

Neurobiology and Treatment of Compulsive Hoarding

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ABSTRACT

Compulsive hoarding is a common and often disabling neuropsychiatric disorder. This article reviews the phenomenology, etiology, neurobiology, and treatment of compulsive hoarding. Compulsive hoarding is part of a discrete clinical syndrome that includes difficulty discarding, urges to save, clutter, excessive acquisition, indecisiveness, perfectionism, procrastination, disorganization, and avoidance. Epidemiological and taxometric studies indicate that compulsive hoarding is a separate but related obsessive-compulsive spectrum disorder that is frequently comorbid with obsessive-compulsive disorder (OCD). Compulsive hoarding is a genetically discrete, strongly heritable phenotype. Neuroimaging and neuropsychological studies indicate that compulsive hoarding is neurobiologically distinct from OCD and implicate dysfunction of the anterior cingulate cortex and other ventral and medial prefrontal cortical areas that mediate decision-making, attention, and emotional regulation. Effective treatments for compulsive hoarding include pharmacotherapy and cognitive-behavioral therapy. More research will be required to determine the etiology and pathophysiology of compulsive hoarding, and to develop better treatments for this disorder.

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INTRODUCTION

Hoarding is defined as the acquisition of and inability to discard items even though they appear to have no value.¹ Clinically significant hoarding behavior is common, with a weighted population prevalence of 5.3%.² Hoarding behavior has been observed in several neuropsychiatric disorders,

Needs Assessment

Compulsive hoarding is an often disabling neuropsychiatric disorder that may be much more common than previously thought. Unfortunately, it is often unrecognized, untreated, and poorly understood. There is a pressing need for clinicians and researchers to better understand how to diagnose, assess, and treat compulsive hoarding effectively. Recent findings suggest that compulsive hoarding is a discrete categorical entity whose phenomenology, etiology, and neurobiology are distinct from those of obsessive-compulsive disorder. These findings have strong implications for the nosology and future diagnostic classification of compulsive hoarding. Both pharmacotherapy and cognitive-behavioral therapy appear to be somewhat effective for compulsive hoarding, but new approaches will need to be developed to improve treatment response.

Learning Objectives

At the end of this activity, the participant should be able to:

- Describe the findings of taxometric, genetic, neuropsychological, and neuroimaging studies of compulsive hoarding.
- Identify the neuroanatomical regions most strongly implicated in the pathophysiology of compulsive hoarding.
- Describe the major components of cognitive-behavioral therapy for compulsive hoarding.

Target Audience: Psychiatrists

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including schizophrenia, dementia, and mental retardation, as well as in non-clinical populations,³ but it is commonly associated with obsessive-compulsive disorder (OCD). Hoarding and saving symptoms are found in 18% to 42% of adults and children with OCD.^{4,6}

THE COMPULSIVE HOARDING SYNDROME

Frost and Hartl⁷ developed criteria for clinically significant compulsive hoarding: (A) the acquisition of, and failure to discard a large number of possessions that appear (to others) to be useless or of limited value; (B) living or work spaces sufficiently cluttered so as to preclude activities for which those spaces were designed; and (C) significant distress or impairment in functioning caused by the hoarding behavior or clutter. Hoarding and saving symptoms are part of a discrete clinical syndrome that includes the core symptoms of urges to save, difficulty discarding, excessive acquisition and clutter, as well as indecisiveness, perfectionism, procrastination, disorganization, and avoidance.³ In addition, many compulsive hoarders are slow in completing tasks, frequently late for appointments, and display circumstantial, over-inclusive language. Patients with prominent hoarding and saving who display these other associated symptoms are thus considered to have the "compulsive hoarding syndrome."^{3,8}

Compulsive hoarding is usually driven by obsessional fears of losing important items that the patient believes will be needed later, or making the "wrong" decision about what to keep or discard. These fears cause substantial distress and lead to compulsions to save items. Hoarders also frequently have excessive emotional attachments to possessions and distorted beliefs about the importance of possessions.¹ The consequent clutter can cause significant social and occupational impairment.^{3,8} In severe cases, it can produce health risks from infestations, falls, fires, and inability to cook or eat in the home.³ Avoidance is prominent and includes behavioral avoidance of discarding or storing items, and cleaning, as well as cognitive avoidance of making decisions or even thinking about the clutter.

