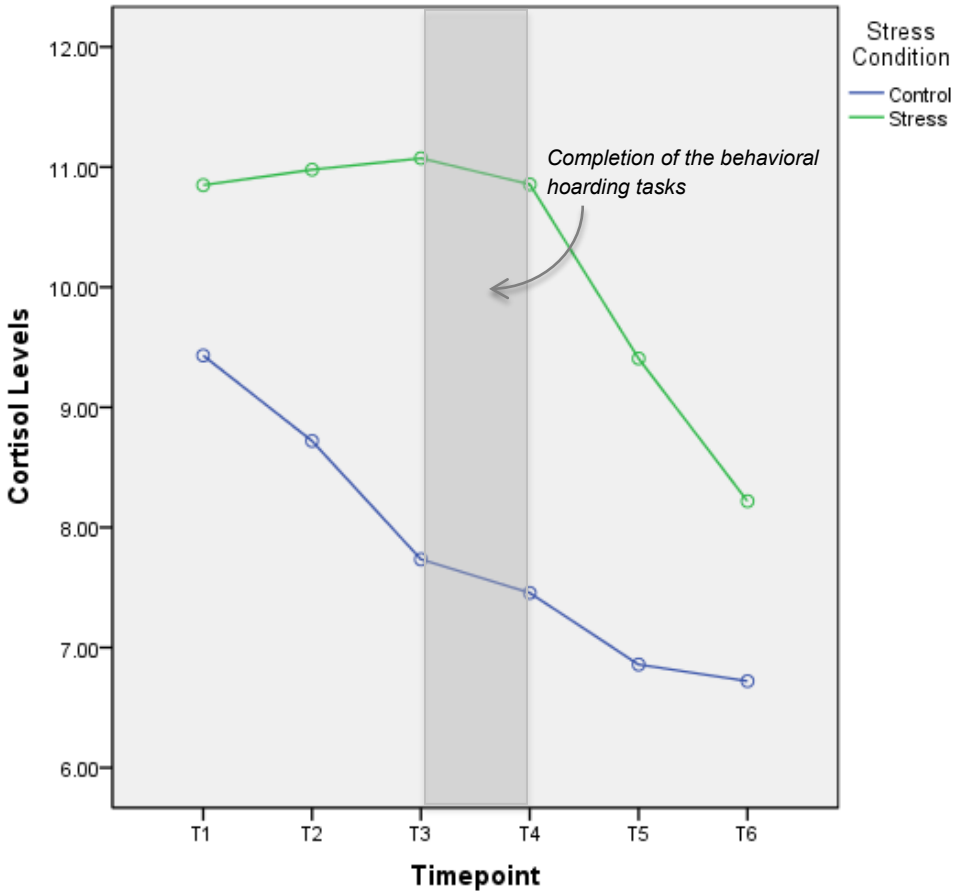
Mean Subjective Stress Ratings in the Two Conditions across Timepoints.



Note. T1 = Baseline; T2 = Mid-Stressor; T3 = Post-Stressor; T4 = 10 minutes Post-Stressor; T5 = 20 minutes Post-Stressor; T6 = 30 minutes Post-Stressor.

Figure 5

Mean Cortisol Levels in the Two Conditions across Timepoints.



Note. T1 = Baseline; T2 = Mid-Stressor; T3 = Post-Stressor; T4 = 10 minutes Post-Stressor; T5 = 20 minutes Post-Stressor; T6 = 30 minutes Post-Stressor.

Figure 6

Difficulties Discarding (BDT) in the Two Conditions based on High or Low Status on the Saving Inventory Revised (SIR) Difficulties Discarding Grouping Variable.

