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Rigidity, Planning and Autistic Traits in Hoarding Disorder: a Comparative Study between Patients with Hoarding Disorder and Obsessive-Compulsive Disorder

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Abstract

Introduction Hoarding symptoms have been described in patients with obsessive-compulsive disorders (OCD). There are indications that hoarding is related to autism problems rather than to OCD. Therefore, we aimed to investigate the presence of autistic traits, theory of mind and rigidity in patients with hoarding disorder (HD) and compare them to OCD patients without hoarding behavior. *Method* 34 participants in three groups (HD; mostly without OCD, OCD without hoarding and healthy controls) were tested on autistic traits (AQ; Autism Spectrum Quotient), theory of mind (Faux-pas Test), cognitive flexibility/ rigidity (Intra-/ Extra-dimensional Set Shifting; ID/EDS, Stroop Color-Word Test), planning (Tower of London; ToL), and obsessive-compulsive personality disorder (OCPD SCID II). *Results* HD and OCD patients displayed similarly elevated scores on the Obsessive-compulsive Inventory-Revised, on behavioral inhibition scale (BIS) and on AQ total score as well as on 4 of five of the AQ subscales compared to controls. Further, HD patients showed higher percentages of OCPD than both OCD patients and controls, and showed a tendency to perform lower on the neuropsychological task that reflects planning (ToL) compared to OCD and controls. On the Faux-pas test, no between-group differences were shown. *Discussion* HD patients show no dysfunction with respect to communication problems. However, they reveal similarly elevated scores as OCD patients on OCD symptoms, on behavioral inhibition, on rigidity (reflected in OCPD scores) and on autism symptoms that reflect a lack of cognitive flexibility. This striking overlap between HD and OCD with respect to behavioral inhibition/ lack of flexibility is in contrast with the notion to place hoarding as a distinct disorder in DSM-V, although sample size is too small to draw definite conclusions. More research is needed on the relationship between hoarding, OCPD and OCD.

Voorwoord

Dit is een onderzoek naar de overlap tussen autistische trekken en neuropsychologische factoren bij patiënten met verzameldwang. Het is een zeer interessante doelgroep. Bij de testafname werd het verschil in eigenzinnigheid van deze mensen, in vergelijking met patiënten met OCD, kenbaar. Het was leuk en soms inspannend om de testbatterij goed af te nemen bij hen, maar bovenal zeer interessant!

Dit onderzoek heeft me meer inzicht gegeven in de problematiek van patiënten met verzameldwang, alsook OCD, maar meer nog heeft het me inzicht gegeven in de moeilijkheid van goed en gedegen onderzoek. Veel tijd heeft gezeten in de testafname en dataverwerking. Het heeft me nog meer dan eens duidelijk gemaakt hoe belangrijk een vooropgezet plan is voor een goede afronding.

De goede samenwerking met Quintine ten Hoopen heeft een grote bijdrage geleverd aan het dit resultaat. Ook gaat veel dank uit naar Mathilde Huisman en Puck Duits voor de begeleiding vanuit het Academisch Angstcentrum Altrecht, Jan-Willem van der Wielen voor zijn medewerking bij de afname van de SCID en tot slot wordt dr. D.C. Cath, begeleidster vanuit de Universiteit Utrecht, bedankt voor haar motiverende begeleiding en scherpe inzichten.

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1. Introduction

Autism spectrum disorders (ASD) include symptoms as qualitative impairments in reciprocal social interaction and communication, and a pattern of stereotyped repetitive behaviors and interest (*DSM-IV-TR*; Amercan Psychiatric Association, 2000). Within the domain of ASD repetitive behaviors are quite common and varied. Repetitive behavior in ASD, as described by South, Ozonoff and McMahon (2005), can be categorized into four subgroups: (a) stereotyped motor mannerisms, (b) preoccupation with nonfunctional objects or part of objects, (c) patterns of interest that are unusual in the narrowness and/or intensity of their pursuit, and (d) extreme rigidity and insistence on sameness. Although these repetitive behaviors are often considered to be highly similar to obsessive-compulsive disorder (OCD) symptoms (Lewis & Bodfish, 1998; Ruta, Mugno & D'Arrigo, 2010), most of these behaviors are not considered as reflecting obsessive compulsive symptomatology (Russell, Mataix-Cols, Anson & Murphy, 2005).

Compulsive hoarding, as described by Frost and Hartl (1996), is defined as the excessive acquisition of large numbers of possessions and the failure to discard them, even if the possessions have little or no value. This becomes clinically relevant when causing significant distress or impairment in daily functioning, for instance when living spaces can no longer be used for their intended purposes, the amount of clutter forms a threat to the persons health or that of others, or the person becomes socially isolated because others can no longer be invited to the house.

In DSM-IV, hoarding is listed as a symptom dimension of OCD and as a diagnostic criterion for Obsessive Compulsive Personality Disorder (OCPD). However, since about 50 percent of the hoarders show no other obsessive-compulsive symptoms or their hoarding is not OCD-related, classifying hoarding as a separate disorder in DSM-V is being considered (Mataix-Cols et al., 2010).

