Utrecht University

Faculty of Social Science

Department of Clinical- and Health Psychology

The influence of Autism traits on the manifestation of Obsessive-compulsive and Hoarding symptoms

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Auteur: F.C.M. Steenvoorden

Eerste beoordelaar: Dr. D.C. Cath

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ABSTRACT

Introduction: Empirical research in recent years has evidently demonstrated an overlap between Autism spectrum disorder (ASD) on the one hand and Obsessive-compulsive disorder (OCD) and Hoarding disorder (HD) on the other. The current study has explored to what extent individuals with OCD and HD, with or without comorbid ASD traits, differ in the manifestation of their disorders. *Method:* A total of 59 individuals (22 HD, 18 OCD, 21 controls) encompassed this explorative study. A dichotomy was created among the HD and OCD patients by using a cutt-of of scores on the Autism Questionnaire (AQ), resulting in the creation of OCD and HD groups with and without ASD symptoms. Patients with OCD or HD and comorbid ASD were compared with patients with 'pure' (i.e. without ASD) OCD and HD patients, using the Obsessive-compulsive Inventory-Revised (OCI-R), the Saving Cognition Inventory (SCI), the Saving Inventory-Revised (SI-R), the Clutter Image Rating (CIR) and the Structured Interview of Hoarding Disorder (SIHD). *Results:* No between patient group differences were found on the total scores and five out of six subscales of the OCI-R. However, OCD + ASD patients did score significantly higher on the 'ordering' symptom subscale of the OCI-R than 'pure' OCD patients. With regard to the HD patients, both groups showed equally elevated scores on the SCI, SI-R and the CIR. The qualitative part of the analyses suggested that two out of the seven HD patients with ASD showed hoarding behaviour evolving around circumscribed or 'special' interests, as opposed to one out of eleven 'pure' HD patients. *Discussion:* When individuals with OCD show comorbid autism traits, ordering symptoms seem to be more prominent. Further, Hoarding seems to point into a final common pathway of dysfunction regardless of ASD comorbidity in HD patients, although Hoarding behaviour in patients with co-morbid ASD does seem to be accompanied with collecting items around a specific interest. Future research with larger study samples should replicate these findings.

Voorwoord

Dit is een onderzoek naar de invloed van autismekenmerken bij patiënten met Obsessief-compulsieve stoornis (OCD) en patiënten met Verzameldwang. Deze studie betreft een component van een grootschaliger onderzoek dat wordt verricht door het Academisch Angstcentrum van Altrecht (AAA), naar de overlap tussen Verzameldwang, OCD, Autisme en ADHD. Het AAA heeft mij de bijzondere kans geboden om in het kader van mijn masterthesis mee te werken aan dit onderzoek. Met veel enthousiasme heb ik deze periode diverse patiënten mogen interviewen en hen aan neuropsychologische testen onderworpen. De openheid en verschillende karakters van de patiënten maakten iedere testafname weer tot een unieke belevenis! De uitvoering van het onderzoek heeft mij veel bijgebracht over de complexe, maar bovenal interessante problematiek van deze patiënten. Daarnaast heeft het mij inzicht gegeven in hoe moeilijk het goed en gedegen uitvoeren van wetenschappelijk onderzoek is. Veel dank gaat uit naar Marloes van der Meulen, voor de fijne en motiverende samenwerking. Ook dank ik dr. D.C. Cath voor haar stimulerende commentaren en aanstekelijke gedrevenheid in het uitvoeren van wetenschappelijk onderzoek.

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1. INTRODUCTION

Obsessive-compulsive Disorder (OCD) is a highly debilitating disease, which is found to be the fourth most common psychiatric disorder in the general population (Myers et al., 1984). Epidemiological studies in different cultures have shown that lifetime prevalence rates of this formerly thought rare phenomenon, are estimated between 1.5 and 3 percent (Bebbington, 1998; Stein et al, 1997).

OCD causes inflicted individuals to experience unwanted, intrusive thoughts (obsessions) that can prompt them to carry out repeated actions (compulsions) to reduce the anxiety produced by those thoughts (American Psychiatric Association, 2000). The most common obsessions concern thoughts about contamination, a need for ordering and symmetry, pathological doubt and aggressive or horrific impulses. Compulsions that are often seen with OCD patients include checking, washing, counting, need to ask or confess, symmetry and precision (Rasmussen & Eisen, 1992). OCD often runs a chronic course, with patients suffering from its symptoms for several years or even decades.

OCD is currently classified as an anxiety disorder in the Diagnostic and Statistical Manual of Mental Disorders (DSM)-IV-TR (American Psychiatric Association, 2004). With the upcoming of DSM-5 however, the nosology and placement of OCD has come under considerable debate. It has been proposed to remove OCD from the anxiety disorders category and move it to an OC spectrum disorders category (Bartz & Hollander, 2006). This proposition is partly due to the fact that patients with OCD show a fair amount of heterogeneity in features. Also, the current nosology of OCD encompasses a diverging amount of symptoms, which are commonly observed in a range of other psychiatric disorders (Calamari, Wiegartz, & Janeck, 1999; Ivarsson & Valderhaug, 2006; Leckman, Grice, Boardman, & Zhang, 1997). This overlap in symptoms across diagnoses gave rise to a considerable amount of research to further understand the apparent overlap between OCD and related disorders as tic disorders, body dysmorphic disorder, eating disorders, autism and impulse-control related disorders (Bienvenu, 2012).

1.1 Autism spectrum disorder

Another disorder that received elaborate attention with respect to its overlap with OCD is autism (Pertusa et al., 2011; Anholt et al., 2010; Ivarsson & Melin, 2008; Bejerot, 2007). Autism spectrum disorder (ASD), also named pervasive developmental disorder, is usually first diagnosed in infancy or childhood (Fombonne, 2005). Essential features are impaired or abnormal development in social interaction and communication, and a restricted repertoire of interests and activities. Repetitive behaviours comprising of certain routines and rituals are also a core feature of ASD (Anholt et al., 2010).

