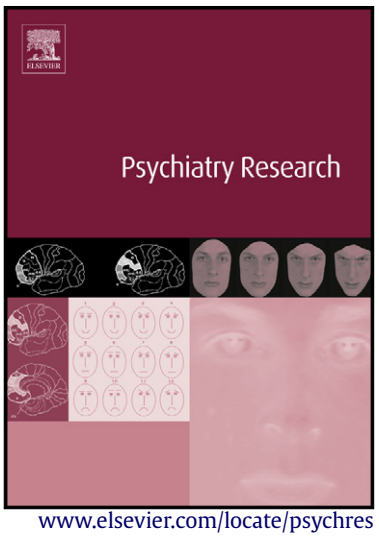

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Two types of impairments in OCD: obsessions, as problems of thought suppression; compulsions, as behavioral-executive impairment

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Abstract

Impairments in executive functioning have been identified as an underlying cause of obsessive-compulsive disorder (OCD). Obsessive patients attempt to suppress certain unwanted thoughts through a mechanism that Wegner referred to as 'chronic thought suppression', whereas compulsive patients are unable to inhibit their rituals. We tested 51 OCD patients using the Yale-Brown Obsessive Compulsive Scale (Y-BOCS), the White Bear Suppression Inventory (WBSI) and the Dysexecutive Questionnaire (DEX). Executive functions were tested using a cognitive test battery. We found that the total WBSI score was correlated with the Y-BOCS obsessive score but not with the Y-BOCS compulsive score. A stronger correlation was observed between the Y-BOCS obsessive score and the 'unwanted intrusive thoughts' factor based on Blumberg's 3-factor model of the WBSI. The total WBSI score was not correlated with the cognitive test results. The DEX score was significantly correlated with the Y-BOCS compulsive score; however, no correlation was found between the DEX score and the Y-BOCS obsessive score. A stronger correlation was observed between the Y-BOCS compulsive score and the 'inhibition' component of the DEX score, as defined by Burgess's 5-factor model. The DEX scores were correlated with cognitive test results measuring attention, cognitive flexibility and inhibitory processes. We conclude that obsessions indicate a failure of cognitive inhibition but do not involve significant impairment of executive functions, whereas compulsions indicate ineffective behavior inhibition and impaired executive functions.

Key words: OCD, dysexecutive syndrome, DEX, thought suppression, WBSI.

Two types of impairments in OCD: obsessions, as problems of thought suppression; compulsions, as behavioral-executive impairment

1. Introduction

Obsessions and compulsions are characteristic symptoms of obsessive-compulsive disorder (OCD). Obsessions are intrusive, unwanted thoughts or images that patients are unable to ignore or block. Additionally, OCD patients tend to perform compulsions, which are perseverative behaviors or rituals that they are unable to interrupt or stop. Executive dysfunction is assumed to underlie both symptoms (Kueltz et al., 2004).

1.1. The dysexecutive syndrome and the Dysexecutive Questionnaire (DEX)

Adequate frontal lobe functioning is necessary for efficient executive functioning. According to Norman and Shallice's classification, executive functions are required in situations where routine activation of behavior would not be sufficient for optimal performance (Norman and Shallice, 1980). The significance of failure of inhibitory functions in dysexecutive syndrome was proposed by several research groups beginning in the early 1980s (Shimura, 1995, Burgess 1997). Prior research has revealed that dysexecutive symptoms can be identified not only in patients with brain injury, but also in those with psychiatric diseases like schizophrenia, depression and OCD (Evan et al., 1997, Tibbo and Warneke, 1999, Cavanagh et al., 2002).

Several validated cognitive tests and questionnaires are available to assess frontal lobe functioning, together with BADS (Behavioral Assessment of the Dysexecutive Syndrome) which is a cognitive test battery that includes the DEX questionnaire. The DEX is a standardized instrument to measure behavioral changes as a result of dysexecutive syndrome. The DEX measures dysexecutive symptoms at the behavioral level and is particularly designed to assess errors in goal-directed behaviors that occur during everyday life (Burgess, 1998). Several research groups have attempted to identify different factors of the DEX through factor analysis (Burgess et al., 1998, Chan et al., 2001, Amieva et al., 2003, Chaytor et al., 2006, Perez et al., 2009). Although researchers have identified different factors (or dimensions) of the DEX, one common factor can be identified in all dimensional approaches, namely, the impairment of inhibitory functions. The BADS/DEX test battery proved to be valid not only in patients with brain injuries but also in patients with psychiatric diseases such as schizophrenia (Evan et al., 1997), schizotype personality disorder (Law et al., 2008), bipolar affective disorder (Cavanagh et al., 2002) and Asperger syndrome (Cederlund et al., 2010). To the best of our knowledge, however, the DEX questionnaire has not yet been used to study the dysexecutive symptoms in OCD.

1.2. The failures of cognitive and behavioral inhibitory processes in OCD

The failure of inhibitory processes has been theorized to occur in OCD by many researchers, although the term 'inhibition' has been used to signify various different features of distinct aspects of OCD (see Table 1). Chamberlain et al. (2005) emphasized the importance of failures of cognitive and behavioral inhibitory processes in OCD. These

