Source Memory in Individuals with Subclinical

Obsessive-Compulsive Symptoms

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Abstract

Patients with obsessive-compulsive disorder often complain of poor memory and results of neuropsychological research have demonstrated impairments, particularly on tasks involving strategic processing. Past research has relied heavily on highly structured tasks where subjects are told exactly what to do. However, memory deficits may be more apparent for unstructured visuospatial tasks. This study examined performance on such a task. In the present study we sought to test source and item memory using an ecologically valid paradigm -The Memory for Rooms Test (MFRT) - a four-room task in which participants attempted to remember objects in the context of rooms.   In addition, we sought to examine verbal and nonverbal memory in individuals with subclinical OCD using the California Verbal Learning Test (CVLT) and Rey-Osterrieth Complex Figure Test (RCFT). On the MFRT, Individuals with subclinical OC symptoms performed more poorly on item recognition. No impairments were found in terms of source memory. On the CVLT and RCFT, individuals with subclinical obsessive symptoms were less likely to utilize efficient organizational strategies. Our results demonstrate impairments in some aspects of organization and memory in individuals with subclinical obsessive-compulsive symptoms.

Source Memory in Individuals with Subclinical Obsessive-Compulsive Symptoms

Obsessive-compulsive disorder (OCD) is a serious and debilitating psychiatric disorder that affects 2.2 million Americans (Kessler, Chiu, Demler, & Walters, 2005). OCD is characterized by: 1) obsessions, unwanted and uncontrollable thoughts or images which are incongruent with an individual's belief system, and 2) compulsions, repetitive behaviors meant to prevent an imagined feared outcome or avoid anxiety (AmericanPsychiatricAssociation, 1994). These behaviors, though providing temporary relief, serve to maintain anxiety and doubt by preventing individuals from invalidating their obsessional fears. Common obsessions include fear of contamination, fear of harming others or being responsible for harm, and doubts about morality or sexuality. Common compulsions include ritualized cleaning, checking, mental rituals, reassurance seeking, counting or arranging. A growing body of research suggests neural and cognitive deficits may be associated with OCD.

Individuals with OCD often report doubt and uncertainty related to memory and originally it was proposed that repetitive behaviors were a response to memory deficits. Research to date does not suggest that individuals with OCD suffer from gross memory impairment. However, a growing body of evidence suggests that individuals with OCD may show impairments, particularly in executive functioning. OCD may be characterized by a frontal-executive deficit. Memory deficits may be secondary to deficits in the ability to spontaneously implement organizational strategies during encoding. In the following sections, I will first review memory deficits associated with

OCD and then propose an unstructured task to examine memory deficits in a group of participants with subclinical OC symptoms.

Verbal Memory

In general, studies have not found deficits on verbal tasks in OCD patients. Results from studies examining verbal working memory as well as declarative verbal memory fail to show impairments in OCD patients (Boone, Annanth, Philpott, Kaur, & Djenderedijian, 1991; Christensen, Kim, Dysken, & Hoover, 1992; Jurado, Junque, Vallejo, & Salgado, 2001; Martin, Wiggs, Altemus, Rubenstein, & Murphy, 1995; Zielinski, Taylor, & Juzwin, 1991). However, deficits have emerged on tasks that require use of strategic clustering, such as the California Verbal Learning Test (Savage & Rauch, 2000). A study by Savage & Rauch (2000) found that OCD patients failed to spontaneously utilize semantic clustering strategies. However, patients with OCD do not appear to be deficient in their ability to implement such strategies when instructed to do so. Deckersbach (2005) found that when individuals with OCD were prompted to use semantic clustering they were able to do so and performed as well as controls. In contrast, individuals with bipolar disorder did not show a similar improvement with prompting. This suggests that OCD patients' recall deficits do not result from impairment in the ability to use such strategies, but rather the impaired ability to *spontaneously* implement efficient strategies.

Nonverbal Memory

In contrast with verbal memory, OCD may produce more consistent impairments on visuospatial memory tasks. When compared to healthy age and gender-matched adults, individuals with OCD show evidence of impaired visuospatial memory on tasks such as the Corsi's Blocks (Zielinski et al., 1991), Raven's Matrices (Flor-Henry, Yeudall, Koles, & Howarth, 1979), the Hooper Visual Organization Test (Boone et al., 1991), and the Rey-Osterrieth Complex Figure Test or RCFT (Deckersbach, Otto, Savage, Baer, & Jenike, 2000; Savage et al., 1996). However, not all studies have found differences in nonverbal memory between OCD patients and healthy controls (Basso, Bornstein, Carona, & Morton, 2001). Impairments may be more evident on tasks with greater organizational demands, such as the RCFT.

The RCFT requires the participant to copy a complex geometrical figure and then reproduce it immediately after the copy (immediate recall) and then again after 30 min (delayed recall). Several studies examining the immediate visual recall rate on this task have found impairments in the performance of individuals with OCD compared to healthy controls (Boldrini et al., 2005; Deckersbach et al., 2000; Savage et al., 1996). The reason for this impairment was suggested by Savage et al. (1999) who found that OCD patients showed impairments in the use of organizational strategies when asked to copy the Rey Osterrieth Figures. For example, patients focused on irrelevant details of the figure instead of constructing larger structural elements. Similarly, Deckersbach et al. (2000) reported that individuals with OCD used a fragmented approach to the reproduction of the figure. Impaired use of organizational strategies were correlated with both impaired immediate and delayed recall of the figure (Deckersbach et al., 2000; Savage et al., 1999; Savage & Rauch, 2000). The failure to spontaneously use strategies efficiently may explain the impaired performance of OCD patients on such tasks (Savage, 1997).

Treatment Studies

Neuropsychological deficits may improve with treatment of OCD. A study by Moritz et al. (1999) compared treatment responders to non-responders at baseline and following behavioral therapy. At baseline, OCD patients performed significantly worse than healthy controls on set shifting and selective attention. Patients who responded successfully to therapy showed a normalization of performance, while non-responders continued to score significantly lower than healthy controls. Similarly, a study by Andres (2007) examined the effects of successful treatment for OCD on cognitive dysfunction in a group of children age 7 to 18 years old. At baseline, the OCD group performed worse on tests of speed of information processing and executive functioning. After successful treatment no significant differences remained between the OCD group and healthy controls. However, not all studies have found improvements in patients with OCD following successful treatment. A study by Nielen & Den Boer (2003) found that impairments in planning, motor speed, and spatial memory did not improve after 12 weeks of therapy with fluoxetine. Most studies suggest that deficits may be ameliorated by successful treatment of symptoms. Improvements on these tasks may be due to increased cognitive flexibility.

Neuroimaging Studies

Functional neuroimaging studies of OCD patients provide further support for a frontal-executive deficit. These studies have found evidence of prefrontal dysfunction, especially in the orbitofrontal cortex, caudate nucleus, and the anterior cingulate cortex (Schwartz, Stoessel, Baxter, Martin, & Phelps, 1996). The orbital frontal cortex is thought to play a role in decision making, motivation, and selecting a strategy in an unstructured setting. A study by Savage (2001) found that blood flow to the orbital frontal cortex during encoding of word lists predicted spontaneous implementation of semantic clustering during immediate recall. Abnormal metabolic activity in the orbital prefrontal cortex and caudate nuclei has also been found to attenuate following treatment with SSRIs (Baxter et al., 1992) and behavior therapy (Schwartz et al., 1996).

Task related neuroimaging studies suggest that OCD patients may process information differently. A study by Nakao et al. (2005) examined performance and brain activation during both symptom provocation and the Stroop task in a sample of OCD patients compared to healthy controls before and after a 12 week treatment with an SSRI or behavioral therapy. Following symptom improvement, OCD patients showed increased Stroop task related activation in the bilateral prefrontal cortices, bilateral ACC, bilateral ACC, parietal cortices, and cerebellum.