RELATIONSHIP OF COMPULSIVE HOARDING TO OCD

Although OCD is considered a single diagnostic entity, factor analyses have consistently identified

at least four principal OCD symptom factors: (A) aggressive, harm-related, sexual, and religious obsessions with checking compulsions; (B) symmetry and order obsessions with arranging, repeating, and counting compulsions; (C) contamination obsessions with washing and cleaning compulsions; and (D) hoarding and saving symptoms.^{9,10} Several analyses have also identified a fifth symptom factor: sexual and religious obsessions and other "taboo thoughts."^{11,12} These symptom factors appear to be relatively stable over time and differ in their neural correlates, genetic inheritance, comorbidity, and treatment response.¹⁰ Cluster analyses, which identify mutually exclusive, categorical subgroups, indicate that some of these symptom factors, including hoarding, may be discrete subtypes of OCD.¹³

Although compulsive hoarding has been considered a symptom dimension within OCD, recent evidence suggests otherwise. Whereas the harm/checking, contamination/cleaning, and symmetry/rituals symptom factors are strongly intercorrelated, hoarding/saving symptoms do not correlate strongly with the other factors.^{9,14} Many compulsive hoarders do not have any other OCD symptoms.^{1,3,14} In fact, none of the participants with clinically significant hoarding behavior in a recent epidemiological study were diagnosed with OCD.²

A taxometric analysis (designed to test whether a construct is best conceptualized as a distinct category or a continuous dimension) of OCD symptoms in an unscreened student sample found that hoarding showed evidence of taxonicity, indicating that it constituted a categorical latent subclass; whereas the other OCD symptoms were found to be dimensional, varying by degrees along a continuum.¹⁵ The taxonic latent structure of compulsive hoarding indicated that it is a discrete categorical entity that may have an etiological mechanism distinct from that of other OCD symptoms.¹⁵ Compulsive hoarders who have (other) OCD symptoms do not differ clinically or demographically from those who do not.¹⁶ Taken together, these findings refute the idea that compulsive hoarding is simply part of OCD and indicate that it is a separate but related OCD spectrum disorder that is frequently comorbid with OCD, similar to body dysmorphic disorder and trichotillomania.¹⁷

The phenomenology of compulsive hoarding is consistent with its conceptualization as an OCD spectrum disorder, as its core features include obsessions, compulsions, and avoidance.⁷ However, compulsive hoarding also has similari-

ties to impulse control disorders. Many hoarders have excessive buying, excessive acquisition of free items, or shop-lifting behaviors that are ego-syntonic or pleasurable.¹⁸

ETIOLOGY OF COMPULSIVE HOARDING

Family and Genetic Studies

Compulsive hoarding shows a familial inheritance pattern, with 50% to 85% of hoarders reporting having a first-degree relative who is a "packrat," while only 26% to 54% report having a family member with other OCD.^{1,4,19} Relatives of hoarding OCD patients have significantly higher prevalence of hoarding, dysthymia, and indecisiveness than relatives of non-hoarding OCD patients.^{5,20} Hoarding symptoms in relatives are related to indecisiveness in probands, suggesting that indecisiveness may be a risk factor for compulsive hoarding.⁵ The hoarding symptom factor is strongly familial in OCD patients, with robust correlations among sibling pairs.²¹

Only a few genetic studies have examined compulsive hoarding. A genome-wide scan in sibling pairs with Tourette's syndrome found that the hoarding phenotype was significantly associated with genetic markers on chromosomes 4, 5, and 17.²² The met/met genotype of the catechol-O-methyltransferase Val158Met polymorphism on chromosome 22 was found to be significantly more prevalent in Afrikaner OCD patients with hoarding symptoms than Afrikaner non-hoarding OCD patients or controls.²³ Strong linkage of compulsive hoarding to a marker on chromosome 14 was found in families with early-onset OCD.²⁴ These findings suggest that compulsive hoarding is a genetically discrete phenotype.¹⁷

