Comparative cognitive profiles of obsessive-compulsive disorder and schizophrenia

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Abstract

A body of neuropsychological research revealed cognitive impairments in patients suffering from obsessive-compulsive disorder (OCD). Only few investigations addressed the question of how specific these impairments are. The present study compared the performances of 19 subjects with OCD to 19 subjects with schizophrenia and 19 healthy controls on neuropsychological tasks across the main cognitive domains (memory, attention, visual spatial and executive functioning). For purposes of data-reduction, single test measures of the test battery applied were aggregated into eight cognitive domain scores. Contrary to our expectation we found comparable performance profiles of obsessive-compulsive (OC) and schizophrenia subjects across domains with impairments primarily affecting simple attentional skills and memory skills. However, deficits of subjects with schizophrenia were greater in magnitude than those of subjects with OCD on all domains assessed. Elevated depression scores exerted a relevant impact on performance deficits in the OC but not in the schizophrenia sample.

Keywords: Obsessive-compulsive disorder; Schizophrenia; Neuropsychological; Cognitive profile

1. Introduction

In the last two decades, neuropsychological research has addressed the question of cognitive impairments in obsessive-compulsive disorder (OCD). After reviewing the neuropsychological literature on OCD, Kuelz, Hohagen, and Voderholzer (2004) concluded that deficits are most consistently found in the area of episodic memory and learning. Regarding nonverbal memory, which was frequently assessed using the Rey Osterrieth Complex Figure Test (RCFT), literature is quite homogeneous, showing obsessive-compulsive (OC) patients to produce reduced recall rates compared to healthy controls (Boone, Ananth, & Philpott, 1991; Kim, Park, Shin, & Kwon, 2002; Martinot et al., 1990). However, these results were questioned by a study of Moritz, Kloss, Jahn, Schick, and Hand (2003), in which RCFT deficits in OC subjects were confined to patients displaying elevated depression scores. Whereas previous studies on OC subjects claimed verbal memory to be unimpaired (Christensen, Kim, Dysken, & Hoover, 1992; Dirson, Bouvard, Cottraux, & Martin, 1995), later investigations revealed impairments in verbal memory when tasks challenge strategic...
and OCD respectively (Whitney, Fastenau, Evans, & Lysaker, 2004). Deficits in visual spatial skills, visual memory, and attention for example were reported for subjects with schizophrenia. Literature has shown some evidence that subjects of both disorders display shared areas of cognitive impairments. Borkowska, Pilaczynska, & Rybakowski, 2003; Cavallaro et al., 2003; Moritz et al., 2002; Whitney et al., 2004). Only specific role of the orbitofrontal cortical (OFC) circuit is discussed (Baxter et al., 1996; Martinot et al., 1990). To share a core frontal lobe pathophysiology. In detail, brain imaging studies revealed metabolic abnormalities of the brain regions that show differences in OCD compared with healthy controls. Investigations also addressed attentional functioning in OCD. In summary, attention span (commonly assessed with the subtest Digit Span Forward of the WAIS-R) and sustained attention turned out to be unaffected (Aronowitz et al., 1994; Cohen et al., 1996; Millicent, Bouvard, Aupertit, & Cottraux, 2000; Zielinski et al., 1991). Whereas Martinot et al. (1990) reported impairments of OC patients on the Stroop Test, the majority of studies received contrasting results (Aronowitz et al., 1994; Boone et al., 1991; Schmidtke, Scharb, Winkelmann, & Hohagen, 1998), indicating that selective attention is spared in OCD. Results are less consistent when speed of information processing is involved: Regarding the Trail Making Test A (TMT A) slower performances of OC subjects compared with healthy controls were found in some studies (Kim et al., 2002; Schmidtke et al., 1998) but not in others (Aronowitz et al., 1994; Cohen et al., 1996; Jurado, Junqué, Vallejo, & Salgado, 2001). Results of these investigations seem to correlate with the status of medication, why Kuelz et al. assume that reduced information processing speed of OC subjects might be mediated by the effects of psychotropic medication. However, in a study of Martin, Wiggs, Altemus, Rubenstein, and Murphy (1995), 18 non-medicated OC subjects showed preserved memory spans but conducted working memory tasks in an abnormally slow pace, reflecting a speed of processing problem on self-paced tasks.