researchers identified two different failures of inhibitory processes in OCD, namely, a failure of cognitive inhibition that primarily relates to obsessive symptoms and a failure in behavior inhibition that is linked to compulsions. The authors hypothesize that these two failures in inhibitory processes are associated with distinct neural pathways and different cognitive dysfunctions. In a subsequent study, Chamberlain et al. (2006) specifically investigated the dysfunction of motor inhibitory control and cognitive flexibility, as this dysfunction has been theorized to be a central characteristic of OCD. Executive motor inhibition impairment can be measured by cognitive assessments, such as the Go/No-go Task, the Stroop Test and the Stop Signal Task. According to the psychometric analysis of Friedman and Miyake (2004), the Stroop test and the Stop Signal Task utilize the same component of the executive inhibitory control system, namely, prepotent response inhibition. The failure of executive cognitive flexibility is correlated with attentional set-shifting disturbance, which can be detected with assessments such as the WCST, the TMT (Trial Making Test), or the Intradimensional/Extradimensional Shift Task (Kueltz et al., 2004, Chamberlain et al., 2006). Chamberlain et al. (2006) investigated motor inhibition using the Stop Signal Task and evaluated cognitive flexibility using the Intradimensional / Extradimensional Shift Task. Impairments in the intentional inhibition of simple motor actions have been demonstrated in OCD patients. Moreover, the impaired inhibition of simple motor responses has also been detected in unaffected first-degree relatives of OCD patients (Chamberlain et al. 2007), which has led to the proposal that response inhibition deficits may provide a useful intermediate marker of brain dysfunction, that is, that these deficits could represent an endophenotype for OCD. Recently, Morein-Zamir et al. used the Thought Stop Signal Task (TSST) to investigate whether the impaired stopping/suppression observed in OCD patients could extend to the inhibition of ongoing thoughts as well (Morein-Zamir et al., 2010).

1.3 Wegner's theory of cognitive inhibition of thoughts and thought suppression: the White Bear Suppression Inventory (WBSI)

The clinical presentation of OCD has driven researchers to investigate the integrity of controlled memory processes and executive functions in this disorder (Heuvel et al., 2005). Wegner et al. investigated memory inhibition processes using a paradigm in which thought suppression was required, i.e., by instructing participants, 'Do not think of a white bear!' (Wegner and Zanakos, 1994). Compared to those who had not used suppression, there was evidence for unwanted thoughts being immediately enhanced during suppression and, furthermore, for a higher frequency of target thoughts during the second stage, called rebound effect (Wegner, 1989). Thought suppression has paradoxical effects because it may cause the suppressed thought to be deeply activated and highly accessible (Wenzlaff and Wegner, 2000). Wegner (1994) theorized that two concurrent systems are triggered when an individual attempts to avoid a particular act or thought. One of these systems is a conscious operating process, which searches for mental content consistent with the intended state until this search is destabilized by distractions. This operating process requires conscious effort, as it is a controlled (non-automatic) process. The other system of Wegner's theory is an implicit monitoring process, which is unconscious and searches for mental content that is inconsistent with the intended state and the achievement of successful control. The operating process requires greater cognitive capacity than the

monitoring process. When the operating process is voluntarily terminated, the monitoring process continues its vigilance for unwanted thoughts. This 'online' monitoring process increases the mind's sensitivity to unwanted material, a phenomenon that can explain the occurrence of post-suppression rebound and the ironic aspects of thought suppression (Wegner 1994, Wenzlaff and Wegner 2000).

Wegner et al. (1987) concluded that certain individuals frequently use thought suppression as a coping mechanism. These investigators called this cognitive inhibition mechanism 'chronic thought suppression' and hypothesized that chronic thought suppression is of outstanding significance in OCD patients. To enable researchers to identify people who are more prone to suppressing thoughts in their daily lives, Wegner and Zanakos (1994) constructed a measure of chronic thought suppression, the White Bear Suppression Inventory (WBSI),which they validated by administering the WBSI to healthy subjects, patients with OCD and patients with depression. The WBSI scores correlated strongly with obsessive scores but were less strongly correlated with compulsive scores. Wegner (1994) thought, that 'thought suppression does not predict compulsive behavior because the two are alternative means of coping with unwanted thoughts. It may be too, that engaging in behaviors that are intended to neutralize unwanted thoughts or solve the problems such thought represent somehow undermines the individual's tendency to self-report attempting to suppress those thoughts.' In a subsequent study, Muris et al. demonstrated that a greater rebound effect of unwanted intrusive thoughts following a thought suppression task was reported by participants with high WBSI scores than by participants with low WBSI scores (Muris et al., 1996). Originally, Wegner and Zanakos published the WBSI as a unidimensional construct; however, the test contains questions related to both intrusive thoughts and thought suppression tendencies. The broad scope of the WBSI can simultaneously serve as both an advantage and a disadvantage of this assessment technique. Therefore, to facilitate more detailed analyses of WBSI results, Höping et al. demonstrated that the WBSI can be decomposed into two factors, namely, unwanted intrusive thoughts and thought suppression. By separating thought intrusions from thought suppression, researchers can conduct differential assessments of these constructs, which may prove to be an important aspect of analyzing WBSI results (Höping and Jong-Meyer, 2003). Blumber et al. collected WBSI data from 935 healthy subjects to examine the WBSI factor structure and identified the following 3 WBSI factors: unwanted intrusive thought, thought suppression and self-distraction (Blumberg et al., 2000) (see Table 2).

1.4. Intrusive thoughts and thought suppression in OCD.

The high rate of recurrence of inhibited ('censored') thoughts is of great significance in everyday clinical practice. The majority of the population experiences unwanted thoughts and images occasionally but can dismiss these undesired thoughts as harmless anomalies. By contrast, obsessions are thoughts that give rise to immediate resistance. Active resistance is a crucial feature of obsessions and is an important criterion for distinguishing obsessions from other types of persistent, negative and unwanted thoughts, which can arise from conditions such as depressive rumination or anxiety (Wenzlaff and Wegner, 2000). Thought suppression is an effortful activity that requires attentional resources and may therefore impair an individual's ability to concentrate on performing other tasks

