Where emotion meets cognition
Nielen, Maria Margaretha Anna

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Obsession-relevant words differentially affect reality monitoring ability of OCD checkers and washers

Abstract

OCD checkers usually doubt whether they performed an action correctly, or only just imagined doing it. This characteristic lack of confidence may result from poor contextual encoding when being confronted with checking-related information. OCD checkers (n = 29), OCD washers (n = 17) and healthy volunteers (n = 14) performed a reality monitoring task with both neutral and compulsion-related words. Measures derived from signal detection theory (sensitivity and response bias) were used to assess memory performance. An item recognition task was added to test for the specificity of the findings. Discriminative ability of checkers remained intact in the context of checking-relevant stimuli, while that of washers was clearly impaired. Second, anxiety-provoking word significantly affected response bias of checkers, while these effects did not occur in washers or normal controls. Finally, both checkers and washers used a more conservative response bias than normal controls. It was concluded that memory distrust of checkers does not seem related to memory function as such, as these patients have a normal ability to reconstruct the source of checking-related memories. Rather, poor memory confidence may be due to the fact that checkers change their criteria when they are judging emotional memories. The general reality monitoring impairment in OCD washers could reflect the interfering effect of anxiety on frontally mediated memory processes.
Pathological doubt is a characteristic feature of Obsessive-Compulsive Disorder (OCD), and seen in its most pure form in patients with checking compulsions (Rasmussen & Eissen, 1998). Typically, these patients repeat their actions until they feel certain that they have performed the action correctly or safely. The presence of checking symptoms has been related to impaired memory function, although there is no compelling evidence for the presence of a general memory deficit in OCD (see for a review, Tallis, 1997). What emerges quite consistently from these studies, though, is the lack of confidence that OCD patients generally have in their own memory (Foa et al., 1997; MacDonald et al., 1997; Tolin et al., 2001; Radomsky et al., 2001).

This remarkable dissociation between objective and subjective memory function in checkers, especially in circumstances that elicit compulsive checking, may be due to a poor memory for contextual detail (Rachman, 2002). That is, checkers would be highly focused on the nature of the threatening event, thereby encoding less details of the context in which that event takes place. This notion receives support from studies showing that OCD patients actually have a better memory for obsession-related stimuli (Constans et al., 1995), whereas their confidence in memory drops proportionally (Foa et al., 1997; Radomsky & Rachman, 1999; Tolin et al., 2001).

One generally accepted method to examine contextual encoding is the reality monitoring paradigm. Reality monitoring is defined as the cognitive mechanism that helps to differentiate information that was derived from perception from imagined information (Johnson, 1997). There have already been some investigations on reality monitoring in OCD, but these studies have yielded divergent results. For instance, Ecker & Engelkamp (1995) found impaired reality monitoring in OCD checkers, while other studies found normal or even superior performance of OCD patients on these tasks (McNally & Kohlbeck, 1993; Merckelbach & Wessel, 2000; Brown et al., 1994). One particular disadvantage of these studies is that they used stimuli that were not related to the individual obsession of the OCD patient. To our knowledge, only one recent study examined the effects of anxiety-provoking stimuli on reality monitoring in OCD (Hermans et al., 2003). In this study, OCD patients were required to either imagine or perform a series of actions, which could be neutral (e.g. opening a book) or obsession-related (e.g. cleaning a washing table or removing a key from a door). After this, they had to estimate the number of times that a particular action had been imagined. The results indicated that OCD patients performed similar to non-anxious controls on
the frequency estimation task. Remarkably, memory confidence of OCD patients was normal for anxiety-provoking actions, whereas it was lowered for neutral actions. This may be explained by the fact that patients were warned before that a test would follow the perform/imagine phase. This knowledge may have enhanced the cognitive processing of anxiety-provoking actions, at the expense of threat-irrelevant information.

