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Neuropsychological functioning in hoarding disorder

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Abstract

Hoarding disorder (HD) is increasingly viewed as distinct from obsessive-compulsive disorder (OCD). In particular, some researchers have suggested that HD is characterized by substantial problems of neurocognitive function; however, HD patients have not yet been compared to OCD patients in this respect. The aim of the present study was to compare neuropsychological test performance in HD patients (n = 27), OCD patients (n = 12), and healthy controls (n = 26). Consistent with previous research, HD patients showed an attenuated ability to sustain attention and poorer employment of adaptive memory strategies compared to healthy controls. HD and OCD patients did not differ significantly on these measures, although moderate effect sizes suggested that hoarders showed somewhat greater attenuation of attentional capacity. Rates of true impairment on any particular neuropsychological test were fairly low across all three groups, although 67% of HD patients (compared to 58% of OCD patients and 42% of healthy controls) scored in the impaired range on at least one measure (odds ratio = 2.22). Results are discussed in terms of emerging conceptualizations of HD as a distinct illness.

Keywords

Hoarding; OCD; neuropsychology; attention; memory; executive function

1. Introduction

Hoarding Disorder (HD), defined as the acquisition of and failure to discard large volumes of possessions, resulting in clutter that precludes normal use of living spaces (Frost and Gross, 1993; Frost and Hartl, 1996), is associated with high levels of functional impairment (Tolin et al., 2008) and health risks (Frost et al., 2000). As an example of the latter, a recent analysis of house fires in Melbourne, Australia, over a 10-year period found that hoarding was determined to be a factor in 24% of all preventable fire fatalities (Lucini et al., 2009).

Increasingly, researchers are suggesting that HD may be distinct from obsessive-compulsive disorder (OCD; Abramowitz et al., 2008; Grisham et al., 2005; Pertusa et al., 2010), and are focusing on possible neurocognitive contributors to the subjective problems of decision-

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making in HD patients. Individuals with HD have a high rate of ADHD comorbidity (Frost et al., 2011; Sheppard et al., 2010), report high levels of indecisiveness and other problems of decision-making (Frost and Gross, 1993; Frost and Shows, 1993; Samuels et al., 2002; Steketee et al., 2003), and exhibit difficulty categorizing possessions (Grisham et al., 2010; Luchian et al., 2007; Wincze et al., 2007). These observations raise the possibility of a pattern of neurocognitive deficits underlying HD.

To date, five published studies (Grisham et al., 2007; Grisham et al., 2010; Hartl et al., 2004; Jang et al., 2010; Lawrence et al., 2006) have examined neuropsychological performance in patients with hoarding behaviors [a sixth study (Anderson et al., 2005) assessing patients who developed hoarding behavior after acquired brain lesions will not be reviewed here]. Hartl et al. (2004) administered the Rey-Osterreith Complex Figure Test (RCFT) and California Verbal Learning Test (CVLT) to 22 HD patients and 24 healthy control participants. HD patients recalled less information on delayed recall on the RCFT and CVLT; less effective organizational strategies on the RCFT using Savage et al.'s (1999) scoring protocol were also noted. Lawrence et al. (2006) administered the Wisconsin Card Sorting Task (WCST) and Iowa Gambling Task (IGT) to 39 OCD patients, 10 of whom received high scores on a measure of hoarding symptoms, and 40 controls. Although hoarding vs. non-hoarding differences were not described for the WCST, hoarding OCD patients performed more poorly than did non-hoarding OCD patients and controls on the IGT (specifically, hoarding OCD patients did not exhibit learning of the correct strategy). Grisham et al. (2007) tested 30 HD patients, 30 mixed clinical (non-OCD) patients, and 30 healthy controls. Compared to healthy controls and mixed clinical patients, HD patients performed worse on Visual Memory Span (VMS) showed greater variability of hit reaction time on the Continuous Performance Task (CPT), and made more errors of commission on the CPT. No differences were found among the groups on the IGT. More recently, Grisham et al. (2010) compared 19 HD patients, 17 mixed clinical (non-OCD) patients, and 20 healthy controls on an Affective Go/NoGo (AGN) task, Intra-Extra Dimensional (IED) set shifting task, the Stockings of Cambridge task (SOC; a computerized adaptation of the Tower of London task), and the Cambridge Gambling Task (GCT; an adaptation of the IGT). The HD group solved significantly fewer problems on the SOC task than did the other two groups, suggesting poorer problem-solving ability. No differences in attention, impulsivity, mental flexibility, or decision making/strategy learning were found on the AGN, IED, or CGT tests. Finally, Jang et al. (2010) administered the RCFT to 144 OCD patients. The number of patients with hoarding symptoms was not reported. The presence of hoarding symptoms, as measured by the symptom checklist of the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS), did not correlate with any RCFT scores (by comparison, symmetry/ordering and obsessions/checking symptoms did correlate negatively with recall and memory organization).

