7-28-2015

Decision making and association in hoarding

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A Dissertation Submitted to The Graduate School at the University of Missouri-St. Louis
in partial fulfillment of the requirements for the degree
Doctor of Philosophy in Clinical and Community Psychology

August 2015

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Abstract

Hoarding is a serious and debilitating disorder that has a chronic course, is difficult to treat, and has a high treatment dropout rate. The most notable feature of hoarding is excessive clutter, which is driven by excessive acquiring of objects and difficulty discarding them. Two little researched factors that appear to be particularly central in contributing to acquiring and difficulty discarding are decision-making deficits and association. This study examined decision making and association, using self-report measures, a computerized decision-making task, and an association task, in a sample of 62 participants, consisting of 39 hoarders and 23 non-hoarding controls. These individuals were recruited from online sources and completed the study online. As predicted, hoarders scored significantly higher than controls on aspects of decision making: indecision, concern over mistakes and perfectionism. As predicted, group differences were not found for actual number of mistakes on a decision-making task. Contrary to predictions, hoarders and controls did not differ on the decision-making aspects of slowness; considering many pieces of information; or the information processing aspect of association. Results revealed no significant correlations between measures of hoarding symptoms and any aspects of decision making or association. Furthermore, concern over mistakes did not predict hoarding symptoms over and beyond actual mistakes. Indecision did not mediate concern over mistakes and hoarding symptoms, nor did indecision mediate perfectionism and hoarding symptoms on either hoarding measure in the hoarding group. These findings provide further support for the role of certain decision-making deficits in hoarding and highlight the need to conceptualize and examine potential ways these deficits impact acquisition and difficulty discarding.

Definition, Prevalence, and Distinct Diagnostic Category of Hoarding

Hoarding disorder is a serious and debilitating disorder that is estimated to impact 4% of the population (Samuels, Bienvenu, Grados, et al., 2008). Although hoarding was described in written literature as early as the 1300's (Alighieri & Ciardi, 1954), hoarding received very little clinical attention until the 1990's because it was thought to be a rare phenomenon (International OCD Foundation, n.d.). Frost and Gross were the first to study and describe the disorder (Frost & Gross, 1993). Frost and Hartl later expanded upon Frost and Gross' initial description by establishing criteria that are still used as the basis for diagnosis today. Specifically, hoarding is "1) the acquisition of, and failure to discard a large number of possessions that appear be useless *or* of limited value; 2) living spaces sufficiently cluttered so as to preclude activities for which those rooms were designed; and 3) significant distress or impairment in functioning caused by the hoarding" (Frost & Hartl, 1996, p. 341).

Since the publication of these seminal articles, hoarding has received increased attention in the research literature, and more recently, in the popular press. Despite some advances in the conceptualization and study of this disorder, little is known about its phenomenology, course, and contributing factors. Although researchers have begun to study hoarding, its minimal research base may be due in part to the fact that, until recently, it was classified as a symptom of obsessive-compulsive disorder by the DSM.

Hoarding and OCD

Hoarding was mentioned in the DSM-IV-TR as a symptom of obsessive-compulsive personality disorder (OCPD), but not as a unique clinical disorder. The DSM stipulated that if hoarding was severe, then a diagnosis of obsessive-compulsive disorder

(OCD) should be considered rather than OCPD (American Psychiatric Association, 2000). Diagnostically, this practice implied that hoarding and OCD were either conceptually the same or similar to one another. However, research findings indicated that one often existed in the absence of the other. These findings indicated that hoarding was present in 1/3 or fewer OCD cases (Samuels et al., 2002), and OCD was found in 16-35% of hoarding cases (Frost, Steketee, Williams, & Warren, 2000; Mataix-Cols et al., 2010; Mueller, Mitchell, Crosby, Glaesmer, & de Zwaan, 2009; Samuels, Bienvenu, Pinto, et al., 2008; Wu & Watson, 2005).

To operationally highlight these differences, obsessive-compulsive disorder (OCD) is characterized by: (1) obsessions, which are unwanted, intrusive thoughts and (2) compulsions, which are repetitive behaviors or various types of mental acts such as counting or other strategies that, in the short term, serve to reduce obsessions and the anxiety or distress caused by the obsessions. Hoarding disorder, on the other hand, involves the accumulation of objects, difficulty discarding objects, and clutter in the home so severe that rooms and objects are unusable for their original purpose (e.g., oven used as storage for kitchenware). Additionally, hoarding need not involve obsessions and compulsions.

Other differences between hoarding and OCD include ego syntonicity, distress caused by the disorder, nature of thoughts in the disorder, and level of insight. Hoarding-related thoughts tend to be ego syntonic and elicit both pleasure and distress whereas thoughts in OCD are ego dystonic and distressing. For example, hoarders may experience pleasure when thinking about their items or thinking about acquisition of additional items, but may experience distress when faced with the prospect of losing an

item (e.g., when discarding) or a potentially missed opportunity (e.g., not acquiring a certain object); their hoarding-related thoughts are typically consistent with their self-conceptualization. Those with OCD appear to experience distress when experiencing obsessional thoughts and their obsessional thoughts are typically inconsistent with their self-conceptualization. Intrusiveness and repetitiveness of thoughts also may differ between the two, where OCD-related thoughts are intrusive, repetitive, and lead to urges to reduce the thoughts, and hoarding thoughts are part of the normal thought stream, are not necessarily repetitive, and do not lead to urges to reduce thoughts. Another difference is insight into symptoms. Although both hoarders and those with OCD may lack insight into the excessiveness or unreasonable nature of their symptoms, hoarders appear to lack insight to a greater degree than those with OCD (Mataix-Cols et al., 2010).

Despite these differences, hoarding and OCD appear to share some similarities. Both appear to exhibit checking, reassurance seeking, and doubting; in OCD, these are in response to obsessions, in hoarding, to discarding (Steketee & Frost, 2007). Further, in hoarding, the behaviors of excessive acquiring, saving, and difficulty discarding appear functionally related to fears, which may include losing important information, losing valued objects, fears of making mistakes, or fears of identity loss; that is, the excessive acquisition, saving, and failure to discard appear to function by reducing the distress caused by the fears. Compulsive behaviors in OCD such as washing and checking also appear functionally related to feared obsessions, like fear of contamination or harm; the compulsions appear to function by reducing the distress caused by the obsessional thoughts/fears (Mataix-Cols et al., 2010). Finally, OCD and hoarding appear to share

some information processing deficits (Mataix-Cols et al., 2010), including decision-making deficits (Samuels et al., 2007).

Given the similarities and differences between the two disorders, researchers have struggled with whether to classify the disorders as part of the same construct or as distinct entities (Mataix-Cols et al., 2010), until recently. In the new version of the DSM (DSM-V), however, hoarding has been operationalized and included as a distinct disorder, "hoarding disorder" (American Psychiatric Association, 2013). The primary diagnostic criteria for hoarding disorder are: "A. Persistent difficulty discarding or parting with possessions, regardless of their actual value. B. This difficulty is due to a perceived need to save the items and to distress associated with discarding them. C. The difficulty discarding possessions results in the accumulation of possessions that congest and clutter active living areas and substantially compromises their intended use. If living areas are uncluttered, it is only because of the interventions of third parties (e.g., family members, cleaners, authorities; American Psychiatric Association, 2013, p. 246). This remains very similar to Frost and Hartl's (1996) early definition, described above. This recent development should provide researchers with better guidelines for determining the presence of hoarding disorder and ultimately, should result in better accuracy in the research of hoarding disorder.

The new version of the DSM and the new diagnostic criteria were not available at the time the study was designed, but the present study utilized Frost and Hart's (1996) definition when conceptualizing hoarding disorder, so the study's conceptualization of hoarding remains in line with standards in the field. The research questions posed by the present study also do not appear notably impacted by the updated conceptualization of

hoarding disorder. And, as such, the present study's conceptualization of hoarding disorder as well as the questions it sought to answer remain relevant.

Information Processing Deficits

The most notable feature of hoarding is excessive clutter, which is driven by excessive acquiring of objects and difficulty discarding (Steketee & Frost, 2007). Although these main features of hoarding have been identified, little research has been conducted on the factors that contribute to their manifestation. Two information processing deficits may be particularly central in contributing to the manifestation of acquiring and difficulty discarding: decision-making deficits and association. Decision-making deficits in hoarding are thought to include indecision, fear of making mistakes, considering too many pieces of information, and slowness in decision making (Frost & Shows, 1993; Frost, Tolin, Steketee, Fitch, & Selbo-Bruns, 2009; Grisham, Norberg, Williams, Certoma, & Kadib, 2010; Kyrios, Frost, & Steketee, 2004; Steketee, Frost, & Kyrios, 2003; Tolin, Frost, & Steketee, 2007; Tolin, Kiehl, Worhunsky, Book, & Maltby, 2009; Wincze, Steketee, & Frost, 2007). Decision-making deficits may be a central contributor to excessive acquiring and difficulty discarding because the acts of acquiring and discarding begin with the decision-making process, rendering it a "gatekeeper" in the acquiring and discarding processes. For example, in discarding, concerns about making mistakes and considering many aspects of an issue may lead to indecision; if a decision is not made about discarding, by default, the decision is made to keep the item. In terms of acquiring, indecision may result in "erring on the side of caution"; that is, acquiring an item "just in case". Excessive acquisition and not discarding contribute to the clutter problem.

If decision making is the gatekeeper in acquiring and discarding, association may be the lure. Association involves the ability to imagine many uses for an item, also called fluency in the creativity literature. In excessive acquisition and difficulty discarding, it may play a central role by making items particularly appealing, luring them into one's home (e.g., "This has so many uses; I have to have it.") and then preventing the items from leaving when they arrive (e.g., "Why would I get rid of such a useful item?"). That is, items that are useful are tempting to acquire and impractical to discard. If more items are acquired and fewer items are discarded, clutter will undoubtedly begin to accumulate.

