

# Neuropsychological Profile of Childhood-Onset Obsessive-Compulsive Disorder

Metehan IRAK, Martine F. FLAMENT

## Abstract

*In this review paper, studies focusing on the neuropsychological characteristics of childhood-onset obsessive-compulsive disorder (OCD) were evaluated. Systematic electronic searches were undertaken using MEDLINE and Psycinfo databases (until June 2006). The presented results are of those that focus on the processes of attention, memory, and executive functions related to the aspects of the measured instruments used. The aim of this review was to provide a general neuropsychological profile of childhood-onset OCD based on the reviewed studies. In general, results showed that there is no clear evidence that the neuropsychological aspects of childhood-onset OCD differ from those of adult-onset OCD. In parallel with this, the processes of attention and memory in childhood-onset OCD are observed to be selective and biased, and this bias is directed towards threat-relevant stimuli related to obsessions and compulsions. In addition, dysfunction in memory and visuospatial processes in OCD patients do not result from memory impairment per se, but rather from an impaired ability to apply efficiently elaborated memory strategies. In childhood-onset OCD, the various lines of evidence consistently include impairment of response suppression and motor inhibition abilities; there is less consistent evidence for reduced set shifting, fluency, conceptual thinking, and planning ability. Whereas clinical observation suggests that a central problem in OCD is at the meta-memory level and that people with OCD have less meta-cognitive ability, processing of meta-cognition in childhood-onset OCD has not yet been investigated adequately. Finally, the results of the reviewed studies were evaluated in terms of the effects of basic co-morbidity, such as depression, Tourette's disorder, tic disorder, and other confounding variables.*

**Key Words:** Childhood-onset obsessive-compulsive disorder, attention, memory, executive functions

## Clinical Characteristics of Childhood-Onset OCD

Obsessive-compulsive disorder (OCD) is a psychiatric disorder characterized by repetitive obsessions and compulsions. It is chronic, but can be cyclic, significantly affecting an individual's social and daily functioning. Although OCD has been recognized as a disorder commonly observed in adulthood, studies have shown that the prevalence rate of OCD is 1%-4 % among adolescents (Douglass et al., 1995; Flament et al., 1988), with more than 80% of OCD patients reporting relevant symptoms starting before the age of 18 years (Pauls et al., 1995). OCD is often comorbid with other psychiatric disorders, namely depression, tic disorder, and other anxiety disorders. The onset of OCD has been observed earlier in boys than in girls, with behaviors reaching their peak approximately around pre-adolescence, and then

again in early adulthood (Pauls et al., 1995; Rasmussen and Eisen, 1992; Zohar, 1999). Adult- and childhood-onset OCD differ from each other in terms of certain clinical characteristics. Childhood-onset OCD, as opposed to adult-onset OCD, starts as early as adolescence and progresses rapidly. These differences lead to neurobiological and other related consequences (Sobin et al., 2000).

There have been numerous theoretical approaches about the etiological factors and treatment of OCD, including psychological and neurobiological explanations. Recently, cognitive-behavioral therapy (CBT) and pharmacological treatment approaches have been commonly used for the treatment of OCD. Although both of these treatment approaches are used for childhood-onset OCD, it is a common opinion that there is a

need for more research on the effectiveness and reliability of these treatment modalities (Flament and Cohen, 2002). On the other hand, research focusing on OCD suggests that neuropsychological approach/evaluation is becoming more common. Based on this, in the following paragraphs theoretical approaches and research findings focusing on the neuropsychological characteristics of OCD are discussed.

