



## Event-based prospective memory and obsessive–compulsive disorder intrusive obsessional thoughts

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### Abstract

Recent studies have found poorer prospective remembering among students selected for elevated obsessive–compulsive disorder (OCD) checking and washing. However, as prospective memory performance also requires retrospective remembering, it is not clear from earlier work whether deficits in prospective memory in samples with OCD symptomatology are due to problems with prospective remembering, or to retrospective memory failures that result in poorer performance on prospective memory tasks. The present study examines performance on matched prospective and retrospective memory tasks among students selected for high ( $n = 48$ ) and low ( $n = 44$ ) scores on the Obsessive–Compulsive Inventory-Revised Obsession subscale. Significant differences between the groups were found in prospective memory (regardless of whether the word was neutral or harm/danger-related), but not retrospective memory. The findings are consistent with the prediction that obsessional thoughts that occupy working memory capacity would have a deleterious effect on a resource-demanding prospective memory task. An additional finding was that there were no group differences in self-reported complaints of problems with prospective memory.

**Key words:** OCD obsessions, prospective memory, retrospective memory, self-reported memory problems

### EVENT-BASED PROSPECTIVE MEMORY AND OBSESSIVE–COMPULSIVE DISORDER (OCD) OBSESSIONS

OCD is characterised by the presence of (1) obsessions, intrusive thoughts, impulses, or images that cause anxiety; and/or (2) compulsions, repetitive behaviours, or mental acts aimed at preventing or relieving distress (American Psychiatric Association (APA), 2000). Clinical OCD is a relatively common condition, with a lifetime prevalence of around 2.5% (APA, 2000), that is associated with significant functional impairment (Markarian et al., 2010). Epidemiological studies suggest that the prevalence of subthreshold OCD symptomatology in the general population is very high, with 13% of a sample of 2,804 adults from six European countries reporting symptoms of OCD at some stage during their lives (Fullana et al., 2010), and more than a quarter (28.2%) of a sample of 2,073 adults in the USA reporting that they had experienced obsessions or compulsions at some time in their

lives (Fullana et al., 2010; Ruscio, Stein, Chiu, & Kessler, 2010). The symptoms of OCD are heterogeneous, with the majority of people experiencing both obsessions and compulsions (Markarian et al., 2010). OCD may be further distinguished by subtypes around which obsessions and compulsions cohere, particularly contamination/washing, harm/checking, hoarding, and symmetry/ordering (McKay et al., 2004). Sookman, Abramowitz, Calamari, Wilhelm, and McKay (2005) argue that examination of specific OCD subtypes is critical for the development of effective, targeted treatments.

Deficits in memory have been examined in OCD harm/checking and contamination/washing subtypes, although the literature concerning memory in OCD is marked by contradictory findings (see Cuttler & Graf, 2009; Muller & Roberts, 2005 for reviews), and recent studies of clinical OCD samples have failed to find evidence of verbal retrospective memory deficits (Moritz, Kloss, von Eckstaedt, & Jelinek, 2009; Moritz, Ruhe, Jelinek, & Naber, 2009).

Retrospective memory refers to memory for information encountered in the past. Commonly used measures of explicit retrospective verbal memory include free recall and yes/no recognition. Explicit retrospective memory measures have in common that instructions at the time of the memory test refer directly to the episode during which the material

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Received 19 February 2012. Accepted for publication 3 August 2012.

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was encoded. Prospective memory refers to the ability to carry out future intentions at a specific time (e.g., remembering to leave the house at 11.00am to attend an appointment an hour later) or in response to a specific event (e.g., remembering to lock the door when leaving). Successful prospective remembering requires that an intention to be remembered is encoded and recalled some time later in response to a cue so that accurate prospective memory task performance has both a prospective component (remembering to remember) and a retrospective component (remembering the content of what is to be remembered). Prospective remembering has often been demonstrated to be resource-demanding (McDaniel & Scullin, 2010), although there is also evidence to support the multiprocess framework that proposes that prospective memory tasks may also be supported by spontaneous, automatic retrieval processes (Meiser & Schult, 2008).