A study by van de Heuvel (2005) compared 22 medication free patients with OCD and 22 healthy controls using an event-related fMRI version of the Tower of London Task. OCD patients performed significantly worse than controls and showed decreased activation in the dorsolateral prefrontal cortex and caudate nucleus during planning. OCD patients also showed increased activation of the anterior cingulate, ventrolateral prefrontal cortex, and hippocampus, which was presumed to be compensatory activation. These results support the theory that impaired planning may be associated with OCD. Following successful treatment, task related activation has also been found to normalize.

Source Memory

A growing body of data suggests that deficits in implementation of organization strategies mediate memory deficits in OCD. Further investigation into how OCD patients perceive and organize information is needed. It may be that individuals with OCD suffer from decreased richness of memory, or lack of detail for the context of a learning episode. Individuals with OCD often report lack of confidence in their memory on tasks where no decrease in accuracy is found when compared to controls. Individuals with OCD may fail to attend to the context of the learning episode and this lack of richness may affect their memory confidence, but deficits in performance may only be apparent on more difficult tasks. OCD may be related to deficits in "source memory," meaning that individuals with OCD may fail to attend to the context and therefore have difficulty integrating information from the learning episode into a coherent whole and differentiating one learning episode from another.

Support for a distinction between source and item memory comes from results of behavioral and neuroimaging studies. A study by Hornstein and Mulligan (2004) found that enactment increases item specific memory while decreasing source memory. Studies of patients with frontal lobe dysfunction often show normal item but deficient source memory (Glisky, Polster, & Routhuieaux, 1995; Janowsky, Shimamura, & Squire, 1989). Glisky (1995) classified a group of healthy older adults as either high or low functioning based on tests of frontal lobe functioning. He found that low frontal function was associated with poorer performance on a source memory task, but not on an item memory task. The opposite results were found for the group based on classification of high and low temporal functioning. Finally, in an event related fMRI study, prefrontal activity was related more to source than item retrieval (Curran, DeBuse, Woroch, & Hirshman, 2006). These studies suggest dissociation between item and source memory. Strategic encoding may be may be more important for source memory.

The type of source information may also be important. A distinction has been proposed between associative or intrinsic source information and organizational or extrinsic source information (Baddeley, 1982; Moscovitch, 1992). Associative source information is more closely tied to 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 to the stimulus it may be less dependent on strategic processing. For example, age related memory deficits are more pronounced on organizational source memory tasks compared to associative source memory tasks (Spencer & Raz, 1995). A small number of studies have examined associative source memory in OCD. Results of these studies have been inconsistent. A study by Rubenstein et al. (1993) investigated memory for actions in a group of college student with subclinical checking symptoms and those with no OCD symptoms. Participants read statements that described actions that they were instructed to either write down, perform, or observe. Following the first phase of the study participants were asked to write down all the actions they could remember and whether they had performed, observed, or written down the action. Individuals with subclinical checking symptoms had significantly more difficulty identifying the actions as well as identifying in what form the action took (observed, written, or performed). A study by Ecker and Engelkamp (1995) found similar results; namely, that OCD patients with checking rituals had greater difficulty distinguishing between performed and imagined actions. However, several other studies have failed to find differences (Constans, Foa, Franklin, & Mathews, 1995; McNally & Kohlbeck, 1993). A potential weakness of these studies is that they focus exclusively on associative source memory, which may be less sensitive to deficits in strategic processing.

Current Study

Research suggests that neuropsychological impairments in OCD may exist particularly for visuospatial tasks that involve executive functioning. Instead of reflecting gross memory impairment, memory deficits in OCD may reflect failure to recognize and exploit important organizational elements of the task. Specifically, individuals with OCD fail to recognize that the larger picture is more important than the details. While individuals with OCD may focus on the details in an attempt to improve memory, paradoxically focusing on the details and neglecting the larger context leads to poor recall.

Past research has relied heavily on highly structured tasks where subjects are told exactly what to do. However, memory deficits may be more apparent for unstructured visuospatial tasks. This study examined performance on such a task. The task involved the presentation of items in the context of four different types of rooms. This allowed us to test memory for objects as well as memory for the context or source (which room the item was viewed in). Items either fit in with the context of the room or were out of place. We examined whether individuals with subclinical OC symptoms differed from controls in item recall, source memory, and organization. This task allowed us to examine organizational strategy, specifically whether there are differences between healthy controls and individuals with subclinical OC symptoms in their tendency to group items together based on room and location. Although an unstructured task reduces the amount of experimental control, we believe that the proposed memory task has greater ecological validity and mirror tasks in which individuals with OCD exhibit the most difficulty. We hypothesized that individuals with subclinical OC symptoms would perform more poorly on verbal and nonverbal memory tasks, including the Memory for Rooms Test. We predicted that the subclinical OC group would differ in their use of organizational strategies and use of organizational strategies would be related to memory recall. We predicted that the subclinical OC group would also perform more poorly on source memory. Specifically, they would have more difficulty identifying the source of the item memory (which room the item was viewed in). Previous research suggests that individuals with OCD may suffer from decreased memory confidence even when performance is intact. We expected that the OC group would have lower memory confidence and that confidence would be related to source memory.

Method

Participants

Participants were 60 students (23 male, 37 females) recruited from the KU psychology department undergraduate subject pool. The Obsessive Compulsive Inventory - Revised Version (OCI-R; Foa, et al., 2002) was used to identify individuals high and low on obsessive-compulsive symptoms. Individuals who scored high (one standard deviation above the mean) or low (below the mean) on the OCI-R were invited to participate. Each participant was administered the Mini International Neuropsychiatric Interview by a trained clinician. Participants who met criteria for any Axis I disorder were excluded from the study. No significant differences were found between the subclinical OC group and healthy controls in terms of age, gender, handedness, ethnicity, education or cognitive ability (see table 1).

Procedure

Participants completed a set of questionnaires. Next, the presence of axis I disorders was assessed using the Mini-International Neuropsychiatric Interview (MINI; Sheehan et al, 1998). After completing the preliminary questionnaires and assessments, participants were shown four different rooms (classroom, living room, bathroom, and bedroom). Individuals were given the following instructions: "I will be showing you a number of rooms, try to remember as much as you can about each room. Your memory will be tested for each room and the contents. You may walk around inside the room, but do not touch anything. You will have 45 seconds per room." Following the initial instructions, before entering each subsequent room participants were told, "now try to remember as much as you can about this room."

Memory Items

Objects were selected that were unique to each context and exemplifiers of each context (i.e., bathroom-toothbrush, living room-coasters, classroom-notebook, etc...). In each condition, 12 objects from each category served as target items and 12 served as distracters (Examples of items can be found in Appendix A). Each room contained six objects that were context congruent and six context incongruent objects. Incongruent objects were selected from the other categories, for example the bathroom always contained six bathroom objects, two living room objects, two bedroom objects, and two classroom objects. Objects were rotated and counterbalanced across conditions. Objects were placed where items might reasonably appear. Digital photographs of the rooms for each condition were taken for a visual record of object placement. The order of room presentation was rotated across conditions. Participants were given 45 seconds per room. Pilot testing suggested that 45 seconds produced correct immediate recall of 50% of the target items and 90% recognition accuracy.

Memory Tasks

Following the encoding period, participants were asked to 1) recall all items they remembered in any order 2) recall items by room 3) complete an item recognition test. During the item recognition test, participants were presented with pictures of items on a computer screen and were asked to identify whether the item was old or new and to rate their confidence in their response. Participants were asked to indicate whether they were completely confident (rating=4), somewhat confident (3), slightly confident (2), or unsure of guessing (1). If participants indicated that the item was old they were asked to make source and *remember-know* judgments, specifically to identify which room they saw the item in and whether they had a specific memory and could recall perceptual details for seeing the item (remember) or whether the item was familiar, they had a feeling it was present but could not recall specific perceptual details (know). Finally after a 40 minute delay, participants were asked to recall all items they remembered in any order. Participants were also asked what strategies they used while in the rooms to encode the items and what strategies they used later when trying to recall the items.