In the present study, we adopted a somewhat different approach to examine reality monitoring of OCD patients in the context of anxiety-provoking stimuli. We employed the reality monitoring paradigm previously used by Brown et al. (1994), in which memory performance was analysed with the help of signal detection theory. The obvious advantage of this method is that it not only provides an index of discriminative ability of the subjects, but computes their response bias as well. This seems important, as response bias indicates what criteria are used by a subject when he or she tries to reconstruct the source of a memory (Johnson, 1997). These criteria may be conservative or more lenient, depending on the nature of the task, the cost of mistakes, social context (Johnson, 1997; Marsh et al., 1997) and probably mood as well (Corwin et al., 1990). It is not unlikely that the lack of memory confidence in OCD is not related to memory function as such, but instead to the evaluations that are made about memory (Brown et al., 1994; Hermans et al., 2003). We think that investigating how these decisional processes are influenced by motivational state may add to the ongoing debate about memory, cognitive confidence and emotion in OCD. A further advantage of the Brown et al. (1994) procedure is that it permits to study implicit encoding of the stimulus material, as subjects are not informed of the subsequent reality monitoring task. This prevents extra cognitive processing of stimulus material, which may enhance subsequent recall.

To recapitulate, the present study investigated whether obsession-related stimuli induce specific changes in either discriminative ability or evaluative processes of OCD checkers. In order to see whether reality monitoring is specifically involved in compulsive checking, we added an item recognition task to the experimental procedure. Recognition of source would require more elaborate controlled operations than recognition of items (Schacter et al., 1998; Tulving, 1983) and seems to be controlled by prefrontal regions (Rugg et al., 1999; Cansino et al., 2002; Dobbins et al., 2002). Comparing performance on these tasks may shed light on the nature of memory involvement in OCD. Furthermore, as we sought to know whether reality monitoring is specifically implicated in the development of checking (and not washing) compulsions, we included a separate control sample of OCD washers in our study.
Methods

Subjects

Forty-six patients who met de DSM-IV (APA, 1994) criteria for Obsessive-Compulsive Disorder agreed to participate in the study. Twenty-nine of them presented with checking symptoms (‘checkers’) and seventeen suffered from washing symptoms (‘washers’). The severity of OCD symptoms was assessed with the Yale Brown Obsessive-Compulsive Scale (Y-BOCS, Goodman et al., 1989). The 17-item Hamilton Depression Rating Scale (HDRS, Hamilton, 1960) was used to assess severity of comorbid depressive symptoms. Within the sample of OCD washers, eleven patients (64.7%) used antidepressive medication, and two combined this with benzodiazepines. Fifteen checkers took antidepressants (51.7%), two combined antidepressants with benzodiazepines and one patient used beta-blockers only.

Fourteen healthy adults, who were matched to the patient groups with respect to age, sex and pre-morbid verbal IQ – as measured with the Dutch translation of the National Adult Reading Test (Schmand et al., 1991) – participated as control subjects. None of these subjects had a history of psychiatric or neurological illnesses. All subjects provided written informed consent after the study procedure had been explained to them. Demographic and clinical characteristics of the three groups are shown in table 1.

Table 1 — Clinical and demographic characteristics of checkers, washers and healthy volunteers. Standard deviations are given between parentheses.

<table>
<thead>
<tr>
<th></th>
<th>OCD washers [n=17, mean (SD)]</th>
<th>OCD checkers [n=29, mean (SD)]</th>
<th>Volunteers [n=14, mean (SD)]</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>39.23 (9.30)</td>
<td>35.00 (8.92)</td>
<td>37.69 (12.86)</td>
<td>1.026</td>
<td>0.365</td>
</tr>
<tr>
<td>Sex (male:female)</td>
<td>4:13</td>
<td>8:21</td>
<td>3:11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated IQ</td>
<td>110.07 (9.44)</td>
<td>109.76 (10.21)</td>
<td>111.64 (8.11)</td>
<td>0.170</td>
<td>0.845</td>
</tr>
<tr>
<td>Medication (y : n)</td>
<td>11 : 6</td>
<td>16 : 13</td>
<td>–</td>
<td>0.402</td>
<td>0.555</td>
</tr>
<tr>
<td>Y-BOCS obsession</td>
<td>10.82 (4.05)</td>
<td>9.14 (3.04)</td>
<td>–</td>
<td>1.60</td>
<td>0.116</td>
</tr>
<tr>
<td>Y-BOCS compulsion</td>
<td>10.88 (4.78)</td>
<td>10.10 (3.36)</td>
<td>–</td>
<td>0.648</td>
<td>0.520</td>
</tr>
<tr>
<td>Y-BOCS total</td>
<td>21.71 (8.54)</td>
<td>19.24 (5.62)</td>
<td>–</td>
<td>1.18</td>
<td>0.248</td>
</tr>
<tr>
<td>HDRS</td>
<td>6.62 (4.53)</td>
<td>8.28 (4.49)</td>
<td>–</td>
<td>1.17</td>
<td>0.246</td>
</tr>
</tbody>
</table>
Stimulus material

