DECISION-MAKING PROCESSES IN YOUTH WITH HOARDING SYMPTOMS

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Abstract

Hoarding symptoms are characterized by (1) a persistent difficulty discarding personal items (2) clutter that interferes with living areas and (3) clinically significant distress or impairment in functioning. Hoarding symptoms are common, affecting 2-6% of the general population and 20% to 56.7% of individuals with obsessive-compulsive disorder (OCD). Research suggests that individuals who hoard have impaired decision-making, particularly when it involve making decisions about personal possessions. This is thought to be a key deficit in hoarding resulting in an inability to discard unneeded possessions. Although the onset of hoarding symptoms is usually during childhood or adolescence (youth), little research has investigated hoarding symptoms in youth.

The present study compared different aspects of decision-making processes between youth with OCD and youth with OCD and hoarding symptoms. Specifically, we assessed decision-making and the influence of ownership using the Balloon Analogue Risk Task (BART) and an endowment trading task, respectively. Additionally, we assessed cognitive flexibility, inhibitory control and delay discounting using the Wisconsin Card Sorting Task (WCST), the Stop Signal Task (SST) and Monetary Choice Questionnaire (MCQ), respectively. Participants included 52 youth (8-18 years old), all with a primary DSM-5 diagnosis of OCD. Parents completed the Child Saving Inventory to measure the presence of hoarding symptoms and to create hoarding severity groups.

Youth with hoarding symptoms exhibited differences in ownership-based decision making; specifically, we found a larger endowment effect compared to the non-hoarding group. Compared to participants with OCD only, participants with hoarding exhibited significantly increased cognitive flexibility and lowered perseveration on the WCST. Performance of the

hoarding and non-hoarding groups did not differ on other aspects of decision-making, including non-ownership decision-making, inhibitory control and delay discounting. Further regression analysis suggested that increased hoarding severity was associated with higher inattentive symptoms and improved performance on the WCST. These findings support the notion that hoarding is associated with specific differences in making decisions about personal items.

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List of Abbreviations

ADHD	Attention Deficit Hyperactivity Disorder
BART	Balloon Analogue Risk Task
CBT	Cognitive Behavioural Therapy
CDI	Children's Depression Inventory
CSI	Children's Saving Inventory
CSI-15	Children's Saving Inventory - 15 items
CY-BOCS	Children's Yale-Brown Obsessive-Compulsive Scale
EB	Endowment Boost
EE	The Endowment Effect
GAD	Generalized Anxiety Disorder
HD	Hoarding Disorder
KSADS	Kiddie Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present State Interview
MDD	Major Depressive Disorder
MCQ	Monetary Choice Questionnaire
OCD	Obsessive Compulsive Disorder
OCPD	Obsessive Compulsive Personality Disorder
ODD	Oppositional Defiant Disorder
SAD	Social Anxiety Disorder
SST	Stop Signal Task
SSRT	Stop Signal reaction time
WCST	Wisconsin Card Sorting Task

Declaration of Academic Achievement

This thesis contains 4 chapters. Chapter 1 describes the background and rationale for the present study. Chapter 2 outlines the measures and procedures used for the study and Chapter 3 describes our results. Finally, Chapter 4 discusses our findings and their implications, study strengths and limitations, then conclusions and future directions.

This study was completed at the Anxiety Treatment and Research Clinic (ATRC), St. Joseph's Healthcare Hamilton, under the supervision of Dr. Noam Soreni. Our study was approved by the Hamilton Integrated Research Ethics Board (HiREB). Participants were recruited through the Pediatric OCD Consultation Team at the ATRC.

I am the primary author of this thesis. I made substantial contributions to this study through recruitment, participant assessments, database management, data analysis and interpretation of the results with the support of Dr. Soreni. I would like to acknowledge the work of previous MiNDS student, Rebecca Wetzel, whose thesis work established a foundation for the current study to build on. Dr. Hall, Dr. McCabe, and Dr. MacKillop provided secondary supervision of this work. I am grateful to all contributors.

CHAPTER 1

1.1 Hoarding Symptoms and Hoarding Disorder

1.1.1 Definition, Symptom Dimensions and Diagnosis

Hoarding is defined by an excessive difficulty with discarding possessions, resulting in over accumulation of items and, ultimately, significant clutter (Frost & Hartl, 1996; Samuels et al., 2017). Hoarding symptoms are common, with prevalence estimates ranging between 2% to 6% in the adult population (Lervolino et al., 2009; Matiax-Cold & Pertusa, 2012; Samuels et al., 2008). The course of hoarding symptoms is said to be chronic and treatment-resistant, such that 94% of those with hoarding symptoms indicate a deteriorating course of symptoms (Tolin et al., 2010).

Previous editions of the Diagnostic and Statistical Manual of Mental Disorders (DSM), have classified hoarding as a manifestation of either Obsessive-Compulsive Disorder (OCD) or Obsessive-Compulsive Personality Disorder (OCPD) (American Psychological Association, 1994). The fifth edition of the DSM (DSM-5; American Psychological Association, 2013), is the first to classify Hoarding Disorder (HD) as a separate diagnostic entity included under Obsessive-Compulsive and Related Disorders.

DSM-5's HD criteria include difficulty discarding or parting with possessions, resulting in significant clutter, as well as causing distress and impairment (American Psychological Association, 2013). It is suggested that difficulty discarding is the core behavioural feature of hoarding (Tolin et al., 2015). Finally, in order for a diagnosis of HD to be made, hoarding symptoms cannot be attributed to another medical condition (e.g., brain injury, cerebrovascular disease) or another mental disorder (e.g., obsessions in OCD, delusions in schizophrenia) (American Psychological Association, 2013). In addition to the main HD diagnostic criteria, the

DSM-5 includes two additional specifiers, acquisition and insight (American Psychological Association, 2013). Acquisition refers to whether or not the individual's hoarding symptoms are accompanied by excessive acquisition of unneeded items. Insight, the second specifier, refers to the level of understanding the individual has regarding their hoarding symptoms, with scores ranging from good or fair insight to absent or delusional beliefs.

Individuals who hoard report several associated beliefs, such as, items are useful or valuable, that they have intrinsic value and emotional attachment or that they feel responsible to the items' fate (American Psychological Association, 2013; Frost et al., 1995; Steketee et al., 2003). Those with hoarding symptoms purposefully acquire items and experience significant distress when discarding.

1.1.2 Impact of Hoarding

Hoarding symptoms are associated with clutter, the congestion of living spaces, to the point of making them unusable (American Psychological Association, 2013). Hoarding symptoms have wide-ranging effects on the individual, their immediate environment, and society as a whole. Those who hoard often experience significant disability and global impairments in their overall functioning (Saxena et al., 2011). More specifically, individuals who hoard report a significantly lower sense of safety in their living arrangements (Saxena et al., 2011). In a sample of individuals with hoarding symptoms, 8-12% indicated that they had either been evicted or threatened with eviction as a result of their hoarding (Tolin et al., 2008). Further research has indicated that individuals who hoard experience negative emotions more intensely and have a lower threshold for tolerating negative emotions and events (Timpano et al., 2014). Finally,

individuals who hoard were significantly more likely to report a range of chronic and severe medical issues and were much more likely to seek mental health services (Tolin et al., 2008).

The impact of hoarding extends well beyond the affected individual to include family and friends. Rees et al., (2017) reported that children of individuals with hoarding symptoms described many psychological and emotional outcomes as a result of their parent's hoarding, including negative emotional responses (i.e., embarrassment, frustration, and resentment), difficulties with self-esteem, impacts on social relationships, isolation and conflict. Individuals who grew up with a parent who hoarded were more likely to report urges towards hoarding behaviours and express significant fear in developing hoarding issues themselves (Sampson, 2013). Furthermore, partners and caregivers for individuals with HD report significant negative consequences of the hoarding symptoms, such as loss of "normal" family life, living spaces and social life, lack of appropriate care and resources and feelings of distress and marginalization (Wilbram et al., 2008).

Hoarding also affects the community and society at large. Health and safety concerns are among the most recognized negative impacts of hoarding (Pertusa et al., 2010). Specifically, hoarding results in extreme clutter and disorganization of living spaces, often resulting in the violation of many health, housing and sanitation regulations, often resulting in eviction (Frost et al., 2011). Significant clutter increases the chances of fires, accidents and animal infestations, which can result in significant health and economic concerns (Frost et al., 2011; Frost et al., 2000; Tolin et al., 2008). There is limited information regarding the frequency and seriousness of hoarding cases; however, a survey of Massachusetts Board of Health officers found that 64% of health officers indicated at least one hoarding complaint in the five years of the study (Frost et al., 2000). Additionally, unsanitary conditions and accumulation of "junk" were cited as the

reason for 88% of the reported hoarding cases, and fire hazards were cited in 67% of the complaints (Frost et al., 2000). Individuals with hoarding symptoms have significant functional impairments, poorer physical, and mental health and require greater healthcare service involvement, demonstrating that hoarding is a profound public health concern (Tolin et al., 2008). Hoarding symptoms and HD are prevalent issues that have a marked impact on affected individuals, their family, and friends, their community and society at large.

1.1.3 Onset and Developmental Course

The literature suggests that the onset of hoarding symptoms is often during youth (childhood and adolescence) (Grisham et al., 2006; Kichuk et al., 2013; Landau et al., 2011; Samuels et al., 2008; Samuels et al., 2002; Seedat & Stein, 2002). There are suggestions that onset and severity of hoarding symptoms may be linked to the occurrences of traumatic or stressful life events for some (Tolin et al., 2010). One study reported that individuals with problematic hoarding, compared to controls, had greater lifetime incidence of traumatic events, such as experiencing possessions being forcibly taken away (31%), sexual assault as an adult (27%), and forced sexual activity as a child (31%) (Hartl et al., 2005).

Although hoarding symptoms often begin in the early years, individuals usually seek treatment at much older age, usually ranging from 40-50 years of age (Frost et al., 2000). Thus, hoarding symptoms often go undetected for years. A study by Grisham and colleagues (2006), suggested that this delay in identification could be related to the relatively late onset of marked functional impairment. Indeed, hoarding symptoms reach moderate levels in early-to-mid 20s and become more problematic in middle to late adulthood (Grisham et al., 2006). As a result, symptoms generally progress and worsen until they significantly impair functioning and quality of life.

1.1.4 Comorbidity of Hoarding

Hoarding symptoms often occur alongside other psychiatric disorders (Frost et al., 2011; Nordsletten et al., 2013; Wheaten & Meter, 2014). Traditionally, hoarding was characterized as a symptom of OCD, and it is estimated that 20% to 56.7% of those meeting criteria for hoarding disorder also meet criteria for OCD (Frost et al., 2014; Samuels et al., 2008; Tolin, et al., 2011). Individuals with HD and OCD are more likely to have greater severity of symptoms, poorer insight, difficulty initiating and completing tasks, and indecision (Samuels et al. 2007). In addition, the comorbidity between hoarding and OCD is often a predictor of worse outcomes. Two studies have found individuals who meet criteria for both HD and OCD, have poorer responses to treatment methods (Bloch et al., 2014; Samuels et al., 2002).