In support with the above-mentioned, there are several features in which patients with hoarding disorder (HD) seem to be distinct from OCD patients (with or without hoarding). In general, hoarding disorder is hardly noticed until the situation at home is getting out of control, which is often not before the age of 50. The age of onset of hoarding symptoms is obviously lower (12 to 13 years), but prevalence increases with age (Grisham, Frost, Stekee, Kim & Hood, 2006). This is in contrast with OCD, in which the first symptoms can occur from the age of eight and patients are often brought under the attention of mental health care professionals at a much younger age than hoarders. OCD symptoms can be grouped into four symptom dimensions: obsessing and checking, symmetry and ordering, cleanliness and washing, and, finally, hoarding (Saxena, 2008). Conversely, as noted before, at least 50 percent of hoarding patients do not display washing, checking, obsessing or symmetry behaviors as found in OCD cases. If HD should be regarded as an entity that is distinct from the repetitive symptoms as displayed by patients with OCD, then how should they be grouped and what exactly is going on at a neuropsychological level in HD patients when compared to OCD patients?

In individuals with HD, the following information processing deficits appear to be involved: (a) indecisiveness; hoarders often have problems with decision making, as saving becomes a way of avoiding to decide what needs to be discarded and what not; (b) difficulties in categorizing and organizing; because of so called under-inclusion, each possession becomes unique and forms its own category which makes it harder to discard. Dysfunctional cognitive beliefs that accompany the problems in discarding are that the objects that are saved can be useful one day, and discarding is considered a waste; (c) a lack of confidence in their own memory coupled with the conviction that everything has to be remembered contribute to keeping possessions (often in sight) so no information will be lost. In addition, (d) most hoarders are highly emotionally attached to their possessions. In some severe cases, the objects hoarded tragically become more important than friends and relatives (Frost & Hartl, 1996; Pertusa et al., 2010).

Some of these problems could suggest an overlap with autism like repetitive behavior, problems in social interaction, inflexibility/ rigidity, problems with planning and difficulties with overview as the distinction between major and side issues. (Anholt et al., 2010; Pellicano, 2007; Sinzig, Morsch, Bruning, Schmidt & Lehmkuhl. 2008).

With respect to the overlap in symptom profile between hoarding, OCD and autism Anholt et al. (2010) investigated associations between OCD symptom dimensions (including the symptom dimension of hoarding) in OCD patients and autism/ADHD symptoms. This study showed higher scores on ADHD and autism scales in OCD patients (specifically the washers, checkers and symmetry group) than controls. OCD patients with co-morbid ADHD yielded showing higher scores on the autism subscales of attention switching problems and difficulties in social skills. Remarkably, the OCD group with hoarding symptoms only scored high on inattention, not on the autism scale. Moreover, a recent study by Tolin and Villavicencio (2010) indicated that hoarders are predominantly bothered by attention deficits, and not by OCD. Unfortunately, they did not measure the role of autism in their study.

A recent study by Pertusa et al. (2011), examining co-morbidity with autism spectrum disorder in inter alia OCD patients and hoarders, investigated a hallmark of autism patients, i.e., deficits in theory of mind that both groups might share. Theory of mind refers to the ability to attribute mental states to oneself or another, so one can predict and make sense of another person's behavior (Belmonte, 2008). In this study hoarders did not perform worse on theory of mind tasks than OCD patients (sometimes even better). No significant difference was found between HD and OCD patients on the total AQ score. However, both groups had higher scores total AQ scores than the healthy control group. Pertusa et al. did not compare the groups on the different subscales of the AQ. Especially the comparison of communication and social skills on the one hand and attention switching and attention to detail on the other would have been interesting.

Another underlying deficit that hoarders, OCD patients and ASD patients might share, reflects problems with organization, categorization and planning. With respect to neuropsychological functioning in

patients with HD versus patients with OCD, very few comparative studies have been performed recently, although research has been done on executive functioning in HD and in OCD patients separately. Grisham, Brown, Savage, Stekee & Barlow, (2007) compared compulsive hoarders with normal controls without anxiety or mood disorders on (non) verbal attention, working memory, response inhibition, and emotion based decision-making. In addition, the results of this study were compared to the results of a group with anxiety and mood disorders, but without OCD or compulsive hoarding, to control for possible differences caused by anxiety or mood disorders in general. The study demonstrated lower reaction times, higher impulsivity rates, more problems distinguishing targets from non targets and worse spatial attention and planning, measured with the *Visual Memory Span,* (VMS; Wechsler, 1987) in the hoarding group compared to normal controls. Interestingly, there was no significant difference in emotion-based decision-making between the groups. This suggests that hoarders might have difficulties categorizing and organizing their possessions due to problems with sustained attention and planning rather than suffering from problems in the decision making process as such (Nydén et al., 2010).

In sum, the following picture emerges: there are differences between patients with HD and OCD. HD patients may seem to be more rigid and more likely to have problems with sustained attention, impulsivity, and planning and organization. In hoarding, the predominant comorbidity with autism does not seem to be based on shared problems with contact and communication, but is rather reflected in shared underlying executive functioning and memory deficits as described before. In OCD patients, the picture is more complex, when looking at symptom profiles and neuropsychological functioning. However, to date very little comparative studies have been performed.

This study aims to extend previous studies by examining autism symptoms together with autism related neuropsychological profiles in patients with hoarding symptoms without OCD, contrasting them to OCD patients without hoarding, and comparing them to normal controls. The research questions are: to what extend is there an overlap in autism traits in patients with HD compared to OCD patients without hoarding and normal controls, when looking at theory of mind and specific neuropsychological functions.

It is hypothesized that individuals with HD are similar to OCD patients and controls with respect to autistic traits as measured with the Autism Questionnaire (AQ) and on theory of mind function. The next hypothesis of this study is that patients with HD will suffer more from cognitive rigidity compared to OCD patients. This will be reflected on SCID II Obsessive Compulsive Personality Disorder interview and on the following neuropsychological functions; set shifting (ID/EDS) and higher outcomes on the cognitive rigidity subscale of the Stroop Color Word Test. Also expected, HD patients perform worse on planning as measured with the Tower of London.

