

OCD and its Effects on Memory

By Mina Li

AUTHOR BIO

Mina Li is a seventeen-year-old junior attending St. Mark's School in Massachusetts. She is especially interested in psychology and neuroscience, which she hopes to explore further in the future. More specifically, the connections between the two topics, including the effects of neurological functions on emotions, behaviors, and cognition. Mina is constantly involved in research at school as well as outside of school, such as her internship at Massachusetts General Hospital. When she is not busy exploring her interests in neuropsychology, she enjoys reading, painting, playing sports, traveling, and spending time with friends.

ABSTRACT

As rates of mental health disorders increase throughout the years, more and more studies have emerged to investigate their effects, such as the effects of Obsessive-Compulsive disorder on memory. Obsessive-Compulsive Disorder was first described in the Diagnostic and Statistical Manual of Mental Disorders in the 1980s.¹ It is organized into 5 main categories: checking, contamination, symmetry/ordering, intrusive thoughts, and hoarding and can be measured using the Y-BOCS. OCD is caused by genetic, neurobiological, behavioral, and environmental factors. Neuroimaging studies reveal overactivation of the orbitofrontal cortex and the basal ganglia. Scientists have discovered the effects of OCD on episodic and procedural memory. In 2004, Robert M Roth conducted a Pursuit Rotor Task with 46 participants. The results reveal that the OCD group has enhanced procedural memory, likely due to the overactivation of some parts of the brain. Furthermore, in 2011, Mika Konishi used the "directed forgetting paradigm" method on 45 participants. The results reveal reduced retrieval inhibition and difficulties in selective encoding in OCD brains, which lead to decreased memory recall performance.

Keywords: *Obsessive-compulsive Disorder, Diagnostic and Statistical Manual of Mental Disorders, Overactivation, Episodic Memory, Procedural Memory, Treatment, Selective Encoding, Memory Deficit.*

INTRODUCTION

Throughout the past few decades, rates of mental health disorders have increased dramatically in adults and adolescents worldwide. In the United States, 19.86% of adults experience a mental illness, which is equivalent to almost 50 million Americans.² Mental disorders are more prevalent than diabetes, cancer, and heart disease.³ One example of a mental disorder that has increased in the rate of diagnosis throughout the past few decades is Obsessive-Compulsive Disorder (OCD). OCD is a chronic and long-term mental disorder in which a person experiences uncontrollable, recurring thoughts and behaviors they feel the need to repeat.⁴ OCD affects 2-3% of adults in the United States.⁵

Symptoms of OCD can be traced back throughout history. However, the name, OCD, was not used until the 20th century. The Diagnostic and Statistical Manual of Mental Disorders (DSM) was published in 1952 in order to classify depressive disorders. Since its publication, research surrounding OCD has expanded dramatically. OCD was first described in the DSM-I in the 1980s and was classified as an anxiety disorder.¹ Then in DSM-5, OCD was removed from Anxiety Disorders and classified as a new category: Obsessive-Compulsive and Related Disorders.⁶ According to the Mental Health Foundation, symptoms of OCD are categorized as obsessions and compulsions. Obsessions that are common in people with OCD include fear of contamination, fear of harm, excessive concern with exactness, hoarding, and intrusive thoughts. Compulsions include repeated actions, repeated words, mental rituals, arranging, and repeated checking.⁷ OCD is organized into 5 main categories: checking, contamination, symmetry/ordering, intrusive thoughts, and hoarding.

Recent studies have discovered that OCD can also negatively impact the memory system. Results from experiments reveal that OCD causes inferior memory performance for OCD patients.⁸ Most symptoms depend on the severity of the disorder in a person. The most widely used measurement tool for assessing the global severity of OCD is the Y-BOCS. The Y-BOCS stands for the Yale-Brown Obsessive Compulsive Scale and comprises 58 items that assess two categories of symptoms: compulsive thoughts and compulsions. The scale consists of 10 questions that are scored on a scale of 0 to 40, 40 being the most severe and 0 being subclinical. A mild level of OCD is considered to be around or less than 16 points.⁹ To receive a diagnosis, a patient has to reach out to a healthcare provider such as a therapist or a psychiatrist. The healthcare provider will ask the patient a list of questions in order to assess their symptoms and then present a diagnosis.