Of all psychiatric conditions, Major Depressive Disorder (MDD) appears to be the most highly comorbid with hoarding symptoms or HD (Frost et al., 2011). Hoarding is associated with significant distress and functional impairments, which may exacerbate depressive symptoms (Frost & Steketee, 2014). In a study of individuals with hoarding disorder, more than 50% also met criteria for MDD (Frost et al., 2011). Additionally, individuals with hoarding symptoms have higher rates of bipolar I (Wheaten et al., 2008) and bipolar II disorders (Fontenelle et al., 2008) compared to non-hoarding patients with OCD.

Attention Deficit/Hyperactivity Disorder (ADHD) is also highly comorbid with hoarding symptoms, with studies suggesting that 20-30% of individuals with HD also met criteria for ADHD (Frost et al., 2011; Sheppard et al., 2010). Individuals with HD experience more ADHD symptoms when compared to both healthy controls and OCD groups (Grisham et al., 2007). Two studies have specifically highlighted the relationship between inattentive symptoms in ADHD and hoarding (Hartl et al., 2005; Tolin & Villavicenio, 2011). Specifically, inattentive symptoms

were significantly higher amongst hoarding participants compared to healthy controls. Further, inattentive symptoms have been shown to significantly predict severity of clutter, as well as difficulty discarding and acquiring items (Tolin & Villavicenio, 2011).

A variety of anxiety disorders also commonly occur among those with hoarding symptoms. In a sample of individuals with hoarding, more than 50% experienced at least one comorbid anxiety disorder (Frost et al., 2011). More specifically, Generalized Anxiety Disorder (GAD) and Social Anxiety Disorder (SAD) are the most common comorbid anxiety disorders, occurring in those with hoarding symptoms compared to those without (Frost et al., 2011). Finally, rates of anxiety disorders are higher in individuals with both OCD and hoarding symptoms, compared to those with only problematic hoarding (Pertusa et al., 2008).

Hoarding symptoms may also co-occur with personality disorders. In the DSM-IV (American Psychological Association, 1994), inability to discard worthless items was included as a diagnostic criteria for Obsessive-Compulsive Personality Disorder (OCPD). In samples of individuals with hoarding, estimates of comorbid OCPD range from 45% to 56.8% (Landau et al., 2011; Samuels et al., 2002). Other personality disorders have been noted in hoarding samples, including avoidant, borderline, paranoid and schizotypal personality disorders (Frost et al., 2011; Samuels et al., 2002; Samuels et al., 2008). Overall, personality disorders are relatively common in samples of individuals with hoarding, with one study reporting that 68% of individuals with hoarding also met criteria for at least one personality disorder (Samuels et al., 2002).

Taken together, existing literature strongly suggests that hoarding symptoms often co-occur with other psychiatric conditions, making hoarding symptoms a complex clinical challenge.

1.1.5 Treatment of hoarding

Various treatments have been considered for the treatment of hoarding symptoms and HD, most commonly, Cognitive-behavioural therapy (CBT) and psychotropic medications. Hoarding-specific CBT treatment courses focus on motivational interviewing, graded exposures to non-acquiring, training in sorting and discarding, cognitive restructuring, and organizational practice (Steketee & Frost, 2007; Steketee & Frost, 2014). A meta-analysis across 12 studies investigating the efficacy of CBT treatment for hoarding symptoms, found that CBT resulted in positive pre-treatment to post-treatment effects, particularly in difficulty discarding, which is the core dimension of hoarding (Tolin et al., 2015). Although various studies have indicated the effectiveness of CBT in treating hoarding symptoms and HD, CBT-based therapy has been shown to be the most effected with an extended treatment course (Tolin et al., 2007)

The study of psychotropic medications for the treatment of hoarding symptoms has resulted in mixed findings (Brakoulias et al., 2015; Saxena, 2011). Due to the historical association of hoarding symptoms and OCD, the most commonly used psychotropic medications to treat hoarding are serotonin reuptake inhibitors (SRIs; Saxena, 2011; Saxena & Summer, 2014). In several adult studies, individuals with hoarding symptoms had worse responses to the SRI treatment (Black et al., 1998; Stein et al., 2008; Mataix-Cols et al., 1999). A study by Saxena and colleagues (2007) however, demonstrated the effectiveness of paroxetine in treating hoarding symptoms with and without comorbid OCD. Additionally, some studies have found not found any effects (positive or negative), in treating hoarding symptoms with SRIs, further demonstrating the mixed results in the literature (Erzegovesi et al., 2001; Shetti et al., 2005). Overall, both CBT and psychotropic medications have been shown to have moderate effects on treating hoarding symptoms.

It is evident that hoarding symptoms are complex and additional research is necessary to improve the efficacy of current treatment methods. Although it is clear that hoarding exists in children, presently, nearly all research has been conducted in adult samples.

1.2 Hoarding Symptoms in Youth

Although hoarding symptoms often begin during youth (Grisham et al., 2006; Kichuk et al., 2013; Landau et al., 2011; Samuels et al., 2008; Samuels et al., 2002; Seedat & Stein, 2002), there is only limited research on hoarding in this age group (Grisham et al., 2006; Morris et al., 2016). Prevalence rates of hoarding symptoms in children are similar to those in adults, with estimates ranging from 2% to 3.7% of children reporting significant hoarding symptoms (Ivanonov et al., 2013). Generally, the severity of hoarding behaviors in youth is limited by the extent to which parents and family members allow excessive acquisition and clutter in living spaces (Morris et al., 2016). As a result, hoarding symptoms during childhood and adolescence may be incorrectly identified as being less severe (Palermo et al., 2011). The negative effects that have been reported in adult samples with hoarding are also demonstrated in youth samples. Research on childhood hoarding has found that children with OCD and hoarding symptoms had reduced functioning (Ale et al., 2013; Gallo et al., 2013; Hamblin et al., 2015; Samuels et al., 2014), poorer insight (Storch et al., 2007) and more prolonged illness duration (Mataix-Cols et al., 2008). Additionally, childhood hoarding symptoms are associated with high rates of comorbid OCD, anxiety disorders, MDD and ADHD (Hacker et al., 2016; Hamblin et al., 2015; Storch et al., 2007).

Investigating hoarding in youth is essential for numerous reasons. First, understanding the onset of symptoms would provide valuable information about the etiology of hoarding in youth (Morris et al., 2016). Secondly, since hoarding symptoms are chronic (Tolin et al., 2010)

earlier identification and interventions could ameliorate severe cases of hoarding in adults. Third, as a result of hoarding symptoms, youth experience significant social, emotional and family impairments (Ale et al., 2013; Gallo et al., 2013). To date, however, very little research has focused on hoarding in youth (Morris et al., 2016). For example, few clinical trials of either CBT (Ale et al., 2013; Gallo et al., 2013) or medications (Saxena, 2011; Saxena & Summer, 2014) to treat youth with hoarding have been completed. Overall, further research on hoarding in this age group will allow for effective and developmentally appropriate interventions and treatments in youth.

1.3 Cognitive Underpinnings of Hoarding

1.3.1 Cognitive Behavioural Model of Hoarding

Prompted by the observation that individuals who hoard have extreme difficulties with discarding items, current frameworks of hoarding hypothesize an important role of cognitive processing deficits (Gilliam & Tolin, 2010; Morris et al., 2016), (Frost and Hartl, 1996). Frost and Hartl (1996) were the first to propose a cognitive-behavioural model of compulsive hoarding (Figure 1.1), describing it as a complex condition resulting from multiple cognitive factors, including: (1) information-processing and decision-making deficits; (2) erroneous beliefs about possessions; (3) behavioural avoidance; and (4) strong emotional attachment to possessions (Frost and Hartl, 1996). This framework provided initial insight into cognitive processing in hoarding, and has been continuously refined over the years to emphasize mechanisms of maintenance including information-processing deficits and maladaptive beliefs about possessions, resulting in emotional distress and avoidance behaviours (Gilliam and Tolin, 2010).

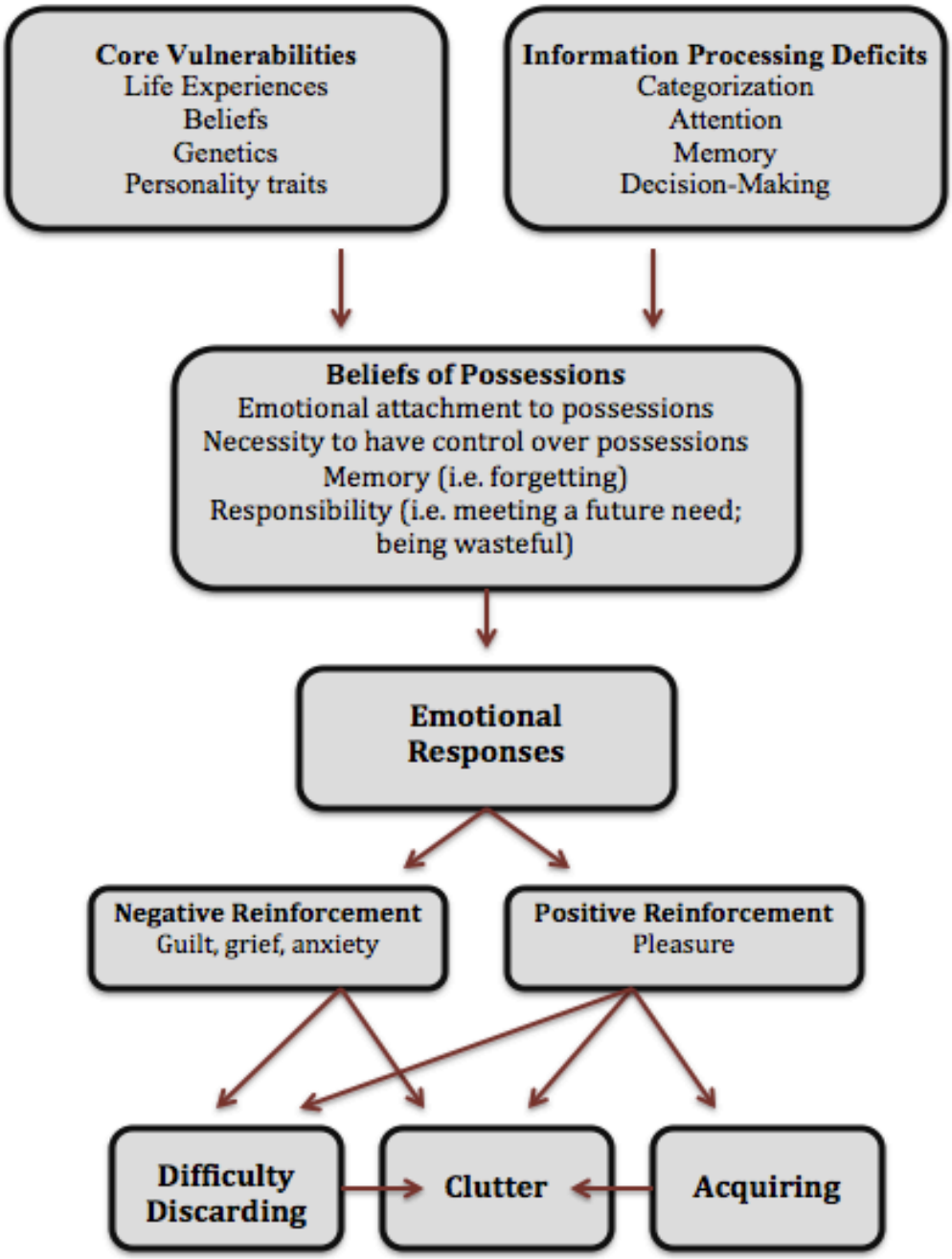

Figure 1.1 Cognitive-Behavioural Model of Hoarding (adapted from Steketee and Frost, 2007).