Thus, the extant research suggests that patients with HD might be characterized by problems sustained attention, impulsivity, and problem-solving, as well as possible problems of memory and memory strategy use. It is noted, however, that no study to date has compared the neuropsychological performance of HD patients to that of OCD patients, with the very limited exception of Lawrence et al.'s (2006) IGT results and Jang et al.'s (2010) investigation of the hoarding symptom dimension among OCD patients. A direct comparison of true HD patients vs. OCD patients might help clarify the current uncertainty regarding diagnostic placement of hoarding (Pertusa et al., 2010), by examining whether HD patients and OCD patients show similar or dissimilar patterns of neurocognitive function. It is further noted that none of these studies reported actual rates of impairment (i.e., below-average performance). Although they showed that individuals with HD performed worse than did control groups, it is not clear whether these differences truly reflect impaired neuropsychological functioning among individuals with HD. The aim of the present study is

to compare the neuropsychological functioning of individuals with HD, individuals with non-hoarding OCD, and healthy control participants. It was predicted that, compared to OCD patients and healthy controls, HD patients would exhibit significantly poorer performance on indices of attention, memory and memory strategy, impulsivity, and executive function.

2. Methods

2. 1. Subjects

Sixty-five adult participants met inclusion criteria of age 18-65; fluent in English; absence of lifetime bipolar, psychotic, developmental, or substance use disorders; absence of medical conditions known to impact brain function; and (for the clinical groups) symptom duration of 1 year or more and *Clinician's Global Impressions* (CGI; Guy, 1976) rating of 4 (moderately ill) or higher. Furthermore, participants were included if they could be classified into one of three diagnostic groups: *HD* (primary diagnosis of Hoarding Disorder, no diagnosis of non-hoarding OCD; $N = 27$), *OCD* (primary diagnosis of non-hoarding OCD, no diagnosis of hoarding; $N = 12$), or *Healthy Controls* (no lifetime psychiatric diagnosis or treatment; $N = 26$). Primacy of diagnoses was ascertained using clinical severity ratings (CSRs) from the *Anxiety Disorders Interview Schedule for DSM-IV* (ADIS-IV; Brown et al., 1994). Two (7%) of the HD participants were taking psychiatric medications (buproprion and velnafaxine), and 2 (17%) of the OCD participants were taking psychiatric medications (fluvoxamine and setraline). It should be noted that patients with co-occurring HD and OCD, which comprise approximately 18% of HD patients (Frost et al., 2011), were excluded.

2.2. Materials

2.2.1. Clinical Interviews—Psychiatric diagnoses were ascertained using the *ADIS-IV* (Brown et al., 1994). Reliability for the various DSM-IV categories contained in the ADIS-IV extends from good to excellent, (α =.41-.86) (Brown et al., 2001). Assessors were trained to criterion (100% agreement on diagnostic classification and within one CSR point on all diagnoses), with regular inter-rater reliability checks to prevent rater drift. Hoarding diagnoses were made using the *Hoarding Rating Scale-Interview* (HRS-I; Tolin et al., 2010), a semi-structured interview that assesses the severity of clutter, acquisition, difficulty discarding, distress, and impairment, each on a 0-8 scale. The HRS-I shows excellent internal consistency and reliably discriminates hoarding from non-hoarding participants (Tolin et al., 2010). OCD symptoms were assessed using the *Yale-Brown Obsessive-Compulsive Scale* (Y-BOCS; Goodman, Price, Rasmussen, Mazure, Delgado, et al., 1989; Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989), a semi-structured interview of the severity of obsessive thoughts and compulsive behaviors. The Y-BOCS shows excellent interrater reliability and sound internal consistency, and strong test-retest reliability (Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989; Woody et al., 1995). For purposes of the present study, hoarding symptoms were not used in calculating Y-BOCS scores. Overall illness severity was determined using the *CGI* (Guy, 1976). The CGI shows good test-retest reliability (Dahlke et al., 1992) and correlates strongly with clinician rated anxiety and depression symptoms (Leon et al., 1993).

2.2.2. Self-Report Measures—Severity of the core features of hoarding (clutter, difficulty discarding, acquiring) was assessed using the *Saving Inventory-Revised* (SI-R; Frost et al., 2004), a 23-item questionnaire of compulsive hoarding severity. Internal consistency is excellent for the total score and for the 3 subscales. The SI-R readily discriminates hoarders from OCD patients and community controls, and correlates significantly with ratings of clutter and impairment (Frost et al., 2004). Specific OCD

symptom dimensions were measured using the *Obsessive-Compulsive Inventory-Revised* (OCI-R; Foa et al., 2002), an 18-item questionnaire that assesses OCD symptoms across six factors, with possible scores ranging from 0-12: 1) Washing, 2) Checking/Doubting, 3) Obsessing, 4) Mental Neutralizing, 5) Ordering, and 6) Hoarding. The OCI-R possesses excellent test-retest reliability in OCD patients (Foa et al., 2002) and reliably discriminates among OCD subtypes (Huppert et al., 2007). Levels of general psychological distress were assessed using the *Depression Anxiety Stress Scale* (DASS; S. H. Lovibond and P. F. Lovibond, 1995), a 42-item self-report measure that assesses symptoms of depression, anxiety, and stress over the past week on a 4-point scale. The three subscales of depression, anxiety, and stress have demonstrated good internal consistency, and factor analyses have supported the convergent and discriminant validity of the scales (P. F. Lovibond and S. H. Lovibond, 1995). In addition, the DASS has demonstrated adequate test-retest reliability, and adequately distinguished between clinician-rated mood and anxiety disorders (Brown et al., 1997).