The mechanism of action for OCD

Scientists have used neuroimaging studies to research the differences in the brain activity between people who have been diagnosed with OCD, and unaffected people. Scientists were able to find that some parts of the OCD brain are more active than the brains of the control group. The most prominent parts (Figure 1) with overactivity are the orbitofrontal cortex and the caudate nucleus, which is a part of the basal ganglia.¹⁰ The normal function of the orbitofrontal cortex in the brain is sensory integration, prediction, and decision-making, and it participates in learning.¹¹ The basal ganglia is primarily in charge of motor control, but it also participates in other roles like executive functions and behaviors, as well as emotions.¹² In the OCD brain, as shown in the PET scan below (Figure 2), the cortex at the top of the brain projects to the striatum, which

contains structures such as the caudate. Then, it projects down to the thalamus, which projects back to the cortex.¹³ This loop is in constant overdrive in the OCD brain. Furthermore, the constant overactivation of some parts of the brain actually causes abnormally enhanced procedural memory in people with OCD.¹⁴ This enhancement is evident in their tendency to repeat an action continuously.

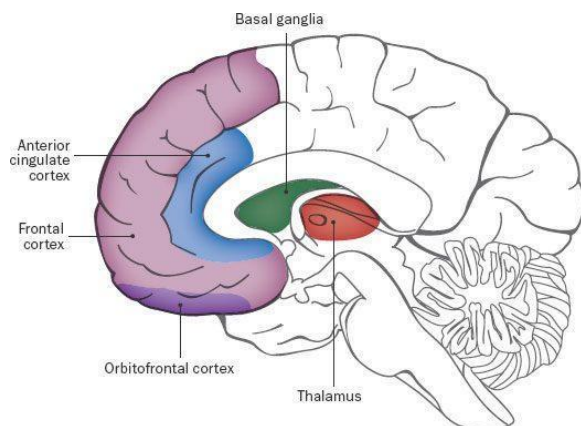


Figure 1: Diagram of the overactivated areas of the OCD brain.¹³



Figure 2: PET scans of the normal brain and the brain of the patient who has OCD.¹⁰

Scientists have also discovered that OCD is not only caused by neurobiological factors, but also a combination of genetic, behavioral, and environmental factors.¹⁵ A study that was funded by the National Institutes of Health found that OCD could be associated with a rare mutation of the human serotonin transporter gene (hSERT).¹⁶ The study reveals

that genetics contributes around 45-65% of the risk for OCD.¹⁴

Behavioral factors play an important role in developing and maintaining compulsions and obsessions. Scientists believe that compulsions are learned responses to help reduce anxiety surrounding obsessions. Therefore, due to the fact that the learned responses may temporarily reduce anxiety, the probability that the individual will repeat the response increases. As a result, the compulsive behavior may become excessive.¹⁵

Environmental factors also play a role in OCD by contributing to its development. For example, some severe traumatic brain injuries have been a factor in the onset of OCD.¹⁷ Furthermore, some children exhibit sudden OCD symptoms after severe bacterial infections¹⁵. The infection does not directly cause OCD but triggers the disorder in people with genetic connections. Additionally, parenting styles are also environmental factors that can contribute to the development of the disorder by causing stress for a child.¹⁸

Treatment options for OCD

There are many types of treatments for OCD, such as medication and psychotherapy.¹⁹ For medications, many antidepressants are approved by the FDA to treat this disorder: Anafranil, Prozac, Lexapro, Paxil, Zoloft, Celexa, etc.²⁰ Most medications listed above are called selective serotonin reuptake inhibitors (SSRIs). These medications are also commonly used for other mental disorders such as anxiety and depression.²¹ SSRI medications reduce symptoms of mental disorders by increasing the balance of serotonin levels in a person's brain.²²

Cognitive-behavioral therapy is a treatment that uses two scientifically based techniques to transform a person's behaviors and thoughts. The two techniques are exposure and ritual prevention and cognitive therapy.¹⁹ In

exposure and ritual prevention therapy, people with OCD are gradually exposed to their obsessions and told not to perform the compulsions they use to reduce their anxiety.²³ Next, cognitive therapy focuses on emotions or thoughts that a person associates with certain misinterpreted experiences. Cognitive therapy for OCD is designed to assist patients in identifying these misinterpretations or unrealistic thoughts and changing their thoughts, which decreases anxiety and compulsions.²⁴ For example, if a patient with OCD experiences ritualistic compulsions and believes that terrible accidents will occur to their family if they do not complete the compulsions, the therapist will challenge this belief by instructing the patient not to complete the compulsion and then seeing whether an accident occurs.²⁵ Then, the therapist will use the results of this experiment in further discussions about other similar thoughts.