2. Methods

2.1 Participants

This study encompassed 37 participants. Due to the low verbal IQ-score based on the Dutch Reading Tests for Adults (Nederlandse Leestest voor Volwassenen; NLV; Schmand, Lindeboom & Harskamp, 1992) 3 participants were excluded, so 34 participants were investigated for this study: 11 with HD (45.5% female, mean age = 50.6, SD = 10.2), 11 OCD patients (55.5% female, mean age = 42.6, SD = 8.7) and 12 healthy controls (45.5% female, mean age = 54.8, SD = 4.6). The HD and OCD patients were recruited from the mental health care service Altrecht Polikliniek Noord, Utrecht.

2.2 Procedure

The control group was matched based on age, sex and educational level and recruited through the snowball method. The controls were administrated the Mini International Neuropsychiatric Interview (MINI; Lecrubier et al., 1997), the Structured Clinical Interview on the DSM IV diagnose of Obsessive-Compulsive Personality Disorder (OCPD SCID II; First, Gibbon, Spitzer, Williams & Benjamin, 2000) and the Structured Interview of Hoarding Disorder (SIHD; Pertusa & Mataix-Cols, 2010) to ensure absence of (major) symptoms of OCD and HD in this group. The exclusion criteria for all groups included mental deficiency, psychoses, major depression and substance abuse or dependence. The recruited participants in the control group were matched to the hoarding group based on age, gender and level of education. The presence of comorbid OCD was not an exclusion criteria in the HD group, 18.2% participants in the HD group had comorbid OCD. Almost all clinical participants were interviewed using the Structured Clinical Interview on the DSM-IV Diagnose of Axis I Disorders (SCID I; First, Gibbon, Spitzer, Williams & Benjamin, 1998) to investigate on the presence of co-morbidities (Table 1). Due to limited language proficiency, one participant is excluded for the Stroop Color Word Test and because of an unreliable score on the Tower of London, one person's outcome was not taken into the analyses. Written informed consent was obtained from all of the participants.

2.3 Instruments and Assessment

SCID II OCPD interview

The Structured Clinical Interview on the DSM IV Diagnose of Obsessive-Compulsive Personality Disorder (OCPD SCID II; First, Gibbon, Spitzer, Williams & Benjamin, 2000) is used to investigated the presence of OCPD according to the DSM-IV. A person can be diagnosed with OCPD when showing a minimum of three out of the eight OCPD traits.

TABLE 1. Comorbidities in the three study groups measured with the Structured Clinical Interview for DSM Diagnoses (SCID (Hoarding and OCD)), the Mini International Neuropsychiatric Interview (MINI (Controls)) and the Structered Interview for Hoarding Disorder (SIHD)

	Hoarding (*N*=11)		OCD (*N*=11)		Controls (*N*=12)	
	N	%	*N*	%	*N*	%
Obsessive-compulsive disorder	2	18.2	11	100	0	0
Panic disorder/agoraphobia	0	0	2	18.2	0	0
Posttraumatic stress disorder	2	18.2	0	0	0	0
Major depressive disorder	3	27.3	4	36.4	0	0
Obsessive-compulsive personality disorder	9	81.8	2	18.2	0	0
Hoarding disorder	11	100	0	0	0	0

AQ

For this study the Dutch translation of Autism-Spectrum Quotient has been used (AQ; Baron-Cohen et al., 2001; Hoekstra et al., 2008). This fifty item self-administered questionnaire is developed for adults with normal intelligence. The scores on each item were 1 ('I fully disagree') to 4 ('I fully disagree'). Scores are dichotomized, with 1 and 2 rescored into 0, and 2-3 rescored into 1, resulting in a total range 0 – 50. A cutoff of $\geq$ 32 is assumed to correctly indentify autistic traits in the general population. The test contains five subscales with ten items each: Social Skills, Attention Switching, Communication, Imagination, and Attention to Detail. The internal consistency of the five subscales has been moderate to high with a Cronbach's α between .5 and .8. The test-retest reliability has been found acceptable (Hoekstra et al., 2008).

BIS/BAS

This study used the Dutch self-report questionnaire of Behavioral Approach System (BAS) and Behavioral Inhibition System Scales (BIS) based on Carver and White's (1994) BIS/BAS Scale. This questionnaire intent to assess individual differences in the sensitivity of the two motivational systems: behavioral inhibition (BIS) and behavioral approach (BAS) (Carver & White, 1994). The BIS is sensitive to punishment and non-reward, the BIS questions measure behavioral inhibition in situations with a possible threat of punishment or negative consequences. The BAS is sensitive to signals of reward and relief, representing a positive feedback mechanism (Fullana et al., 2004; Gray, as cited in Franken et al., 2005). The list contains 7 BIS-items and 13 BAS-items, with scores on each item between 0 ('totally disagree') to 3 ('totally agree'). The BAS contains three subscales: fun seeking (BAS-Fun; 4 items), reward responsiveness (BAS-Reward; 5 items) and drive (BAS-Drive; 4 items). The Dutch BIS/BAS Scales can be considered as a reliable and valid instrument to

measure individual differences in sensitivity of the behavioral approach system and the behavioral inhibition system (Franken et al., 2005).