(Wegner, 1994). Thought suppression renders an individual hypervigilant to thoughts and thought processes; as a result, thought triggers and thought traces are much more salient than normal for the individual in question and the inevitable thought recurrences that arise during the suppression process exacerbate the negative appraisal of the meanings of these thoughts (Purdon, 2004). Research on thought suppression in OCD has yielded inconsistent findings (Purdon 2004), but these findings do suggest that thought suppression efforts and their impact may contribute significantly to the severity of impairment associated with OCD; therefore, it may prove useful for clinical and research purposes to evaluate suppression as a potential severity indicator of OCD. (Purdon 2004, Magee et al., 2007). However, the existing measures of OCD symptoms and severity (the Padua Inventory, the Obsessive Compulsive Inventory, the Maudsley Obsessional Compulsive Inventory and the Yale-Brown Obsessive Compulsive Scale) do not directly evaluate suppression (Purdon et al., 2007). Therefore, drawing on the ideas of Purdon et al. (2007), we conjecture that the WBSI, which is a validated questionnaire for assessing both intrusive thoughts and thought suppression tendencies, may be a relevant measurement tool for completing the symptom severity scales that are used in OCD.

1.4. Aim of the study

In the present study, we defined two OCD subgroups based on the obsessive and compulsive subscores of the Y-BOCS symptom severity scale. For the assessment of cognitive functioning, validated cognitive tests of sustained attention, cognitive flexibility (set-shifting ability) and executive inhibition were used. We did not include any healthy controls in this study, as the present analysis focused on the characteristic differences between the predominantly obsessive and predominantly compulsive subgroups of OCD rather than on the differences between OCD patients and a healthy control group.

1. The aim of this study was to use the WBSI to assess the levels of intrusive thought occurrences and thought suppression tendencies in OCD patients and to use the DEX to evaluate the dysexecutive symptoms of these patients; the results of these questionnaires were related to executive functions in the OCD patients.

2. In the case of obsessions, it has been established that the core failure is ineffective cognitive inhibition (Chamberlain et al., 2005); therefore, we were interested in discovering whether 'chronic thought suppression', as measured by the WBSI, is typical of all OCD patients or whether this thought suppression is more apparent in patients with either only obsessive or only compulsive symptoms. Because the WBSI measures both components of thought suppression (namely, intrusive thoughts and thought suppression tendencies), we were particularly interested in Blumberg's dimensional approach, which can separate these two components. We were also interested in elucidating the relationship in OCD patients between thought suppression and executive functions, which were assessed by the aforementioned cognitive tests. In accordance with Wegner's (1994) theory, we hypothesized that obsessive thoughts in OCD are the consequence of an over-activated automatic monitoring system; this monitoring system does not require effortful activity and therefore should not produce a general executive deficit.

3. We theorized that a failure occurs in behavioral-executive inhibitory processes in the case of compulsions (Chamberlain et al., 2005). We were particularly interested in the correlations between the dysexecutive functions measured by the DEX and the Y-BOCS and the obsessive and compulsive subscales. In addition, we wished to discover the correlation between the cognitive test results and the dysexecutive functions measured by the DEX and the 5 individual factors of the DEX (following Burgess's dimensional approach). Because compulsions are conscious, effortful activity, we theorized, in accordance with Wegner's (1994) theory, that compulsions indicate a failure in conscious operating processes, which require significant cognitive capacity. This failure, in turn, leads to relevant impairments in the goal-directed behaviors of everyday life for OCD patients (as measured by the DEX) as well as executive dysfunction (as measured by the cognitive tests).

2. Methods

2.1. Participants

A total of 51 OCD patients were selected from the Nyírő Gyula Hospital, Department of Psychiatry I and II, Budapest, Hungary (30 males, 21 females; mean age = 32.35 years, S.D. =9.93; mean years of education =13.33, S.D. = 2.95). A psychiatrist confirmed the diagnosis following the Structural Clinical Interview for DSM-IV Axis I Disorders (SCID-I) (First, 1997). Patients were either being treated for OCD or had received treatment in the past. Individuals were included in the study if they had a DSM-IV diagnosis of OCD and were between 18 and 65 years old. Type of obsessions and compulsions: 1/ Aggressive (58.8 %) 2/ Contamination (59.8 %) 3/ Sexual (19.6 %) 4/ Hoarding (6.8 %) 5/ Religious (25.5 %) 6/ Symmetry (36.3 %) 7/ Somatic (41.4 %) 8/ Cleaning-washing (57.8 %) 9/ Checking (58.8 %) 10/ Repeating (50 %) 11/ Counting (33.3 %) 12/ Ordering (27.4 %) 13/ Hoarding-collecting (12.7 %). Duration of illness: Mean: 10.51 years, Range 1-26, Standard deviation: 6.65. Type of medication: Serotonin Reuptake Inhibitor, SRI: 28 patients, Serotonin Noradrenalin Reuptake Inhibitor, SNRI: 17 patients. Medication free: 6 patients. Mean medication years: 7.41. (Min: 0 years. Max: 30 years. Range: 30 years. St. dev.: 6.66.). Behavioral therapy program: A total of 32 patients out of 51 (65 %) received behavioral therapy (sections of 45 minutes delivered twice a week) over 3 mounts. Severity of OCD symptoms was assessed with the Y-BOCS and depressive symptoms were assessed with the Hamilton Rating Scale for Depression (HDRS) (Mean: 9.86; St. dev.: 6.09). We excluded subjects with any other current comorbid psychiatric diagnosis (Axis I or Axis II). The project was approved by the institutional ethical review board. After being given a detailed description of the investigation by the clinicians, patients were asked to sign an informed consent document. All patients were assured that participation in the study would not interfere with their clinical treatment.

2.2. Instruments

2.2.1. Psychometric scales

The Yale-Brown Obsessive Compulsive Scale (Y-BOCS) is a clinician-rated, semi-structured interview-based scale that is broadly used to assess obsessive-compulsive symptoms and

their severity (Goodman et al., 1989). This scale yields an obsession score (maximum: 20), a compulsion score (maximum: 20) and a combined total score (maximum: 40).