Personal experience with OCD:

I am choosing to write about how OCD affects memory mainly out of curiosity because as someone that has been professionally diagnosed with OCD, I have a poor memory and constantly forget things. I would like to learn more about the possible connections between the two. I would also like to help spread awareness of the disorder and clear up the many misconceptions surrounding OCD. Out of the 5 main categories of OCD I discussed above, I mainly fall into three categories: checking, contamination, and ordering. For me, OCD shows up through my constantly repeated checking of things: the way I constantly run back upstairs to make sure I locked the door, the way I repeatedly go through all my homework assignments to make sure I completed them all, and the way I make hundreds of lists every day, so I do not forget anything. I also wash my hands abnormally often to ensure that I am not contaminated with anything, even if I have not

moved from my seat since the last time I washed my hands. In addition, I also have ritualistic routines for common daily routines, for example, making my bed in the morning. Every person with OCD has different experiences with the disorder and different symptoms. The symptoms listed above are a few of my experiences with OCD. Therefore, not everyone with OCD experiences the same compulsions and obsessions.

The case study on effects on procedural memory

The effects of OCD on the brain is a long-debated subject among scientists. Some scientists believe that OCD causes memory impairments in the episodic memory of patients, evident in their repetitive checking behaviors.²⁶ Some believe that the disorder causes the abnormality of procedural memory.²⁷

Procedural memory is a kind of long-term memory involving the performance of skills and actions.²⁸ Many scientists believe that OCD can perform differently in procedural memory.²⁹ In 2004, Robert M Roth and his colleagues published an experiment of theirs concerning the effects of OCD on memory. One part of the experiment focused on the effects on procedural memory. 27 patients with OCD and 29 healthy control participants were chosen for the experiment.²⁹ Subjects with OCD all met the diagnostic criteria for OCD defined in the DSM-IV. On the Pursuit Rotor Task, participants were told to hold a light sensor wand and follow the motion of a light emitting disk that rotates. Participants first completed 3 twenty-second trials at 4 different disk rotation speeds (15, 30, 45, 60 rpm).²⁹ The rotation speed at which each participant was able to track the target closest to 5s was used. Next, participants participated in 6 test blocks of 4 twenty-second trials. They received 20 seconds of rest time between trials and 60 seconds of rest time between each block.

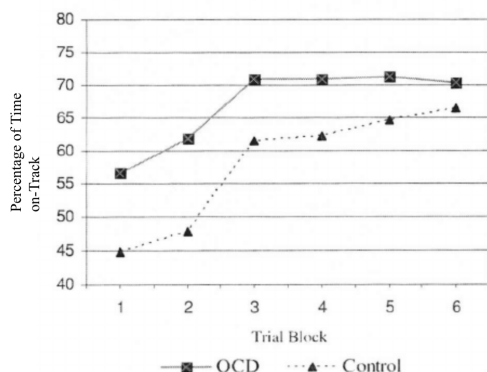


Figure 3: Graph of the percentage of time participants stayed on-target on the Pursuit Rotor Task.²⁹

The majority of participants performed the tests at 60 rpm while the rest performed at 45 rpm. As shown in Figure 3, the results indicate that OCD patients stayed on-target for a longer duration than the control group for the first 3 blocks. The last 3 blocks had similar results in both groups. In summation, the results of the experiment indicate that the OCD group has better procedural memory than the control group. The enhanced procedural memory of people with OCD is likely associated with overactivation in numerous parts of the brain.²⁹

The case study on effects on episodic memory

The following experiment explains the effects of OCD on episodic memory, more specifically, the encoding and retrieval process of memory in the brain. The experiment was published in 2011 by Mika Konishi and colleagues.²⁶ They used a method called a “directed forgetting paradigm” to examine episodic memory in relation to clinical features of OCD. A “directed forgetting paradigm” is when a subject is told to intentionally forget information they learned. The scientists believed that intentional forgetting uses a mechanism in memory to reduce intervention in processing and retrieval of important information, although unintentional forgetting can simply be a failure

to remember.²⁶ The “directed forgetting paradigm” depends on whether the information has been encoded into the long-term memory before the subject is instructed to forget.

