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Executive functioning in older adults with hoarding disorder

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Background: Hoarding disorder (HD) is a chronic and debilitating psychiatric condition. Midlife HD patients have been found to have neurocognitive impairment, particularly in areas of executive functioning, but the extent to which this is due to comorbid psychiatric disorders has not been clear.

Aims/Method: The purpose of the present investigation was to examine executive functioning in geriatric HD patients without any comorbid Axis I disorders ($n = 42$) compared with a healthy older adult comparison group ($n = 25$). We hypothesized that older adults with HD would perform significantly worse on measures of executive functioning (Wisconsin Card Sort Task [Psychological Assessment Resources, Lutz, Florida, USA] (Psychological Assessment Resources, 2003) and the Wechsler Adult Intelligence Scale-IV digit span and letter–number sequencing tests [Pearson, San Antonio, TX, USA]).

Results: Older adults with HD showed significant differences from healthy older controls in multiple aspects of executive functioning. Compared with healthy controls, older adults with HD committed significantly more total, non-perseverative errors and conceptual level responses on the Wisconsin Card Sort Task and had significantly worse performance on the Wechsler Adult Intelligence Scale-IV digit span and letter–number sequencing tests. Hoarding symptom severity was strongly correlated with executive dysfunction in the HD group.

Conclusions: Compared with demographically-matched controls, older adults with HD have dysfunction in several domains of executive functioning including mental control, working memory, inhibition, and set shifting. Executive dysfunction is strongly correlated with hoarding severity and is not because of comorbid psychiatric disorders in HD patients. These results have broad clinical implications suggesting that executive functioning should be assessed and taken into consideration when developing intervention strategies for older adults with HD. Copyright © 2013 John Wiley & Sons, Ltd.

Introduction

Hoarding disorder (HD) is a chronic psychiatric condition that begins early in life and may worsen with age (Ayers *et al.*, 2010). Studies of midlife HD patients have found neurocognitive deficits in several cognitive domains including executive functioning, yet we do not know to what extent these deficits are present in older adults who may show greater impairment because of age-related cognitive decline. Further, it is not clear to

what extent the neurocognitive deficits found in midlife HD patients are related to comorbid psychiatric disorders. Therefore, the present investigation sought to examine executive functioning in a group of geriatric HD patients without any comorbid Axis I psychiatric disorders compared with a healthy older adult comparison group.

The prevalence of clinically significant hoarding in the general population has been estimated at 3%–5% (Samuels *et al.*, 2008; Mueller *et al.*, 2009; Iervolino

et al., 2009). HD has recently been accepted into the Diagnostic and Statistical Manual Version 5 set for release in 2013. The diagnostic criteria for HD include persistent difficulty discarding or parting with possessions, regardless of their actual value, owing to a perceived need to save items, distress associated with discarding leading to the accumulation of possessions that congest and clutter active living areas and substantially compromise their use, and clinically significant distress or impairment in social, occupational, or other important areas of functioning (including maintaining a safe environment for self and others) (Mataix-Cols *et al.*, 2010). Early conceptualizations of hoarding postulated cognitive deficits as contributory factors (Frost and Hartl, 1996).