Organization scores were calculated to quantify the degree to which participants grouped objects according to room or area during immediate free recall. Participants received points for consecutively recalled items from the same room or area. Because the probability of clustering increases as the number of items recalled increases, we corrected for the overall number of words recalled using an equation adapted from Delis et al. (1987).

Following the source memory recognition task, participants completed the Rey Osterreith Complex Figure Test (RCFT), California Verbal Learning Task (CVLT), and Wechsler Adult Intelligence Scale-IV vocabulary subtest. The order of individual tests was counterbalanced. The RCFT is a measure of nonverbal recall and can also be used to examine organizational strategies. Participants were instructed to copy a complex figure. Immediately following completion of the figure and after a 20-minute delay, participants were asked to recreate the figure from memory. Participants used colored pencils to permit analysis of order in which the figure was drawn. Construction accuracy was scored using the system of Meyers and Meyers (1995). Organizational strategy was evaluated according to Savage et al. (1999).

Participants also were given the CVLT, a verbal memory task that includes a list of words that can be organized by semantic category. Participants listened to a list of words in five trials each followed by free recall. A distracter list was then read and recalled followed by free and cued recall of the target list immediately and following 20 min delay. After delayed recall, a recognition test was given of the target words. Finally, participants were given the Wechsler Adult Intelligence Scale-IV vocabulary subtest, which served as an estimate of cognitive ability.

Measures

Yale-Brown Obsessive Compulsive Inventory- Self Report Version (Y-BOCS; Baer, 1993). The Y-BOCS is a self report measure of OCD symptoms. The 10-item severity scale yields a total score (0 – 40) based on individual's obsessions and compulsions. The self report YBOCS has been shown to have good psychometric properties (Steketee, Frost, Bogart, 1996).

Obsessive Compulsive Inventory-Revised (OCI-R; Foa, Huppert, Leiberg, Langer, Kichic, Hajcak and Salkovskis, 2002). The OCI-R is an 18 item self report measure of distress associated with obsessions and compulsions. The OCI-R includes 6 subscales: washing, checking, ordering, obsessing, neutralizing and hoarding. The OCI-R has good internal consistency and reliability (Foa et al., 2002). The OCI-R has demonstrated good convergent and divergent validity in a college sample.

Beck Depression Inventory (BDI; Beck et al., 1961). The BDI consists of 21 items that assess depressive symptoms. Each item is composed of four statements that reflect symptom severity. Individuals rate symptoms on a scale of 0 to 3. Total score ranges from 0 to 63. The BDI-II has reported internal consistency of .91, and correlates strongly with other measures of depression.

Beck Anxiety Inventory (BAI; Beck et al., 1988). The BAI is a 21 item scale that measures severity of anxiety in adults and adolescents. Scores range from 0 to 63. The BAI has reported internal consistency of .92 and good reliability.

The Mini-International Neuropsychiatric Interview (MINI; Sheehan et al, 1998). The MINI is a brief diagnostic interview used to make diagnoses according to DSM-IV criteria for Axis I disorders. The MINI has been found to have excellent interrater reliability, test–retest reliability, and convergent validity with other structured diagnostic interviews (i.e., SCID).

Results

A mixed model, repeated measures ANOVA with experimental group (subclinical OC vs. control) and gender as the between subject factors, and trial as the within subjects factor was used to analyze verbal and nonverbal memory recall. Two factor (group x gender) ANOVAs were used to analyze indices where repeated measures design was not appropriate. Because gender was included in all analyses, a one way ANOVA was used to analyze group differences on demographic variables and symptom severity. Within the subclinical OC group, no significant differences were found between males and females in terms of symptom severity (i.e., anxiety, depressive symptoms, and obsessive-compulsive symptoms) or demographic variables. Similarly, within the healthy control group no differences were found between males and females in terms of demographics and symptom severity (see table 2).

CVLT Analysis

No group or gender differences were found on CVLT recall or recognition. Mean CVLT recall, recognition, and organizational scores are presented in Table 3. A mixed model ANOVA with group and gender as the between subjects factors and free recall trial (trial one free recall, trial five free recall, short delay free recall, and long delay free recall) as the within subject factor revealed no significant main effects for group, $F(1, 56) = .636$, $p = .428$, partial eta2= .011, or gender, $F(1, 56) = .094$, $p = .76$, partial eta2=.002, and no gender x group interaction, $F(1, 56) = .096$, $p = .758$, partial eta2=.002. Analysis of recognition discriminability revealed no significant main effects for group, $F(1,56) =$

.323, p=.572, partial eta2= .006, or gender, F(1,56) = .736, p=.395, partial eta2=.013, and no significant gender x group interaction, F(1,56) =.099, p=.754, partial eta2=.002.

To determine whether individuals with subclinical OC symptoms differed from healthy controls in terms of organizational strategy we analyzed use of semantic, serial, and subjective organization. Analysis of organization revealed main effects for group and for sex. The subclinical OC group used semantic clustering significantly less frequently than controls, F(1, 56) = 4.041, p=.049, partial eta2= .067, but did not differ in their use of serial, F(1,56) = .159, p = .692, partial eta2=.115, or subjective clustering, F(1,56) = .382, p =.539, partial eta2=.007. Males were found to use serial clustering significantly less than females F(1, 56) =5.31, p=.044, partial eta2= .071. Males and females did not differ in terms or semantic, F(1,56) = .110 , p=.741, partial eta2=.002, or subjective organization, F(1,56) = .301, p=.585, partial eta2=.005. No significant group x gender interactions were observed for serial, F(1, 56) = 2.43, p=.125, partial eta2= .042, subjective, F(1. 56) = 681, p=.413, partial eta2= .012, or semantic clustering, F(1, 56) = 3.23, p = .078, partial eta2= .055. The results of this analysis suggest that although no differences were found in terms of recall performance, individuals with subclinical OC symptoms may be less likely to utilize efficient organizational strategies (semantic clustering).

RCFT Analysis

Groups did not differ on RCFT recall. Mean RCFT accuracy, percent recall, and organization scores are presented in Table 4. Copy accuracy on the RCFT was evaluated using a repeated measures ANOVA with group and gender as the between subject factors and trial (copy, immediate recall and delayed recall) as the within subjects factor. No significant main effect was found for group, $F(1, 56) = 2.09$, $p = .154$, partial eta2=.036, or gender $F(1,56) = 1.93$, $p = .17$, partial eta2= .033, and no significant group x gender interaction was observed, $F(1, 56) = .498$, $p = .483$, partial eta2=.009.

Analysis of percent recall revealed no significant main effect for group on percent recall copy to immediate recall, $F(1, 56) = 1.72$, $p = .195$, partial eta2 = .030, or percent recall immediate to delayed recall, $F(1,56) = .435$, $p = .512$, partial eta2 = .008. A marginally significant group main effect was found for percent recall copy to delayed recall $F(1,56) = 4.00$, $p = .05$, partial eta2 = .067, indicating a trend toward lower delayed percent recall for the subclinical OC group compared to controls.

To determine whether individuals with subclinical OC symptoms differed from healthy controls in terms of organizational strategy on the RCFT we analyzed copy organization. Analysis of copy organization revealed no main effect for group, $F(1,56) = .888$, $p = .35$, partial eta2 = .016, or gender, $F(1, 56) = .043$, partial eta2 = .001. However, a significant group x gender interaction was found $F(1, 56) = 4.7$, $p = .034$, partial eta2=.078 (see Figure 1). Simple main effects analysis revealed that females in the subclinical OC group scored significantly lower on copy organization compared to female controls, $F(1,56) = 6.35$, $p = .015$. However, subclinical OC males did not differ from male controls, $F(1,56) = .60$, $p = .44$. Females with subclinical OC symptoms were less likely to utilize structural elements of the figure and more likely to utilize a fragmented approach. These results suggest that although recall accuracy was not impaired, females in the subclinical group were less likely to use an efficient strategy. It is possible that gender differences were confounded with symptom severity. However, within the OC group severity of depressive symptoms, anxiety and OCD symptoms (i.e., YBOCS score; see figure 2) were not significantly correlated with copy organization, all p's > .05.