Although other information processing deficits have been conceptualized as contributing to hoarding behavior (Hartl et al., 2004; Hartl, Duffany, Allen, Steketee, & Frost, 2005; Lawrence et al., 2006; Steketee et al., 2003; Wincze et al., 2007), these do not seem to bear as directly on excessive acquiring and difficulty discarding, but rather seem to have a more indirect or peripheral role in impacting acquiring and discarding. For example, categorization/organization deficits involve trouble with organizing and grouping items, often with the problem of generating too many categories for items (Wincze et al., 2007). Difficulty categorizing and sorting can lead to clutter because objects are placed randomly throughout the house, but it is not clear that organizational difficulties themselves prevent clutter from leaving the home. Further, it is unclear how these difficulties might *directly* contribute to acquisition. Perhaps disorganization in the home affects one's ability to find necessary items, so they "re-purchase" the item, and as a result, have multiples in the home. But, disorganization itself is not the reason the item was brought into the home and added to the clutter, a practical need for the item was the

reason. Therefore, organizational difficulties may not lead to increase in clutter per se, as in decision making and association, but rather, a cluttered appearance of home.

Despite the apparent importance of decision making and association in hoarding, they have not received a great deal of empirical attention. In fact, association does not appear to have been examined at all. Decision-making deficits have been examined to some extent, including indecision, fears of making mistakes, and slowness (Frost et al., 2009; Kyrios et al., 2004; Steketee et al., 2003; Tolin et al., 2009; Wincze et al., 2007), but these areas have not had an abundance of empirical support, and one area, considering too many pieces of information in decision making, does not appear to have been examined at all.

Decision Making

Given that hoarding is a relatively newly described phenomenon and has only just been included in the DSM, psychologists do not yet have a good understanding of how hoarding behaviors develop. Researchers hypothesize and provide some data to support that decision-making deficits are involved in hoarding (Grisham et al., 2010; Steketee et al., 2003; Wincze et al., 2007) but it is not clear exactly how decision-making deficits contribute to hoarding behavior. Because there is so little information on hoarding, in order to better understand how it develops, researchers have drawn information from other areas. As discussed, OCD appears to share some characteristics with hoarding (e.g., decision-making deficits; Grisham et al., 2010; Samuels et al., 2007), and theory has been developed to understand decision-making deficits in this disorder, so researchers have drawn from the understanding of decision-making-deficit theory in OCD to hypothesize

about decision making in hoarding (Frost & Gross, 1993; Frost & Hartl, 1996; Frost & Shows, 1993).

Decision making in OCD

Indecision. Reed (1985) proposed that, in terms of decision making, all individuals are more indecisive when it comes to decisions about things that are personally important. He hypothesized that those with OCD simply have a different threshold for importance. Specifically, a *lower* threshold, such that those with OCD deem more things to be important than individuals without OCD. As a result, he thought that indecisiveness was more pervasive in OCD because individuals with OCD simply had more to be indecisive about. Research appears to at least partially support Reed's (1985) hypothesis with the finding that that those with OCD are more indecisive than those without OCD (Ferrari & McCown, 1994; Grisham et al., 2010).

Concern over mistakes and perfectionism. Expanding upon the indecisiveness theory in OCD, researchers propose that perfectionistic beliefs and fears may play a role in indecision (Salzman, 1980; Straus, 1948). Perfectionism refers to the belief that a perfect state exists, and as such, individuals make efforts to achieve and maintain that state (Bhar & Kyrios, 2005). Straus (1948) proposed that these perfectionistic beliefs lead to fears about making mistakes, which leads individuals to hesitate in decision making because they are uncertain whether they will make the right decision; this process subsequently manifests as indecision. That is, individuals want to be sure that they are doing things perfectly, making the perfect decision, so they hesitate or avoid decisions because they are not sure (Salzman, 1980). A model of indecisiveness, then, would look like the model depicted in Figure 1. Research has found support for the presence of these

variables in OCD (Chik, Whittal, & O'Neill, 2008; Ferrari & McCown, 1994; Tolin, Worhunsky, & Maltby, 2006) and support for the relationships between some of these variables in OCD (Ferrari, 1995; Libby, Reynolds, Derisley, & Clark, 2004). Specifically, those with OCD exhibit relationships between perfectionism and indecision (Ferrari, 1995; Libby et al., 2004) and perfectionism and concern over mistakes (Chik et al., 2008; Libby et al., 2004).

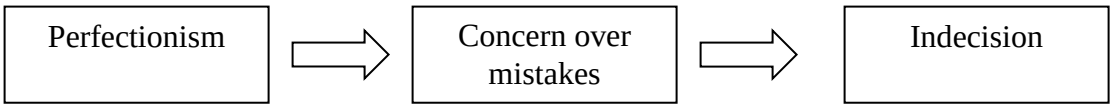

Figure 1. Model of indecisiveness in OCD

Considering many pieces of information and slowness in decision making. In order to prevent making decisions that result in mistakes, it was hypothesized that individuals with OCD consider as much information as possible to ensure that they will arrive at a "perfect" decision (Ladouceur et al., 2000; Milner, Beech, & Walker, 1971; Reed, 1985). It was also proposed that indecisiveness takes time (Reed, 1977), as may be expected if individuals are engaging in this process of gathering additional information to arrive at a perfect decision. As such, those with OCD may postpone or avoid decisions, which may increase the time it takes to make a decision, also called "slowness" (Dittrich, Johansen, & Fineberg, 2011; Ladouceur et al., 2000; Lewin, Caporino, Murphy, Geffken, & Storch, 2010; Olley, Malhi, & Sachdev, 2007). Although direct relationships between concerns about mistakes and considering many pieces of evidence, considering many pieces of information and slowness, and indecision and slowness do not appear to have

been examined in a clinical OCD sample, these aspects of decision making have been individually related to OCD symptoms, as cited above. As such, it is a reasonable assumption that these variables are related in OCD.

It is reasonable to hypothesize that these variables are also related in hoarding, as depicted in Figure 2. Although pieces of the model of indecision have been described, there does not appear to be a complete and formal conceptualization of this particular model in OCD or hoarding. Each piece of the model is discussed below as it relates to hoarding. It was expected that the relationships in this model would also hold for hoarding.

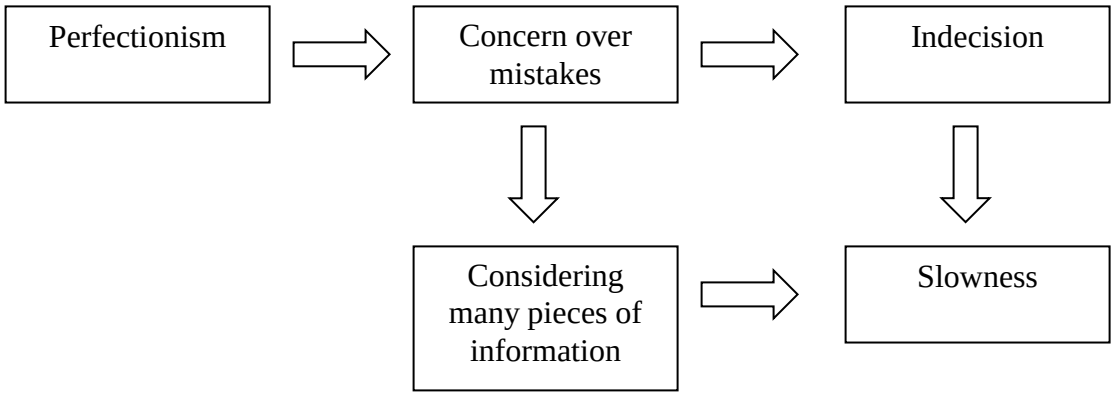

Figure 2. Full model of indecisiveness in OCD

Decision Making in Hoarding

Indecision. There is at least partial research support for Reed's (1985) hypothesis of indecision development in hoarding. Indecision appears to be the aspect of decision making with the most support in hoarding, though it still does not have a large research base (Grisham et al., 2010; Steketee et al., 2003; Wincze et al., 2007). The fact that a

hoarding-specific scale of indecisiveness was developed and validated, the Frost Indecisiveness Scale, has likely facilitated the study of this aspect of decision making in hoarding. Not only does indecisiveness correlate with hoarding symptomatology (Frost et al., 2009), indecisiveness appears to be markedly more pronounced in hoarding than a similar disorder, OCD, with hoarders endorsing significantly more indecisiveness than those with OCD and nonclinical controls (Steketee et al., 2003; Wincze et al., 2007).

Concern over mistakes and perfectionism. Although indecision is beginning to gain a larger research base, the underlying aspects that appear to be driving indecision have received far less investigation. Fears/concerns that one will make the "wrong" decision appear to be the product of perfectionistic beliefs in OCD (Chik et al., 2008; Libby et al., 2004) and are hypothesized to be the product of perfectionism in hoarding (Frost & Shows, 1993). Fears that lead to questions like, "What if I decide to throw this item away and find that I really need it later?" may be problematic in hoarding because they may lead to vacillation and eventual avoidance of making a decision (Frost & Gross, 1993), or a decision to "err on the side of caution" and keep the item "just in case". If a decision is not made about discarding, by default, the decision is made to keep the item, clutter may begin to accumulate, and a hoarding problem may begin to manifest. During the acquiring process, fears that one will make the wrong decision can also be problematic. Fear of making the wrong decision/a mistake also may result in "erring on the side of caution"; that is, acquiring an item "just in case". Acquisition of additional items can further contribute to the accumulation of clutter. Data supports the relationship of these fears about making mistakes to hoarding behaviors (Frost et al., 2009; Kyrios et al., 2004). Data also supports relationships between hoarding behaviors and

perfectionism (Kyrios et al., 2004; Mataix-Cols et al., 2010; Samuels et al., 2002; Tolin et al., 2006). Further, those who hoard exhibit a relationship between perfectionism and concern over mistakes, as the indecision model hypothesizes (Frost & Gross, 1993).

Considering many pieces of information. As discussed in OCD, fears about making mistakes are hypothesized to lead individuals to consider a great deal of information to arrive at the "right" decision and avoid making a mistake. Considering many pieces information is also conceptualized as contributing to decision-making problems in hoarding (Steketee & Frost, 2007). The process of considering many pieces of information prior to making a decision would not seem to be a problem in and of itself and may actually be a good idea in cases of important decisions. But, if we consider the hypothesis that some individuals may have a lower threshold for importance (e.g., of situations, items, etc.), such that many objectively unimportant things are considered important, considering all aspects of a situation/item could become overwhelming, and stressful. In hoarding, if such a threshold is in place when making decisions about discarding individual items, and more specifically, mundane individual items that most would consider trash (e.g., newspapers, pizza boxes, disposable plastic cups), one can surmise that simply sorting the trash would be a very time consuming and stressful task. Furthermore, it is probably not practically possible to make a careful decision about each item that is discarded without taking much of the day. So, if this process occurs, it probably becomes too time consuming to sort through all items, and inevitably, trash starts to pile up. Additionally, if individuals who hoard have a lower threshold for what is important, and not simply the habit of carefully considering all information prior to making a decision to keep or throw an item, they will probably decide to keep more items

than most people, because they consider more items to be important. If this process occurs, clutter is even more likely to pile up. Despite the potential impact of considering many pieces of information on difficulty discarding, and the ultimate accumulation of clutter, this aspect has not yet been examined empirically in hoarding.