There is evidence for neurocognitive deficits in midlife hoarding patients including impairments in memory, attention, and executive functioning (e.g.,categorization, organization, decision making, and problem solving). Hartl and colleagues (Hartl *et al.*, 2004) found that compulsive hoarding patients had significantly worse visual and verbal delayed recall than healthy controls. Compulsive hoarders also appear to have deficits in organization and categorization. When hoarding participants were asked to organize objects into categories, they created a significantly large number of categories and reported more anxiety when categorizing personally relevant items than normal controls (Wincze *et al.*, 2007). Hoarding participants were also under-inclusive when categorizing objects and showed poor organization of information. Further, obsessive–compulsive disorder (OCD) patients with hoarding symptoms demonstrated less effective organizational strategies and planning than did normal controls and OCD patients who did not hoard on the Iowa Gambling Task (IGT—Bechara *et al.*, 1994) (Lawrence *et al.*, 2006). However, these IGT results were not replicated in another sample of hoarding patients (Grisham *et al.*, 2007). Grisham and colleagues (Grisham *et al.*, 2007) found that hoarding patients had difficulty identifying targets and non-targets; performed on worse spatial attention; demonstrated a slow, variable reaction time; and had increased impulsivity compared with a community comparison group as well as a mixed mood and anxiety disorders clinical group. A follow-up to this investigation found executive functioning deficits in planning, categorization, and decision making as well as attentional difficulties in hoarders compared with non-clinical controls (Grisham *et al.*, 2010). This work is further supported by recent findings highlighting difficulties in executive function specific to concentration/working memory and cognitive flexibility as measured by the Wisconsin Card Sort Test

(WCST—Delis *et al.*, 2001a, 2001b) in an adult sample (McMillan *et al.*, 2012). For the most part, the midlife hoarding literature indicates deficits in executive functioning and higher order cognitive functions. In contrast to these investigations, one recent study did not find executive functioning impairment in hoarding patients but did find difficulties with sustained attention and adaptive memory organizational strategies in patients with HD compared with healthy controls (Tolin *et al.*, 2011).

Only one neuropsychological investigation has been conducted with older hoarding patients. Utilizing the Delis–Kaplan Exe DELIS–KAPLAN EXECUTIVE FUNCTION SYSTEM Card Sorting Test (Pearson, San Antonio, TX, USA)(Delis *et al.*, 2001a, 2001b), Mackin and colleagues (Mackin *et al.*, 2011) found preliminary evidence that older adults with major depression and hoarding behaviors had categorization and problem solving impairment compared with non-hoarding older adults with depression. Because all subjects in that study had major depression, it is unclear whether similar executive dysfunction would be seen in non-depressed older HD patients. Moreover, patients in that study did not necessarily meet criteria for HD. No studies to date have investigated neurocognitive functioning in geriatric patients with HD diagnosed or assessed with standardized hoarding severity measures. Given the increased frequency of neurocognitive complaints and decline among older adults (Baxendale, 2011) and the decline in executive functioning that occurs with age (e.g., Rhodes, 2004; Fisk and Sharp, 2004), the importance of examining executive function in older adult hoarding patients is particularly salient.

Executive functioning deficits have consistently been found in older adults with mood and anxiety disorders such as major depressive disorder (e.g., Lockwood *et al.*, 2002; Butters *et al.*, 2004; Thomas *et al.*, 2009) and generalized anxiety disorder (e.g., Mantella *et al.*, 2007)—two of the most commonly comorbid disorders in patients with HD (Frost *et al.*, 2011). Yet no published neuropsychological study of compulsive hoarding patients to date has excluded patients with comorbid mood and anxiety disorders, so the extent to which those comorbid disorders may have accounted for the neurocognitive abnormalities found in those studies is unknown. Therefore, we sought to determine whether geriatric HD was associated with executive dysfunction even in the absence of any comorbid Axis I psychiatric disorders. We also sought to determine whether executive dysfunction was related to the severity of hoarding symptoms and the functional impairment they produce. We hypothesized that older adults with HD would perform significantly

worse than a healthy comparison group of older adults on tests of executive functioning including the domains of problem solving, shifting set, categorization, working memory, mental control, and concentration. We further hypothesized that hoarding severity would be strongly associated with the degree of executive dysfunction displayed by these participants, which would support the cognitive behavioral theory put forth by Frost and Hartl (1996) of cognitive deficits underlying the symptomatic expression of hoarding.