Harris and Menzies (1999) demonstrated that state anxiety was negatively associated with performance on a laboratory prospective memory task, and argued that worry associated with anxiety competed with prospective memory for limited working memory capacity required for successful prospective remembering. Harris and Cumming (2003) extended these findings, showing that performance on an event-based prospective memory test, but not a matched retrospective memory measure, was associated with state anxiety. This study was important, as it implied a deficit with the prospective component of respective remembering rather than with the retrospective memory component.

Recently, Cuttler and Graf (2007, 2008) reported that those with subclinical OCD checking perform poorly on a naturalistic event-based measure of prospective memory, and this has been replicated in a clinical sample with OCD checking (Harris, Vaccaro, Jones, & Boots, 2010). Marsh et al. (2009) examined prospective memory in a student sample selected for elevated OCD washing concerns using a laboratory measure of event-based prospective memory. Marsh et al. found that students with OCD washing concerns performed more poorly than either students who were non-anxious or students who were mildly depressed when detecting neutral cues (animals), but performance was not impaired for concern-related cues (bodily fluids). These authors attributed the poorer performance of their sample with OCD washing concerns in response to neutral cues to restricted working memory capacity due to anxiety, noting the consistency of this finding with that of Harris and Menzies (1999) despite very different methodologies. The unimpaired performance on the concern-related cues was attributed to biased attentional allocation to threat-related stimuli facilitating prospective remembering. Cue salience is known to influence prospective memory performance, and emotional cues have been shown to elimi-

nate age-related performance decrements on a laboratory prospective memory procedure (Altgassen, Phillips, Henry, Rendell, & Kliegel, 2010). Unfortunately, neither Cuttler and Graf (2007, 2008), Harris et al., 2010, or Marsh et al. (2009) included a matched retrospective memory measure, so the extent to which the findings are attributable to memory for intention (prospective), rather than memory for the content of what is to be remembered (retrospective), is not clear.

We were also interested in whether participants would be aware of their memory failures. Cuttler and Graf (2008) reported increased complaints about both prospective and retrospective memory among their student samples with elevated checking concerns. However, at least two studies have found no evidence of increased complaints about prospective memory in clinical OCD checking (Harris et al., 2010; Moritz, Kuelz, Jacobsen, Kloss, & Fricke, 2006). Harris et al. (2010) argued that for those with clinical OCD checking, checking may have become a habitual and effective strategy for avoiding prospective memory failures, so that the subjective experience of actual prospective memory failures in the preceding 6 months would be no greater for those with clinical OCD checking than for controls. Alternatively, those with clinical OCD may not be aware of their prospective memory failures.

Intrusive obsessive thoughts are a common feature of OCD, and up to 25% of those with clinical OCD report experiencing obsessions in the absence of overt compulsions (Abramowitz, McKay, & Taylor, 2008). Arguably, if it is restricted working memory capacity that accounts for prospective memory problems associated with OCD, then those with prominent obsessions with or without compulsions would be most likely to experience prospective memory problems. The present study examined prospective and retrospective memory for neutral and harm/danger-related cues in a laboratory task among a sample selected for high and low scores on the obsessive subscale of the Obsessive-Compulsive Inventory-Revised (OCI-R; Foa et al., 2002). Subjective complaints about prospective and retrospective memory were also assessed. It was predicted that those with elevated scores on the obsession subscale would perform more poorly on prospective remembering of neutral cues than those with low scores on this measure. No effect of obsession group was expected on (1) responding to harm/danger-related words if biased attention negates the working memory problem (Marsh et al., 2009), or (2) retrospective memory (Moritz, Kloss, et al., 2009; Moritz, Ruhe, et al., 2009) where the presence of task instructions would be expected to reduce the working memory demands of the task. The relationship between obsession group and prospective memory was expected to be independent of depression scores (Harris & Menzies, 1999; Marsh et al., 2009).

## METHOD

### Materials

#### *OCI-R (Foa et al., 2002)*

The OCI-R is an 18-item instrument derived from the 42-item Obsessive–Compulsive Inventory (Foa, Kozak, Salkovskis, Coles, & Amir, 1998). The OCI-R assesses the distress associated with common OCD symptoms in the past month, and the subscale scores for checking (OCI-R Check), washing (OCI-R Wash), ordering (OCI-R Order), obsessing (OCI-R Obsess), hoarding (OCI-R Hoard), and mental neutralising (OCI-R Neutral) can be calculated in addition to a total score. The OCI-R has been demonstrated to have good internal consistency in a clinical sample of adults with OCD (Foa et al., 2002), and Hajcak, Huppert, Simons, and Foa (2004) have confirmed the factor structure, reliability, and convergent and divergent validity of the OCI-R in a non-clinical student sample.