Specific information-processing deficits that are hypothesized to be associated with hoarding include attention, memory, categorization, decision-making and impulsivity (Frost and Hartl, 1996; Steketee and Frost, 2003). The vast majority of current research on information-

processing in hoarding has been conducted in adult samples, with little investigation into information-processing in youth who hoard. Understanding if information-processing deficits are present in youth with hoarding symptoms would provide important understanding of the etiology and course of hoarding symptoms (Morris et al., 2016). Specifically, if deficits are not present at onset, it is possible that deficits seen in adults could be a consequence, rather than the cause of, living in cluttered and disorganized environments (Morris et al., 2016). Finally, given the early onset and prevalence of hoarding in this age group, additional research is necessary to understand information-processing youth who hoard.

1.3.2 Decision-Making in Hoarding

Difficulty making decisions is considered a critical information-processing deficit of hoarding (Frost & Hartl, 1996). It has been proposed that hoarding is an avoidance behaviour related to indecisiveness (Frost & Gross, 1993). Accordingly, keeping an item may be a way to avoid decision-making about discarding an item. In line with this hypothesis, individuals who hoard might have a higher threshold for deciding what to discard (Frost & Hartl, 1996), requiring more evidence to support the decision to discard personal items. Using self-report measures of decision-making, individuals who hoard expressed greater fears about making decisions and had less positive feelings past decisions (Frost et al., 2011; Samuels et al., 2007; Tolin & Villavicencio, 2011). Additional research suggests that putative decision-making difficulties in hoarding may be associated with core executive functioning deficits (Steketee and Frost, 2013). Therefore, indecision may not be specific to hoarding situations, instead affecting many other aspects of the individual's life (Steketee & Frost, 2010; Plimpton et al., 2009).

Overall, existing literature on decision-making processes in hoarding is inconsistent. Neuropsychological investigations of decision-making are typically completed using gambling

tasks that also incorporate emotional and cognitive factors during risk-relation conditions (Woody et al., 2014). To date, the majority of studies have found no consistent differences between adults with problematic hoarding and those without (Blom et al., 2011, Grisham et al., 2007; Grisham et al., 2012;Tolin & Villavicencio, 2011). Since hoarding is associated with difficulty discarding personal possessions it is likely that decision-making deficits are not appropriately assessed through general risk-related decision-making tasks (Grisham et al., 2010). Instead, decision-making in hoarding should be assessed using ownership-based decision-making paradigms, rather than risk-related tasks.

1.3.3 Ownership-Based Decision-Making and the Endowment Effect

An alternative approach to the study of decision-making deficits in hoarding was first studied by Tolin and Colleagues, who suggested that the condition involves a specific impairment of decision-making during discarding or replacing *personally owned items* (Tolin et al. 2009, Tolin et al., 2012). Researchers assessed brain activity while participants made decision on whether to keep or destroy personal items (i.e. junk mail) and control items. Compared to controls, participants with hoarding symptoms took significantly longer to make decisions about personal items compared to control items. Additionally, participants with hoarding symptoms reported higher levels of anxiety when making decisions about their personal items compared to control items. On a neural level, participants with hoarding symptoms had abnormal activations of the anterior cingulate cortex and insula. Specifically, these regions were hyperactive when making decisions about personal items and hypoactive when making decisions about the control items. Researchers hypothesize that the abnormal activation patterns were related to problems in attributing emotional significance of items and regulating emotions during decision-making (Tolin et al. 2009, Tolin et al., 2012). This finding supports the notion that a specific decision-

making deficit exists, particularly with personally relevant possessions in hoarding, yet the underlying factors for this observed phenomenon in hoarding remain unknown.

Research suggests that cognitive decision-making processes are affected by representation of value (Blakemore & Robbins, 2012). It is plausible that impaired decision-making related to personal items in hoarding is associated with disruptions in the way individuals assign a value to, predict future utility levels of, and evaluate experienced outcomes pertaining to items as they make decisions on obtaining, keeping or discarding items (Sonuga-Barke & Fairchild, 2012). From a Behavioural Economics perspective, value-attribution is an important factor in decision-making, a process that is thought to be abnormal in those who hoard (Frost and Hartl, 1996). According to this perspective, individuals are viewed as active agents who assign value to items based on tastes and preferences and the expected utility of items (Sonuga-Barke and Fairchild, 2012).

A possible explanation for abnormal value-based appraisal of personal items in those who hoard can be found in the Endowment Effect (EE), defined as the increase in the valuation of a good or object merely because we own it (Thaler, 1980). When presented with two objects, equal in value and utility, individuals tend to attribute a higher value to the item that they personally own. Given the association between deficits in value-attribution of personal items and hoarding, it is possible that hoarding is associated with an inflated EE. Currently, many studies provide evidence for the existence of the EE in both adult and youth samples (Kahneman et al., 1990; Harbaugh et al., 2001; Morewedge & Giblin, 2009). To date, however, no study has investigated the association between EE and hoarding in adults or children.

1.3.4 Alternative Aspects of Decision-Making Processes in Hoarding: Cognitive Flexibility

Hypothesized decision-making deficits may also be associated with more general aspects of cognition such as cognitive flexibility or impulsivity (Carbonella & Timpano, 2016; Timpano et al., 2014). Cognitive flexibility refers to the ability to inhibit irrelevant material and attend flexibly between mental sets and is thought to be an important component of executive functioning (Carbonella & Timpano, 2016). Currently, the relationship between cognitive flexibility and hoarding has received little empirical attention. It is proposed that cognitive flexibility may be impaired since those who hoard experience difficulty staying on task and often get distracted by specific possessions (Carbonella & Timpano, 2016). Research has indicated that individuals with higher self-reported hoarding symptoms demonstrated greater cognitive inflexibility than those with low ratings of hoarding (Carbonella and Timpano, 2016; Lawrence et al., 2006). Conversely, other research has found that those with compulsive hoarding did not appear to have deficits in cognitive flexibility (Morein-Zamir et al., 2014). To date, cognitive flexibility has not been investigated in youth hoarding symptoms.

1.3.5 Alternative Aspects of Decision-Making Processes in Hoarding: Impulsivity

Individuals with hoarding symptoms often experience increased rates of impulsivity (Frost et al., 2011; Vickers et al., 2016). In a study of adults with compulsive hoarding, 78.3% of participants met criteria for an impulse control disorder (Frost et al., 2011). Similar to those with impulse control disorders, individuals who hoard often report experiencing pleasure or relief when engaging in acquiring or saving behaviours (Steketee and Tolin, 2011). Despite this association, the relationship between impulse control and hoarding symptoms is not well understood. Broadly, impulsivity is action without foresight (Wistanley et al., 2006). It has been reported that adult samples of hoarding and anxious individuals did not differ in self-reported impulsivity (Rasmussen et al., 2013). Conversely, other studies have reported that those with

high hoarding symptoms had higher levels of impulsiveness on self-report measures (Fitch & Cougle, 2013; Grisham et al., 2007). In another study of young adults, hoarding was associated with higher rates of impulsivity, particularly attentional and motor impulsivity, as well as urgency (Timpano et al., 2013).

Although studies have begun to recognize impulsivity in adult hoarding, more extensive research is necessary for both adult and youth hoarding populations. As discussed, decision-making is thought to be a fundamental deficit in individuals who hoard (Frost and Hartl, 1996). Research suggests that individuals with higher levels of impulsivity had significant deficits in decision-making performance compared to those with low impulsivity (Franken et al., 2008). Understanding the relationship between impulse control and decision-making would provide important insight into potential factors that influence the decision-making process in those who hoard.

Multiple cognitive constructs, including inhibitory control and delay-discounting allow for researchers to empirically examine impulsivity (Vickers et al., 2016). Inhibitory control is the ability to suppress actions that are no longer required (Aron & Poldrack, 2005; Verbruggen & Logan, 2008) and considered to be a fundamental executive function process critical in situations requiring withholding, switching or interrupting ongoing actions and thoughts (Schachar et al., 2000; Verbruggen & Logan, 2008). Research has investigated inhibitory control in adults who hoard, however, findings are inconsistent (Grisham et al., 2007; Grisham et al., 2010; Rasmussen et al., 2013). One study assessed inhibitory control by comparing adults with hoarding symptoms to those with a principal diagnosis of an anxiety disorder (Rasmussen et al., 2013). Hoarding group participants had significantly poorer inhibitory control compared to the anxious group. Conversely, other studies have found no differences in inhibitory control and risk-taking

behaviours between those with hoarding, anxiety and mood disorders and healthy controls (Grisham et al., 2007; Grisham et al., 2010). To our knowledge, no studies to date have investigated inhibitory control in youth who hoard.

Hoarding is also future-oriented; individuals who hoard often acquire and protect possessions that they think they may need later (Frost and Hartl, 1996). Delay discounting, defined as the decline in the present value of a reward the longer the delay to receive it is (Odum, 2011), is an important concept associated with impulsivity and future-orientation. Empirical paradigms of delay discounting ask participants to answer a series of options between a smaller reward received sooner or a more substantial reward with a longer delay (Steinberg et al., 2009). A study by Vickers and colleagues (2016) found that those with hoarding were less likely to discount larger delayed monetary rewards, therefore being more patient. These findings support the notion that hoarding is associated with future-orientation, however this effect was domain-specific to financial rewards but not to consumable goods (Vickers et al., 2016). Taken together, emerging research has begun to explore the relationship between hoarding and impulse control, however, much of the research is inconsistent, demonstrating the need for continued research.

1.4 Summary

Hoarding symptoms are characterized by a persistent difficulty discarding personal items, and clutter that interferes with living areas as well as significant distress and impairment in functioning. Hoarding symptoms generally have an onset during youth, highlighting the importance of studying hoarding in this age group. Although hoarding symptoms are common, the underlying mechanisms of the disorder are not well understood. The CBT model of Hoarding (Frost and Hartl, 1998) emphasizes the importance of cognitive processing in hoarding symptoms. Currently, research has highlighted the important role of information-processing

deficits in hoarding symptoms. Of these processes, evidence suggests that differences in decision-making could contribute to hoarding symptoms. To date, however, few studies have investigated decision-making processes in hoarding symptoms, leaving a significant gap in the current understanding (Grisham et al., 2006; Morris et al., 2016), with even fewer studies conducted in youth. The current study explored decision-making in youth with OCD and hoarding symptoms. Specifically, we propose that broader consideration is needed for a number of factors that influence the decision-making process in hoarding. We explored aspects of decision-making related and unrelated to personal items, the ability to make and change decisions, the ability to consider long-term versus short-term gains, and more global aspects of inhibitory control.

1.5 Current Study

The overarching aim of the present study is that decision-making processes differ between youth with OCD and hoarding symptoms compared to youth with OCD who do not have hoarding symptoms. Specifically, we asked if asked youth with OCD and hoarding symptoms differed in ownership-based decision-making compared to youth with OCD? We hypothesized that youth who hoard would exhibit differences in an ownership-based decision-making task.