2.2.3. Neuropsychological Tests—The *Wechsler Test of Adult Reading* (WTAR) (Holdnack, 2001) was used to estimate premorbid intellectual function. The University of Pennsylvania version (Kurtz et al., 2001) of the *Continuous Performance Test* (CPT; Beck et al., 1956) was used to assess sustained visual attention and impulsivity. Mean hit (correct response) reaction time (*HRT*) was selected as a measure of sustained attention, and number of commission errors was selected as a measure of impulsivity; both variables have been used in prior research (Grisham et al., 2007). The *California Verbal Learning Test-II* (CVLT-II; Delis et al., 2000) was used to assess verbal memory. The dependent measure was the total number of words recalled across the 5 list presentations. The *Rey-Osterrieth Complex Figure Test* (RCFT; Osterrieth, 1944) was used to measure visual organization and visual memory. The Myers and Myers (1995) administration and scoring procedures were used, as well as Savage et al.'s (1999) organizational score for assessing memory strategy use. The dependent measures selected, based on previous research (Hartl et al., 2004), were delayed recall and organizational score. The *Hooper Visual Organization Test* (HVOT; Hooper, 1958) was used to measure visuospatial/visuomotor functioning. Total correct was the dependent measure. The 128-card paper-and-pencil version (Heaton, 1981) of the *Wisconsin Card Sorting Test* (WCST; Berg, 1948) was used as a measure of rule-learning and conceptual flexibility. Number of total errors was selected as the dependent measure. The *Tower of London* (TOL; Shallice, 1982) test, a measure of planning and implicit and skill memory, was also used. The number of moves to complete the task was the dependent measure. The *Stroop Color Word Test* (Golden, 1978) was used as a measure of selective attention and cognitive flexibility. Time to complete the color-word condition was the dependent measure. The *Controlled Oral Word Association Test-FAS* (COWAT-FAS; Benton and Hamsher, 1989) was used as a measure of the ability to generate words to a phonemic cue. Total correct across the three trials was the dependent measure. The *Animal Naming Test* (Rosen, 1980) was used as a measure of the ability to generate words to a semantic cue. Total number of words generated was selected as the dependent measure.

2.3. Procedures

Participants were recruited via newspaper advertisements and flyers, as well as from the patient flow at a specialty anxiety clinic. Of note, the hoarding participants were recruited specifically for hoarding or clutter problems, not for OCD, which may result in a more representative sample given the rather low rate of true OCD among hoarders (Frost et al., 2011). After providing written informed consent, participants met with a trained graduate-level interviewer who administered the ADIS-IV, HRS-I, Y-BOCS, and CGI. Once these measures were completed, participants completed the battery of neuropsychological measures, administered by a trained graduate-level assessor, in a separate, single session.

2.4 Statistical Analyses

Data were analyzed using SPSS version 15. Differences on neuropsychological tests among the three groups were examined using a series of oneway Analyses of Variance (ANOVAs) with Tukey HSD follow-up tests. Effect size estimates were calculated as Cohen's *d*. These analyses were repeated as Analyses of Covariance (ANCOVAs), using age, DASS Depression, and DASS Anxiety scores as covariates. To examine more closely the prevalence of true neuropsychological impairment, participants were coded as impaired or not impaired on each measure according to whether their scores deviated from published norms by 1.5 SD or more. Rates of impairment among the three groups were compared using χ^2 analyses. Effect size estimates were calculated as odds ratios (ORs). Exploratory Pearson correlations were conducted between CPT HRT scores and each subscale of the OCI-R.

3. Results

3.1. Sample Characteristics

Table 1 shows that the OCD group was younger on average, and consisted of more men, than were the hoarding and healthy control groups. Subsequent analyses of neuropsychological tests used age-corrected T-scores (when available in test manuals, corrections for gender and education were also used). As expected, the hoarding group exhibited higher SI-R scores than did the other two groups, and the OCD group exhibited higher (non-hoarding) Y-BOCS scores than did the other two groups. The OCD groups scored higher than did the hoarding group in anxiety and stress, and both groups scored higher on depression, anxiety, and stress than did healthy controls. The two clinical groups did not differ in terms of the frequency of comorbid anxiety or depressive disorders. Examination of specific OCD symptom dimensions on the OCI-R confirmed the expected differences among the groups. HD participants scored higher on the Hoarding subscale than did the OCD and healthy control groups, which did not differ from each other. Mild elevations were also seen on the Obsessing and Ordering subscales. The OCD group scored higher than did the other two groups on all other OCI-R subscales except Ordering, on which they did not differ from the HD group. Among OCD participants, the highest scores were obtained for Obsessing and Checking.

3.2. Neuropsychological Functioning

Table 2 shows performance on neuropsychological tests for hoarding, OCD, and healthy control groups. A significant difference among the groups was found for hit response time on the CPT; follow-up tests showed that the HD group had significantly higher response times (suggesting poorer attentional capacity) than did the healthy control group. They did not differ significantly from the OCD group; however, a moderate effect size ($d = 0.5$) between HD and OCD patients was detected. Organizational scores on the RCFT also showed a significant difference among the groups, with the HD group showing lower scores (suggesting poorer memory organization strategies) than did the healthy control group; again, the HD and OCD groups did not differ. A significant difference on the HVOT was found, with the OCD group showing higher scores (suggesting better visual organization) than did the HD or healthy control groups, which did not differ from each other. Significant between-group differences were not evident for other neuropsychological indices. However, examination of effect sizes suggests that HD participants showed attenuated performance on RCFT delayed recall compared to OCD and healthy control participants. HD participants' performance was somewhat better on CVLT-II total recall compared to OCD and healthy control participants. Somewhat superior performance, compared to OCD participants, was noted for WCST total errors, TOL total moves, COWAT-FAS total, and Animal Naming total.