In this experiment, 28 OCD patients and 17 healthy control participants from ages 16 to 68 were recruited. All of the 28 OCD patients met the DSM-IV criteria for the diagnosis of OCD. Their mean score indicates moderate severity of the disorder. The experiment uses two cue types: remember and forget. There are two conditions: List and Item. As shown in Figure 5, in the List condition, participants were shown a list of words one at a time for 5 seconds each on a computer, and told to learn as many as possible. After half the list has been shown, instructions to forget the previous words were given. Then participants were given the rest of the list to remember. In the Items condition, participants received a list of words, each followed by a “o” or “x”. “O” indicated an instruction to remember (R-cued word) while “x” indicated an instruction to forget (F-cued word).

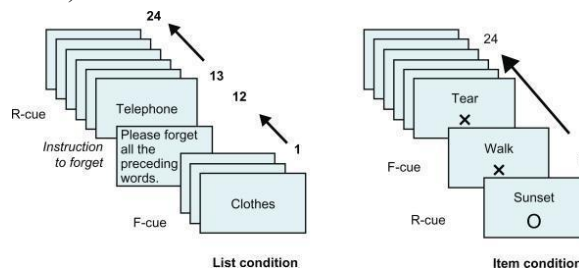


Figure 4: Illustration of List and Item conditions.²⁶

As seen in Figure 5, results indicate that the control group recalled more F-cued words in the List condition than in the Item condition. The recall of R-cued words was around the same for both conditions. The results for OCD patients indicate that the OCD group remembered fewer R-cued words than the control group for both List and Item conditions. In addition, there was no group difference in the recall of F-cued words.

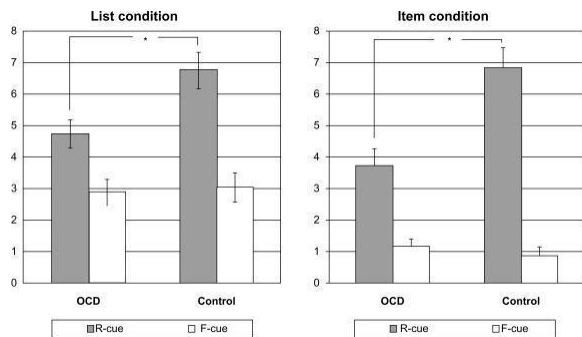


Figure 5: Graph of correct words recalled under the List and Item conditions.²⁶

In the List condition, R-cued and F-cued words experience the same encoding procedure. Therefore, the method of directed forgetting should reflect successful retrieval inhibition or the suppression of F-cued words. For the Item method, since each word was followed by an instruction to either forget or remember the words, selective encoding is the essential factor underlying the effect of the directed forgetting method. As depicted in Figure 4, OCD patients recalled fewer R-cued words than control participants, while they recalled around the same amount of F-cued words as control participants. The reasoning behind this result is because the encoding and retrieval of F-cued words in OCD patients blocked the recall of R-cued words. OCD patients had impaired selective recall of important words because of the intrusion caused by the accidental recall of unnecessary words. In summary, the results of the experiment showed that OCD is distinguished by an intentional cognitive inhibition deficit. OCD patients had reduced retrieval inhibition of unnecessary words compared to control participants. In addition, OCD patients also showed reduced retrieval inhibition of neutral materials. Thus, OCD patients have reduced retrieval inhibition of irrelevant material despite any emotional significance. This amount of retrieval inhibition can be seen as frontal dysfunction. In addition to reduced retrieval inhibition, OCD patients also

exhibited difficulties in selective encoding, which can be caused by frontal dysfunction. The frontal lobe is responsible for voluntary action and higher cognitive skills, such as problem-solving, thinking and planning, and organizing³⁰. Deficits in selective encoding and retrieval inhibition are most likely attributed to poor organizational skills caused by frontal dysfunction. Therefore, OCD patients likely have decreased memory recall performance due to deficient frontal-related organizational skills instead of a general memory deficit.²⁶

Conclusion

As the rate of mental illnesses continues to increase across the world, more and more studies have emerged to discover the effects of those illnesses on the brain.³¹ One mental disorder that scientists have focused on is OCD. More specifically, recent studies have looked into the effects of OCD on memory. Experiments using the “directed forgetting paradigm” method indicate that OCD can cause deficient frontal-related organizational skills, which contributes to decreased memory performance.²⁶ Furthermore, scientists have also found that OCD can enhance procedural memory, likely due to the overactivation in the brain.²⁹ Lastly, it is important to make a note of the limitations that may have impacted the results of the experiments. For example, both of the studies mentioned in this paper had a limited number of participants, which increases the margin of error.³² Therefore, the small group of participants does not represent the large population of people with OCD, and their experiences may differ dramatically.

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