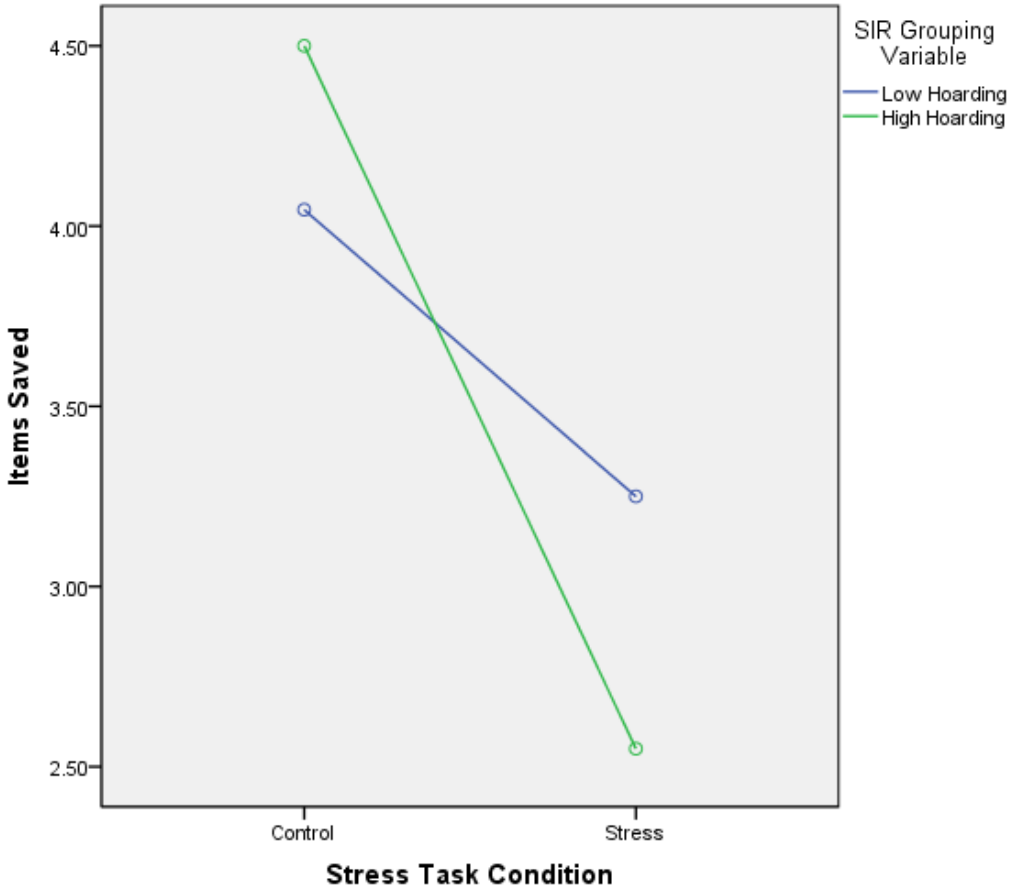


Figure 7

Interaction between Stress Condition and Negative Urgency (UPPS) in Predicting Difficulties Discarding (BDT).