Despite our growing knowledge regarding the kind of cognitive impairments in OCD, only few investigations contributed to the question of how specific and how incapacitating these impairments are. To address the specificity issue, studies need to directly compare neuropsychological abilities of OC subjects to those of other psychiatric patients. The comparison to schizophrenia is of special interest since the following facts point to an association between OCD and schizophrenia: (1) A substantial proportion of schizophrenia patients show symptoms of OCD or fulfill the criteria for a diagnosis of OCD. Published rates of schizophrenia subjects suffering from an additional OCD diagnosis vary from 7.8% to 46% (Bottas, Cooke, & Richter, 2005; Poyurovsky et al., 2003). Therewith, incidence rates of OCD in schizophrenia exceed incidence rates of OCD in normal population noticeably. (2) Both disorders are suggested to share a core frontal lobe pathophysiology. In detail, brain imaging studies revealed metabolic abnormalities of the dorsolateral prefrontal cortex (DLPFC) in schizophrenia (Weinberger, Berman, & Zec, 1986), whereas in OCD, a specific role of theorbitofrontal cortical (OFC) circuit is discussed (Baxter et al., 1996; Martinot et al., 1990). (3) Literature has shown some evidence that subjects of both disorders display shared areas of cognitive impairments. Deficits in visual spatial skills, visual memory, and attention for example were reported for subjects with schizophrenia and OCD respectively (Whitney, Fastenau, Evans, & Lysaker, 2004). Comparative neuropsychological approaches conducted in the past focused on frontal lobe functioning in OCD and schizophrenia (Abbruzzese et al., 1995, 1997; Borkowska, Pilaczynska, & Rybakowski, 2003; Cavallaro et al., 2003; Moritz et al., 2002; Whitney et al., 2004). Only one study (Whitney et al., 2004) compared the performances of obsessive-compulsive and schizophrenia subjects on a broader range of cognitive tasks. However, in this study no healthy control group was assessed, making it difficult to determine cognitive deficits of clinical significance.
The present investigation seeks to find out whether obsessive-compulsive and schizophrenia subjects show distinguishable cognitive performance profiles. Another purpose was to determine the magnitude of cognitive deficits in both groups. We extended the existing approaches by comparing 19 subjects with obsessive-compulsive disorder to 19 subjects with schizophrenia and 19 healthy control subjects on measures across the main cognitive domains: memory, attention, visual spatial processing, and executive functioning. Since a previous meta-analysis of Heinrichs and Zakzanis (1998) reported moderate to large deficits in subjects with schizophrenia for all 22 cognitive measures evaluated, we also expected schizophrenia subjects to show pronounced deficits on tests of working memory, verbal and visual episodic memory, simple and complex attention, visual spatial processing, cognitive flexibility and concept formation. Subjects with obsessive-compulsive disorder on the other hand were expected to display more selective deficits confined to verbal and visual episodic memory and to higher cognitive functioning (but not the WCST).

2. Methods

2.1. Subjects

2.1.1. Subjects with obsessive-compulsive disorder (OCD)

Nineteen OCD outpatients were recruited from two outpatient clinics (Department of Clinical Psychology and Psychotherapy, University of Marburg and Christoph-Dornier-Foundation for Clinical Psychology, Marburg) or by an advertisement in a local newspaper. Demographic and clinical characteristics of the sample are shown in Table 1. All subjects fully met the criteria for current OCD of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) (American Psychiatric Association, 1994a) on the basis of structured clinical interviews (see Section 2.2). Clinical assessment revealed that 7 subjects were suffering predominately from compulsive acts and three predominately from obsessive thoughts. Nine subjects were of the mixed type, experiencing both obsessional thoughts and acts. A mean Total Score of 19.8 (S.D. = 7.3) on the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS) (Goodman et al., 1989) indicated a medium symptom severity with subjects being similarly stressed by Obsessions (M = 9.6; S.D. = 4.8) and Compulsions (M = 10.3; S.D. = 4.2). Exclusion criteria were a positive history of head injury, neurological disorder, psychosis or substance dependence. The presence of psychiatric comorbid diagnoses (other than psychosis or substance dependence) did not constitute an exclusion criterion. Comorbid diagnoses were found in six cases: 4 subjects presented with recurrent major depressive disorder, four with anxiety disorders, one with somatoform pain disorder and one with obsessive-compulsive personality disorder. Nine OC subjects were on anxiolytic psychotropic medication.

Table 1
Demographic and clinical characteristics of subjects

<table>
<thead>
<tr>
<th>Variable</th>
<th>Schizophrenia subjects</th>
<th>OC subjects</th>
<th>Control subjects</th>
<th>Statistic</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>29.6 ± 8.5</td>
<td>31.8 ± 10.3</td>
<td>31.1 ± 8.0</td>
<td>F (2;54) = 0.316</td>
<td>0.731</td>
</tr>
<tr>
<td>Education (y)</td>
<td>16.4 ± 5.6</td>
<td>16.5 ± 3.0</td>
<td>16.4 ± 3.0</td>
<td>F (2;54) = 0.001</td>
<td>0.999</td>
</tr>
<tr>
<td>Female sex, no. (%)</td>
<td>7 (37)</td>
<td>14 (74)</td>
<td>10 (53)</td>
<td></td>
<td>0.088*</td>
</tr>
<tr>
<td>Right-handed, no. (%)</td>
<td>15 (79)</td>
<td>16 (84)</td>
<td>14 (74)</td>
<td></td>
<td>0.918*</td>
</tr>
<tr>
<td>Age at onset (y)</td>
<td>24 ± 5.8</td>
<td>19.4 ± 9.4</td>
<td>n(29.84) = 1.833c</td>
<td>0.077</td>
<td></td>
</tr>
<tr>
<td>Duration of disorder (y)</td>
<td>5.9 ± 5.3</td>
<td>13.6 ± 7.0</td>
<td>n(36) = -3.847 &lt;0.001*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAIS-R: information, scaled score</td>
<td>11.4 ± 3.3</td>
<td>9.8 ± 4.4</td>
<td>12.5 ± 2.2</td>
<td>F (2;54) = 2.964</td>
<td>0.060</td>
</tr>
<tr>
<td>BDI, Total Raw Score</td>
<td>13.5 ± 11.1</td>
<td>13.6 ± 10.5</td>
<td>4.1 ± 4.5</td>
<td>F (2;54) = 6.679</td>
<td>0.003#</td>
</tr>
<tr>
<td>BDI &gt; 10, no. (%)</td>
<td>10 (53)</td>
<td>11 (58)</td>
<td>2 (11)</td>
<td></td>
<td>0.004#</td>
</tr>
<tr>
<td>BSI, GSI T Score</td>
<td>58.9 ± 13.5</td>
<td>63.3 ± 16.8</td>
<td>45.8 ± 11.7</td>
<td>F (2;53) = 7.796</td>
<td>0.001#</td>
</tr>
</tbody>
</table>