#### *Depression, Anxiety, Stress Scale (DASS-21; Lovibond & Lovibond, 1995)*

The DASS-21 assesses depression, anxiety, and stress symptoms across the past 7 days. The DASS-21 has been demonstrated to have good psychometric properties and is used extensively with non-clinical samples (Brown, Chorpita, Korotitsch, & Barlow, 1997).

#### *Worry Domains Questionnaire-Short Form (WDQ-SF; Stöber & Joormann, 2001)*

The 10-item WDQ-SF assesses worry across five domains: relationships, lack of confidence, aimless future, work, and financial issues. Stöber and Joormann (2001) demonstrated that the short version of the instrument has good internal consistency.

#### *Prospective and Retrospective Memory Questionnaire (PRMQ; Smith, Della Sala, Logie, & Maylor, 2000)*

The PRMQ is a standardised self-report inventory with 16 questions concerning the frequency of memory failures in the last 6 months. The scale contains a prospective memory subscale (PRMQ-PRO) with questions such as ‘do you decide to do something in a few minutes’ time and then forget to do it?’ and a retrospective memory (PRMQ-RET) subscale including items such as ‘do you forget something that you were told a few minutes before?’ Each item is rated on a 5-point scale (1 = never to 5 = very often). Both subscales have high reliability (prospective memory = 0.84, retrospective memory = 0.80; Crawford, Smith, Maylor, Della Sala, & Logie, 2003).

#### *Prospective and retrospective memory tests (cf. Harris & Cumming, 2003)*

The memory tests were presented on computer and were based on those used by Harris and Cumming (2003). Two lists of eight items for use in the memory tests were constructed. Each list comprised four words related to harm/danger (D) and four neutral words (N) (List 1: *disaster* (D), *catastrophe* (D), *devastate* (D), *guilty* (D), *register* (N), *approximate* (N), *coriander* (N), *silver* (N); List 2: *burn* (D), *injury* (D), *wreck* (D), *fault* (D), *lawn* (N), *colony* (N), *dwelling* (N), *chart* (N)), with average Kucera–Francis word frequency of 17.44 (standard deviation (*SD*) = 9.91; MRC Psycholinguistic database: Coltheart, 1981). The words were selected from a list of words that had been rated independently for relevance to OCD concerns by three independent psychologists with expertise in anxiety and OCD. There was no significant difference between the two lists in word frequency,  $t_{14} = 0.27$ ,  $p = .79$ , 95% confidence interval (CI) (–12.52, 9.77),  $r^2 = 0.005$ . Further, there was no significant difference between the neutral and harm/danger words in either list in imageability, word frequency, or word length (all  $p$ 's > .05). Half of the participants were randomly assigned to receive instructions to remember List 1, and the remaining participants were asked to remember List 2.

Lists 1 and 2 were each further divided into two sets of four words, two harm/danger words and two neutral words, matched for frequency (List 1A, List 1B, List 2A, List 2B). These were later used in either the prospective or retrospective memory test, counterbalanced between participants, so that the maximum score for the prospective and retrospective memory tests was 4, and the maximum score for harm/danger and neutral words on each test was 2. The memory tasks were embedded within a semantic association task. For this task, two sets of 34 additional words were constructed with an average Kucera–Francis word frequency of 20.69 ( $SD = 10.89$ ). There was no significant difference between the word frequency of the two additional lists,  $t_{66} = 1.74$ ,  $p = .09$ , 95% CI (–9.85, 0.68),  $r^2 = 0.04$ , or between the word frequency of the additional lists and the memory lists,  $t_{82} = 1.33$ ,  $p = .19$ , 95% CI (–1.60, 9.60),  $r^2 = 0.02$ . The memory targets were embedded within each word list so that the final lists used in the semantic association task comprised two sets of 38 words. Each list was later used in either the prospective or retrospective memory procedure (counterbalanced between participants), so that the maximum total score for the prospective and retrospective memory tests was 4, and the maximum score for harm/danger and neutral words on each test was 2.