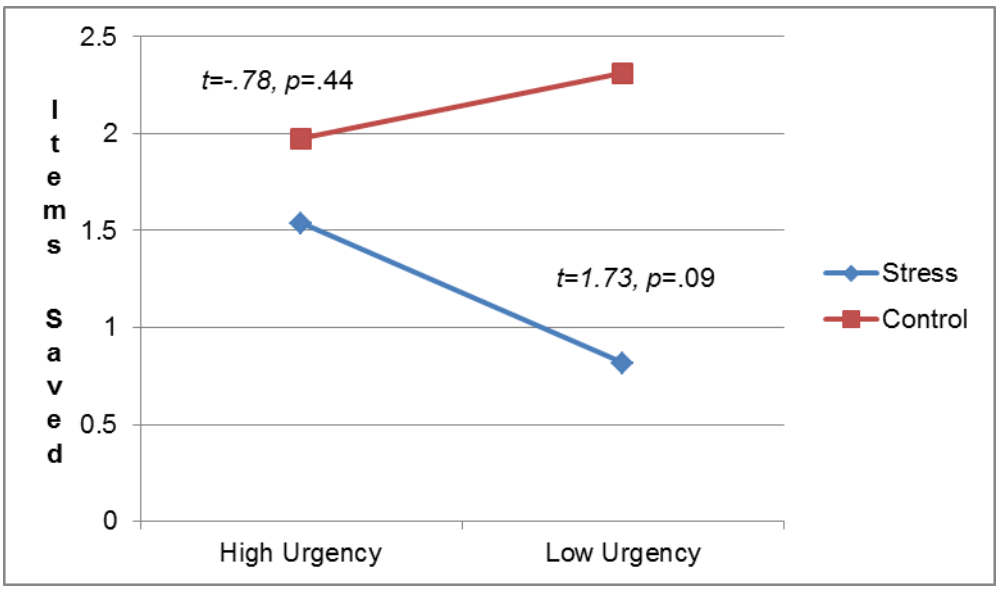
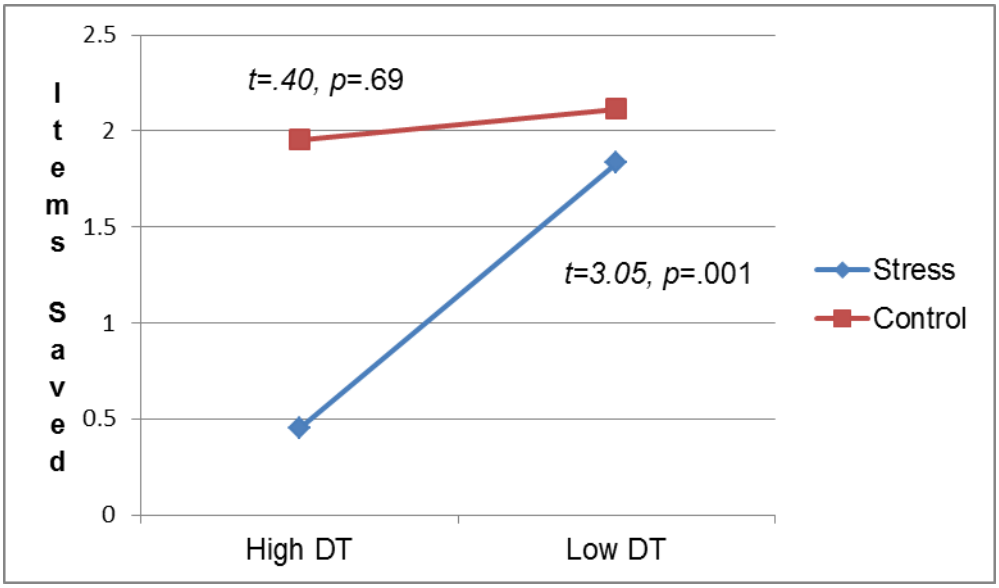


Figure 8

Interaction between Stress Condition and Distress Tolerance (DTS) in Predicting Difficulties Discarding (BDT).



Note. DT = Distress tolerance.

Tables

Table 1

Summary of Key Studies on Hoarding and Stress.

Author	Major findings	Type of sample	Design	Definition of stress
Hartl et al., 2005	(1) HD have greater frequency of TLEs	Clinical v. Controls	Cross-sectional	Trauma - Self-Report
Grisham et al., 2006	(1) HD with SLE around onset of symptoms had a later age of onset	Clinical	Cross-sectional	SLEs - Interview
Cromer et al., 2007	(1) TLEs associated with HD	Clinical	Cross-sectional	Trauma - Interview
Tolin et al., 2010	(1) SLEs associated with HD; (2) Interpersonal SLEs important in the onset and exacerbation of HD	Clinical	Cross-sectional	SLEs - Self-Report
Landau et al., 2011	(1) TLEs associated with HD; (2) ½ of HD linked onset to SLEs	Clinical v. Controls	Cross-sectional	Trauma - Interview
Timpano et al., 2011	(1) SLEs associated with HD; (2) Emotional intolerance mediates the relationship	Nonclinical Unselected	Cross-sectional	SLEs - Self-report

Note. HD = Hoarding disorder or hoarding symptoms; SLEs = Stressful life events; TLEs = Traumatic life events.