BAI

Beck Anxiety Inventory (BAI; Beck, Epstein, Brown & Steer, 1988). The BAI is a 21-item self-report inventory of symptoms of anxiety. The participant rates each item on a four-point scale ranging from 0 ('not at all') to 3 ('severely'). The range of the total score is 0-63, with higher scores suggesting a higher degree of anxiety. The cutoff-scores are as follows: 0-7 is minimal anxiety, 8-15 is mild anxiety, 16-25 is moderate anxiety and 26-63 is severe anxiety. The cut-off score for clinically significant anxiety on the BAI is set at 16 or above. The reliability, internal consistency, convergence with other anxiety measures and the discriminate validity of the BAI proved all to be well established (Fydrich, Dowdall & Chambless, 1992).

BDI

Beck Depression Inventory (BDI; Beck, Steer & Garbin, 1988). The BDI is a 21-item self-report measurement that asseses symptoms of depression. The participant rates the items on a four-point scale, with a range from 0-63. The cutoff scores are as follows: <10 is no or minimal depression, 10-18 is mild to moderate depression, 19-29 is moderate to severe depression and 30-63 is severe depression. The BDI has been shown to be internally consistent ($\alpha = .86$ for psychiatric patients; $\alpha = .81$ for nonpsychiatric patients). It has been found to be reliable and valid in psychiatric and normal populations (Beck, Steer & Garbin, 1988).

OCI-R

Obsessive-Compulsive Inventory-Revised (OCI-R; Foa et al., 2002) is a self-report instrument with 18 items to measure common OCD symptoms. Participants rate the degree to which they have been bothered by each symptom using a five-point scale from 0 (not at all) to 4 (very much). The test-retest reliability and the internal consistency has been found to be good (Timpano, Keuogh, Mahaffey, Schmidt & Abramowitz, 2010). The test also differentiates between patients with and without OCD (Foa et al., 2002).

SI-R

Saving Inventory-Revised (SI-R; Frost, Steketee & Grisham, 2004). The SI-R is a 23-item questionnaire with three subscales: Difficulty Discarding, Excessive Clutter and Compulsive Acquisition. Each item assesses the presence and extent of a symptom of one of these three subscales. The participant rates the items on a five-point scale from 0 (not present) to 4 (extreme distress or permanent presence of the symptom) The total range is 0 – 92. A good internal consistency and test-retest reliability has been shown, as well as concurrent and divergent validity in clinical and non-clinical samples (Frost, Steketee & Grisham, 2004).

ID/EDS

Intra-dimensional/Extra-dimensional Set Shifting (ID/EDS; Fray, Robbins & Sahakian,1996). The test is part of the Cambridge Neuropsychological Test Automated Battery (CANTAB) and is used to examine rigidity. It is a reliable and valid computerized task (Fray & Robbins, 1996). The ID/EDS contains 9 stages to be completed; every stage is completed after 6 consecutive correct responses. There are two key stages, the intra-dimensional shift (stage 6) and the extra-dimensional shift (stage 8). Every trial contains two abstract figures, characterized by pink figures and white lines, displayed in two of the four squares on the display. The participant has to choose for the right figure. For example, stage 1 contains two simple pink shapes, one is correct. Once the participant knows the rule of which shape is correct, the rule changes. The participant then has to find out the new rule. If the participant after 50 trials has not selected the correct figure within six consecutive trails, the task is ended; switchcost is the number of errors on a stage before the participant finds out the (new) rule. The performance on stage 8 (the shift of attention from intradimensional sets to an extradimensional dimension of a previously unrewarded perceptual dimension), gives a good indication of set shifting abilities, and thus reflects cognitive flexibility/ rigidity. The most important outcome measure entails: number of trials needed to switch from one dimension to the other.

Tower of London

The Tower of London (ToL; Shallice, 1982) is a computerized task to measure planning and problem solving. The task is a so-called tower transformation task. Three different colored balls are placed on three different height rods that can hold three, two or one balls. The participants are instructed to rearrange the balls from the initial arrangement to the goal arrangement by moving one ball at the time (Berg, Byrd, McNamara & Case, 2010). In each situation the solution could require a minimum of 1 step and a maximum of 5 steps to rearrange the balls to the goal situation. The participant has to answer in 45 seconds how many steps are needed by pushing one of the buttons on the keyboard (“1”, “2”, “3”, “4” or “5”), and if no answer is given within 45 seconds, the next trial appears. The task contains 9 practice trails followed by feedback after every answer and 100 trials without feedback. In this study we’ve looked at the following outcomes: mean reaction time per trail and percentage accurate trails per stage. “Stage” is being the amount of steps needed to achieve the goal arrangement. The ToL has been shown to be highly effective in the detection of individual or group differences in planning and problem solving capability (Unterrainer & Owen, 2006).

Faux Pas Test

The adult version of the Faux-Pas is based on the children’s version of the Faux-Pas test by Baron-Cohen, O’Riordan, Stone, Jones & Plaisted (1999). The Faux Pas Test Adult Version (Stone, Baron-Cohan &

Knight, 1998) is a test that assesses the theory of mind inferences and empathy, including control questions for memory and collaboration. The test consists of nine stories, in six stories there is an actual presence of a 'faux pas'; a social situation that should be labeled by the participant as awkward. The experimenter reads out each story, while the stories are placed in front of the participants so they can read the stories as well. After each story the experimenter asks questions about a possible presence of a faux pas. Questions are asked about the detection of the faux pas (*did anyone say something awkward?*), about the person's identification (*who said something awkward?*), about the content (*what was awkward?*), about the explanation (*why was it awkward?*), about the false belief (*did he/she know that …?*), and an empathy question is asked (*how did…feel?*). The score and interpretation of the given answers is done on the basis of written instructions by Baron-Cohen, O'Riordan, Stone, Jones & Plaisted (1999). The score range is 0-56, with a maximum of 56 points when all the stories are correctly interpreted.