Numerous studies have been investigating the extent to which OCD patients exhibit

autism traits. An interesting finding among these studies was brought out by Bejerot (2001). She investigated the relationship between OCD on the one hand and High Functioning Autism (HFA) and Asperger disorder on the other. The results indicated that in adult OCD patients, up to twenty percent of the patients showed pronounced autistic traits, such as problems within the domain of socialization and aggression inhibition.

Another study regarding this subject was conducted by Anholt and colleagues (2010). They have investigated associations between inter alia OCD symptom dimensions and autism symptoms. The results pointed out that OCD patients scored higher on autism scales than healthy controls. The social skills subscale of the Autism Questionnaire (AQ) showed significant correlations with all OC symptom dimensions. This meant that deficits in social skills were also found with the OCD patients in this study, in line with previous findings by Bejerot (2001).

In addition to this symptom overlap, particular neuropsychological patterns are also shared between OCD and ASD patients. Various studies have suggested that both disorders share executive function problems. Executive functions are 'depicted as the *central executive* component of the information-processing system – the component that directs attention, monitors activity, and coordinates and integrates information and activity' (Anderson, Northam, Hendy & Wrennall, 2001, p. 92) More specifically the overlap in executive functioning problems seem to be in the domains of planning, organization and categorization. (Delorme et al., 2007; Grisham, Brown, Savage, Steketee, 2008.)

The above findings have repeatedly demonstrated that OCD and ASD indeed share similarities and that OCD patients show various ASD features and symptoms. However, from these studies it remains unclear what possible consequences the comorbidity between OCD and ASD might have for the expression of OC characteristics. In other words, *what is the influence of autism traits on the manifestation of obsessive-compulsive symptoms?* It would be highly interesting to know how patients with OCD and comorbid ASD may differ in OC symptom characteristics, compared to 'pure' OCD patients.

Knowledge about this subject would be of great importance to the adult clinician, since it could decrease the odds of missing underlying autism. In this way the clinician could be prevented from installing ineffective treatment regimens, for it is suggested that OCD patients with autistic traits will need special approaches and assistance to achieve social functioning (Bejerot, 2007). Nevertheless, relatively little comparative phenomenological research has been performed between pure OCD on the one hand and OCD with ASD on the other (Cath, Ran, Smit, Van Balkom & Comijs, 2008).

1.2 OCD and OCD+ASD

One of the studies that did bring this field of interest to attention was executed by McDougle

and colleagues (1995). They investigated the types of repetitive thoughts and behaviour demonstrated in ASD subjects (with relatively low IQ) by administering the Yale-Brown Obsessive Compulsive Scale to adults with autistic disorder and comparing them with age- and sex-matched adults with OCD. The study demonstrated that, compared to the obsessive-compulsive group, ASD patients described more ordering, hoarding, touching, tapping and self-damaging behaviours, less checking, repeating and counting behaviour than OCD patients. McDougle and colleagues concluded that overall the repetitive behaviours seen in autism differ from those seen in OCD, with ASD showing a less complex and less well organized constellation of repetitive behaviours compared to the obsessive-compulsive group.

An important limitation of this study was the relatively large difference in IQ between the groups (mean IQ of 69.7 in ASD vs. normal IQ in OCD subjects), a finding that could – at least partially – explain the reported differences between both disorders (Cath et al., 2008). A study that made up for this drawback was conducted by Russel, Mataix-Cols, Anson & Murphy (2005). These researchers compared high functioning ASD subjects (normal IQ) with pure OCD subjects, resulting in higher OCD severity ratings in the OCD group, as well as higher frequencies of somatic obsessions and repeating rituals.

Both aforementioned studies examined ways in which OCD patients and ASD patients are either similar or different. Yet it still remains unclear to what extent OCD patients with ASD traits could be distinguished from 'pure' OCD patients (i.e. without comorbid ASD). Cath and colleagues (2008) have tried to answer this question in their research. They investigated which features discriminate 'pure' anxiety disordered patients (i.e. Obsessive Compulsive Disorder and Social Anxiety Disorder (SAD)) from those with comorbid ASD. Results indicated that 'pure' OCD patients experience more severe OC symptom severity, which could be explained by the lower obsession severity when ASD is involved. Even though it was expected that comorbid ASD subjects would differ on symptom characteristics from pure OCD patients, there were no differences between comorbid ASD and OCD subjects with respect to OC symptoms. However, this might well have been due to the relatively small sample size (OCD: n = 12; ASD: n =12) and therefore low power to detect between-group differences.

This limitation and the overall lack of attention this matter has received so far, as opposed to its highly relevance for clinical practice, offers reason to consider the phenomenological differences between OCD and OCD with ASD again. Furthermore, these findings will be extended by studying the influence of ASD on a specific and controversial subtype of OCD: hoarding.

1.3 Hoarding

Compulsive hoarding (HD) has been defined as the excessive acquisition of large numbers of

possessions and the failure to discard them, even if the possessions are of apparently little 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 (Frost & Hartl, 1996).

Most clinical descriptions of hoarding have associated it with obsessive-compulsive disorder. Various estimates of the frequency of hoarding among OCD patients range from 20 (Rasmussen & Eisen, 1992) to 31 percent. However, hoarding has been observed in conjunction with other disorders as well, like organic mental disorders (Greenberg, Witztum & Levy, 1990), attention-deficit/hyperactivity disorder (ADHD) (Anholt et al., 2010; Tolin & Villavicencio, 2011) eating disorders (Frankenburg, 1984), and – the topic of interest in this study – autism spectrum disorder (McDougle et al., 1995).