Table 2

Demographics and Baseline Characteristics by Condition.

Baseline characteristic	Overall sample *N* = 80	Stress condition *n* = 40	Control condition *n* = 40	Statistic
General demographics	% of total	% of subsample	% of subsample	χ^2
Gender – female	63.70%	65.00%	62.50%	0.05
Ethnicity				3.47
Not Hispanic or Latino	76.30%	85.00%	67.50%	
Hispanic or Latino	18.80%	12.50%	25.00%	
Unknown or Not Reported	5.00%	2.50%	7.50%	
Race				8.96
White/Caucasian	67.50%	62.50%	72.50%	
Black/African American	3.80%	2.50%	5.00%	
Asian	20.00%	30.00%	10.00%	
Other	8.80%	5.00%	12.50%	
Medication use – yes	18.80%	32.50%	15.00%	0.74
Caffeine use – yes	26.30%	32.50%	20.00%	1.61
Smoker – yes	10.00%	17.50%	2.50%	5.00*
	M (SD)	*M (SD)*	*M (SD)*	*t*
Age	18.95 (1.47)	18.95 (1.32)	18.95 (1.63)	.00
Hours Slept	6.77 (1.74)	6.89 (2.00)	6.65 (1.45)	-.61
Hoarding relevant variables	*M (SD)*	*M (SD)*	*M (SD)*	*t*
SIR	25.93 (14.07)	26.53 (14.24)	25.32 (14.05)	-0.38
BIR: Urge to Save	68.74 (14.61)	65.45 (16.25)	72.03 (12.10)	2.05*
BIR: Value	63.53 (18.58)	58.95 (19.76)	68.10 (16.30)	2.26*
BIR: Responsibility	52.00 (23.04)	46.25 (23.27)	57.75 (21.57)	2.29*
BIR: Emotion	56.24 (18.22)	53.90 (20.06)	58.58 (16.07)	1.15
BIR: Memory	51.83 (20.57)	49.73 (20.69)	53.93 (20.49)	0.91
BIR: Control	46.45 (23.25)	43.75 (21.91)	49.15 (24.50)	1.04

Note. Medication Use = Took medication the day of the experiment; Caffeine Use = Consumed caffeine the day of the experiment; SIR = Saving Inventory Revised; BIR = Baseline Item Ratings; BIR: Urge to Save = Urge to Save Items; BIR: Value = Value of Items; BIR: Responsibility = Feelings of Responsibility for the Items; BIR: Emotion= Emotional Attachment to the Items; BIR: Memory = Need to Save to Remember the Items; BIR: Control = Need to Maintain Control over the Items.
* $p < .05$.

Table 3

Means, Standard Deviations, and Range for Primary Study Variables.

Measure	*M*	*SD*	Range
BDT: Items Saved	3.58	1.68	0-8
BDT: Urge to Save	49.61	18.58	0-86
BAT: Items Purchased	6.41	3.58	0-14
BAT: Money Spent	108.56	76.30	0-321
SIR	25.93	14.07	2-69
SCI	63.36	25.84	24-142
DASS Depression	8.55	7.85	0-32
SIAS	31.51	13.09	0-60
ACS	49.03	7.82	31-47
UPPS-P Urgency	28.58	8.03	12-47
ASI-3	19.50	14.48	0-68
DTS	3.31	.69	2-5

Note. BDT = Behavioral Discarding Task; BAT = Behavioral Acquiring Task; SIR = Saving Inventory Revised; SCI = Saving Cognitions Inventory; DASS Depression = Depression Anxiety Stress Scales Depression subscale; SIAS = Social Interaction and Anxiety Scale; ACS = Attentional Control Scale; UPPS-P Urgency = UPPS Impulsive Behavior Scale Urgency subscale; ASI-3 = Anxiety Sensitivity Index-3; DTS = Distress Tolerance Scale.