Method

Participants

All participants were 58 years of age or older. Participants in the hoarding group met the Diagnostic and Statistical Manual of Mental Disorders-5 diagnostic criteria for HD based on clinical interview. Further, this diagnosis was confirmed by a consensus conference including at least two licensed professionals with expertise in hoarding a score of 20 or greater on the University of California at Los Angeles Hoarding Severity Scale (UHSS—Saxena et al., 2007) and a score of 40 or greater on the Savings Inventory-Revised (SI-R—Frost et al., 2004a, 2004b). Exclusion criteria for both groups included moderate to severe cognitive deficits indicated by scores below 23 on the Mini Mental Status Exam (MMSE), current or history of any neurodegenerative disease or traumatic brain injury or active suicidal ideation, and meeting criteria for any current Axis I diagnosis. Use of any benzodiazepines was prohibited 24 h prior to testing. Healthy older adults were excluded if they were taking any psychotropic medications. HD participants were excluded if they had any changes in their psychotropic medications within the 12 week period preceding the assessment.

Procedure

HD participants and the healthy comparison group were recruited with posted flyers throughout San Diego County for two potential studies: one an assessment-only investigation and one treatment study (baseline utilized) for late life hoarding. Participants were examined for a total of 3 h by a licensed clinical psychologist or advanced graduate student with specialty training in neuropsychology. The evaluation included clinician-administered psychiatric symptom rating scales, a series of neuropsychological tests, and self-report questionnaires. All participants provided verbal and written informed consent to the study procedures. Procedures were approved by the local institutional review board.

Diagnostic assessment

Mini-International Neuropsychiatric Interview (M.I.N.I—Sheehan et al., 1998) is a brief diagnostic interview that uses decision-tree logic to assess different mental disorders. This interview has demonstrated excellent reliability and validity and produces the same diagnoses as the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I—First et al., 1997) in 85%–95% of cases.

The SI-R (Frost et al., 2004a, 2004b) is a 23-item self-report measure used to assess hoarding severity. Subtests include excessive clutter, excessive acquisition, and difficulty discarding. The SI-R has demonstrated reliability ($\alpha = 0.92$) and good convergent validity with other scales of hoarding. The current investigation demonstrated similar internal consistency ($\alpha = 0.98$).

The UHSS (Saxena et al., 2007) is a 10-item clinician-administered scale that measures the severity of multiple aspects of the compulsive hoarding syndrome including urges to save, difficulty discarding, excessive acquisition, clutter, indecisiveness, procrastination, slowness, and impairment from hoarding. This scale is in the process of being validated (Saxena and Ayers, in progress). Preliminary results show that in a sample of 62 hoarding and 65 control participants without any psychiatric diagnoses the UHSS demonstrates good reliability (Cronbach's $\alpha = 0.70$). Within the hoarding sample, the UHSS demonstrated good internal consistency ($\alpha = 0.96$) and was significantly correlated with the SI-R ($r = 0.59$, $p = 0.000$) demonstrating convergent validity.

Neuropsychological battery

Screening measure. The MMSE (Folstein et al., 1975). The MMSE is a brief, widely used 30-item screening test for cognitive impairment. Scores less than 23 indicate potential moderate to severe cognitive impairment. This measure was used as a screen during the initial assessment.

Executive function. The WCST-64 and 128 Item (Delis et al., 2001a, 2001b) measure the executive functions of shifting set, problem solving/hypothesis testing, and response maintenance (Greve et al., 2005). Participants are instructed to categorize a series of cards according to one of the three stimulus features (color, shape, or number of illustrations on them) without this principle

being revealed to the subject. After each association, the only feedback given is whether a match is correct or incorrect, the idea being that participants should infer how to categorize on the basis of the feedback they received. The computerized short version (WCST-64) was used for the first eight subjects and then replaced by the WCST-128 computerized version in order to provide for a more comprehensive assessment. The WCST variables of interest included the WCST total errors, conceptual level responses, perseverative errors, and non-perseverative errors.