### Participants

A total of 124 undergraduates were recruited for the study. The upper and lower tertiles of the OCI-R Obsession subscale

**Table 1** Means and standard deviations for participant characteristics and objective and subjective memory measures for groups based on OCI-R Obsession subscale scores

	LoObs ( <i>n</i> = 44)	HiObs ( <i>n</i> = 48)
Number of females (%)	31 (70.45)	34 (70.83)
Age (years)	18.98 (1.82)	18.65 (1.21)
OCI-R Obsession	1.00 (0.81)	6.71 (1.58)*
OCI-R Total	12.43 (7.85)	26.52 (8.51)*
WDQ Total	13.75 (6.74)	19.60 (7.07)*
DASS-Depression	4.86 (4.30)	13.96 (9.11)*
DASS-Anxiety	3.77 (4.07)	10.29 (7.57)*
Prospective memory: neutral	0.98 (0.98)	0.38 (0.73)*
Prospective memory: harm/ danger	0.80 (0.90)	0.40 (0.71)*
Retrospective memory: neutral	1.34 (0.78)	1.23 (0.86)
Retrospective memory: harm/ danger	1.41 (0.69)	1.17 (0.72)
PRMQ-Prospective	22.00 (4.93)	23.02 (4.05)
PRMQ-Retrospective	19.75 (3.85)	19.73 (4.39)

LoObs = OCI-R Obsession score 0–2; HiObs = OCI-R Obsession score 5–11. OCI-R Obsess = Obsessive-Compulsive Inventory-Revised Obsessing subscale; OCI-R Total = Obsessive-Compulsive Inventory-Revised Total Score; WDQ Total = Worry Domains Questionnaire Total; DASS-Depression = Depression, Anxiety, Stress Scale Depression Subscale; DASS-Anxiety = Depression, Anxiety, Stress Scale Anxiety Subscale. Prospective memory: neutral = event-based prospective memory neutral cues (range 0–2); prospective memory: harm/danger = event-based prospective memory harm/danger cues (range 0–2); retrospective memory: neutral = recognition memory neutral cues (range 0–2); retrospective memory: harm/danger = recognition memory harm/danger cues (range 0–2); PRMQ-Prospective = Prospective and Retrospective Memory Questionnaire Prospective subscale; PRMQ-Retrospective = Prospective and Retrospective Memory Questionnaire Retrospective subscale.

\* $p < .05$ .

were used to select two groups for the main analyses: high-obsession group (HiObs; OCI-R Obsession score 5–11;  $n = 48$ ) and low-obsession group (LoObs; OCI-R Obsession score 0–2;  $n = 44$ ). There were no differences between the LoObs and HiObs groups in age,  $t_{90} = 1.04$ ,  $p = .30$ , 95% CI (-0.31, 0.37),  $r^2 = 0.01$ , or sex distribution,  $\chi^2(1, N = 92) = 0.002$ ,  $p = .57$ . The HiObs group had significantly higher scores on OCI-R Obsession subscale,  $t_{90} = 22.04$ ,  $p < .001$ , 95% CI (-6.24, -5.18),  $r^2 = 0.85$ ; OCI-R Total,  $t_{90} = 8.23$ ,  $p < .001$ , 95% CI (-17.49, -10.69),  $r^2 = 0.43$ ; WDQ Total,  $t_{90} = 4.06$ ,  $p < .001$ , 95% CI (-8.71, -2.99),  $r^2 = 0.15$ ; DASS-Depression,  $t_{90} = 6.20$ ,  $p < .001$ , 95% CI (-12.09, -6.10),  $r^2 = 0.30$ ; and DASS-Anxiety,  $t_{90} = 5.20$ ,  $p < .001$ , 95% CI (-9.07–3.97),  $r^2 = 0.23$ ; see Table 1). The scores on the OCI-R Total and OCI-R Obsession scales for the sample of  $N = 124$  students recruited here were 18.81 ( $SD = 10.0$ ) and 3.85 ( $SD = 2.7$ ), respectively. These scores are comparable to those reported by Hajcak et al. (2004) from a sample of 395 undergraduate students ( $M = 18.91$ ,  $SD = 11.4$  and  $M = 2.92$ ,  $SD = 2.8$  for OCI-R Total and OCI-R Obsession scores, respectively). The mean OCI-R Total and OCI-R Obsession scores for the HiObs group in the present study were comparable to those reported by Huppert et al.