The Hamilton Depression Rating Scale (HDRS) is a 21-item clinician-rated scale for assessing the severity of current depressive symptoms (Hamilton, 1960). The maximum score is 63 points. A score of 15 points or more is considered to be a reliable indicator of current depression.

2.2.2. Neuropsychological tests of executive functions

To assess phonemic fluency, we used the Verbal Fluency Test (VFT). The administration procedure allows 60 seconds for the participant to generate as many words as possible according to specific rules (i.e., all words must begin with a specified letter) (Benton, 1968). All patients were asked to generate a list of words beginning with a specific letter in one minute. This task was repeated three times with different letters. The results of the three attempts were combined and the total score indicated the phonemic fluency. The number of words repeated during the three attempts indicated the patient's perseverative tendency.

To assess semantic fluency, we used the Categorical Fluency Test (CFT) (Newcombe, 1969). All patients were asked to generate as many words as possible from a given semantic category (e.g., animals, vegetables, vehicles) in one minute. The task was repeated three times with different semantic categories. The three results were combined and the total score indicated categorical fluency. The number of repeated words during the task indicated the patient's perseverative tendency.

The Trail Making Test (Reitan et al., 1985) consists of two parts. Trail Making Test Part A (TMA) requires the participant to use a pencil to draw lines between numbers (1–20) positioned randomly on a sheet of paper. Trail Making Test Part B (TMB) requires the participant to alternate between numbers and letters to draw a continuous line to alternately connect the digits 1 to 13 and the letters A to L on a sheet of paper. The total time required for completion of both parts was recorded. The total time for TMA and TMB was used as a measure of executive function.

The Stroop Color and Word Test (Golden, 1978) consists of three conditions. The first condition (word reading) requires the participant to quickly read color words. The second condition (color naming) requires the participant to quickly name the color of "Xs" printed in colored ink and the third condition (interference) requires the participant to name the color of ink in which color words are printed. We used a computerized version of the Stroop test with 30 computer-generated items in each condition. We calculated two indices from each condition as measures of executive functioning in the Stroop test response time in milliseconds and number of errors.

In the Wisconsin Card Sorting Test (WCST) (Heaton et al., 1993), participants are asked to match cards that vary by color, shape and number to four "key cards." Participants are not told how to sort the cards, but must determine the correct category from the feedback

given by the examiner, which changes periodically throughout the test. The full 128-card computerized version was administered. The numbers of perseverative and non-perseverative errors committed during the test and the number of categories completed was used as a measure of executive function.

2.2.3. Questionnaires for assessment of behavioral dysexecutive symptoms

2.2.3.1. The Dysexecutive Questionnaire (DEX)

The DEX is a standardized instrument used to measure behavioral changes as a result of the dysexecutive syndrome. The DEX is part of the BADS (Behavioral Assessment of the Dysexecutive Syndrome) test battery (Burgess, 1998). The DEX is especially designed to assess errors of goal-directed behavior in everyday life. The DEX is a 20-item questionnaire with self-reported and informant-reported versions. The questionnaires are identical, except for minor changes in phrasing. In our study, the informant reported questionnaires were completed by significant others (family members). The DEX required informants to rate on a Likert-type scale from 0 (never) to 4 (very often) how often they observe each of the 20 executive problems. The total score ranges between 0 and 80. In Burgess et al. described a model of the DEX with five cognitive factors: inhibition, intentionality, executive memory, positive affect and negative affect (Burgess, 1998). See Table 3. We chose in our study Burgess's 5-factor model of the DEX because it has the most empirical support. The scores for each factor were calculated by summing the scores of the corresponding items. We used a Hungarian translation of the DEX (relevant others form), which was translated by an independent translator.

2.2.3.2. The White Bear Suppression Inventory (WBSI)

The WBSI (Wegner and Zanakos, 1994) is a self-report questionnaire with 15 self-report items measuring thought intrusion and the attempt to remove thoughts from consciousness.
Participants had to indicate on a five-point rating scale (where a score of 1 indicates "strongly disagree" and 5 "strongly agree") the extent to which they agreed with the statements of the test. Thus, the total score, which indicates the overall level of thought suppression, ranges from 15 to 75. We chose Blumberg's 3-factor model of the WBSI because Blumberg and his colleagues performed a factor analysis of the results using the largest sample, resulting in a model with the highest available statistical power in the literature. The scores of each of Blumberg's 3 factors were calculated by summing the scores of the items listed after the name of each factor. (See Table 2.) The WBSI was translated into Hungarian and back into English. The back-translation was reviewed and corrected by the authors. After this procedure, we used the Hungarian version of the WBSI in the present study.

2.3. Statistical analysis

All statistical analyses were performed using SPSS 13.0 for Windows. Pearson correlation was used to assess the relationships between Y-BOCS scores and the total and factor scores

of the DEX and the WBSI. Pearson correlation was also used to investigate the relations between cognitive test results and WBSI and DEX scores.

3. Results

3.1. Descriptive statistics

Descriptive statistics of the 51 OCD patients in the sample are presented in Table 4. The WBSI scores were analyzed using Blumberg's 3-factor model and the DEX scores were analyzed using Burgess's 5-factor model (for details, see Methods). The results are shown in Table 4. Based on the normative scales of the DEX questionnaire the presence and severity of executive problems of our 51 OCD patients were between 31 and 53 percentil, which shows a severe executive impairment comparing to the normal control of the manual of the DEX.