Hoarding Secondary to Brain Lesions

There have been several case reports of compulsive hoarding resulting from damage to the orbitofrontal cortex (OFC) and medial prefrontal cortex (mPFC), caused by cerebral hemorrhage from ruptured anterior communicating artery aneurysms,^{25,26} resection of olfactory meningioma,²⁷ or fronto-temporal dementia.^{28,29} Anderson and colleagues³⁰ compared nine patients with compulsive hoarding that began after brain damage to 54 non-hoarding brain-damaged patients. All hoarding patients had damage to prefrontal cortex, with the greatest lesion overlap in right mPFC, orbitofrontal pole, anterior cingulate cortex (ACC), and adjacent white matter.³⁰ These brain regions mediate judgment and deci-

sion-making abilities, which are worse in compulsive hoarders than non-hoarding OCD patients.³¹

NEUROBIOLOGY OF COMPULSIVE HOARDING

Structural Neuroimaging

Only one study published to date has examined the structural neuroanatomical correlates of compulsive hoarding symptoms. Gilbert and colleagues³² found a trend-level association between severity of hoarding symptoms and lower gray matter volume of left primary motor cortex in OCD patients, whereas washing compulsion severity was associated with smaller volume in right motor cortex.

Functional Neuroimaging

Our group found that medication-free compulsive hoarders had a different pattern of baseline cerebral glucose metabolism than both controls and non-hoarding OCD patients, as measured by [¹⁸F]-fluorodeoxyglucose positron emission tomography (FDG-PET).³³ Compulsive hoarders did not have the characteristic hypermetabolism in OFC, caudate, and thalamus seen in non-hoarding OCD patients.^{33,34} Instead, they showed significantly lower metabolism in the posterior cingulate cortex (PCC), compared to controls. Greater hoarding severity significantly correlated with lower activity in dorsal ACC (dACC) and anterior medial thalamus.³³ However, this study had several limitations that affected its interpretability. Hoarding and non-hoarding OCD subjects were divided retrospectively and were originally recruited and enrolled based on having OCD, not hoarding symptoms. Hoarders were significantly older than controls and non-hoarding OCD patients, and had a much higher proportion of females. Therefore, we sought to replicate our findings in a new, larger sample of compulsive hoarders and matched controls.

We obtained FDG-PET brain scans on 20 medication-free adults with compulsive hoarding syndrome and 18 age- and gender-matched healthy controls, and found that compulsive hoarders had significantly lower normalized glucose metabolism in bilateral dorsal and ventral ACC than controls. No differences were found in brain regions usually associated with OCD. Greater hoarding severity was significantly correlated with lower relative activity in right dACC, right PCC, and bilateral putamen. Thus, compulsive hoarding appears to be a neurobiologically distinct disorder with a unique pattern of abnormal brain function that does not overlap with that of non-hoarding OCD.³⁵

These findings have important implications for not only the classification of compulsive hoarding, but also its neurobiology and treatment. The dACC, described as limbic motor cortex that governs response selection,³⁶ plays a key role in decision-making, especially in choosing between multiple conflicting options.^{37,38} It is also involved in conflict monitoring, error detection, focused attention, executive control, and willed motivation.^{39,40} Lesions of a corresponding region in monkeys render them unable to sustain appropriate behavior, due to an impairment in the ability to integrate their recent history of choices and outcomes over time.⁴¹ Thus, dysfunction of the dACC may mediate compulsive hoarders' difficulties with attention,⁴² making appropriate choices,³¹ using their past experiences to counter obsessional fears, and sustaining behavior. The dACC is also involved in selective attention to one's own emotional responses,⁴³ reappraisal of negative stimuli,⁴⁴ and suppression of arousal⁴⁵ and negative affect.⁴⁶ dACC dysfunction could account for compulsive hoarders' difficulty modulating their distress about losing possessions. Treatments that increase dACC activity, such as cholinesterase inhibitors,⁴⁷ stimulants,^{48,49} or modafinil,⁵⁰ might be effective for the compulsive hoarding syndrome.³⁵

Neural Correlates of Hoarding Symptom Provocation

Symptom provocation neuroimaging studies reveal patterns of brain activation occurring while patients experience symptoms. Symptom provocation studies of OCD have consistently found activation of the OFC, caudate, and thalamus during the provoked state, usually greater in OCD patients than in controls, with occasional activation of the ACC and other regions.³⁴ However, few studies have investigated brain activation during provocation of compulsive hoarding symptoms.