1.4 Hoarding and ASD

Besides the discussed link between OCD and ASD, there are indications that hoarding holds a connection with autism by itself. Several clinical observations suggest that both disorders share phenomenological features such as social isolation (Leckman et al., 1997), a strong attachment to items (Mataix-Cols, Baer, Rauch & Jenike, 2000) and schizotypal personality symptoms (Grisham et al., 2008).

Furthermore, according to Ruta and colleagues (2010) the association between the two disorders seems already apparent at a very young age. This study points out that children and adolescents with Asperger Syndrome (AS) exhibit higher frequencies of hoarding behaviours than do typically developing children. Moreover, hoarding is commonly reported among adults with ASD as well (McDougle et al., 1995) and are frequently seen in clinical practice in adults with ASD (Bejerot, 2007).

However, it has been suggested that the hoarding characteristics observed in ASD are different from that observed in typical hoarders, since the kind of hoarding behaviour that individuals with ASD display seem to evolve around circumscribed or 'special' interests in their way of collecting items. Pertusa et al., 2012; South, Ozonoff and McMahon, 2005). For example, South et al. (2005) explored the presence of repetitive behaviours in people with AS and HFA concluding that 33 percent of the individuals with HFA and 20 percent of those with AS collected objects related to their topic of special interest.

This possible difference in hoarding behaviour was sufficient reason for Pertusa and colleagues (2011) to further explore the phenomenological features in which hoarders and ASD patients with hoarding behaviour might either differ or be similar. Pertusa et al., (2011) aimed at answering this question in their study of the relationship between autistic traits,

theory of mind, and hoarding behaviour from a bidirectional perspective in HD, ASD, OCD and anxiety disorder patients. Although the objective of their study was highly interesting, they failed to answer their question thoroughly. Concerning their research question about the presence of hoarding behaviour in ASD, they only paid attention to the mere *presence* of hoarding behaviour in ASD. They neglected to look at the hoarding behaviour with respect to content.

For this reason the current study will extend the investigation started by Pertusa, by intending to answer the question of *how the presence of autism traits in hoarders may influence the exact manifestation of hoarding characteristics as such.* Is there for example an essential difference in the items they have acquired over the years? Are there possible variations in attitudes and beliefs between typical hoarders and hoarders with autism? Or with regard to the three symptom clusters of hoarding; compulsive acquisition, extensive clutter and difficulty discarding (Frost, Steketee, & Grisham, 2004) is there a cluster that mainly characterizes the hoarder with autism? This explorative study aims at answering i.a. these intriguing questions.

1.5 Current study

Conclusively it can be stated that the empirical research in recent years has evidently demonstrated an overlap between ASD and OCD on the one hand and ASD and hoarding on the other. In current study two research questions are central.

The first question is: to what extent do OCD patients with and without autism differ on OCD symptom characteristics? It is hypothesized that 'pure' OCD patients will show a more complex symptom profile by (1) having a larger amount of symptoms and (2) more symptom domains will be covered in pure OCD patients compared to OCD patients with ASD and (3) OCD+ASD patients might show differences in the OC symptoms covered, compared to pure OCD patients. Furthermore it is expected that (4) OCD patients with ASD will demonstrate less symptoms regarding obsessions and rituals than 'pure' OCD patients.

The second research question in this study is: to what extent are there hoarding characteristics that discriminate hoarding patients with autism from hoarding patients without autism? It is hypothesized that there are essential differences between hoarders with and without autism. Considering the assumption that comorbidity in general worsens the long-term outcome of disorders (Ghaziuddini & Zafar, 2008) it is expected that hoarding with ASD will lead to more severe hoarding symptoms compared to hoarders without autism, reflected in higher scores on the scales that measure hoarding symptomatology. With regard to hoarding characteristics it is hypothesized -in line with South et al. (2005)- that hoarders with ASD will show hoarding evolving around circumscribed or 'special' interests.

2. METHODS

2.1 Participants

All patients were recruited from the mental health care service Altrecht Polikliniek Noord, Utrecht. The control group was recruited via the snowball method. A total of 59 participants encompassed this explorative study. These 59 individuals consisted of 20 HD patients, 18 OCD patients, and 21 healthy controls. The study groups were matched on age, sex and educational level. The patient characteristics, including mean ages and standard deviations, sex and comorbidities are described in table 1.

Table 1. Mean ages (M) + standard deviations (SD) in years, sex and comorbidities within the OCD, HD and Control patients.

	OCD-HD (N = 18)	HD (N=20)	Controls (N=21)
M (SD) in years	41.2 (8.2)	50.4 (11.1)	46.9 (12.8)
Female sex	9 (50%)	11 (55%)	8 (38%)
Comorbidity			
Obsessive-compulsive disorder	18	4	0
Hoarding disorder	0	20	0
Obsessive-compulsive Personality disorder with/ without hoarding item	4/4	11/9	0
Autism spectrum disorder	0	1	0
Major depressive disorder	1	1	0
Dysthymia disorder	0	5	0
Impulse-control disorder	0	3	0
Social phobia	4	3	0
Tourette syndrome	3	0	0
ADHD	0	3	0
Panic disorder/agoraphobia	2	0	0
Posttraumatic stress disorder	0	2	0
Alcohol abuse	1	1	0
AQ $\geq$ 26	7	8	0

2.2 Procedure

All participants have visited Altrecht Polikliniek Utrecht-Noord. They were included in the study after receiving and signing the informed consent. All clinical patients were administered the Structured Clinical Interview on DSM-IV diagnoses (SCID-I) to investigate the presence of comorbidities (see table 1.). Also, these patients were subjected to a specific part of the SCID-II, namely the Structured Clinical Interview on the DSM IV diagnose of Obsessive-compulsive Personality Disorder (OCPD SCID II; First, Gibbon, Spitzer, Williams

& Benjamin, 2000). This instrument was applied to investigate the presence of OCPD symptoms according to the DSM-IV-TR. The diagnosis OCPD is warranted when a person displays a minimum of four out of the eight OCPD traits.