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CHAPTER 2: METHODOLOGY

2.1 Participants

Fifty-two youth (n=52) were enrolled in this study. All participants were: (1) between the ages of 8 and 18 years old, (2) fluent in English, and (3) had a confirmed diagnosis of OCD by a licensed psychiatrist according to the DSM-5, as assessed by the Kiddie Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present State Interview (KSADS). Exclusion criteria included: (1) DSM-5 diagnoses of schizophrenia spectrum disorders, bipolar spectrum disorders, autism spectrum disorders, or a known diagnosis of a learning disability and (2) history of known neurological disorder. We did not exclude patients with ADHD or tic disorders due to the high rate of comorbidity with OCD (Freeman et al., 2000; Scharf et al., 2012).

Participants were recruited from the Pediatric OCD Consultation Team, at the Anxiety Treatment and Research Clinic (ATRC), St. Joseph's Healthcare Hamilton. All study participants were initially assessed by a registered Child and Adolescent Psychiatrist, (NS).

2.1.1 Choice of an OCD Sample

All participants had a primary DSM-5 diagnosis of OCD, confirmed by a registered Child and Adolescent Psychiatrist, (NS). The decision to study hoarding in a sample of youth with a primary diagnosis of OCD was made due to the known difficulty of recruiting youth solely based on hoarding symptoms. Even when present, hoarding symptoms are often not the primary reason for treatment seeking. Often, hoarding symptoms accompany other issues such as OCD, anxiety and/or ADHD (Frost et al., 2011; Nordsletten et al., 2013; Wheaten & Meter, 2014). On the other hand, the prevalence of hoarding symptoms in OCD is much higher than in the general population (20% to 56.7% of those meeting hoarding criteria also meet criteria for OCD (Frost et

al., 2011; Samuels et al., 2002; Tolin et al., 2011)), and the easy access to this group through the ATRC supported the feasibility of our recruitment approach.

2.2 Clinical Instruments

Kiddie Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present State Interview (KSADS; Kaufman et al., 1997; Kaufman et al., 2016) The KSADS is a semi-structured diagnostic interview that is based on the DSM-IV and includes updates based on changes to the DSM-5. The KSADS assesses mood disorders, anxiety disorders, psychotic behaviours, disruptive behavior and eating disorders. The KSADS is a widely used diagnostic measure in both research and clinical settings, and has been psychometrically demonstrated to have good validity and reliability (Ambrosini, 2000; Birmaher et al., 2009). The KSADS was administered by a trained clinician (NS), during an initial psychiatric assessment and consultation. Interview questions were asked, and responses from both child/adolescent and parent(s) were considered. Based on the results of the KSADS youth with a confirmed diagnosis of OCD were eligible to participate in the study. Additionally, the KSADS was used to assess comorbid conditions within the sample.

Children's Yale-Brown Obsessive-Compulsive Scale (CY-BOCS; Goodman et al., 1991) is a semi-structured interview and checklist designed to rate obsessive and compulsive symptom severity during the preceding week. Specifically, a total of ten items assess time spent, distress, resistance, interference, and degree of control for obsessions and compulsions. Responses are recorded on a five-point Likert scale, including none, mild, moderate, severe and extreme. Summing the five relevant items derives obsession and compulsion severity scores; a total score is derived by summing all ten scale items. The psychometric properties of the CY-BOCS have

been well-researched and have demonstrated good validity and reliability (Storch et al., 2004; Storch et al., 2006). The CY-BOCS was administered by a trained clinician to both child/adolescent and parent(s). Higher scores on the CY-BOCS indicate worse obsessive and compulsive symptoms. In the current study obsessive, compulsive and total scores on the CY-BOCS were compared between hoarding and non-hoarding groups.

Children's Saving Inventory-Parent Version (CSI; Storch et al., 2011) is a parent-rated clinical scale of the presence and severity of hoarding symptoms in youth. The CSI is based on the Saving Inventory-Revised (SI-R; Frost et al., 2004), a well-established self-report clinical rating scale designed to assess hoarding symptomatology in adults. The SI-R has demonstrated to have good psychometric properties (Frost et al., 2008; Hayward & Coles, 2009). The CSI contains 20 questions designed to measure a child/adolescents' hoarding symptoms, including Difficulty Discarding, Clutter, Excessive Acquisition, and Distress/Impairment (Frost et al., 2004; Storch et al., 2011). Parent(s) were asked to indicate how much each statement coincides with their child in the past week. Responses were based on a 5-point Likert scale; choices include none, a little/minimal, some/moderate, most/much, almost all/completely. Higher scores on the CSI are indicative of more severe hoarding symptoms. The CSI has been shown to be a reliable and valid measure of hoarding symptoms in children and adolescents (Storch et al., 2011).

For the purposes of this study, participants were divided into groups according to CSI score. Specifically, the highest scoring 33.3% were classified as the "Hoarding Group" and the lowest scoring 66.7% were classified as the "Non-hoarding Group". Each participant's CSI score was calculated based on 15 items (CSI-15; Soreni et al., 2018) involving difficulty discarding, clutter, and distress/impairment. Unlike the original, 20-item CSI, the CSI-15 adheres to DSM-5's HD criteria by excluding all questions that pertain to excessive acquisition (excessive

acquisition is not a diagnostic criterion in the DSM-5 for HD, instead it is a specifier (American Psychological Association, 2013). The CSI-15 has demonstrated good reliability and validity for use in a youth sample (Soreni et al., 2018).

Children's Depression Inventory (CDI; Kovacs, 1983) is a self-report questionnaire used to assess presence and severity of depressive symptoms in youth. The CDI contains 27-items that ask the child to indicate one of the three descriptions of feelings and behaviours over the past week, resulting in the following sub-scales: negative mood, personal problems, ineffectiveness, anhedonia and negative self-esteem. Higher scores on the CDI indicate the presence of greater depressive symptoms. This measure has been extensively used and has demonstrated to be a reliable and valid measure (Saylor et al., 1984). In the current study, the CDI was completed by the child/adolescent prior to psychiatric consultation. We used the total raw score of the CDI to measure the presence and severity of depressive symptoms in our sample.

***Conners 3rd Edition – Parent Form (Conners 3*;** Conners, 2008) is a parent-rated clinical rating scale that assesses symptoms of attention deficit/hyperactivity disorder (ADHD) and related issues in children ages 6-18 years old (Conners, 2008). The Conners 3 includes 27 items that generate the following subscales: inattention and hyperactivity and related concerns with executive functioning, learning, aggression, and peer-family relations (Conners, 2008). The Conners 3 is a reliable measure that is widely used and validated in youth samples (Morales-Hidalgo et al., 2017). For the purpose of this study, parent(s) completed the form prior to psychiatric consultation. Overall scores and subscale scores for inattention and hyperactivity/impulsivity on the Conners 3 were used to investigate the relationship between OCD, hoarding and ADHD symptoms in the study sample.

2.3 Decision-Making Cognitive Measures

Endowment Task (Harbaugh et al., 2001; Knetsch, 1989) the EE was studied using a trading paradigm, which has been previously used in children and young adults and published by Harbaugh et al. (2001). Participants are told "we are going to play a game that involves trading items, make sure to listen carefully so you end up with the items that you want". Participants are then given one item and told, "This is yours; it belongs to you now", doing this *endows* them with that item. Participants are then given ten seconds to examine the item. Next, participants are shown a second item and asked, "You could keep your item that I just gave you, or do you want to trade me for my item?". This provides them with an opportunity to trade the item that they are endowed with for another similar item. The participants choose to either keep the item they were endowed with or to trade it for the other item. This procedure is completed for two trials, with participants being given a single opportunity to trade the endowed items for neutral items in each trial. The items included various toys and school items (highlighter, sticky notes, notebook, cards etc.) and were chosen based on previous research (Harbaugh et al., 2001), as they are both familiar, and appeal to both boys and girls. Further, the items in each pair were roughly of equivalent utility and monetary value. The order in which items were endowed to participants was randomized.

The primary outcome measure of the EE is the Endowment Boost (EB), which refers to the average across two items of increasing the chances an individual will select an object when endowed with it, relative to being endowed with the other object (Harbaugh et al., 2001). The EB is equal to½ pA|A/pA|B + ½ pB|B/pB|A, where pA|B denotes the probability of selecting object A when endowed with object B (Harbaugh et al., 2001). Generally speaking, the EE is observed if the EB is measured as greater than 1; that is, the probability that a subject chooses "item A" is

higher if they were initially endowed with item A than if they were endowed with "item B". A second measure of the EE was calculated, called Willingness to Trade (WTT). WTT refers to the number of times the participant traded away their endowed item for the neutral item on the three trading opportunities; WTT can equal zero to two. Both the EB and WTT will be used as indicators of the EE between hoarding and non-hoarding groups.

Balloon Analogue Risk Task (BART; Lejuez et al., 2002) is a child-friendly computerized task designed to measure risky decision-making. Participants are shown a computer-simulated balloon and a balloon pump, and then instructed that they would earn 5 cents for every pump that does not result in the balloon exploding. Participants are told that the balloon could explode at any time after the trial begins, which would result in a loss of all money earned for the given trial. Participants are then given the option to stop inflating a balloon at any time to bank the money they earned on that trial in the 'total earned box' and move on to the next balloon. The task consists of 30 trials and usually takes between 10-20 minutes.

Performance on the BART has been correlated with self-reported real-world risk taking behaviours and has been validated in youth samples (Lejuez et al., 2002; Lejuez et al., 2003). Additionally, scores on the BART correlate with measures of sensation-seeking, impulsivity and lack of behavioural control (Lejuez et al., 2002). One study has used the BART to assess impulsivity in an adult hoarding sample (Rasmussen et al., 2013). To date, however, no study has used the BART to investigate risk-related decision-making abilities in a youth hoarding sample. In the current study, scores on the BART were used to examine if risk-related decision-making performance differed between hoarding and non-hoarding groups. The primary BART outcome measure is "average adjusted number of pumps across" (Lejuez et al., 2003). This adjusted value refers to the average number of pumps across balloons, excluding the popped balloons.

Wisconsin Card Sorting Test (WCST; Grant & Berg, 1948; Heaton et al., 1993) was chosen as a measure of cognitive flexibility. The WCST is a card exercise that tests one's ability to respond to a changing pattern of reinforcement (Grant & Berg, 1948). The participant is asked to categorize a pack of cards into several groups, but is not told how to categorize the cards; they are only told whether their categorization choice is "right" or "wrong". Once the participant has made 10 correct classifications, (reinforcing trials), the experimenter changes the "correct" sorting category, unbeknownst to the participant (Grant & Berg. 1948). Therefore, the participant must shift to a different set of responses in order to obtain reinforcement. Cognitive flexibility is displayed by the ease with which the WCST participant is able to switch from one set of responses to a different set of responses.

Participants' performance was scored via computer against normative performance data. WCST normative data was taken from a sample of 899 normal participants from 6 distinct samples in the US, and categorized into age-related groups (Heaton et al., 1993). The WCST has been used and validated as a measure of cognitive flexibility and executive functioning in youth (Romine et al., 2003). Currently, relevant outcome measures used were total errors (an index of executive function) perseverative and non-perseverative errors (an index of cognitive flexibility and self-monitoring; Grant & Berg, 1984; Taha, 2017). We tested whether children with hoarding symptoms differed from children with OCD-only in cognitive flexibility as measured by the WCST.