Slowness in decision making. As discussed in OCD, the process of preventing mistakes involves considering all aspects of a situation and worrying about making the perfect decision. In OCD, this process appears to result in the postponing or avoidance of decision making (Dittrich et al., 2011; Lewin et al., 2010; Olley et al., 2007). If similar decision-making processes occur in hoarding, one would expect that the decision-making process would take more time in hoarders. The extra time these processes take may result in slow progress on discarding or avoidance of the decision-making process altogether because of the time commitment required. Slowness in decision making among hoarders has been examined empirically (Tolin et al., 2009), but not as it relates to indecision specifically. Not only were hoarders expected to exhibit a relationship between hoarding and slowness on a decision-making task, hoarders were expected to exhibit relationships between slowness on a decision-making task and self-reported indecision.

Full decision-making model in hoarding. As discussed, many of the relationships in this model have been studied in OCD. One of these relationships appears to have been studied in hoarding; the relationship between perfectionism and indecision (Frost & Gross, 1993). Although some of the individual variables have been examined as they relate to hoarding symptoms or as they differ between hoarders and controls, the relationships among these variables have not been fully examined in a clinical hoarding population and the model as a whole has not been examined in hoarding. The

relationships not yet examined include perfectionism and concern over mistakes, concern over mistakes and indecision, concern over mistakes and considering many pieces of information, considering many pieces of information and slowness, and indecision and slowness.

Mistakes in hoarding. In addition to the factors described in the model, other factors may be involved in decision-making deficits in hoarding. Although fears/concerns about decision making and actual indecision appear to be present in hoarding, it is unclear whether the fear of making the wrong decision extends beyond the fear to an actual propensity for making mistakes. Those who hoard may report concerns of making the wrong decision but it is not clear that they actually make "wrong" decisions commensurate with their fear level, which would reinforce their concern over potentially making a "wrong" decision. This is unclear because, prior to this study, it had not been addressed conceptually or empirically.

In order to make a prediction about whether hoarders actually make more mistakes or just fear they will make more mistakes, let us consider the data from another information processing deficit in hoarding, memory. Research supported the presence of both actual memory deficits and the perception of memory deficits in hoarders (Hartl et al., 2004); however, further analyses revealed that the perception of memory deficits persisted after accounting for actual memory deficits. That is, the perception of memory deficits was unrealistic in proportion to actual deficits. Just as with memory, it is possible that even if individuals who hoard do make mistakes when making decisions, their fears of making such mistakes is unrealistic in proportion to actual mistakes made.

Further, even if hoarders do make mistakes commensurate with fears, it is not clear that they make more mistakes than individuals who do not hoard, so the present study examined mistakes in those who hoarded versus to those who did not.

Association

A second information processing deficit that may directly impact acquisition and difficulty discarding is association. As with decision making, association may contribute to both acquiring and difficulty discarding, which in turn contribute to clutter. Association in the hoarding literature refers to the ability to generate multiple uses for an item. Individuals with this ability see an item not only for the item's intended use but for all of its possibilities, and it is this process of generating multiple uses that appears to make an item especially attractive. For example, if a rock is seen as a doorstop, paperweight, weapon, and decorative item, it appears more useful than just a rock.

Aside from a conceptualization that lists association as one of the information processing deficits in hoarding (Steketee & Frost, 2007), researchers do not appear to have studied its existence in hoarding. Research is needed to uncover whether it is, in fact, present in hoarding and ultimately, to better understand how it contributes to the key players in hoarding, excessive acquiring and difficulty discarding.

Association has been studied, however, in the creativity literature where it is called fluency and divergent thinking. Fluency is considered a talent in the creativity literature, correlating with applied aspects of creativity like starting businesses, writing plays or novels, and obtaining patents (Plucker, 1999; Torrance & Sternberg, 1988; Torrance & Treffinger, 2004). In the context of hoarding, however, this ability may be detrimental. For hoarders trying to discard an item, generating many uses for an item

may provide a basis for arguments to keep an item and may impede the generation of arguments for discarding. As a result, few items would be discarded and clutter may accumulate. In the context of acquiring, the ability to see so many possibilities in one item may render the item almost intoxicating, greatly increasing the likelihood that the individual with hoarding disorder will obtain the item, and the more items that are acquired, the more clutter that accumulates.

Given the potential impact of association on both acquiring and difficulty discarding/decluttering, further study of this factor in hoarding is important to both empirically establish its presence and better understand how it functions within the disorder. The first question is, are association and hoarding behavior actually related? If this is the case, hoarders should demonstrate a positive relationship between fluency scores and scores on hoarding measures. The next question is, is association more prevalent in hoarders than those without hoarding concerns? If hoarders do indeed exhibit greater association than others, then, if presented with an object and asked to provide a number of uses for the item, they should generate more ideas than someone without a hoarding disorder.

Hypotheses

Hypothesis I. Scores on specific aspects of decision making were expected to each be greater in the hoarding group than in controls: indecision, perfectionism, concern over mistakes, considering many pieces of information, and slowness. The hoarding group was *not* expected to make more mistakes on a decision-making task than controls. Further, the hoarding group was expected to score higher than controls on association/fluency.

Hypothesis II. Within the hoarding group, each of these aspects of decision making (indecision, perfectionism, concern over mistakes, considering many pieces of information, and slowness) was expected to be related to hoarding symptoms, except number of mistakes. Association scores were also expected to be positively related to hoarding scores.

Hypothesis III. In the hoarding group, concern over mistakes was expected to predict hoarding symptoms over and beyond actual mistakes on a decision-making task.

Hypothesis IV. The indecision model, as depicted in Figure 2, was predicted to be confirmed in hoarders, such that perfectionism was predicted to be related to concern over mistakes which was predicted be related to indecision. Indecision, in turn, was predicted to be related to slowness. Concern over mistakes was also predicted to be related to considering many pieces of information which was, in turn, predicted to be related to slowness.

Hypothesis V. The indecision model was expected to fit better for the hoarding group than the control group.

Hypothesis VI. Additionally, the model suggests that indecision may play a mediating role between concern for mistakes and hoarding and that indecision might also play a mediating role between perfectionism and hoarding, so the present study sought to test these relationships.

Method

Participants

All participants were at least 18 years of age, fluent in English, and denied presence of a psychotic disorder, brain injury and dementia. A total of 135 participants

were recruited for the study, but as discussed below (Preliminary Analyses section), many participants had missing or incomplete data; after these individuals were eliminated, 67 participants remained. The vast majority of this remaining sample was female: 62 participants or 92.5 %. This large proportion of females, and thus, small proportion of males poses a problem for subsequent analyses, because if potential sex differences exist, these cannot be examined due to insufficient power. And, indeed, previous research has indicated sex differences on at least two of the variables examined by the study, indecision and concern over mistakes (Cremades, Donlon, & Poczwardowski, 2013; Rassin & Muris, 2005; Rassin, Muris, Franken, Smit, & Wong, 2007). As such, the males were eliminated from the sample, leaving a final sample of 62 participants, ranging in age from 24 to 76 years (M = 46.06, SD = 13.1). A great majority of the sample identified as Caucasian (80.6%), most identified as married (46.8%), and as having a bachelor's degree (46.8%; see Table 1).

Table 1

Demographic Characteristics

Characteristic[a]	Group	*N* Hoarding Group	% of Characteristic in Hoarding Group	*N* Control Group	% of Characteristic in Control Group	*N* Combined Sample	% Combined Sample
Sex							
	Female	39	62.9%	23	37.1%	62	100%
	Caucasian	34	54.8%	16	25.8	50	80.6
	Hispanic or Latino	2	3.2%	4	6.5	6	9.7
Ethnicity	African American, Asian, Native American/Alaska Native, Arabic, Pacific Islander/Native Hawaiian,	0	0%	0	0%	0	0
	More than one Ethnicity	3	4.8%	3	4.8%	6	9.7
Marital Status	Married	18	29%	11	17.7	29	46.8
	Divorced or Separated	8	12.9%	2	3.2%	10	16.1
	Living w/ significant other	2	3.2%	4	6.5%	6	9.7
	In committed relationship	2	3.2%	3	4.8%	5	8.1
	Single	9	14.5%	3	4.8%	12	19.4
Education Level	GED or High School Diploma	9	14.5%	0	0%	9	14.5
	Associate's	4	6.5%	1	1.6%	5	8.1
	Bachelor's	17	27.4%	12	19.4%	29	46.8
	Master's	7	11.3%	8	12.9%	15	24.2
	Doctoral	2	3.2%	2	3.2%	4	6.6

Measures

Background information. Participants responded to questions concerning age, sex, ethnicity, marital status, number of children, income level, color blindness status, occupation, and years of education. Additional questions inquired about participants' mental health history, specifically, whether they have ever been diagnosed with or experienced symptoms of a psychotic disorder (e.g., schizophrenia), dementia, brain injury, drug use problem, or other mental disorder. Participants were asked to list current medications, whether they are currently or have ever received therapy, and whether they are currently or have ever received therapy specific to hoarding problems. Participants were also asked whether they have a family member who hoards, and the degree of their relation to that individual.

Obsessive-compulsive symptomatology. The Obsessive-Compulsive Inventory-Revised was used to assess for OCD symptomatology. The scale is an 18-item, self-report measure, which uses a 5-point Likert response set (0 = not at all to 4 = extremely) to assess presence and severity of OCD symptoms over the past month (Foa et al., 2002). Sample items include, "I feel I have to repeat certain numbers." and "I frequently get nasty thoughts and have difficulty getting rid of them." The scale provides a total score, and 6 subscales, which include washing, checking, ordering, obsessing, hoarding, and neutralizing. High scores represent a greater extent of symptom severity. Data indicate that the scale has above strong internal consistency (.90) and good test-retest reliability (.84) as well as good convergent validity (.85) (Foa et al., 2002). Internal consistency data for the present study are good: α=.81.