3.2. Correlations between Y-BOCS scores and the total and factor scores of the DEX and the WBSI

Correlations of Y-BOCS scores with the total and 5-factor scores of the DEX and with the total and 3-factor scores of the WBSI are shown in Table 5. The total DEX score showed a moderate correlation with the total Y-BOCS score ($r=0.327$ / $p< 0.019$). The total DEX score was not correlated with the total Y-BOCS obsessive score ($r= 0.139$ / $p< 0.331$), but it was correlated with the total Y-BOCS compulsion score ($r= 0.352$ / $p< 0.011$). The 'inhibition' factor score of the DEX was significantly correlated with the total Y-BOCS score ($r=0.301$ / $p<0.032$) and the correlation was even stronger with the compulsive Y-BOCS score ($r=0.368$ / $p<0.008$), but no correlation was found with the obsessive Y-BOCS score. The 'positive affect' factor score of the DEX was not correlated with either the total Y-BOCS score or the obsessive Y-BOCS score, but it was positively correlated with the compulsive Y-BOCS score ($r=0.279$ / $p< 0.048$). The 'negative affect' factor score of the DEX strongly correlated with both the total Y-BOCS score ($r=0.404$ / $p<0.003$) and the compulsive Y-BOCS score ($r=0.414$ / $p<0.003$), but not with the obsessive Y-BOCS score. The total Y-BOCS score was significantly correlated with the total WBSI score ($r=0.290$ / $p< 0.039$). The total WBSI score was strongly correlated with the total Y-BOCS obsessive score ($r=0.402$ / $p< 0.003$) but was not correlated with the total Y-BOCS compulsive score ($r=0.075$ / $p< 0.600$). The 'unwanted intrusive thoughts' factor score of the WBSI was correlated with the total Y-BOCS score ($r=0.278$ / $p<0.048$) and the obsessive Y-BOCS score ($r=0.450$ / $p<0.001$), but not with the compulsive Y-BOCS score. The 'thought suppression' factor score of the WBSI was not correlated with either the total or the compulsive Y-BOCS scores, but it was correlated with the obsessive Y-BOCS score ($r=0.298$ / $p< 0.034$).The 'self-distractors' factor score of the WBSI was not correlated with either the total or the compulsive Y-BOCS scores, but it was correlated with the obsessive Y-BOCS score ($r=0.352$ / $p<0.011$). The WBSI and DEX total scores were uncorrelated with each other ($r= 0.053$ / $p<0.713$). The factor scores of the DEX and the WBSI were also not correlated.

3.3. Correlations between WBSI scores and cognitive test results

Descriptive statistics of cognitive tests are presented in Table 6. We found no correlation between the total WBSI scores and any of the cognitive test results in the present study. Using Blumberg's 3-factor model of the WBSI, we found only a few correlations between the WBSI factors and cognitive test results. The so-called 'thought suppression' factor of the WBSI was negatively correlated with the TMB ($r=-0.284$ / $p< 0.043$) and with the number of errors in the Stroop interference task ($r=-0.310$ / $p<0.027$). There was no correlation between this factor and other cognitive test results. Furthermore, we found no significant correlation between either of the other two WBSI factors (unwanted intrusive thoughts and self-distractors) and cognitive test results.

3.4. Correlations between DEX scores and cognitive test results

The total DEX score was positively correlated with performance on the TMA ($r=0.291$ / $p< 0.038$) and the TMB ($r=0.408$ / $p< 0.003$). Also, the total DEX score was positively correlated with the number of perseverative errors on the WCST ($r=0.441$ / $p< 0.001$), but negatively correlated with the number of categories completed on the WCST ($r=-0.301$ / $p< 0.032$) and with the number of words per category on the CFT ($r=-0.387$ / $p< 0.005$). We also investigated the correlation between the DEX factors using Burgess's 5-factor model and cognitive test results. First, the 'inhibition' factor showed no correlation with the TMA, but a positive correlation with the TMB ($r=0.299$ / $p<0.033$). This factor was not correlated with the WCST scores. The 'intentionality' factor was positively correlated with performance on the TMA ($r= 0.310$ / $p<0.027$) and the TMB ($r= 0.369$ / $p< 0.008$). Also, it was significantly positively correlated with perseverative errors on the WCST ($r= 0.385$ / $p<0.005$), but not correlated with non-perseverative errors and the number of categories completed score of the WCST. However, it showed a strong negative correlation with CFT results ($r=-0.344$ / $p<0.013$). The 'executive memory' factor was positively correlated with the TMA ($r= 0.301$ / $p<0.032$) and TMB test results ($r= 0.375$ / $p< 0.007$). It was not correlated with response time on the Stroop word-reading and color-naming tasks, but was positively correlated with the response time on the Stroop interference task ($r= 0.325$ / $p<0.021$). This DEX factor was positively correlated with perseverative errors ($r= 0.483$ / $p<0.001$), uncorrelated with non-perseverative errors and negatively correlated with the number of categories completed score of the WCST ($r=-0.315$ / $p<0.024$). Additionally, it showed a strong negative correlation with CFT results ($r=-0.320$ / $p<0.022$). The 'positive affect' factor was not correlated with the TMA test results, but positively correlated with those of the TMB ($r= 0.314$ / $p<0.025$) and negatively correlated with CFT results ($r=-0.283$ / $p<0.044$). This factor was positively correlated with perseverative errors on the WCST ($r=0.314$ / $p<0.014$). The 'negative affect' factor was positively correlated with the TMA ($r= 0.432$ / $p<0.002$) and the TMB tests ($r=0.403$ / $p< 0.003$). Also, it was positively correlated with the response time for the Stroop word-reading ($r=0.348$ / $p<0.013$) and color-naming tasks ($r= 0.270$ / $p<0.058$) and strongly positively correlated with the response time on the Stroop interference task ($r=0.393$ / $p<0.005$). It showed a strong negative correlation with CFT results ($r=-0.464$ / $p<0.001$). Furthermore, it was positively correlated with the number of perseverative WCST errors ($r= 0.402$ / $p<0.003$), but not correlated with non-perseverative errors and negatively correlated with the number of categories completed score of the WCST ($r=-0.285$ / $p<0.043$).