Stop Signal Task (SST*;* Logan & Cowan, 1984): is a widely used computerized measure of inhibitory control. In the SST, participants learn to respond to a stimulus (go-trials). On a subset of these trials, an auditory stop-signal that is played shortly after the go-stimulus will indicate that participants should withhold their response (stop-trials). The delay between the stop and go

stimulus is adjusted according to performance so that on average participants will be unable to successfully inhibit a response on 50% of the trials. The primary outcome measure of the SST is the stop-signal reaction time (SSRT) (i.e., the time required for the stop signal to be processed; Ornstein et al., 2010). Using the SSRT, we examined whether there is a difference in inhibitory control between hoarding and non-hoarding groups.

Monetary Choice Questionnaire (MCQ; Steinberg et al., 2009): is a measure of delay discounting, which is widely used in the evaluation of individuals' preference for future versus immediate outcomes (Steinberg et al., 2009). This measure was included because hoarding has been shown to be associated with poor impulse control and higher comorbidity with Impulse Control Disorders (Hayward & Coles, 2009). The participant is asked to choose between an immediate reward of less value (e.g.., $50 today) and a variety of delayed rewards of more value (e.g., $100, in 60 days). The primary MCQ outcome measure is the Overall K value, which is the rate of discounting calculated per participant (Gray et al. 2016), reflecting the.extent to which participants favor the delayed and more valuable reward over the immediate but less valuable reward. The higher one's Overall K value is, the more they discount larger future rewards (Gray et al. 2016). In the current study, we investigated whether the presence hoarding in a sample of youth with OCD will be associated with differences in delay discounting as measured by MCQ's overall K value.

2.4 Study Procedure

Prior to the start of the study, studies procedures have been approved by the the Hamilton Integrated Research Ethics Board. Youth that met eligibility criteria were presented with study details by referring clinician (NS), in the presence of their parent. Interested patients were asked

to complete a consent to contact form and were subsequently contacted by myself to explain further study details and to book an appointment for a study session. Enrolled participants were invited to the ATRC at St. Joseph's Healthcare Hamilton, West 5th Campus. Here, I met with participants and parent(s) to explain the purposes of the study and complete assent and consent forms, according to the Hamilton Integrated Research Ethics Board protocols. Then, parent(s) were shown to an assessment room, where they completed a questionnaire about their son or daughter and waited for the duration of the study session.

Participants were seen in a clinical assessment room, which had a table and two chairs, along with two computers and assessment materials (i.e., questionnaires, stimulus books). The door and blinds were closed to eliminate potential distractions. Study sessions took a total of 2.5 hours, excluding breaks, which were offered to the participant at their discretion. Before the study session, the participants did not know the tasks and assessments that would be completed. At the tine of the study visit, participants' group status (hoarding vs. non-hoarding) was blinded. The child/adolescent completed the study tasks under my instruction. Following completion, participants and their parent(s) were thanked for their participation.

2.5 Data Analysis

Statistical analyses were completed using IBM SPSS Statistics 23 (IBM Corp., 2015). Sample characteristics were first calculated to obtain sample demographic information. Next, CSI-15 total scores were calculated by summing scores of Discarding, Clutter, and Distress/Impairment dimensions for each participant. Using the CSI-15 total score, two groups were created in the sample. Specifically, those scoring in the highest third on CSI-15 total score were placed in the Hoarding Group (i.e., highest scoring 33.3%) and those in the lowest scoring third on CSI-15 total score were placed in the Non-Hoarding Group (i.e., lowest scoring 66.7%).

Fisher's Exact tests were used to compare the prevalence of medication use and clinical comorbidities in the hoarding and non-hoarding groups. Demographic variables, as well as relevant variables from clinical (CYBOCS, CDI, CSI-15, Conners 3) and cognitive measures (BART, WCST, SST, MCQ) were tested for normality using Shapiro-Wilk tests. Independent samples t-tests were completed for variables meeting assumptions of normality, comparing hoarding and non-hoarding groups. Variables that did not meet assumptions of normality were analyzed using non-parametric Mann-Whitney U tests, to compare hoarding and non-hoarding groups. Fisher's Exact tests were used to analyze the EE between hoarding and non-hoarding groups. Finally, multiple linear regression analysis was completed to investigate the relationship between hoarding severity and clinical or cognitive variables that were found to differentiate hoarding from non-hoarding participants.

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CHAPTER 3: RESULTS

3.1 Sample Demographics

Fifty-two youth (n=52, 26 females and 26 males), ranging from 8 to 18 years old completed the study. All participants had a confirmed primary diagnosis of DSM-5 OCD, as assessed by the KSADS. The mean (SD) age of the sample was 13.14 (2.76) years. The sample was divided according to hoarding severity on the CSI-15. Hoarding (n=18) and non-hoarding (n=34) groups characteristics are summarized in Table 3.1. The two groups did not significantly differ in male to female ratio (p = 0.667) or in the use of psychotropic medications (p = 0.161).

Table 3.1.
Demographic and clinical variables of the study groups.

Variable	Hoarding Group (n=18)	Non-Hoarding Group (n=34)	Sig.
Mean Age (*SD*)	13.22 (3.30)	13.03 (2.46)	0.829
Gender			
Female (%)	10 (55.56%)	16 (47.06%)	0.386
Male (%)	8 (44.44%)	18 (52.94%)	0.386
Medication Status			
Yes (%)	7 (38.89%)	16 (47.06%)	0.395
No (%)	11 (61.11%)	18 (52.94%)	0.395

3.2 Clinical Comorbidities

Clinical comorbidities are summarized in Table 3.2. Fisher's exact test revealed that the hoarding group had significantly more cases of comorbid ADHD (p=0.001), compared to the non-hoarding group. Additional Fisher's exact tests found no significant differences between the

two groups in the occurrence of GAD (p=0.562), SAD (p=1.000), Separation Anxiety (0.682), Panic Disorder (p=0.405), ODD (p=0.166), Tic Disorder (p=0.727) or MDD (p=0.114).

Table 3.2.
Current clinical comorbidities according to the KSADS.

Variable	Hoarding Group (n=18)	Non-Hoarding Group (n=34)	Sig.
ADHD	11 (61.11%)	5 (14.71%)	**0.001***
GAD	10 (55.56%)	15 (44.12%)	0.562
SAD	5 (27.78%)	10 (29.41%)	1.00
Separation Anxiety	3 (17.65%)	4 (11.76%)	0.682
Panic Disorder	3 (17.65%)	3 (8.82%)	0.405
ODD	4 (22.22%)	2 (5.88%)	0.166
Tic Disorder	3 (16.67%)	8 (23.53%)	0.727
MDD	3 (16.67%)	1 (0.00%)	0.114

Note. KSADS = Kiddie Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present State Interview; ADHD = Attention Deficit/Hyperactivity Disorder; GAD = Generalized Anxiety Disorder; SAD = Social Anxiety Disorder; ODD = Oppositional Defiant Disorder; MDD = Major Depressive Disorder

3.3 Clinical Measures

Mean group scores for clinical measures are summarized in Table 3.3 and Table 3.4. Independent samples t-test revealed no significant differences in obsessive, compulsive and total scores on the CY-BOCS according to hoarding symptom severity. Additionally, participant groups did not significantly differ on overall scores on the CDI. The hoarding group exhibited significantly higher scores on all CSI-15 dimensions (Figure 3.2). Specifically, hoarding group scores on difficulty discarding [U=5.50, p<0.001], clutter [U=38.00, p<0.001], distress

[U=95.50, p<0.001] and total scores [U=0.00, p<0.001] were significantly higher than the non-hoarding group. Group differences also emerged on the Conners 3 (Figure 3.3). Specifically, the hoarding group scored significantly higher on dimensions of inattention [U=181.50, p=0.016], learning problems [U=169.50, p=0.008], executive function [U=142.50, p=0.002] and peer relations [U=199.00, p=0.029], but not hyperactivity/impulsivity (p=0.513).

Table 3.3.

Mean and standard deviation scores of the CYBOCS and CDI.

Variable	Hoarding Mean (SD) (n = 18)	Non-Hoarding Mean (SD) (n = 34)	Mean Difference	t(df)	Sig.
CYBOCS					
Obsessions	12.44 (3.45)	10.82 (3.70)	-1.62	-1.57(37)	0.125
Compulsions	11.50 (4.50)	11.97 (3.51)	0.47	0.42(50)	0.679
CYBOCS Total	23.94 (7.52)	22.88 (7.08)	-1.06	-0.50(50)	0.617
CDI					
CDI Total	12.67 (7.12)	11.59 (9.21)	-1.08	-0.43(50)	0.667

Note. CYBOCS = Children's Yale-Brown Obsessive-Compulsive Scale; CDI = Child Depression Inventory

Table 3.4.

Mean and standard deviation scores of the CSI-15 and Conners 3.

Variable	Hoarding Mean (SD) (n = 18)	Non-Hoarding Mean (SD) (n = 34)	Z	U value	Sig.
CSI-15					
Difficulty Discarding	19.28 (5.91)	4.27 (3.60)	-5.80	5.50	**< 0.001***
Clutter	7.56 (3.48)	1.97 (1.36)	-5.21	38.00	**< 0.001***

Distress	2.23(1.71)	0.12 (0.41)	-4.96	95.50	**< 0.001***
CSI-15 Total	29.11 (8.90)	6.38 (4.49)	-5.89	0.00	**< 0.001***
Conners 3					
Inattention	6.50 (3.75)	3.85 (3.82)	-2.41	181.50	**0.016***
Hyperactivity	3.17 (2.81)	2.56 (2.46)	-0.66	181.50	0.513
Learning Problems	4.33 (3.53)	2.38 (3.53)	-2.67	169.50	**0.008***
Executive Function	6.50 (3.75)	3.21 (2.89)	-3.17	142.50	**0.002***
Peer Relations	2.44 (3.23)	1.00 (1.50)	-2.18	199.00	**0.029***

Note. CSI-15 = Child Saving Inventory-15 items

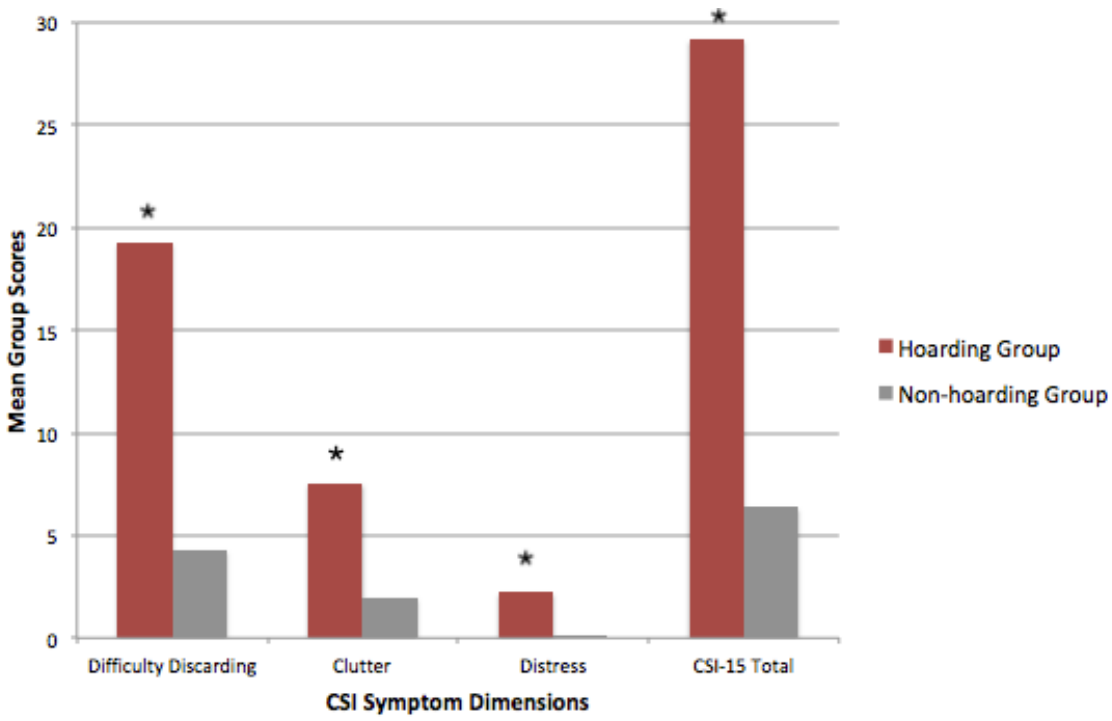

Figure 3.2. Comparison of hoarding symptoms dimensions on the CSI-15 according to hoarding group.