Statistics: Students t-test and one-way analysis of variance (ANOVA) followed by Tukey’s procedure for post hoc comparison between the three independent groups (respectively Games–Howell procedure in case of heterogeneous variances): *difference between schizophrenia subjects vs. control subjects, p < 0.05. #Difference between OC subjects vs. control subjects, p < 0.05. *Difference between schizophrenia subjects vs. OC subjects, p < 0.05.

a Table values are given as mean ± S.D. unless indicated otherwise.
b Fisher’s exact test (two-tailed).
c Homogeneity correction in case of heterogeneous variances.
d Premorbid intellectual functioning estimated by means of the subtest Information of the German version of the Wechsler Adult Intelligence Scale-Revised (WAIS-R).
2.1.2. Subjects with schizophrenia

The schizophrenia sample comprised 19 inpatients (see Table 1 for sample characteristics) who met the DSM-IV criteria (American Psychiatric Association, 1994a) for a lifetime diagnosis of schizophrenia based on structured clinical interviews (see Section 2.2). Thirteen subjects (68.4%) were of the paranoid subtype, two (10.5%) were classified as disorganized, one (5.3%) as catatonic, and two (10.5%) as undifferentiated. One of the subjects (5.3%) was diagnosed as schizoaffective. Symptom severity indexed with the Positive and Negative Syndrome Scale (PANSS) (Kay, Fiszbein, & Opler, 1987) revealed a mean Total Score of 84.5 (S.D. = 24.7), a mean summary score of the Positive Scale of 18.2 (S.D. = 8.5) and a mean summary score of the Negative Scale of 22.1 (S.D. = 9.1). None of the subjects had a history of head injury, neurological disorder, or substance abuse. At the time of test administration, all subjects with schizophrenia were on antipsychotic medication. Eighteen subjects were receiving atypical neuroleptics, one was receiving a combination of atypical and typical neuroleptics. Five subjects were experiencing their first manifestation of a schizophrenic episode, all others had experienced at least one previous episode.

2.1.3. Healthy control subjects

Nineteen healthy control subjects (see Table 1) were matched to the two clinical groups according to age, gender, and years of education. Subjects were recruited by an advertisement in a local newspaper and by leaflets distributed in town. Control subjects were not taking any psychoactive medication and were free of any psychiatric disorder (verified by SCID Screening Inventory), neurological disorder and significant medical illness.

Before test administration the study was explained to the subjects in detail and informed written consent was obtained. Control subjects were paid for participation. The Ethical Committee of the Medical Faculty of the University of Marburg had approved of the study design.

2.2. Assessment

2.2.1. Clinical assessment

In both clinical groups current and lifetime psychiatric diagnoses were determined by use of the German version (Wittchen, Wunderlich, Gruschwitz, & Zaudig, 1997) of the Structured Clinical Interview for DSM-IV (SCID) (American Psychiatric Association, 1994b). The psychopathology of subjects with OCD was evaluated using the German authorized translation (Hand & Böttner-Westphal, 1991) of the Y-BOCS (Goodman et al., 1989). The psychopathology of subjects with schizophrenia was evaluated using the PANSS (Kay et al., 1987). All three samples were given the German versions of the Beck’s Depression Inventory (BDI) (Hautzinger, Bailer, Worrall, & Keller, 2000) and the Brief Symptom Inventory (BSI) (Franke, 2000), self-report measures of depression and a broad variety of psychopathological symptoms.

2.2.2. Neuropsychological assessment

Subjects received a comprehensive battery of neuropsychological tests. Assessment comprised measurements of memory, attention, visual spatial and executive functioning. The German version of the Wechsler Adult Intelligence Scale-Revised (WAIS-R) (Tewe, 1991; Wechsler, 1981) was applied to estimate premorbid intellectual functioning (subtest Information) and to assess visual spatial skills (subtest Block Design). Compared to the American test version items of the German WAIS-R are translated into German language and adapted to the local political system. The scoring bases on a German normative sample. Memory performance was assessed by means of eight subtests of the German version of the Wechsler Memory Scale-Revised (WMS-R) (Härtig et al., 2000; Wechsler, 1987). As in case with the WAIS-R prose passages of the German WMS-R are translated and test results are related to a German normative sample. In a measurement of working memory subjects have to repeat digit or block sequences as presented and in reversed order (Digit Span Forward and Backward and Visual Memory Span Forward and Backward). Verbal episodic memory performance was examined with the subtests Logical Memory I and II that require subjects to recall two short prose passages immediately after oral presentation and after a 30-min delay. Similarly, the subtests Visual Reproduction I and II ask subjects to copy from memory four consecutively presented visual designs immediately after presentation and after a 30-min delay (assessment of visual episodic memory). In the area of attention, the test battery included tests of different complexity. The Trail Making Test (TMT) (Reitan, 1992) comprises two parts: In Part A, a measure of psychomotor speed and attention, participants have to connect consecutively numbered circles from 1 to 25 as fast as possible. The more demanding Part B requires subjects to connect 25 consecutively numbered and lettered circles by
Table 2
Cognitive domains