Hoarding symptomatology. The Saving Inventory-Revised and Clutter Image Rating Scale was used to assess for hoarding symptomatology. The Saving Inventory-Revised is a 23-item, self-report measure, which uses a 5-point Likert response set to assess the existence and extent of the primary aspects of hoarding disorder: acquisition, difficulty discarding, and clutter (Frost, Steketee, & Grisham, 2004). The scale provides a total score as well as three subscales (excessive acquisition, difficulty discarding, and clutter). Sample items include, "How much control do you have over your urges to acquire possessions?"; "How frequently does clutter in your home prevent you from inviting people to visit?"; and "How often do you decide to keep things you do not need and have little space for?" High scores on each scale as well as the total score represent greater extent of hoarding disorder features. Data indicate that the scale has good convergent validity (.73) and above strong internal consistency reliability (.92; Frost et al., 2004). Additionally, the scale has been shown to differentiate those with and without hoarding disorder (Frost et al., 2004). Internal consistency data for the present study are above strong: α=.97.

Hoarding status (i.e., hoarder or control) was identified through the use of cut scores on a hoarding measure (International OCD Foundation). In order to be included in the "hoarding" group, participants needed to obtain Saving Inventory-Revised total scores greater than 40; controls needed scores less than or equal to 40. When these cut scores were applied, 23 participants (37.1%) were labeled "controls" and 39 participants (62.9%) were labeled "hoarders."

The Clutter Image Rating Scale is a pictorial rating scale of clutter severity in an individual's home (Frost, Steketee, Tolin, & Renaud, 2008). The scale allows for ratings of 9 main rooms, plus extra rooms and a car, on a 9-point clutter severity rating, ranging

from 1 (no clutter) to 9 (severe clutter). Main rooms include living room, kitchen, bedrooms, dining room, hallway, garage, basement, and attic. Pictorial images begin with completely uncluttered rooms and advance to rooms with clutter almost to the ceiling. Individuals select the picture that best reflects the state of clutter in their own home. Clutter that is indicative of a clinically significant problem is represented by scores of 4 or above. A clutter composite comprised of kitchen, living room, and bedroom 1 has been used in previous research and was used in the present study (Frost et al., 2008). The Clutter Image Rating Scale has exhibited adequate test-retest (.73), adequate inter-observer (.78), and good internal consistency reliability (.84) as well as good convergent validity (.63; Frost et al., 2008). Internal consistency data for the present study are good (George & Mallery, 2003; Kline, 2000): α=.81.

Indecisiveness. The Indecisiveness Scale (Germeijs & De Boeck, 2002) is a 22-item, self-report measure, which uses a 7-point Likert response set (1 = strongly agree to 7 = strongly disagree) to assess general indecisiveness, including difficulty in decision making, delay of decision making, avoidance of decision making, and worry about decisions made. Sample items include, "It's hard for me to come to a decision." and "I try to avoid making a decision;" these items were derived in part from the Frost Indecisiveness Scale. The scale provides a total score, with *low* scores representing a *greater* extent of indecisiveness. To facilitate ease of interpretation of results, the present study inverted the scale, so that high total scores represented higher levels of indecisiveness and potential correlations would be positive. Data indicate that the scale has above strong internal consistency (.91) and adequate test-retest reliability (.67) (Germeijs & De Boeck, 2002). The present study, utilized a 5-point Likert scale, rather

than the original 7-point scale used in the validation study of the measure, so the scale is referred to hereafter as the "modified Indecisiveness Scale." Despite the deviation, internal consistency data for the 5-point scale in the present study are adequate: α=.76.

Concern over mistakes. The Concern over Mistakes dimension of the Frost Multidimensional Perfectionism Scale (FMPS) was utilized to measure concern over mistakes in the present study (Frost, Marten, Lahart, & Rosenblate, 1990). The FMPS is a 35-item, self-report measure, which uses a 5-point Likert response set (1 = strongly disagree to 5 = strongly agree) to assess 6 dimensions of perfectionism (Concern over Mistakes, High Personal Standards, Perceived Parental Expectations, Parental Criticism, Doubts about Actions, and Tendency to be Organized). The Concern over Mistakes dimension has been used in previous research to measure concern over mistakes in hoarding, OCD, and nonclinical controls (Chik et al., 2008; Frost & Gross, 1993; Frost & Shows, 1993; Kyrios et al., 2004; Libby et al., 2004). Concern over Mistakes has 9 items, with a maximum score of 45. Sample items include, "I should be upset if I make a mistake." and "People will probably think less of me if I make a mistake." Data indicate that the Concern over Mistakes dimension has good internal consistency reliability (.88) and good convergent validity (.87; Frost et al., 1990). Internal consistency data for the present study are above strong: α=.90.

Perfectionism. The Striving for Perfection and Negative Reactions to Imperfection Scale was utilized to measure perfectionism in the present study (Stoeber, Otto, Pescheck, Becker, & Stoll, 2007; Stoeber & Rambow, 2007). The Striving for Perfection and Negative Reactions to Imperfection Scale is a 10-item, self-report measure, which uses a 6-point Likert response set (1 = never to 6 = always) to assess the

domains of Striving for Perfection and Negative Reactions to Imperfection as well as total perfectionism. High scores on domains represent higher levels of that particular domain. Sample items for the Striving for Perfection dimension include, "I strive to be as perfect as possible" and "It is important for me to be perfect in everything I attempt."; sample items for the Negative Reactions to Imperfection include "I am dissatisfied if I do not fulfill my high expectations." and "I feel extremely stressed if everything doesn't go perfectly." Data indicate that both dimensions and the total score have above strong internal consistency reliability (.93) and adequate convergent validity (.41; Stoeber et al., 2007; Stoeber & Rambow, 2007). Internal consistency data for the present study are above strong: α=.94.

Considering many pieces of information, slowness, and mistakes. The Information Sampling Task is a computer task designed to measure several aspects of decision making (Clark, Robbins, Ersche, & Sahakian, 2006). Specifically, the task measures the time it takes to make a decision, total correct trials and total errors, and total amount of information needed to make a decision. The task has demonstrated above strong internal consistency reliability (.96; Clark et al., 2006).

Participants are presented with a set of 25 gray boxes on a computer screen. Behind each box is one of two colors that are revealed by clicking on the boxes; these colors change each trial. Below the 25 gray boxes are two boxes representing the two colors in the set of 25 boxes. The goal of the task is to determine which color is dominant behind the 25 boxes. Participants win points for correctly determining the dominant color and lose points for selecting the non-dominant color. When the participant has made their determination of which color is dominant, the participant must

click to select the colored box that represents their choice from the 2 boxes below the 25 boxes.

Participants completed 20 separate trials, 10 fixed win trials and 10 decreasing win trials. In the "fixed win trials" participants win 100 points per trial for correct answers and lose 100 points per trial for incorrect answers, regardless of the number of boxes opened. In this series of trials, it is to the participants' advantage to open all boxes prior to making a decision. In the "decreasing win trials", participants have the potential to win a maximum of 250 points per trial for correct decisions and lose 100 points per trial for incorrect decisions. However, in this series of trials, it is to the participants' advantage to open as *few* boxes as possible because participants lose 10 points per box opened from their 250-point win potential. For example, if someone opens 10 boxes, they only have the potential to win 150 points for a correct selection but still can lose 100 points for an incorrect decision.

The present study examined total number of mistakes, considering many pieces of information, and slowness (latency). Total number of mistakes represented failing to select the dominant color, given the information provided (number of colored boxes already opened). It was calculated by totaling the number of incorrect guesses across all trials. Considering many pieces of information represents the number of boxes a participant opened prior to making a decision about which color was dominant. This was calculated as the average number of boxes (across trials) that the participant chose to open prior to making a decision. Slowness or latency was how long it took to make a decision about which color was dominant each trial. It was calculated as the average amount of time (across trials) that it took the participant to pick the dominant color.

Association. The Guilford Alternative Uses Task (Guilford, 1967) is a 6-item task that was designed to measure several aspects of creativity: originality, fluency, flexibility, and elaboration. Of relevance to this study is the fluency aspect of creativity. Participants are asked to generate as many uses as possible for common household items. Fluency is determined by adding up the total number of responses per item. A larger number of responses reflects a higher level of fluency. The task has demonstrated adequate alternate forms reliability (.67) and has demonstrated divergent validity (Corder & Corder, 1974; Guilford & Hoepfner, 1971; Schotte & Clum, 1987). Internal consistency data for the present study are above strong: α=.93.

Procedure

Participants for the study were recruited solely from online sources. A clinical sample of individuals with hoarding disorder was recruited from a study posting on the International Obsessive-Compulsive Disorder Foundation's website and other hoarding-related websites. Control participants were recruited from postings on Craigslist. Participants read a brief description of the study and the inclusion/exclusion criteria on the web posting. If they met criteria for the study, they were asked to submit an email inquiry for the study link, username and password; a response with this information was autogenerated for the participant.

When participants arrived at the study page, they read an informed consent page and clicked an icon at the bottom of the page to denote consent. After consenting, participants completed the background questionnaire, Obsessive-Compulsive Inventory, Saving Inventory-Revised, Clutter Image Rating Scale, modified Indecisiveness Scale, Concern over Mistakes Dimension of the Frost Multidimensional Perfectionism Scale,

Striving for Perfection and Negative Reactions to Imperfection Scale, Information Sampling Task, and Guilford Alternative Uses Task. In exchange for study participation, participants were given the option to enter a drawing for an iPad. Upon completion of data collection, one participant was awarded an iPad.

Study measures and tasks were administered in an online format, using the online survey and questionnaire tool, Inquisit. Inquisit allows for interoperation among websites and has the ability to pass respondent identification numbers to other sites and then back to itself. Data are stored on the Inquisit server until downloaded; data collected outside of Inquisit are still linked with the same identification number but are stored on the server of the outside site. All data were stored on Inquisit's server, and were password protected.

Data collection occurred in 3 phases. Phase 1 was a piloting phase using 15 nonclinical controls recruited by word-of-mouth. These individuals were used to test for glitches in the online data collection process as well as for integrity of the data. These participants provided feedback on their experiences taking the survey. Based on their feedback, changes were made to formatting and attempts were made to fix technological errors. Phase 2 was a final check on data integrity and system glitches. It was an active data collection phase for both hoarding and control groups, and paused after glitches occurred with the study's online survey and questionnaire tool, Inquisit. Data collection resumed after glitches were presumably fixed, but these glitches continued for the duration of the survey.