Subjects engaged in a reality monitoring task that was adapted from Brown and colleagues (1994). For the purposes of this task, two lists of 24 words were prepared. Every list consisted of 12 neutral words and 12 emotional words. With respect to the emotional words in the patient groups, words were selected that were specifically related to their nature of the compulsions, that is, checking and washing complaints (see Appendix 1). The checking and washing words were matched to each other with respect to valence and imaginability. These parameters were derived from a pilot study in 5 ocd patients who did not participate in the current experiment.

Emotional words for the normal control group were obtained by selecting words with a high negative valence from a normative database (Tops et al., in press). The resulting list was matched to the two ocd word lists with respect to valence. In every word list, both emotional and neutral words contained an equal proportion of words in which the fourth letter was higher (n = 4), lower (n = 4) or equal (n = 4) than the first letter. Words were printed in lowercase letters on index cards, which were placed in a booklet with an equal number of interspersed blank cards. A tape recording was prepared in which a beep sounded every 5 seconds. Each beep corresponded to a card in the booklet: if the card was blank, then a word was read aloud on the tape; if the card contained a word, then the tape was silent. Equal numbers of emotional and neutral words were presented visually and auditory. For each group, two booklets and two tapes were prepared for counter balancing purposes, allowing each word in the list to appear visually and auditory equally often. Stimuli were presented in a pseudorandom order, with the restriction that no more than three words from an affective or letter category or from the same presentation modality were presented consecutively.

Procedure

The experimental procedure started with a letter-height judgment task. The list with 24 words were presented and subjects were instructed to indicate, after each word, whether the height of the fourth letter was a) higher, b) equal, or c) lower than the first letter. For the written words, subjects could base their decision on the perceptual features of the words. For the spoken words, subject were instructed to visualize the word and to use this image to make the letter-height judgment. The experimenter recorded the accuracy of all responses.
After the 24 words were presented, subjects completed two surprise recognition tasks on the computer. First, an old-new recognition task was administered in which the 24 old target words were presented mixed with an equal number of new distractor words. Half of the new distractor words was emotional, the other half had a neutral content. New and old words were matched to each other with respect to valence and number of letters. Subjects indicated with a forced-choice procedure whether a word was presented during the preceding letter-height judgement task or not.

After this, a reality monitoring task was administered. Subjects were informed that all target words from the letter classification task would be presented on the screen, and that they had to indicate whether a particular word had been seen or imagined. Unlike Brown et al. (1994) we used a forced-choice recognition procedure, as it has been suggested that this is a more reliable estimate of reality monitoring (Dodson & Johnson, 1993). Another difference with the Brown et al. (1994) procedure was that we did not test reality monitoring again after subjects had been instructed of the upcoming memory task. Presentation of both recognition tasks was controlled by the Micro Experimental Laboratory (MEL) software package (version 2.0; Schneider, 1995) on a IBM-compatible computer. Words were presented in pseudorandom order and tasks were subject-paced. After completion of the recognition tasks, participants rated all words from the letter classification task on two dimensions: (a) valence and (b) to what extent the word was related to their individual OCD complaints. These ratings were made on a 9-point Likert scale.