<table>
<thead>
<tr>
<th>Cognitive domain</th>
<th>Neuropsychological variables</th>
<th>Cronbach’s alpha^a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working memory</td>
<td>WMS-R: Digit Span Forward</td>
<td>( \alpha = 0.61 )</td>
</tr>
<tr>
<td></td>
<td>WMS-R: Digit Span Backward</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WMS-R: Visual Memory Span Forward</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WMS-R: Visual Memory Span Backward</td>
<td></td>
</tr>
<tr>
<td>Verbal memory</td>
<td>WMS-R: Logical Memory I</td>
<td>( \alpha = 0.94 )</td>
</tr>
<tr>
<td></td>
<td>WMS-R: Logical Memory II</td>
<td></td>
</tr>
<tr>
<td>Visual memory</td>
<td>WMS-R: Visual Reproduction I</td>
<td>( \alpha = 0.88 )</td>
</tr>
<tr>
<td></td>
<td>WMS-R: Visual Reproduction II</td>
<td></td>
</tr>
<tr>
<td>Simple attention</td>
<td>TMT: Part A</td>
<td>( \alpha = 0.76 )</td>
</tr>
<tr>
<td></td>
<td>SCWT: Reading Condition</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SCWT: Naming Condition</td>
<td></td>
</tr>
<tr>
<td>Complex attention</td>
<td>TMT Difference Score: Part B–Part A</td>
<td>( \alpha = 0.74 )</td>
</tr>
<tr>
<td></td>
<td>SCWT Difference Score: Interference Condition–Naming Condition</td>
<td></td>
</tr>
<tr>
<td>Visual spatial skills</td>
<td>TMT: Part A</td>
<td>( \alpha = 0.61 )</td>
</tr>
<tr>
<td></td>
<td>WAIS-R: Block Design</td>
<td></td>
</tr>
<tr>
<td>Executive skills: flexibility</td>
<td>WCST: errors</td>
<td>( \alpha = 0.88 )</td>
</tr>
<tr>
<td></td>
<td>WCST: Perseverative Errors</td>
<td></td>
</tr>
<tr>
<td>Executive skills: concept formation</td>
<td>WCST: Categories Completed</td>
<td></td>
</tr>
</tbody>
</table>


alternating between the two sequences (assessment of the ability to shift strategy). The Stroop Color-Word Test (SCWT) (Stroop, 1935) was administered in a version by Bäumler (1985) which comprises three conditions: (1) reading of color names (“blue”, “green”, “red” or “yellow”) (Reading Condition), (2) identifying the color of bars printed in blue, green, red or yellow (Naming Condition), and (3) identifying the color of the ink that a word is printed in (e.g. green) while the word itself is a different color name (e.g. “red”) (Interference Condition). Whereas Reading and Naming assess attention and verbal abilities, the third condition requires subjects to ignore the more salient characteristic of a stimulus and is supposed to assess selective attention. Executive functions like cognitive flexibility and concept formation were evaluated using the Wisconsin Card Sorting Test (WCST) (Heaton, 1981). The test asks subjects to sort a deck of cards on the basis of a series of unknown categories. The sorting-category changes in test progress. Feedback of the test instructor (i.e. “correct” or “wrong”) that accompanies each sort of the participant allows to determine the correct category by which to sort the cards as well as the change of sorting category. Executive functions are employed in detecting the correct sorting category and adapting when the category changes. Test indices considered for evaluation were Number of Categories Completed, Total Errors and Perseverative Errors.

Following approaches by Bilder et al. (2000) and Lencz et al. (2006), the subtests of the test battery were used to construct eight cognitive domain scores. Those domain scores reduce the number of variables by aggregating the performance across tasks representative for a cognitive area. Assignment of subtests to domains (see Table 2) followed rational criteria but was subject to the rule that Cronbach’s alpha coefficient exceeded 0.60 for each domain.

As displayed in Table 2, internal reliability (Cronbach’s alpha) for the eight cognitive domains was acceptably high. Domain scores were computed by converting the test scores of OC and schizophrenia subjects into z-scores relating to the mean performance of healthy control subjects and taking an equally weighted mean of the z-scores of those subtests representative for a cognitive domain.

2.3. Statistical power

Regarding performance differences between schizophrenia subjects and healthy controls, literature points to large effect sizes on WCST parameters and on tasks of verbal memory and complex attention (e.g. Stroop Test or TMT
At least medium effect sizes are reported on tests of working memory, nonverbal memory, simple attention and visual spatial skills (for meta-analysis, see Heinrichs & Zakzanis, 1998). As far as performance differences between OC subjects and healthy controls are concerned, data basis is inconsistent and allows estimations of effect sizes at most for verbal and visual memory. Here, literature points to large effects. Regarding the direct comparison of OC and schizophrenia subjects, existing data is insufficient for the estimation of any effect sizes.

With group sizes of \( n = 19 \), we were able to detect large but not medium or small performance differences between groups (Cohen, 1992). However, this is not necessarily a major limitation since only large effects can be assumed to be effects of clinical significance.