Table 4

Associations between Baseline Item Ratings (BIR) and Difficulties Discarding and Acquiring Tendencies.

	BDT: Items Saved	BAT: Items Purchased
BIR: Urge to Save	.48***	.14
BIR: Responsibility	.50***	.02
BIR: Value	.57***	.12

Note. BAT = Behavioral Acquiring Task; BDT = Behavioral Discarding Task; Urge to Save = Urge to Save Items; Value = Value of Items; Responsibility = Feelings of Responsibility for the Items.
*** $p < .001$.

Table 5

Associations between Covariates (SIAS and DASS Depression) and Difficulties Discarding and Acquiring Tendencies.

Measure	SIAS	DASS Depression
BAT: Items Purchased	-.01	.29*
BAT: Money Spent	.03	.23*
BDT: Items Saved	.00	.31**
BDT: Urge to Save	-.09	.19
BDT: Distress	-.09	.13
BDT: Grief	.01	.23*
BDT: Indecision	.02	.19

Note. SIAS = Social Interaction and Anxiety Scale; DASS Depression = Depression Anxiety Stress Scales Depression subscale; BAT = Behavioral Acquiring Task; BDT = Behavioral Discarding Task.
* $p < .05$. ** $p < .01$.

Table 6

Descriptive Statistics, Including Means (Standard Deviations), for Negative Affect (PANAS) and Subjective Stress as a Function of Stress Task Condition.

Timepoint	Stress condition	Control condition	*t*
Negative Affect			
T1: Baseline	12.75 (3.26)	12.93 (4.70)	.19
T3: Post-stressor	17.83 (6.21)	13.48 (5.02)	-3.45**
Subjective Stress			
T1: Baseline	2.40 (2.39)	2.38 (2.18)	-.05
T2: Mid-stressor	4.85 (2.47)	2.45 (2.01)	-4.77***
T3: Post-stressor	4.43 (2.42)	2.55 (2.12)	-3.69***
T4: 10 min. Post-stressor	2.78 (2.52)	2.98 (2.04)	.39
T5: 20 min. Post-stressor	2.00 (2.28)	2.65 (2.14)	1.32
T6: 30 min. Post-stressor	1.58 (2.01)	2.38 (2.17)	1.71

Note.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 7

Descriptive Statistics, Including Means (Standard Deviations), for Cortisol Levels as a Function of Stress Task Condition.

Timepoint	Stress condition	Control condition	*t*
T1: Baseline	10.74 (6.49)	9.32 (4.58)	-1.14
T2: Mid-stressor	10.98 (5.61)	8.65 (4.25)	-2.08*
T3: Post-stressor	11.07 (6.33)	7.68 (3.77)	-2.88**
T4: 10 min. Post-stressor	10.86 (6.65)	7.42 (3.67)	-2.83**
T5: 20 min. Post-stressor	9.41 (5.39)	6.86 (3.44)	-2.46*
T6: 30 min. Post-stressor	8.23 (4.28)	6.72 (3.54)	-1.67

Note. Cortisol is listed in nmol/L.
* $p < .05$. ** $p < .01$.

Table 8

Linear Regression Analyses with Stress Task Condition Predicting Secondary Outcome Variables of Difficulties Discarding and Acquiring Tendencies (Hypothesis 1.1).