### **Neuropsychological Test Results in Childhood-Onset OCD**

Today, the existence of many neuropsychological tests with advanced psychometric characteristics, which are sensitive to detailed brain functioning, makes it possible for neuropsychological tests to be taken by patient groups, to be performed on one dimension, and to be score-based. With these particular characteristics, neuropsychological testing and evaluation, like in other psychiatric disorder groups, are part of the research approach focusing on cognitive processes in OCD. We reviewed studies on the neuropsychological performance of childhood-onset OCD patients and present an evaluation of the results. With this purpose in mind, a literature search was performed using both MedLine and PsycInfo databases encompassing studies dated until June 2006. This study included research investigating the neuropsychological performance of 0 to 19 year-old OCD patients, and did not directly investigate the effects of any treatment methods (pharmacotherapy and/or psychotherapy) on their effects on cognitive performance. The keywords used in the literature search were as follows: OCD, neuropsychology, cognition, attention, memory, executive functions, information processing, meta-cognition, and meta-memory. As a result of the literature search, 6 studies focusing on the relevant issues were found and are presented in Table I. Among these studies, only the study by Gladstone et al. (1993) was published as a summary in a conference, and details of this study were taken from the review article by Cox (1997). Findings are presented under attention, memory, and executive function subheadings, respectively.

#### **Attention**

In one of the first studies in this area, Foa and McNally (1986) found that in a dichotic listening task, adult OCD patients understood or noticed threat-related words better than they did neutral words. The difficulties experienced during cognitive performance are suggested to be closely related to anxiety, leading to disruptive effects and interfering thoughts prohibiting

fluency during cognitive processing, and occupying consciousness (Eysenck, 1997; Gotlib et al., 1996). When cognitive functioning in OCD is in question, OCD patients are said to not display any problems with attention performance. Consequently, the more commonly accepted approach suggests that these patients have selective attention tendencies; defined as paying attention to selective characteristics of stimuli in the environment and not paying attention to or ignoring the remainder of the stimuli (Diniz et al., 2004; Kuelz et al., 2004; Moritz et al., 2004).

Many of the studies which have studied various aspects of attention performance in childhood-onset OCD, have reported that it is less of a factor in adult OCD patients. In a study by Cox et al. (1989), the neuropsychological performance of 8 to 18 year-old OCD patients was compared to that of a healthy control group matched in terms of age, sex, and hand preference (Table 1). In terms of attention performance, the only difference found between the two groups was in their dichotic listening task total linear scores; the total linear percentage of the OCD group was lower than the healthy control group. Similarly, in a study by Gladstone et al. (1993) 8 to 13 year-old children with Tourette's disorder (TD) were matched for age, sex, and intelligence quotient (IQ) with children diagnosed with OCD, and their neuropsychological performances were compared. Results showed that the sustained attention performance in both groups was lower than normative values (Cox, 1997). The authors interpreted the results as attention being disrupted in OCD and TD (Gladstone et al., 1993).

In a study by Behar et al. (1984) the neuropsychological test performance of OCD patients (mean age: 13.7 years) who were receiving a 10-week clomipramine treatment were compared to a healthy control group matched for age, gender, and IQ. Additionally, the sizes of their cerebral ventricles were measured with CT (computer tomography). According to the CT results, cerebral ventricles of the OCD patients were significantly larger than those of the healthy control group. Although in some memory tests the OCD group scored significantly lower (Table I) than controls, there was no significant difference between the scores of attention and perception tests between the two groups. More specifically, although the scores of the Dihaptic (Tactual) Testing, Reaction Time, and Two-Flash Threshold Test were in favor of the healthy control group, the differences between the two groups were not found to be statistically significant. As the reaction time and reaction threshold scores were not significantly different, the authors suggested that the

**Table I.** General characteristics and results of studies that investigated the neuropsychological characteristics of childhood-onset OCD.