Results

Preliminary Analyses

Missing data, duplicate data, and outliers. Data were collected from 135 cases. Because of difficulties with the computer program designed to run the study, not all participants were able to complete the entire survey, as it did not open at all for some, froze or crashed at points throughout the study; this led some participants to attempt the study more than once and others to give up entirely. In order to determine which cases had duplicate data from the same participant, a unique identifying variable was developed, comprised of age, education and marital status. Duplicates of the unique identifier were checked; those with partial data were deleted (indicating multiple attempts), and only cases with full data were kept. All duplicate unique variables had either partial data or only one case of complete data. The data were then cross-checked by IP address duplicates to ensure that no one had purposely taken the survey for more than one entry into the iPad drawing, using different demographic information to "fool" the investigator. As it happened, all duplicate IP address data had already been eliminated using the unique variable duplicate check.

After duplicate data checks were completed, 116 participants with unique data remained. Next, missing data analysis was conducted to determine whether data were missing at random. Proportion of missing data ranged from 4.3 to 29.3% on the measures. Little's MCAR test was not significant: $\chi^2 = 70.34$, $df = 77$, p = .691, indicating that data were missing at random. Next, participants missing an entire independent or dependent measure were removed from the dataset, resulting in a sample, N = 70. These 70 participants were deleted because the analyses could not be conducted without these measures. This sample had no remaining missing data, which is likely due

to the way the survey was programmed; that is, participants had to respond to all questions before moving on to the next page, and ultimately, the next questionnaire or task, so those who did not complete one or two questions on a page were unable to complete any of the following, entire measures. As a result, it was unnecessary to impute missing data on a single measure.

Next, extreme values analysis and boxplot graphing were conducted to identify outliers. Analyses indicated three outliers falling within the extreme interquartile range (at least 3*IQR from the rest of the sample). These cases were deleted, leaving a sample of N = 67. As mentioned in the Participants section, the sample contained few males and previous research indicates that sex differences may exist on some of the variables in the present study, specifically, indecision and concern over mistakes (Cremades et al., 2013; Rassin & Muris, 2005; Rassin et al., 2007). Because of these differences, standard procedure would be to run checks for interactions with sex and other variables, however, the small number of men in the present study (N=5) does not allow for subanalysis of this population so these data were excluded from further analyses to prevent potential impact on data integrity. The present study proceeded with analyses from 62 participants (39 hoarders, 23 controls).

Distribution characteristics.

***Univariate normality*.** ANOVA models assume normality of distribution and homogeneity of variance. Kolmogorov-Smirnov tests of normality, descriptive statistics, as well as visual inspection of histograms, indicated that scores for certain groups on 2 of 7 dependent variable measures, were skewed and/or kurtotic. Specifically, the Alternate Uses Total Score exhibited skewness = -.26 and kurtosis = -1.28 for the control group but not the hoarding group. The Information Sampling Task, total mistakes score exhibited skewness =

1.06 and kurtosis = 1.31 for the control group, and skewness = 1.32 and kurtosis = 1.38 for the hoarding group.

Types of variable transformation are dependent on the type and direction of violation (e.g., logarithm for leptokurtotic and positively skewed data and reflect and square root for platykurtotic and reflect and logarithm for leptokurtotic and negatively skewed data; Tabachnick & Fidell, 2007). However, the transformations utilized to correct for skewness and/or kurtosis may not alleviate violations of the assumption of homogeneity of variance, as different transformations may be needed to address this issue. Furthermore, data transformations can render scores on measures difficult to interpret, so different options were considered, including the use of nonparametric tests, such as the Kruskal-Wallis (K-W), to test mean differences. However, one of the dependent variables also violated the assumption of homogeneity of variance (Alternate Uses total score), as indicated by significant Levene's test. This is an issue because the K-W test also assumes homogeneity of variance (Cone & Foster, 2006). Schmider, Ziegler, Danay, Beyer and Buhner (2010) and Horn (n.d.) suggest that ANOVA models are more robust against violation of the normality assumption than violation of homogeneity of variance (i.e., heterogeneity). As such, an analysis that is robust against heterogeneity of variance was recommended for use in the present study and utilized to examine group differences: the Welch ANOVA (Wren, 2015).

Multicollinearity. Multiple regression analyses assume absence of high intercorrelations of independent (predictor) variables; that is, multicollinearity. Checks for multicollinearity reveal Variance Inflation Factors (VIF) below 5 and tolerances above .10 for all independent variables included in regression analyses, indicating that multicollinearity was not present. Hierarchical multiple regression analyses proceeded without transformation or utilization of a nonparametric test.

Measure Integrity

Given the small sample size and technological issues with data collection, a bivariate correlation matrix was computed for all measures, and intercorrelations examined to ensure congruency among measures. In the hoarding sample, the two hoarding measures (Saving Inventory-Revised and Clutter Image Rating Scale) were significantly correlated, r=.53, which indicates convergent validity of these measures in the present sample. In previous research, intercorrelations among the Clutter Image Rating Scale and Saving Inventory-Revised subscales (relationship with total score on the Saving Inventory Revised was not published) range from r=.28 to .57 for hoarders (Frost et al., 2008), which appears to fit with the present study's finding. Further, the concern over mistakes subscale of the Frost Multidimensional Perfectionism scale was significantly correlated with the perfectionism total score of the Striving for Perfection Scale, r=.62, indicating convergent validity. Finally, the Obsessive Compulsive Inventory was significantly correlated with concern over mistakes, r=.40 and perfectionism r=.38, which makes sense given that these are obsessional beliefs in OCD (Wilhelm & Steketee, 2006).

In the control sample, the two hoarding measures (Saving Inventory-Revised and Clutter Image Rating Scale) were significantly correlated, r=.52, which indicates convergent validity of these measures in the present sample. The concern over mistakes subscale of the Frost Multidimensional Perfectionism scale was significantly correlated to the perfectionism total score of the Striving for Perfection Scale, r=.71, indicating convergent validity. The Obsessive Compulsive Inventory was also significantly correlated with the Saving Inventory-Revised, r=.58, which is in line with previous research examining these two measures in controls, r=.55 (Fontenelle et al., 2010). Further, the Obsessive Compulsive Inventory was significantly correlated with the

perfectionism total score of the Striving for Perfection scale, *r*=.52, and the Indecisiveness Scale, *r*=.52, which seem logical given that perfectionism is an obsessional belief in OCD (Wilhelm & Steketee, 2006) and indecision is often noted in OCD (Ferrari & McCown, 1994; Grisham et al., 2010). Taken together, the intercorrelations among measures in both groups suggest that measure integrity is sufficient to proceed with the main analyses.

Covariates. Before conducting the main analyses, analyses were run to test for potential covariates, which included ethnicity, education level, marital status, and age. Chi-square tests did not yield significant differences among groups for ethnicity, education level, or marital status for any of the dependent variables, and as a result, these were not used as covariates. Further, Pearson correlations did not yield significant relationships between age and any of the dependent variables, so age was not used as a covariate in the main analyses.

Main Analyses

Hypothesis I. Scores on specific aspects of decision making were predicted be greater in the hoarding group than control group. These aspects of decision making are indecision, perfectionism, concern over mistakes, considering many pieces of information, and slowness. The hoarding group was *not* expected to make more mistakes on a decision-making task than controls (i.e., null hypothesis was not expected to be rejected). Further, the hoarding group was predicted to score higher than the control group on association/fluency. The present study utilized a Welch ANOVA to test for differences between the hoarding and control groups on measures of indecision, perfectionism, concern over mistakes, considering many pieces of information, slowness, mistakes, and association/fluency. To have adequate power (80%) to detect a medium effect at the 0.05 significance level, a power analysis, using G*Power 3.0 indicates that

66 participants are needed (Faul, Erdfelder, Lang, & Buchner, 2007). Sample size (N = 62) was close to adequate to conduct this analysis.

As predicted, results revealed significant group differences on several measures of decision making, such that the hoarding group scored higher than controls on indecisiveness, Welch's $F(1, 60) = 10.05$, $p < .00$; perfectionism, Welch's $F(1, 60) = 12.68$, $p < .00$; and concern over mistakes, Welch's $F(1, 60) = 10.42$, $p < .00$. Also, as predicted, the hoarding group did not differ from the control group on actual mistakes, Welch's $F(1, 60) = 1.05$, $p = .31$.

Contrary to predictions, the hoarding and control groups did not differ significantly on the decision-making aspects of considering many pieces of information, Welch's $F(1, 60) = .03$, $p = .86$; and slowness, Welch's $F(1, 60) = .68$, $p = .41$. Groups also did not differ as predicted on association/fluency, Welch's $F(1, 60) = .44$, $p = .51$.

These findings indicate that hoarders were more likely to endorse items theorized to impact decision making, as outlined in Figure 1. Specifically, hoarders reported higher levels of indecision, perfectionism, and concern over making mistakes. Despite reporting higher concern for making mistakes, hoarders did not actually make more mistakes than controls on a decision-making task (i.e., The Information Sampling Task). Contrary to predictions, the hoarding and control groups did not differ significantly on the decision-making aspects of considering many pieces of information or slowness. Also contrary to predictions, the groups did not differ on association/fluency (see Table 2). Taken together, these findings provide partial support for Hypothesis I.