DV	Predictors	B	*SE* B	β	*t*
BDT: Urge to Save	BIR	.23	.03	.65	7.92***
	Stress Condition	-7.17	-.19	-.19	-2.38*
BDT: Grief	BIR	.02	.01	.36	3.20**
	Stress Condition	.51	.58	.10	.88
BDT: Distress	BIR	.02	.00	.38	3.94**
	Stress Condition	-.28	.44	-.07	-.63
BDT: Indecision	BIR	.02	.01	.34	3.11**
	Stress Condition	-.07	.53	-.02	-.13
BAT: Money Spent	**Stress Condition**	-20.98	17.11	-.14	-1.23

Note. In bold are the predictors of interest; BDT = Behavioral Discarding Task; BAT = Behavioral Acquiring Task; BIR = Composite Variable of Baseline Item Ratings.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 9

Linear Regression Analyses with Subjective Stress Response as a Predictor, the Composite Variable of Baseline Item Ratings (BIR) as a covariate, and Secondary Outcome Variables of Difficulties Discarding and Acquiring Tendencies as the Dependent Variables (Hypothesis 2.1).

DV	Predictors	B	*SE* B	β	*t*
BDT: Urge to Save	BIR	.26	.03	.73	6.64***
	∆ in Subjective Stress	.19	.94	.02	.20
BDT: Grief	BIR	.02	.01	.40	2.65*
	∆ in Subjective Stress	.17	.17	.15	1.02
BDT: Indecision	BIR	.02	.01	.47	3.25
	∆ in Subjective Stress	-.05	.18	-.04	-.27
BDT: Distress	BIR	.02	.01	.48	3.33**
	∆ in Subjective Stress	.05	.13	.05	.37
BAT: Money Spent	**∆ in Subjective Stress**	10.74	4.95	.33	2.17*

Note. In bold are the predictors of interest; BDT = Behavioral Discarding Task; ∆ = Change; BAT = Behavioral Acquiring Task.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 10

Linear Regression Analyses with Biological Stress Response as a Predictor, the Composite Variable of Baseline Item Ratings (BIR) as a covariate, and Secondary Outcome Variables of Difficulties Discarding and Acquiring Tendencies as the Dependent Variables (Hypothesis 2.1).

DV	Predictors	B	*SE* B	β	*t*
BDT: Urge to Save	BIR	.25	.04	.73	6.54***
	∆ in Cortisol	-.25	.43	-.07	-.58
BDT: Grief	BIR	.02	.01	.43	2.81**
	∆ in Cortisol	.01	.07	.02	.12
BDT: Indecision	BIR	.02	.01	.48	2.62**
	∆ in Cortisol	.05	.08	.09	.63
BDT: Distress	BIR	.02	.01	.53	3.70**
	∆ in Cortisol	.03	.06	.07	.47
BAT: Money Spent	**∆ in Cortisol**	-.87	2.43	-.06	-.36

Note. In bold are the predictors of interest; BDT = Behavioral Discarding Task; ∆ = Change; BAT = Behavioral Acquiring Task.
** $p < .01$. *** $p < .001$.

Table 11

Linear Regression Analyses with Saving Inventory Revised (SIR) subscales as Predictors and Subjective or Biological Stress Response as the Dependent Variables (Hypothesis 3.1).

DV	Predictors	B	*SE* B	β	*t*
∆ in Subjective Stress	SIR discarding	-.04	.11	-.10	-.39
	SIR acquisition	-.12	.14	-.22	-.84
	SIR clutter	.06	.09	.16	.72
∆ in Cortisol	SIR discarding	.32	.23	.35	1.39
	SIR acquisition	.04	.31	.04	.13
	SIR clutter	-.27	.19	-.32	-1.44

Note. ∆ = Change.

Table 12

Linear Regression Analyses with Saving Cognitions Inventory (SCI) scores as Predictors and Subjective or Biological Stress Response as the Dependent Variable (Hypothesis 3.2).

