T.C.

BAHCESEHIR UNIVERSITY

GRADUATE SCHOOL OF EDUCATION

THE DEPARTMENT OF COGNITIVE NEUROPSYCHOLOGY

INVESTIGATING THE ROLE OF VERBAL EPISODIC MEMORY AND JUDGEMENT OF LEARNING IN OBSESSIVE-COMPULSIVE DISORDER: EFFECTS OF COGNITIVE BEHAVIORAL THERAPY

MASTER'S THESIS

SERRA AKYURT GÜVENER

ISTANBUL 2023

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ABSTRACT

INVESTIGATING THE ROLE OF VERBAL EPISODIC MEMORY AND JUDGEMENT OF LEARNING IN OBSESSIVE-COMPULSIVE DISORDER: EFFECTS OF COGNITIVE BEHAVIORAL THERAPY

Akyurt Güvener, Serra
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Studies investigating memory processes and memory confidence in obsessive-compulsive disorder (OCD) provided equivocal results. Besides these contradictory findings about memory and memory confidence, it is an almost generally accepted finding that metacognition and meta-memory processes are the central cognitive problems in OCD. It was also proposed that metacognitive processes may cause cognitive impairment in individuals with OCD. Moreover, it has been suggested that CBT may have improved one's perspective and confidence in one's cognitive performance. This study aimed to investigate the role of verbal episodic memory and metacognitive judgments (judgment of learning: JOL) in OCD, and to examine changes after cognitive behavioral therapy (CBT). For this purpose, clinical measurements were obtained from a total of 96 participants, including 46 individuals diagnosed with OCD and 50 controls. They were asked to complete an experimental task assessing verbal episodic memory performance and OCD evaluations. All of these measurements were collected from the OCD group both before and after 10 sessions of CBT. Likewise, the same measurements were taken from the healthy control group matched with the OCD group in terms of age, education, and gender. As a result, after CBT, an increase was observed in the JOL judgments and accuracy of the OCD group, while such a difference was not observed in their memory performances.

Keywords: OCD, CBT, JOL, Episodic Memory, Metacognitive Judgement

ÖZ

INVESTIGATING THE ROLE OF VERBAL EPISODIC MEMORY AND JUDGEMENT OF LEARNING IN OBSESSIVE-COMPULSIVE DISORDER: EFFECTS OF COGNITIVE BEHAVIORAL THERAPY

Akyurt Güvener, Serra
Bilişsel Nöropsikoloji Yüksek Lisans Programı
Tez Danışmanı: Prof. Dr. Metehan Irak

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Obsesif Kompulsif Bozukluktaki (OKB) bellek performansının ve belleğe güvenin nasıl olduğuna ilişkin sonuçlar çelişkilidir. Bununla birlikte, bazı çalışmalar, hastalarla kontrol grubu arasında bellek doğruluğunda fark olmadığını göstermiştir, ancak OKB grubunda belleğe olan güvenin değiştiği gözlemlenmiştir. Bellekle ilgili bu çelişkili bulgulara rağmen, neredeyse genel sonuç, bu hastaların düşük üst bilişsel değerlendirmeye sahip olduğu yönündedir. Bu, üst bilişsel süreçlerin OKB'li bireylerdeki bilişsel bozukluğun altında yatan neden olabileceğini düşündürmektedir. Ayrıca, bilişsel davranışçı terapinin (BDT) bir kişinin bilişsel performansına yönelik bakış açısını ve güvenini iyileştirmiş olabileceği öne sürülmüştür. Bu çalışmanın amacı, OKB durumunda sözel olaysal belleğin ve üstbilişsel değerlendirmelerin (ÖK) rolünü araştırmak ve BDT sonrasındaki değişiklikleri incelemektir. Bu amaçla, 46 OKB teşhisi konmuş ve 50 kontrol olmak üzere toplam 96 katılımcıdan klinik ölçümler alındı ve sözel olaysal bellek performansı ile ÖK değerlendirmelerinin ölçüldüğü deneysel bir görevi tamamlamaları istendi. Bütün bu ölçümler, OKB grubundan, hem 10 seanslık BDT öncesinde hem de BDT sonrasında alındı. Aynı şekilde, yaş, eğitim ve cinsiyet değişkenleri açısından OKB grubuyla eşleştirilmiş sağlıklı kontrol grubundan da aynı ölçümler alındı. Sonuç olarak, BDT sonrasında OKB grubunun ÖK değerlendirmelerinde ve doğruluk oranlarında artış gözlemlenirken, böyle bir farklılık bellek performanslarında gözlenmedi.

Anahtar Kelimeler: OKB, BDT, ÖK, Olaysal Bellek, Üst Bilişsel Yargı

To my dear father, mother, sister, and my beloved husband

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able to read my thesis now because you don't feel well, but I'm sure these days will pass, you will be healthy again, and you will proudly read my thesis. Thank you very, very much for being my closest friend, teacher, and father.

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CBT	Cognitive Behavioral Therapy
HC	Healthy Control
JOL	Judgement of Learning
OCD	Obsessive Compulsive Behavior

Chapter 1

Introduction

1.1 Clinical Features of OCD

Obsessive-compulsive disorder (OCD) is defined as a psychiatric disorder in which people lead repetitive, unwanted thoughts, ideas, or obsessions to compulsive behaviors (American Psychiatric Association, 2013). OCD is a complex mental disorder characterized by obsessions and/or compulsions that cause significant distress and impairment in daily functioning (Attademo & Bernardini, 2020). The clinical features of OCD can vary widely among individuals, but several common clinical manifestations are frequently observed.

One of the key clinical features of OCD is the presence of obsessions, which are intrusive and unwanted thoughts, images, or urges that cause distress and anxiety. These obsessions often revolve around themes such as contamination, symmetry, or harm, and individuals with OCD typically recognize that these thoughts are irrational and excessive. On the other hand, compulsions involve repetitive behaviors or mental acts that individuals feel compelled to engage in as a response to their obsessions. These compulsions aim to reduce anxiety or prevent a feared event, but they do not have a realistic perception of the event. Common examples of compulsions are excessive hand washing, checking, or counting (Ruscio et al., 2008).

The severity of OCD can vary from mild to severe, and it is frequently characterized by diminished insight, high comorbidity with other psychiatric disorders, and significant impairment in daily functioning. Individuals with OCD often experience comorbidity with anxiety, mood disorders, and impulse-control and substance use disorders (Ruscio et al., 2008). Additionally, OCD is associated with psychotic disorders like schizophrenia, which can influence the clinical manifestation and functioning of individuals affected by OCD (Okamura et al., 2022).

Some demographic and phenotypic factors that have been found to be associated with specific clinical features of OCD. For example, studies have shown that males with OCD are more likely to exhibit externalizing behaviors and comorbid externalizing disorders, while females with OCD are more likely to exhibit comorbid

internalizing disorders (Efe et al., 2021). The age of onset of OCD can also influence the clinical features, with early-onset OCD being associated with specific obsessions and comorbid attention-deficit/hyperactivity disorder (ADHD) (Benatti et al., 2020).

The clinical presentation of OCD can be summarized as a spectrum of potentially overlapping syndromes that may coexist in any patient and extend beyond the traditional boundaries of OCD (Mataix-Cols et al., 2005). Depression and anxiety are commonly associated with OCD. Studies have reported higher rates of depression and anxiety disorders in individuals with OCD (Mahasuar et al., 2011). A study by Carter et al. (2004) found that rates of anxiety disorders and major depressive disorder (MDD) were higher among individuals with OCD compared to control relatives. Furthermore, comorbid depression and anxiety in individuals with OCD have been associated with specific neurobiological differences. A meta-analysis by Fouche et al. (2022) found that OCD patients with comorbid depression had lower shape surface area in the thalamus, caudate nucleus, putamen, hippocampus, and nucleus accumbens. OCD patients with comorbid anxiety had lower shape surface area in the putamen and left caudate nucleus. These findings suggest that comorbid depression and anxiety may have distinct neurobiological correlates in OCD. A study by Segalàs et al. (2021) found that OCD is often comorbid with anxiety disorders and mood disorders, including depression. Overall, there is a high prevalence of depression and anxiety in individuals with OCD. Comorbid depression and anxiety in OCD may have distinct neurobiological correlates and are associated with increased severity of symptoms.