Table 2

Group Differences: Welch ANOVA

Variable	Group	*M*	*SD*	Range	*Welch's F*	95% CI
Indecisiveness	Control (N=23)[a]	59.96	14.69	29-88	10.05*	(53.61, 66.31)
	Hoarder (N=39) [a]	73.82	17.66	26-107	10.05*	(68.10, 79.55)
Perfectionism	Control	30.30	10.20	11-50	12.68*	(25.89, 34.72)
	Hoarder	40.10	10.62	10-56	12.68*	(36.66, 43.55)
Concern over Mistakes	Control	23.52	8.36	10-41	10.42*	(19.91, 27.13)
	Hoarder	30.20	7.59	13-41	10.42*	(27.75, 32.66)
Number of Mistakes	Control	2.74	2.00	0-8	1.05	(1.87, 3.61)
	Hoarder	3.46	3.00	0-12	1.05	(2.49, 4.43)
Considering Many Pieces of Information	Control	12.97	4.90	4.70-21.45	0.03	(10.86, 15.09)
	Hoarder	12.71	6.04	0-24.05	0.03	(10.76, 14.68)
Slowness	Control	32785.73	10721.90	15194.94-58630.64	0.68	(28149.23, 37422.22)
	Hoarder	36058.79	17192.37	8882.00-72285.93	0.68	(30485.67, 41631.91)
Association/Fluency	Control	21.30	9.66	3-33	0.44	(17.13, 25.48)
	Hoarder	19.85	7.48	5-35	0.44	(17.42, 22.27)

a= samples sizes are the same for all variables

*$p \leq .05$

Hypothesis II. Within the hoarding group, each of the aspects of decision making (indecision, perfectionism, concern over mistakes, considering many pieces of information, and slowness) were expected be related to hoarding scores, except number of mistakes. Association scores were also expected to be positively related to hoarding

scores. Pearson zero-order correlations were used to examine relationships between hoarding measures and measures of indecision, perfectionism, concern over mistakes, considering many pieces of information, slowness, actual mistakes, and association/fluency. To have adequate power (80%) to detect a medium effect at the 0.05 significance level, Cohen's (1992) power table indicates that 85 participants are needed. Sample size for hoarders (N=39) was not adequate. This analysis was conducted as an exploratory analysis.

Contrary to predictions, results revealed no significant correlations between the two measures of hoarding symptoms, Saving Inventory Revised total score and Clutter Image Rating composite score and any aspects of decision making, including number of mistakes. However, number of mistakes was *not* expected to correlate with hoarding symptoms, so this finding was as predicted. Also contrary to predictions, results also revealed no significant correlations between the two measure of hoarding symptoms and association/fluency (see Table 3). Taken together, these findings do not provide support for Hypothesis II.

Table 3

Hoarding, Decision Making and Association/Fluency Correlations in Hoarders[a]

	Concern Over Mistakes	Indecisiveness Total	Perfectionism Total	Association Total	Mistakes	Slowness	Considering Many Pieces of Information
Clutter Composite	.08	-.03	.09	.29	-.01	.12	-.02
Saving Inventory Total	.14	.21	.02	-.00	-.02	.05	-.08

*$p \leq .05$

[a] Sample size N=39

Hypothesis III. In the hoarding group, concern over mistakes was expected to predict hoarding symptoms over and beyond actual mistakes on a decision-making task. A hierarchical multiple regression analysis was used to test whether concern over mistakes predicts hoarding symptoms in the hoarding group over and beyond actual mistakes on a decision-making task (see Table 4). To have adequate power (80%) to detect a medium effect with 2 predictors at the 0.05 significance level, Cohen's (1992) power table indicates that 67 participants are needed. The hoarding sample size (N = 39) was not adequate to conduct this analysis. This analysis was conducted as an exploratory analysis.

The first analysis was conducted using the Saving Inventory Revised total score as the dependent variable. Scores in the first block (total mistakes) accounted for 0% of the variance in the data, and were not statistically useful in predicting scores on the dependent measure. When the scores on concern over mistakes were entered into the second block, the model accounted for 2% of the variance, though it was not statistically useful in predicting scores on the dependent measure.

The second analysis was conducted using the Clutter Image composite score as the dependent variable. Scores in the first block (total mistakes) accounted for 0% of the variance in the data, and were not statistically useful in predicting scores on the dependent measure. When the scores on the concern over mistakes were entered into the second block, the model accounted for 1% of the variance, though it was not statistically useful in predicting scores on the dependent measure (see Table 4). Taken together, these findings do not provide support for Hypothesis III.

Table 4

Predictors of Hoarding Scores in Hoarders: Hierarchical Multiple Regression Findings[a]

Dependent Variable	Predictors	R	R^2	F Change	Standardized Coefficients Beta
Saving Inventory Revised Total	Total Mistakes	.02	.00	.01	-.02
	Total Mistakes & Concern Over Mistakes	.14	.02	.74	.02 .15
Clutter Image Rating Composite	Total Mistakes	.01	.00	.01	-.01
	Total Mistakes & Concern Over Mistakes	.08	.01	.20	.01 .08

*$p \leq .05$

[a] Sample size N=39

Hypothesis IV. The indecision model, as depicted in Figure 2, was expected to be confirmed in hoarders, such that perfectionism would be related to concern over mistakes which would be related to indecision. Indecision, in turn, would be related to slowness. Concern over mistakes would also be related to considering many pieces of information which would, in turn, be related to slowness. A path model was proposed to confirm the indecision model in the hoarding group. To have sufficient power to detect effects, Bentler and Chou (1988) recommend 5-10 participants per parameter. Given that each variable has 3 parameters, this equates to 15-30 participants per variable. For the present study, with 5 variables, 75-150 participants were needed to detect effects. The hoarding

sample size (N = 39) was not adequate to conduct this analysis; this analysis was not conducted.

Hypothesis V. The indecision model was expected to fit better for the hoarding group than the control group. A multiple group path analysis was proposed to test differences in the path model between the hoarding and control groups. To have sufficient power to detect effects, Bentler and Chou (1988) recommend 5-10 participants per parameter. Given that each variable has 3 parameters, this equates to 15-30 participants per variable. For the present study, with 5 variables, 75-150 participants were needed *per group* to detect effects; 150-300 participants in total. The hoarding sample size (N = 39) and control sample size (N = 23) were not adequate to conduct this analysis; this analysis was not conducted.

Hypothesis VI. The indecision model, as depicted in Figure 1, suggests that indecision may play a mediating role between concern for mistakes and hoarding and that indecision might also play a mediating role between perfectionism and hoarding. A series of regression analyses were performed to determine whether indecision mediates the relationship between concern over mistakes and hoarding as well as whether indecision mediates the relationship between perfectionism and hoarding. To have adequate power (80%) to detect a medium effect with 2 predictors at the 0.05 significance level, Cohen's (1992) power table indicates that 67 participants are needed. Sample size for hoarders (N = 39) was not adequate. This analysis was conducted as an exploratory analysis.

Prediction 1 posits that indecision mediates concern over mistakes and hoarding. The first analysis was conducted using the Saving Inventory Revised total score as the dependent variable. Scores in the first block (indecisiveness) accounted for 4% of the variance in the

data, but were not statistically useful in predicting scores on the dependent measure. When the scores on the concern over mistakes were entered into the second block, the model accounted for 6% of the variance, though it was not statistically useful in predicting scores on the dependent measure (see Table 5).

The second analysis was conducted using the Clutter Image composite score as the dependent variable. Scores in the first block (indecisiveness) accounted for 0% of the variance in the data, but were not statistically useful in predicting scores on the dependent measure. When the scores on the concern over mistakes were entered into the second block, the model accounted for 1% of the variance, though it was not statistically useful in predicting scores on the dependent measure. Prediction 1 was not supported (see Table 5).

Table 5

Predictors of Hoarding Scores in Hoarders: Hierarchical Multiple Regression Findings[a]

Dependent Variable	Predictors	R	R^2	F Change	Standardized Coefficients Beta
Saving Inventory Revised Total	Indecisiveness	.21	.04	1.69	.21
	Indecisiveness & Concern Over Mistakes	.25	.06	.76	.21 .14
Clutter Image Rating Composite	Indecisiveness	.03	.00	.03	-.03
	Indecisiveness & Concern Over Mistakes	.08	.01	.20	-.03 .08

*$p \leq .05$

[a] Sample size N=39

Prediction 2 posits that indecision mediates perfectionism and hoarding. The first analysis was conducted using the Saving Inventory Revised total score as the dependent variable. Scores in the first block indecisiveness) accounted for 4% of the variance in the data, but were not statistically useful in predicting scores on the dependent measure. When the scores on perfectionism were entered into the second block, the model accounted for 5% of the variance, and it was not statistically useful in predicting scores on the dependent measure (see Table 6).

The second analysis was conducted using the Clutter Image composite score as the dependent variable. Scores in the first block (indecisiveness) accounted for 0% of the variance in the data, and were not statistically useful in predicting scores on the dependent measure. When the scores on perfectionism were entered into the second block, the model accounted for 1% of the variance, though it was not statistically useful in predicting scores on the dependent measure (see Table 6). Prediction 2 was not supported (see Table 6). Taken together, these findings do not support Hypothesis VI.

Table 6

Predictors of Hoarding Scores in Hoarders: Hierarchical Multiple Regression Findings[a]

Dependent Variable	Predictors	R	R^2	F Change	Standardized Coefficients Beta
Saving Inventory Revised Total	Indecisiveness	.21	.04	1.69	.21
	Indecisiveness & Perfectionism	.21	.05	.05	.21 .04
Clutter Image Rating Composite	Indecisiveness	.03	.00	.03	-.03
	Indecisiveness & Perfectionism	.09	.01	.25	-.02 .08

*$p \leq .05$

[a] Sample size N=39

Discussion

The most notable feature of hoarding is excessive clutter, which is driven by excessive acquiring of objects and difficulty discarding (Steketee & Frost, 2007). Although these main features of hoarding have been identified, little research has been conducted on the factors that contribute to them. Two factors that appear to be particularly central in contributing to acquiring and difficulty discarding are decision-making deficits and association. In order for treatments to be effective, psychologists need to better understand the factors that contribute to the disorder, such as decision-making processes and association.

Despite the apparent importance of decision making and association in the treatment of hoarding, they have not received a great deal of empirical attention. In fact, association does not appear to have been examined at all. To facilitate a better understanding of these factors, the present study examined decision-making processes and association in hoarding, comparing these findings to a control group without hoarding disorder.

Group Differences in Decision Making and Association

Certain aspects of decision making (i.e., indecision, perfectionism, concern over mistakes, considering many pieces of information, and slowness) were expected to be present in hoarding and to a greater extent than in control participants. These aspects, as depicted by the model in Figure 2, were examined in a clinical group of hoarders and in a non-hoarding group of controls in the present study.

The findings indicate that hoarders were more likely to endorse items theorized to impact decision making. Specifically, hoarders scored higher on measures of indecision, perfectionism, and concern over making mistakes, as predicted. These findings are in line with those from previous research on indecision (Steketee et al., 2003), perfectionism (Frost & Gross, 1993), and concern over mistakes (Frost & Gross, 1993). Hoarders and controls did not differ, however, on the decision-making aspects of considering many pieces of information and slowness.

