



Research report

Altered source memory retrieval is associated with pathological doubt in obsessive–compulsive disorder



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HIGHLIGHTS

- This study examined object and source memory in OCD using a novel task.
- Group differences emerged in neural correlates of object and source retrieval.
- Altered source retrieval was associated with doubting symptoms in OCD.

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ABSTRACT

Individuals with obsessive–compulsive disorder (OCD) often complain of doubt related to memory. As neuropsychological research has demonstrated that individuals with OCD tend to focus on details and miss the larger context, the construct of source (contextual) memory may be particularly relevant to memory complaints in OCD. Memory for object versus contextual information relies on partially distinct regions within the prefrontal cortex, parietal and medial temporal lobe, and may be differentially impacted by OCD. In the present study, we sought to test the hypothesis that individuals with OCD exhibit impaired source memory retrieval using a novel memory paradigm – The Memory for Rooms Test (MFRT) – a four-room memory task in which participants walk through four rooms and attempt to encode and remember objects. Demographically matched individuals with OCD and healthy controls studied objects in the context of four rooms, and then completed a memory retrieval test while undergoing functional magnetic resonance imaging (fMRI). While no differences were observed in source memory accuracy, individuals with OCD exhibited greater task related activation in the posterior cingulate cortex (PCC) relative to healthy controls during correct source memory retrieval. During correct object recognition, individuals with OCD failed to recruit the dorsolateral prefrontal (DLPFC)/premotor, left mPFC, and right parietal regions to the same extent as healthy controls. Our results suggest abnormal recruitment of frontal–parietal and PCC regions during source versus object memory retrieval in OCD. Within the OCD group, activation in the PCC and the premotor/DLPFC was associated with greater pathological doubt. This finding is consistent with the observation that OCD patients often experience extreme doubt, even when memory performance is intact.

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1. Introduction

Individuals with obsessive–compulsive disorder (OCD) often complain of poor memory and neuropsychological research

has demonstrated impairments, particularly on tasks involving strategic processing [17,51,52,65]. Meaningful organization of information is known to enhance encoding and retrieval of new memories, and previous research has shown that individuals with OCD over-focus on details and miss the larger context [52]. Given findings that individuals with OCD tend to miss the “big picture,” source memory may be particularly relevant to OCD. Source memory refers to the ability to remember the specific context of a learning episode. Poor source memory may contribute to doubt,

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which in OCD is often characterized by a feeling of uncertainty that an action aimed at preventing harm has been completed [43]. Compulsive checking may further contribute to doubt related to memory as checking leads to the creation of multiple episodes under very similar contexts (e.g., “How do I know I am remembering the most recent time I turned off the stove and not some other time?”). Indeed van den Hout [64] showed that repeated checking reduced memory confidence and vividness of the last checking episode in a non-clinical sample. The goal of the present study was to test the hypothesis that OCD is associated with impairment in source memory retrieval, and abnormal recruitment of frontal-parietal and cingulate cortices regions.

Source memory involves the binding of content with context. One example of source memory is the need to remember where objects are located. The ability to recall where an object was seen involves linking the item (object) with source (location). Support for a distinction between source and item memory comes from results of behavioral and neuroimaging studies in healthy and neurologically impaired groups. For example, a study by Koriat et al. [30] found that performing an action increases memory for that action (item specific memory) while decreasing memory for the context of the action (source memory). Therefore, it is possible that the act of compulsive checking may increase item specific memory while decreasing source memory. While memory for the action may be intact, low memory confidence likely arises from poor memory for the context of the action (e.g., “I remember checking the stove. Am I remembering the last time or some other time?”). This may partially explain the paradoxical observation that repeated checking diminishes memory confidence in OCD [44,64].