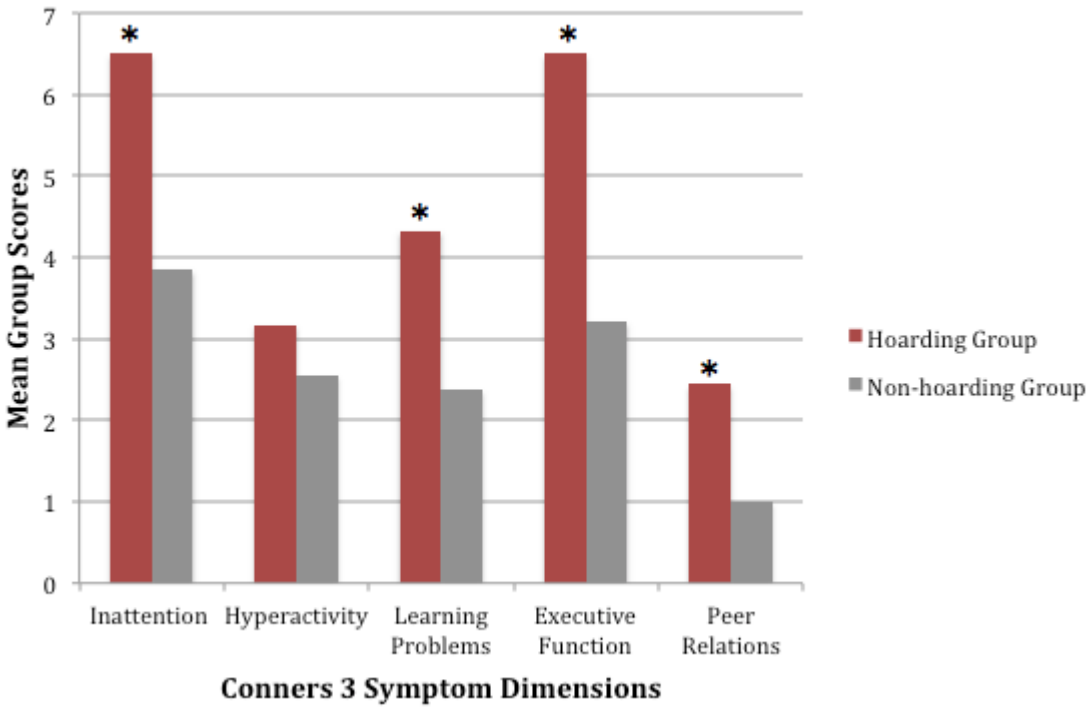

Figure 3.3. Comparison of ADHD symptoms dimensions on the Conners 3 according to hoarding group.

3.4 Endowment Task

Performance on the Endowment Task is summarized in Tables 3.5 to 3.11. The rows indicate the good (item) the youth was endowed with and the columns are which good they chose. Overall, there were no significant EB and trading differences between hoarding and non-hoarding groups. We analyzed the endowment boost across the entire sample for both item pairings. Fisher's exact test rejected the null hypothesis of no endowment effect on both Pair 1 ($p=0.012$; Table 3.5) and Pair 2 ($p=0.050$; Table 3.6). These results suggest a significant EB throughout the entire sample. Moreover, analysis revealed a nearly significant endowment boost ($p=0.054$) in the hoarding group on Pair 1 (Table 3.5). Specifically, hoarding participants were 2 times more likely to choose the good they were endowed with than the good they were not. In comparison, participants in the non-hoarding group were only 0.5 times more likely to choose

the good they were endowed with than the good they were not. On Pair 2 of the EE task the EB did not significantly differ (p=0.347), thererefore, there was no significant preference for the endowed item. The same pattern was seen, however, such that the hoarding group had a higher EB (EB=2.02) compared to the non-hoarding group (EB=0.84). Finally, no significant between groups differences emerged in WTT on a Fisher's Exact test (p=0.723), indicating that the hoarding groups did not vary in how willing they were to trade away the endowed item (Table 3.11).

Table 3.5

Endowment Task Choices (Pair 1) for full sample (n=52)

	Item Kept			Total
		C	D	
Item Endowed	C	19 ($P_{C\|C}$=(0.70)	8 ($P_{D\|C}$=(0.30)	27
	D	8 ($P_{C\|D}$=(0.32)	17 ($P_{D\|D}$=(0.68)	25
Total				52

Endowment Boost: 1.43

P-value of hypothesis of no endowment effect: 0.012

Table 3.6

Endowment Task Choices (Pair 2) for full sample (n=52)

	Item Kept			Total
		E	F	
Item Endowed	E	16 ($P_{E\|E}$=(0.67)	8 ($P_{F\|E}$=(0.33)	24
	F	9 ($P_{E\|F}$=(0.33)	19 ($P_{F\|F}$=(0.67)	27
Total				52

Endowment Boost: 1.10

P-value of hypothesis of no endowment effect: 0.050

Table 3.7

Endowment Task Choices (Pair 1) for Hoarding group (n=18)

	Item Kept			Total
		C	D	
Item Endowed	C	8 ($P_{C\|C}$=(0.80)	2 ($P_{D\|C}$=(0.20)	10
	D	2 ($P_{C\|D}$=(0.25)	6 ($P_{D\|D}$=(0.75)	8
Total				18

Endowment Boost: 2.02

P-value of hypothesis of no endowment effect: 0.054

Table 3.8

Endowment Task Choices (Pair 1) for Non-hoarding group (n=18)

	Item Kept			Total
		C	D	
Item Endowed	C	11 ($P_{C\|C}$=(0.65)	6 ($P_{D\|C}$=(0.35)	17
	D	6 ($P_{C\|D}$=(0.35)	11 ($P_{D\|D}$=(0.65)	17
Total				34

Endowment Boost: 0.52

P-value of hypothesis of no endowment effect: 0.169

Table 3.9

Endowment Task Choices (Pair 2) for Hoarding group (n=18)

	Item Kept			Total
		E	F	
Item Endowed	E	7 ($P_{E\|E}$=(0.70)	3 ($P_{F\|E}$=(0.30)	10
	F	2 ($P_{E\|F}$=(0.25)	6 ($P_{F\|F}$=(0.75)	8
Total				18

Endowment Boost: 2.01

P-value of hypothesis of no endowment effect: 0.347

Table 3.10

Endowment Task Choices (Pair 2) for Non-hoarding group (n=34)

	Item Kept			Total
		E	F	
Item Endowed	E	9 ($P_{E\|E}$=(0.64)	5 ($P_{F\|E}$=(0.36)	14
	F	7 ($P_{E\|F}$=(0.35)	13 ($P_{F\|F}$=(0.65)	20
Total				34

Endowment Boost: 0.84

P-Value of hypothesis of no endowment effect: 0.163

Table 3.11.

Willingness to Trade by hoarding group

Number of Trades	**Hoarding Group (n=18)**	**Non-Hoarding Group (n=34)**
0	10 (55.56%)	15 (44.12%)
1	7 (38.89%)	15 (44.12%)
2	1 (5.55%)	4 (11.76%)

3.5 Cognitive Measures

Participants' performance on neuropsychological tests is summarized in Table 3.12 and Table 3.13. Shapiro-Wilk tests indicated that performance scores on the BART and the WCST did not meet the assumption of normality, therefore Mann-Whitney U tests were used. No significant differences in performance emerged on the BART between hoarding and non-hoarding groups. In contrast, we observed significant differences in performance on the WCST between hoarding and non-hoarding groups. More specifically, the hoarding group made significantly less perseverative errors, t(50)=3.00, p=0.004, non-perseverative errors, t(50)=2.51,

p=0.015, and total errors, t(50)=3.32, p=0.002 than the non-hoarding group. No significant differences in performance emerged on the BART between hoarding groups. Scores on the SST and MCQ met the assumption of normality. Independent samples t-test revealed no significant differences in performance on the SST and MCQ according to hoarding symptom severity.

Pearson Correlation results are summarized in Table 3.14. Analysis revealed a significant negative correlation between hoarding severity and Total Errors on the WCST, r=-0.351, p=0.005. Performance on the BART, SST and MCQ were not significantly correlated with hoarding severity. Additionally, scores on the SST (SSRT) and MCQ (log overall K) were significantly correlated r=0.227, p=0.047.

Table 3.12.
Mean and standard deviation scores on the WCST and the BART.

Variable	Hoarding Mean (SD) (n = 18)	Non-Hoarding Mean (SD) (n = 34)	Z	Mann Whitney U	Sig.
BART					
Average Pumps Adjusted Total	25.96 (14.53)	27.91 (13.43)	-0.75	267.00	0.453
WCST					
Total Errors	11.29 (4.18)	14.65 (8.17)	-2.57	172.50	**0.010***
Perseverative Errors	6.00 (2.76)	8.59 (4.12)	-2.52	176.00	**0.012**
Non-perseverative Errors	5.17 (2.83)	7.94 (5.15)	-2.07	199.00	**0.039***

Note. WCST = Wisconsin Card Sorting Task; BART = Balloon Analogue Risk Task

Table 3.13.
Mean and standard deviation scores on the SST and the MCQ.

Variable	Hoarding Group (n= 18)	Non-Hoarding Group (n= 34)	Mean Difference	t(df)	Sig.
SST					
SSRT	345.57 (172.92)	348.97 (174.41)	3.39	0.067(50)	0.947
MCQ					
Log Overall K	-4.47 (1.73)	-4.73 (1.72)	0.26	0.523(50)	0.603

Note. MCQ = Monetary Choice Questionnaire; SST = Stop Signal Task; SSRT = Stop Signal Reaction Time

Table 3.14.