MFRT Analysis

No group differences were found on MFRT recall. Mean MFRT recall, recognition and organizational scores are presented in Table 5. Recall accuracy on the MFRT was evaluated using a repeated measures ANOVA with group and gender as the between subject factors and trial (Immediate, Cued and Delayed Recall) as the within subjects factor. A significant main effect was found for gender, $F(1,56) = 11.42$, $p=.001$, partial eta2= .17. Females recalled a greater number of objects than males. No main effect was found for group, $F(1, 56) = .066$, $p=.8$, partial eta2=.001, and no significant gender x group interaction was found, $F(1, 56) = 1.065$, $p=.306$, partial eta2= .019.

Although there were no effects for recall overall, there was a significant gender x group interaction on recall of context incongruent items, $F(1, 56) =4.75$, $p=.034$, partial eta2=.078, see Figure 3. Group had a significant effect on the percent of context incongruent items recalled for men, F(1,56) = =5.24, $p=.026$, but not for women, $F(1, 56)= .38$, $p=.54$. As can be seen in Table 4, men in the subclinical OC group recalled a lower percentage of context incongruent items when compared to healthy controls.

Analysis of recognition discriminability revealed a significant main effect for group $F(1,56) = 4.25$, $p = .044$, partial eta2= .071, and gender, $F (1,56) = 5.87$, $p =.019$, partial eta2=.095. The subclinical OC group scored significantly lower than healthy controls on item recognition. Females scored significantly higher than males. No significant gender x group interaction was observed, $F(1, 56) = 2.40$, $p=.127$, partial eta2=.041.

To determine whether differences in performance were due to errors in failure to recognize target items as old or the failure to identify distracter items as new, we examined false positive and false negative errors. No significant gender differences were found in terms of false positive errors, F(1, 56) = 3.027, p =.087, partial eta2=.051, or false negative errors, F(1, 56) = 2.15, p=.15, partial eta2= .037. However, the subclinical OC group committed a significantly greater number of false positive errors compared to the control group, F(1, 56) = 4.05, p=.049. No significant differences were found between the subclinical OC group and control group in terms of false negative errors, F(1, 56) = .289, p=.593, partial eta2=.005.

Organization

The subclinical OC and healthy control group did not differ in terms of room clustering, F(1, 56) = .798, p=.376, partial eta2= .014. Females utilized room clustering significantly more than males, F(1, 56) = 7.46, p=.008, partial eta2=.118. No significant gender x group interaction was found, F(1, 56) = .004, p=.949, partial eta2 =001. Area clustering was also examined, no differences were found in terms of group, F(1,56) = .03, p=.86, partial eta2=.001, or gender, F(1,56) =1.91, p= .172, partial eta2=.033, and no significant gender x group interaction was observed, F(1,56) = .398, p=.51, partial eta2=.007.

Relationship Between Symptom Severity and Performance

To determine whether greater symptom severity was related to poor memory and organization within the OC group, correlations were calculated between memory and organization and measures of OC symptom severity. Using a one-tailed Pearson’s correlation, with alpha set at .01, no significant relationship was found between memory and organization indices and OC symptom severity (See Table 7).

Metamemory

The subclinical OC and healthy control group did not differ in their confidence ratings for either correct or incorrect item responses, $F(1,56) = 1.46$, $p=.23$, partial eta2 =.025 and $F(1,56) = 1,56) = .634$, $p= .429$, partial eta2= .011, respectively (See Table 6). However, compared to the control group the subclinical OC group reported significantly lower confidence that they had seen an item when they committed a source error (incorrectly identified the room the item appeared in), $F(1, 47) = 4.91$, $p = .032$, partial eta2 = .095. The percentage of *remember* judgments was identical in the subclinical OC (M= 79.6%) and healthy control group (M=79.6%).

Discussion

Our results demonstrate impairments in some aspects of organization and memory in individuals with subclinical obsessive-compulsive disorder. To our knowledge, this is the first study to examine organizational strategies in individuals with subclinical OC symptoms. On the RCFT and CVLT, individuals with subclinical OC symptoms were less likely to spontaneously implement efficient strategies. On the MFRT, we found that recognition performance was impaired in individuals with subclinical OC symptoms when compared to healthy control subjects. These results suggest that some of the deficits observed in clinical OCD are also present in individuals with subclinical symptoms.

Contrary to expectations we did not find deficits on MFRT source memory or organization in individuals with subclinical OCD. This may be due to a ceiling effect as mean source memory accuracy was high (91%). Although subjects were asked to recall items in any order, almost all individuals attempted to recall the items by room. We instructed participants that they would be tested on their memory for the room and its contents. It is possible that changing the study instructions might increase the difficulty of source memory judgments. Although no deficits in recall, organization by room, and source memory were found, the subclinical OC group performed more poorly on recognition memory. Analysis of incorrect responses revealed that the subclinical OC group committed significantly more false positives errors than the healthy control group.

While past research has suggested that individuals with OCD suffer from lack of confidence in their memory, no differences were found between individuals with subclinical OC symptoms and controls in terms of confidence for either correct or incorrect item responses. However, compared to the control group the subclinical OC group reported significantly lower confidence that they had seen an item when they committed a source error (incorrectly identified the room the item appeared in). This suggests that for individual with subclinical OC symptoms memory confidence is influenced to a greater degree by source memory. A study by Hornstein and Mulligan (2004) found that enactment increases item specific memory while decreasing source memory. Future research should examine the impact on compulsive checking on source memory accuracy. Perhaps, checking reduces source memory and this results in decreased confidence in patients with OCD while leaving memory for the action intact.

On the RCFT and CVLT, no impairments were found in terms of memory performance; however individuals with subclinical OC symptoms were less likely to implement efficient strategies. This suggests that individuals with subclinical OC symptoms are able to compensate for deficient organizational strategies. Prior research suggests that at least a portion of individuals with OCD utilize effortful strategies to compensate for tendencies towards less efficient processing. For example, in patients with clinical OCD, increased reaction time and neural activation has been observed when memory performance is intact compared to healthy controls. (Ciesielski, 2005).

Significant gender differences were found on the MFRT task, regardless of clinical group. Females were more likely to cluster items by room during free recall and performed better than males on recall, recognition, and source memory. One possible explanation may be that males put forth less effort than females. However, males performed as well as females on the RCFT and CVLT which suggests that differences were not due to insufficient effort. These results are consistent with findings of a female advantage in memory for objects and their location (Duff & Hampson, 2001; Lejbak, Vrbancic, & Crossley, 2008). Results of meta-analysis suggest that this advantage may be particularly robust for studies using common objects, such as those used in this study, as opposed to abstract stimuli (Voyer et al., 2007).

The results of our study also suggest gender differences in some aspects of memory and performance in patients with subclinical OCD. For example, on the RCFT we found that females, but not males, in the subclinical OCD group were less likely to utilize an efficient organizational strategy. One possible explanation may be that the OC females differed from the OC males in terms of symptom severity. However, no significant gender differences were found between the males and females within the OC group on measures of OC symptom severity, depressive symptoms or anxiety. Furthermore within the OC group, RCFT copy organization was not found to be significantly related to measures of OCD symptom severity, anxiety or depressive symptoms. Surprisingly, few studies have examined the effect of gender on neuropsychological deficits in OCD. Future research is needed to determine whether gender differences influence neuropsychological deficits in patients with clinical OCD as this could explain some of the inconsistencies in the literature.