4. Discussion

The WBSI total score was strongly correlated with the Y-BOCS total score. This result is in line with the findings of Wegner et al. (1994), as these researchers determined that the WBSI is a sensitive indicator of both intrusive thoughts and thought suppression in OCD and is correlated strongly to the OCD symptoms assessed by the Y-BOCS. This support the theory of Purdon's (2004/ 2007), that thought suppression is essential aspect of OCD. Also draw the attention to the tight connection of OCD symptomatology and thought suppression tendencies, which can be assessed by the WBSI. Another result of this study that was consistent with Wegner's theories was that the WBSI total score was strongly correlated with the Y-BOCS obsessive severity subscore but not with the Y-BOCS compulsive severity subscore. Because the WBSI consists of items about both unwanted thoughts and thought suppression, we sought to separate these two components, using Blumberg's 3-factor model of the WBSI.

We found that the total Y-BOCS score was correlated with the 'unwanted intrusive thoughts' factor of Blumberg's model, although the total Y-BOCS score was not correlated with the other two factors (thought suppression and self-distractors) of the WBSI. However, during our analyses of the association between the Y-BOCS and the WBSI factors on the basis of Y-BOCS subgroups, we discovered that the Y-BOCS obsessive subscores were correlated with each of the WBSI factors, whereas the Y-BOCS compulsive subscores were not correlated with any of the WBSI factor scores. This result implies that the correlation between the total scores of the WBSI and the Y-BOCS was driven by the Y-BOCS obsessive subscore and not by the Y-BOCS compulsive subscore. High rate of unwanted intrusive thoughts in OCD keeps the thought suppression at a high level, as noted from the thought suppression scores on WBSI. This failure of cognitive inhibition has been suggested as a possible underlying mechanism in obsessions by Chamberlain (2005). Those patients who experience obsessions, in which cognitive inhibition is impaired, score high on the WBSI, but in the case of compulsion, where the main failure is impairment of behavior inhibition, the patients report less intrusive thoughts and thought suppression tendencies measured by the WBSI. This result can harmonizes to the approach of Purdon (2004 / 2007), who supposed, that suppression may be a first line of defense against an obsession and in a second stage of defense is to perform a ritual. She theorized that rituals are performed, when the obsessive-intrusive thoughts are negated, because of the extreme level of distress they causes.

Dysexecutive symptoms are related to impaired frontal lobe functioning. Based on the normative scales of the DEX, it is possible to detect the executive impairment of our 51 OCD patient group. As can be observed from the summary statistics and percentile data, the DEX results demonstrate the presence and severity of executive problems in OCD patients, who tend to suffer from severe executive impairment.

The total DEX score was significantly correlated with the Y-BOCS. Therefore, the more serious the symptoms of an OCD patient were, the more likely it was for the patient's family members to report dysexecutive symptoms. Moreover, the Y-BOCS obsessive and compulsive subscores were differently associated with the total DEX score. The compulsive

subscore was found to be significantly correlated with the total DEX score, whereas the obsessive score was not. These results indicate that the DEX was sensitive to the severity of OCD symptoms; in addition, this finding demonstrates that impairments in executive functioning are not typically observed in obsessions, but are frequently associated with the compulsions. The generalizability of these results is limited because we did not use a healthy control group; in the future, we are planning to validate the DEX by involving healthy subjects in a similar study. In the present study, however, our primary goal was the comparison of the OCD subgroups.

The results of this study became even more pronounced if the factorial classification of the DEX was considered. In the patients of this investigation, the 'inhibition' factor scores of the Burgess dimensional model were significantly correlated with the severity of OCD symptoms, as indicated by the Y-BOCS. Very distinctive results were also obtained from our analysis of the association between the 'inhibition' factor score and the obsessive and compulsive severity subscores. We found that the inhibition factor score of the DEX was correlated with the compulsive severity score, but not with the obsessive score. This result implies that the impaired inhibition of dysexecutive symptoms (measured by the Burgess's 'inhibition' factor items by the DEX) is not correlated with a failure of cognitive inhibition (i.e., obsessions) but is instead correlated with inhibitory dysfunction at the behavioral level (i.e., compulsions). These results suggest that executive impairments as demonstrated at the behavioral level by the DEX seem to be associated with compulsions rather than obsessions. Failure of behavioral inhibition has been suggested as a possible mechanism in compulsions by Chamberlain et al. (2005). These results also indicate that obsessive patients had few or no dysexecutive symptoms as measured by the DEX; however, compulsive patients had DEX scores that were notably higher. In accordance with Wegner's (1994) theory, we concluded that in the case of compulsions, the OCD patients voluntarily decide to complete the ritualistic compulsive behavior, thus consciously suppressing their intrusive thoughts. This conscious operating process involves effortful cognitive activity, which in turn causes dysexecutive impairments.

Chamberlain et al. (2005) hypothesizes that each type of failure in inhibitory processes is associated with distinct cognitive dysfunctions, but did not published data on this aspect. To assess this theory, we investigated the correlations between the two questionnaires and the results of a cognitive test battery that was administered to the 51 OCD patients.