The severity of OCD symptoms in patients can be influenced by high levels of anxiety and depression. Research has shown that individuals with high anxiety and depression levels tend to have more severe OCD symptoms (Ruscio et al., 2008). A study by Ruscio et al. (2008) found that the severity of OCD, as assessed by the YBOSC, is associated with poor insight, high comorbidity, high role impairment, and a higher likelihood of seeking treatment. This suggests that individuals with higher levels of anxiety and depression may experience more severe OCD symptoms and functional impairment. Furthermore, the study also highlighted the high prevalence of subthreshold OCD symptoms, which may contribute to the overall burden of OCD. These subthreshold symptoms, along with comorbid anxiety and depression, may help explain the inconsistencies in prevalence estimates across different surveys.

In addition to the impact on symptom severity, high anxiety and depression levels in individuals with OCD can also affect treatment outcomes. Research has shown that individuals with comorbid anxiety and depression may have poorer response to treatment and higher rates of relapse (Ruscio et al., 2008). Overall, high levels of anxiety and depression can significantly impact the severity of OCD symptoms in individuals. The presence of comorbid anxiety and depression may contribute to the overall burden of OCD and can also affect treatment outcomes.

In conclusion, the clinical features of OCD are diverse and can vary among individuals. These commonly include obsessions, compulsions, poor insight, high comorbidity with other psychiatric disorders, and impairment in daily functioning. Additionally, certain demographic factors such as gender and age of onset may be associated with specific clinical features. Further research is needed to enhance our understanding of the varied nature of OCD and to develop more precise interventions for affected individuals.

1.2 Cognitive Processes in OCD

Various deficits and dysfunctions characterize the cognitive processes in OCD. These include impairments in executive functions, attention, memory and metacognition and they play a role in OCD symptoms (Cuttler & Graf, 2009). Executive functions refer to cognitive processes involved in goal-directed behavior, cognitive flexibility, inhibitory control, and decision-making. Studies have shown that individuals with OCD may exhibit deficits in executive functions, such as cognitive inflexibility, response inhibition, set-shifting, and planning (Chamberlain et al., 2006; Nakao et al., 2014; Hamidian et al., 2021; Ren et al., 2021; Zincir & Hariri, 2023). These deficits are thought to be related to dysfunction in the frontostriatal circuitry, which mediates inhibitory control and cognitive processes.

Attentional deficits are also commonly observed in individuals with OCD. They may exhibit attentional biases (Nakao et al., 2014). Attentional bias refers to the tendency to selectively attend to and focus on certain stimuli while ignoring others. In the context of OCD, attentional bias plays a significant role in the maintaining and exacerbating of symptoms (Heuvel et al., 2005). Research has shown that individuals with OCD exhibit attentional biases towards OCD-related

stimuli, such as contamination-related words or images (Cisler & Olatunji, 2010; Najmi & Amir, 2010). These biases are characterized by longer response latencies and greater attentional focus on OCD-related stimuli compared to neutral stimuli (Cisler & Olatunji, 2010). Attentional biases in OCD are thought to contribute to the perseveration and rumination associated with the disorder (Najmi & Amir, 2010). Neuroimaging studies have shown altered connectivity between brain networks involved in attentional processes, such as the default mode and frontoparietal network, in individuals with OCD (Stern et al., 2012). Additionally, a study by Choudhury et al. (2017) highlighted impairments in attention, processing speed, and executive functions in individuals with OCD. These cognitive impairments can contribute to slower reaction times in individuals with OCD.

Memory impairments have been reported in individuals with OCD, including deficits in episodic memory, working memory, and visuospatial memory (Zincir & Hariri, 2023; Hamidian et al., 2021; Kim et al., 2021). These deficits can manifest in impairments in recall, recognition, learning, and strategic processing during memory tasks (Kim et al., 2021). Dysfunction in the frontal-striatal system and alterations in neurotransmitter systems have been implicated in these memory deficits. It is important to note that the cognitive deficits observed in OCD can vary across individuals and may be influenced by factors such as symptom severity, comorbidities, and medication status. Furthermore, individuals with OCD may display under-confidence in their cognitive abilities, including memory and perception. This reduced confidence may be related to actual performance deficits in cognitive tasks (Dar et al., 2022).

In summary, individuals with OCD may exhibit deficits in executive functions, attention, and memory. These deficits are thought to be related to dysfunction in the frontostriatal circuitry and alterations in neurotransmitter systems. Understanding these cognitive processes is crucial for developing effective interventions and treatments for OCD.

1.3 Memory in OCD

Neurobiological models of OCD propose dysfunction in the cortico-striatal-thalamic-cortical circuit, which is involved in the maintenance of cognitive control

functions (Khayrullina et al., 2022). Functional neuroimaging studies have revealed abnormal activity in the temporal areas during memory performance in OCD patients. Specifically, memory encoding and maintenance processes are modulated by the prefrontal cortex, which interacts with the inferior temporal gyrus (Park et al., 2020). The impairments in episodic memory in OCD are consistent with neurobiological models proposing dysfunction in the frontal-striatal system (Savage et al., 2000).

Memory deficits have been reported in individuals with OCD (Savage et al., 2000). Studies have found impairments in both verbal and nonverbal memory in OCD patients (Segalàs et al., 2008; Savage et al., 2000). In previous studies, it has been found that individuals with OCD have lower recall item counts compared to control participants (Deckerbars, et al., 2000). Additionally, another study observed that individuals with OCD exhibited lower memory performance compared to the control group, and it was suggested that this memory performance could be associated with the checking behavior observed in individuals with OCD (Sher, et al., 1984). In short, it has been suggested in the past literature that individuals with OCD have difficulties in episodic memory tasks and that especially their controlling behavior may be related to the episodic memory problem (Exner et al., 2009).

There is also evidence suggesting that memory dysfunction in OCD may be influenced by clinical variables. Older age at onset of OCD has been associated with poorer performance on verbal memory tasks (Segalàs et al., 2008). Additionally, the severity of OCD symptoms has been found to be associated with lower scores on some verbal memory tasks (Segalàs et al., 2008). Depressive symptoms have also been shown to influence nonverbal memory in OCD patients (Segalàs et al., 2008). Furthermore, it has been observed that episodic memory performance is also influenced by the type of stimuli (Friedman et al., 1996; Otten & Rugg, 2001). When threat-related stimuli are used, individuals with OCD have shown a positive memory performance towards these items (Radomsky & Rachman, 1999).

Foa et al. (1993) claimed that the problems of patients with OCD started at the encoding stage. This finding formed the basis of subsequent studies, and the introduced the cognitive bias approach. According to that, people with OCD fail to ignore irrelevant information during encoding. These impairments can result in difficulties retrieving relevant content (Long et al., 2020).

However, the results of studies on memory problems in OCD are controversial (Woods et al., 2002). Out of 114 comparisons conducted between individuals with OCD and control groups, a significant difference in memory performance was observed in only 29 of them (Cuttler & Graf, 2009). Furthermore, another meta-analysis study indicated that memory impairment may be associated with OCD, but it falls short of explaining all the problems related to the OCD (Woods, et al., 2002). In a study comparing OCD checkers, non-checkers, and a control group, no significant difference was found in verbal memory performance. These findings suggest that the control behavior in individuals with OCD may be a response to their symptoms rather than solely attributable to memory impairment. Additionally, it is argued that this control behavior may be associated with lower memory confidence in individuals with OCD (Macdonald et al, 1997). Accordingly, many studies have shown that individuals with OCD do not have a memory disorder, and that they have biased memory processes as a result of a biased attention focused on OCD symptoms (Irak & Flament, 2009; Foa et al., 1993). However, it was later argued that the biased approach was insufficient. It has recently become more prominent that the basic cognitive process underlying OCD is metacognitive beliefs (Irak & Tosun, 2008). Some studies have found a positive relationship between metacognitive processes and OCD symptoms. The low confidence of individuals with OCD in their memory supports this argument (Exner et al., 2009).

It is important to note that there are varying views on memory dysfunction in OCD, and the exact mechanisms underlying these deficits are still not fully understood. Some studies suggest that memory deficits in OCD may be related to emotional aspects of the disorder or lack of confidence secondary to OCD symptoms (Nakao et al., 2014). Further research is needed to find out the specific nature and underlying mechanisms of memory deficits in OCD.

1.4 Metacognition in OCD

Metacognition is a system that monitors and controls information processing. It is defined as a structure that includes being aware of events and functions in one's mind, and being able to direct mental events and functions purposefully (Koriat & Helstrup, 2007). In this direction, the metacognition system comes into play in

remembering or forgetting the information that needs to be remembered and being aware of the information in the memory (Metcalfe et al., 1994). In the context of OCD, research has examined the role of metacognition in understanding the disorder and its symptoms.