The present study used a subclinical OCD population. It is unclear whether deficits observed in patients with OCD are state or trait specific. Some studies suggest that neuropsychological deficits in patients with OCD are state specific and ameliorate with appropriate treatment (Moritz et al.,1999). However, other studies have reported deficits in unaffected relatives of patients with OCD (Chambers et al., 2007) and the persistence of deficits following treatment (Nielen & Den Boer, 2003). It may be that some neuropsychological deficits are trait specific and others are state dependent. Results of our study suggest that some deficits may be present in individuals with subclinical OCD. The majority of past studies examining memory performance in individuals with subclinical OCD have failed to exclude individuals with clinical OCD and other psychological disorders.

A strength of this study is the use of a structured diagnostic interview and exclusion of individuals with any axis I psychological disorder, including clinical OCD. A limitation of the study is that the subclinical group was not homogenous with regard to the type of OC symptoms. It is possible that impairments may be specific to symptom type. For example, some studies suggest that OCD impairments may be more consistent in patients with primarily checking concerns (Omori et al., 2007).

Conclusions

Our results demonstrate impairments in some aspects of organization and memory in individuals with subclinical obsessive-compulsive disorder. Contrary to expectation we did not find deficits in source memory. Future research is needed to determine whether source memory deficits exist in patients with clinical OCD. Tasks with greater sensitivity to the subtle cognitive deficits reported in OCD may allow increased understanding of cognitive functioning in patients with this disorder. Despite the growing body of literature suggesting memory deficits in patients with OCD and evidence of frontal-striatal dysfunction, few studies have examined neural correlates of memory impairment in OCD. Neuroimaging studies may further enhance our understanding of the processes underlying memory deficits in patients with OCD.

References

American PsychiatricAssociation. (1994). *Diagnostic and Statistical Manual of Mental Disorders* (4th edition ed.). Washington, DC: American Psychiatric Press.

Andres, S., Lazaro, L., Salamero, M., Boget, T., Penades, R., & Castro-Fornieles, J. (2007). Changes in cognitive dysfunction in children and adolescents with obsessive-compulsive disorder after treatment. *J Psychiatr Res*.

Baddeley, A. D. (1982). Implications of neuropsychological evidence for theories of normal memory. *Philos Trans R Soc Lond B Biol Sci, 298*(1089), 59-72.

Basso, M. R., Bornstein, R. A., Carona, F., & Morton, R. (2001). Depression accounts for executive function deficits in obsessive-compulsive disorder. *Neuropsychiatry Neuropsychol Behav Neurol, 14*(4), 241-245.

Baxter, L. R., Jr., Schwartz, J. M., Bergman, K. S., Szuba, M. P., Guze, B. H., Mazziotta, J. C., et al. (1992). Caudate glucose metabolic rate changes with both drug and behavior therapy for obsessive-compulsive disorder. *Arch Gen Psychiatry, 49*(9), 681-689.

Boldrini, M., Del Pace, L., Placidi, G. P., Keilp, J., Ellis, S. P., Signori, S., et al. (2005). Selective cognitive deficits in obsessive-compulsive disorder compared to panic disorder with agoraphobia. *Acta Psychiatr Scand, 111*(2), 150-158.

Boone, K. B., Annanth, J., Philpott, L., Kaur, A., & Djenderedijian, A. (1991). Neuropsychological characteristics of nondepressed adults with obsessive-compulsive disorder. *Neuropsychiatry, Neuropsychology and Behavioral Neurology, 4*, 96-109.

Beck, A; Epstein, N., Brown, G., Steer, R. (1988). An inventory for measuring clinical anxiety:

Psychometric properties. *Journal of Consulting and Clinical Psychology,* 56(6), 893-897.

Chamberlain, S.R., Fineberg, N.A., Menzies, L.A., Blackwell, A.D., Bullmore, E.T., Robbins, T.W., et al. (2007). Impaired cognitive flexibility and motor inhibition in unaffected first degree relatives of patients with obsessive-compulsive disorder, *Am J Psychiatry,* 164, 335-8.

Christensen, K. J., Kim, S. W., Dysken, M. W., & Hoover, K. M. (1992). Neuropsychological performance in obsessive-compulsive disorder. *Biol Psychiatry, 31*(1), 4-18.

Constans, J. I., Foa, E. B., Franklin, M. E., & Mathews, A. (1995). Memory for actual and imagined events in OC checkers. *Behav Res Ther, 33*(6), 665-671.

Ciesielski, K. T., Hamamalainen, M. S., Lesnik, D.A., Geller, D.A., & Ahifors, S.P. (2005). Increased MEG activation in OCD reflects a compensatory mechanism specific to the phase of a visual working memory task. *NeuroImage,24*, 1180-1191.

Curran, T., DeBuse, C., Woroch, B., & Hirshman, E. (2006). Combined pharmacological and electrophysiological dissociation of familiarity and recollection. *J Neurosci, 26*(7), 1979-1985.

Deckersbach, T., Otto, M. W., Savage, C. R., Baer, L., & Jenike, M. A. (2000). The relationship between semantic organization and memory in obsessive-compulsive disorder. *Psychotherapy and Psychosomatics, 69*(2), 101-107.

Deckersbach, T., Savage, C. R., Dougherty, D. D., Bohne, A., Loh, R., Nierenberg, A., et al. (2005). Spontaneous and directed application of verbal learning strategies in bipolar disorder and obsessive compulsive disorder. *Bipolar Disorder, 7*, 166-175.

Delis, D. C., Kramer, J.H., Kaplan, E., & Ober, B.A. (1987). California Verbal Learning Test Manual. San Antonio, TX: Psychological Corporation.

Duff, S. & Hampson, E. (2001). A sex difference on a novel spatial working memory task in humans. *Brain and Cognition*, 47, 470-493.

Ecker, W., & Engelkamp, J. (1995). Memory for actions in obsessive-compulsive disorder. *Behavioural and Cognitive Psychotherapy, 23*(4), 349-371.

Flor-Henry, P., Yeudall, L. T., Koles, Z. J., & Howarth, B. G. (1979). Neuropsychological and power spectral EEG investigations of the obsessive-compulsive syndrome. *Biol Psychiatry, 14*(1), 119-130.

Glisky, E. L., Polster, M. R., & Routhuieaux, B. C. (1995). Double dissociation between item and source memory. *Neuropsychology, 9*, 229-235.

Hornstein, S. L., & Mulligan, N. W. (2004). Memory for actions: enactment and source memory. *Psychon Bull Rev, 11*(2), 367-372.

Janowsky, J. S., Shimamura, A. P., & Squire, L. R. (1989). Source memory impairment in patients with frontal lobe lesions. *Neuropsychologia, 27*(8), 1043-1056.

Jurado, M. A., Junque, C., Vallejo, J., & Salgado, P. (2001). Impairment of incidental memory for frequency in patients with obsessive-compulsive disorder. *Psychiatry Res, 104*(3), 213-220.

Kessler, R. C., Chiu, W. T., Demler, O., & Walters, E. E. (2005). Prevalence, severity, and comorbidity of twelve-month DSM-IV disorders in the National Comorbidity Survey Replication (NCS-R). *Archives of General Psychiatry, 62*(6), 617-627.

Lejbak, L., vrbancic, M.,& Crossley, M. (2008). The female advantage in object location memory is robust verbalizibility and mode of presentation stimuli, Brain and Cognition, doi: 10.1016/j.bandc.2008.06.006.

Martin, A., Wiggs, C. L., Altemus, M., Rubenstein, C., & Murphy, D. L. (1995). Working memory as assessed by subject-ordered tasks in patients with obsessive-compulsive disorder. *J Clin Exp Neuropsychol, 17*(5), 786-792.

McNally, R. J., & Kohlbeck, P. A. (1993). Reality monitoring in obsessive-compulsive disorder. *Behav Res Ther, 31*(3), 249-253.

Moritz, S., Kloss, M., Katenkamp, B., Birkner, C., & Hand, I. (1999). Neurocognitive functioning in OCD before and after treatment. *CNS Spectrums, 4*, 21-22.

Moscovitch, M. (1992). Memory and working-with-memory: A component process model based on modules and central systems. *Journal of Cognitive Neuroscience, 4*, 257- 267.