Stroop Color-Word Test

The Stroop Color-Word Test (Stroop, 1935) is a reliable measurement of cognitive flexibility and control, and executive functioning among Dutch respondents (Van der Elst, Van Boxtel, Van Breukelen & Jolles, 2006). The Stroop tests in this study consist of four subtasks. Each subtask shows 100 stimuli on a white A4 paper in a 10 x 10 matrix. The first subtask (naming color words) shows color words in random order (red, blue, yellow) printed in black ink. The second subtask (naming colors) shows colored blocks in red, blue or yellow. The third subtask (inhibition) contains color words written in colored ink, not corresponding to color written, for example, the word red printed in yellow ink. The participant has to name the color of the ink, not the written word. The fourth subtask (inhibition/switching) also has color words in colored ink, but some words are bordered by a black square. If so, not the color of the word must be named, but the written word.

The participants were instructed to read the words or name the colors (depending on the subtask) as quickly as possible. There was no time limit to complete the subtask. The time to complete each subtask was measured in seconds and mistakes were being noted. Because the completion time on the Stroop is dependent on age, scores were being rescaled into 1 (slowest) to 19 (fastest), considering the participant's age and completion time in seconds.

2.4 Statistical analyses

Data were analyzed using SPSS version 16. Categorical data were compared using Chi-square tests. A one-way analysis of variance (ANOVA) has been used to compare the continuous independent variables, followed by LSD post hoc tests. We have chosen for this liberal approach (without too stringent corrections) since these were exploratory analyses in which we wanted to avoid type II errors rather than type I errors. Pearson correlations were used to calculate the correlation between the AQ, Tower of London, OCI-R, SI-R, OCPD,

IDEDS, Faux Pas and the Stroop. Cohen's classification for correlations ≥.50 were defined as large correlations correlation between .30 and .49 as medium, and correlation from .10 to .29 as small (Field, 2009). Linear regression analyses were performed to investigate the relation between scores on the AQ (dependent variable) and the OCI-R, SI-R and OCPD (independent variables). The sample size is not equal for every analysis, as a result of missing data or outliers. All analysis were two-tailed, and significance was set at $p<.05$.

3. Results

3.1 Sociodemographic variable

A one-way ANOVA showed significant differences in age between the three study groups (F=3.72, df=2,31, p<.05). The OCD patients were significantly younger than hoarders and the control group. To test whether age would influence results, we performed correlation analyses between age and all variables under study. Since there were no significant correlations found (data not shown) we decided not to consider age in subsequent analyses. As expected, no significant differences were found in gender, but the level of education appeared to be the lowest for the OCD group. However, again, since level of education was not correlated to any of the dependent variables under study, level of education was not considered in subsequent analyses (Table 2). The participants in three study groups were all Caucasian and therefore did not differ on ethnic composition.

TABLE 2. Sociodemographic characteristics in the three groups

	hoarding (N=11)		OCD (N=11)		Controls (N=12)		$F/\chi2$		
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	***F***	**df**	***P***
Age	50.6	10.2	42.6	8.7	52.7	4.6	3.72	2,31	.036
	N	***%***	***N***	***%***	***N***	***%***	**χ2**		
Female	5	41.7	6	55.5	5	45.5	0,4	2	.819
Education ≥ HBO	7	70	3	27.3	11	91.7	14.12	8	.08

SCID II OCPD interview

According to the SCID II OCPD interview (First, Spitzer, Gibbon, Williams & Benjamin, 2000) a person can be diagnosed with OCPD when showing a minimum of three out of the eight OCPD traits. Remarkably, 81.1% of our hoarding group met these criteria (Table 3).

Because hoarding is one of the diagnostic criteria for OCPD, two one way ANOVA's were performed: one comparing the total number of present traits of OCPD between the groups, and one comparing the total number of traits present, leaving the hoarding trait out of the analysis. Interestingly, the ANOVA considering all OCPD traits shows significant differences between all groups (F=24.79 , df=2,30 , P= <0.001), and so does the ANOVA without the hoarding trait (F=18,86, df=2,30 , P= <0.001). The post hoc analyses show significant differences between all groups, hoarders suffering the most OCPD traits.

TABLE 3. OCPD traits in the three groups

	Hoarding (*N*=11)		OCD (*N*=11)		Controls (*N*=12)				
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	***F***	**df**	***P***
Total OCPD traits	5.27	2.34	2.9	1.37	0.42	0.1	24.79	2,3	0.00
OCPD traits without Hoarding	4.27	2.33	2.8	1.4	0.25	0.62	18.86	2,3	0.00

3.2 Self-Report Questionnaires

AQ

A one-way ANOVA showed a significant main effect of the three groups in the AQ total score (F=11.4, df=2,30, p<.05). A LSD post hoc test showed a significant difference between the control group versus both the OCD group and the HD group. All the subscales (except subscale 'attention to detail') revealed a significant difference

between these groups, namely a higher score on the AQ for the hoarding- and OCD group compared to the control group, and no significant differences between the hoarding- and OCD group (Table 4).