(2007) from a sample of 186 people diagnosed with OCD ( $M = 26.3$ ,  $SD = 12.8$  for OCI-R Total, and  $M = 6.6$ ,  $SD = 3.8$  for OCI-R Obsession; see Table 1).

## Procedure

### Phase 1: Instructions and encoding check

After reading the information sheet and giving their consent to participate, participants were instructed that they would be asked to learn and remember a list of eight words, and that their memory for these words would be tested later during a semantic association task. Participants were told that during the semantic association task, words would be presented on the screen, and they would be asked to record the first word that they thought of related in meaning to the word on the screen. They were also instructed that some of the words on the semantic association task would be from the memory list, and that when they recognised a word from the original list, they should press the X key to indicate that they remembered the word, in addition to recording a semantic associate. Participants were instructed to make sure that they had understood the prospective memory instructions as these would not be repeated later. Participants were then presented with the eight-word study list at a rate of one word every 5 s, and performed a recognition encoding check where they were asked to identify the eight studied words from a list of 16 words comprising the target words from Lists 1 and 2. This check was conducted to confirm that there was no significant difference between the counterbalanced lists in memory performance at initial encoding,  $t_{89} = 1.54$ ,  $p = .13$ , 95% CI (-0.05, 0.38),  $r^2 = 0.03$ , and no significant difference between the HiObs and LoObs groups in initial encoding that may account for differences in later prospective or retrospective memory retrieval differences,  $t_{89} = 0.29$ ,  $p = .78$ , 95% CI (-0.25, 0.19),  $r^2 = 0.001$ . The average performance on the encoding check for both groups was high (HiObs: 96.6%; LoObs: 96.3%).

### Phase 2: Questionnaires

Immediately following the encoding check, participants completed the PRMQ, the OCI-R, the WDQ-SF, and the DASS-21.

### Phase 3: Semantic association task, prospective memory and retrospective memory tests

At the beginning of the semantic association task, participants were instructed that they would see a word appear on the screen and that their task was to type an associate of the word. Participants were also instructed to keep a running total of the number of words on the list that started with the letter 's'. The prospective memory instruction to press the X

key if the word was remembered from the earlier list was not repeated, and formed the prospective memory intention. After the first 38 items had been presented, an additional instruction reminding participants that if they saw a word that they recognised from the original memory list, they should also press the X key to indicate that they remembered the word was presented on each trial. The latter part of the semantic association task, therefore, incorporated an explicit retrospective recognition memory test, as the instructions at the time of the memory test referred directly to the episode during which the material was encoded. The memory tests were, thus, always carried out in the same order, with the prospective memory test first. Had the order of tests been counterbalanced, the interval during which participants had to retain the intention to remember would have been very brief, as the instruction was incorporated in the retrospective memory task. Neutral and harm/danger words were presented randomly with the restriction that (1) no target word was presented in the first four items of a list; and (2) half of the neutral and harm/danger words were presented among the first 38 words (prospective memory), and the remainder were presented among the final 38 words (retrospective memory). The delay between the presentation of the study list and the semantic association task was approximately 10 min, and the whole procedure took no more than 30 min, excluding the introduction and debrief.

## RESULTS

### Prospective memory performance

A 2 (obsession group)  $\times$  2 (cue type) analysis of variance (ANOVA) was conducted. There was a significant main effect of obsession level,  $F(1, 90) = 8.93$ ,  $p = .004$ , 95% CI (0.17, 0.83),  $\eta_p^2 = 0.09$ , where those in the HiObs group had lower prospective memory scores than those in the LoObs group (see Table 1). However, there was no significant main effect of cue type,  $F(1, 90) = 3.06$ ,  $p = .08$ , 95% CI (-0.01, 0.17),  $\eta_p^2 = 0.03$ . There was a significant interaction between obsession group and cue type,  $F(1, 90) = 4.84$ ,  $p = .03$ , 95% CI (0.02, 0.39),  $\eta_p^2 = 0.05$ . Follow-up tests indicated that there was a significant difference in performance on the neutral and harm/danger-related items, where performance was poorer for the harm/danger-related items, for the LoObs group only. The pattern of results was unchanged when either DASS-Depression or DASS-Anxiety score was entered as a covariate.