Nakao, T., Nakagawa, A., Yoshiura, T., Nakatani, E., Nabeyama, M., Yoshizato, C., et al. (2005). Brain activation of patients with obsessive-compulsive disorder during neuropsychological and symptom provocation tasks before and after symptom improvement: a functional magnetic resonance imaging study. *Biol Psychiatry, 57*(8), 901-910.

Nielen, M. M., & Den Boer, J. A. (2003). Neuropsychological performance of OCD patients before and after treatment with fluoxetine: evidence for persistent cognitive deficits. *Psychol Med, 33*(5), 917-925.

Omori, I.M., Murata, Y., Yamanish, T, Nakaai, S., Akechi, T., & Mikuni, M., Furukawa, T.A. (2007). The differential impact of executive attention dysfunction on episodic memory in obsessive-compulsive disorder patients with checking symptoms vs. those with washing symptoms, *J Psychiatr Res*, 41(9): 776-84.

Rubenstein, C. S., Peynirdoglu, Z. F., Chambless, D. L., & Pigott, T. A. (1993). Memory in subclinical obsessive-compulsive checkers. *Behaviour Research and Therapy, 31,* 759-765.

Savage, C. R. (1997). Neuropsychology of subcortical dementias. *Psychiatr Clin North Am, 20*(4), 911-931.

Savage, C. R., Baer, L., Keuthen, N. J., Brown, H. D., Rauch, S. L., & Jenike, M. A. (1999). Organizational strategies mediate nonverbal memory impairment in obsessive-compulsive disorder. *Biol Psychiatry, 45*(7), 905-916.

Savage, C. R., Keuthen, N. J., Jenike, M. A., Brown, H. D., Baer, L., Kendrick, A. D., et al. (1996). Recall and recognition memory in obsessive-compulsive disorder. *J Neuropsychiatry Clin Neurosci, 8*(1), 99-103.

Savage, C. R., & Rauch, S. L. (2000). Cognitive deficits in obsessive-compulsive disorder. *Am J Psychiatry, 157*(7), 1182-1183.

Schwartz, J. M., Stoessel, P. W., Baxter, L. R., Jr., Martin, K. M., & Phelps, M. E. (1996). Systematic changes in cerebral glucose metabolic rate after successful behavior modification treatment of obsessive-compulsive disorder. *Arch Gen Psychiatry, 53*(2), 109-113.

Spencer, W. D., & Raz, N. (1995). Differential effects of aging on memory for content and context: a meta-analysis. *Psychol Aging, 10*(4), 527-539.

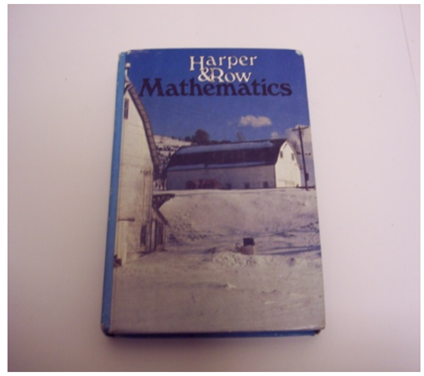
van den Heuvel, O. A., Veltman, D. J., Groenewegen, H. J., Cath, D. C., van Balkom, A. J., van Hartskamp, J., et al. (2005). Frontal-striatal dysfunction during planning in obsessive-compulsive disorder. *Arch Gen Psychiatry, 62*(3), 301-309.

Voyer, D., Postma, A., Brake, B., & Imperato-McGiney, J. (2007). Gender differences in object location memory: A meta-analysis. *Psychonomic Bulletin and Review*, 14, 23-38.

Zielinski, C. M., Taylor, M. A., & Juzwin, K. R. (1991). Neuropsychological deficits in obsessive-compulsive disorder. *Neuropsychiatry, Neuropsychology and Behavioral Neurology 4*, 110-116.

List of Appendices

Appendix A. Sample pictures of objects from the Memory for Rooms Test



Appendix B. Pictures of Rooms - Memory for Rooms Test

Living Room

Bathroom

Bedroom

Classroom

Appendix C. Sample Room Pictures with Context Congruent and Context Incongruent Items

Table 1

Demographic and Clinical Characteristics of Participants

Variable[a]	Subclinical OC	Healthy Control	Statistic	P
	(n=30)	(n = 30)		
Gender (% Female)	64%	60%	χ^2=.071	.791
Age	19.3(1.66)	19.1(1.47)	t(58)= -.493	.624
Ethnicity (% Caucasian)	86.6%	90.0%	χ^2=.162	.688
Education	13.6(.67)	13.6(1.03)	t(49.9)=.148	.88
WAIS-R Vocabulary	12.6(1.91)	12.3(1.99)	t(58) =-.59	.55
Handedness (% Right)	87%	93%	χ^2=.820	.365
OCI-R	30.0(8.58)	3.9(3.50)	t(38.4) = -15.4	**<.001**
YBOCS	11.2(4.25)	2.14(2.50)	t(47.2)=-10.01	**<.001**
BAI	13.6(8.30)	5.20(4.81)	t(42.6)=-4.67	**<.001**
BDI	7.45(4.76)	3.11(3.24)	t(58)=-4.119	**<.001**

WAIS-R Vocabulary: Wechsler Adult Intelligence Scale-Revised Vocabulary Subscale, *OCI-R:* Obsessive-Compulsive Inventory Revised, *Y-BOCS:* Yale-Brown Obsessive Compulsive Scale, BAI: Beck Anxiety Inventory, *BDI:* Beck Depression Inventory.

[a] Table values are given as mean (standard deviation) unless indicated otherwise.

Table 2

Demographic Information by Gender

Variable	**Subclinical OC**		**Healthy Control**		**F**
Gender	*Male* (n = 11)	*Female* (n=19)	*Male* (n=12)	*Female* (n=18)	
Age	20.18(2.2)	19.11(1.5)	19.08(1.5)	19.11(1.5)	ns
Ethnicity (% Caucasian)	86%	91%	91%	89%	ns
Education	13.82(.75)	13.58(.61)	13.67(.90)	13.67(1.1)	ns
WAIS-R Vocabulary	12.72(1.79)	12.63(2.0)	11.50(2.07)	12.94(1.8)	ns
OCI-R	27.8(4.81)[a]	32.8(8.9)[a]	3.38(.47)[b]	3.9(3.1)[b]	F(3,59)=99.4
OCI-R- Checking	6.18(2.56)[a]	5.05(2.75)[a]	.75(1.7)[b]	.88(1.3)[b]	F(3,59)=24.08
YBOCS	11.45(3.72)[a]	11.05(4.62)[a]	1.6(2.42)[b]	2.47(2.6)[b]	F(3,58)=32.11
BAI	9.9(7.1)	16.7(9.1)[a]	4.1(3.94)[b]	5.3(1.25)[b]	F(1, 59) = 11.1
BDI	6.55(4.6)	7.97(4.8)[a]	3.46(3.61)	2.88(3.07)[b]	F(3, 59)=5.88

Note. Means in the same row with different superscripts indicate a significant difference at $p<.05$ based on post hoc tests (Tukey HSD or Dunnett T3 for Unequal Variances). *WAIS-R Vocabulary:* Wechsler Adult Intelligence Scale-Revised Vocabulary Subscale, *OCI-R:* Obsessive-Compulsive Inventory Revised, OCI-R- Checking: Obsessive-Compulsive Inventory Revised Checking Subscale, *Y-BOCS:* Yale-Brown Obsessive Compulsive Scale, BAI: Beck Anxiety Inventory, *BDI:* Beck Depression Inventory.