Wechsler Adult Intelligence Scale-IV letter–number sequencing (*WAIS-IV*—Wechsler, 2008) is an attention and working memory task with mental sorting as its interfering operation. The participant is read a combination of letters and numbers and is asked to recall the numbers first in ascending order followed by the letters in alphabetical order. Raw scores for letter–number sequencing were utilized.

Wechsler Adult Intelligence Scale-IV digit span (WAIS-IV—Wechsler, 2008) is an attention and verbal working memory task that requires mental control and concentration. The participant is read a series of numbers and is asked to recite the list back. A second task requires the participant to recall the list backwards. Raw scores from each subject's total correct forward and backward recall were combined as the outcome variable.

Data analysis

Statistical analyses were carried out using SPSS 18.0. (IBM, Armonk, NY, USA). All data were evaluated for normality of distribution and homogeneity of variance. No significant variation from the normal distribution was found. Demographic variables between the two groups were compared using one-way analysis of variance and chi-square. Multivariate analysis of covariance was used to investigate group differences in executive functioning measures with age, gender, and education as covariates. Raw scores were utilized for all analyses from neurocognitive tests. Partial eta squares were calculated for these analyses to provide information about effect sizes. To identify significant associations between hoarding severity and executive dysfunction, Pearson correlations were calculated between UHSS and SI-R scores and performance on executive functioning (standardized scores) tests.

Results

Forty-two participants with HD and no comorbid Axis I psychiatric disorder and 25 healthy older adults without any psychiatric disorder participated in the study. Thirty-seven prospective participants with HD were excluded for having a comorbid Axis I disorder. Persons recruited to participate in the healthy comparison group were similar to the hoarding group with respect to age and educational level to control for the potential effects of these characteristics on neuropsychological performance. As a result, the groups did not differ significantly on relevant demographic characteristics including age, educational level, or gender ratio (Table 1). Eleven subjects were taking antidepresssant medications. Yet, they did not meet criteria for any Axis I diagnosis as measured by structured interview Mini-International Neuropsychiatric Interview or clinical interview when probed further about potential Axis I comorbidities.

Hypotheses were largely supported (Table 2). Concentration and working memory, as measured by WAIS-IV letter–number sequencing and digit span, were significantly different between groups ($F_{1,58} = 12.06$, $p = 0.001$ for letter–number sequencing; $F_{1,58} = 8.45$, $p = 0.005$ for digit span). Significant group differences were also found in WCST total errors ($F_{1,58} = 4.53$, $p = 0.038$); HD participants made significantly more errors on the WCST than the normal comparison group. Further, HD participants made significantly more non-

Table 1 Sample characteristics

	HD Participants Mean (sd)	Non-Psychiatric Participants Mean (sd)	$F_{1,66}$	p
Gender	20 male, 22 female	16 male, 9 female		
Age	66.90(6.65)	66.76 (7.11)		
Education	16.05(1.67)	15.28 (2.22)		
Ethnicity	4 Latino,	1 African American,		
	2 African American,	24 Caucasian		
	36 Caucasian			
Savings Inventory-Revised	53.35 (12.63)	9.95 (6.28)	229.98	0.000
UCLA Hoarding Severity Scale	25.64(6.02)	3.52 (3.24)	286.54	0.000

Table 2 Mean (standard deviation) of neurocognitive functioning raw scores in non-anxious or depressed HD and non-psychiatric participants using age, gender, and education as covariates