### Retrospective memory performance

A 2 (obsession group)  $\times$  2 (cue type) ANOVA was conducted. Neither the main effects of obsession level,  $F(1, 90) = 1.71$ ,  $p = .20$ , 95% CI (-0.09, 0.45),  $\eta_p^2 = 0.02$ ; cue type,  $F(1,$

90) = 0.001,  $p = .97$ , 95% CI (-0.17, 0.17),  $\eta_p^2 < 0.001$ , nor the interaction between these,  $F(1, 90) = 0.592$ ,  $p = .44$ , 95% CI (-0.47, 0.21),  $\eta_p^2 = 0.007$ , was significant (see Table 1). The pattern of results was unchanged when either DASS-Depression or DASS-Anxiety score was entered as a covariate.

### PRMQ

A 2 (obsession group)  $\times$  2 (type of memory complaint) ANOVA was conducted. There was a significant main effect of type of memory complaint,  $F(1, 90) = 49.88$ ,  $p < .001$ , 95% CI (1.99, 3.55),  $\eta_p^2 = 0.36$ , where there were more reported failures of prospective remembering compared with retrospective remembering. However, neither the main effect of obsession group,  $F(1, 90) = 0.38$ ,  $p = .54$ , 95% CI (-2.11, 1.11),  $\eta_p^2 = 0.004$ , nor the interaction between obsession group and type of memory complaint,  $F(1, 90) = 1.76$ ,  $p = .19$ , 95% CI (-2.60, 0.52),  $\eta_p^2 = 0.02$ , was significant (see Table 1). The pattern of results was unchanged when either DASS-Depression or DASS-Anxiety score was entered as a covariate.

## DISCUSSION

Recently, it has been reported that prospective memory is poorer among those with OCD symptoms of checking compulsions (Cuttler & Graf, 2007, 2008; Harris et al., 2010) and washing compulsions (Marsh et al., 2009). If prospective memory deficits in OCD are associated with reduced working memory capacity as suggested by Marsh et al. (2009), then it would be expected that those selected for elevated levels of intrusive obsessional thoughts would be likely to have deficits in prospective remembering. Here, a sample of students with scores on a measure of obsessions similar to those of a sample with clinical OCD (Huppert et al., 2007) performed more poorly on prospective remembering of both neutral and harm/danger-related targets. This is partly inconsistent with the findings of Marsh et al. from their sample with OCD washing concerns, who found that students with elevated scores on a measure of OCD washing had impaired prospective remembering of neutral cues, but not contamination-related cues (body fluids). Marsh et al. used cues that were individually selected for participants, and therefore the salience of the cues for each individual is likely to have been higher than in the present study. Marsh et al. attributed performance on the concern-related cues to biased attentional allocation overcoming the cognitive capacity limitations associated with OCD. However, attentional bias is not consistently reported in OCD (e.g., Harkness, Harris, Jones, & Vaccarro, 2009; Moritz & von Muhlenen, 2008).

There were no differences between the groups on retrospective memory of either neutral or harm/danger-related cues. These findings are consistent with those of Moritz, Kloss, et al. (2009) and Moritz, Ruhe, et al. (2009) concerning verbal retrospective memory, and with results reported by Radomsky and Rachman (2004) concerning memory for objects. The groups were not significantly different in the number of memory complaints, and both groups reported more frequent prospective memory failures in the previous 6 months. Cuttler and Graf (2008), in a subclinical sample with OCD checking, found that those with elevated OCD checking scores reported more prospective and retrospective memory failures on the PRMQ. However, the findings of Harris et al. (2010) with a clinical OCD checking sample were consistent with those reported here, that is, no difference between the groups in self-reported prospective or retrospective memory problems.

Poorer objective prospective memory but no evidence of more prospective memory complaints among those with elevated OCD obsessions may be due to the nature of the tasks used in the present study. The prospective memory measure was experimental, requiring participants to remember to press a specific key when a study list word appeared on the screen, while the PRMQ asks about failures of memory in everyday life, such as forgetting appointments. The consequences of forgetting to attend appointments in terms of delay and embarrassment to the individual are likely to be much more significant than those of failing to respond to a cue on a laboratory task, and recent work has suggested that task consequences influence prospective memory performance (Aberle, Rendell, Rose, McDaniel, & Kliegel, 2010; Jeong & Cranney, 2009).