There are two types of monitoring for metacognition: retrospective (e.g. judgement of learning [JOL]) and prospective (e.g. feeling of knowing [FOK] and ease-of-learning [EOL]) (Irak et al., 2023). Retrospective monitoring is associated with recognition and recall as in classical memory functioning. After the retrospective monitoring process is finished, that is, after a reaction occurs, prospective monitoring begins (Nelson & Narens, 1990). According to some behavioral models, retrospective and prospective metacognitive judgements are substantially connected to memory performance strength (Irak et al., 2019).

JOLs are judgments made by individuals about how well they have learned or will be able to remember information. They are based on various cues, including intrinsic cues (such as item difficulty) and extrinsic cues (such as list repetition or stimulus duration) (Koriat, 1997). JOLs have been found to be influenced by both intrinsic and extrinsic factors, although extrinsic factors may be discounted to some extent (Koriat, 1997). EOL judgments, on the other hand, are judgments made about how easily materials could be learned. They are closely related to memorability judgments and are based on the individual's perception of the EOL. EOL judgments have been shown to predict later recall performance (Libkuman et al., 2007). FOK judgments are judgments made about whether unrecalled items are still in memory. They are based on the individual's feeling of familiarity or fluency with the information. FOK judgments are often considered to be an automatic form of memory that is more quickly available than recollection (Marewski & Schooler, 2011).

The main hypotheses underlying these metacognition types include the trace access hypothesis, the familiarity hypothesis, and the heuristics hypothesis. The trace access hypothesis suggests that JOLs are based on the accessibility of the memory trace, with stronger traces leading to higher JOLs (Cong & Jia, 2022). The familiarity hypothesis proposes that FOK judgments are based on the feeling of familiarity or fluency with the information, with higher familiarity leading to higher FOK judgments (Marewski & Schooler, 2011). The heuristics hypothesis suggests that

JOLs are influenced by various heuristics or decision-making strategies, such as reliance on intrinsic cues or mnemonic-based heuristics (Koriat, 1997). In summary, metacognitive judgements such as JOLs, EOL judgments, and FOK judgments are types of metacognitions that involve making judgments about learning and memory. These judgments are influenced by various cues and heuristics, such as item difficulty, familiarity, and mnemonic-based strategies. Understanding these metacognition types and hypotheses can provide insights into how individuals monitor and regulate their own learning and memory processes.

Studies have shown that individuals with OCD may exhibit deficits in metacognitive processes. Dysfunctional metacognitive beliefs have been found in individuals with OCD. The metacognitive model of OCD proposes that beliefs about the importance of thinking and metacognitive processing play a role in maintaining of OCD symptoms (Kim et al., 2021). For example, patients with OCD have been found to exhibit underconfidence in their performance and decision-making (Hoven et al., 2022). This underconfidence may contribute to excessive doubting and checking behaviors commonly seen in OCD

On the other hand, patients with gambling disorder (GD), which shares compulsivity features with OCD, have been found to exhibit overconfidence (Hoven et al., 2022). These differences in metacognitive biases between OCD and GD suggest that metacognition may play a role in the specific symptomatology of different compulsive disorders. Neuroimaging studies have also provided insights into the neural correlates of metacognition in OCD. Functional magnetic resonance imaging (fMRI) studies have shown that metacognitive processes are associated with activity in the ventromedial prefrontal cortex (VMPFC) (Hoven et al., 2022). Differences in VMPFC activity have been observed between OCD and GD patients, suggesting that the underlying neural circuitry may influence metacognitive processes in these disorders.

A meta-analysis study by Woods et al. (2002) showed, checking behavior is closely related to confidence in memory performance. It has been emphasized that lack of confidence in individuals with OCD is effective in metacognitive decisions and this is associated with negative metacognitive beliefs that people with OCD have poor memory in general (Derin & Irak, 2020; Tuna et al., 2005). The doubt that individuals with OCD feel whether they have done an action or not is another

approach that reveals a problem with confidence in memory. This ambivalence regarding the reliability of memory is thought to be important in the emergence and maintenance of control compulsions (Muller & Roberts, 2005). The literature mentions that while the continuous control behavior reduces the confidence in memory, this lack of confidence is also in a cyclical relationship that causes the control behavior to be repeated (Radomsky et al., 2006).

It was suggested that (e.g. Tuna et al., 2005) that individuals with OCD may experience difficulties in metamemory, which refers to knowledge or beliefs about one's own memory processes and strategies used to control memory. For instance, Hoven et al. (2019) found that individuals with OCD-like checking behavior declined in memory confidence levels in OCD-relevant scenarios, while memory performance itself was unaffected. This suggests that repeated checking behaviors in OCD can lead to reduced confidence in memory. Another study by Radomsky et al. (2006) investigated the effects of repeated checking on memory confidence. Participants who engaged in repeated relevant checking reported significantly reduced memory confidence, vividness, and detail, while repeated irrelevant checking did not produce these decreases. This suggests that checking itself can influence memory confidence in OCD. In a study conducted by Dar et al. (2022), subjective confidence ratings and memory performance were examined, and it was observed that the OCD group underestimated their performance by giving lower confidence ratings compared to controls. Overall, the literature suggests that individuals with OCD may experience difficulties in metamemory, including reduced memory confidence and dysfunctional metacognitive beliefs. These findings suggest that the main problem in information processing in OCD is at the metamemory level (Derin and Irak, 2020)

Judgment of learning (JOL) is a type of metacognitive judgment that refers to the ability to assess one's own learning and memory performance accurately. It is argued that metacognitive assessments such as JOL predict failure and success in recognition (Koriat & Helstrup, 2007). Recent findings indicate that such metacognitive decisions are made by integrating and using monitoring processes and controlling the familiarity and availability of information (Irak et al., 2019).

While limited research specifically examines JOL in OCD, studies have investigated cognitive processes related to learning and memory in OCD that may

have implications for JOL. Neuropsychological studies have shown that individuals with OCD may exhibit impairments in cognitive flexibility, working memory, and response inhibition (Gottwald et al., 2018). These cognitive deficits could potentially impact JOL, as accurate JOL requires the ability to flexibly assess and monitor one's learning and memory processes. Furthermore, studies have examined the relationship between metacognitive beliefs and symptoms of OCD (Didonna et al., 2018). It is possible that metacognitive beliefs in OCD, such as excessive doubting or the need for certainty, could influence JOL by affecting individuals' confidence in their learning and memory abilities.

While there is limited direct research on JOL in OCD, the cognitive and metacognitive processes implicated in OCD suggest that individuals with OCD may exhibit differences in JOL compared to healthy individuals. More research is needed to investigate JOL in OCD using experimental paradigms that assess individuals' ability to monitor and evaluate their learning and memory performance. This could provide further insights into the cognitive processes underlying OCD and potentially inform the development of interventions targeting JOL in OCD.

In conclusion, metacognition plays a critical role in OCD. Problems in metacognitive processes, such as underconfidence during memory tasks, have been observed in OCD. Neuroimaging studies have identified neural correlates of metacognition in OCD, including activity in the VMPFC. Further research is needed to fully understand the role of metacognition in OCD and its implications for treatment.

1.5 Cognitive Behavioral Therapy and OCD

Among behavioral interventions in OCD, cognitive behavioral therapy (CBT) is thought to have a very high effect (Andersson et al., 2012; Foa et al., 2005). In a study conducted by Zaccari et al. (2021), examining the effects of CBT on OCD, a reduction in symptoms and Y-BOCS scores was observed. These findings demonstrate that CBT is an effective treatment for OCD. CBT for OCD typically involves exposure and response prevention (ERP), which aims to help individuals confront their fears and reduce compulsive behaviors (Andersson et al., 2012). Several studies have demonstrated the efficacy of CBT in reducing OCD symptoms,

with response rates averaging 50-70% (Andersson et al., 2012; Sousa et al., 2006). CBT has been shown to lead to significant reductions in obsessive-compulsive symptoms and improvements in overall functioning. CBT works by targeting the cognitive and behavioral processes that contribute to OCD symptoms. The cognitive component of CBT focuses on identifying and challenging maladaptive thoughts and beliefs related to obsessions and compulsions. This may involve cognitive restructuring techniques, such as examining evidence for and against irrational beliefs and developing more adaptive ways of thinking (Gragnani et al., 2022). The behavioral component of CBT involves exposure to feared situations or stimuli, without engaging in the associated compulsive behaviors. Through repeated exposure, individuals learn that their feared outcomes are unlikely to occur and that their anxiety decreases over time (Andersson et al., 2012).