To examine more closely the potential impact of age, depression, and anxiety on neuropsychological functioning, a series of ANCOVAs were conducted. When controlling for age and for depression (DASS), the results for CPT HRT were unchanged; however, in each case, the RCFT organizational score no longer differed significantly among the groups. When controlling for anxiety (DASS), the results were unchanged.

The relationship between sustained attention (CPT HRT) and specific OCD symptom dimensions was explored using correlations with the OCI-R subscale scores in the entire sample. As shown in Table 3, only the Hoarding subscale correlated significantly with attenuated attention. This pattern was not altered when controlling for age, depression (DASS), and anxiety (DASS) scores. Thus, among possible OCD symptom dimensions, Hoarding alone appears to be associated with diminished attentional capacity.

As shown in Table 4, the number of normatively impaired individuals was too small for adequate power for χ^2 analyses (and indeed was frequently 0); therefore, no statistical analyses were significant. It is noted, however, that nearly one quarter of the HD group, compared to 11% and 4% of the OCD and healthy control groups, respectively, scored in the impaired range on CPT hit response time [odds ratio (OR) of hoarding vs. non-hoarding participants = 5.14]. Two thirds of HD participants scored in the impaired range on at least one measure of neurocognitive function. By comparison, 58% of OCD participants and 42% of healthy control participants scored in the impaired range on at least one measure (OR = 2.22).

4. Discussion

The present results add to a growing body of research (Grisham et al., 2007; Grisham et al., 2010; Hartl et al., 2004; Lawrence et al., 2006) investigating hoarding disorder from a neuropsychological perspective. The present results extend those of previous studies by examining rates of true neuropsychological impairment, assessing a broader range of neuropsychological functioning than previous studies, and using an OCD control group. Consistent with the findings of Grisham et al. (2007), we found that HD participants exhibited poorer ability to sustain attention than did healthy controls (and indeed, this was the only domain in which a large number of HD patients showed normative impairment). Grisham et al. also found that HD patients performed more poorly on this task than did mixed anxiety patients. In the present study, HD participants did not perform significantly more poorly than did OCD patients, although the effect size was in the moderate range and it is likely that a larger sample would have detected a significant difference. Furthermore, among the symptom dimensions measured by the OCI-R, Hoarding alone was significantly associated with problems of attention. We did not replicate Grisham et al.'s finding of increased impulsivity on the CPT, although it is noted that a second study by the same research group also failed to replicate this finding on similar task (Grisham et al., 2010). Consistent with Hartl et al. (2004), we found that HD patients used less effective memory organizational strategies than did healthy control participants (although, as noted previously, a confound of age and depression cannot be ruled out for this finding). Unlike Hartl et al., however, the present HD patients did not exhibit impaired verbal or nonverbal memory (although a nonsignificant trend, with moderate effect sizes, for greater prevalence of nonverbal memory impairment is noted).

Contrary to expectations based on high levels of self-reported decision-making problems (Frost and Gross, 1993; Frost and Shows, 1993; Samuels et al., 2002; Steketee et al., 2003) and observations of difficulty categorizing possessions (Luchian et al., 2007; Wincze et al., 2007), we did not find evidence of impaired executive functions in HD patients. In addition to normal WCST, COWAT-FAS, and Animal Naming performance, HD patients performed

adequately on the TOL, a finding that contrasts with previous results using a similar task (Grisham et al., 2010). The absence of executive functioning deficits also contrasts with previous research showing impaired performance on the IGT (Lawrence et al., 2006), although it is noted that other studies have failed to replicate that result (Grisham et al., 2007; Grisham et al., 2010). One possible explanation for this discrepancy is that the present sample of HD patients, perhaps related to their high motivation to participate in research and treatment, was not representative of the larger population of individuals with HD. The finding of unexpectedly high IQ (mean = 113) could be consistent with that hypothesis. It is also worth noting that the present results are relatively untainted by possible medication side-effects; medication use in previous HD samples was either high (Lawrence et al., 2006) or was not reported (Grisham et al., 2007; Grisham et al., 2010; Hartl et al., 2004). Greater differences in neuropsychological performance between HD and control samples in previous studies could, therefore, reflect cognitive side effects of medication rather than the characteristics of the disorder itself. Another possibility is that the self-reported and observed problems of decision-making in people with HD do not represent an overall neurocognitive impairment (as would be detected using standardized tests), but rather are affected by emotional responses to possessions. Consistent with this possibility, Wincze et al. (2007) found that HD patients exhibited difficulty categorizing their own possessions, but did not exhibit difficulty categorizing items that did not belong to them. To address this possibility, it might be useful to use standardized neuropsychological tests under conditions of cognitive load or mood induction in order to determine whether HD patients' cognitive functions deteriorate under such conditions. In healthy individuals, mood induction does not cause substantial declines in neurocognitive performance (Chepenik et al., 2007), although there may be some subtle impact on frontal lobe function (Bartolic et al., 1999).

The relatively small sample size, particularly in the OCD group, is a limitation of the study. This limitation is of particular concern when interpreting the lack of significant differences in impairment rates (Table 3). Given the odds ratios obtained, it is likely that significant differences would have been obtained with a larger sample on measures such as impaired attention (CPT HRT) and nonverbal memory (RCFT delayed recall).