### 2.4. Statistical analysis

Statistical computations were based on raw scores, scaled scores, or \( z \)-scores. For comparison of demographic variables between two samples t-tests were applied. To compare differences between all three samples one-way analyses of variance (ANOVA) were conducted followed by Tukey’s procedure for post hoc comparison or Games–Howell procedure in case of heterogeneous variances. Chi-square tables were used to compare frequencies and Fisher’s Exact Test was performed to assess statistical significance. For comparison of neuropsychological test performance, sample differences on the cognitive domain scores were compared using one-way analysis of variance followed by Tukey’s or Games–Howell procedure for post hoc comparison. To assess the impact of depression on the results found, analyses of covariance were conducted. The relationship between clinical rating scores and neuropsychological test performance was examined using Pearson’s correlations. To evaluate the impact of medication in the OCD group sub-samples of medicated and non-medicated subjects were compared via Mann–Whitney U-test. To control for effects of antipsychotic medication in the schizophrenia sample, the correlation between medication dosage (chlorpromazine equivalents) and neuropsychological test performance was analyzed. All statistical comparisons were performed using the Statistical Package for the Social Sciences (SPSS for Windows, Version 11.5).

### 3. Results

#### 3.1. Premorbid intellectual functioning of samples

Table 1 shows the results of OC, schizophrenia and control subjects on the subtest Information of the WAIS-R. Mean scaled scores of all three samples fell within the normal range, indicating a mean premorbid intellectual functioning of subjects. Moreover, one-way analysis of variance revealed no significant performance differences between the three groups (for statistical details see Table 1).

#### 3.2. Comparative performance of samples across cognitive domains

##### 3.2.1. Working memory

One-way analysis of variance revealed no significant differences of samples on the working memory score (see statistical details in Table 3). As pictured in Fig. 1 there was a trend for control subjects to perform better than OC subjects and for OC subjects to perform better than subjects with schizophrenia on the working memory tasks.

##### 3.2.2. Verbal memory

Groups differed significantly on the verbal memory score (ANOVA, for statistical details see Table 3). Post hoc analysis (Tukey’s procedure) showed that both clinical samples performed significantly poorer than control subjects [OC subjects vs. control subjects: \( p = 0.021 \), schizophrenia subjects vs. control subjects: \( p = 0.003 \)] whereas OC and schizophrenia subjects did not differ significantly from each other.

##### 3.2.3. Visual memory

Regarding the visual memory score, one-way analysis of variance yielded the same pattern of results as noted for the verbal memory score (see statistical details in Table 3): The two clinical samples performed significantly poorer than control subjects on tasks of visual memory [Games–Howell procedure, OC subjects vs. control subjects:
Table 3
Performance of clinical samples across cognitive domains

<table>
<thead>
<tr>
<th>Variable</th>
<th>Schizophrenia subjects (n = 19)</th>
<th>OC subjects (n = 19)</th>
<th>Statistic</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working memory</td>
<td>−2.0 ± 3.8</td>
<td>−0.9 ± 2.7</td>
<td>F (2:50) = 2.165</td>
<td>0.125</td>
</tr>
<tr>
<td>Verbal memory</td>
<td>−1.4 ± 1.2</td>
<td>−1.1 ± 1.3</td>
<td>F (2:52) = 6.726</td>
<td>0.003*#</td>
</tr>
<tr>
<td>Visual memory</td>
<td>−3.0 ± 3.9</td>
<td>−1.5 ± 1.0</td>
<td>F (2:51) = 7.891</td>
<td>0.001*#</td>
</tr>
<tr>
<td>Simple attention</td>
<td>−6.7 ± 5.0</td>
<td>−2.1 ± 3.1</td>
<td>F (2:47) = 15.408</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Complex attention</td>
<td>−1.1 ± 2.2</td>
<td>−0.3 ± 1.4</td>
<td>F (2:47) = 1.823</td>
<td>0.173</td>
</tr>
<tr>
<td>Visual spatial skills</td>
<td>−0.1 ± 1.9</td>
<td>0.7 ± 1.2</td>
<td>F (2:51) = 1.690</td>
<td>0.195</td>
</tr>
<tr>
<td>Executive skills: flexibility</td>
<td>−2.9 ± 3.7</td>
<td>−2.0 ± 3.4</td>
<td>F (2:47) = 4.206</td>
<td>0.021</td>
</tr>
<tr>
<td>Executive skills: concept formation</td>
<td>−0.5 ± 1.3</td>
<td>−0.2 ± 1.1</td>
<td>F (2:47) = 0.789</td>
<td>0.460</td>
</tr>
</tbody>
</table>

Statistics: One-way analysis of variance (ANOVA) followed by Tukey’s procedure for post hoc comparison between the three independent groups (respectively Games–Howell procedure in case of heterogeneous variances): * difference between schizophrenia subjects vs. control subjects, p < 0.05. # Difference between OC subjects vs. control subjects, p < 0.05. • Difference between schizophrenia subjects vs. OC subjects, p < 0.05.

p < 0.001, schizophrenia subjects vs. control subjects: p = 0.019 whereas OC and schizophrenia subjects did not differ significantly from each other.

3.2.4. Simple attention

Groups differed significantly on the simple attention score (ANOVA, for statistical details see Table 3). Post hoc analysis (Games–Howell procedure) showed that all three samples differed significantly from each other on tasks of simple attentional processing with control subjects performing significantly better than OC subjects [p = 0.048] and schizophrenia subjects [p = 0.002] and OC subjects performing significantly better than schizophrenia subjects [p = 0.027].

3.2.5. Complex attention

One-way analysis of variance revealed no significant differences of samples on tasks of complex attentional processing (see statistical details in Table 3). As pictured in Fig. 1 there was a trend for OC subjects to perform better than subjects with schizophrenia whereas OC subjects and control subjects differed only marginally.