Table 3

California Verbal Learning Test Performance by Gender

Variable	Subclinical OC		Healthy Control		F	P
Gender	*Male*	*Female*	*Male*	*Female*		
Free Recall						
Trial One	6.18(1.54)	6.47(1.31)	6.50(1.98)	7.33(2.11)	ns	
Trial Five	12.45(1.92)	12.68(2.42)	12.92(2.27)	13.22(1.93)	ns	
Short Delay Free Recall	11.55(2.42)	11.21(2.42)	11.58(2.15)	11.61(2.62)	ns	
Long Delay Free Recall	11.45(3.39)	11.26(2.23)	11.58(2.42)	11.61(2.64)	ns	
Recognition						
Recognition Discriminability	3.17(.83)	3.38(.63)	3.38(.47)	3.48(.52)	ns	
Organization						
Semantic Clustering	.75(1.78)[a]	-.04(.84)[a]	.83(1.6)[b]	1.4(1.47)[b]	F(1, 56) =4.04	**.049**
Serial Clustering	.67(.99)[a]	1.74(1.05)[b]	1.01(1.24)[a]	1.16(1.15)[b]	F(1, 56) = .110	**.044**
Subjective Clustering	1.0(.78)	1.33(.94)	1.05(1.07)	.98(.82)	ns	

Note. Means in the same row with different superscripts indicate a significant difference at p<.05.

Table 4

Rey-Osterrieth Complex Figure Test Performance by Gender

Variable	**Subclinical OC**		**Healthy Control**		**F**	**P**
Gender	*Male*	*Female*	*Male*	*Female*		
Accuracy						
Copy	33.45(1.69)	31.68(3.18)	33.3(2.06)	32.31(3.20)	ns	
Immediate Recall	23.4(4.32)	19.58(7.85)	23.79(6.24)	23.5(6.01)	ns	
Delayed Recall	21.45(3.50)	19.24(7.37)	23.96(5.80)	22.72(6.13)	ns	
Percent Recall						
Copy to Immediate	70.18(13.46)	60.77(22.43)	71.23(17.37)	72.34(15.83)	ns	
Immediate to Delayed	93.38(16.40)	100.82(15.05)	102.4(14.44)	96.70(10.68)	ns	
Copy to Delayed	64.4(11.94)^{a}	59.51(19.83)^{a}	71.92(16.58)^{b}	69.87(15.05)^{b}	ms	**.05**
Organization						
Copy Organization	4.09(1.44)	2.95(1.95)^{a}	3.50(1.88)	4.44(1.78)^{b}	$F(1,56) = 4.72$	**.034**

Note. Means in the same row with different superscripts indicate a significant difference at $p \leq .05$.

Table 5

Memory for Rooms Test

Variable	Subclinical OC		Healthy Control		F	P
Gender	*Male*	*Female*	*Male*	*Female*		
Recall						
Immediate Recall	19.90(4.35)[a]	25.84(5.60)[b]	20.50(7.42)[a]	24.27(5.54)[b]	F(1,56)=9.9	.003
Cued Recall	20.37(5.33)[a]	26.84(6.16)[b]	19.8(9.44)[a]	24.72(5.86)[b]	F(1,56)=10.1	.002
Delayed Recall	24.55(5.47)[a]	33.16(6.99)[b]	28.25(6.27)[a]	30.67(6.03)[b]	F(1,56)=10.83	.002
Type of Item						
% Imm Recall Context Incongruent	43.26(6.35)[a]	48.36(7.81)	51.76(12.76)[b]	46.54(8.22)	F(1,56)=4.75	.034
Recognition						
Recognition Discriminability	86.46(4.95)[a,d]	91.99(6.76)[a,e]	91.49(4.57)[b,d]	92.71(3.78)[b,e]	[a,b]F(1,56)=4.25	.044
					[d,e]F(1,56)=5.87	.019
False Positives	6.45(3.88)[a]	3.89(5.71)[a]	3.58(3.75)[b]	2.17(2.89)[b]	F(1,56)=4.05	**.049**
False Negatives	6.54(3.30)	3.79(3.55)	4.58(3.53)	4.83(2.50)	ns	
Source Judgments % Correct	88.01(8.62)[a]	94.4(5.06)[b]	88.87(8.25)[a]	92.94(5.68)[b]	F(1,56)=8.75	**.005**
Organization						
Room Clustering	3.00(.67)[a]	3.45(.73)[b]	3.16(.62)[a]	3.58(.30)[b]	F(1,56) =7.5	**.008**
Area Clustering	4.50(1.61)	4.85(2.10)	4.29(1.92)	5.23(1.32)	ns	

Note. Means in the same row with different superscripts indicate a significant difference at p<.05.

Table 6

Memory for Rooms Test Mean Confidence Ratings

Variable	Subclinical OC		Healthy Control		F	P
Gender	*Male*	*Female*	*Male*	*Female*		
Confidence						
Correct Resp	3.13(.26) [b]	3.46(.29) [a]	3.36(.38) [b]	3.43(.29) [a]	$F(1, 56)=5.83$	.019
Source Error	2.78(.81) [a]	3.05(.66) [a]	3.24(.67) [b]	3.42(.50) [b]	$F(1,56)=10.83$	.032
Incorrect Resp	2.20(.28)	2.58(.57)	2.58(.72)	2.48(.81)	ns	

Note. Means in the same row with different superscripts indicate a significant difference at $p < .05$.

Table 7

Zero Order Correlations Between Memory Indices and OC Symptom Severity By Gender

Variable	**Female**		**Male**	
CVLT	*OCI-R*	*OCI-R Checking*	*OCI-R*	*OCI-R Checking*
Short Delay Free Recall	.434	.223	.06	.11
Delayed Free Recall	.495	.530	.533	.105
Semantic Clustering	.120	.252	-.253	.039
RCFT				
Immediate Recall	.520	.320	.136	.173
Delayed Recall	.544	.355	.011	.621
Copy Organization	-.216	-.061	.046	-.005
MFRT				
Immediate Recall	-.167	-.409	-.245	-.411
Recognition Discrim	.039	-.380	-.284	.156
Room Clustering	-.027	-.236	-.414	-.280
Percent Source Accuracy	-.05	-.305	-.366	-.157

Note. One tailed Pearson’s Correlation. All correlations were not significant at the .01 alpha level.