DV	Predictor	B	*SE* B	β	*t*
∆ in Subjective Stress	SCI responsibility	-.22	.10	-.66	-2.11*
	SCI control	.29	.13	.45	2.30*
	SCI emotion	-.10	.06	-.49	-1.68
	SCI memory	.39	.14	1.02	2.73*
∆ in Cortisol	SCI responsibility	-.14	.25	-.20	-.56
	SCI control	-.32	.32	-.22	-1.00
	SCI emotion	.08	.15	.17	.52
	SCI memory	.04	.35	.05	.11

Note. ∆ = Change.
* $p < .05$.

Table 13

Associations between Risk Variables and Difficulties Discarding and Acquiring Tendencies.

Risk Variables	BDT: Items Saved	BAT: Items Purchased
Attentional Control (AC)	.10	-.04
Negative Urgency	.11	.12
Anxiety Sensitivity (AS)	.11	.18
Distress Tolerance (DT)	-.31**	-.16

Note. BAT = Behavioral Acquiring Task; BDT = Behavioral Discarding Task.
* $p < .05$. ** $p < .01$. *** $p < .001$

Appendix A

Behavioral Discarding Task script

Phase 1

"Now, please think of 10 belongings that you keep in your room. These belongings should be items which you save and would have difficulty throwing away, yet which have no real monetary value, meaning you would not be able to exchange them for money. In other words, they should be something most people might discard without distress, but for whatever reason it's something you save. Some examples might be magazines, mementos of trips and family events, a card from a significant other, or notes from a class you are no longer taking, etc… Now, while picturing the item in your head, write a detailed description of each of those items on these pieces of paper. Remember, only list one specific item for each index card. So, if you are thinking of a box of cards from various friends, think of one card out of the whole box to list as one of your items or list two cards from the box as two separate items."

Phase 2

"Ok, now let's move on to another task. Now, this task is interested in decision processes involved in saving versus discarding a variety of items—since this can be kind of stressful sometimes. Per our instructions, all of the items you wrote down should technically be easy to discard since they have no real monetary value and most people wouldn't have a problem tossing them. But of course all of us have our reasons for saving stuff! For this task, you are going to imagine you're in a situation where you have to choose whether to save or leave behind each of the items. Now, imagine that you are in your dorm room, and your RA announces over the intercom that you will need to vacate the premises, due to a fire, and assures you that it is not only a fire drill. You can only take what you can carry with you, so you should leave behind as many items as possible. Whatever you leave behind may be destroyed and very certainly damaged by the fire. In the next two minutes, I will ask you to decide which items you will bring with you. For each item you decide to leave behind, I will place the sheet of paper through the shredder to be destroyed.

[Going through the items on colored sheets of paper in order, for each item, ask] **"**What is your urge to save this item?," *and then* **"**Do you want to save or leave behind this item?"

Script for the Stress Condition for the Stress Manipulation

Speech Preparation and Task

"As I mentioned previously, in this experiment, you will be completing several additional tasks. Each task looks at different behaviors and thought patterns and how they affect how you process information. The first task will be a speech, which I will evaluate according to flow, eloquence, and sophistication of word choice. In addition, we will videotape the speech so that a panel of your peers can rate the strength of your argument. I will provide the topic for your speech, and the details about the other task in a moment. You will be given 2 minutes to prepare, and then 5 minutes to complete your speech. During this time, you should build an argument supporting your position on the death penalty. Rather than providing an emotional argument or opinion, you should provide a scientific argument supporting your position. You can use this piece of paper to take notes while you prepare; however, you will NOT be allowed to use your notes when you give your speech. Your time starts now."

"Your time limit is up. I need to collect your paper. Please stand up and face the camera.
You have five minutes to make your argument. I'll let you know when the time is up or if you have failed to fill up the entire 5 minutes. Start now."

"Your time limit is up."

Arithmetic Task

"Okay, we now want you to solve a calculation task. Please turn toward me. When I say begin, I would like you to count aloud backwards from 2083 to zero in 13-step sequences. Please calculate as quickly and correctly as possible. Should you miscalculate, I will point out your mistake by saying "Error, 2083" and you have to start all over again. Do you have any questions? Please begin then."