| Study (Year)           | Participants                                                                                                        | Matching & Exclusion Criteria                                                                                                                                               | Tests Used                                                                                                                                                                                                                              | Significant Differences between Groups                                                                                                                                                                                                                           | Comments                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------------|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Behar et al. (1984)    | OCD group, n = 17 (14M, 3F)<br>Age = 13.7 ± 1.6<br>AO: 2-14 years                                                   | Age ( ± 1 year), sex, race, hand preference<br>Total IQ > 85 ( ± 15) &<br>Behavior or learning difficulty, family history of psychiatric disorders, significant head injury | Money Direction Sense<br>Road Map<br>Stylus Maze Learning<br>ROCFT<br>Rey Vocabulary List Learning<br>Touch Sense Test (Diphatic)<br>Reaction Time and Two-Flash Threshold Task                                                         | Away and toward errors scores<br>High error rates, more frequent rule breaking<br>Copying<br>-<br>-<br>-                                                                                                                                                         | - Significant differences are in favor of the control group.<br>- Clinical group received a 10-week clomipramine treatment<br>- There was no significant relation between the low neuropsychological test results and the obsession type.                                                                                                                                                            |
| Cox et al. (1989)      | OCD group, n = 42 (30M, 12F)<br>Age = 8-18 (14 ± 2.7)<br>AO: -<br><br>CG, n = 35 (26M, 9F)<br>Age = 8-18 (14 ± 2.6) | Gender, age, hand preference, verbal and performance IQ > 85 &<br>Psychotic symptoms, primary depression, neurological problem                                              | Stylus Maze Learning<br>WCST<br>Money Direction Sense<br>Road Map<br>Visual recognition threshold for words and patterns<br>ROCFT<br>Rey Audiovisual Learning Test<br>Listening task: monolithic and dichotic<br>Diphatic encoding task | Route and Rule-breaking Errors<br>Consecutive correct sorting<br>Correct moves, setting directions by groups<br>Words, shapes<br>Copying, Error rate<br>Total over 5 trials, Trials by groups<br>Total correct scores for dichotic listening<br>Correct response | - Significant differences are in favor of the control group.<br>- Patient group's medication usage was not specified.<br>- There is a significant difference between the Performance and Verbal IQ (OCD > Control)<br>- Scores of both groups are close to each other except WCST, Maze learning and ROCFT.<br>- Group differences were not found to be associated with the OCD symptoms's severity. |
| -Flament et al. (1990) | OCD group n = 27 (18M, 9F)<br>Age = 10-18<br>AO: 10.3 ± 3.7<br><br>CG, n = 29 (21M, 8F)<br>Age = 10-17              | Age, gender, IQ > 80+, symptom duration > 1 year &<br>Physical illness, organic mental disorder, psychotic disorder or primary emotional disorder                           | Money Direction Sense<br>Road Map<br>Stylus Maze Learning                                                                                                                                                                               | Away and toward, and total scores<br>Errors, crossovers, combined score                                                                                                                                                                                          | - Significant differences are in favor of the control group.<br>- In the follow-up study the test performance of the OCD group increased significantly.<br>- 19 of the patients in the follow-up study received clomipramine treatment for five weeks.<br>- Low performance scores in neuropsychological tests were not associated with symptom severity in both measures.                           |

lower scores of the OCD patients on some neuropsychological tests could not be explained by an attention problem or by obsessive style. In summary, the findings on attention indicate that in childhood-onset OCD, as in the adult group, there is a bias in attention processing. However, as there are only a few studies on attention and the variation of the basic characteristics measured by the applied tests, it was not possible to create a general profile on this topic.

## Memory

Aspects of the behaviour seen in people with OCD (e.g., checking) are certainly suggestive of memory problems (e.g., failure to appropriately encode memories for self-actions). For example, a problem such as checking might indicate that the individual is either unable to code his or her behavior in memory in a suitable way or that he or she cannot remember it. Although there are approaches suggesting a malfunction in the reality