It was stated that the cognitive problem in OCD patients was caused by a problem in organizational strategies during the processing of stimuli, and that OCD patients could not learn new stimuli. Eventually, this emerged as a memory problem. It has been stated that another factor that may affect the performance of individuals may be metacognition, and it has been suggested that CBT may have improved one's perspective and confidence in one's own cognitive performance. That improvement happened because CBT focuses on organizational strategies, beliefs, and behaviors (Nedeljkovic et al., 2011). Current approaches addressing CBT effectiveness in OCD mostly focus on metacognitive beliefs and impaired cognition and behavioral strategies associated with these beliefs (Clark, 2006).

Neurobiological research has provided insights into the mechanisms underlying the effectiveness of CBT in OCD. Studies have shown that CBT can lead to changes in brain activity and connectivity in regions involved in fear extinction and cognitive control, such as the amygdala, prefrontal cortex, and striatum (Tyagi et al., 2019; Milad et al., 2013). CBT may enhance fear extinction mechanisms, which are impaired in individuals with OCD (Milad et al., 2013). Another study by Saxena et al. (2008) examined the rapid effects of brief intensive CBT on brain glucose metabolism in individuals with OCD. The study used positron emission tomography (PET) to measure brain glucose metabolism before and after CBT. The results showed that after CBT, there was a significant decrease in glucose metabolism in the orbitofrontal cortex, anterior cingulate cortex, and caudate nucleus, which are brain

regions associated with OCD symptoms. This suggests that CBT may lead to improvements in metacognition by modulating the neural activity in these regions.

In summary, CBT is an evidence-based treatment for OCD that has been shown to be effective in reducing symptoms and improving functioning. CBT works by targeting maladaptive thoughts and beliefs through cognitive restructuring and exposing individuals to feared situations or stimuli without engaging in compulsive behaviors. Neurobiological research suggests that CBT can lead to changes in brain activity and connectivity associated with fear extinction and cognitive control.

1.6 Aim of the Study

It is unclear whether the real problem in people with OCD is due to an impairment in memory, low confidence in their memory, or both. The results on memory performance in OCD are controversial, but some studies reported that the OCD group has problems with episodic memory (Woods et al., 2002). According to mentioned literature, it is expected that if the stimulus was strongly encoded in healthy individuals, it is expected to make high and accurate JOL judgments. As the encoding phase weakens, the degree of metacognitive judgment decreases, and accuracy changes accordingly (Irak et al., 2023).

However, some studies have shown that individuals with OCD do not demonstrate memory accuracy problems; they exhibit lower memory confidence than healthy controls (Moritz & Jaeger, 2018). Besides these contradictory findings about memory, the almost general conclusion indicates that these patients have low metacognitive judgment. This may suggest that metacognitive processes may be the underlying cause of cognitive impairment in individuals with OCD. For this reason, it would be beneficial to examine the metamemory judgments under specific memory task (e.g. episodic memory) in individuals with OCD. Furthermore, it has been suggested that CBT interventions can assist in enhancing metacognitive processes in individuals with OCD by promoting positive beliefs, which can have beneficial effects in their daily functioning (Papageorgiou et al., 2018). However, the effectiveness of CBT on OCD has only been examined in two studies conducted in Turkey (Duman et al., 2022; Şafak et al., 2014). Also, studies investigated effects of CBT on memory and metamemory judgments in patients with OCD is very limited.

The central importance of metacognitive processes in OCD and the focus on metacognitive processes in CBT in treating OCD indicate that these two processes should be considered together. In this way, the change in memory and metacognitive processes of individuals who have undergone successful CBT treatment can be clarified. Therefore, this study aims to examine the memory and metamemory judgments of individuals with OCD compared to healthy individuals, along with investigating the effectiveness of CBT in OCD. Thus, individuals with OCD received 10-session CBT, and their episodic memory and JOL performances were measured pre-and post-CBT and were compared with healthy controls in terms of age, gender, and education variables. The episodic memory tasks consisted of verbal stimuli. Also, the fact that previous studies' stimuli used in memory tasks are associated with OCD symptoms creates debates about the validity of the findings in daily life. For this reason, stimuli that are not related to OCD symptoms will be used when making the comparison.

There are 3 hypotheses of the study. Firstly, in terms of clinical measurements, it is expected that the OCD group would differ from the control group prior to CBT, and this difference is expected to diminish after CBT. Additionally, it was hypothesized that there would be a difference between pre-CBT and post-CBT measurements in the OCD group, indicating a reduction in symptoms. Secondly, based on previous literature, it was expected that individuals with OCD would exhibit lower JOL judgments, indicating lower confidence in their memories compared to the healthy control group during the pre-CBT phase. It was expected that the OCD group's JOL judgments would increase in the post-CBT phase, approaching the levels of the healthy control group. Finally, regarding JOL accuracy, it was anticipated that the OCD group would perform less than the healthy control group in the pre-CBT phase. In the post-CBT phase, it was expected that the OCD group would exhibit improved JOL accuracy, without significant differences from the healthy control group. In other words, it was expected that the OCD group, after CBT, would demonstrate a more consistent metamemory performance, without significant differentiation from the healthy control group in this aspect.

This thesis is a part of TÜBİTAK project (No: 121K575; Irak, 2021).

Chapter 2

Method

2.1 Participants

The study was conducted with 96 participants (27 males, 69 females) in total who were divided in two groups. The first group consisted of 46 people diagnosed with OCD between the ages of 18-45 (*M*=25.13, *SD*=7.73*)*. All individuals included in the clinical group met the diagnostic criteria for OCD as outlined in the Diagnostic and Statistical Manual of Mental Health Disorders (DSM-5) (American Psychiatric Association, 2013).

Second group consisted of 50 healthy controls (HCs) between the ages of 18-47 (*M*=26.10, *SD*=8.34*)* without any psychiatric or neurological diagnosis. HCs matched with clinical group in terms of age, gender, and education. Participation in both groups took place on a voluntary basis. Exclusion criteria for all participants in the study were: (1) a history of neurological disease or head injury, (2) an unstable medical condition, (3) substance use disorder, (4) mental retardation, and (5) color blindness. Inclusion and exclusion criteria for the clinical group were (1) at least primary school graduate, (2) Y-BOCS total score of 18 and above (moderate symptom severity) (Farris, et al., 2013), (3) any medical condition that may affect the diagnosis, (4) a comorbid mood, anxiety, psychotic or OCD, and related the disease is the absence of any therapy history, (5) have not received any psychopharmacological treatment and, if they have taken it in the past, have completed at least a three-week washout period. In addition to the criteria specified for the HCs, the Structured Clinical Interview for DSM-5 Disorders (SCID-5) will be applied to check that there were no psychological/psychiatric problems. Participants in the clinical group will be selected from among the patients receiving outpatient or inpatient treatment in Ankara City Hospital (ACH) Psychiatry Clinic. Participants in the control group were reached through announcements made in classes at Bahçeşehir University and on social media. All participants who complete the study will be given a gift voucher of 75 TL.

A total of 4 individuals from the OCD group withdrew from the study. 2 people wanted to withdraw from the study in the exposure method part of the therapy procedure, and 2 people wanted to withdraw from the study at the stage of filling out the clinical scales at the beginning of the study. A total of 2 people from HCs were excluded from the study. 1 person was excluded after SCID application because it was found to be suitable for the diagnosis of panic attack subclinically, and 1 person was excluded because her reading speed was far below the average. As a result, a total of 96 people were included in the study, 46 in the OCD group and 50 of them were HCs.

2.1.1 Socio-demographic characteristics. The socio-demographic information of all the participants and the drug use and OCD type of the clinic group are given in table 1.