Furthermore the Structured Interview of Hoarding Disorder (SIHD; Pertusa & Mataix-Cols, 2010) was administered to the participating patients, which is a recently developed semi-structured interview based on the proposed diagnostic criteria for HD in DSM V. This instrument is currently being tested on reliability and validity. For now it can be stated that the interview appears to be of value in clinical practice to investigate the presence of an independent Hoarding Disorder versus Hoarding+OCD.

Healthy control subjects were administered the Mini International Neuropsychiatric Interview (MINI; Lecrubier et al., 1997) to assess a current mood or anxiety disorder. Likewise the control subjects were subjected to the OCPD SCID II (First, Gibbon, Spitzer, Williams & Benjamin, 2000) and the SIHD (Pertusa & Mataix-Cols, 2010) to ensure that no major symptoms of OCPD and HD were present in this group. If a control subject had showed these symptoms, this would have obscured the natural differences between healthy participants and the patient groups. Therefore these control participants would have been excluded from the study. The exclusion criteria for all groups included mental deficiency (IQ < 70), active psychosis and current substance dependence.

2.3 Self-report Questionnaires

All participants completed self-report questionnaires, including the AQ, OCI-R, SI-R, SCI, CIR and BDI-II.

AQ: With regard to autism symptomatology, all participants were administered a Dutch translation of the Autism Questionnaire (AQ; Baron-Cohen, Wheelwright & Skinner, 2001; Hoekstra et al. 2008). This instrument contains 50 items regarding the presence of autism traits in adults. Each item concerns a statement, which is answered to as either: definitely true (4), slightly true (3), slightly untrue (2), or definitely untrue (1). These scores are then dichotomized by transforming 1 - 2 into 0 and 3 - 4 into 1, resulting in a total range of 0-50 with higher scores indicating the presence of more autistic traits. The AQ consists of five subscales: social skills, attention switching, attention to detail, communication, and imagination. It has been shown to have reasonable face and construct validity (Baron-Cohen et al. 2001) and the test-retest reliability is acceptable (Hoekstra et al., 2008).

Originally an AQ-score of ≥ 32 has been assumed to correctly identify the presence of autism traits in the general population (Baron-Cohen et al., 2001). However Woodbury-Smith, Robinson, Wheelwright & Baron-Cohen (2005) found an AQ-score of ≥ 26 to correctly classify the largest number of patients, with a sensitivity of .95 and a specificity of .52. Since the current study is of exploratory nature it seemed more important to consider the

highest possible degree in sensitivity. Therefore the cut-off point of ≥ 26 was used in this study as an indicator of presence of autism traits.

BDI-II: The Beck Depression inventory – II (BDI-II; Beck, Steer & Garbin, 1988) contains 21 items and measures current depressive symptoms. The participant is instructed to rate the items on a four point scale, resulting in a total range of 0 – 63. It is assumed that a score of < 10 indicates no or minimal depression, scores between 10 -18 suggests mild or moderate depression, 19-29 moderate to severe depression and 30 – 63 is signifying a severe depression. The BDI has been shown to be internally consistent (α= .86 for psychiatric patients; α = .81 for non-psychiatric patients) and to be a reliable and valid measurement in psychiatric and normal populations (Beck, Steer & Garbin, 1988).

OCI-R: The Obsessive-Compulsive Inventory-Revised (OCI-R; Foa et al., 2002) is a self-report instrument with 18 items to measure the presence and severity of common OCD symptoms. The instrument contains the following subscales: washing, obsessions, hoarding, ordering, checking and compulsions (neutralizing). 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 are good (Timpano et al., 2010) and this instrument appears to accurately differentiate 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 factor analytically defined subscales: Difficulty discarding, Excessive clutter and Compulsive acquisition. Each item measures 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 instrument presents with good internal consistency and test–retest reliability, as well as known-groups validity and concurrent and divergent validity in clinical and nonclinical samples (Frost et al., 2004).

SCI: The Saving Cognition Inventory (SCI; Steketee, Frost & Kyrios, 2003) was devised to measure hypothesized attitudes and beliefs among compulsive hoarders. The SCI was initially generated based on several sources: the theoretical model of Frost and Hartl (1996), clinical information from patients, and empirical evidence regarding types of beliefs among those with hoarding problems (Frost et al., 1995). The current version comprises 24 items regarding the most prominent cognitive dimensions of compulsive hoarding (the subscales): emotional attachment, control, responsibility, and memory. Participants are instructed to rate the extent

to which a thought influenced their decision about whether to discard a possession on a 7-point Likert scale from 0 (not at all) to 7 (very often).

CIR: The Clutter Image Rating (CIR; Frost, Steketee, Tolin, & Renaud, 2008) is a unique and innovative assessment due to its pictorial design. It contains nine photographs (gradually ranging from no clutter to extensive clutter) for each of three main rooms in most people's homes: living room, kitchen, and bedroom. The CIR shows strong reliability across time, context and observers, as well as good convergent and divergent validity and treatment sensitivity (Frost et al., 2008; Tolin et al., 2009). The CIR holds an important advantage over the clutter scale of the SIR. That is the CIR allows observer-based assessment and assessment free of the vagueness of the word 'clutter'. (Pertusa et al., 2010)

2.4 Analyses: Quantitative and Qualitative

To investigate the first research question*:* to what extent do OCD patients with and without autism differ in OCD symptom characteristics? the OCI-R was used. This sub study, from now on referred to as study 1, focused entirely on the participating eighteen OCD patients (without hoarding). These patients were divided by means of the AQ in either the 'pure' OCD group (i.e. OCD without (-) ASD) or the OCD with autism group (i.e. OCD with (+) ASD). In study 1. this group variable functioned as the independent variable and the OCI-R was the dependent variable.

