Psychiatry Research 180 (2010) 99–104

Contents lists available at ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

Emotional interference in obsessive–compulsive disorder: A neuropsychological study using optimized emotional Stroop test

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ARTICLE INFO

Article history:
Received 6 February 2009
Received in revised form 4 October 2009
Accepted 27 October 2009

Keywords:
Obsessive–compulsive disorder
Emotion
Attention
Cognition
Neuropsychology

ABSTRACT

Contents related to threat and associated cognitive processes are proposed to be the central characteristic of obsessive–compulsive disorder (OCD) according to 'threat-relatedness hypothesis'. However, evidence for attention bias toward emotionally salient stimuli using the emotional Stroop test is equivocal. This discrepancy could be due to methodological issues, mainly differences in the lexical characters of words. Fifty Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV) OCD patients (23 washers and 27 checkers) and 50 age-, handedness- and sex-matched healthy controls were examined with an optimized version of the emotional Stroop test (i.e., with lexically matched words) and color-Stroop test. Twenty-four patients were clinically symptomatic and 26 were remitted. OCD patients had significantly higher attention bias only for negative OCD stimuli as calculated by negatively valenced OCD interference score but not for neutral or non-OCD emotional stimuli. Symptomatic patients had significantly higher bias, but not the remitted patients. There were no significant correlations between other illness-related variables (age at onset, illness duration, and medication dose) and Stroop test performance. Study findings suggest the presence of selective emotional bias for OCD relevant stimuli in these patients and this bias is potentially related to symptomatic status. These observations are in tune with the threat-relatedness hypothesis.

1. Introduction

There is substantial evidence that obsessive–compulsive disorder (OCD) is associated with brain dysfunction and cognitive deficits involving frontal–striatal circuits (Chamberlain et al., 2005). Neuropsychological studies in OCD have documented deficits in attention, executive functions, and memory. A deficit in the ability to attend to relevant stimuli, while simultaneously ignoring irrelevant stimuli, is central to the symptomatology of OCD (Clayton et al., 1999).

Moreover, attention bias toward emotionally salient stimuli has been demonstrated in this disorder (Kuelz et al., 2004, Williams et al., 1996) and studies have shown that patients with OCD have bias toward threat-related information (Bannon et al., 2002, Cohen et al., 2003). These findings are in support of the "threat-relatedness hypothesis". This hypothesis proposes that contents related to threat and associated cognitive processes are central characteristic of OCD (Beck and Clark, 1997). Also, it has been suggested that treatment has the effect of modifying the meaning of these thoughts to the kind of level experienced by most other non-obsessional people (Salkovskis, 1999).

The emotional Stroop test (EST), the emotional analog of the color-Stroop test (CST) (Stroop, 1935), helps to examine this selective attention to an emotionally salient stimulus (MacLeod, 1991; Williams et al., 1996). In this test, when OCD patients are presented with colored words with contents relevant to their obsessive–compulsive (OC) concerns, bias to emotional content will delay voluntary color naming. A longer reaction time for OCD relevant words (ex: contamination) in comparison to neutral words (ex: pen) gives the measure of 'emotional interference' (Tata et al., 1996). Though the EST is an analog of the original CST, recent reports suggest differences in design between CST and EST with respect to the lexical characters of words used (Larsen et al., 2006). That is, in CST, the words are identical across congruent and incongruent trials and ensure that the differences cannot be due to lexical differences in the stimulus words. However, in the EST the emotional words are always different from the neutral words and thus it is crucial that they are matched on all lexical features that influence word recognition such as length, frequency, and orthographic neighborhood (number of words into which a single word can be transformed by changing one letter in the word with other letters unchanged). For example, if the emotional words (ex: uncertain) are longer than the neutral words (ex: pen), then any slowing in reaction time to name their colors might be due, in part, to the additional visual processing time imposed by the more complex stimulus words (Larsen et al., 2006).

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doi:10.1016/j.psychres.2009.10.017

Most of the previous emotional stroop studies conducted in OCD have not used lexically matched words and usage of lexically matched words has been strongly recommended to derive valid interpretation in EST (Larsen et al., 2006). Hence, it is plausible that this might have contributed to the discrepant findings in previous studies; some studies reported increased attention bias toward OCD relevant stimuli (Foa et al., 1993; Lavy et al., 1994; Unoki et al., 1999) but other studies reported no such attention bias (Kampman et al., 2002; McNally et al., 1992; McNeil et al., 1999; Moritz et al., 2004). In addition, previous studies were manually administered, which can potentially result in bias and error (Lavy et al., 1994). Only a recent study addressed some of these methodological issues. The authors examined 23 patients and controls using EST and CST and reported the absence of attentional bias for OCD relevant stimuli and recommended use of visual stimuli (Moritz et al., 2008). Later, they reported increased attention bias to OCD relevant stimuli in washers and checkers using visual stimuli (Moritz et al., 2009).

Thus, the current study aimed to examine the emotional interference in OCD patients in comparison to healthy controls using a methodologically optimized emotional stroop test (OEST). The words were matched on all lexical characters which can potentially influence word processing speed, namely length of word, frequency of use of the word, and orthographic neighborhood (Larsen et al., 2006). In addition, we administered the test using a fully automated computerized program. We examined patients in both symptomatic and remitted states to study whether the bias to emotionally salient information decreases after treatment and symptom remission.