OCI-R

A one-way ANOVA showed significant differences between the three groups on OCI-R total score (F=10.40, df=2,30, p<.001) and on the subscales 'obsessing' (F=7.92, df=2,30, p<.05), 'hoarding' (F=55.72, df=2,30, p<.001), 'ordering' (F=4.08, df=2,30, p<.05) and 'checking' (F=6.37, df=2,30, p<.05). LSD post hoc tests showed significant differences between the controls versus the OCD and HD group on the total score and the subscales Obsessing, Hoarding, Ordering and Checking. Not surprisingly, a significant difference between HD and OCD is found on the subscale 'hoarding', however not on the other scales (Table 4). When controlled for the subscale OCI-R hoarding, the hoarding group still scored significant higher compared to the OCD and controls on the OCI-R total score (F=7.64, df=2,29, p<.005).

BIS/BAS

No significant differences were found on the BAS total score, nor on the subscales. The hoarders and OCD patients scored significantly higher on the BIS than controls (F=4.18, df=2,30, P= <0.05), and no significant differences between the hoarding- and OCD group (Table 4).

SI-R

Significant differences between the HD group versus the OCD group and the controls were found by an one-way ANOVA (F=44.42, df=2,30, p<.05). As expected, the HD group scored significantly higher compared to the OCD and controls, and no significant differences between the OCD group and controls (Table 4).

TABLE 4. AQ, OCI-R and SI-R scores in the three groups

	hoarding (N=11)		OCD (N=11)		Controls (N=12)				
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	***F***	**Df**	***P***
AQ total score	26.2	6.2	22.0	7.1	13.4	6.0	11.4	2,30	<.001**
AQ social skills	4.4	2.3	4.9	2.7	2.1	2.3	4.4	2,30	.021*
AQ attention switching	7.1	1.3	5.1	3.4	3.0	1.8	8.33	2,30	.001**
AQ attention to detail	5.2	3.0	4.9	2.3	3.2	1.7	2.48	2,30	.101
AQ communication	4.3	1.6	3.5	2.1	2.3	1.7	3.55	2,30	.041*
AQ imagination	5.2	2.7	3.5	1.5	2.9	1.6	3.86	2,30	.032*
OCI-R total score	23.3	11.9	17.2	11.6	4.8	4.6	10.40	2,30	<.001**
OCI-R washing	1.7	2.5	1.9	2.7	0.3	0.9	2.09	2,30	0.142
OCI-R hoarding	8.2	1.7	1.0	1.5	1.8	1.9	55.72	2,30	<.001**
OCI-R checking	4.5	3.5	4.7	4,1	0.5	1.4	6.37	2,30	0.005*
OCI-R neutralizing	1.5	2.2	1.5	1.8	0.3	0.9	1.98	2,30	0.155
OCI-R obsessing	2.6	2.4	4.7	3.5	0.7	0.8	7.92	2,30	0.002**
OCI-R ordering	4.8	2.9	3.3	3.8	1.3	1.6	4.08	2,30	0.027*
BAS totaal	24.2	7.3	22.5	5,7	24.8	4.2	0.45	2,30	0.642
BAS reward	11.5	2.8	12.4	3.3	12.7	1.5	0.58	2,30	0.566
BAS drive	6.4	2,9	5	2.1	5.9	2.6	0.83	2,30	0.448
BAS fun	6.3	3.2	5.2	2.4	6.2	1.6	0.68	2,30	0.515
BIS total	18.2	2.4	18.3	3.3	14.5	4.5	4.18	2,30	0.025*
SI-R	77.7	12.6	39.7	11.7	39.4	7.6	44.42	2,30	<.001**

BDI and BAI

All groups were tested on measurements of anxiety (BAI) and depression (BDI), which are known to affect the performances on psychological tests. A one-way ANOVA showed significant main effects between the three groups on the BAI (F=6.46, df=2,30, p<.05) and the BDI (F=11.31, df=2,30, p<.05). LSD post hoc tests revealed that the control group scored significant lower on the BAI and the BDI compared to the HD and OCD group. No significant differences were found between the HD and OCD group and also no correlations were found between the BAI or BDI and any neuropsychological tests in this study, so these variables were not considered further.

3.3 Neuropsychological tests

Faux Pas Test

An ANOVA revealed no significant differences on the Faux Pas test, indicating the three groups show no differences in deficits in theory of mind.

Stroop Color-Word Test

No significant differences between the groups were found on each subtest. Nevertheless, the HD group shows a trend to lower scores on the inhibition (subtest 3) and on inhibition/switching (subtest 4), although these differences were not significant between the three groups. Scaled scores were obtained, that is the time to complete one subtest minus the completion time of another subtest. The comparison of the scaled scores of inhibition versus the combined scores of naming color words (subtest 1) and naming the colors (subtest 2) shows a trend that the hoarding group performed worse, although not significant. The same for inhibition/switching versus the combined scores on naming color words and naming the colors. Overall, despite not significant the hoarding group tend to performed worse on the inhibition/switching compared to OCD and controls (Table 5).

TABLE 5. Scaled Stroop scores in the three study groups

	HD (*N*=10)		OCD (*N*=11)		Controls (*N*=12)				
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	***F***	**df**	***P***
Stroop 1	11.2	2.1	10.5	4.8	11.1	1.7	0.17	2,30	0.843
Stroop 2	11.4	2.0	10.9	2.7	11.8	1.7	0.44	2,30	0.649
Stroop 3	12.0	2.5	13.5	2.0	13.2	2.2	1.23	2,30	0.307
Stroop 4	9.2	3.9	10.6	3.0	12.0	1.1	2.7	2,30	0.084
Stroop4 vs Stroop 1+2	-2.1	3.9	-0.01	3.7	0.6	2.3	1.88	2,30	0.171
Stroop 4 vs Stroop 3	-2.8	4.2	-2.8	1.9	-1.2	2.4	1.22	2,30	0.309
Stroop 3 vs Stroop 1+2	0.7	2.1	2.8	2.9	1.8	2.4	1.8	2,30	0.183

ID/EDS

An ANOVA showed no significant differences between the three study groups on the ID/EDS (Table 6). Although not significant, less OCD patients (63.6%) reached stage 8, making the shift from intra-dimensional to extra-dimensional, compared to hoarders (90.9%) and controls (83.3%), and they tended to have more switch costs. The hoarders were similar to controls on this test.