![Profiles of neuropsychological performance by group](image)

Fig. 1. Profiles of neuropsychological performance by group (raw scores were transferred to z-scores in relation to the mean performance of healthy control subjects, which score M = 0, S.D. = 1).
3.2.6. Visual spatial skills

One-way analysis of variance revealed no significant differences of samples on the visual spatial skills score (see statistical details in Table 3). Fig. 1 demonstrates that the performance of subjects with schizophrenia on visual spatial tasks nearly equals that of control subjects whereas the performance of OC subjects even exceeds that of control subjects.

3.2.7. Executive skills: Flexibility

One-way analysis of variance yielded a significant overall effect of “group” on the executive skills score (see statistical details in Table 3). However, post hoc analyses (Games–Howell procedure) failed to reach significance, whereby the comparison between control subjects and subjects with schizophrenia \( p = 0.052 \) just missed the \( \alpha \)-level of 0.05.

3.2.8. Executive skills: Concept formation

No significant group differences were found on the WCST-Index Categories (ANOVA, for statistical details see Table 3). Fig. 1 shows that all three samples demonstrated similar abilities on concept formation/abstraction.

3.3. Profiles of neuropsychological performance by group

Fig. 1 pictures the samples performance profiles across neuropsychological domains. With the exception of the visual spatial skills score, performance of control subjects exceeded that of clinical samples on all cognitive domains. Additionally, OC subjects surpassed the performance of subjects with schizophrenia on all domains. Apart from the general superiority of OC compared to schizophrenia subjects we found a notable parallelism of performance profiles in subjects with schizophrenia and subjects with OCD across the eight cognitive domains: Obsessive-compulsive and schizophrenia subjects performed nearly normally on the domain “executive skills: concept formation” (representing functions like abstraction/concept formation) and on tasks assessing visual spatial skills. In both clinical samples slight but non-significant deviances from healthy control subjects were found on the working memory tasks and on the domain “complex attention”. The most pronounced deficits in obsessive-compulsive as well as in schizophrenia subjects were found on tasks assessing simple attentional skills (i.e. psychomotor speed) followed by deficits on visual memory and verbal memory. Within the mnemonic domain, both samples showed larger deficits on visual memory tasks than on tasks of verbal memory and working memory. Regarding the domain “executive skills: flexibility” obsessive-compulsive subjects and schizophrenia subjects revealed impairments but these failed to reach significance because of large standard deviations within the clinical groups.

3.4. Impact of potentially confounding variables

3.4.1. Influence of medication

Influence of medication on cognitive performance was analyzed separately for each clinical group. To assess the impact of medication within the OCD group, subgroups of medicated \( (n = 9) \) vs. non-medicated \( (n = 10) \) OC subjects were compared via Mann–Whitney U-test on sociodemographic (age, sex, education), clinical (duration of illness, BDI score, Y-BOCS total score) and neuropsychological variables (cognitive domain scores). Medicated and non-medicated subjects did not differ with regard to sociodemographic, clinical or neuropsychological test variables.

To control for potential effects of antipsychotic medication within the schizophrenia sample, correlations between medication dosage (chlorpromazine equivalents) and neuropsychological test performance were analyzed. Analyzes revealed that antipsychotic dosage had an impact on the performance of subjects with schizophrenia on the domain “simple attention” in that higher dosages of medication went along with poorer performances of patients \( r = -0.622, \ p = 0.031 \). This covariation remained significant after controlling for symptom severity as a potentially mediating variable [partial correlation, controlling for PANSS total score: \( r = -0.6490, \ p = 0.031 \)]. Thus, it has to be assumed that the performance deficits of schizophrenia subjects on measures of simple attentional functioning are at least partially mediated by the influence of antipsychotic dosage.
3.4.2. Influence of depression

Analyses of covariance (ANCOVA) revealed that all performance differences that were found between subjects with schizophrenia and healthy control subjects remained significant after entering BDI scores as a covariate [verbal memory: \( F(2;51) = 3.518, p = 0.037 \), post hoc comparison: \( p = 0.034 \); visual memory: \( F(2;50) = 5.977, p = 0.005 \), post hoc comparison: \( p = 0.004 \); simple attention: \( F(2;46) = 12.731, p < 0.001 \), post hoc comparison: \( p < 0.001 \)]. The difference between schizophrenia subjects and OC subjects on the simple attention score also remained significant \( [F(2;46) = 12.731, p < 0.001, \text{post hoc comparison: } p = 0.001] \). However, all significant differences that were found between OC subjects and control subjects disappeared after controlling for depression.

3.4.3. Influence of symptom severity

To examine the impact of symptom severity on patients’ test performance, clinical rating scores (for OC subjects: Y-BOCS total score; for schizophrenia subjects: PANSS total score) and cognitive domain scores were correlated via Pearson’s correlations. Neither in the OC sample nor in the schizophrenia sample did clinical ratings significantly covariate with neuropsychological test scores.