Script for the Control Condition for the Stress Manipulation

Sit quietly and Writing Task

"As I mentioned previously, in this experiment, you will be completing several additional tasks. Each task looks at different behaviors and thought patterns and how they affect how you process information. The first task will be a writing task. I am going to ask you to sit quietly for the next two minutes, and then you will have 5 minutes to write as many details as possible about your favorite movie or book. For instance, you can write about your favorite characters, the plot, and why you like it. I will be back in 2 minutes."

"You can use this piece of paper to write. You have five minutes to do this writing task. I'll let you know when the time is up. You can start writing now."

Solitaire

"Okay, we now are going to have you play solitaire on the computer."

Behavioral Acquiring Task Instructions

In this task, imagine you are shopping online before going on a vacation for Spring Break, and that all items you purchase will be mailed to you within the week. You can spend $500 on anything you need for the trip. So that you can keep track of your spending, in the upper-right hand corner of the computer screen, you will see the amount of money on your credit card decrease as you go along. However, remember, the bill will be sent to your parents. Also, if you do not spend all of the money, you will be able to keep whatever you have left over. Click the mouse to continue.

You will see a series of pictures of items you can purchase, with the associated price and item description listed underneath. For each object, you will decide whether or not to purchase the item. Please imagine that you are buying each object as best you can, and make your decision based on what you would actually buy if you were shopping before a vacation.

You cannot ask questions about the items, their authenticity, or condition. You must decide based on the information available in the pictures alone. Just use your best judgment. Click the mouse to continue.

If you would like to purchase an item, click the picture of the item.

If you do not want to buy any of the items, or if you have already selected all the items you would like to purchase on a screen, click the NEXT button in the lower right hand corner of the screen to continue shopping.

Please ask the experimenter now if you have any questions. Click the mouse to continue.

Debriefing Script

“We would now like to share with you a little bit more about this study. The goal of this investigation was to examine the relationship between stress and hoarding behaviors. The questionnaires and behavioral tasks were designed to assess symptoms of anxiety, mood, stress, and hoarding.”

“We all get anxious or nervous in stressful situations, and we experience some physiological changes (such as faster heart beat) as a result of it. Whereas some people try to calm themselves down by distracting themselves, other people might find comfort in objects they own (such as a teddy bear) or go shopping to calm themselves down. This study was designed to gain a better understanding of the role that acquiring, discarding, and saving behaviors play in our physiological reactions to a stressor. Given this goal, there were some aspects of the study that we could not discuss with you in advance. For example, we had to create a minor stressful situation without your knowledge. To do this, we told you that your speech would be presented to a panel of undergraduate and graduate students and faculty so they can evaluate the quality of your speech; however, we will not be presenting the recording to anyone. The task was necessary to create some anxiety. Lastly, the arithmetic task that asked you to count backwards in 13-step increments, was also designed to produce some anxiety. This is an incredibly difficult task that is designed for people to have difficulty with. If we could have told you about how you were actually performing on these tasks, we would have. However, as I explained earlier, it is critical that we put you in these situations in order to produce minor anxiety. This was important to our ability to see differences in people’s physiological reactions to it. We regret that we had to present this false and stressful information to you, but this really was our only option to be able to interpret our results. We realize that this might induce feelings of frustration but we hope that our explanation clears up any negative feelings you might have. We really appreciate your participation in this study.”

“It is important that people not come into the study aware of the goals. Some of your friends and classmates may participate in this study, so we ask that you not disclose the goals of this study to them.”

“If you are experiencing any distress or discomfort from participation in this study and would like to speak with someone, the University of Miami Counseling Center can be reached at (305)284-5511. If you have any further questions, please feel free to contact a study coordinator at (305)284–5394 or paso@psy.miami.edu.”