TABLE 6. ID/EDS scores of the three study groups

	HD (*N*=10)		OCD (*N*=11)		Control (*N*=12)		*F*/χ2		
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	***F***	**df**	***P***
Total False NS	22.2	12.6	28.0	18.6	18.8	18.5	0.87	2,31	0.427
Total False NS ID	10.7	12.7	5.4	6.5	7.3	9.9	0.81	2,31	0.453
TotalFalse NS ED	8.0	8.9	14.0	9.9	7.2	10.2	1.67	2,31	0.206
ID Switchcost	23.8	15.6	16.0	3.9	19.5	12.8	1.19	2,31	0.318
ED switchcost	20	14.5	32.8	16.5	19.2	18.3	2.39	2,31	0.108
	N	**%**	**N**	**%**	**N**	**%**	**χ2**		
Stage 8 reached	10	90.9	7	63.6	10	83.3	2.68	2	.262

Tower of London

An ANOVA revealed no significant differences on mean reaction times between the three groups. Althought, a trend seems apparent, that is, OCD patients were faster than hoarders, mean reaction times per stage for accuracy as well as inaccuracy trials revealed no significant differences between the three groups and were not considered further. The percentage accurate trials of stage 1 and 2 did not differ, on stage 3 and 5 hoarders performed significantly worse than OCD patients (F= 4.11, df=2,30, p<.05) and normal controls (F=5.078 , df=2,30, p<.05), on stage 4 the ANOVA was not significant. Overall, a trend can be seen that hoarders had less accurate trials from stage 3 and above than the OCD group and the controls (Table 7).

3.4 Regression analyses

To further investigate whether the presence of obsessive-compulsive symptoms is due to autistic symptoms, OCPD traits or to the performance on the ToL or Stroop, a multiple regression analyses was performed with the OCI-R total score as dependent variable and the AQ total score, AQ attention switching score, BIS score, mean reaction time on the ToL, scaled scores on the Stroop and the number of present OCPD traits as independent variables (stepwise method). The result shows that the number of present OCPD traits as unique variable exclusively predicted the variance in the OCI-R total score over the entire sample (Adjusted R^2=.52, β=.42, p<.05).

Next, a regression analyses with SI-R total score as dependent variable, is preformed to investigate if the presence of hoarding symptoms is due to the previously mentioned independent variables (stepwise method). Again, interestingly, the number of present OCPD traits solely predicted the variance in the SI-R total score over the entire sample (Adjusted R^2=.53, β=.53, p<.01).

TABLE 7. Mean reaction time and Percentage accurate answers per stage of the ToL in the study groups

	HD (*N*=10)		OCD (*N*=11)		Control (*N*=12)				
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	***F***	**Df**	***P***
Mean RT (sec.)	13.2	3.4	10.4	3.3	11.8	2.5	2.17	2,30	0.132
Accuracy level 1 (%)	96.4	5.0	96.8	6.0	96.4	6.0	0.02	2,30	0.977
Accuracy level 2 (%)	88.6	12.5	93.6	7.4	89.5	11.1	0.70	2,30	0.503
Accuracy level 3 (%)	73.6	18.5	87.3	13.3	89.5	8.8	4.11	2,30	0.026*
Accuracy level 4 (%)	60.9	32.2	74.1	12.8	80.9	7.0	2.74	2,30	0.081
Accuracy level 5 (%)	53.2	20.8	71.4	11.0	72.3	14.2	5.08	2,30	0.013*

4. Discussion

This study explored autistic traits in patients with hoarding disorder, obsessive-compulsive disorder and healthy controls, while examining typical autism-related issues such as theory of mind and cognitive flexibility as expressed in neuropsychological functions as rigidity.

The primary hypothesis that HD group is similar to controls with respect to autism traits and theory of mind at symptom level, was partially confirmed. The HD group scores were equal to the OCD group on the AQ and theory of mind, but higher to the controls. This result is consisted with a study by Pertusa et al. (2011). They investigated the presence of autistic traits and deficits in theory of mind in patients with HD. Their results on the AQ were similar to ours. Although the scores of the HD and OCD are significantly higher than in the controls, the scores were, in line with Pertusa et al., not above the cut-off scores for autism. It seems justified to state that communication/contact problems related to autism are not at the core of hoarding behavior. These findings are also in line with a previous study by Anholt et al. (2010), revealing that OCD patients with comorbid hoarding do not show more autistic traits than healthy controls. However, the presence of autistic traits in individuals with HD could be related to the presence of comorbid OCD in this group. More likely, the small sample size of this study may account for the differences found.

However, these data must be interpreted with caution, since only 1 person with OCD showed elevated scores on the hoarding subscale of the OCI-R and only two individuals in the HD group were diagnosed with comorbid OCD. Overall, patients with "pure" HD (without OCD) do not show significant autistic traits or deficits in theory of mind compared to controls.