Data analysis

Number of hits and false alarms on the item recognition and reality monitoring task were converted using algorithms derived from signal detection theory. First, this yielded a measure for the ability to discriminate between the criterial classes of items (sensitivity). For the reality monitoring task, this is the ability to discriminate between words that were seen and words that had been imagined. For the item recognition task, it reflects the ability to differentiate between old and new words. Second, subjects can differ in the criteria they use to make a decision when they are not certain about the nature of a word (response bias). This measure is an index of the a priori sense of how likely particular events are and reflects the subjects’ bias towards a certain kind of decisions (Brown et al., 1994). In the reality monitoring task, response bias reflects how conservative subjects are in deciding that a certain word was actually seen. For item recognition, response
bias indicates how willing subjects are to assign a distractor item to the category of old items based on its familiarity. Discrimination ($d'_L$) and response bias ($C_L$) were computed with the following formulas (Corwin et al., 1990):

\[
d'_L = \ln \left( \frac{HR(1-FAR)}{(1-HR)FAR} \right)
\]

\[
C_L = 0.5 \left( \ln \left( \frac{(1-FAR)(1-HR)}{(HR)FAR} \right) \right)
\]

Although there are different algorithms to derive measures for discrimination and response bias, the use of $d'_L$ and $C_L$ has the advantage that they are independent from each other (Corwin et al., 1990; Snodgrass et al., 1988). First, manipulations of discriminability (e.g. by using high and low frequency words) do not affect response bias and vice versa. In addition, $C_L$ can to register changes even if performance is at chance level (Corwin et al., 1990). Characteristically, $C_L$ varies between -1 and 1, in which scores lower than zero reflect a more liberal criterion and scores higher than zero a more conservative criterion.

We computed $d'_L$ and $C_L$ for both neutral and emotional words on the two recognition tasks. Statistical analyses were performed with SPSS version 9.0 (SPSS Inc.; Nie et al., 1986). In case $d'_L$ and $C_L$ were distributed normally (Kolgomorov-Smirnov test), a repeated measures analysis of variance (ANOVA) with Word and Group was used to test for main and interaction effects on $d'_L$ and $C_L$. Post-hoc independent and paired t-tests were used to establish the nature of the observed interaction effects. Finally, we used Pearson product moment correlations to establish relationships between $d'_L$, $C_L$ and clinical characteristics of participants.

**Results**

**Demographic and clinical characteristics**
The groups did not differ with respect to age, sex, and estimated IQ. Furthermore, OCD checkers and washers had a comparable severity of OCD and depressive symptoms (see table 1).

**Rating of emotional and neutral words**
All three groups rated the negative words to be moderately to highly aversive (see table 2). We found no differences in the valence ratings of OCD washers, checkers and healthy volunteers, suggesting that the emotional load of the negative words...
was equal for the three groups ($F_{2,33} = 2.51; p = 0.097$). The groups did not differ in their rating of the neutral words ($F_{2,33} = 1.95; p = 0.158$). With respect to the relevancy of the selected OCD words, both OCD checkers and washers rated these words to be moderately to highly related to their individual complaints, with no differences between the two OCD groups ($t_{22} = 0.55; p = 0.586$).

### Reality monitoring task

**Exploratory analysis**

Exploratory analyses with the Shapiro-Wilks statistic revealed that sensitivity and response bias in all groups were normally distributed.

**Checkers versus normal controls**

Repeated analysis of variance (ANOVA) on sensitivity ($d'$) scores of OCD checkers and normal controls did not yield a significant effect of group ($F_{1,41} = 0.934; p = 0.340$) or word type ($F_{1,41} = 0.168; p = 0.684$). However, we found a significant Word x Group interaction ($F_{1,41} = 4.44; p = 0.041$), indicating that negative emotional words had a different effect on discriminative ability of OCD checkers than on that of healthy controls. Post-hoc $t$-tests revealed (trend-like) evidence that OCD checkers had more trouble than controls in discriminating seen from imagined items when these had an emotional content ($t_{41} = 1.93; p = 0.060$) (see figure 1). However, paired $t$-test within the OCD checking sample revealed that sensitivity for checker-relevant words was not poorer than that for neutral words ($t_{28} = 1.36, ns$). In a second ANOVA, we examined the effect of word type on response bias ($C_2$) in checkers and healthy controls. This time, there was a significant effect of group ($F_{1,41} = 11.43; p = 0.002$), indicating that when OCD checkers were not sure about the source of a word, they said more often than controls that the word had been imagined rather than seen. Furthermore, we found a significant interaction

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**Table 2** — Ratings of valence and relatedness to obsession for neutral and emotional words. Standard deviations are given between parentheses.