To investigate the second research question: to what extent are there hoarding characteristics that discriminate hoarding patients with autism from hoarding patients without autism? multiple instruments were used, namely the SCI, SI-R and CIR. These instruments functioned as dependent variables. This sub study, from now on referred to as study 2, was directed at the twenty participating HD patients (with 20% having comorbid OCD). A 'pure' HD group (i.e. HD without (-) ASD) and a group of HD patients with autism (i.e. HD with (+) ASD) was created, together forming the HD group variable. The SCI, SI-R and CIR functioned as dependent variables and were analysed to explore possible differences between hoarders +/- OCD.

Besides these quantitative analyses, the second research question concerning the influence of autism on HD characteristics was also answered in a qualitative manner. The hypothesis stating that hoarders with ASD will show hoarding evolving around circumscribed or specific interests was explored by means of the SIHD and an extensive interview that occurred during the patient's HD treatment. The presence of a specific interest was operationalized in current study as: an interest that needs to be restricted and narrow in such a way, that one or two 'labels' or 'category names' would capture the entire collection of hoarded items completely. If it is not possible to place the collected items amongst one or

maximum two labels, it is not considered to be a collection evolving around a specific interest.

2.5 Statistical Analyses

The Statistical Package for the Social Sciences (SPSS, version 20.0) was used to analyse the quantitative data. Chi-square tests were executed to compare categorical data. One-way analyses of variance (ANOVA) were performed with continuous independent data. Within some of the data sets Levene's test revealed significant results, meaning the group variance were unequal and therefore the assumption of homogeneity of variance violated (Field, 2009). In order to still adequately test these topics Welch's test was used, as this alternative statistic is robust to the possibility of unequal group variances. When the analyses required post hoc testing, Fisher's Least Significant Difference (LSD) was applied. This particularly liberal post-hoc test was preferred, because this study mainly encompassed exploratory analyses in which it was considered more important to avoid Type II errors rather than Type I errors. Pearson's correlations were calculated between the different dependent variables under study, in which Cohen's classification system defined the size of the correlations (large $\geq$.50, medium .30 to .49, small .10 to .29).

Linear regression analyses were performed to investigate whether scores on the AQ (independent variable) would predict the outcomes on the OCI-R, SI-R, SCI, CIR and belonging subscales (dependent variables). The sample size is not equal for every analysis regarding the HD group, as a result of missing data. All analysis were two-tailed, and significance level was set at $p<.05$.

3. RESULTS

3.1 Socio-demographic analyses

Starting with the exploration of the basic assumptions, the socio-demographic data in this study turned out to be consistently normally distributed. Also, Levene's test appeared non-significant in most analyses, which is an indication of homogeneous variance. In the following section it will only be noted when the data did not meet the basic assumptions requirements.

A one-way ANOVA showed no significant differences in age between the three groups (F=2.87, df=2, p>05). The OCD patients had an average age of 40.6 (sd =9.0), the HD patients were by average 49.0 (sd = 11.3) years and the control group were on average 47.5 (sd = 13.2) years. Also, no significant differences were found in gender.

There were significant between-group differences in marital status and level of education. As expected, the control group had a partner significantly more often (81%) than both patient groups (HD group: 20%, OCD group: 17%). To test whether marital status would influence further results, correlational analyses were performed between this variable and the dependent variables under study. These subsequent analyses pointed out that marital status had a small though significant correlation (P=-0.28) with the SI-R. This led to the decision to include marital status as a covariate in the analyses regarding the SI-R.

Also, level of education was significantly different between the groups (p=0.005); the control group (HBO/university; 18) and the HD patients (10) had more often completed a higher education than the OCD group (4) (F=8.19, df=2, p<0.05). Again, correlational analyses were performed between this variable and the other dependent variables, to examine the possible influence on further outcomes. These showed a significant correlation of medium size (-0.34) with the AQ total score (p<0.05). Thus, level of education was also included as a covariate in subsequent analyses.

BDI

The BDI was administered in this study to measure severity of depression, which can effect the outcomes on psychological measurements. To test whether the presence of a depression influences results, BDI total scores were dichotomised with scores higher than 28 being indicative of a currently present depressive episode (Beck, Steer & Garbin, 1988). Pearson's chi-square test showed no significant differences between the groups (OCD, HD, controls) in the presence of a depression $\chi2$ (1, $N = 59$) =4.49 $p = .10$. For this reason it was decided not to consider the depression variable in further analyses.

AQ dichotomized scores

As mentioned in the Method section, the AQ was applied in this study as the key instrument to divide the OCD patients in two groups: OCD patients with and without autism traits. A

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similar partitioning was implemented with the HD patients. A one-way ANCOVA with level of education as a covariate showed that the three groups under study differ significantly on the AQ total score, with the healthy control group scoring significantly lower (M=12.57, sd=5.46) than the two patient groups (HD: M=24.15, sd=5.68 en OCD: M=21.78, sd=7.7) (F=15.88, df=2, p < .05). Moreover, the AQ scores of both HD and OCD patients seem remarkably high. Within the OCD group 7 patients scored above the cut-off point of 26, as well as 8 out of the 20 HD patients. Within the control group no participants scored above the cut-off point of 26.

3.2 Study 1. Obsessive-compulsive disorder

As expected, the OCI-R total scores differed significantly between the OCD (M=16.61, sd=10.79) group and the HD group (M=20.10, sd=11.42) on the one hand and the healthy controls on the other. (M=4.95, sd=4.78) (F=20.70, df=2, p < .05). Interestingly, the HD and OCD group showed equally elevated scores on the OCI-R, irrespective of eliminating the hoarding items from the OCI-R (OCI-R without hoarding subscale M=15.88, sd=10.41 in OCD; M=12.95, sd=10.66 in HD group).