**Table 1.** Continued.

| Study (Year)            | Participants                                                               | Matching & Exclusion Criteria                                                                                                                                                                                         | Tests Used                                                         | Significant Differences between Groups                       | Comments                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bornstein (1991)        | TD group (Low OCD)<br>n = 62<br>Age = 6-18 (12.21 ± 2.9)<br>AO: 5.7 ± 2.5  | - There are no significant group differences in age, gender, education level, and symptoms duration.<br>- Lower OCD group has significantly lower age of onset.<br>- High OCD group has significantly lower Total IQ. | WCST                                                               | Number of completed categories and perseverative error score | - Significant group differences are in favor of low OCD group.<br>- Almost 50% of all patients received pharmacotherapy and this percentage is significantly higher in high OCD group.<br>- Groups are determined by taking 70 as cut off point in TD Control List.                                                                                            |
|                         | TD group (High OCD)<br>n = 38<br>Age = 6-18 (12.71 ± 2.9)<br>AO: 5.7 ± 2.5 |                                                                                                                                                                                                                       | Halstead-Reitan Test Battery                                       | -                                                            |                                                                                                                                                                                                                                                                                                                                                                |
| Gladstone et al. (1993) | OCD group<br>n = 12<br>Age = 8-13<br>AO: -                                 | Age, gender, and IQ                                                                                                                                                                                                   | WCST                                                               | -                                                            | Low performance in drawing simple and complex designs                                                                                                                                                                                                                                                                                                          |
|                         | TD group<br>n = 12<br>Age = 8-13<br>AO: -                                  |                                                                                                                                                                                                                       | Rey Audiovisual Learning Test<br><br>Vocabulary list learning task | -                                                            |                                                                                                                                                                                                                                                                                                                                                                |
| Beers et al. (1999)     | OCD group,<br>n = 21 (12M, 9F)<br>Age = 12.3 ± 2.9<br>AO: 8.9              | Age, gender, SES and IQ &<br>Psychiatric or neurological disorder except OCD; for the CG psychotic or affective disorder in first degree relatives                                                                    | Stroop                                                             | Vocabulary reading and color naming scores                   | - Significant differences are in favor of the OCD group.<br>- There were no group differences in age, gender, SES, WISC-3 Vocabulary and hand preference<br>- There were no significant correlations among neuropsychological measures, clinical test scores, age of onset, and duration of illness.<br>- There is no medication history in the patient group. |
|                         |                                                                            |                                                                                                                                                                                                                       | WCST                                                               | -                                                            |                                                                                                                                                                                                                                                                                                                                                                |
|                         | CG<br>n = 21 (12M, 9F)<br>Age = 12.2 ± 2.9                                 |                                                                                                                                                                                                                       | Controlled Oral Word Association Test                              | Total score                                                  |                                                                                                                                                                                                                                                                                                                                                                |
|                         |                                                                            |                                                                                                                                                                                                                       | Hanoi Tower                                                        | -                                                            |                                                                                                                                                                                                                                                                                                                                                                |
|                         |                                                                            |                                                                                                                                                                                                                       | Go/No-go Test                                                      | B subtest                                                    |                                                                                                                                                                                                                                                                                                                                                                |
|                         |                                                                            |                                                                                                                                                                                                                       | California Verbal Learning Test                                    | -                                                            |                                                                                                                                                                                                                                                                                                                                                                |
|                         |                                                                            |                                                                                                                                                                                                                       | Grooved Pegboard Test                                              | -                                                            |                                                                                                                                                                                                                                                                                                                                                                |
|                         |                                                                            |                                                                                                                                                                                                                       | WISC-3                                                             | -                                                            |                                                                                                                                                                                                                                                                                                                                                                |

CG: Control group; AO: Age of Onset; WCST: Wisconsin Card Sorting Test; ROCFT: Rey-Osterrieth Complex Figure Test; TD: Tourette's Disorder; IQ: Intelligence Quotient.

checking and memory performance of OCD patients (Constans et al., 1995; Hermans et al. 2003), the results of some studies do not support this. In a larger number of studies (Ceschi et al., 2003; MacDonald et al., 1997; Tolin et al., 2001) no difference was found between various memory performances of OCD patients and the healthy control group. Consequently, some studies have found that the memory performance of OCD patients is diminished when compared to a healthy control group (Savage et al., 2000; Tallis et al., 1999; Tuna et al., 2005; Zitterl et al., 2001), and that the memory performance related to threat-relevant stimuli is higher in OCD pa-

tients than in a healthy control group (Constans et al., 1995; Randsmsky and Rachman, 1999; Randsmsky et al., 2001).

In a study performed by Flament et al. (1990), the neuropsychological performance of 10 to 18 year-old OCD patients who received a 5-week clomipramine treatment was measured before and after the treatment (2-7 years) and was then compared to a healthy control group. The OCD group was observed to have made numerous mistakes in The Money Road Map Test of Directional Sense, especially in tasks in which the position was expected to be turned towards the right direction

or the opposite direction. In the Stylus Maze learning task, OCD patients were found to have elevated error rates during the task, and tended to brake more rules when compared to the healthy control group. Although, in a follow-up study, an increase in the performance of OCD patients on both tests were found, and the previously-mentioned error rates were in favor of the control group. Additionally, the low performance scores in the neuropsychological tests were not related to symptom severity in either of the measurements. The Money Road Map Test of Directional Sense is a test that measures basic visual-spatial perception ability, such as mentally representing objects and their respective positions in space, and transforming them if necessary (Zacks et al., 2000). The Stylus Maze learning task on the other hand, is a test sensitive to right temporal lobe functioning, and measures learning and visual-spatial perception ability. Results of this study, taking what both of the tests measure into account, suggest a problem in visual-spatial perception/memory functioning in OCD.