<table>
<thead>
<tr>
<th></th>
<th>Neutral</th>
<th></th>
<th>Emotional</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>valence</td>
<td>relatedness</td>
<td>valence</td>
<td>relatedness</td>
</tr>
<tr>
<td>Checkers (n = 20)</td>
<td>0.17 (0.41)</td>
<td>-2.65 (0.77)</td>
<td>-2.55 (0.48)</td>
<td>1.69 (0.98)</td>
</tr>
<tr>
<td>Washers (n = 10)</td>
<td>0.28 (0.67)</td>
<td>-2.74 (0.77)</td>
<td>-2.98 (0.40)</td>
<td>1.41 (1.51)</td>
</tr>
<tr>
<td>Volunteers (n = 13)</td>
<td>0.61 (0.57)</td>
<td>-</td>
<td>-2.52 (0.76)</td>
<td>-</td>
</tr>
</tbody>
</table>
between word type and group ($F_{1,41} = 5.64; p = 0.022$), indicating that emotional words had a differential effect on decision rules of checkers as compared to volunteers. Post-hoc paired t-tests within the OCD checking sample revealed a significant effect of word type ($t_{28} = 2.38; p = 0.019$) indicating that these patients used different decisional criteria for emotional than neutral words. This effect was not significant in the healthy control group ($t_{13} = 1.15, ns$) (see figure 2).

**Figure 1** — Performance on the reality monitoring task. Sensitivity of memory for neutral and emotional words in checkers, washers and healthy controls. Bars represent 1 S.E.M.

**Figure 2** — Performance on the reality monitoring task. Response bias for neutral and emotional words in checkers, washers and healthy controls. Bars represent 1 S.E.M.
**OCD washers versus normal controls**

Comparison of sensitivity scores between OCD washers and healthy controls yielded a main effect of group ($F_{1,29} = 6.112; p = 0.020$) (see figure 1). This demonstrates that OCD washers were impaired in discriminating between percepts and images, regardless whether these were of neutral or washer-relevant words. We did not find an interaction between word type and group ($F_{1,29} = 0.833, ns$) or a main effect of word type ($F_{1,29} = 1.74, ns$). When we analysed $C_L$-scores of OCD washers and controls, there was a small but statistically significant effect of group ($F_{1,29} = 4.43; p = 0.044$), indicating that in case of doubt, OCD washers attributed words more often to the auditory modality than controls did. The lack of an interaction between word type and group ($F_{1,29} = 2.89; p = 0.100$) indicated that this effect was not modulated by the emotional content of the words (see figure 2).

**OCD washers versus OCD checkers**

Comparison of the two OCD samples only yielded a significant main effect of word type for response bias ($F_{1,44} = 6.53; p = 0.014$). This indicates that both OCD groups attributed emotional words more often to the perceptual modality than neutral words.

**Old–new recognition task**

When subjects were required to differentiate old target from new distractor items, analysis of variance between OCD checkers and controls revealed again a clearly significant interaction between word type and group ($F_{1,41} = 12.38; p = 0.001$) (see figure 3). This effect was due to the fact that recognition memory of control subjects significantly improved for emotional items ($t_{13} = 3.16; p = 0.007$) while this effect was absent in OCD checkers ($t_{45} = 0.48, ns$). The main effects of either word type ($F_{1,41} = 2.69; p = 0.108$) and group ($F_{1,41} = 0.438; p = 0.512$) were not significant. Second, comparison of OCD washers and controls produced a main effect of word ($F_{1,29} = 6.54; p = 0.016$) indicating that in both groups, emotional words were better recognized than neutral words (see figure 3). This time, there was no longer significant evidence that OCD washers performed poorer on the recognition task ($F_{1,29} = 3.89; p = 0.058$). There were no significant main or interaction effects when comparing task performance of OCD checkers and washers. With regard to response bias, all group comparisons yielded a highly significant main effect of word, which demonstrates that all three groups used markedly
more liberal decisional criteria for emotional as compared to neutral words. The lack of significant interaction effects indicates that this effect of word was equal for all three groups (see figure 4).