In healthy subjects, the prefrontal cortex, medial temporal lobe and parietal regions support source memory retrieval [35,56]. Greater activation in prefrontal cortex has been consistently associated with source versus item memory [19,35]. Within the medial temporal lobe, the hippocampus is thought to bind different aspects of experience, and therefore contributes to source memory [20,22]. Activity in the posterior cingulate and parietal regions are also consistently observed during episodic and source retrieval, the latter may be dependent on top-down attention driven processes [9,32]. Memory for different types of information (contextual versus object) may, therefore, rely on distinct regions within the PFC, parietal, posterior cingulate cortex and medial temporal lobe, and may be differentially impacted by obsessive-compulsive symptoms. While no studies that we are aware of have examined neural correlates of source memory in OCD, functional neuroimaging studies have found abnormal recruitment of frontal-parietal regions during tasks that tap episodic memory. Based on this past research, we predicted that individuals with OCD would exhibit impaired source memory retrieval coupled with abnormal recruitment of frontal-parietal and posterior cingulate cortex regions during source versus item memory retrieval.

The type of source information may also be important [4,39]. Associative source information is more closely associated with the stimulus itself (e.g., color of the word or mode of presentation), while extrinsic or organizational source information is independent of the stimulus (e.g., where an object appeared or in what order). Because associative source information is more closely tied with the stimulus it may be less dependent on organization [57]. While some studies support memory deficits in OCD [29,49], other studies have failed to find differences in behavioral performance between individuals with OCD and healthy controls [12,34,38]. Given findings that individuals with OCD neglect the context of the learning episode and focus on irrelevant details rather than structural elements [51], impairments are likely to be greater on organizational source memory tasks. The present study focused on organizational source memory in order to maximally stress effortful linkages in source memory. It is also possible that

individuals with OCD demonstrate similar behavioral performance, but still engage alternate brain networks, possibly in a compensatory fashion. For example, a previous study demonstrated altered frontoparietal activation during a working memory task in OCD, even while behavioral performance was unaffected [16].

Past research has also suffered from a lack of ecological validity. Although memory deficits have been reported on some neuropsychological tests [2,52], it is not clear how differences in performance observed in OCD on these abstract tests translate to real life settings. Accordingly, the present study examined performance in the context of a memory test with high ecological validity. The task involved objects presented in the context of four different household rooms that participants walked through prior to the scanning session. This allowed us to test memory retrieval for objects as well as memory for source (which room the object was viewed in) during scanning. Given previous work supporting the role of the PFC, PCC and parietal regions in source memory in healthy adults [25,28] and evidence of frontal-parietal dysfunction in OCD during working memory [16], we hypothesized that individuals with OCD would exhibit source memory impairments and that such impairments would be coupled with abnormal recruitment of these regions during correct source versus object retrieval. As individuals with OCD often report doubt and decreased vividness for memory episodes, even when no obvious differences in behavioral performance are observed [7], we expected to observe relationships between severity of doubting symptoms and abnormal activation of these regions during source versus object retrieval.

2. Methods and materials

2.1. Participants

Participants were sixteen females with OCD and seventeen healthy control females. Because past studies suggest that males and females process context information differently [42], for this initial study we selected an all female sample. Participants were recruited from an outpatient treatment program, advertisements, and an undergraduate research subject pool. All participants were between 18 and 50 years of age. Groups were matched for age, gender (all female), handedness (all R), education, and general cognitive ability (estimated IQ). Each participant was administered the Mini International Neuropsychiatric Interview (MINI; [55] and the Wechsler Abbreviated Scale of Intelligence Vocabulary and Matrix Reasoning subtests (WASI; [13] by a trained clinician. Participants in the OCD group met criteria for OCD as assessed by the MINI.

Study exclusion criteria included the presence of any other Axis I disorder, neurological illness or injury, MRI contradiction, or current use of antipsychotic, stimulant, or anxiolytic (e.g., benzodiazepine) medication. As previous research suggests that compulsive hoarding may be distinct from OCD in terms of neurobiology and clinical course [53], individuals with clinically significant compulsive hoarding symptoms [58] were also excluded. Individuals who were taking antidepressant medication (SSRI only) were on a stable dose for at least two months prior to scanning. The University of Kansas Medical Center Human Subjects Committee approved all study procedures, and informed written consent was obtained from all study participants.

2.2. Memory encoding task

The current study aimed to build on previous memory paradigms [19,36], by employing a recently developed ecologically valid task to tap into object and source memory. Traditionally, item and source memory tasks have been limited to photographs of objects (e.g., abstract shape) and sources (e.g., red or blue

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