Table 1

Demographic Characteristics of the Participants

Variables	OCD		HC	
	N (%)	Mean (SD)	N (%)	Mean (SD)
Gender				
Female	33		35	
Male	13		15	
Age	46	25.13 (7.73)	50	26.06 (8.38)
Year of Education				
University (More than 12 years)	18 (39.10%)		19 (38%)	
Highschool (12 years)	27 (58.70%)		29 (58%)	
Primary (8 years)	1 (2.20%)		2 (4%)	
Years of Ilness		7.14 (7.14)		
Type of Medication				
Antidepressants	38 (82.6%)			
None	7 (15.20%)			
Missing	1 (2.2%)			
OCD Type				
Contamination/Cleaning/Washing	11 (23.90%)			
Aggressive/Sexual/Religious	2 (4.30%)			
Responsibility for harm and checking	6 (13%)			
Mixed	27 (58.70%)			

2.2 Measures

2.2.1 Episodic memory task. As mentioned above, this thesis study focused on a specific part of a TUBITAK project (no: 121K575; Irak, 2021) . There were three experimental tasks, and each task had five phases in the project. Different stimuli were used in three tasks, namely, word, scene, and face. In this thesis the word-word pair task was used. However, this study will focus on the first three stages (encoding, JOL and recognition) of the experimental task. Memory and metacognitive judgment performances measured with the classical learning-decision-recognition paradigm (see Figure 1). The stimuli in the verbal episodic memory task consisted of familiar and unfamiliar Turkish words (for example, kalem, şinik, etc.). Familiar words were selected from the Word Frequency Dictionary of Written Turkish (Göz, 2003) among words with a length of 5-8 letters. Unfamiliar words were chosen from studies on this subject to be 5-8 letters long (Tekin, 1977; Demir, 2010). The stimulus pool, created for unfamiliar words, was tested through a pilot study with a sample of 75 individuals, and accordingly, words with the lowest frequency were selected and identified. To determine whether stimuli are threat-related triggers for individuals diagnosed with OCD, opinions were sought from an expert group consisting of three professionals, including two clinical psychologists and one psychiatrist. For the OCD group, the stimuli in the tasks to be used before and after CBT will be different from each other and will be created by selecting randomly from the specified stimulus pools. The OCD group was invited to participate in the study twice, both before and after CBT, while measurements were taken from the control group only once.

This task will consist of 3 phases in order: learning, judgment of learning and recognition. In the first stage which is learning, 84-word pairs will be shown to the participants. The word on the left of pairs, which was used as a cue in the upcoming phases of the experiment, was always a familiar word. Half of the words on the right consisted of familiar words, while half consisted of unfamiliar words. To check for primacy and recency effects, two-word pairs (four in total) at the beginning and end of the list were selected from familiar words but were not included in the analysis. At this stage, the instruction was given to the participants that this is a memory exercise, that word pairs will be shown on the computer screen, and they should learn them

because they will be asked questions about these words in the future. Each pair of words appeared in the middle of the screen for 3 seconds in a 40-point Arial font. The presentation time between word pairs was 1 second. After all the words were presented, the second stage, the JOL, started. At this stage, the cue word shown on the left during the learning phase of each word pair was displayed on the screen and the participants were asked whether they remembered the other pair of the displayed word. Participants gave their answers by choosing one of the "I remember", "I'm not sure" or "I don't remember" options that appear on the screen via the mouse. The order of presentation of the stimuli at this stage were different from the learning stage. The cue word displayed on the screen for 3 seconds, after a 1-second blank screen, a screen with 3 options displayed and the participants asked to choose one of the options on the screen via the mouse. Finally, participants asked to complete the recognition phase. At this stage, a total of 80 word pairs, 40 of which were presented during the learning phase, and 40 of which were new, were shown to the participants. Each word pair presented on the screen for 3 seconds. The types and numbers of target words in the new word pairs will be the same as the target words in the learning phase. Participants asked to indicate whether they have seen each of the word pairs before. The left button of the mouse was used for the "I saw" response, and the right button was used for the "I did not see" response. Participants had to give their answers by pressing the relevant mouse button while the word pair appeared on the screen.

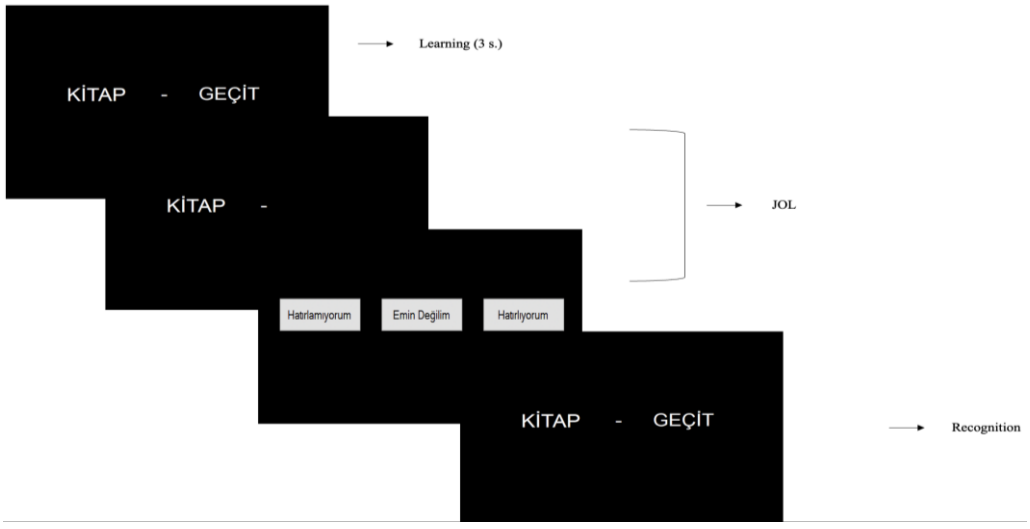

Figure 1. Experimental task was used in the study

2.2.2 Maudsley obsessive-compulsive inventory. The Maudsley Obsessive-Compulsive Inventory (MOCI) is a 30-item self-report questionnaire in a true/false format. For each item, "true" answers are scored as 1 point, while "false" answers are scored as 0. An increase in the total score indicates an increase in the severity of symptoms. This scale, developed by Hodgson & Rachman (1997) to investigate the level and type of obsessive-compulsive disorder. It has 4 subscales: cleaning, checking, slowness and doubting. Turkish reliability and validity were demonstrated by Erol and Savaşır (1988). In addition to the original, 1 more subscales have been added in the Turkish version of MOCI. This subscale added was rumination. 7 more items have been added depending on this subscale. The test-retest reliability of the Turkish version of the MOCI was determined to be .88. The Cronbach's alpha coefficient for the overall scale was $\alpha = .86$, indicating high internal consistency. The alpha coefficients for the subscales ranged from .61 to .65, suggesting acceptable internal consistency for these dimensions.

2.2.3 Yale-Brown obsessive compulsive scale (Y-BOCS). It is a scale developed by Goodman et al. (1989) to measure the type and severity of obsessive-compulsive symptoms and should be administered by a clinician. Consisting of 19 items in total, but only the first 10 items of this scale are used to determine the severity of obsessions and compulsions. Each question can have a minimum score of 0 and a maximum of 4. The minimum score that can be obtained on the Y-BOCS is 0, while the maximum score is 40. Its internal consistency was .87. Its Turkish adaptation and validity-reliability study was performed by Karamustafalıoğlu et al. (1993) and Tek et al. (1995). The Turkish version of this scale will be used in the study. The Turkish version's interrater reliability was .96. For obsession subscale interrater reliability ranged between .85 to .97 and for compulsion subscale was from .74 to .97. According to the Y-BOCS scale, 10-17 points can be defined as mild OCD, 18-29 points as moderate OCD, and 30 and above as severe OCD (Kuru & Türkçapar, 2013).

2.2.4 State-trait anxiety inventory. State-Trait Anxiety Inventory (STAII) is a self-report questionnaire consisting of 40 items in total, 20 of which are state anxiety and 20 items are trait anxiety. It is developed by Spielberger et al., (1983) Each

question is answered on a 4-point Likert scale. While the state anxiety scale gives information about the current anxiety level, the trait anxiety scale gives information about the general anxiety level. The Reliability and Validity of the Turkish version was demonstrated by Öner and Lecompte (1983). The Cronbach's alpha coefficient for trait anxiety was found to be α= .87, indicating high internal consistency. Similarly, the Cronbach's alpha coefficient for state anxiety was α= .96, also indicating high internal consistency. In the adaptation of the STAI to the Turkish population, the reliability coefficient, as determined by the alpha correlation, was .83, reflecting a satisfactory level of internal consistency.

2.2.5 Beck depression inventory (BDI). BDI is a self-assessment type scale developed by Beck et al. (1961) and consists of 21 items. The purpose of the scale is to objectively determine the degree of depression. Each item is scored between 0 and 3. It was adapted into Turkish by Hisli (1988) and this version will be used in the study. Cronbach's alpha coefficient of the scale was α= .80 and split-half reliability was .74. A score of 17 or more obtained from the scale indicates a depression above normal (Hisli, 1988). The maximum total score that can be obtained from the scale is 63 and as the score increases, it indicates that depressive symptoms increase.

2.2.6 Beck anxiety scale (BAI). BAI (Beck et al., 1961) is a self-evaluation type scale developed to determine the severity of anxiety symptoms and consists of 21 items. Each item is evaluated between 0 and 3 points. The maximum total score that can be obtained from the scale is 63.

The Turkish validity and reliability study was conducted by Ulusoy (1993) and it has been shown to be a valid and reliable tool in measuring the level of anxiety. The scale does not have a cutoff score. As the score increases, it indicates that the level of anxiety increases.