Correlation values for hoarding severity (CSI-15 total) and cognitive tasks

Variable	CSI-15 Total	Total Errors (WCST)	WTT	Pumps Adjusted Average (BART)	Log Overall K (MCQ)	SSRT (SST)
CSI-15 Total	r=1 n=52	r =-0.351 **p =0.011*** n =52	r =-0.052 p =0.714 n =52	r =0.069 p =0.625 n =52	r =0.021 p =0.883 n =52	r =0.048 p =0.736 n =52
Total Errors (WCST)	r =-0.351 **p =0.011*** n =52	r =1 n =52	r =0.067 p =0.638 n =52	r =0.055 p =0.697 n =52	r =-0.023 p =0.874 n =52	r =0.097 p =0.495 n =52
WTT	r =-0.052 p =0.714 n =52	r =0.067 p =0.638 n =52	r =1 n =52	r =0.020 p =0.888 n =52	r =-0.139 p =0.327 n =52	r =-0.165 p =0.242 n =52
Pumps Adjusted Average (BART)	r =0.069 p =0.625 n =52	r =0.055 p =0.697 n =52	r =0.020 p =0.888 n =52	r =1 n =52	r =-0.073 p =0.609 n =52	r =0.114 p =0.420 n =52
Log Overall K (MCQ)	r =0.021 p =0.883 n =52	r =-0.023 p =0.874 n =52	r =-0.139 p =0.327 n =52	r =-0.073 p =0.609 n =52	r =1 n =52	r =0.227 **p =0.047*** n =52
SSRT (SST)	r =0.048 p =0.736 n =52	r =0.097 p =0.495 n =52	r =-0.165 p =0.242 n =52	r =0.114 p =0.420 n =52	r =0.227 **p =0.047*** n =52	r =1 n =52

Note. CSI-15 = Child Saving Inventory-15 items; WCST = Wisconsin Card Sorting Task; WTT=Willingness to Trade; BART= Balloon Analogue Risk Task; MCQ = Monetary Choice Questionnaire; SST = Stop Signal Task; SSRT = Stop Signal Reaction Time

3.6 The association between hoarding severity, inattention and WCST performance

Two multiple regression analyses were completed to examine the relationship between hoarding severity, inattention and WCST performance. The first multiple regression analysis examined hoarding severity and the contributions of symptoms of inattention and total errors on the WCST. Regression results are summarized in Table 3.8 and Table 3.9. The results of the regression indicated that the model explained 27.1% of the variance and that the model was a significant predictor of hoarding severity, [F(2,49)=9.11, p<0.001], R^2= 0.271. Symptoms of inattention (β = 0.387, p=0.003) and total errors on the WCST (β = -0.315, p=0.013) both significantly contributed to the model. Further, perseverative errors (p=0.211) and non-perseverative errors (p=0.959) did not significantly contribute to the model. A secondary multiple regression analysis was completed to explore total errors on the WCST and the contributions of hoarding severity and inattentive symptoms. The results of the regression indicated that the model explained 12.6% of the variance and that the model was a significant predictor of hoarding severity, [F(2,49)=3.54, p=0.37], R^2= 0.126. Hoarding severity (β = -0.377, p=0.013) significantly contributed to the model, however symptoms of Inattention (β = 0.436, p=0.665) did not.

Table 3.15

Regression coefficients with Hoarding Severity

Coefficient	B	Standard Error	β	t	Sig.
Inattention	1.182	0.375	0.387	3.156	0.003
Total Errors	-0.524	0.204	-0.315	-2.569	0.013
Perseverative Errors	-0.507	0.399	-0.304	-1.269	0.211
Non-perseverative	-0.038	0.744	-0.012	-0.520	0.959

Errors					

Table 3.16

Regression Coefficients with WCST Performance (Total Errors)

Coefficient	B	Standard Error	β	t	Sig.
CSI-15 total	-0.226	0.088	-0.377	-2.569	0.013
Inattention total	0.118	0.270	-0.315	0.436	0.665

Note. CSI-15 = Children's Saving Inventory – 15

Chapter 4: DISCUSSION

Chapter 4.1 Study Findings and Implications

The present study was the first to investigate aspects of decision-making in youth with OCD and hoarding. More specifically, we examined the relationship between ownership, cognitive flexibility, impulse control and hoarding symptoms in youth with OCD. Overall, we hypothesized that ownership related decision-making would differ between youth with OCD and hoarding symptoms compared to youth with only OCD. Contrary to our hypothesis, youth in the hoarding group did not significantly differ from youth in the non-hoarding group on the ownership-based (endowment) decision-making task. Youth with OCD and hoarding symptoms did not differ in risk-related decision-making. Group differences emerged in cognitive flexibility. Specifically, the hoarding group performed significantly better than the non-hoarding group, indicating increased cognitive flexibility. Finally, there were no significant differences on impulse control measures (inhibitory control and delay discounting) between hoarding and non-hoarding participants.

The focus of the present study was on decision-making processes, particularly those that may involve personal items, and hoarding symptoms in youth. Research suggests that individuals with hoarding symptoms have impaired decision-making, particularly when they concern personal items. (Tolin et al., 2009; Tolin et al., 2012). Although this finding is thought to reflect a key deficit in hoarding that results in the inability to discard unneeded possessions, the processes underlying difficulty discarding remain unclear.

We explored the specific influence of ownership on the decision-making process through the use of an endowment trading paradigm. The Endowment Effect (EE) refers to the increase in the valuation of a good or object merely because we own it (Thaler, 1980). When presented with

two objects, equal in value and utility, individuals tend to attribute a higher value to the item that they personally own. This phenomenon highlights the influence of ownership, particularly when determining value or making decisions about personally owned items. We suggested that hoarding symptoms would be associated with a more pronounced EE. Although the EE has been demonstrated in healthy adult and youth populations (Kahneman et al., 1990; Harbaugh et al., 2001; Morewedge & Giblin, 2009), the present study is the first to apply the EE to a youth hoarding sample.

In our study, hoarding participants were 2 times more likely to choose the good they were endowed with rather than the good they were not (overall EB=2.01). In comparison, participants in the non-hoarding group were only 0.68 times more likely to choose the good they were endowed with compared to the good they were not (overall EB=0.68). However, no statistically significant differences emerged between groups on either of the trading pairs on the endowment task. Interestingly, a trend in the data was identified with a nearly significant endowment boost in the hoarding group on Pair 1 (Table 3.7). These results, though not significant, indicate that the hoarding group was less likely to choose items at random and showed a preference for the endowed item, selecting the endowed item 80% of the time in Pair 1. Given the small sample size of the hoarding group (n=18), we propose that our current sample was probably underpowered to detect significant between-groups EE.

We hypothesized that the EE is more pronounced in those who hoard and plays a role in exacerbating difficulty discarding. The EE is demonstrated when the EB is greater than 1 (Harbaugh et al., 2001). Harbaugh and Colleagues (2001) investigated the EB in an American youth sample and found an overall EB of approximately 2.43 in a similar trading paradigm. Meaning, children were on average 2.43 times more likely to select the item they were endowed

with relative to the non-endowed item. In the present study, the overall EB values for the entire sample, hoarding and non-hoarding groups were 1.27, 2.01, and 0.68, respectively. Thus, the presence of the EE was detected in the whole sample and the hoarding group, but not in the non-hoarding group. This indicates that, contrary to findings in the general population, OCD-only participants did not show a particular preference for endowed items, whereas the hoarding group did. This difference in the EB between hoarding and non-hoarding groups is hard to interpret. It is unclear whether this difference in EB was as a result of hoarding symptoms increasing the EB in the hoarding group, or if the decreased EB in the non-hoarding group was due to underlying features of an OCD population (i.e., lower than normal tendency to prefer endowed items in OCD). Thus, future studies will need to include larger sample size, and focus on groups selected primarily based on the presence of hoarding symptoms.

Next, we did not find any performance differences in a risk-related decision-making task between youth with OCD and hoarding symptoms and those who do not hoard. These tasks involve decision-making while incorporating emotional and cognitive information (Woody et al., 2014). Although differences in decision-making are hypothesized to play a central role in hoarding symptoms, many empirical investigations have found no deficits in decision-making on risk-related decision-making tasks between adults with problematic hoarding and those without (Blom et al., 2011, Grisham et al., 2007; Tolin & Villavicencio, 2011). Additionally, a study by Rasmussen and colleagues (2013) found no differences in performance on the BART between groups of individuals with either hoarding or anxiety disorders. Much of the literature suggests, however, that decision-making deficits are specific to personally owned objects, which likely are not detected by gambling-based tasks (Grisham et al., 2010). Our study, to date, is the first to assess risk-related decision making in youth hoarding sample. Analysis revealed no significant

differences between the hoarding and non-hoarding groups, suggesting that our findings in youth are consistent with existing literature in adults. Therefore, it is possible that risk-related decision-making paradigms do not adequately assess decision-making deficits in hoarding. Additionally, our results suggest that differences in ownership-based decision-making were not explained by deficits in overall decision-making. Our findings are consistent with the notion that deficits in decision-making in hoarding are specific to personally owned items.

Our analysis indicated that youth with OCD who hoard differed from youth with OCD in cognitive flexibility. Specifically, participants in the hoarding group showed higher cognitive flexibility (ability to change cognitive strategies) and fewer perseveration errors (i.e., using "old" rules after a rule-shift) on the WCST. The hoarding group made significantly fewer total errors and perseverative errors compared to the non-hoarding group. According to age-matched normative data (Heaton et al., 1993), the hoarding groups' performance was quite superior. Specifically, the group scored in the 81st and 83rd percentiles for total and perseverative errors, respectively. Indicating that they performed more accurately on this task than 81-83% of the age-matched sample. Comparatively, OCD-only participants performed close to average, scoring in the 56th percentile for total errors and the 52nd percentile for perseverative errors.

The present study was the first to explore cognitive flexibility in youth with hoarding symptoms. Literature examining cognitive flexibility in hoarding is inconsistent, and no clear relationship has been identified. Several studies have detected no differences in cognitive flexibility in adult samples with hoarding symptoms (Grisham et al., 2010; Lawrence et al., 2006; Morein-Zamir et al., 2014; Tolin et al., 2011) as well as in adults with OCD who hoard (Lawrence et al., 2006). In contrast, a single study that used the cognitive flexibility test (Carbonella and Timpano 2016) reported that adults with higher self-reported hoarding

symptoms demonstrated greater cognitive inflexibility (worse WCST performance) than those with low ratings of hoarding. Contrary to these findings, our current results identified improved performance in the hoarding group, suggesting higher cognitive flexibility, rather than deficits. It is thus possible that increased flexibility (and accuracy) may lead to more difficulties when youth are considering the need to discard a personal item.

The interpretation of our WCST findings is not straightforward given the apparent discrepancy from previous results. First and foremost, it is important to note that our sample consisted of youth participants, whereas existing studies have focused on adults. Thus, either there exists a specific developmental trajectory in hoarding that involves a switch from high cognitive flexibility during youth to "normal" levels in adulthood, or there is a substantial difference between samples with youth and adults who hoard. Indeed, given the lack of longitudinal studies of hoarding, it is entirely possible that those are two distinct groups of individuals.