It must be acknowledged that participants in the high- and low-OCD obsession groups were students selected for scores on a self-report measure of OCD symptoms, and no participants had known diagnoses of OCD. However, previous research looking at the impact of OCD symptomatology on prospective memory has also used analogue samples (Cuttler & Graf, 2007, 2008; Marsh et al., 2009), and the mean OCI-R Total and Obsession subscale scores for the high-OCD obsession group were comparable to those reported previously from a clinical OCD sample (Huppert et al., 2007).

In terms of comparability with the findings of earlier work, it is acknowledged that the measure of event-based prospective remembering used in the current study (responding to specific to-be-remembered words while carrying out an ongoing syllable counting task) is rather different from both the naturalistic task used by Cuttler and Graf (2007, 2008), in which participants had to remind the experimenter to return a personal belonging, and the experimental task reported by Marsh et al. (2009), in which participants were asked to respond to members of a category (bodily fluids, animals, furniture). However, event-based prospective

memory tasks, in which participants are asked to learn and then respond to specific words when they occur in the context of an ongoing task, are not uncommon in the prospective memory literature (e.g., Cohen, Jaudas, & Gollwitzer, 2008; Harris & Cumming, 2003). Cohen et al. (2008) have shown that remembering three or more prospective memory targets is associated with slowed responding to words on a lexical decision task, suggesting that such tasks are resource-demanding and are likely to be influenced by factors that impact on available working memory capacity.

All participants included in the present study performed well on an encoding check, diminishing the likelihood that deficits in prospective remembering are due to failure to encode the targets initially; this is a strength of this kind of prospective memory task. Of course, those in the HiObs group might have forgotten the target words sooner, but this explanation seems unlikely given that there was no difference between the groups based on OCI-R Obsession scores in performance on the later retrospective memory task.

This study compared performance on matched prospective and retrospective memory tasks, and demonstrated that differences in performance between the high- and low-OCD obsession groups occurred only on the prospective memory task. Previously, it has been reported that students selected for elevated scores on measures of OCD complain of difficulties with both prospective and retrospective remembering in the previous 6 months (Cuttler & Graf, 2008), but no study has examined the presence of objective prospective and retrospective memory problems in a single study. The present findings indicated that poorer memory performance among those with elevated OCD obsessions was specific to the prospective memory task, consistent with the interpretation that prospective memory is particularly resource-demanding, and that the presence of obsessive thoughts occupies available working memory capacity. The view that prospective memory tasks, including the one used here, are resource-demanding must be treated with caution until further evidence directly examining this is available. As noted previously, the resource requirements of prospective memory tasks remain a topic of debate within the literature, and there is evidence that prospective memory tasks may be supported by spontaneous, automatic retrieval processes (Meiser & Schult, 2008).

Contrary to our expectations, the HiObs group did not perform better on the harm/danger-related words than on the neutral words in the prospective memory task. This may be because the cues, while identified by three independent expert raters as relevant to OCD concerns about harm/danger, were not selected based on specific individual concerns (Marsh et al., 2009). Further work with individuals selected for elevated levels of obsessions using stimuli matched to individual concerns and using a background task from which resource use could be better inferred is needed

to verify this possibility. Nevertheless, one strength of the current 'normative' approach is that the neutral and harm/danger-related targets used for the retrospective and prospective memory tests were matched for word frequency, which may be difficult to accomplish with individually chosen stimuli.

In summary, the current study used a rigorous experimental paradigm that allowed control for potential confounds, such as pre-existing differences in retrospective memory, which may have otherwise provided alternative interpretations of our finding of poorer prospective memory in those with elevated scores on a measure of OCD obsessions. We suggest that the mechanism underlying this deficit may be compromised working memory due to the presence of intrusive thoughts in those with elevated OCI-R Obsession scores, but further research assessing working memory performance, prospective memory, and retrospective memory among those high and low on a measure of OCD obsessions is needed to substantiate this interpretation.

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