3.2.1 OCD-ASD vs. OCD+ASD

As noted above, the AQ was utilized to divide the OCD patient into two groups. Eleven out of eighteen OCD patients scored lower than 26 on the AQ (M=17.00, sd=5.12). These patients formed the 'pure' OCD group. The seven OCD patients who scored ≥ 26 constituted the OCD + ASD group (M=29.30, sd=4.11). As expected, both groups differed significantly in their AQ total score (F=28.43, df=1, p < .05).

Analyses revealed that these two groups did not differ in age, level of education, gender and marital status. Furthermore there was no difference in the presence of depression. For this reason there were no indications to consider one or more of these variables as a covariate in further analyses.

A one-way ANOVA revealed no significant differences between the 'pure' OCD group (M=14.0, sd=9.15) and the OCD+ASD group (M=20.71, sd=12.58) on the OCI-R total score (F=1.73, df=1, p = .21). In five out of six subscales of the OCI-R no significant differences were discovered, except for the subscale 'ordering' (F=8.28, df=1, p <0.05). The OCD+ASD patients scored significantly higher on this subscale than the 'pure' OCD patients. The 'ordering' subscale concerns the following three items: *1. I get upset if objects are not arranged properly. 2. I get upset if others change the way I have arranged things. 3. I need things to be arranged in a particular order.*

Table 2. Means (M), standard deviations (sd) and significance values (*p*) of the OCD group and the OCD+ASD group on the OCI-R.

	OCD – ASD (N=11)	OCD+ASD (N=7)	
	M (sd)	M (sd)	*p*
OCI-R total score	14.0 (9.2)	20.7 (12.6)	.207
OCI-R washing	2.6 (3.9)	3.1 (3.5)	.785
OCI-R obsessing	4.5 (3.9)	4.4 (3.1)	.988
OCI-R hoarding	0.7 (1.1)	1.6 (1.8)	.234
OCI-R ordering	0.9 (2.4)	5.3 (4.1)	.011*
OCI-R checking	3.9 (3.3)	5.3 (3.8)	.383
OCI-R neutralizing	0.9 (1.5)	1.2 (1.7)	.551

* Significant at the p=0.05 level.

Subsequently linear regression analyses were performed between the AQ total score as independent variable and the OCI-R total and subscale scores on the other. The results indicated that, overall, the models applied were not able to significantly predict the different outcome variables (table 3).

Table 3. Explained variance (R $_2$), unstandardized beta coefficient (β) and significance values (p) of the linear regression analyses between the AQ total score and the OCI-R total and subscale scores with the OCD patients.

	Predictor:	AQ total score	
	R $_2$	β	*p*
OCI-R total score	.056	- .332	0.343
OCI-R washing	.018	- .033	0.782
OCI-R obsessing	.004	0.029	0.804
OCI-R hoarding	.058	.045	0.336
OCI-R ordering	.320	.276	0.162
OCI-R checking	.005	.032	0.782
OCI-R neutralizing	.005	-.015	0.785

3.3 Study 2. Hoarding disorder

A one-way ANOVA was performed on the SI-R total scores (with 'marital status' as a covariate) and the SCI total scores (without any covariate), to examine whether this instrument is able to adequately distinguish HD patients from the other participants under study. As expected, the SCI total scores of the three groups differed significantly (*F*=52.34, df=2, *p* < .05). The HD group scored higher (M=73.61, sd=15.00) than both the OCD(-HD) group (M=40.75, sd=11.34) and the control group (M=37.33, sd=8.03). The OCD group and the control group did not differ. As expected, the one-way ANOVA regarding the SI-R

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revealed significant differences between the groups as well (F=19.05, df=2, $p < .05$), with the HD patients scoring the highest on average (M=93.85, sd=32.27) relative to the OCD patients (M=43.94, sd=20.77) and the healthy controls (M=44.05, sd=21.20). Again, the OCD patients and the controls did not differ in scores.

3.3.1 HD-ASD vs. HD+ASD: Quantitative Analyses

Similar to the partitioning process in study 1, a division was made among the HD patients by use of the AQ, resulting in the creation of two groups. Twelve out of the twenty HD patients scored lower than 26 on the AQ total score (M=20.75, sd=3.89). These participants constituted the 'pure' HD group. The eight HD patients who showed scores of 26 or higher on the AQ total score are considered the HD+ASD group (M=29.25, sd=3.77). As expected both groups differed significantly in their AQ total score (F=23.49, df=1, $p < .05$).

Equivalent to study 1.there were no indications for the use of covariates in further analyses, since the 'pure' HD group and the HD+ASD group did not differ in age, level of education, gender, marital status and presence of depressive feelings.

A one-way ANOVA revealed no significant differences between the 'pure' HD group and the HD+ASD group with respect to the SCI total scores. Also, no significant differences were identified between the groups regarding the SCI subscales: memory, responsibility, control and emotional attachment (table 3.)

Furthermore multiple one-way ANOVA's revealed no significant differences between the 'pure' HD patients and the HD+ASD patients on the SI-R total scores. Possible differences regarding the SI-R subscales acquisition, saving and clutter also appeared non-significant (table 3.).

Table 4. Means (M), standard deviations (sd) and significance values (*p)* of the HD group and the HD+ASD group on the SCI and SI-R.

