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ORIGINAL PAPER

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A check on the memory deficit hypothesis of obsessive-compulsive checking

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Abstract A number of recent studies have challenged the hypothesis that patients with obsessive-compulsive disorder (OCD) display global memory deficits. An alleviated form of the memory deficit hypothesis posits that OCD patients share deficits to vividly recall memory episodes. According to the latter view, checking rituals can be understood as counter-productive coping strategies to "enrich" memory episodes in order to make them more distinctive. A source memory task was administered to 27 OCD (17 checkers) and 51 healthy participants. Along with confidence judgments, a *remember-know* procedure was employed to assess whether OCD patients display problems with conscious/vivid recollection. Patients with or without checking compulsions did not exhibit differences to controls on source memory accuracy and meta-memory. Patients forgot more self-generated items, which, however, was related to comorbid depressive but not OCD symptoms. Findings challenge the ubiquity of memory deficits in OCD. To account for the inconclusive pattern of results in the literature, it is suggested that patients mistrust their memories and adopt checking rituals only when perceived responsibility is inflated.

Key words obsessive-compulsive disorder · memory · meta-memory · memory confidence

Introduction

When patients with obsessive compulsive disorder (OCD) are asked why they perform checking rituals, dissatisfaction with their memory is often expressed. Accordingly, it has been proposed early that patients with OCD, particularly checkers, have objective memory impairments which they try to compensate with excessive checking (Sher et al. 1983, 1989). While a number of studies have essentially confirmed this assumption (for reviews see Kuelz et al. 2004; Tallis 1997), a strong formulation of this hypothesis has recently suffered a number of empirical set-backs. For example, it has been demonstrated that memory impairments may be confined to a subgroup of OCD patients with comorbid depression (Moritz et al. 2003) and that memory problems, particularly with nonverbal material, may be secondary to organizational problems (Mataix-Cols et al. 2003; Penades et al. 2005; Savage et al. 1999, 2000). While a recent study (Moritz et al. in press-a) verified that nonverbal memory performance, as assessed by the Rey-figure, was moderately predicted by sub-optimal organizational strategies, organizational strategies had a negligible impact for less complex memory performance. This renders it unlikely that even such secondary memory problems can fully account for simple checking rituals such as repeatedly turning off the hearth or closing the door (see also Bohne et al. 2005).

In the absence of consistent evidence for objective impairment, the possibility remains that patients mistake common memory problems for real deficits or exaggerate the presence of subtle impairment. Such a view would predict decreased scores on self-report measures of memory. In a recent study (Moritz et al. in press-b), memory problems (prospective, verbal, nonverbal) were reported by OCD patients as often as by healthy controls, whereas depressed patients scored significantly lower than the healthy and OCD sample on most parameters. Division of the OCD group into checkers and non-checkers did not moderate the results. Interestingly, depressive symptomatologys was associated with a number of subjective cognitive deficits across all groups.

A third area of memory research in OCD is primarily concerned with the question whether OCD patients, particularly checkers, share problems with vivid recollection (Ecker and Engelkamp 1995; Reed 1985), as also found in schizophrenic patients (Bacon et al. 2001; Dan-

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ion et al. 1999; Huron and Danion 2002; Huron et al. 1995). Further, it has been put forward that OCD patients may heavily rely on visual information and share an impairment to integrate information obtained from different perceptual channels (Ecker and Engelkamp 1995; Reed 1985; Tallis 1997). Deficits in conscious recollection of a memory trace would decrease the sense of personal involvement (or "flavor") when tasks are performed and presumably trigger a feeling of insecurity whether a task was performed or only intended. Checking rituals may thus implicitly or explicitly serve the purpose to put a personal stamp on an act to increase its vividness and retrievability in episodic memory. While such a strategy may at first sight seem promising to assure task completion, repetition of such "add-ons" may not help to distinguish successive memory episodes in the long run: chains of rituals look increasingly alike thus blurring the distinctiveness of a current episode (Tolin et al. 2001; van den Hout and Kindt 2003). This in turn could also explain why many OCD patients change their rituals over time by means of prolongation or slight altering of the "compulsive script".

In the present study, we assessed whether patients with OCD indeed have problems with memory and meta-memory. Meta-memory in the present context is defined as people's knowledge and beliefs about the trustworthiness and fallibility of their own memory. Subjects were administered a source memory task with subsequent recognition. For the recognition phase, participants were required to make source memory, *remember-know* and confidence judgments. A strong claim of the memory deficit hypothesis would assume overall decreased memory accuracy in OCD, especially in checkers. The signature of the hypothesis that recollection is less vivid in OCD patients would be a decreased number of remember ratings relative to controls (i. e., items are recollected solely on the basis of familiarity and not with perceptual details). Problems to integrate information obtained from different perceptual channels and high reliance on visual information would lead to source memory problems, as studied items in the present study, which were either self- or computer-generated, did not differ with respect to visual properties.