Measure	HD Participants	Non-psychiatric Participants	$F_{1,66}$	p	Partial Eta Squared
WAIS-IV Letter Number Sequencing	**7.57 (2.77)**	**10.28 (2.17)**	**12.06**	**0.001**	**0.19**
WAIS-IV Digit Span	**14.12 (4.90)**	**18.12 (3.70)**	**8.45**	**0.005**	**0.14**
WCST Total Errors	**33.11 (20.51)**	**21.00 (10.65)**	**5.55**	**0.022**	**0.09**
WCST Perseverative Errors	16.34 (12.75)	11.20 (6.05)	---	---	---
WCST Non-perseverative Errors	**16.74 (11.18)**	**9.79 (5.14)**	**6.05**	**0.017**	**0.10**
WCST Conceptual Level Response	**49.17 (22.50)**	**60.95 (20.43)**	**7.42**	**0.009**	**0.12**

perseverative errors ($F_{1,63} = 4.25$, $p = 0.044$) and performed worse on conceptual level responses ($F_{1,63} = 4.25$, $p = 0.044$) on the WCST. Interestingly, the only true deficit for HD participants was in non-perseverative errors (T-score = 38), whereas WCST total errors approached deficit level (T-score = 41). There was no significant difference between groups in WCST perseverative errors.

Within the hoarding group, hoarding severity was strongly associated with poor performance on the WCST but not with WAIS digit span or letter–number sequencing performance (Table 3). Both UHSS and SI-R scores showed significant correlations with WCST total errors, non-perseverative errors, perseverative errors, and conceptual level responses.

Discussion

This is the first study to examine neurocognitive functioning in older adults with HD diagnosed using strict diagnostic criteria and assessed with validated, specific measures of hoarding severity and a neuropsychological battery of tests that assessed various domains of executive functioning. It was also the first neuropsychological study of HD patients that excluded all comorbid Axis I psychiatric disorders eliminating the potential confound of the effects of comorbid disorders on neurocognitive performance. We found that older

participants with HD performed significantly worse than their healthy peers in several domains of executive function including concentration, mental control, working memory (WAIS digit span and letter–number sequencing), as well as set shifting, inhibition, and cognitive flexibility (WCST).

On the WCST, older HD patients had significantly worse scores for total errors, conceptual level responses, and non-perseverative errors. A greater number of total errors may indicate problems with conceptual skills and set shifting (Delis et al., 2001a, 2001b). Significant group differences in non-perseverative errors, but not perseverative errors, on the WCST suggest that older HD patients have greater tendency to become distracted and may have deficient inhibition (Steinmetz and Houssemand, 2011) and attentional set-shifting processing (Barcelo, 2001). Findings in non-perseverative errors suggest that hoarding participants have difficulty with categorizing, learning efficiently, maintaining attention, and utilizing feedback. Differences between groups in conceptual level responses may reflect difficulties with insight, abstract thinking, set shifting, and maintaining cognitive set. Older adults with HD also had significantly worse performance than healthy older controls on the WAIS digit span and letter–number sequencing subtests indicating problems with attention, mental control, and verbal working memory.

Multiple aspects of executive functioning including categorization, set shifting, working memory, concentration,

Table 3 Correlations of hoarding severity and measures of executive functioning (n=42, HD participants)

	Saving Inventory-Revised	UCLA Hoarding Severity Scale
WAIS-IV Letter Number Sequencing	−0.07	0.03
WAIS-IV Digit Span	−0.09	−0.23
WCST Total Errors	**0.33***	**0.43****
WCST Perseverative Errors	**0.35***	**0.43****
WCST Non-Perseverative Errors	0.24	**0.40****
WCST Conceptual Level Response	**0.31***	**0.41****

*Correlation significant at the 0.05 level (2-tailed)
**Correlation significant at the 0.001 level (2-tailed)

and mental control appear to be problematic in both midlife and older hoarding patients. Our results are somewhat consistent with those of previous neuro-cognitive investigations of midlife individuals with hoarding (e.g., Grisham *et al.*, 2007; Wincze *et al.*, 2007). For example, findings from McMillian and colleagues (McMillan *et al.*, 2012) in a midlife hoarding sample suggested problems with forming effective strategies, inadequate feedback response, and poor concept formation as measured by the WCST. However, our findings are in contrast to those of other studies that did not find executive functioning deficits on the WCST (e.g., Tolin *et al.*, 2011; Lawrence *et al.*, 2006). Lawrence did find significant results on the IGT. Notably, Lawrence and colleagues examined only OCD participants with "prominent hoarding" rather than hoarders who did not have comorbid OCD. Thus, comorbidity of OCD and hoarding symptoms may have confounded results. Further, those investigations were not conducted in geriatric participants. Nevertheless, the growing literature supports the presence of executive functioning problems in HD patients across the life span.