Figure 3 — Performance on the old-new recognition task. Sensitivity of memory for neutral and emotional words in checkers, washers and healthy controls. Bars represent 1 S.E.M.

Figure 4 — Performance on the old-new recognition task. Response bias for neutral and emotional words in checkers, washers and healthy controls. Bars represent 1 S.E.M.
Correlations between memory performance, symptoms and demographic characteristics

Neither sensitivity nor response bias on the reality monitoring task correlated with symptoms or demographic characteristics of OCD patients. On the item recognition task, we found a significant relation between discriminative ability for neutral words and estimated IQ ($r = 0.65, p < 0.001$).

Discussion

Memory confidence of OCD checkers usually decreases in anxiety-provoking situations (Foa et al., 1997; Tolin et al., 2002; Rachman, 2002), which is possibly due to less efficient encoding of contextual details of the event. The present study examined how obsession-related words affect discriminative and judgmental abilities of OCD patients when performing a reality monitoring task. In order to see whether reality monitoring is specifically involved in the generation of checking behaviour, we tested whether the effects also occurred in item memory. Furthermore, performance of checkers was compared with that of a separate control group consisting of OCD washers.

Data on the reality monitoring task reveal that anxiety-provoking words affected discriminative ability of checkers differently than that of normal controls. In particular, checkers had no problems in remembering the source of neutral words, whereas they tended to become less accurate than controls when dealing with checking-related words. Although these findings seem to confirm our initial hypothesis, a closer look at the data reveals that anxiety arousing words did not actually impair reality monitoring ability of checkers. In fact, the differential response to emotional words was not very pronounced, and it was composed of a joint effect occurring simultaneously in patients and controls. From this, we can infer that sensitivity of memory does not seem to play an important role in checking behaviour.

One interesting finding was that OCD checkers, unlike OCD washers or normal controls, changed their decision criteria when they were dealing with obsession-relevant words. More specifically, when these patients tried to remember the source of an emotional word, they were more inclined to say that it was seen than when the word was neutral. This suggests that the affective content of the word influenced the judgmental processes needed to reconstruct memory. It is not entirely clear why OCD checkers classified emotional words more often as being perceptually derived. One possible explanation may be that emotional words...
(even in case these were presented auditorily) evoked more affective, perceptual and semantic associations in OCD checkers than neutral words did. The presence of such details usually makes subjects decide that a memory originated from perception rather than imagination (Dobson & Markham, 1993; Markham & Hynes, 1993; Johnson, 1997). These data suggest that OCD checkers, unlike OCD washers, come to think differently about their memory when dealing with obsession-relevant material. Future research should point out how these altered evaluations contribute to the memory distrust that characterises these OCD patients.

A second finding concerning response bias was that OCD patients (that is, both checkers and washers) were in general more inclined to say that a word had been imagined rather than seen. Such a ‘conservative’ response bias indicates that patients need considerably more information in order to feel certain about a decision, and as such could explain their memory distrust (Brown et al., 1994). These findings contrast with those of Brown and colleagues who found a normal response bias in OCD (Brown et al., 1994). One possible explanation for these contradictory findings may lie in the nature of the normal control group that was selected for the two studies. In particular, most control subjects included by Brown and colleagues presented with low to moderate depressive symptoms, while our normal controls had no depressive complaints. As it has been found that subjects with a depressed mood use a rather conservative response bias (Corwin et al., 1990; Brown et al., 1994), the more stringent response bias found in our OCD patients may merely reflect their lowered mood.

We added an old–new recognition task to the experiment, in order to see whether anxiety provoking words interfere with other forms of memory as well. We found that performance of healthy controls significantly improved when they had to recognize words with an affective content. Instead, item memory of OCD checkers did not seem to profit of the emotional content of a word, suggesting that confrontation with threatening information also had an effect on the cognitive operations underlying item memory. However, we think that one should be careful in drawing definite conclusions from these data, as checking-relevant words did not actually lower memory performance within OCD checkers. Moreover, we cannot exclude the possibility that the old/new discrimination was more difficult for OCD patients than for controls, as both old and new OCD words were probably highly familiar to the patients.