Mataix-Cols and colleagues⁵¹ provoked various types of OCD symptoms in OCD patients and controls. During hoarding-related provocation, OCD patients showed significantly greater activation of the left dorsal motor/premotor cortex, right OFC, and left fusiform gyrus than controls. The degree of provoked hoarding-related anxiety correlated with activation of left dorsal motor/premotor cortex. In contrast, provoked contamination-related anxiety and harm/checking-related anxiety correlated with activation of different brain regions.⁵¹ These investigators then provoked hoarding/saving symptoms in OCD patients with and without prominent hoarding symptoms, as well as normal controls, by having

them view pictures of commonly hoarded objects while imagining that these objects belonged to them, and that they "must throw them away forever."⁵² OCD patients with prominent hoarding symptoms showed significantly greater activation of bilateral frontal pole and anterior mPFC than both non-hoarding OCD patients and controls, and greater cerebellar activation than controls. Both hoarding and non-hoarding OCD patients showed significantly less activation of the left OFC than controls. Provoked hoarding-related anxiety correlated with activation of the left ventromedial PFC, right ventrolateral PFC, right amygdala, left thalamus, and bilateral hippocampus, mesial temporal cortex, sensory-motor cortex, and cerebellum. Provoked anxiety was negatively correlated with activation of left dACC, bilateral temporal cortex, dorsolateral PFC, and various parieto-occipital cortical regions. Hyperactivation of the ventromedial PFC, a region involved in decision-making about potential gains and losses, may reflect compulsive hoarders' greater difficulties in deciding upon the value or importance of objects they were imagining having to discard, whereas relative under-activation of dACC, dorsolateral PFC, and parieto-occipital cortex may reflect deficient emotional regulation and planning abilities.⁵²

Tolin and colleagues⁵³ imaged compulsive hoarders and healthy controls while they made decisions about whether to keep or discard personal possessions versus others' possessions, and found that hoarders showed significantly greater activation of left lateral OFC, amygdala, midbrain, and cerebellum than controls. Compulsive hoarders had significantly less activation of left superior frontal cortex than controls while deciding to discard personal possessions. Refusal to discard was associated with activation of ventral ACC, gyrus rectus, and left temporal cortex, and right precentral gyrus.⁵³

Neuropsychological Studies

Compulsive hoarders often report problems with attention and memory, and have some actual neurocognitive deficits. Compared to normal controls, compulsive hoarders had worse delayed visual and verbal recall, used less effective organizational strategies for visual recall, and reported significantly less confidence in their memory and more catastrophic assessments of the consequences of forgetting.⁵⁴ Compulsive hoarders have also been found to have slower reaction time, greater impulsivity, and worse spatial attention than both clinical comparison subjects and normal controls.⁴² Further, compulsive hoarders take

more time than non-hoarding OCD patients to sort personally relevant items and create more piles, indicating under-inclusive categorization.⁵⁵

Hoarding OCD patients report significantly more difficulty making decisions than healthy controls or non-hoarding OCD patients.^{3,5} OCD patients with prominent hoarding symptoms showed impaired performance on the Iowa Gambling Task,⁵⁶ which tests the ability to make advantageous versus risky decisions, and a different pattern of autonomic skin conductance responses, compared to low- or non-hoarding OCD patients.³¹ Hoarding OCD patients also show a trend toward poorer procedural learning, compared to other OCD patients.⁵⁷

The results of neuroimaging and neuropsychological studies converge to reveal that the pathophysiology of compulsive hoarding involves abnormalities in the neural systems mediating decision-making, attention, organization, and emotional regulation. Together, they demonstrate that the neurobiology of compulsive hoarding is distinct from that of non-hoarding OCD.