These results obtained from the Flament et al. (1990) study are similar to the results obtained from Behar et al. (1984). As mentioned before, the clinical group was found to have larger ventricles, and no difference was found between the the groups on both their attention and perception test results. However, in both of the studies, the OCD group performed lower than the control group in some memory scores. The results showed that the away, toward, and combined scores on The Money's Road Map Test of Directional Sense, the error rate and rule breaking on the Stylus Maze Learning Task , and copying scores on the Rey-Osterrieth Complex Design Test were all significantly different and favored the healthy control group. The authors suggest that there is not enough evidence yet to explain this difference and noted a high level of depression in the OCD group as a confounding variable. The negative effect depression severity, especially on the memory and learning process of information processing (Eysenck, 1997; Gotlib, et al., 1996), supports this explanation. On the other hand, clinical-level depression is a comorbid diagnosis often reported by OCD patients. Nonetheless, in the studies summarized above, the significantly low cognitive performance levels in the OCD group were not associated with OCD symptom severity or with other clinical measures, such as depression.

In contrast, in a study by Gladstone et al. (1993), although the subjects in the OCD group had no problem in learning and recall performance with the vocabulary list task, their performance scores on drawing

both simple geometric designs and a complex figure was significantly lower than the normative scores. This low level of performance was observed more in remembering complex figures. In spite of these results, the authors argued that the OCD patients' normal performance on the vocabulary learning and recall task, and their low performance on the drawing simple and complex figure test are not sufficient enough to be able to differentiate if these results are due to a memory deficit or if there is a disability in visual-spatial processing during copying (Cox, 1997). However, the authors interpreted these results as a disability in visuospatial/constructional deficit in OCD and TD (Gladstone et al., 1993). This interpretation is consistent with the findings of Flament et al. (1990), which suggest a problem in visual-spatial memory/perception ability in OCD patients.

In summary, the findings regarding memory do not suggest a memory malfunction in OCD. The findings do, however, indicate a different functioning in memory performance and visual-spatial perception ability, which is not as functional, when compared to a healthy control group. Studies in support of and those that do not support a memory problem in OCD are relatively balanced and this dilemma in memory performance might be explained by a process prior to memory, such as attention. Thus, selective and biased functioning during the attention process seems to lead to related memory bias functioning and visual-spatial perception.

### **Executive Functions**

The idea that there is little evidence that supports either memory or attention problems in OCD, and that OCD patients have a memory and attention bias, leads one to think that the source of this bias might be a meta-cognitive system problem. As a matter of fact, there are many studies (Cox 1997; Kuelz, et al., 2004; Moritz, et al., 2002; Otto, 1992) suggesting a problem in executive functions in OCD patients. Executive functions are used to define high-level cognitive functioning. More specifically, executive functions refer to 'higher-order cognitive functions', such as volition, planning, self-regulation, maintenance of cognitive set and set-shifting ability, goal directed behaviours, sustained attention, impulse control, motor inhibition, and working memory (Lezak, 1995; Spreen and Strauss, 1998). These high level functions enable the coordination and integration of basic lower level cognitive functioning. In general, executive functions are associated with the frontal lobe.

Set shifting, planning, and perseveration are the most

commonly studied executive function deficits in OCD. Studies done in this area (Abbruzzese et al., 1997; Bohne et al., 2005; Cavedini et al., 1998; Morritz et al., 2001; Rowe et al., 2001; Spitznagel and Suhr, 2002) found that adult OCD patients' executive function scores were lower than in healthy controls. On the other hand, different studies investigating the same executive functions found that the performances of the OCD patient and control group were not always the same. Kuelz et al. (2004), noting these differences in the results, suggested that insufficient matching, in terms of education level, co-morbidity, and medication use, might cause these differences.