Methods

Participants

Patients with a presumed diagnosis of OCD were screened by trained clinicians for validity of diagnosis prior to further investigation. Preselected patients underwent a psychopathological assessment using the neuropsychiatric interview (MINI, Sheehan et al. 1998). Finally, 27 patients with obsessive-compulsive disorder were enrolled in the study (10 male, 17 female; age: 32.43 years (SD = 8.86); years of formal education: 11.65 (SD = 1.67); number of previous hospitalizations: 1.69 (SD = 1.41)). Through advertisement, an established subject pool, and word-of-mouth, 51 healthy controls were recruited for participation and screened with the MINI interview for absence of any psychiatric disorder (27 male, 24 female; age: 35.81 years (SD = 9.33); years of formal education: 11.00 (SD = 1.76)). The Yale-Brown Obsessive-Compulsive Scale (Y-BOCS, Goodman et al. 1989) and the Hamilton Depression Rating Scale (HDRS, Hamilton 1960) were administered to assess the severity of OCD (M = 24.44, SD = 6.83) and depressive symptomatology (M = 13.63, SD = 7.01).

The short form of the Hamburg Obsessional Compulsive Inventory (HOCI, Klepsch 1991) was administered to OCD patients. The HOCI assesses 72 core obsessions and compulsions along six scales (checking; cleaning; arranging things (order); counting, touching and speaking; thoughts of words and pictures; thoughts of doing harm to self/others (aggressive thoughts)). Patients were dichotomized into checkers and non-checkers according to norm values of the HOCI (high symptom group: scores greater-equal STANINE 5).

None of the subjects had a known current or past history of brain damage, severe substance abuse or another axis I diagnosis. Comorbid depression was tolerated in patients. Nineteen of the patients were prescribed antidepressive medication. All patients were investigated prior to a cognitive-behavioral intervention in our hospital.

Experiment

Participants were presented word riddles on a computer screen. The riddles were derived from real words, which were jumbled by randomly selecting 1–2 letters, and displacing them to a different location in the letter-string (e. g., *tebla*). Along with the word riddle, a short written verbal cue (e. g., *furniture*) was provided to facilitate and disambiguate responses (e. g., *table*). In alternating order, the correct answer had either to be provided by the participant or was given by the computer, as indicated via a brief cue prior to each word riddle. Importantly, items for computer and self-generated trials did not differ with respect to visual aspects. For computer-generated trials, a pre-recorded female voice was presented, providing the correct answer in advance to the presentation of the word riddle. Participants were instructed not to verbally repeat the computer-generated answer. In total, 48 word riddles were presented, of which half were solved by the participant. The items consisted of each 16 positive, neutral and negative words.

Subsequent to the learning trial, participants were presented a recognition task. The recognition task consisted of 96 items: 48 old items (i. e., solutions to the word riddles) and 48 new items in random order. The distractor items were again evenly distributed along the three affective categories (i. e., 16 positive, 16 neutral and 16 negative words). Recognition items were written in a different font and color than the word riddles to prevent physical matching. In half of the cases, the new items were related to the self-generated (i. e., 12 items) and computer-generated items (i. e., 12 items). Twenty-four distractor words were unrelated to the studied words. The stimulus material was derived from a pool of words that were rated by 20 independent raters for fulfillment of valence requirements. Conditions were matched for word frequency in the German language.

For the recognition task, participants were asked to provide three judgments in response to each item. First, participants had to specify whether an item was computer-generated, self-generated or new. Second, the participants were required to evaluate whether they were entirely certain (rating = 4), rather certain (3), rather uncertain (2) or guessing (1) about their response. Third, they had to indicate for each item that was judged as old, whether they could either vividly *remember* the item being presented (i. e., if the patient could recall a specific perceptual detail about the item or the situation) or if the item was merely familiar (*know* feeling) to them. No feed-back was provided to the participant whether or not the response was correct.

Results

Sociodemographic variables and memory accuracy

Samples did not differ on any sociodemographic background variable (ps > 0.1). No differences resulted on sociodemographic variables when the OCD group was

split into checkers (n = 17) and non-checkers. Since the OCD sample showed a slight excess of female participants, which was not statistically significant ($p > 0.15$), gender was carefully considered as a potential moderator. However, none of the following analyses was substantially altered when gender was entered as an additional factor.