TREATMENT OF COMPULSIVE HOARDING

Initial Assessment

Effective management of compulsive hoarding must begin with a thorough neuropsychiatric evaluation to rule out primary psychotic disorders, dementia, or other neurological disorders that could present with hoarding symptoms, and rule out major depression as a primary cause of clutter, since apathy, fatigue, or hopelessness could lead to failure to clean, discard, or organize possessions. Initial evaluation should include assessment of the amount of clutter, types of items saved, usability of living and work spaces, potential health and safety hazards, beliefs about possessions, information processing deficits, avoidance behaviors, insight, motivation for treatment, social and occupational functioning, and activities of daily living.⁵⁸

Pharmacotherapy

A few studies of OCD patients have found that hoarding symptoms were associated with poor response to pharmacotherapy with serotonin reuptake inhibitors (SRIs), but most have not. One small study found that hoarding symptoms predicted non-response to paroxetine, placebo, or cognitive behavioral therapy (CBT) for OCD.⁵⁹ In a case series of 18 compulsive hoarders treated openly with a variety of SRIs, only one patient had an adequate

response, eight had partial responses, and nine had no response.¹⁹ Higher scores on the hoarding symptom factor predicted poorer response in an analysis of placebo-controlled trials of SRI treatment for OCD patients.¹¹ High scores on a hoarding/symmetry factor also predicted worse outcome in placebo-controlled, double-blind trials of citalopram, escitalopram, and paroxetine for OCD.^{60,61}

However, several other studies that examined OCD symptom factors and treatment response did not confirm this association. Instead, sexual/religious obsessions were uniquely found to predict poorer long-term outcome after SRI treatment in one study,⁶² and were the only OCD symptoms significantly more prevalent in treatment-refractory OCD patients than treatment responders in another.⁶³ Poor insight and somatic obsessions were significantly more common in non-responders to SRIs than responders in one study,⁶⁴ whereas sexual obsessions, washing compulsions, and miscellaneous compulsions predicted non-response to SRIs in another.⁶⁵ These studies all found no significant effect of hoarding/saving symptoms on response to SRI treatment. In addition, a family study found that a very similar proportion of hoarding and non-hoarding OCD patients reported response or remission with SRI treatment.⁵

Three studies have examined whether OCD symptom types predict response to pharmacotherapy in children and adolescents with OCD. Of these, two found no association of any specific symptoms and treatment response,^{66,67} but one naturalistic study found that children with hoarding symptoms had a significantly lower rate of response to pharmacotherapy than children with aggressive obsessions and checking rituals.⁶⁸ Thus, hoarding is not a consistent predictor of poor response to SRI medications.

Only one study to date has prospectively and quantitatively measured response to pharmacotherapy in patients with the compulsive hoarding syndrome.⁶⁹ Compulsive hoarders (n=32) and non-hoarding OCD patients (n=47) were treated openly with paroxetine monotherapy for 12 weeks. Compulsive hoarders responded equally as well to paroxetine as non-hoarding OCD patients, with significant and nearly identical improvements in OCD symptoms, depression, anxiety, and overall functioning. Very similar proportions of hoarders and non-hoarding OCD patients were strong responders and partial responders. The proportion of dropouts was also similar. Compulsive hoarders who completed treatment showed a mean 31% decline in symptom severity. Hoarding/saving symptoms

improved as much as other OCD symptoms. No correlation was found between hoarding severity and treatment response. These results suggest that SRI medications are just as effective for compulsive hoarders as for non-hoarding OCD patients.⁶⁹

Apart from one case report of a compulsive hoarding patient with comorbid attention-deficit/hyperactivity disorder and schizotypal personality disorder who responded to a combination of fluvoxamine, risperidone, and amphetamine salts,⁷⁰ no data exist on treatment of compulsive hoarding with non-SRIs.