To our surprise, OCD washers were significantly worse than controls in discriminating seen from imagined words, regardless of the affective content of the words. This finding sharply contrasts with the excellent reality monitoring capacity of OCD washers reported previously (Brown et al., 1994). Although tentative, the
The most parsimonious explanation for these contradictory results is that memory of OCD washers was adversely influenced by the presence of washer-relevant items in our study. Cognitive theories on compulsive washing presume that OCD washers are very much oriented towards protecting oneself from potential contaminators, possibly resulting in an avoidant and hypervigilant information processing style (Rachman, 2003; Foa et al., 1994; Lavy et al., 1994; Tata et al., 1996). Although speculative, the unanticipated occurrence of washer-relevant words in the reality monitoring task may have caused these patients to devote their attention towards the identification of imminent threat words. Consequently, fewer attentional resources may have been available for the encoding the contextual details of the words. The finding that item memory of washers was intact suggests that washer-relevant word preferably interfere with the more demanding processes that are involved in source memory. Together, these data seem to imply that emotional arousal has more substantial effects on memory of OCD washers than on memory of OCD checkers.

Taken together, we found no direct evidence that anxiety provoking words disrupt reality monitoring ability of OCD checkers. Of course, the emotional impact of stimuli used in the current study is relatively modest as compared to those used in symptom provocation studies (e.g. McGuire et al., 1994; Breiter et al., 1996). However, it was recently found that reality monitoring of OCD patients even remains unaffected when dealing with ideographically selected actions that were tailored to their individual concerns (Hermans et al., 2003). Together, these data suggest that reality monitoring ability does not play a major role in compulsive checking behaviour, thereby supporting findings from earlier studies in OCD (McNally & Kohlbeck, 1993; Brown et al., 1994; Merckelbach & Wessel, 2000).

A somewhat different picture emerges, though, when we consider the judgmental processes that are involved in source reconstruction. It turned out that OCD checkers used different evaluative standards when judging emotional memories. This confirms the notion that memory confidence is more related to evaluations about memory than to memory function itself (Hermans et al., 2003). As far as we know, this is the first study demonstrating an effect of emotion on response bias in OCD checkers. Previous studies have relied on questionnaires to assess how memory confidence changed in stressful situations (Hermans et al., 2003; Tolin et al., 2001). One difficulty of such behavioural ratings is that they form a rather indirect measure of response bias, as they are obtained by asking subjects to reflect on their performance (Brown et al., 1994). Using signal detection analysis, we had a measure that was not only able to register the effect of anxiety provoking stimuli in OCD patients, but also to discriminate decision
making of OCD checkers and washers. So far, it remains to be determined how the observed change in response bias relates to the chronic doubt that characterizes OCD checkers. We nevertheless think that this issue is worth to pursue in future research. For instance, negative emotions may not only affect the decision criteria involved in memory, but also those needed to judge one’s own actions, which in turn could lead to problems in reality testing and evaluating feedback (O’Connor, 2001). This seems to be supported by recent findings that OCD checkers had significantly more problems in processing the outcome of their actions under conditions of negative feedback (Nielen et al., submitted).

One final area that remains to be explored is the interaction between cognitive and affective processes in patients with washing compulsions. Although the literature is not very explicit about the cognitive mechanisms that underlie compulsive washing (Rachman, 2002), our data suggest that anxiety interferes with frontally mediated processes that are needed to retrieve the source of a word. It is tempting to speculate that in these patients, excessive activation of the affective system (involving the amygdala and hippocampus) goes at the expense of more frontally mediated control functions, although this awaits confirmation by upcoming studies.

**Acknowledgements**

We thank Erna Berendsen, Mattie Tops and Patricia van Oppen for their contribution in preparing the stimulus material and Pieter Hoekstra for his help in patient recruitment.
**Appendix** — Neutral and emotional words used for checkers, washers and healthy controls.

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*in English:*

<table>
<thead>
<tr>
<th>neutral</th>
<th>checkers</th>
<th>emotional</th>
<th>washers</th>
<th>healthy controls</th>
</tr>
</thead>
<tbody>
<tr>
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*in Dutch:*

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References


Nielen MMA, Smit HGOM & Den Boer JA. Functional impairments of ocd patients on a visuomotor associative learning task. (submitted for publication)