With respect to the small sample size of this study, findings are ambiguous to the second hypothesis, namely that that the HD group will show more rigidity compared to the other investigated groups. Patients in the HD group do not perform worse on the set-shifting task (ID/EDS). However, a puzzling finding is that the HD group seems to have more difficulty with the intra-dimensional shift, compared to the OCD patients who seem to have more difficulty with the shift from intra-dimensional to extra-dimensional. This latter can be deduced from the fact that almost 64 percent of the OCD do not reach stage 8 (the intra- to extra-dimensional shift) compared to 91 percent and 83 percent of respectively the HD group and the controls. This seems to show a trend that OCD could play a role in the extra-dimensional switch. Interestingly, the dimensions of the ID/EDS do not correlate with the subscale Attention Switching of the AQ. Thus, the subjective problems that patients experience in daily life situation with attention switching do not seem to correlate with the more cognitive (and less emotional) task represented by the ID/EDS, a finding that corresponds with the literature on this issue (Van Eeuwijk, 2011). On the other hand, HD

patients did perform, although not significant, worse on Stroop inhibition/switching subtest. This task may be more sensitive to investigate the level of rigidity.

Another finding of this study is the result of the BIS/BAS. There are no differences on the BAS scores, examining sensitivity to reward between the groups, but the OCD and the HD group appears more sensitive to punishment and non-reward, as measured by the BIS total score. These findings are consistent with previous research, also finding high sensitivity to punishment and low impulsivity in OCD patients with hoarding symptoms (Fullana et al., 2004). Moreover, these results are in line with with a recent neuro-imaging study in which HD patients were found to excessively recruit lateral orbitofrontal cortices (OFC) while deciding on whether to discard personalized objects (Tolin et al., 2009). Lateral orbitofrontal cortices are known to be involved in decision-making processes, specifically in processing negative reward (Kringelbach, 2005). Lateral OFC is also involved in affective processing (Northoff et al., 2006), and thus increased BIS scores may reflect a tendency of HD patients to experience discarding affectively neutral possessions as more emotional and related to more punishment than normal controls. Future research should perhaps be more focused on inhibition systems in patients with HD.

The third hypothesis, that HD patients will show more difficulties in planning and organization compared to OCD patients (and controls) was partly confirmed. Because difficulties in organizing belongings are shown in HD, deficits in planning were expected. Although the results on the ToL revealed no differences in reaction time between the three groups on the ToL, a trend was visible that the HD group has more trouble in planning. The more difficult stages (namely stage 3, 4,and 5) clearly showed more errors in the HD group. Dysfunctional planning occurs in hoarding, as well as in OCD as in ASD patients (Anholt et al., 2010; Nyden et al., 2010). The differences across these groups might appear at a higher level of organizational and planning skills. Whether hoarders encompass the group that is mostly incapacitated in these skills needs further exploration in larger study groups.

In line with the performance on the ToL, a trend could be seen that the HD group shows more difficulties in attention switching as shown on the Stroop (inhibition/switching subtest), although the result was not significant. This test of rigidity also seems to measure another rigidity dimension as seen on the ID/EDS and AQ; no correlations were found between these tests.

Nevertheless, these are interesting results, especially in the discussion whether HD should be included in the DSM as a separate disorder (Mataix-Cols, 2010). Individuals with HD seems to have the tendency to be more rigid and have more trouble with planning. This may could explain the difficulties in organizing. However, it seems that these problems are only more pronounced in hoarders than in OCD patients and do not reflect qualitative differences between the two disorders.

This would not justify separate disorder categories at this stage of knowledge. Therefore, to put HD patients in a distinct category from both OCD and OCPD in DSM-V seems premature. Studies with more power, comparing 'pure' hoarders (without OCD) with OCD with hoarding patients, with 'pure' OCD patients (without hoarding), both at the level of symptoms, of neurocognitive function, and at a genetic level, are needed to resolve this issue.

In conclusion, patients with HD show both differences and similarities with ASD problems. In contrast to ASD patients, they do not seem to have significant problems with contact/communication or theory of mind. However, with respect to some functions of cognitive flexibility and planning/organization, they do show resemblances with ASD. Thus, HD individuals seem to show a trend to be more rigid than OCD patients when examining performance on the ID/EDS and Stroop. Besides, the majority of HD patients meets criteria of OCPD, more so than patients with OCD. These are interesting finding, which can contribute to the discussion that HD should be a separate disorder in the DSM-V.

This study has some limitations. The most important limitation of this study is the small sample size and therefore our study shows a lack of power and sample size needs to be increased. A single outlier on a test can have a large effect on the overall results. As mentioned before, one must be careful with the interpretation of this study. Further, the OCD group appeared to be less educated despite the best effort to match the groups. However, education level did not seem to modify the overall results and therefore we did not control for this in subsequent analyses. Third, measures of the OCI-R were relatively low across the patient groups, especially in the OCD group. However, the participants in this study had a reliable and valid diagnoses made by the SCID or MINI.

Fourth, the Faux-Pas Test revealed no differences in theory of mind between the HD, OCD and controls. Together with the elevated scores of the HD and OCD groups on the AQ, discriminative scores on theory of mind between these groups were expected. Therefore questions can be raised about the reliability and validity of the Faux-Pas Test.

The clinical observation in this study is that the individuals in the HD group were more emotionally complex and more self-opinionated. This striking overlap between HD and OCD with respect to behavioral inhibition/ lack of flexibility is in contrast with the notion to place hoarding as a distinct disorder in DSM-V. If HD really is a separate disorder, then future studies should focus on better identifying what this disorder distinguishes from OCD and OCPD. Present study revealed possible difference in rigidity and planning in HD and OCD. Further research should expand these findings in a larger sample to gain more power.

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