Our findings demonstrate that youth participants with OCD and hoarding differed from the non-hoarding group on measures of inattention and the total numbers of errors on the WCST. Thus, we completed a multiple regression analysis to investigate the relationship between inattentive symptoms, WCST's performance, and hoarding severity. Our analysis revealed that, as the number of total errors on the WCST increased, the severity of hoarding severity decreased. Furthermore, inattentive symptoms did not contribute to the differential performance on the WCST, instead, performance was significantly associated with hoarding severity. Taken as a whole, our finding suggests that inattention and increased cognitive flexibility may be two discrete factors that are associated with the increased severity of hoarding symptoms in youth,

highlighting the possibility that understanding the presence hoarding symptoms cannot be simply reduced to a single cognitive factor.

Furthermore, our analysis suggests no between-group differences in either inhibitory control or delay discounting. Correlation results, however, found a significant correlation between performance on the SST and the MCQ. Inhibitory control refers to the ability to suppress actions when they are no longer required (Aron & Poldrack, 2005; Verbruggen & Logan, 2008) and is a key component of executive functioning and is important in situations requiring withholding, switching or suddenly interrupting ongoing actions and thoughts (Schachar et al., 2000). Presently, the literature on inhibitory control in hoarding is inconsistent. Our findings are in line with previous research in adults with hoarding that found no differences in inhibitory control compares to individuals with anxiety disorders and healthy controls (Grisham et al., 2007; Grisham et al., 2010). In contrast, a study by Rasmussen and Colleagues identified differences in inhibitory control in adults with hoarding symptoms to those with a principal diagnosis of an anxiety disorder (Rasmussen et al., 2013). Similarly, a functional neuroimaging study identified differences in neural activation on an inhibitory control task between adult hoarding, OCD and healthy participants (Tolin et al., 2014). These differences in neural activation, however, were not reflected in differences in the behavioural performance on the inhibitory control task (Tolin et al., 2014). It is suggested that differences in inhibitory control can be identified at a neural level, however generally are not reflected differences in behavioural performance, as was seen in our youth sample. Further, all existing research has been completed in adult samples; this study is the first to assess inhibitory control in youth who hoard.

We also did not detect any between-group differences in delay discounting, which refers to the decline in the present value of a reward the longer the delay to receive it is (Odum, 2011). In the current study, youth in hoarding and non-hoarding groups did not differ in their discounting rate, meaning they had similar rates of declining the value of future rewards. Aditionally, our analysis indicated that there were no differences in discounting between our groups on discounting rates based on different magnitudes of reward (low, medium, high). To date, one study by Vickers and colleagues (2016) has investigated delay discounting in adults with hoarding symptoms. Researchers found that those with high hoarding were less likely to discount larger delayed monetary rewards, therefore being more patient. This effect, however, was specific to monetary rewards; for consumable goods (i.e., snacks and pens), there were no differences between the high and low hoarding groups. In contrast, our results did not reflect the same pattern of heightened patience for monetary rewards in our youth sample on the Monetary Choice Questionnaire. On this task youth participants were asked to consider monetary rewards; however, it is unclear whether this age group was capable of appropriately considering the monetary decisions on the task. Further, our results are potentially influenced by the high rates of ADHD in the hoarding group, as ADHD has been associated with higher rates of delay discounting (Barkley et al., 2001). Taken together, it appears that differences in delay discounting may exist in adult hoarding samples, but this effect was not demonstrated in the current youth sample with OCD and hoarding symptoms, again suggesting the need for longitudinal studies of hoarding.

The careful sample characterization process in the study supported the validity of our findings. First, as expected, our hoarding group scored significantly higher on all hoarding dimensions (difficulty discarding, clutter and distress dimensions) and overall scores on the CSI-

15. We chose to exclude scores related to acquisition on the original CSI as acquisition is not a diagnostic criterion included in the DSM-5 (American Psychiatric Association, 2013). Interestingly, similar findings (not in manuscript) emerged even when analyses were repeated for study groups based on total scores on the original CSI, which included acquisition symptoms. Second, there were no significant age or sex differences across the two study groups, decreasing the likelihood that our findings were driven by these variables. In this sample, the average age for both hoarding and non-hoarding groups was approximately 13 years old. This is of particular importance given the known profound cognitive development that takes place during this age group (Bjorkland & Causey, 2017). Additionally, hoarding and non-hoarding groups did not differ in the use of psychotropic medications, and there were no differences in OCD severity.

Finally, although the hoarding and non-hoarding groups did not significantly differ in co-occurring anxiety disorders, MDD, ODD or Tic Disorder, significant between-group differences were observed for comorbid ADHD and, specifically, inattention. 61% of participants in the hoarding group also met criteria for ADHD, compared to only 15% of the non-hoarding group. On the Conners 3, a measure of ADHD related symptoms, the hoarding group scored significantly higher on scores of inattentive symptoms, learning problems, cognitive function problems and problems related to peer relations. Also, regression analysis suggested that increased inattentive symptoms were associated with worsened hoarding severity as seen in the hoarding group. These results are in line with, and contribute to, the growing body of literature that suggests that ADHD, and in particular inattention, is associated with the presence of hoarding symptoms (Tolin et al., 2011). Self-report and neuropsychological data have suggested that impaired attention may be a core component of hoarding (Tolin and Villavicencio, 2011). Groups of individuals who hoard identify a high level of attentional problems (Grisham et al.,

2007; Hartl et al., 2004). Furthermore, attentional deficits were found in studies investigating neuropsychological functioning in adults with hoarding symptoms (Grisham et al., 2007; Tolin et al. 2010; Tolin and Villavicencio 2011). In summary, the finding of increased ADHD and inattention symptoms strengthens the validity of our findings by conforming to previously published studies.

4.2 Study Strengths and Limitations

The current study adds to the growing research investigating cognitive processing in childhood hoarding. To our knowledge, this study is the first to assess ownership and non-ownership-based decision-making, cognitive flexibility, inhibitory control and delay discounting in youth who hoard. Results on the endowment trading task and the WCST are compelling and provide preliminary support of differences in decision-making processes in hoarding symptoms in youth. This study is strengthened by the similarity in the characteristics of the hoarding and non-hoarding groups. Specifically, groups did not significantly differ on a number demographic and clinical measures, such as age, sex, medication use, the severity of OCD symptoms and depression, and the presence of co-occurring anxiety disorders. By controlling for these factors, we are able to explore hoarding symptoms in youth with more clarity. Additionally, this study has added to the understanding of the relationship between hoarding symptoms and inattentive symptoms. Finally, this study uniquely incorporates a Behavioural Economics approach through an endowment trading paradigm to investigate hoarding symptoms. Given the observed trend in the current data, it is evident that the potential role of endowment and ownership merits additional empirical investigation.

There are several limitations to the current study that must be considered. The most notable limitation is the lack of a healthy control group and the focus on a convenience sample of youth

with OCD. Subsequent studies should assess aspects of decision-making in youth with hoarding symptoms, with and without OCD and healthy participants. Doing so will provide a better focus on the core hoarding symptoms. Another limitation to consider is the relatively small sample size of this study which limits the generalizability of our findings. A larger sample size would increase our ability to detect group differences, particularly given the emerging relationships and trends in the current results. In addition, our primary group selection variable, hoarding symptoms, relied on a single parent-rated questionnaire of hoarding severity. This is problematic since parents may not always accurately identify hoarding-related symptoms. However, there are currently no empirically tested self-report measures for hoarding in youth populations. A third limitation that should be considered that our hoarding group was created according to a hoarding symptom severity scale and relative to the rest of the sample, rather than using DSM-5 diagnostic criteria. Doing so potentially limits how representative our hoarding group is to clinically significant cases of HD. Finally, this study is limited by having only two valid trading trials across the sample on the endowment trading task. This task was a central measure of ownership-based decision-making in this study, therefore, increasing the number of trading trials would have improved the reliability of the data. Another limitation of the current endowment trading paradigm is it is difficult to calculate the statistical significance of the data. The primary measure of this task is the EB, which can only be calculated as a group score. Quantifying and statistically examining for between-groups differences is challenging as there is no individual EB score for a participant.

4.3 Conclusions and Future Directions

The present study was the first to investigate aspects of decision-making processes in youth who hoard. Specifically, we examined ownership-based decision-making, risk-related

decision-making and the potential influence of cognitive flexibility and inhibitory control on decision-making. Our results suggest that compared to youth with OCD only, youth with OCD and hoarding symptoms had higher comorbid ADHD, worse ADHD symptoms, and increased cognitive flexibility. Furthermore, our results highlighted possible differences in ownership-based decision-making through the enhanced EE in hoarding participants. Additionally, our results showed that hoarding symptoms were not associated with differences in risk-related decision-making and inhibitory control.

Based on the results of the current study, there are several suggested directions for future research. First, this study had a relatively small sample size, indicating that future studies should attempt to replicate these findings in larger samples of youth and adults who hoard. Furthermore, future work should replicate this study using a sample of youth recruited based on the presence of hoarding symptoms, rather than an OCD, or even an ADHD sample. Historically, hoarding was thought to be a component of OCD; however emerging evidence suggests that hoarding symptoms and OCD are distinct disorders (American Psychiatric Association, 2013). As evidenced in the current study, hoarding symptoms are highly comorbid with ADHD. Future research should continue to investigate the relationship between hoarding symptoms and ADHD. Additionally, future studies would benefit from comparing youth with hoarding symptoms (with and without OCD) to a healthy control group.

Regarding the EE, future studies should continue to empirically assess the EE in those who hoard. In the present study, our results, although not significant, suggest preliminary support for an enhanced EE in youth who hoard. The current EE trading paradigm, however, used only three trading trials to assess the EE and the EB. Thus, future studies should expand on the endowment exchange paradigm to include more trading opportunities. Additionally, our research

group has developed a youth-friendly neuroimaging paradigm of the endowment trading task. This allows brain activation to be examined through functional magnetic resonance imaging (fMRI) while the participant completes the EE task. Continued research using this paradigm will identify potential differences in decision-making at a neural level. Moreover, preliminary trends in the current EE data reinforce the important role that ownership play in hoarding symptoms. Future studies should focus on empirically assessing processes of ownership and the implication it has on hoarding.

Finally, the present study was the first to examine many aspects of executive functioning including, attention, decision-making, inhibitory control, and impulsivity. Some research has suggested that hoarding symptoms in adults were associated with deficits in executive functioning (Grisham et al., 2006; Steketee and Frost, 2013). Meanwhile, other research has not reliably demonstrated executive functioning impairments in adults who hoard (Tolin et al., 2011). With the exception of the WCST finding (increased cognitive flexibility in the hoarding group worsened hoarding symptoms were not associated with other executive function deficit. It is possible that the executive functioning deficits seen in adult hoarding samples are not present in youth who hoard. Future research should focus on replicating these findings in a larger sample and comprehensively assessing executive function in youth and adults who hoard.

In recent years awareness of problematic hoarding has increased, and research has begun to understand components of hoarding, however, it is evident that greater attention and research efforts are necessary. Current frameworks of hoarding have implicated differences in decision-making as being central to hoarding symptoms, however, many aspects of the decision-making process remain unknown. Accordingly, future research should focus on other aspects of decision-making as well as cognitive processing in those who hoard. Doing so will provide critical insight

into hoarding symptoms which is crucial to improving symptom detection and treatment outcomes.

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