Hoarding is increasingly viewed as distinct from OCD (Pertusa et al., 2010), and neurocognitive impairment has been proposed as a major difference between these two disorders (Tolin, 2011; Tolin and Villavicencio, 2011). The present results add to this conceptualization by demonstrating that individuals with HD appear more likely than do individuals with non-hoarding OCD to demonstrate some form of cognitive impairment (67% vs. 58%, OR = 1.43), with the most common difference seen in sustained attention. Previous neuroimaging research has shown differences in neural activity between OCD patients with and without hoarding symptoms (An et al., 2009; Saxena et al., 2004), although these findings have yet to be extended to non-OCD patients with HD. This is an important research gap, since the majority of HD patients do not appear to have OCD (Frost et al., 2011), and some studies have shown that hoarding symptoms are associated more closely with other anxiety and mood symptoms than with OCD symptoms (Frost et al., 2011; Tolin et al., 2011; Wu and Watson, 2005). Thus, it appears likely that HD is distinct from OCD in terms of both neurophysiology and neuropsychological functioning.

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References

Abramowitz JS, Wheaton MG, Storch EA. The status of hoarding as a symptom of obsessive-compulsive disorder. Behaviour Research and Therapy. 2008; 46:1026–1033. [PubMed: 18684434]

An SK, Mataix-Cols D, Lawrence NS, Wooderson S, Giampietro V, Speckens A, Brammer MJ, Phillips ML. To discard or not to discard: the neural basis of hoarding symptoms in obsessive-compulsive disorder. Molecular Psychiatry. 2009; 14:318–331. doi: 4002129 [pii] 10.1038/sj.mp.4002129. [PubMed: 18180763]

Anderson SW, Damasio H, Damasio AR. A neural basis for collecting behaviour in humans. Brain. 2005; 128:201–212. [PubMed: 15548551]

Bartolic EI, Basso MR, Schefft BK, Glauser T, Titanic-Schefft M. Effects of experimentally-induced emotional states on frontal lobe cognitive task performance. Neuropsychologia. 1999; 37:677–683. doi: S0028-3932(98)00123-7 [pii]. [PubMed: 10390029]

Beck LH, Bransome ED Jr. Mirsky AF, Rosvold HE, Sarason I. A continuous performance test of brain damage. J Consult Psychol. 1956; 20:343–350. [PubMed: 13367264]

Benton, AL.; Hamsher, KS. Multilingual aphasia examination. AJA Associates; Iowa City, IA: 1989.

Berg EA. A simple objective technique for measuring flexibility in thinking. Journal of General Psychology. 1948; 39:15–22. [PubMed: 18889466]

Brown TA, Chorpita BF, Korotitsch W, Barlow DH. Psychometric properties of the Depression Anxiety Stress Scales (DASS) in clinical samples. Behaviour Research and Therapy. 1997; 35:79–89. [PubMed: 9009048]

Brown TA, Di Nardo PA, Lehman CL, Campbell LA. Reliability of DSM-IV anxiety and mood disorders: implications for the classification of emotional disorders. Journal of Abnormal Psychology. 2001; 110:49–58. [PubMed: 11261399]

Brown, TA.; DiNardo, PA.; Barlow, DH. Anxiety Disorders Interview Schedule for DSM-IV. The Psychological Corporation; San Antonio, TX: 1994.

Chepenik LG, Cornew LA, Farah MJ. The influence of sad mood on cognition. Emotion. 2007; 7:802–811. doi: 2007-17748-014 [pii] 10.1037/1528-3542.7.4.802. [PubMed: 18039049]

Dahlke F, Lohaus A, Gutzmann H. Reliability and clinical concepts underlying global judgments in dementia: implications for clinical research. Psychopharmacology Bulletin. 1992; 28:425–432. [PubMed: 1296220]

Delis, DC.; Kramer, JH.; Kaplan, E.; Ober, BA. CVLT-II. The Psychological Corporation; New York: 2000.

Foa EB, Huppert JD, Leiberg S, Langner R, Kichic R, Hajcak G, Salkovskis PM. The Obsessive-Compulsive Inventory: Development and validation of a short version. Psychological Assessment. 2002; 14:485–496. [PubMed: 12501574]

Frost RO, Gross R. The hoarding of possessions. Behaviour Research and Therapy. 1993; 31:367–382. [PubMed: 8512538]

Frost RO, Hartl TL. A cognitive-behavioral model of compulsive hoarding. Behaviour Research and Therapy. 1996; 34:341–350. [PubMed: 8871366]

Frost RO, Shows DL. The nature and measurement of compulsive indecisiveness. Behaviour Research and Therapy. 1993; 31:683–692. [PubMed: 8216169]

Frost RO, Steketee G, Grisham J. Measurement of compulsive hoarding: Saving Inventory-Revised. Behaviour Research and Therapy. 2004; 42:1163–1182. [PubMed: 15350856]

Frost, RO.; Steketee, G.; Tolin, DF. Comorbidity in hoarding disorder. 2011. Submitted for publication

Frost RO, Steketee G, Williams L. Hoarding: a community health problem. Health and Social Care in the Community. 2000; 8:229–234. [PubMed: 11560692]

Golden, CJ. Stroop Color Word Test. Stoelting; Chicago: 1978.