2.2.7 Structured clinical interview for DSM-5 (SCID-5). The SCID-5 (First et al., 2016) is a clinician-used semi-structured interview to make diagnoses. It was adapted into Turkish by Elbir et al. (2019). In this study, SCID-5 was applied only to the participants in the control group before participating in the study to ensure that

there was no psychiatric disorder that would prevent them from participating in the study.

2.2.8 Socio-demographic information form. The participant's demographic information and current and past health information will be obtained through the questions in this form (Appendix A). This form generated by the researcher.

2.3 Procedure

The study was initiated after the approval of the Medical Ethics Committee of Ankara City Hospital. The participants in the clinical group were evaluated by psychiatrists in terms of symptom criteria and severity before they were included in the experiment. If they are found eligible to participate, they invited into the experiment. All questionnaires and episodic memory task are practiced in a single session. In determining the order of application of the experiments and scales, the counterbalancing method was used. The OCD group completed the experiment in the ACH's, while the control group completed the experiment in the Bahcesehir University's experiment room. The experimental session was last approximately 1.5 hours. After the implementation of the experiment and clinical measurements, the OCD group began the CBT process. After completing 10 sessions of CBT, the participants in the OCD group were again called to the hospital for clinical measurements and the implementation of the episodic memory task.

Chapter 3

Result

Firstly, data screening was done to detect missing values as well as univariate and multivariate outliers. Neither univariate nor multivariate outliers were found. Analyzes were made on a total of 96 participants.

3.1 Sociodemographic Characteristics

The demographic characteristics of participants are presented in Table 1. Independent samples t-test showed that age (t (94) = -.58, p = .55) and year of education (t (94) = -.08, p = .93) differences between the two groups were not significant.

Table 2

Participant's Mean Age (and Standard Deviations), According to Gender and Level of Education

Level of Education	*OCD*				*HC*			
	Male		Female		Male		Female	
Primary (8 years)	-	N=0	45(-)	N=1	47(-)	N=1	43(-)	N=1
High school	19.71(1.97)	N=7	22.55(6.28)	N=20	24.5(8.54)	N=6	21.95(4.57)	N=22
University	33.16(8.32)	N=6	26.91(6.12)	N=12	24.85(1.86)	N=7	30.81(9.45)	N=11

OCD: People with obsessive compulsive disorder; HC: Healthy controls

3.2 Group Comparisons on Clinical Measures

The mean scores and standard deviations of the OCD group before and after CBT and of HCs for Y-BOCS (OCD group only), MOCI, BDI, BAI, and STAI are shown in table 3,4 and 5. A separate variance analysis (ANOVA) was conducted to compare two groups on clinical measurement scores. In pre-CBT Y-BOCS total score indicated that symptom severity was moderately severe. In all comparisons, the OCD group has significantly higher scores than HCs in the pre-CBT condition (F (1,92) $\geq$ 14.12; $p \leq .001$) (see Table 3).

Table 3

Comparison OCD and HCs on Clinical Measures at Pre-CBT

Measure	OCD *M (SD)*	HC *M (SD)*	*F*
YBOSC	28 (4.48)	-	-
MOCI	25.47 (5.47)	8.80(4.62)	258.65***
BDI	21.80 (10.05)	5.38(4.86)	106.41***
BAI	25.97 (16.85)	5.60(5.34)	63.52***
TAI	51.67 (8.65)	42.30 (13.56)	15.97***
SAI	41.91 (7.40)	35.54 (9.04)	14.12***

**** p <.001; OCD???; HC: Healthy controls; YBOSC: Yale Brown Obsessive Compulsive Scale*

The mean scores and standard deviations of the OCD group after CBT and HCs for clinical measurements are shown in Table 4. Except the TAI, for all scales OCD groups' scores were higher and significantly different compared to HCs (F $(1,92) \geq 5.23$; $p \leq .02$). When examining the mean scores of clinical scales, it is observed that the scores in the post-CBT phase are closer to those of HCs compared to the pre-CBT phase. Additionally, YBOSC scores have decreased from a severe level to a mild level.

Table 4

Comparisons OCD and HCs on Clinical Measures at Post-CBT

Measure	Post CBT *M (SD)*	HC *M (SD)*	*F*
YBOSC	8.58 (4.73)	-	-
MOCI	12.34 (6.58)	8.80(4.62)	8.55**
BDI	8.43 (7.96)	5.38(4.86)	5.23*
BAI	11.15 (10.15)	5.60(5.34)	11.12***
TAI	45.39 (5.63)	42.30 (13.56)	2.06
SAI	42.10 (6.25)	35.54 (9.04)	16.85***

** p <.05; ** p < .01; *** p <.001; CBT: Cognitive behavioral therapy; HC: Healthy controls; YBOSC: Yale Brown Obsessive Compulsive Scale*

Mean scores and standard deviations of OCD group for clinical measures at Pre CBT and post CBT are shown in table 5. A repeated measures ANOVA was conducted to compare clinical measurement scores on different times. It was observed that OCD group showed improvement in terms of clinical symptoms. Except SAI score for all clinical measurements OCD group's clinical symptom scores significantly decreased after CBT (F $(1,45) \geq 21.76$; $p \leq .001$).

Table 5

Comparison Pre-CBT and Post-CBT on Clinical Measures

Measure	Pre CBT *M (SD)*	Post CBT *M (SD)*	*F*
YBOSC	28 (4.48)	8.58 (4.73)	492.13***
MOCI	25.47 (5.47)	12.34 (6.58)	161.83***
BDI	21.80 (10.05)	8.43 (7.96)	64.36***
BAI	25.97 (16.85)	11.15 (10.15)	55.33***
TAI	51.67 (8.65)	45.39 (5.63)	21.76***
SAI	41.91 (7.40)	42.10 (6.25)	.012

**** p <.001; CBT: Cognitive behavioral therapy; HC: Healthy controls; YBOSC: Yale Brown Obsessive Compulsive Scale*

3.3 Group Comparisons on JOL Judgments

Separate ANOVAs were conducted to examine the group effect on variables during JOL judgments. Dependent variables were the mean of JOL confidence (was calculated for all, familiar, and unfamiliar items), proportion (percentage) of correct recognition (was calculated for inlist, outlist, familiar, and unfamiliar items), reaction time (RT) (was calculated for correct and incorrect recognition) and JOL accuracy scores (gamma score).

The results of the OCD groups' pre-CBT and HCs are presented in Table 6. Results showed that JOL judgments for all, familiar, and unfamiliar items significantly differed among the groups, and the OCD group gave lower JOL judgments than the HCs (F (1,94) $\geq$ 4.95; $p \leq .028$). In addition, although it was not significant, the JOL accuracy of HCs was higher than the OCD group. For RT, although both groups' RT for correct responses were similar, the OCD group's RT for incorrect responses is slower compared to HCs. However, these RT differences were insignificant. Lastly, Although the OCD group was better than HCs for recognition performance, these differences were aslo insignificant for all stimulus types.

Table 6

Comparisons OCD and HCs on Judgments of Learning Phase of Word-word Pair Task at Pre-CBT: ANOVA Results With Descriptive Statistics

	Pre CBT *M (SE)*	HC *M (SE)*	*F*
JOL Judgment for AI	1.54 (.04)	1.69 (.04)	5.79*
JOL Judgment for FI	1.65 (.05)	1.83 (.05)	5.20*
JOL Judgment for UFI	1.43 (.03)	1.56 (.04)	4.95*
JOL Accuracy	-.21 (.05)	-.11 (.05)	2.01
Correct JOL-r AI	47.78 (2.52)	39.38 (1.89)	7.22**
Inlist JOL-r for AI	71.38 (3.19)	62.07 (3.07)	4.41*
Inlist JOL-r for FI	73.55 (3.42)	64.89 (3.02)	3.61
Inlist JOL-r for UFI	69.44 (3.29)	58.83 (3.57)	4.71*
Outlist JOL-r AI	24.27 (3.53)	16.83 (2.05)	3.44
Outlist JOL-r for FI	24.22 (3.72)	14.59 (2.53)	5.07*
Outlist JOL-r for UFI	25.94 (3.58)	18.67 (2.20)	3.08
RT for Correct JOL-r	1258.27 (20.81)	1258.60 (24.96)	.00
RT for Incorrect JOL-r	1363.48 (16.30)	1313.90 (29.33)	1.31

** p <.05; ** p < .01; *** p <.001; CBT: Cognitive behavioral therapy; HC: Healthy controls; JOL: Judgment of learning; AI: All item, FI: Familiar item; UFI: Unfamiliar item; RT: Reaction time; JOL-r: JOL Recognition*

The OCD groups' JOL performances after CBT was compared with HCs, and ANOVA results are presented in Table 7. results showed that the two groups did not differ in terms of JOL judgements after CBT., Although the results showed that the two groups did not significantly different in terms of JOL judgments, Surprisingly the OCD group gave higher JOL judgements for all, familiar, and unfamiliar items than HCs. The OCD group was closer to the HCs in JOL accuracy than before the CBT, and the difference in JOL accuracy between the groups was not significant. For recognition scores, only all and outlist familiar items differed significantly between the two groups and OCD group had higher performance than HCs (F (1,93) $\geq$ 4.57; p $\leq$ .035). Lastly, although there was no significant difference in RTs between the two groups, the clinical group was faster than HCs after the CBT.