Figure 1

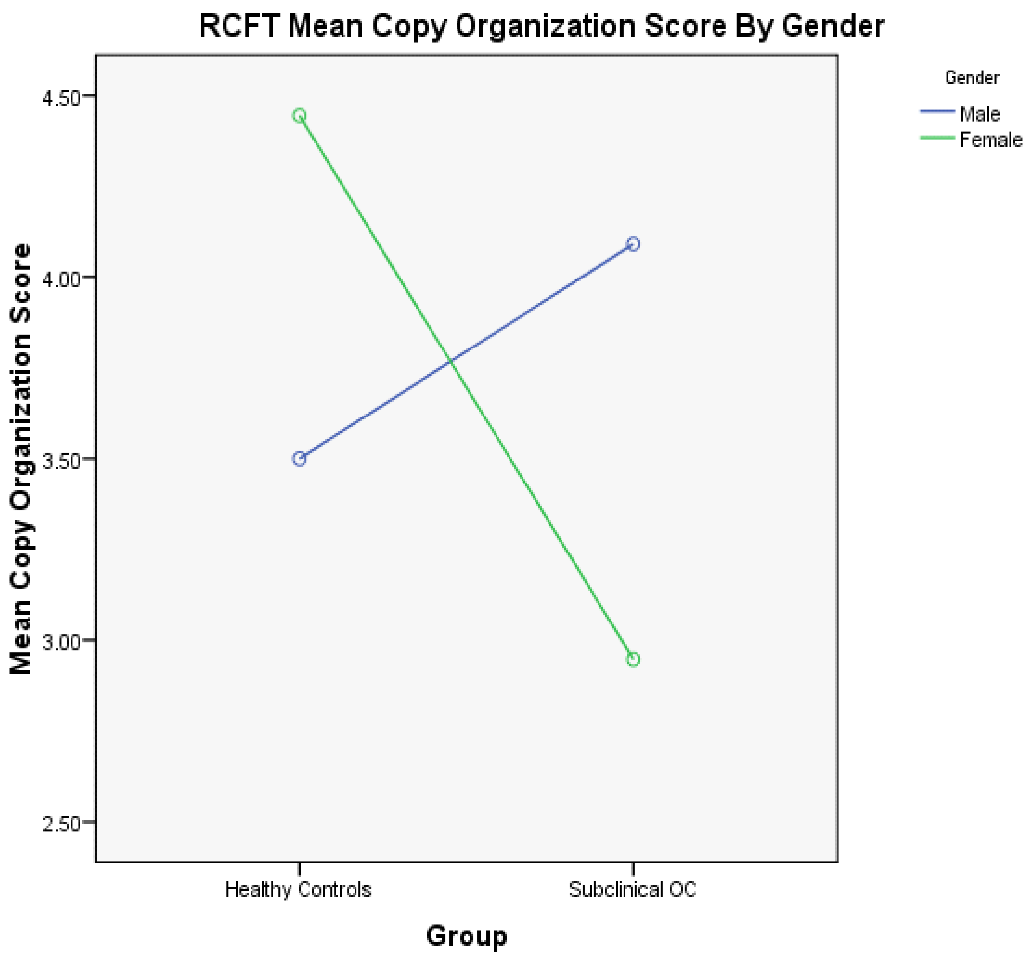
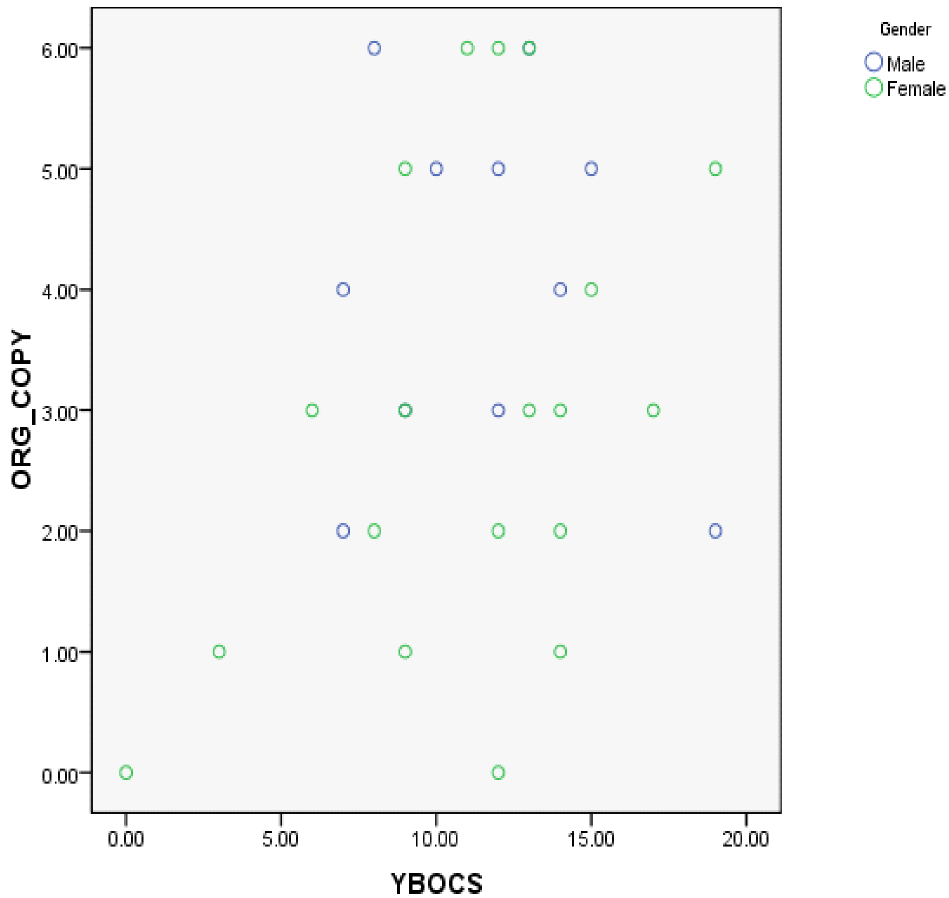

RCFT Mean Copy Organization Score By Gender
Mean Copy Organization Score
4.50
4.00
3.50
3.00
2.50
Healthy Controls
Subclinical OC
Group
Gender
Male
Female

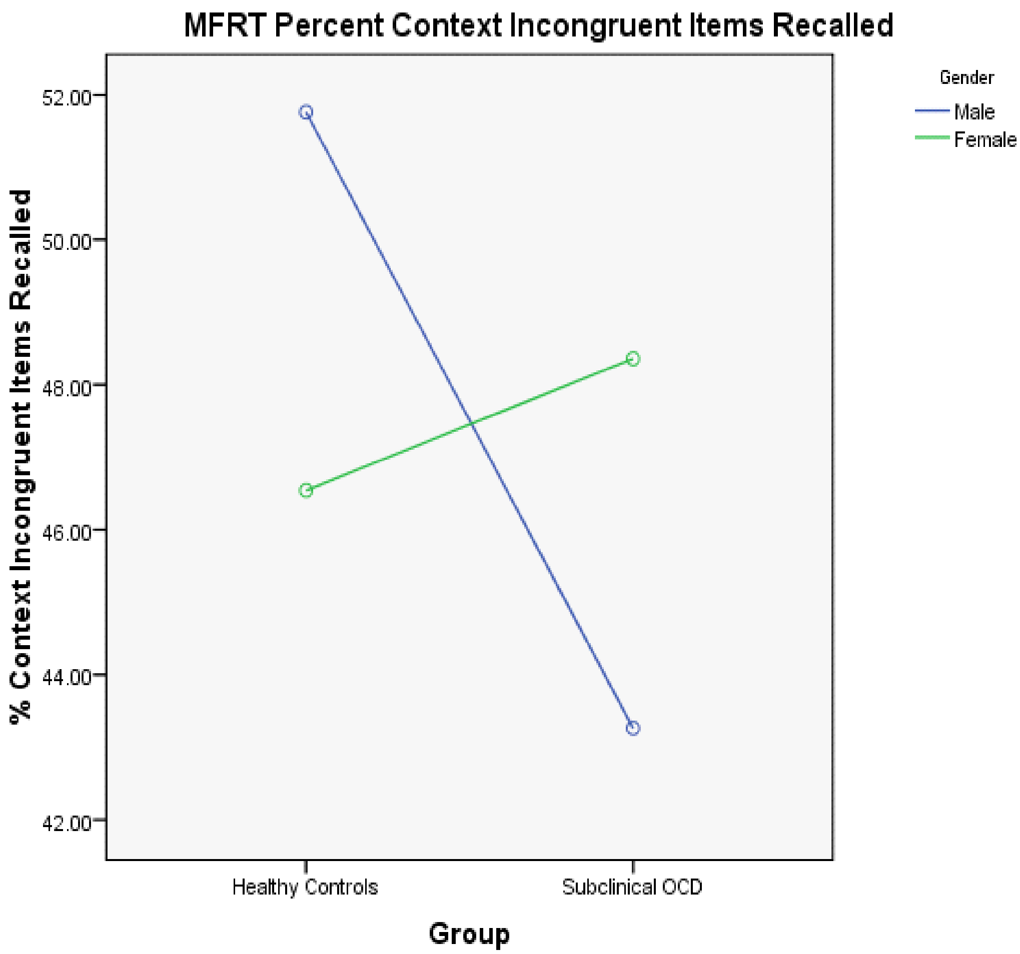
Figure 2

Relationship Between Severity of OCD Symptoms (YBOCS) and RCFT Copy Organization



Note. Scatter plot shows no significant relationship was found within the OC group between YBOCS score and organization on RCFT

Figure 3


MFRT Percent Context Incongruent Items Recalled
% Context Incongruent Items Recalled
52.00
50.00
48.00
46.00
44.00
42.00
Healthy Controls
Subclinical OCD
Group
Gender
Male
Female