Goodman WK, Price LH, Rasmussen SA, Mazure C, Delgado P, Heninger GR, Charney DS. The Yale-Brown Obsessive Compulsive Scale. II. Validity. Arch Gen Psychiatry. 1989; 46:1012–1016. [PubMed: 2510699]

Goodman WK, Price LH, Rasmussen SA, Mazure C, Fleischmann RL, Hill CL, Heninger GR, Charney DS. The Yale-Brown Obsessive Compulsive Scale. I. Development, use, and reliability. Arch Gen Psychiatry. 1989; 46:1006–1011. [PubMed: 2684084]

Grisham JR, Brown TA, Liverant GI, Campbell-Sills L. The distinctiveness of compulsive hoarding from obsessive-compulsive disorder. Journal of Anxiety Disorders. 2005; 19:767–779. [PubMed: 16076423]

Grisham JR, Brown TA, Savage CR, Steketee G, Barlow DH. Neuropsychological impairment associated with compulsive hoarding. Behaviour Research and Therapy. 2007; 45:1471–1483. [PubMed: 17341416]

Grisham JR, Norberg MM, Williams AD, Certoma SP, Kadib R. Categorization and cognitive deficits in compulsive hoarding. Behaviour Research and Therapy. 2010; 48:866–872. doi: S0005-7967(10)00107-5 [pii] 10.1016/j.brat.2010.05.011. [PubMed: 20542489]

Guy, W. Assessment manual for psychopharmacology. U.S. Government Printing Office; Washington, DC: 1976.

Hartl TL, Frost RO, Allen GJ, Deckersbach T, Steketee G, Duffany SR, Savage CR. Actual and perceived memory deficits in individuals with compulsive hoarding. Depression and Anxiety. 2004; 20:59–69. [PubMed: 15390215]

Heaton, RK. Wisconsin Card Sorting Test Manual. Psychological Assessment Resources; Odessa, FL: 1981.

Holdnack, J. Wechsler Test of Adult Reading Manual. The Psychological Corporation; San Antonio, TX: 2001.

Hooper, HE. The Hooper Visual Organization Test. Manual. Western Psychological Services; Beverly Hills, CA: 1958.

Huppert JD, Walther MR, Hajcak G, Yadin E, Foa EB, Simpson HB, Liebowitz MR. The OCI-R: Validation of the subscales in a clinical sample. J Anxiety Disord. 2007; 21:394–406. [PubMed: 16814981]

Jang JH, Kim HS, Ha TH, Shin NY, Kang DH, Choi JS, Ha K, Kwon JS. Nonverbal memory and organizational dysfunctions are related with distinct symptom dimensions in obsessive-compulsive disorder. Psychiatry Res. 2010; 180:93–98. doi: S0165-1781(10)00175-7 [pii] 10.1016/j.psychres.2010.04.016. [PubMed: 20483482]

Kurtz MM, Ragland JD, Bilker W, Gur RC, Gur RE. Comparison of the continuous performance test with and without working memory demands in healthy controls and patients with schizophrenia. Schizophrenia Research. 2001; 48:307–316. [PubMed: 11295383]

Lawrence NS, Wooderson S, Mataix-Cols D, David R, Speckens A, Phillips ML. Decision making and set shifting impairments are associated with distinct symptom dimensions in obsessive-compulsive disorder. Neuropsychology. 2006; 20:409–419. [PubMed: 16846259]

Leon AC, Shear MK, Klerman GL, Portera L, Rosenbaum JF, Goldenberg I. A comparison of symptom determinants of patient and clinician global ratings in patients with panic disorder and depression. Journal of Clinical Psychopharmacology. 1993; 13:327–331. [PubMed: 8227491]

Lovibond PF, Lovibond SH. The structure of negative emotional states: comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. Behaviour Research and Therapy. 1995; 33:335–343. [PubMed: 7726811]

Lovibond, SH.; Lovibond, PF. Manual for the Depression Anxiety Stress Scales. The Psychology Foundation of Australia; Sydney: 1995.

Luchian SA, McNally RJ, Hooley JM. Cognitive aspects of nonclinical obsessive-compulsive hoarding. Behaviour Research and Therapy. 2007; 45:1657–1662. [PubMed: 17014824]

Lucini, G.; Monk, I.; Szlatenyi, C. Bachelor of Science Thesis. Worcester Polytechnic Institute; Worcester, MA: 2009. An analysis of fire incidents involving hoarding households..

Myers, JE.; Meyers, KR. Rey Complex Figure Test and recognition trial manual. Psychological Assessment Resources; Lutz, FL: 1995.

Osterrieth PA. Le test de copie d'une figure complexe. Archives de Psychologie. 1944; 30:206–356.

Pertusa A, Frost RO, Fullana MA, Samuels J, Steketee G, Tolin D, Saxena S, Leckman JF, Mataix-Cols D. Refining the diagnostic boundaries of compulsive hoarding: a critical review. Clinical

Psychology Review. 2010; 30:371–386. doi: S0272-7358(10)00020-6 [pii] 10.1016/j.cpr.2010.01.007. [PubMed: 20189280]

Rosen WG. Verbal fluency in aging and dementia. Journal of Clinical Neuropsychology. 1980; 2:135–146.