The total WBSI score was not correlated with the cognitive test results, indicating that patients with high tendency for the intrusion of unwanted thoughts and thought suppression efforts nonetheless retained their executive functions. These data are in accordance with Wegner's theory that monitoring processes do not require relevant cognitive capacity. Using Blumberg's 3-factor model of the WBSI, we found that the cognitive test results were associated with the 'thought suppression' factor, but not with the 'unwanted intrusive thoughts' and 'self-distractors' factors. The 'thought suppression' factor was negatively correlated with cognitive flexibility, as measured by the TMB, as well as with inhibition abilities, which were measured by the Stroop interference task. These results suggest that OCD patients use thought suppression as a coping mechanism that allows them to become more 'efficient' with respect to reaction time. The stronger (or the

more efficient) the 'thought suppression', the more attention allocatable to interference tasks measured by the TMB and Stroop 3 (number of errors). This results are in accordance with the findings of the priming experiment of Morein-Zamir et al. (2010) who found that inhibitory deficit was correlated with thought suppression and response inhibition was correlated with unintentional thought suppression. Our results are in accordance with the findings of Chamberlain et al. (2006), as they detected impaired cognitive flexibility and motor inhibition in OCD patients. A direct comparison of our results with the results of Chamberlain is limited by the fact that we correlated the cognitive flexibility and the motor inhibition of patients with their WBSI scores, whereas Chamberlain et al. examined the correlations between the cognitive and motor results for patients and their Y-BOCS severity scores. The strong correlation between the WBSI and the Y-BOCS draws attention to the thoughts of Purdon (2004 / 2007): despite that thought suppression tendencies are strongly correlated with OCD symptoms they are not part of the Y-BOCS and other symptom severity scales used for OCD assessments, which is a significant deficiency.

The total DEX score was associated with several cognitive test results. OCD patients with high DEX scores displayed less sustained attention (measured by the TMA) and their performance on a set-shifting task (measured by the TMB) that requires cognitive flexibility was poor. The perseverative tendencies, as an impairment in set-shifting, are related to impaired inhibition, which is measured by the WCST perseverative errors (see Aron et al. 2004). The frequent WCST perseverative errors demonstrated by these patients also imply impairments in inhibition, as this result demonstrates that OCD patients with high DEX scores stick rigidly to previously valid strategies. The total DEX score was negatively correlated with both the number of categories completed on the WCST and the CFT score; thus, the more severe the dysexecutive deficit was for patients, the fewer categories those patients completed in the WCST and the fewer words they generated per category in the CFT. These results are in accordance with the findings of Chamberlain et al. (2006), who demonstrated impaired cognitive flexibility in OCD patients. Nevertheless, our discovery that dysexecutive symptoms are not typical of all OCD patients but are instead predominantly restricted to the compulsive subgroup of these patients contributes new information that complements the knowledge gained from previous studies of OCD (Kultz et al. 2004; Chamberlain et al. 2005). The OCD patients who exhibited high scores on the 'inhibition' factor of Burgess's 5-factor model of the DEX also demonstrated executive inhibition deficits, as evidenced by the longer times that these patients required to complete the TMB set-shifting task. This cognitive inflexibility was even more pronounced for the 'intentionality' factor; moreover, the patients with high 'intentionality' factor scores also displayed significantly longer reaction times in the TMB task, which requires inhibition ability. The 'executive memory factor' appeared to be correlated not only with the cognitive deficits, but also with executive inhibitory deficit, measured by the interference condition of the Stroop 3 (time). This factor reflects both, the level of inhibitory and cognitive flexibility functions.

All 51 patients demonstrated mixed (i.e., both obsessive and compulsive) symptoms, as each patient had both intrusive thoughts and ritualistic behaviors. The mixed nature of OCD symptoms for the studied patients limits our interpretations of the results of this investigation but is consistent with the well-established observation that both symptom

groups are present in all OCD patients, although the degree of obsessive or compulsive influences will vary for each patient. Another limitation of our study is the fact that all of the patients that participated in this research were taking antidepressant medication. However, the effect of the medication is unlikely to be significant, as we compared two subgroups of OCD patients with each other. Additionally Chamberlain et al. (2007) found that SRI medication did not address the response inhibition deficit of the OCD groups, a result that suggests that SRI medication does not influence inhibition performances.

Conclusions: The present study provides evidence supporting the presence of executive dysfunctions in OCD patients. Our results indicate that obsessions involve a failure of thought suppression, as measured by the WBSI, but the preservation of relatively intact executive functions. By contrast, for compulsions, the primary failure involved is the ineffectiveness of behavior inhibition, as measured by the DEX and the dysexecutive symptoms noted by the DEX results are correlated with impaired executive functions. The WBSI is sensitive to obsessive symptoms, whereas the DEX is sensitive to compulsive symptoms. As OCD has mixed symptomatology, these two scales appear to be useful for the diagnostic separation of OCD's obsessive and compulsive symptoms.

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Tables

Table 1: The different aspects of inhibition that are theorized in OCD

Dysexecutive Questionnaire (DEX) (Burgess 1997)	Chamberlain 2005	Chamberlain 2006 / Morein-Zamir 2010	White Bear Suppression Inventory (WBSI) (Wegner 1994)	Wegner 1994 (Ironic Process Theory)
-the assessment of the dysexecutive symptoms in everyday goal-directed behaviors (behavior level) -inhibition factor/dimension	-cognitive inhibition impairment (obsessions) -behavior inhibition impairment (compulsions)	-motor inhibition impairment -cognitive inflexibility (measured by neurocognitive tests)	-thought intrusions -cognitive inhibition of unwanted thought: thought suppression	-operating inhibitory processes (conscious) -monitoring processes (unconscious)

Table 2. Blumberg's 3-factor model of the White Bear Suppression Inventory (WBSI).

I. Factor: 'unwanted intrusive thoughts'
2. Sometimes I wonder why I have the thoughts I do.
3. I have thoughts that I cannot stop.
4. There are images that come to mind that I cannot erase.
5. My thoughts frequently return to one idea.
6. I wish I could stop thinking of certain things.
7. Sometimes my mind races so fast I wish I could stop it.
9. There are thoughts that keep jumping into my head.
15. There are many thoughts that I have that I don't tell anyone.
II. factor: 'thought suppression'
1. There are things I prefer not to think about.
8. I always try to put problems out of mind.
11. There are things that I try not to think about.
14. I have thoughts that I try to avoid.
III. factor: 'self distracters'
10. Sometimes I stay busy just to keep thoughts from intruding on my mind.
12. Sometimes I really wish I could stop thinking.
13. I often do things to distract myself from my thoughts.