A 5 x 3 x 3 x 2 four-way ANOVA with Source (self, computer, new items related to self-generated items, new items related to computer-generated items, new unrelated items), Attributed Source (self, computer, new) and Valence (positive, negative, neutral) as within-subject factors, Group as between-subject factor and number of responses as dependent variable was conducted. We would like to confine the results to the main findings and all effects involving Group. The ANOVA revealed a highly significant interaction of Source x Attributed Source, $F(8,608) = 361.114$, $p < 0.001$: as expected, the attributed source mostly matched the correct source (see Table 1). Moreover, the three-way interaction of Group x Source x Attributed Source was significant, $F(8,608) = 2.31$, $p = 0.02$. Exploratory t-tests revealed that this effect reflected group differences for self-generated items: patients more often attributed self-generated items as new, $t(76) = 2.68$, $p = 0.01$. Valence did not interact with any results involving Group as a factor (see below). Computation of signal detection parameters (d' and beta) did not reveal group differences ($p > 0.1$).

When the above analysis was confined to the 17 patients with checking compulsions, the one significant t-test comparison obtained for the entire group failed to reach a conventional level of significance ($0.05 < ps < 0.1$). No differences emerged between checkers and non-checkers.

Meta-memory

Regarding memory confidence, the OCD ($M = 3.00$, $SD = 0.43$) and healthy sample ($M = 2.98$, $SD = 0.40$) were indistinguishable, $t(76) = 0.17$, $p > 0.8$. Valence and Response Type (correct, incorrect responses) did not moderate any of the results ($ps > 0.1$). The percentage of *remember* judgments was similar in OCD ($M = 38.30\,\%$, $SD = 20.02$) and healthy participants ($M = 37.68\,\%$, $SD = 23.41$, $p > 0.9$). Simple t-test comparisons for all "old" response combinations (i. e., 5 items types x allocation to either computer or self) accompanied with *remember* judgments did not yield any group differences ($ps > 0.8$) with the exception of the new-unrelated condition where none of the OCD patients but some of the healthy subjects thought that the items were computer-generated (healthy: $M = 0.16$; OCD: $M = 0.00$; $p = 0.01$). Similar results were obtained in the sub-sample with checking compulsions.

Impact of psychopathology, medication

Y-BOCS total and subscores (obsessions, compulsions) as well as the severity of washing and checking compulsions as assessed with the HOCI did not correlate with false-positive, false-negative, source memory errors and the frequency of *remember* ratings. Interestingly, severity of checking compulsions was associated with greater memory confidence ($r = 0.42$, $p = 0.04$). The HDRS total score was correlated with the tendency to mistake self-generated words as new ($r = 0.39$, $p = 0.04$). Patients medicated with antidepressant agents (n = 19) did not differ from non-medicated patients on memory accuracy, confidence and percentage of *remember* judgments.

Discussion

The present results further challenge a strong formulation of the memory deficit hypothesis of OCD (Moritz et al. in press-a; Moritz et al. 2003; Tolin et al. 2001). OCD patients neither displayed decreased performance for overall memory nor for source memory. Further, samples were indistinguishable regarding memory confidence (for a compatible finding see Cabrera et al. 2001), vividness of recognition and signal detection parameters (see also Brown et al. 1994). The only significant group difference reflected increased forgetting of self-generated items in OCD. This was related to depressive

Table 1 Mean response accuracy in the source memory task, irrespective of item valence. Standard deviations are set in brackets. Attribution are set in rows; original sources are set in columns

	Old		New		
	Computer (C) (n = 24)	Self (S) (n = 24)	Related to C (n = 12)	Related to S (n = 12)	Unrelated (n = 24)
Healthy					
Computer	**14.55 (3.77)**	5.16 (3.24)	2.02 (1.67)	2.06 (1.79)	1.67 (2.27)
Self	2.71 (2.69)	**15.49 (4.42)**	0.55 (0.86)	0.55 (0.81)	0.43 (0.81)
New	6.75 (3.65)	3.35 (2.28)	**9.43 (2.03)**	**9.39 (1.97)**	**21.90 (2.78)**
OCD					
Computer	**13.37 (5.12)**	4.97 (3.06)	1.85 (1.94)	1.78 (1.53)	1.44 (1.87)
Self	2.26 (2.14)	**12.96 (5.58)***	0.37 (0.63)	0.52 (1.01)	0.19 (0.48)
New	8.37 (5.35)	6.07 (5.01)**	**9.78 (2.33)**	**9.70 (1.86)**	**22.37 (2.32)**

t-test difference: * p = 0.05, ** p = 0.01
correct responses are set in bold type

and not OCD symptomatology emphasizing the importance to control for comorbid depression in OCD research (see Moritz et al. 2003 for compatible findings), particularly in view of a high prevalence of depression and other disorders in OCD (Angst et al. 2005; Grabe et al. 2001). Confinement of the OCD sample to checkers further degraded group differences on this variable.