Samuels JF, Bienvenu OJ, Riddle MA, Cullen BA, Grados MA, Liang KY, Hoehn-Saric R, Nestadt G. Hoarding in obsessive compulsive disorder: results from a case-control study. Behaviour Research and Therapy. 2002; 40:517–528. [PubMed: 12043707]

Savage CR, Baer L, Keuthen NJ, Brown HD, Rauch SL, Jenike MA. Organizational strategies mediate nonverbal memory impairment in obsessive-compulsive disorder. Biological Psychiatry. 1999; 45:905–916. doi: S0006-3223(98)00278-9 [pii]. [PubMed: 10202579]

Saxena S, Brody AL, Maidment KM, Smith EC, Zohrabi N, Katz E, Baker SK, Baxter LR Jr. Cerebral glucose metabolism in obsessive-compulsive hoarding. American Journal of Psychiatry. 2004; 161:1038–1048. [PubMed: 15169692]

Shallice T. Specific impairments of planning. Philos Trans R Soc Lond B Biol Sci. 1982; 298:199–209. [PubMed: 6125971]

Sheppard B, Chavira D, Azzam A, Grados MA, Umana P, Garrido H, Mathews CA. ADHD prevalence and association with hoarding behaviors in childhood-onset OCD. Depression and Anxiety. 2010; 27:667–674. doi: 10.1002/da.20691. [PubMed: 20583294]

Steketee G, Frost RO, Kyrios M. Cognitive aspects of compulsive hoarding. Cognitive Therapy and Research. 2003; 27:463–479.

Tolin DF. Understanding and treating hoarding: A biopsychosocial perspective. J Clin Psychol. 2011; 67:517–526. doi: 10.1002/jclp.20795. [PubMed: 21360705]

Tolin DF, Frost RO, Steketee G. A brief interview for assessing compulsive hoarding: The Hoarding Rating Scale-Interview. Psychiatry Research. 2010; 178:147–152. doi: S0165-1781(09)00178-4 [pii] 10.1016/j.psychres.2009.05.001. [PubMed: 20452042]

Tolin DF, Frost RO, Steketee G, Gray KD, Fitch KE. The economic and social burden of compulsive hoarding. Psychiatry Research. 2008; 160:200–211. [PubMed: 18597855]

Tolin DF, Meunier SA, Frost RO, Steketee G. Hoarding among patients seeking treatment for anxiety disorders. J Anxiety Disord. 2011; 25:43–48. doi: S0887-6185(10)00164-7 [pii] 10.1016/j.janxdis.2010.08.001. [PubMed: 20800427]

Tolin DF, Villavicencio A. Inattention, but not OCD, predicts the core features of hoarding disorder. Behav Res Ther. 2011; 49:120–125. doi: S0005-7967(10)00249-4 [pii] 10.1016/j.brat.2010.12.002. [PubMed: 21193171]

Wincze JP, Steketee G, Frost RO. Categorization in compulsive hoarding. Behaviour Research and Therapy. 2007; 45:63–72. [PubMed: 16530724]

Woody SR, Steketee G, Chambless DL. Reliability and validity of the Yale-Brown Obsessive-Compulsive Scale. Behaviour Research and Therapy. 1995; 33:597–605. [PubMed: 7598684]

Wu KD, Watson D. Hoarding and its relation to obsessive-compulsive disorder. Behaviour Research and Therapy. 2005; 43:897–921. [PubMed: 15896286]

Table 1

Sample Characteristics

	Hoarding (*N* = 27)	**OCD (*N* = 12)**	**Healthy Control (*N* = 26)**	***F***	χ^2
Age	53.67 (9.98)[a]	31.00 (10.13)[b]	44.81 (12.12)[c]	18.14**	
Female [N (%)]	24 (89%)[a]	5 (42%)[b]	18 (69%)		9.46*
White [N (%)]	23 (85%)	10 (83%)	24 (92%)		5.13
SI-R Clutter	24.85 (5.89)[a]	5.42 (4.42)[b]	2.69 (3.53)[b]	156.57**	
SI-R Difficulty Discarding	19.63 (5.36)[a]	6.58 (5.43)[b]	2.96 (3.81)[b]	84.44**	
SI-R Acquiring	14.96 (4.58)[a]	4.17 (4.28)[b]	2.50 (2.32)[b]	79.93**	
DASS Depression	6.44 (5.83)[a]	9.33 (7.50)[a]	0.46 (1.14)[b]	16.29**	
DASS Anxiety	3.23 (3.80)[a]	6.33 (5.30)[b]	0.35 (0.74)[c]	13.78**	
DASS Stress	9.74 (6.46)[a]	15.17 (10.80)[b]	1.23 (1.70)[c]	23.63**	
Y-BOCS (without hoarding)	6.79 (6.49)[a]	19.75 (5.12)[b]	0.31 (0.74)[c]	68.85**	
OCI Hoarding	9.07 (2.38)[a]	2.50 (3.00)[b]	1.42 (1.47)[b]	87.81**	
OCI Checking	1.41 (1.57)[a]	6.25 (4.20)[b]	0.38 (0.57)[a]	34.07**	
OCI Neutralizing	1.19 (1.52)[a]	4.00 (4.51)[b]	0.12 (0.43)[a]	13.34**	
OCI Obsessions	1.59 (1.80)[a]	8.08 (3.85)[b]	0.19 (0.57)[c]	64.32**	
OCI Ordering	3.85 (2.89)[a]	3.75 (2.56)[a]	1.46 (1.30)[b]	8.11**	
OCI Washing	1.07 (2.09)[a]	4.00 (3.52)[b]	0.08 (0.27)[a]	15.68**	
Comorbid Anxiety Disorder [N (%)]	9 (33%)	3 (25%)	--		0.27
Comorbid Depressive Disorder [N (%)]	10 (37%)	3 (25%)	--		0.54

Scores are shown as *M* (*SD*) unless noted otherwise.