	HD-ASD (N=12)	HD+ASD (N=8)	
	M (sd)	M (sd)	*p*
SCI total score	92.5 (31.5)	95.9 (35.5)	0.826
SCI memory	17.9 (6.3)	19.8 (9.4)	0.606
SCI responsibility	20.2 (9.4)	20.8 (8.7)	0.891
SCI control	14.6 (3.9)	16.1 (3.7)	0.391
SCI emotional attachment	39.8 (15.5)	39.3 (17.2)	0.938
SI-R total score	74.2 (17.3)	72.7 (11.7)	0.847
SI-R acquisition	23.0 (5.5)	22.3 (3.3)	0.761
SI-R saving	23.1 (4.8)	23.7 (5.4)	0.754
SI-R clutter	27.2 (6.4)	27.3 (4.9)	0.971

The CIR was also taken into account in the analyses of this study. A one-way ANOVA revealed no significant differences between the 'pure' HD patients (M=22,92, sd=10.20) and the HD+ASD patients (M=23,00, sd= 8.44) (F=0.00 df=1, p= 0.985) on this particular hoarding instrument.

Finally, linear regression analyses were performed to investigate whether the AQ total score was able to predict scores on the SI-R and its subscales, the SCI and its subscales, and the CIR. Again, the AQ total score did not seem to adequately predict outcomes on the afore mentioned variables (table 5.)

Table 5. Explained variance (R_2), unstandardized beta coefficient (β) and significance values (p) of the linear regression analyses between the AQ total score and the SCI total and subscale scores, the SI-R total and subscale scores, and the CIR total scores with the HD patients.

	HD-ASD (N=12)	HD+ASD (N=8)	
	R_2	β	p
SCI total score	.028	.949	0.482
SCI memory	.068	.345	0.268
SCI responsibility	.023	.240	0.522
SCI control	.114	.228	0.145
SCI emotional attachment	.002	.137	0.835
SI-R total score	.018	-.342	0.601
SI-R acquisition	.031	-.140	0.487
SI-R saving	.023	-.141	0.550
SI-R clutter	.004	-.061	0.808
CIR total score	.001	.048	0.903

3.3.2 HD-ASD vs. HD+ASD: Qualitative Analyses

To find out whether there are differences in the characteristics of collected items by 'pure' HD patients on the one hand and HD patients with considerable autism traits on the other, the structured interview of hoarding disorder was administered and analysed. Table 6. describes which items have been collected by the hoarding patients and whether this gives any indications of the presence of specific interests, which could motivate their hoarding behaviour. Two out of the seven HD + ASD patients seemed to have a specific interest, as opposed to one person out of the 11 HD – ASD patients.

Table 6. Description of the content of collected items by 18 HD cases.

HD Case	Content of collected items	Presence of specific interest	AQ-Score ≥ 26
# 1	Newspapers, items on sale. Mainly emotionally valuable items and usable items. No broken items	No	35
# 2	Clothing, tools and material for 'experiments'	No	29
# 3	Clothing, shoes, books, jigsaw puzzles, toiletries and groceries on sale.	No	29
# 4	All sorts of items about plants and the city Utrecht Travel books.	Yes	28
# 5	Especially magazines (no specific topic mentioned) advertisement leaflets, forms, receipts, garbage.	No	26
# 6	(Emotional valuable) items of the past and of her son. No specific items mentioned.	No	26
# 7	Clothing, fabrics and tools for creating clothing.	Yes	26
# 8	An extended variety of items, both (emotional) valuable and not valuable, like plastic cups.	No	24
# 9	Books, CD's, art, postcards, train tickets. Specific topics: Classical Music, Latin-America, psychiatry, religion, etc.	No	24
# 10	Books, technical applications, articles of everyday use. Explicitly mentioned not to be specific.	No	24
# 11	Mentions that any item or object is difficult to discard. Items are organized by category or material (lots of ceramic).	No	23
# 12	Paper, clothing, books,	No	23

	presents, newspapers and drawing material.		
# 13	Tools, camping material, boxes.	No	22
# 14	Mainly items related to pigs. Plush pigs, pictures and posters of pigs, pig sculptures etc. Also, non-specific items from the street	Yes	19
# 15	Shoe-laces, pepper- and saltcellars, buttons, bags of wool, mirrors, wind lights, dust rags, receipts to check for discount	No	19
# 16	Old-fashioned devices such as record players, tape recorders. As well as CD's, art, food, pens and other inexpensive objects.	No	18
# 17	Magazines and books regarding topic of current interest. Guitars, guitar strings, books about baking pastry. Lists of 'things to do'.	No	14
# 18	Food, clothing, toilet paper, sanitary pads.	No	14

4. DISCUSSION

This study set out to explore the influence of autism traits on the manifestation of obsessive-compulsive disorder in OCD patients on the one hand and the influence of autism traits on the manifestation of hoarding disorder in hoarding patients on the other.

The first part of this study focused on the OCD patients. The primary hypothesis that 'pure' OCD patients (i.e. OCD patients without ASD) would show a more complex symptom profile than the OCD patients with ASD, by demonstrating a larger amount of symptoms, was not confirmed. The OCI-R total score, that provides an indication of the amount of present OCD symptoms, did not differ between the OCD patients with and without ASD. The second hypothesis, namely that within the pure OCD patients the symptoms would be covered by more domains compared to OCD patients with ASD, was not confirmed, as the results showed that overall the OCD symptoms in both groups were fairly equally divided over the various subscales. The third hypothesis, that OCD + ASD patients would show specific OCD symptom profiles was confirmed, as OCD+ASD patients showed more symptoms with respect to the subscale 'ordering'. These results suggest that OCD patients with ASD might be more focused on this specific symptom domain.

When comparing these results with the findings by McDougle et al., (1995), on the one hand these results are not in line with these authors, since the more complex profile in pure OCD patients as shown by McDougle et al., wasn't shown in our group. Divergent results can be explained by differences in characteristics of the study groups (ASD subjects with low IQ in the McDougle study versus OCD+ASD patients with normal to high IQ in our study). With respect to the finding of more ordering symptoms in the OCD patients with ASD, findings are fully in line with other studies (McDougle et al., 1995; Bejerot 2007).