In a study performed by Bornstein (1991), the neuropsychological test performance of 100 OCD and TD patients aged 6 to 18 years, including low and high symptom severity OCD groups, were compared using the Wisconsin Card Sorting Test (WCST) and Halstead-Reitan Test Battery. Results indicated that the only significant differences were for the number of categories completed and perseverative error scores, with the differences in favor of the OCD group with low symptom severity. On the other hand, no significant group differences were found in any of the Halstead-Reitan Test Battery scores (Broshek and Jaffrey, 2000) measuring various executive functions, such as memory, abstract thinking, language, sensorimotor integration, imperceptions, and motor abilities. In spite of the fact that the high symptom severity OCD group had a higher rate of medication use, no significant effect was found on the neuropsychological scores. Additionally, the results of the variance analysis showed a significant effect of both duration of illness and symptom severity on the number of completed categories and the perseverative error scores on the WCST. This suggested that the low WCST scores could be explained by the OCD symptoms being more severe in this group. Conversely, there were significant negative correlations between the degree of OCD severity, Wechsler Total IQ, number of completed categories, and perseverative error scores of the WCST. These correlations did not change when the results of partial correlation analyses were obtained, controlling for total IQ and symptom severity (according to the TD Symptom List). These results also support the view that the low WCST scores could be explained by OCD symptom severity. Finally, focusing on the increased number of perseverative errors, it was hypothesized that the obsessive characteristics (alone or observed with TD) could be related to weak frontal lobe functioning, especially in the orbitofrontal and dorsolateral frontal areas which contain the

caudate nucleus (Bornstein, 1991). As a criticism of this interpretation, the only difference between the groups was in the perseveration scores of the WCST, a result that weakens the interpretation. The neurophysiology of OCD corresponds to the neural network, including the orbital cortex, caudate, and thalamus; however, in the relevant paper it is noted that the TD-related primary brain areas are the basal ganglia. Although there are neuroanatomical studies pointing to an association between the basal ganglia and frontal lobe (DeLong et al., 1983; Schel and Strick, 1984), there is a need for brain observation studies and neuropsychological test results supporting a functional relationship between these areas.

Beers et al. (1999) studied the neuropsychological test performance of 21 childhood-onset OCD patients (mean age: 12.3 years) that did not receive any pharmacological treatment, and compared the results to those of a healthy control group matched for age, gender, intelligence, and socioeconomic status (SES). Results suggested that there were significant differences in Stroop's word and color naming, Controlled Oral Word Association Test total score, and Go/No-Go Task B subtest scores, with those differences being in favor of the OCD group. For all other tests, no significant group differences were found. These results were the opposite of the expected results and they were explained by the patient group not being clinically depressed and not having used any medication until the time of the study. In other words, in the Beers et al. (1999) study, no cognitive dysfunction was observed in childhood-onset OCD patients who were not depressive, who were diagnosed early, and who did not receive any medication treatment. Subsequently, some of the neuropsychological test performance scores of this group were found to be higher than in the healthy control group. The results of this study suggest the importance of co-morbidity as a major confounding variable in studies investigating cognitive functioning in OCD. The fact that depression commonly accompanies OCD and, as mentioned previously, depression affects cognitive processes negatively (Eysenck, 1997; Gotlib et al., 1996), we can conclude that these notions support this approach. Additionally in both studies (Cox et al., 1989; Flament et al., 1990) there was no significant association between neuropsychological measures and the severity of OCD symptoms. Moreover, there was no mentioning of a relationship with other clinical observations. Yet, the relationship between the level of depression and neuropsychological and cognitive measures was not investigated in any of the reviewed studies. This fact is considered to be a common weakness of studies investigating

cognitive performance in childhood-onset OCD. Some authors, based on results with the adult group, considered that the neuropsychological tests used might not have been sensitive enough to measure the functioning of the fronto-striatal loop, which is the main structure involved in OCD, and suggested that the problems in cognitive functioning observed in OCD might develop at later stages of the disorder. This situation leads to a new research question. A longitudinal or cross-sectional study investigating how the cognitive processes in OCD are affected would answer many significant questions in this area.