One explanation for this difference might be that indecision, perfectionism, and concern over making mistakes were measured differently than considering many pieces of information and slowness. The former were measured using self-report and the latter, with a decision-making computer task. A difference simply in type of measurement may account for these findings. Psychometrically speaking, different types of measurement (self-report

versus task) can tap different aspects of a construct. It is possible that self-perception of decision-making concerns may be more impactful on hoarding behavior than actual decision-making problems, meaning that perceiving that one has decision-making problems could contribute to more problems with decision making than would actual decision-making deficits. It would not necessarily matter whether they were actually prone to making mistakes; the belief about mistakes and the concern it incites are sufficient to impact hoarding behavior. Although this concern over mistakes and actual mistakes discrepancy has not been examined prior to this study, we can consider findings from studies of other information-processing deficits to garner support for the hypothesis that perception of deficits might be as impactful as actual deficits. Indeed, if we examine the data from the information-processing deficit of memory, the findings indicate that the perception of memory deficits in hoarders was out of proportion to actual memory deficits on a memory task (Hartl et al., 2004). Another conceptual explanation might be that the decision-making computer task, examining considering many pieces of information and slowness, might be too generic, and not personally relevant. If we consider the findings of another information-processing deficit, categorization/organization, the findings indicate that hoarders perform similarly to controls on a generic sorting task, but when sorting personal items, they take more time (slowness) and make more categories (Wincze et al., 2007). This aspect of personal relevance may be the key.

Related to this line of argument, consider the next finding from the present study: that hoarders and controls did not differ significantly on actual mistakes on a decision-making task (i.e., The Information Sampling Task). Thus, despite reporting higher concern for making mistakes, hoarders did not actually make more mistakes than controls on a decision-making task. This indicates that perceived concern for making mistakes is out of

proportion to actual mistakes on a decision-making task. Further, it is possible that, if given a decision-making task that involved personally relevant items, hoarders may make more actual mistakes than controls on such a task.

Taken together, perhaps these differences between hoarders and controls have to do with emotional investment in items and the magnitude of decision making when it pertains to their items or even personal factors (e.g., investments, yard-cleaning services, housing options, meal options). Indeed, Reed (1985) also proposed that, in terms of decision making, all individuals are more indecisive when it comes to decisions about things that are personally important. And, clinical observation indicates that hoarders are able to function in high-powered jobs that require high-stakes decision making (e.g., executives, doctors, engineers) but are often thwarted by seemingly lower-stakes decisions (e.g., which tree-trimming service to use) or even simple decision-making tasks (e.g., what to order at a restaurant), including those decisions related to hoarded items, such as whether to discard decades-old grocery receipts, when the decision appears personally relevant.

Finally, the previously unexamined information-processing deficit of association/fluency (i.e., generating many uses for an object) was hypothesized to differ between the groups, such that hoarders were predicted to score higher on association/fluency. Hoarders and controls did not differ significantly in the present study, however. One reason for this could be that the groups do not actually differ on this aspect of information processing. Another explanation, as discussed above in reference to slowness and considering many pieces of information, could be related to the way in which association was measured, with an actual association task, rather than a self-report of association. More specifically, one type of measurement taps may a different aspect of a

construct than does another (self-report versus task). So, along this line, a conceptual explanation might be that self-perception (self-report) of association may be more impactful on hoarding behavior than actual association ability (task); however, neither the present study nor previous studies have measured self-perception of association. Another explanation might be, as argued above, that the objects assessed by the task (and for which multiple uses were generated), must be personally relevant to hoarders in order for group differences to occur. Indeed, clinical experience indicates that individual hoarders acquire and keep different items, such that each unique individual has his or her favorite item categories. For some clients, this category is clothing, for others books, and for others still, craft supplies. Perhaps if the study had examined and compared personally relevant items, hoarders would have generated more uses than controls.

Relationships among Hoarding Symptoms, Decision Making, and Association

Within the hoarding group, each of the aspects of decision making (indecision, perfectionism, concern over mistakes, considering many pieces of information, and slowness) were expected be related to hoarding scores, except number of mistakes. Association scores were also expected to be positively related to hoarding scores. Pearson zero-order correlations were used to examine these relationships (see Table 3).

Contrary to predictions, results revealed no significant correlations between the two measures of hoarding symptoms, Saving Inventory Revised total score and Clutter Image Rating composite score, and any aspects of decision making, including number of mistakes. However, number of mistakes was *not* expected to correlate with hoarding symptoms, so this finding was as predicted. Also contrary to predictions, results revealed no significant correlations between the two measure of hoarding symptoms, Saving Inventory Revised total score and Clutter Image Rating composite score, and association/fluency. These findings are

puzzling, given that previous work has found relationships between hoarding symptomatology and aspects of decision making (Frost & Gross, 1993; Frost et al., 2009; Rassin et al., 2007; Steketee et al., 2003).

Closer examination of these previously reported findings, however, indicates that these results were found using community samples, combined samples of controls and hoarders, or measuring different aspects of hoarding than the present study (e.g., compulsive acquisition, rather than a broad range of hoarding symptoms). Research involving correlations among hoarding symptoms, and aspects of decision making, using only a hoarding sample appears difficult to find.

It is possible that a restriction in range in the dependent variables for the hoarding group, as defined by a cut off of 40 and above on the Saving Inventory Revised, may have resulted in the nonsignificant correlations between hoarding symptomatology and dependent variables. However, examination of dependent variable histograms, means and standard deviations did not indicate a restriction of range (see Table 2 for means and standard deviations).

A related question is whether the effects of hoarding on decision making would be manifest if the hoarding group is expanded to include those with subclinical levels of hoarding symptoms, thus expanding the range of hoarding symptom severity. Following guidelines from previous research, a cutoff score of 1.2 standard deviations below the mean for hoarders was used to examine this question (Frost et al., 2004). The results from this analysis were still not significant.

Another explanation for these findings could be that severity of hoarding symptomatology does not actually relate to these aspects of decision making or association in a linear manner. Rather, a threshold or ceiling of hoarding symptom

severity may exist, above which decision-making deficits and greater association/fluency are present at higher levels than for nonhoarders. Inspection of the scatterplots suggests that most hoarders exhibit elevations on decision-making aspects compared to controls (this phenomenon is not apparent with association/fluency), but these elevations do not appear tied to hoarding severity. This phenomenon, in which individuals in different categories—hoarders and nonhoarders—exhibit difference patterns of relationships with dependent variables, potentially cannot be assessed using a simple correlation due to the categorical, rather than continuous, distribution of hoarding symptom severity. The significant differences between groups on the decision-making aspects, and the lack of significant correlations within the hoarding group, provides some support this possibility for decision-making issues but not for association/fluency.

Decision-Making Model in Hoarding

One goal of the study was to test the proposed decision-making model in hoarding and to determine whether it fit better for hoarders than controls. Given that previous research has only examined pieces of the model, testing the entire model, and even several pieces together, may have provided the opportunity to learn more about how decision-making processes work in hoarding and whether these processes work differently in the general population. Unfortunately, the sample size of the present study, and ultimately lack of power, prevented the examination of the fit of the entire decision-making model. Because the sample was too small to test the entire model, the present study did attempt to examine several pieces of the model, utilizing regression analyses. Sample size and ultimately, power, was also an issue for these analyses, but not to the

extent as they were for model testing (which requires a much larger sample), so these analyses were conducted but as "exploratory analyses."

Contrary to predictions, concern over mistakes did not predict hoarding symptoms on either hoarding measure over and beyond actual mistakes and neither concern over mistakes or actual mistakes predicted hoarding symptoms on either hoarding measure.

Furthermore, although the indecision model, as depicted in Figure 1, suggests that indecision may play a mediating role between concern over mistakes and hoarding and that indecision might also play a mediating role between perfectionism and hoarding, these predictions were not confirmed in the present study. Indecision did not mediate concern over mistakes and hoarding symptoms on either hoarding measure, and indecision did not mediate perfectionism and hoarding symptoms on either hoarding measure.

Given that bivariate correlational analyses did not produce significant relationships among any of these measures, the findings of these regression analyses are not surprising. The reasons for the lack of significant regression relationships are likely similar to those of the bivariate correlational analyses: the lack of real-world relationships, and/or the presence of a threshold of hoarding symptomatology that predicts high scores on the information-processing deficits of decision making and association, rather than hoarding and information processing scores that are tied together by severity increases/decreases.

Sample characteristics. The large proportion of females in the present study begs the question, why? Certainly these numbers do not reflect those of the general population. And, one would imagine that these numbers do not reflect those of the

hoarding population either; however, gender prevalence in hoarding is still unknown (International OCD Foundation). It is possible, then, that hoarding is much more prevalent in females, which could be the explanation for the high proportion of females in the current study. As it happens, much of the hoarding research reflects higher rates of females to males in research samples (Frost et al., 2004, 2008; Samuels, Bienvenu, Pinto, et al., 2008; Tolin, Frost, Steketee, & Fitch, 2008), with one large scale study exhibiting a 93.5% rate of female hoarders (Tolin et al., 2008), which is similar to the rate in the present study. Another explanation is that females are more likely to volunteer for and participate in online research; and the data support this supposition (Smith, 2008). To further elucidate this point, examination of the methodology for various hoarding studies indicates that a probabilistically sampled study (which would, in theory, be a better representation of the general population) found higher rates of male hoarders than female hoarders: 55% and 44%, respectively (Samuels, Bienvenu, Grados, et al., 2008). Conversely, nonprobabilistic samples, specifically, convenience samples, seeking volunteers, found higher rates for women (Frost et al., 2004, 2008; Samuels, Bienvenu, Pinto, et al., 2008; Tolin et al., 2008). As for why women are more likely to participate in research, Smith (2008) hypothesizes that the higher response rates by women might be related to social exchange theory, wherein women are more likely to develop connective selves, men to develop separative selves (Chodorow, 1978; Emerson, 1972a, 1972b; England & Kilbourne, 1990). If women and men subsequently respond in ways consistent with these respective selves, then, by extension, women should be more likely to share information rather than seek it (as is the case for men), participating in research,

rather than consuming it (as is the case for men). And, indeed, this is what the research finds (Jackson, Ervin, Gardner, & Schmitt, 2001).

Other demographic variables were also examined to determine whether the sample compared to samples in previous hoarding research, including age, ethnicity, marital status, and education level. Unfortunately, these data were not reported in many studies, and those that did report, did not always report all demographic data.