Deficits in executive functions have been found in multiple psychiatric illnesses across the lifespan including OCD, late life generalized anxiety disorder, and depression (Kuelz *et al.*, 2006; Mohlman and Gorman, 2005; Alexopoulos *et al.*, 2008). In a sample of older depressed patients with hoarding behaviors, compared with non-hoarding older depressed patients, Mackin and colleagues (Mackin *et al.*, 2011) found significant differences in aspects of executive functioning including categorization and problem solving. Our results were consistent with these findings. However, our results are particularly interesting given that we found executive function differences in HD participants who did not have any other Axis I psychiatric disorder. The fact that even those HD participants who had no comorbid psychiatric disorders showed significant differences from older controls in several domains of executive function indicates that executive dysfunction in HD patients is not merely because of comorbid mood, anxiety, OCD, or other psychiatric disorders. Thus, our findings add to the growing literature on the nature and potential impact of executive dysfunction across a range of late life psychiatric disorders.

Further, we found that executive functioning was strongly correlated with the severity of compulsive hoarding symptoms as measured by both self-report and clinician-administered rating scales. Correlations between UHSS scores and WCST performance were even stronger than those between SI-R scores and WCST performance suggesting that executive dysfunction might be closely related with the associated features of

indecisiveness, perfectionism, and procrastination that are assessed by the UHSS but not by the SI-R. These associated features have been found to be uniquely and significantly associated with hoarding status, significantly correlated with hoarding severity, and strong predictors of social impairment in an epidemiological study of HD (Timpano *et al.*, 2011). These findings suggest that executive dysfunction may contribute to both the symptomatic expression of HD as well as the degree of functional impairment suffered by HD patients.

These results are not surprising as we often see executive functioning difficulties in the clinical manifestation of HD. Difficulty using feedback from the environment is apparent as HD patients continue to behave in ineffective ways despite ample evidence that their strategies are not working (e.g., McMillan *et al.*, 2012). A classic example is "churning" possessions around the room rather than actually making choices and discarding items. HD patients continue this strategy despite years of poor results. Further, an inability to shift strategies and think flexibly (e.g., McMillan *et al.*, 2012) affects how they manage and make choices about their possessions. Novel and unexpected situations or items may easily cause confusion such that they do not complete tasks such as sorting or discarding unneeded items. Problem solving is often poor (e.g., Grisham *et al.*, 2007; Mackin *et al.*, 2011) as seen in their difficulty finding solutions to everyday problems. In addition, poor decision making is evidenced in difficulty making simple decisions especially decisions about whether to save or discard possessions. The aforementioned difficulties, coupled with poor concentration, mental control, and working memory, impact abilities to maintain household organization and persist with discarding tasks (e.g., Hartl *et al.*, 2004; Grisham *et al.*, 2010). These executive functioning deficits likely explain why these patients often need a long course of treatment to learn necessary skills.

This study has several limitations including a relatively small comparison group, lack of ethnic diversity, and the use of multiple comparisons. These results should be replicated using a larger sample and possibly other standardized measures of executive functioning to verify these findings. However, this study also has strengths such as strict inclusion and exclusion criteria; specific, valid measures of hoarding severity; use of a non-psychiatric older adult comparison group; and a validated neurocognitive assessment battery. This study is timely as our diagnostic understanding of HD is growing (Mataix-Cols *et al.*, 2010), yet treatment remains suboptimal (Ayers *et al.*, 2011) for geriatric hoarding patients.

Acknowledgement

Conflict of interest

None declared.

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