Absence of substantial memory deficits in OCD may appear unexpected and counter-intuitive in view of frequent reports of memory dissatisfaction in OCD patients. OCD patients typically justify hoarding behavior, compiling lists and certain forms of checking with their inability to adequately memorize essential information. However, such subjective observations do not automatically imply that patients would judge their performance level to be inferior relative to controls! In fact, we have previously found that subjective memory complaints in OCD patients occurred to a comparable extent in healthy participants (Moritz et al. in press).

To accommodate clinical observations of memory dissatisfaction in OCD with the present results two theoretical explanations seem fruitful. First, memory dissatisfaction could be an expression of perfectionism, a personality trait that has long been regarded as a vulnerability factor for OCD (Hoover and Insel 1984). This theory shifts the focus from a normative memory deficit to an alteration of *desired* memory. However, unlike a "true" perfectionist who is overly accurate on all or at least most aspects of a certain class of behavior, OCD patients show marked inconsistencies (e. g., they might check over and over again that none of the glassware in the house have cracks [harm prevention] but at the same time being not overly concerned that other domestic items are broken).

In our opinion, a second hypothesis that is based on a theory by Salkovskis and coworkers (2000) more convincingly explains why patients indulge in checking behavior and parsimoniously account for the noted behavioral dissociations. According to Salkovskis, OCD patients have an inflated perceived responsibility. In this view, safety behaviors such as checking are only applied under circumstances where one's own life or the life of other people is endangered or catastrophic consequences are feared ("good is simply not good enough"). In agreement with this, a recent study (Radomsky et al. 2001) has demonstrated that under conditions of high perceived responsibility memory confidence was low in OCD checkers, whereas under low responsibility memory confidence was raised. A number of studies have shown that the adoption of rituals/safety behaviors is by no means uncommon in healthy adults and children (Evans et al. 2002; Muris et al. 1996; Rachman and de Silva 1978), especially during stress or real threat to oneself or others (excessive superstitious rituals, wearing magic charms etc.). Based on Salkovskis' (2000) theory, we pertain that the core difference between OCD patients and healthy subjects is on the perceived level of responsibility and/or risk evaluation.

One may object that the safety behaviors/rituals performed by normal subjects are benign and less excessive rendering it unlikely that differences on individual thresholds for perceived responsibility can fully account for obsessive checking. However, it should be recalled that at the beginning of the disorder patients often display few compulsions, which mostly go unnoticed by the social environment and then gradually increase. Concordantly, a number of studies have found a positive correlation between the severity of compulsions with length of illness (e. g., Moritz et al. 2002). Moreover, with a lower threshold of perceived responsibility the likelihood of compulsive behavior to occur is clearly enhanced. This could trigger a vicious circle as there is good evidence obtained in both healthy and OCD patients that repeated checking paradoxically lowers memory confidence (Tolin et al. 2001; van den Hout and Kindt 2003, 2004). Perseverative behavior promotes conceptual as opposed to perceptual encoding thereby blurring the distinctiveness of successive checks. Put differently, patients may not check because they have a primary abnormality with vivid encoding. Vice versa, reduced vivid encoding is a (normal) consequence of repetitive checking. Compulsive behavior of healthy subjects on the other hand is bound to rare situations and may therefore not affect everyday functioning.

Some reservations need to be acknowledged. The present task only employed verbal material and it can be objected that memory for self-generated words is not the same as memory for motor actions, for which evidence of metamemory dysfunction in OCD is most consistent (McNally and Kohlbeck 1993). Therefore, the present methodology should be expanded to other material types to confirm the generalizability of our findings. Moreover, while the present study assessed two important indices of metamemory (confidence, remember-know), other parameters exist such as feeling of knowing or feeling of doing which may provide non-redundant information. Indeed, recent studies have found abnormalities on these indices in OCD patients (Jurado et al. 2002; Tuna et al. 2005).

From the results we strongly suggest that memory training is not a promising complement of cognitive behavioral therapy for OCD checkers. In fact, memory training may perhaps even be counter-indicated in OCD as such programs could perpetuate the patient's belief that he or she has indeed severe memory problems, which could further fuel checking behavior. If memory problems are in fact detectable via neurocognitive tasks, comorbid depression, side-effects of anticholinergic medication, as well as other influences should be carefully considered as contributing factors.

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