The average age of hoarders in the present study is middle aged (M = 50.54, SD = 11.46), and this is in line with that found in other research samples of hoarders (Frost et al., 2004; Frost et al., 2008; Tolin et al., 2008), as is the average age of the control group (M = 38.48, SD = 12.38; Frost et al., 2004). The hoarders in the present sample were primarily Caucasian (87.2%), which compares to other research in which these data are reported (Frost et al., 2008; Tolin et al., 2008). Ethnicity data for controls in other hoarding studies were not available. A large portion of the hoarders in this sample were married: 46.2%. This is in line with the rates previous researchers have found, though marriage rates for controls were not included (Samuels, Bienvenu, Grados, et al., 2008; Tolin et al., 2008). Level of education in this study appears higher than that in other hoarding studies; this is addressed in the limitations section below. Although the present sample displays a larger proportion of females and higher education level than previously reported in hoarding research, age, ethnicity, and marital status appear to be in line with previous research. And, at least one large-scale hoarding study reported similarly high rates of female participants (Tolin et al., 2008). Taken together, these comparisons suggest that the present study may be representative of the current hoarding research precedents.

Limitations

Small sample size was a limitation in this study. Although small sample size has historically been a problem in psychological research (Marszalek, Barber, Kohlhart, & Holmes, 2011), it does not mean that current research needs to perpetuate this problem. Small sample size can contribute to Type II error. Effects may have been present but the sample may not have been large enough to detect them (i.e., under powered). Furthermore, effects that were found may not be an accurate representation of "true" results; findings may have been stronger if sample was larger. If nothing else, more definitive statements could be made about findings if the sample was larger. That is, the present study would be able to say that small sample size did not likely contribute to failure to find significance or meaningful effect sizes; rather, the failure to reject the null could likely be attributed to lack of real-world differences, relationships, predictors, processes. Additionally, because the sample size for each group is small, it is not as likely to be representative of population as a whole; thus generalizability of these findings to the general population and population of hoarders is low.

The small sample limited sophistication of analysis techniques, which impacts the quality of the results (e.g., simple group comparisons or bivariate relational designs versus model testing). This is also an issue because it impacts the design of future studies, based upon this research (Marszalek et al., 2011); that is, future research may consider the findings from the present study and then design studies based upon an underpowered study with potential Type II errors. Problems with power notwithstanding, there are "good" reasons psychological research has been historically underpowered, including lower levels of funding than other areas of research (medicine), lower base rates of disorders (e.g., 40% lifetime risk for cancer; National Cancer Institute, 2014,

versus an estimated 4% for hoarding; Samuels, Bienvenu, Grados, et al., 2008), harder to capture samples (many people with mental health problems do not present to treatment), and so on. Difficulty obtaining larger samples should not dissuade researchers from conducting the research. Indeed, even in medical research of rarer disorders, case studies are much more useful than no research at all.

After cases were dropped due to missing or incomplete data, almost the entirety of the sample was female (92.5%), and, as a result, the males were dropped for conceptual and statistical reasons. Thus, generalizability of the results to males is not possible. All that can really be said is that these findings apply to female hoarders and females in general, without hoarding problems.

Determining hoarding status is a limitation in this study and any study conducted on hoarding prior to the release of DSM-V, which includes the first standardized set of diagnostic criteria for hoarding disorder. Prior to this, researchers had suggested criteria to use for diagnosis and design of measures but no standard criteria. This is an issue because what constitutes "hoarding" can differ from study to study. Also, it takes time to develop and validate measures based upon these new criteria. This study, as with many before, used measures that predate the standardized diagnostic criteria. Further, inclusion in the hoarding group was completed by a self-report measure of hoarding, rather than a clinical interview. Although this measure is validated and considered a good measure of hoarding symptomatology, it is not a replacement for a diagnostic interview conducted by a trained clinician, which is the standard diagnostic procedure for mental health disorders in the field.

Previous studies on hoarding have used primarily samples that are a mix of those with "pure" hoarding and hoarding with OCD. As such, findings cannot be said to be unique to compulsive hoarding. The present study sought to improve upon previous studies and examine a "pure" hoarding sample; however, due to small sample size, the following study was also unable to parse out those with OCD, and ultimately, utilize a "pure" hoarding sample. Doing so would have lowered power even further. So, the results of the present study are generalizable to those with OCD and hoarding, rather than "pure" hoarding.

Related to measurement of variables, the indecision measure for the current study utilized a 5-point Likert scale, rather than a 7-point Likert scale, as was used in its validation study. This measure has not been validated with a 5-point Likert scale, which could impact psychometric properties due to restriction of range. Cronbach's Alpha for this measure is =.76, indicating adequate internal consistency reliability, despite the deviation.

Several technology-related issues likely had an impact on the present study. The survey program itself was not very user-friendly, as it required completion of several steps, including downloading Java scripts, to simply open the study. Many participants were likely deterred by this process, and those who were not, experienced challenges with the survey freezing up, crashing, or not running at all on their computers. When participants had trouble completing the survey, some complained very loudly on the recruiting sites, criticizing the researcher and research, which very likely impacted recruitment as well as the characteristics of the sample that was recruited. These issues not only impacted ability to collect data but the generalizability of the data collected.

The recruiting issues in both groups undoubtedly impacted ability to recruit the proposed sample size, including the ability to recruit a random sample of controls and

hoarders, representative of the general population and hoarding population, as well as reducing the power level of analyses. Many pieces of data were incomplete and thus discarded because of these problems (135 cases were ultimately reduced to 62). Thus, the final dataset may not be representative of those who normally participate in hoarding research because a large proportion of the initial sample was excluded. Furthermore, the process of simply getting into the survey and then completing it fully took some participants several tries; those who completed the survey may differ from those who did not on certain characteristics (e.g., frustration tolerance), which likely impacted the composition of the final sample and ultimately, generalizability. Finally, data from the control and hoarding groups were collected from different types of websites: hoarders from hoarding-related websites, tending to be more informational and help-based and controls from Craigslist, a website geared towards advertisement. This could mean that the samples were different because the type of information sought might reflect the type of person visiting the site.

Another technology-related issue is that the use of computer programs and online data collection limits sample to those with computer and internet access; results are generalizable only to those with computer and internet access. Another issue, resulting from technological difficulties was the amount of time it took to collect data (i.e., two and one-half years). That is to say, the length of time it took to collect the data is a limitation; an older sample could differ from a newer sample and in ways that the study is unable to measure (e.g., increasingly tech savvy population, greater access to technology as time passed).

Along these lines, given the difficulty individuals had in accessing and fully completely the survey, the study might have inadvertently selected out only those tech savvy enough to complete the survey, independent of time passing and increased technology savviness in the population as a whole. Although the present study did not directly measure tech savviness, education level might serve as a proxy for this, given that one of the areas people with higher degrees are educated (directly and indirectly) is use of technology. Upon examination of the education level of the present sample, the data reveal that 77.6% of the sample had a Bachelor's degree or higher. Although other research reports a college-educated majority in their samples (hoarders and nonhoarders), the current study's proportion is much larger than in other research (Frost et al., 2004, 2008), and may indicate a more tech savvy population. This impacts the generalizability of these data.

Related to education level, those with a higher education level may perform better on cognitive tasks, such that the results may not be an accurate reflection of the hoarding and nonhoarding populations, and may positively skew current data. Although initial checks of data did not reveal differences on cognitive tasks by education level, the cell sizes were small in some of groups and may not have had sufficient power to detect effects. Therefore, the present study sought to further investigate this issue by increasing cell size in order to better examine the potential impact of education level on cognitive tasks. Education was collapsed into two groups, Bachelor's degree and higher and below Bachelor's degree; a Welch ANOVA was run to test differences on cognitive tasks. Results did not reveal any significant differences on cognitive tasks, and thus, did not indicate an impact of education level on cognitive tasks.

Although steps were taken to ensure legitimacy of data, that is, to ensure that no one "faked" data, through measures such as identifying and deleting duplicate IP addresses and removing duplicates based upon unique identifiers, it is still possible that some individuals were able to complete the survey multiple times by using different IP addresses and different identifying information. Bots (computer programs designed to "act human" and complete tasks, such as completing survey data) can be an issue with online data collection; however, it is very unlikely that bots were able to complete this survey due to the way participants gained entrance to the study and aspects of study design (e.g., the nature of the responses required). Specifically, participants were required to click on a link to the study page, then manually type in a username and password to complete the study. Several survey responses required manually typing in an answer to a given question. Of those data left in the survey after data cleaning, the quality and logical nature of the responses provided indicated human response.

The decision-making computer task, the Information Sampling Task, is a complex and unique task for measuring decision making. However, the complexity not only makes the task difficult to score, calculation of traditional internal consistency reliability analyses is a particular challenge. Therefore, it is difficult to tell whether someone responded to the task in an engaged manner or simply responded randomly, which could definitely compromise the integrity of the data. To prevent this issue in the future, the task should be interspersed with questions that require a coherent answer. This might ensure that participants are paying attention while completing the task and thus, providing valid data.

Finally, any voluntary research sample is limited to those willing to participate in research. This fact applies to the present study and impacts generalizability of responses to

the entire population, and most notably impacts generalizability to those who chose not to participate in research.

Future Directions

Decision making and association are important in the understanding and treatment of compulsive hoarding but have not received a great deal of empirical attention. The present study expanded upon previous research on decision making, utilizing different measurement techniques and studied association for what appeared to be the first time. Although the sample size was small, these results are still important and the lessons learned can be used in designing future research. First, future studies should find ways to maximize recruiting of hoarding and control populations. Furthermore, now that a standardized set of criteria for assessing and diagnosing compulsive hoarding exists, it would be important to develop measures based on these criteria and use them in future studies. Along these lines, future work should strive to parse out OCD from hoarding in these samples, examining a pure hoarding sample. If needed, compulsive hoarding diagnostic criteria and measures of hoarding disorder should be revised according to new findings, using these pure hoarding samples. All tasks should include reliability checks, even if these are not inherent to the measure; for example, the Information Sampling Task should be interspersed with questions that require a coherent answer to ensure that participants are paying attention and not responding randomly. Finally, as deliberated in the discussion section, hoarders may respond differently to tasks if tasks are less generic; future work should examine personally relevant items/factors in both decision-making and association tasks.

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