Table 7

Comparisons OCD and HCs on Judgments of Learning Phase of Word-word Pair Task at Post-CBT: ANOVA Results With Descriptive Statistics

	Post CBT *M (SE)*	HC *M (SE)*	*F*
JOL Judgment for AI	1.78 (.05)	1.69 (.04)	1.63
JOL Judgment for FI	1.92 (.05)	1.83 (.05)	1.50
JOL Judgment for UFI	1.64 (.05)	1.56 (.04)	1.45
JOL Accuracy	-.04 (.05)	-.11 (.05)	.70
Correct JOL-r AI	46.18 (2.38)	39.38 (1.89)	5.05*
Inlist JOL-r for AI	69.18 (2.78)	62.07 (3.07)	2.91
Inlist JOL-r for FI	71.73 (2.67)	64.89 (3.02)	2.83
Inlist JOL-r for UFI	66.19 (22.51)	58.83 (3.57)	2.26
Outlist JOL-r AI	23.53 (3.57)	16.83 (2.05)	3.24
Outlist JOL-r for FI	22.42 (2.92)	14.59 (2.53)	4.57*
Outlist JOL-r for UFI	22.20 (2.83)	18.67 (2.20)	.97
RT for Correct JOL-r	1209.77 (20.14)	1258.60 (24.96)	2.28
RT for Incorrect JOL-r	1290.84 (26.44)	1313.90 (29.33)	.33

** p <.05; CBT: Cognitive behavioral therapy; HC: Healthy controls; JOL: Judgment of learning; AI: All item, FI: Familiar item; UFI: Unfamiliar item; RT: Reaction time; JOL-r: JOL Recognition*

A repeated measure ANOVA was conducted to compare the OCD group's cognitive performances before and after therapy, and results are presented in table 8. Results showed that JOL judgments for all, familiar, and unfamiliar items significantly differed and the OCD group showed improvement in JOL judgements after CBT (F (1,45) $\geq$ 22.84; $p \leq .000$). Moreover, After CBT, JOL accuracy was significantly higher than pre-CBT (F (1,41) = 6.64, p =.014). However, recognition performances did not differ significantly. Lastly, after CBT, the OCD group's RT for correct and incorrect responses significantly decreased (F (1,42) $\geq$ 8.08; $p \leq .005$).

Table 8

Comparison Pre-CBT and Post-CBT on Judgments of Learning Phase of Word-word Pair Task: ANOVA Results With Descriptive Statistics

	Pre CBT *M (SD)*	Post CBT *M (SD)*	*F*
JOL Judgment for AI	1.54 (.29)	1.78 (.34)	33.30***
JOL Judgment for FI	1.65 (.38)	1.92 (.39)	31.31***
JOL Judgment for UFI	1.43 (.25)	1.64 (.34)	22.84***
JOL Accuracy	-.21 (.34)	-.04 (.35)	18.57***
Correct JOL-r AI	47.78 (16.97)	46.18 (16.14)	.46
Inlist JOL-r for AI	71.38 (21.42)	69.18 (18.87)	.29
Inlist JOL-r for FI	73.55 (22.95)	71.73 (18.14)	.75
Inlist JOL-r for UFI	69.44 (22.13)	66.19 (22.51)	.64
Outlist JOL-r AI	24.27 (23.72)	23.53 (21.37)	.09
Outlist JOL-r for FI	24.22 (24.99)	22.42 (19.81)	.33
Outlist JOL-r for UFI	25.94 (24.08)	22.20 (19.35)	1.63
RT for Correct JOL-r	1258.27(139.60)	1208.78(138)	8.80**
RT for Incorrect JOL-r	1348.35(187.68)	1274.64(144.13)	11.40**

** p <.05; ** p < .01; CBT: Cognitive behavioral therapy; HC: Healthy controls; JOL: Judgment of learning; AI: All item, FI: Familiar item; UFI: Unfamiliar item; RT: Reaction time; JOL-r: JOL Recognition*

Summary of the Results; As a result of clinical measurements, it has been observed that the symptom severity of the OCD group decreased in the post-CBT condition. In addition, when comparing clinical measurements between pre-CBT and post-CBT, it was observed that measurements of individuals with OCD were significantly different, indicating a positive change.

In the pre-CBT condition, the OCD group exhibited lower JOL judgments and was significantly different from the HCs. However, this difference disappeared in the post-CBT condition. It was observed that the OCD group's JOL judgments significantly increased after CBT. Although not significant in the pre-CBT condition, the OCD group's JOL accuracy was lower than HCs, and this difference decreased after CBT. Additionally, the OCD group's JOL accuracy significantly improved in post-CBT condition compared to the pre-CBT. In terms of memory performance, both in the pre-CBT and post-CBT conditions, the OCD group performed better than HCs, although not significantly.

Chapter 4

Discussion

This study aimed to investigate the role of verbal episodic memory and metacognitive judgments (JOL) in OCD, and to examine changes after CBT. For this purpose, both clinical and cognitive measurements were obtained from individuals with OCD both before and after CBT. The same measurements were also taken from age, gender, and education level-matched HCs with the OCD group. In the OCD group, it has been observed that OCD group's symptom severity and other clinical measures (depression and and anxiety scores) significantly decreased following CBT and also compared to HCs. In line with the aim of the study, the recognition, JOL and reaction times of people with OCD were compared before and after CBT. the OCD group's JOL judgment was significantly lower than HCs before CBT but higher after CBT. Moreover, JOL judgment of the clinical group significantly increased after CBT. Both groups had lower metacognitive judgments for familiar items than unfamiliar items. On the other hand, OCD group's recognition performance was not affected by CBT. In all groups, the recognition for inlist words is higher than outlist. Prior to CBT, the OCD group exhibited similar reaction times to HCs for correct responses, while they had higher reaction times for incorrect responses. After CBT, the OCD group is faster than HCs in both correct and incorrect answers. The OCD group had a significant decrease in RTs after CBT.

4.1 Effects of CBT on Clinical Measures

According to the literature mentioned above, individuals with OCD have a high probability of experiencing comorbid anxiety and depression. According to the results obtained from our study, prior to CBT, individuals in the OCD group were found to significantly score higher in all clinical measurements (MOCI, BDI, BAI, STAI) compared to the HCs. This indicates that prior to CBT, the OCD group's levels of depression and anxiety were significantly higher than those of the HCs. After CBT, a significant decrease in clinical measurements of the OCD group, except for SAI, was observed. Following CBT, in comparisons made with the HCs, the OCD group still maintained significantly higher scores except for SAI; however,

score differences between two groups were observed to decrease. The elevated levels of depression and anxiety in the OCD group compared to the HCs are consistent with the existing literature (e.g., Segalàs et al., 2021; Mahasuar et al., 2011; Carter et al. 2004). Moreover, the past literature (e.g., Ruscio et al., 2008) has demonstrated that high levels of anxiety and depression are also associated with symptom severity in the OCD. Looking at the results obtained in this study, based on YBOSC scores, symptom severity was in the severe range before CBT and regressed to the mild range after CBT. The reduction in depression and anxiety scores following CBT suggests a potential influence on the regression of symptom severity within the OCD group. Understanding the relationship between anxiety, depression, and OCD severity is crucial for developing effective interventions and improving the quality of life for individuals with OCD.