In a study by Gladstone et al. (1994), the WCST scores of the TD and OCD groups did not differ from normative values. On the other hand both groups performed significantly lower in the continuous performance test regarding eliminating the incorrect responses (Cox, 1997). In relevant studies it was unclear through which test or task this performance was measured: however, the mentioned performance, the elimination of irrelevant stimuli, is among the executive functions discussed in previous sections. As a matter of fact, although no difference was found in WCST scores, the authors interpreted the significant decrease in eliminating incorrect responses performance as a malfunction of the executive functioning in OCD and TD (Gladstone et al., 1993). In conclusion, in spite of the fact that results of the studies investigating executive functioning in childhood-onset OCD are inconsistent, the OCD patients demonstrated a lower performance in some executive functioning tasks (i.e., response suppression and motor inhibition) and research findings on other executive functions are also inconclusive.

## CONCLUSION

In this paper, studies investigating the neuropsychological characteristics of childhood-onset OCD were evaluated. Relevant evaluations were presented under the subheadings of cognitive processes, such as attention, memory, and executive functions. Accordingly, results of studies of childhood-onset OCD support that memory and attention are not dysfunctional in OCD, but that there is biased or selective memory and attention functioning in OCD. The mentioned bias of memory and attention was observed to be directed at anxiety provoking or threat-relevant stimuli related to obsessions and/or compulsions. Taking this into consideration, childhood-onset OCD patients differed from healthy control groups in terms of selective memory and

attention bias related to these stimuli. The present findings did not demonstrate that these biases were different in childhood-onset OCD than in adult-onset OCD or that specifically related with this age group. Basic factors, such as the various neuropsychological tests being used or the variety of the sampling groups, limit the validity of such an interpretation. Also, as mentioned in previous sections, attention plays a major role in memory when it is a matter of information processing. When we consider attention and memory functioning together in OCD, we can say that biased attention leads to biased memory. Nevertheless, the question of how the mentioned bias changes according to the kind of memory and attention, still remains to be answered. Clinical observations show that the memory bias is a working memory problem; however, this needs to be supported with additional studies. With this in mind, a detailed analysis of the relationship between attention and memory processes in childhood-onset OCD, focusing on various attention and memory tasks, would help answer many questions on this topic.

General results of the studies investigating executive functions demonstrated that childhood-onset OCD patients, in comparison to healthy controls, performed significantly lower in the executive functions of response suppression and motor inhibition. However, there are conflicting results in the studies of other executive functioning, such as perseveration, set shifting, and fluency. These conflicts are also observed in the results of adult-onset OCD patients, as well. As presented in previous sections, a general finding is that OCD groups, as compared to the healthy controls, performed lower on tests (e.g. OAT, DAT) measuring the functioning of the orbitofrontal area and executive functions, such as set shifting and fluency. However, these findings do not contribute to create a general profile, as there are basic confounding variables, such as the variance in the study groups. Additionally, these executive function tests which were used in the studies of childhood-onset and adult-onset OCD are different. As a result, it is not possible to compare adult- and childhood-onset OCD based on these findings. Studies using neuropsychological tests, which include OAT and DAT, and that measure different aspects of executive functioning would be significantly helpful in enlightening many questions regarding executive functioning in childhood-onset OCD.

Clinical observations of OCD indicate that the basic problem is at the meta-cognitive level. For example, the fact that the trust on memory performance, which is a type of meta-cognitive function, is lower in the OCD

group than in the control group is a common finding in these type of studies. On the other hand, studies on meta-cognition in childhood-onset OCD are almost non-existent. When the information processing models in normal groups are considered, we see that meta-cognition (as a high-level system), in addition to controlling, organizing, and managing information processing also plays a role in the transition among subsystems (Nelson and Narens, 1990). In contemporary information-processing models on memory and executive functioning, meta-cognition is seen to play a complementary

and integrative role. Moreover, it is suggested that using various experimental tasks that measure different aspects of meta-cognition will play a key role in understanding information processes in OCD. There is a need for new findings and sub-models for investigating the transitions among attention, memory, and executive functioning in childhood-onset OCD. Along with this, the models developed for investigating cognitive and neuropsychological processes in childhood-onset OCD need to be tested with new research designs that include meta-cognitive processes.

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