4. Discussion

4.1. Cognitive performance of OC subjects

The pattern of impairments we found in the obsessive-compulsive sample is largely in line with existing literature. Our finding of preserved working memory performance in OC subjects is in accordance with the majority of studies on short-term memory span (Aronowitz et al., 1994; Martin et al., 1995; Moritz et al., 2002; Okasha et al., 2000; Zielinski et al., 1991). In the area of episodic memory previous investigations initially stressed impairments of OC subjects on visual spatial learning tasks (Boone et al., 1991; Christensen et al., 1992; Dirson et al., 1995; Kim et al., 2002), but subsequent studies demonstrated verbal memory skills to be also affected (Deckersbach et al., 2000; Savage et al., 2000). The tasks administered in these later investigations (RCFT; CVLT) require the use of effective organizational encoding and retrieving strategies which led to the assumption that in OCD memory problems might be secondary to an underlying executive deficit (Kuelz et al., 2004; Savage et al., 2000). However, Zitterl et al. (2001) found nonverbal and verbal memory impairments of OC subjects on another memory test (the Lern-und Gedächtnistest, LGT-3) as well. By applying the WMS-R we used material that does not impose high demands on strategic aspects of information processing. Nevertheless, we were able to confirm episodic memory impairments of OC subjects on tasks of both, verbal and visual content. As expected, and in accordance with the majority of studies (Abbruzzese et al., 1995; Deckersbach et al., 2000; Zielinski et al., 1991), our findings give further evidence that those functions assessed with the WCST are not disturbed in OCD. The WCST was originally considered to assess executive (especially dorsolateral prefrontal) functioning (Goldberg & Weinberger, 1988). However, there is an increasing body of evidence suggesting that performance on the test may not be as differentially sensitive to frontal lobe dysfunction as was originally thought (van den Broek, Bradshaw, & Szabadi, 1993). As it is a characteristic for higher cognitive tasks to be complex in nature, the WCST captures different cognitive functions. Factor analytical approaches for example, demonstrated that Wisconsin Card Perseverative Errors loaded on a visual spatial factor (−0.55), together with WAIS-R Block Design (0.55) (Larrabee, 2000). Assuming that the WCST at least partly assesses visual spatial functions, the finding of preserved WCST performance in the OC sample is congruent with our finding of intact performance of OC subjects on the visual spatial domain. However, in contrast to the results of Larrabee, our data does not show significant correlations between WCST Perseverative Error Scores and WAIS-R Block Design Scores in any of the groups examined. We did not explicitly include other tests of executive functioning apart from the WCST, but the tasks we subsumed under the domain “complex attention” (TMT B-A; SCWT Interference Condition–Naming Condition) impose additional demands on higher cognitive processes (set-shifting; distractibility). Although some previous investigations reported deficits of OC subjects on the TMT B (Hollander, Liebowitz, & Rosen, 1991) and the SCWT Interference Condition (Hollander et al., 1991; Martinot et al., 1990), we found OC subjects to exhibit no difficulties on these tasks. Instead, our OC sample showed marked difficulties on tasks subsumed under the domain “simple attention” (TMT A; SCWT Reading Condition; SCWT Naming Condition). Here, speed of information processing is a crucial factor. Existing literature is inconsistent regarding the role of information processing speed in OCD. Some studies reported slower performances of OC subjects compared to healthy control subjects (Basso, Bornstein, Carona, & Morton, 2001; Moritz
et al., 2001; Schmidtke et al., 1998), others did not (Aronowitz et al., 1994; Cohen et al., 1996; Jurado et al., 2001). Kuelz et al. suggested that the status of medication could have a relevant impact on speed of information processing in OCD. However, we found reduced performance speed in OCD subjects on anxiolytic medication and in those without. With regard to visual spatial skills, interpretation of previous data is hampered by the fact that many of the tasks used rely on the interaction of different cognitive functions. Although some studies revealed visual spatial difficulties of OC subjects on tasks comparable to those we applied (e.g. Christensen et al., 1992), our OC sample even surpassed the performance of healthy control subjects on the visual spatial domain. Against the background of this finding it is to be questioned whether the impairments of OC subjects on the visual memory tasks of the WMS-R reflect a “core” visual memory deficit. Rather the encoding of the figural WMS-R material could have taken place on the basis of verbal encoding strategies.

Altogether our findings stress impairments of OC subjects on verbal and visual episodic memory and on speed-based attentional tasks. The OC sample did not show difficulties on tests assessing visual spatial or higher cognitive functions.

4.2. Influence of depressive symptoms

A major point of criticism with regard to previous neuropsychological studies on OCD was the failure to account for the potential impact of comorbid psychiatric disorders on cognitive performance. A number of recent investigations found a positive correlation between the severity of depressive symptoms and neuropsychological dysfunction in OCD (Basso et al., 2001; Moritz et al., 2001, 2003). We therefore statistically controlled for the effects of depressive symptoms on the cognitive performance of OC subjects. Analyses of covariance revealed that all significant performance differences that were found between OC subjects and healthy control subjects disappeared after entering BDI scores as a covariate. This leads to the interpretation that in previous studies on OCD comorbid depressive symptoms may have artificially inflated executive, attentional and mnemonic deficits (as it was noticed by Moritz et al., 2001, 2003). Cognitive difficulties in OCD are thus at least partly due to comorbid depressive symptoms.

As opposed to the OC sample, depressive symptoms did not notably contribute to cognitive performance deficits in the schizophrenia sample. The impairments of subjects with schizophrenia in the areas of verbal and visual memory and on tasks assessing simple attentional skills remained significant after controlling for depression scores. This is of particular interest since both clinical samples presented with comparable depression scores (see Table 1).