4.2 Effects of CBT on Metamemory in OCD

Current research on OCD has established a connection between doubt and individuals' perceptions and beliefs regarding their cognitive processes, memory, and meta-memory, rather than indicating actual deficiencies in memory. Wells & Mathews (1994) have argued that understanding psychopathologies necessitates considering beliefs about cognitive processes and the level of confidence in one's memory. In the context of OCD, focusing on internal mental processes diminishes individuals' confidence in their ability to carry out actions or rituals correctly. Consequently, individuals find themselves compelled to engage in further and repetitive actions (e.g. Radomsky, 2006; Ranchman, 2002) until they achieve the desired outcome. According to Rachman (2002), anxious arousal can disrupt the recall of specific events, leading individuals to interpret this as evidence of personal incompetence. The presence of negative beliefs about memory amplifies uncertainty regarding one's behavior, leading to repetitive and checking behaviors. This contributes to a cyclic pattern that further erodes an individual's confidence in their memory and behavior, ultimately contributing to an increase of OCD symptoms. Moreover, our study findings indicate that individuals with OCD exhibit impaired metamemory performance across various types of stimuli, including both familiar and unfamiliar content, as well as symptom-free stimuli. This indicates that they do

not engage in item-specific metamemory judgments and generally have low confidence in their memory. These observations suggest the presence of metamemory deficits in OCD and this finding is supportive of the existing literature (Irak et al, in press; Nedeljkovic & Kyrios, 2007; Tuna, Tekcan & Topcuoglu, 2005; Foa et al. 1997).

In the post-CBT results, a significant gap in JOL judgments between individuals with OCD and HCs has narrowed, and the OCD group has approached the HCs. Furthermore, following CBT, JOL judgments have significantly increased compared to pre-CBT levels. These findings indicate that CBT has led to positive changes in metamemory among individuals with OCD. The metacognitive model of OCD suggests that beliefs concerning the significance of thinking and metacognitive processing contribute to the persistence of OCD symptoms (Kim et al., 2021). Individuals with OCD are believed to experience underconfidence in their memory performances, and it is suggested that this underconfidence contributes to the emergence of doubting and checking behaviors commonly observed in OCD (Hoven et al., 2022). In light of this information, the reduction in symptom severity following CBT could be associated with an increase in individuals' confidence in their memory. As individuals with OCD gain greater confidence in their memory abilities, they may no longer require doubting and checking behaviors, as they no longer experience underconfidence in their memory performance. When examining the changes in JOL accuracy after CBT, a positive increase is evident, indicating that individuals with OCD were able to predict their memory performances more consistently after CBT. In previous literature (e.g., Nedeljkovic et al., 2011), it has been suggested that CBT may enhance an individual's perspective on their own cognitive performance and confidence, and this assertion is consistent with the findings of this study. CBT aims to teach individuals adaptive ways to cope with anxiety and engage in appropriate activities, which directly contradicts the maladaptive behaviors associated with OCD (Merlo et al., 2009). By challenging and modifying dysfunctional beliefs and thought patterns, CBT helps individuals develop more realistic and rational thinking, reducing the severity of OCD symptoms. In line with previous literature, there is a positive change in JOL judgments accompanying the reduction in OCD symptoms. This particularly supports the perspective that the central cognitive variables in OCD are metacognition and metamemory.

4.3 Effects of CBT on Memory and Reaction Time in OCD

The findings regarding memory problems in OCD in the literature are contradictory (Woods et al., 2002). In some of the previous studies, it has been found that individuals with OCD have lower memory performance (Exner et al., 2009; Segalàs et al., 2008; Woods et al., 2002; Deckerbars et al., 2000; Savage et al., 2000; Sher, Mann, & Frost, 1984). It has been claimed that the memory problem observed in individuals with OCD may lead to controlling behavior (Exner et al., 2009). On the other hand, some prior research findings have indicated that, despite the absence of memory impairments among individuals diagnosed with OCD, they exhibit high levels of doubt, diminished confidence in their memory abilities, and reduced metamemory judgments (e.g., Nedeljkovic & Kyrios, 2007; Olson et al., 2016; Savage et al., 2006 Macdonald et al., 1997). These studies, however, have attributed the source of the control behavior observed in individuals with OCD to lower confidence in memory rather than low memory performance (Macdonald et al., 1997). The reason for these contradictory findings may be the heterogeneity of OCD itself. OCD is a complex disorder with diverse symptom presentations and underlying neurobiological mechanisms (Abramovitch et al., 2011). The variability in symptom severity, symptom dimensions, and cognitive profiles among individuals with OCD can influence memory performance. For example, individuals with predominantly obsessions may exhibit different memory profiles compared to those with predominantly compulsions.

Our data has demonstrated that there is no impairment in memory performance among individuals with OCD. The number of remembered items for unfamiliar stimuli is lower in the OCD group compared to familiar ones. However, since a similar situation is also observed in HCs, it can be interpreted that familiarity does not have a significant effect on the recognition performance of individuals with OCD. This finding further supports the idea that the primary issue in individuals with OCD lies at the metacognitive level rather than being primarily related to memory. After CBT, there was no observed improvement in memory performance compared to before CBT; however, considering the reduction in symptom severity, it can be interpreted that this improvement is not related to memory but rather linked to an increase in metacognitive judgments.

Prior to CBT, although the OCD group did not exhibit differentiation in RTs for correct answers, their RTs were significantly slower for incorrect answers. However, after CBT, both correct and incorrect answers from the OCD group were faster than those of HCs. Furthermore, in comparison to pre-CBT performance, a significant decrease in RTs was observed in the OCD group's responses. The improvement in RTs after CBT could potentially be associated with the reductions observed in anxiety scores post-CBT. Rueppel et al. (2021) found that reaction times of individuals with anxiety disorders increased following incorrect responses. In this context, the prolonged reaction times observed in individuals with comorbid conditions, such as OCD, might be anticipated. Additionally, considering the significant improvement in anxiety scores within the OCD group after CBT, it raises the possibility that this improvement could contribute to the observed enhancement in reaction times. Furthermore, it is likely that this improvement in reaction times is associated with an increase in JOL judgments within the OCD group after CBT, reflecting an enhancement in their confidence in memory. Individuals with OCD, previously underconfident in their memory performances, might have taken longer to respond due to this underconfidence. Now, with more consistent metacognitive judgments and increased confidence in their memory, their response times could have shortened.

4.4 Strengths and Limitations

Our study outcomes advanced the comprehension of episodic memory and metamemory processes in OCD. Firstly, by employing neutral stimuli in the verbal episodic memory task, the potential symptomatic effect of items on the OCD group was prevented. The utilization of stimuli unrelated to OCD symptoms allowed for a purer understanding of cognitive functioning within OCD. This is highly valuable for comprehending the fundamental issues in OCD and developing appropriate treatments. To the best of our knowledge, there is no other study in the existing literature that comprehensively investigates the efficacy of CBT in OCD with such a high number of participants, utilizing both clinical and cognitive measurements. In order to comprehend the impact of CBT on individuals with OCD, our study, employing both clinical and cognitive measurements, contributes to the field by

providing insights into the outcomes of the treatment. Furthermore, the findings in the existing literature regarding whether the fundamental issue in OCD is memory-related or linked to metacognitive processes were contradictory. Given the divergent outcomes, we examined how individuals with OCD differed from a control group before CBT. Due to the conflicting results, this was a subject that required further investigation. Furthermore, post-CBT examination of changes within the OCD group using both clinical and cognitive measurements has strengthened the validation of whether the core issue in individuals with OCD is related to memory or metacognitive processes.

Additionally, our research has some limitations. First, although strict inclusion and exclusion criteria were utilized in the study, there was an increase in the COVID-19 pandemic during the participant recruitment phase. This fluctuation during the pandemic may have led to changes in the characteristics of participants in both groups. The pandemic could potentially contribute to exacerbating symptoms in individuals with OCD or facilitating the emergence of new forms of obsessions, particularly for those without pre-existing concerns related to contamination or cleaning. Several studies have demonstrated that individuals with OCD have been disproportionately affected by the pandemic (Banerjee et al., 2020; Storch et al., 2020). The second limitation in this study is that, in addition to including OCD and HCs, it could have been beneficial to add another psychiatric group as a third group. By doing so, it would have been possible to eliminate the potential lack of specificity. Thirdly, the available selection of unfamiliar words in the database was more constrained compared to the range of familiar words. However, to prevent this limitation, a pilot study was conducted, resulting in the selection of all familiar and unfamiliar stimuli. Fourthly, as previously mentioned, this thesis focused on a small portion of a larger study. During the data collection for this thesis, participants were asked to complete clinical scales and engage in an experimental task that encompassed learning, recognition, JOL, and FOK measurements. These experimental tasks were conducted for word, face, and place stimuli. In this study, emphasis was placed solely on the experimental task involving word pairs, as well as the JOL and recognition stages. However, given that participants were required to complete both clinical measurements and the three experimental tasks, a fatigue effect might have been induced in the OCD group. Finally, the OCD group in our

study exhibited heterogeneity in terms of subtypes of OCD symptoms. These limitations should be taken into consideration and addressed in future studies.

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