Within each row, groups with different superscript letters are significantly different ($p < .05$).

* $p < .05$.

** $p < .01$.

Table 2

Mean (Standard Deviation) Neuropsychological Test Scores for Hoarding Patients, OCD Patients, and Healthy Controls.

	Hoarding	OCD	Healthy Control	*F*	*d* Hoarding vs. OCD	*d* Hoarding vs. Healthy Control
CPT HRT[1]	60.46 (11.57)[a]	54.69 (11.28)	50.00 (10.00)[b]	5.89**	0.50	0.97
CPT commission errors[1]	48.62 (6.14)	48.83 (5.10)	50.00 (10.00)	0.21	-0.04	-0.17
CVLT-II total recall	63.56 (11.54)	60.75 (10.91)	58.46 (11.19)	1.35	0.25	0.45
RCFT delayed recall	43.33 (9.05)	48.08 (11.87)	45.81 (8.45)	0.37	-0.45	-0.28
RCFT organizational score	42.05 (10.23)[a]	43.71 (11.69)	50.46 (11.48)[b]	4.11*	-0.15	-0.77
Hooper total correct	50.56 (3.96)[a]	55.58 (6.08)[b]	50.92 (5.00)[a]	4.98**	-0.98	-0.08
WCST total errors	48.72 (9.11)	51.44 (8.73)	49.83 (9.46)	0.30	-0.30	-0.12
TOL total moves	53.65 (11.61)	56.11 (8.80)	55.33 (8.87)	0.31	-0.24	-0.16
Stroop color-word score	52.48 (15.09)	50.92 (8.91)	50.35 (9.62)	0.21	0.13	0.17
COWAT-FAS total	47.52 (7.56)	45.25 (7.30)	47.35 (11.88)	0.26	0.31	0.02
Animal Naming total	51.56 (11.09)	44.50 (7.65)	50.27 (9.56)	2.15	0.74	0.12
WTAR	113.30 (9.13)	114.08 (9.54)	111.42 (10.57)	0.39	-0.08	0.19

Results are shown as mean (SD) of age-corrected T scores, with the exception of WTAR scores which are in standard score format (M = 100, SD = 15).

CPT = Continuous Performance Test. CVLT-II = California Verbal Learning Test-II. RCFT = Rey-Osterreith Complex Figure Test. WCST = Wisconsin Card Sorting Test. COWAT = Controlled Oral Word Association Test. WTAR = Wechsler Test of Adult Reading.

Within each row, groups with different superscript letters are significantly different ($p < .05$).

[1] T scores for CPT derived from the mean (SD) of the healthy control group.

* $p < .05$.

** $p < .01$.

Table 3

Correlations Between CPT Hit Reaction Time and OCD Symptom Dimensions on the OCI-R

OCI-R Subscale	CPT HRT Uncontrolled	CPT HRT Controlling for Age, Depression, and Anxiety
Hoarding	.390**	.300*
Checking	.168	.237
Neutralizing	.007	.005
Obsessing	.026	-.137
Ordering	.200	.085
Washing	.121	.112

CPT = Continuous Performance Test. OCI-R = Obsessive-Compulsive Inventory-Revised.

* $p < .05$.

** $p < .01$.

Table 4

Proportion of Hoarding Patients, OCD Patients, and Healthy Controls Scoring in the Impaired Range on Tests of Neuropsychological Function.

	Hoarding	OCD	Healthy Control	χ^2	OR (Hoarding vs. Nonhoarding)
CPT HRT	23.1% (n = 6)	11.1% (n = 1)	4.0% (n = 1)	4.06	5.14
CPT commission errors	3.8% (n = 1)	0% (n = 0)	4.0% (n = 1)	0.37	1.42
CVLT-II total recall	0% (n = 0)	0% (n = 0)	3.8% (n = 1)	1.52	--
RCFT delayed recall	14.8% (n = 4)	0% (n = 0)	7.7% (n = 2)	2.30	3.13
RCFT organizational score	14.8% (n = 4)	16.7% (n = 2)	3.8% (n = 1)	2.19	2.03
Hooper total correct	7.4% (n = 2)	16.7% (n = 2)	3.8% (n = 1)	1.91	0.93
WCST total errors	14.8% (n = 4)	25.0% (n = 3)	15.4% (n = 4)	0.69	0.77
TOL total moves	7.4% (n = 2)	0% (n = 0)	0% (n = 0)	2.90	--
Stroop color-word score	7.4% (n = 2)	0% (n = 0)	0% (n = 0)	2.90	--
COWAT-FAS total	3.8% (n = 1)	7.7% (n = 2)	8.3% (n = 1)	0.49	0.45
Animal Naming total	3.8% (n = 1)	8.3% (n = 1)	3.8% (n = 1)	0.46	0.69
WTAR	0% (n = 0)	0% (n = 0)	3.8% (n = 1)	0.47	--
Any impairment	66.7% (n = 18)	58.3% (n = 7)	42.3% (n = 11)	3.23	2.22

CPT = Continuous Performance Test. CVLT-II = California Verbal Learning Test-II. RCFT = Rey-Osterreith Complex Figure Test. WCST = Wisconsin Card Sorting Test. COWAT = Controlled Oral Word Association Test. WTAR = Wechsler Test of Adult Reading. OR = Odds ratio. *$p < .05$. **$p < .01$. Within each row, groups with different superscript letters are significantly different ($p < .05$).