4.3. Specific cognitive profiles in OCD and schizophrenia?

One main intention of our investigation was to evaluate whether differential cognitive profiles can be found for OCD and schizophrenia. Surprisingly, we found a notable parallelism of performance profiles in schizophrenia and obsessive-compulsive subjects across cognitive domains with both groups showing deficits mainly in the areas of attention and memory. Thus, different from the meta-analytic results of Heinrichs and Zakzanis (1998), and against our prediction, the schizophrenia sample did not reveal significant deficits compared to healthy controls across the whole range of tasks applied. This might be due to the limited statistical power of our study design, caused by only 19 participants per group. However, in direction, impairments in subjects with schizophrenia were of a greater magnitude than those in OC subjects on all domains assessed. The finding of corresponding performance profiles in OCD and schizophrenia contradicts our expectation and negates the suggestion of unique patterns of performances in the two samples.

Another purpose of the present study was to determine the magnitude of cognitive deficits in both groups. Clinical relevance of impairments is commonly assumed if performance lays one to one and a half standard deviations below the appropriate population norm (z-score: −1.0 to −1.5). In our schizophrenia sample, this value was exceeded for the domains “working memory”, “visual memory”, “simple attention” and “executive skills: flexibility”. Concerning the obsessive-compulsive subjects it was exceeded for the domains “simple attention” and “executive skills: flexibility” (see Fig. 1). Thus, although more pronounced in the schizophrenia sample, subjects of both populations experience cognitive deficits at a magnitude which is supposed to hamper every day cognitive functioning.

The interpretation of our data against the background of other comparative approaches is complicated by the fact that existing comparative investigations concentrated mainly on executive tasks. The study that most closely resembles our approach is that of Whitney et al. (2004). The authors also assessed obsessive-compulsive subjects and subjects with schizophrenia (with and without obsessive-compulsive symptoms) on a broader range of tasks.
covering executive functions, visual spatial skills, visual memory, verbal memory and attention. Similar to our findings, shapes of performance profiles of the three groups were very similar. Furthermore, as in our study, there was a trend for obsessive-compulsive subjects to outperform schizophrenia subjects on all tests applied. Significant differences between obsessive-compulsive and schizophrenia subjects were confined to tasks assessing visual and verbal memory function. Here results differ from ours since we found significant performance differences between the two clinical samples only on tasks of simple attentional processing.

How can our main results of (A) similar performance profiles in OC and schizophrenia subjects and (B) greater magnitude of cognitive deficits in schizophrenia compared to OC subjects be explained? One might speculate that the parallelism of profiles can be ascribed to the shared frontal lobe pathophysiology of both disorders. However, given that OC and schizophrenia subjects were not significantly impaired on tasks reflecting frontal lobe dysfunction, this explanation might not be the only one and not the most plausible. The fact that comorbid depressive symptoms have aggravated neuropsychological deficits in our OC sample, whereas elevated depression scores did not significantly contribute to performance deficits in the schizophrenia sample, points to (at least partially) different mechanisms in the pathogenesis of cognitive dysfunction in OCD and schizophrenia. The fact that cognitive deficits in schizophrenia are rather stable over the course of disease (Heaton et al., 2001; Hughes et al., 2002; Rund, 1998), whereas in OCD they seem to be more transient and at least partly reversible (Buhllmann et al., 2006; Kuelz et al., 2006), lends further support to this assumption.

To explain the similar cognitive performance profiles in OCD and schizophrenia despite assumingly different pathogenic mechanisms, we propose that cognitive functions are differentially prone to detrimental factors. Attentional skills, for example, appear to be easily disturbed, leading to dysfunctions in the area of attention as a consequence of even minor neurological damages. Such a hierarchy of vulnerability among neuropsychological functions could also explain why previous investigations failed to bring up evidence of specific cognitive disturbances in psychiatric disorders (Heinrichs & Zakzanis, 1998; Henry & Crawford, 2005; Laws, 1999; Moritz et al., 2002).

4.4. Methodological considerations

A number of restraints must be taken into account in evaluating the results of the present investigation. First of all, OCD and schizophrenia both are clinically heterogeneous disorders with various syndromatic patterns. Our sample sizes did not allow us to differentiate between homogeneous sub-samples that might well differ with respect to neuropsychological impairments. Another weak point in our design is the absence of any method to assess the effort subjects were willing to put in the presented tasks. Hence, we cannot rule out that motivational problems have reduced the validity of the test battery and skewed our data. Moreover, as noticed by Kuelz et al. (2004, page 230), a general problem arises from the fact that most of the neuropsychological tests applied are rather complex measures “not designed to differentiate between various psychiatric disorders but rather to detect marked neuropsychological dysfunctions”.

By aggregating single test scores into domain scores, we reduced the number of dependent variables and therewith the problem of multiple testing which results from analyzing a limited number of subjects on a large number of cognitive measures. At the same time we simplified an otherwise complex data pool. On the other hand, the chosen procedure implicates that deficits can now only be allocated to broader areas of cognitive functioning and failures on single specific test measures might be less well represented.

4.5. Conclusion

Compared to schizophrenia – the psychiatric condition with most pronounced neurocognitive deficits – cognitive performance problems in OCD seem to be of a similar kind, but much smaller in magnitude. Deficits in both psychiatric populations primarily occur on test measures tapping performance speed and in tests measuring verbal and visual memory. Visual spatial skills and executive functions seem to be rather spared. Comorbid depressive symptoms, although of comparable intensity in both clinical groups, influenced cognitive performance differentially. Together with the different course of neuropsychological deficits across the course of disease found by other researchers, this might point to different pathogenic processes leading to cognitive deficits in OCD and schizophrenia. Of interest to future research would be to follow our suggestion that a specific hierarchy of vulnerability among neuropsychological functions might account for the failure of our and previous investigations to reveal differential patterns of cognitive impairments in psychiatric disorders.
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