Cognitive-Behavioral Therapy

Hoarding symptoms have consistently been associated with poor response to traditional CBT for OCD. OCD patients with prominent hoarding symptoms have been found to be more likely than non-hoarding OCD patients to drop out of CBT prematurely,⁷¹ less likely to respond to outpatient CBT,^{71,72} and less likely to respond to intensive inpatient CBT.⁷³ However, a recent study of pediatric OCD found no effect of hoarding symptoms on response to CBT.⁷⁴

Hartl and Frost⁷⁵ and Steketee and colleagues⁷⁶ developed a CBT treatment strategy based on their cognitive-behavioral model of compulsive hoarding, which conceptualizes compulsive hoarding as involving four main problem areas: (A) information-processing deficits; (B) problems in forming emotional attachments; (C) behavioral avoidance; and (D) erroneous beliefs about the nature of possessions.⁷ Their treatment includes cognitive restructuring, decision-making training, and exposure and response prevention involving discarding of saved clutter. They treated seven compulsive hoarders with 15 group treatment sessions and individual home visits.⁷⁵ After 20 weeks of treatment, five of the seven patients had noticeable improvement in acquisition, awareness of irrational reasons for saving, and organizational skills. The ability to discard possessions also improved, but more slowly. This study also demonstrated the need to address patient motivation and involve family members in treatment.⁷⁶ The same research group then treated 14 unmedicated compulsive hoarders with 26 individual sessions of CBT conducted over a 7–12-month period.⁷⁷ Ten patients completed treatment and showed significant, pre- to post-treatment decreases in hoarding severity (28% drop) and clutter but not global clinical severity. Of the 10 treatment completers, 5 were rated “much improved” or “very much improved.”⁷⁷

Combined, Multi-Modal Treatment

Our group developed an intensive, multi-modal treatment protocol for compulsive hoarding based on Frost and colleagues⁷ model but modified for use in a short-term, intensive treatment setting, and broadened it by including pharmacotherapy, structuring daily activities, and involving families. OCD patients (n=190), 20 of whom had the compulsive hoarding syndrome, were treated for 6 weeks in a partial hospitalization program with intensive, daily CBT for several hours a day, and the vast majority received medication. Intensive CBT focused on four main areas: discarding, preventing incoming clutter, organizing, and introducing alternative behaviors.⁵⁸ Even though most of the compulsive hoarders had previously failed trials of SRIs or outpatient CBT, they showed significant improvement, with a mean 35% decrease in symptom severity, and 45% of them were classified as responders to treatment. However, non-hoarding OCD patients had significantly greater improvement, with a mean 46% decrease in symptom severity.⁸

Unfortunately, there have been no controlled trials of pharmacotherapy or CBT for compulsive hoarding. Based on the open trials summarized above, both SRIs and CBT appear to be effective treatments for compulsive hoarding, but combined, multi-modal treatment is more effective than either medication or CBT alone.

CONCLUSIONS

The taxometric, genetic, neuropsychological, and neuroimaging studies summarized above indicate that compulsive hoarding syndrome is a discrete entity, with a unique profile of core symptoms, associated features, genetic markers, and neurobiological abnormalities that differ from those of OCD. Therefore, strong consideration should be given to classifying compulsive hoarding as a separate disorder in the upcoming *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition, with its own diagnostic criteria.

The pathophysiology of compulsive hoarding involves abnormalities in the neural systems mediating decision-making and emotional regulation, including the ACC, OFC, and mPFC. Dysfunction of the dACC appears to be a marker of compulsive hoarding severity and may mediate both the core symptoms and the associated features of the compulsive hoarding syndrome. Effective treatment for compulsive hoarding may require a combination of CBT, pharmacotherapy, training in organization and time management, and family involvement.

FUTURE DIRECTIONS

There is much we do not know about compulsive hoarding. Most studies of OCD used diagnostic or screening instruments that excluded the many patients with compulsive hoarding but no other OCD symptoms. Future studies should examine the more well-defined categorical phenotype of compulsive hoarding syndrome, to improve their chances of elucidating its etiology and neurobiology.¹⁷ More effective treatments must be developed for this common and disabling disorder. Better pharmacotherapies must be identified through clinical trials, particularly of non-SRIs, such as stimulants, anti-glutamatergic agents, and cognitive enhancers. Future treatment approaches should target the information-processing deficits that may underlie compulsive hoarding, including deficits in decision-making, organization, and categorization, as well as poor insight and motivation for treatment. Techniques such as motivational interviewing⁷⁸ and motivational enhancement therapy that have been successful for OCD,⁷⁹ addictions, and impulse-control disorders,⁸⁰ might be useful for compulsive hoarders as well. **CNS**

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