The interesting finding of the current study appears to be in line of expectations considering what is established about autism in previous research. That is, various studies already showed that autistic patients frequently have a rigid adherence to routine, in which symptoms relatively similar to ordering are evident as well. For example, Prior & Macmillan (1973) found that behaviour such as creating and maintaining patterns, lining things up in rows and insisting that furniture and other objects remain in the same place were important behavioural aspects that autistic patients in their study demonstrated more than non-autistic patients. Likewise, Rumsey, Rapoport and Sceeny (1995) investigated 14 autistic men and concluded that arranging objects was demonstrated by 86 % percent of these patients.

These results could possibly explain for the fact that the OCD patients with comorbid autism in our study seem to show more ordering symptoms as well. Moreover, neuropsychological studies might also support the pronounced presence of ordering in the OCD + ASD patients. As mentioned in the introduction, various studies have demonstrated that obsessive-compulsive patients and autism patients seem to show similar impairments in

executive functions as planning and organization (Delorme et al., 2007; Grisham, Brown, Savage, Steketee, 2007.). Maybe these organizational problems are reflected in the ordering symptom domain across the disorders, and are more severe in OCD+ASD patients. When this would be the case, the need for ordering could perhaps function as some sort of coping mechanism to reduce the stress that comes with the chaotic, unorganized mindset. Future research is warranted to further investigate this hypothesis.

According to the fourth hypothesis in this study, it was expected that OCD patients with ASD would demonstrate less symptoms regarding obsessions and rituals than pure OCD patients. The results could not confirm this, since both groups seemed indiscriminative in their amount of obsessions and rituals as measured by the obsessing, washing and checking subscales. These results are in line with findings by Cath et al., (2008), who did not find any differences in OC symptom characteristics (i.e. obsessions and rituals) measured with the Y-BOCS. However, similar to Cath., et al (2008), the relatively small sample size and therefore low power in this study might explain for the lack of significant findings in the current study.

The second part of current study oriented on the participating hoarding patients. Contrary to our expectations, the 'pure' hoarders (i.e. without ASD) did not differ from the hoarders with ASD on the SCI, SI-R and the CIR. These results suggest that the hoarders with and without autism are similar in the extent of possessions they seem to acquire, clutter and fail to discard, plus they seem equally distressed and impaired by these three prominent symptoms. The lack of significant results on the CIR is consistent with the SI-R outcomes, and therefore seems to further support the notion that the intensity of clutter resembles between the groups. At the same time, both patient groups seem to have similar attitudes and beliefs concerning their hoarding behaviour. They seem to be equally emotionally attached to their collected items, feel similar needs for control, feel equally responsible for their possessions and have similar amounts of trust in their memories. Thus, hoarding seems to point into a final common pathway of dysfunction regardless of ASD comorbidity.

The qualitative part of the analyses seems to suggest that more hoarders with ASD show hoarding behaviour evolving around circumscribed or 'special' interests. However, these results should be interpreted with caution.

4.1 Limitations

As mentioned before, this study was performed with a relatively small sample size. Therefore it has low power, which makes it harder to detect potential differences. This might as well explain why no differences were found between the hoarders with and without ASD. Next to this limitation, there are some other drawbacks to this study. As mentioned before, the instruments used in this study were all self-report questionnaires. This requires having adequately developed introspective abilities, which might not have been the case with our

patients, especially when autism traits were present.

On top of that, measures of the OCI-R in this study were conspicuous. Firstly, since the HD patients in this study scored relatively high on the OCI-R. Although the fact that twenty percent of the HD patients had comorbid OCD may have contributed to this outcome, it still seems noteworthy. Furthermore, the recommended cutoff-score with this instrument is 21, with scores at or above this level indicating the likely presence of OCD (Foa et al., 2002). The OCD patients in this study altogether had mean scores lower than this cut-off point. However, the participants in this study did have a reliable and valid diagnose made by trained researchers on the basis of the SCID.

Further, using the AQ as the key instrument to explore the presence of comorbid autism traits may not have been the most optimal choice. Firstly, it is noteworthy that in current study the total AQ scores on average seemed high for all OCD and HD patients. This seems especially remarkable considering it was mentioned by Bejerot (2001, p.169) that, "those individuals with the most obvious autistic features seem to be less able to identify these traits in themselves". Holmes & Young (2013) investigated this topic, by exploring the potential influence of social and intellectual impairments on self-report instruments with adults with Asperger's disorder. They concluded that some adults with Asperger's Disorder substantially under or over-reported the extent of their symptomatology relative to clinicians, parents, caregivers and spouses, consequently limiting the suitability of self-report diagnostic measures for some individuals. Future studies would therefore benefit from applying other measures of ASD in addition to the self-report instruments, ideally structured interviews and observational methods (Holmes & Young, 2013).

4.2 Conclusions and future directions

In conclusion, with these limitations in mind, when individuals with OCD show comorbid autism traits, ordering symptoms seem to be more prominent. In other typical OC symptom characteristics (washing, hoarding, obsessing, checking and neutralizing) there appears to be no difference between OCD patients with and without ASD. Further, individuals with HD do not seem to manifest their hoarding behaviour differently when autism traits are present. That is, the HD individuals with and without ASD seem to have similar attitudes and beliefs regarding their hoarding, as well as similar amounts of distress and impairment due to the saving, clutter and failure to discard. However, the results do suggest that the presence of comorbid autism in individuals with HD is accompanied with mainly collecting items around a specific interest. Future research should however replicate these findings by expanding the sample to gain more power and therefore be able to draw more thorough conclusions.

With respect to the treatment of HD, these findings suggest that for an adequate treatment of hoarding disorder, clinicians need not be extra alert to comorbid autism as this

doesn't seem to effect the hoarding manifestation as such. However, if autism traits are present, these individuals might benefit more from treatment of hoarding when it is enriched with specific therapy proven to be effective for autism patients. Future research could further explore this topic to figure out the most fruitful way to adequately diagnose and treat these complex disorders.

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