Table 3.The characteristics of the dysexecutive symptoms measured by the Dysexecutive Questionnaire (DEX) using Burgess's 5-factor model.

I. factor: 'Inhibition'
1. Impaired abstract reasoning
2. Impulsivity
9. Disinhibition
13. No concern for others' feelings
15. Restlessness
16. Response suppression problems
20. No concern for social rules
II. factor: 'Intentionality'
4. Planning problems
7. Lack of insight
17. Knowing-doing dissociation
18. Distractibility
19. Poor decision making
III. factor: 'Executive memory'
3. Confabulation
6. Temporal sequencing problems
14. Perseveration
IV. factor: 'Positive affects'
5. Euphoria
10. Variable motivation
12. Aggression
V. factor: 'Negative affects'
8. Apathy
11. Shallow affect

Table 4. Descriptive statistics of the Yale-Brown Obsessive Compulsive Scale (Y-BOCS) total scores, obsessive scores and compulsive scores; Hamilton Depression Rating Scale (HDRS) total score; White Bear Suppression Inventory (WBSI) total score and 3 factor scores based on Blumberg's 3-factor model; Dysexecutive Questionnaire (DEX) total score and the 5 factor scores based on Burgess's 5-factor model.

	Minimum	Maximum	Mean	Std. Deviation
Y-BOCS total score	9	38	25,12	7,23
Y-BOCS obsession subscore	0	20	12,51	4,27
Y-BOCS compulsion subscore	1	20	12,59	5,10
HDRS total score	2	26	9,86	6,09
WBSI - Unwanted intrusive thoughts factor	11	39	27,90	7,13
WBSI - Thought suppression factor	4	19	12,51	3,32
WBSI - Self distracters factor	3	15	10,96	2,81
DEX total score	1	64	28,98	15,47
DEX - Inhibition factor	0	23	9,06	6,02
DEX - Intentionality factor	0	19	7,75	5,02
DEX - Executive memory factor	0	10	3,04	2,63
DEX - Positive affects factor	0	12	4,86	3,23
DEX - Negative affects factor	0	8	4,51	2,12

Table 5. Correlation results for theYale-Brown Obsessive Compulsive Scale (Y-BOCS) total score, the obsessive scores and the compulsive scores; total scores of the Dysexecutive Questionnaire (DEX) and Burgess's 5-factor model scores of the DEX; and total scores of the White Bear Suppression Inventory (WBSI) and Blumberg's 3-factor model scores of the WBSI.

		DEX	DEX inhibition factor	DEX intentionality factor	DEX executive memory factor	DEX positive affects factor	DEX negative affects factor	White Bear Inventory	WBSI unwanted intrusive thoughts factor	WBSI thought suppression factor	WBSI self distractors factor
Y-BOCS total score	Pearson Correlation	,327	,301	,267	,189	,226	,404	,290	,278	,222	,250
	Sig. (2-tailed)	,019	,032	,058	,184	,110	,003	,039	,048	,118	,076
Y-BOCS obsessive subscore	Pearson Correlation	,139	,077	,138	,153	,054	,192	,402	,450	,298	,352
	Sig. (2-tailed)	,331	,589	,335	,283	,705	,178	,003	,001	,034	,011
Y-BOCS compulsive subscore	Pearson Correlation	,352	,368	,266	,141	,279	,414	,075	,017	,068	,058
	Sig. (2-tailed)	,011	,008	,059	,322	,048	,003	,600	,906	,634	,688

Table 6. Descriptive statistics of cognitive tests. Cognitive functions measured by the tests are shown in the second column. Verbal Fluency Scale (VFS) indicates the number of words generated in three trials and the number of perseverative errors per three minutes. Category Fluency Test (CFS) indicates the number of words in a single category generated in three trials and the number of perseverative errors per three minutes. Trail Making Test Part A (TMA) and Part B (TMB) results are expressed in seconds. For the three tasks of the Stroop test, word reading, color naming and interference, the time to complete each task and the number of errors in each task are given. For the Wisconsin Card Sorting Test (WCST), the numbers of perseverative errors, non-perseverative errors and categories completed are indicated.

	Type of cognitive function	Minimum	Maximum	Mean	Std. Deviation
Verbal Fluency Test (number of words)	Attention	11	64	36,45	11,53
Verbal Fluency Test (number of perseverative errors)	Inhibition	0	3	0,88	1,05
Category Fluency Test (number of words in category)	Attention	20	59	41,71	8,51
Category Fluency Test (number of perseverative errors)	Inhibition	0	6	1,22	1,68
TMA (sec)	Attention	20	98	49,53	19,78
TMB (sec)	Attention, cognitive flexibility	26	195	87,86	38,14
Stroop 1 (time) (msec)	Attention	795	1958	1206	275
Stroop 2 (time) (msec)	Attention, cognitive flexibility	853	2359	1355	366
Stroop 3 (time) (msec)	Attention, motor inhibiton	860	3463	1672	573

Stroop 1 (number of errors)	Attention	0	2	0,19	0,44
Stroop 2 (number of errors)	Attention, cognitive flexibility	0	1	0, 0588	,2376
Stroop 3 (number of errors)	Inhibition	0	28	2,76	7,32
WCST (number of perseverative errors)	Attention, cognitive flexibility	3	60	16,31	14,05
WCST (number of non-perseverative errors)	Attention, cognitive flexibility	2	48	12,65	8,93
WCST (number of categories completed)	Attention	1	6	5,04	1,52