We administered OEST in a large sample of OCD patients ($N=50$) in comparison with age-, sex-, and handedness-matched healthy controls ($N=50$). We hypothesized that in comparison to healthy controls OCD patients will have significantly longer reaction time for processing 'OCD relevant' words. In accord with threat-relatedness hypothesis, we hypothesized that only the symptomatic patients but not the remitted will have longer reaction time in comparison to controls.

2. Methods

2.1. Study subjects

Subjects included 50 OCD patients recruited from specialized OCD clinic and the adult clinical services of National Institute of Mental Health And Neurosciences (NIMHANS) and 50 healthy controls selected from volunteers through word of mouth. All subjects were aged between 15 and 45 years, had at least 12 years of formal education with optimal "working" English knowledge (for the study purpose this was operationalized as those subjects with minimum 12 years of education in whom a clinical interview in English was feasible). Handedness was assessed using the Edinburgh handedness inventory (Oldfield, 1971) and only right-handed subjects were included. No subject had a history of neurological/medical disorder, color blindness, and auditory or visual impairment. After complete description of the study, subjects gave written informed consent. The Institute's ethics committee approved the study.

Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV) diagnosis of OCD was established using a comprehensive clinical interview and confirmed by the MINI international neuropsychiatric interview (M.I.N.I) (Sheehan et al., 1998). All patients were assessed using the Yale Brown Obsessive–Compulsive Scale (YBOCS) — severity and symptom check list (Goodman et al., 1989). Only those with predominant washing or checking OC symptoms were included. Washing or checking was considered a predominant symptom if it was the main reason for consultation and caused considerable distress, interference, and time, and other symptoms not diagnosed as predominant. We excluded those with predominance of both washing and checking and also those with other predominant symptoms such as hoarding or symmetry. We ascertained this by obtaining detailed information from patient and reviewing clinical charts, which had symptom assessment using YBOCS. Patients with current comorbid Axis I psychiatric disorder were excluded. In addition, we excluded patients with lifetime diagnosis of bipolar disorder, schizophrenia, and substance abuse/dependence.

Healthy comparison subjects were recruited through 'word of mouth'. Healthy controls were chosen from different backgrounds to suit the varying socio-demographic status of the patients. Healthy controls were evaluated in detail to rule out history suggestive of psychiatric illness and were screened using MINI (Sheehan et al., 1998). None of the control subjects had a family history of psychiatric disorder in their first-degree relatives.

Forty-four patients were on treatment with psychotropics and the remaining six were not on any medication. All 44 patients were on treatment with serotonin reuptake inhibitors (fluoxetine — 18; paroxetine — 3; citalopram — 2; fluvoxamine — 4; venlafaxine — 2; sertraline — 8; clomipramine — 4; and escitalopram — 3). We calculated fluoxetine equivalent as described earlier by Weilburg et al. (2003) for these drugs and mean ± S.D. fluoxetine equivalent was 45.30 ± 27.80 mg/day. Out of the 50 patients, only three were recieving benzodiazepines. All three were on clonazepam with a mean dose of 1.16 ± 0.28 mg/day. Eleven of them were on antipsychotic augmentation (risperidone — 6; ziprasidone — 1; haloperidol — 1; olanzapine — 1; flupenthixol — 1; and quetiapine — 1).

2.2. Word selection for optimized EST

The initial pool of words consisted of OCD relevant stimuli used in a prior study (Lavy et al., 1994). Words were of two groups: those which were OCD relevant and generated a positive emotion — positively valenced OCD relevant words (ex: neat) and those which generated a negative emotion — negatively valenced OCD relevant words (ex: dirty). We used separate sets for washers and checkers. Using the English lexical project database (Balota et al., 2002; Larsen et al., 2006), the length, frequency, and orthographic neighborhood size of these OCD relevant words were calculated. Then, from the same database, we generated words for the other groups, namely, non-OCD emotional words and affectively neutral words with matched lexical characteristics. Non-OCD emotional words consisted of words which were unrelated to OC concern but generated positive (ex: joyful) or negative (ex: abuse) emotions. Thus, in essence, there were five sets of words (Appendix A). The groups of words for checkers and washers were comparable on all lexical characters. There was no significant difference in lexical characters among the three groups of words as examined by analysis of variance (ANOVA) ($P>0.3$) (Table 1).

2.3. Task and procedure

The computerized task was constructed based on Cogent 2000, which is a MATLAB® (The Mathworks, Inc., Natick, MA, USA) toolbox for presenting stimuli and recording responses with precise timing. We administered the test in a quiet environment with subjects being seated at 50 cm from the computer screen. We gave a practice task with color bars (12 trials) in a black background at the center of the computer screen and later presented the stimuli from different groups incorporating both OEST and color-stroop words in pseudorandom order. Target stimulus depicting the word (arial font, size 30) appeared on screen for 3000 ms followed by a blank screen for 1000 ms before the next word. The words were projected in lower case in blue, green, or red color. The software recorded the display time, response keystroke times automatically with 1 ms accuracy.

Table 1
Comparative profile of the lexical characteristics of the words of OEST.[$]

Lexical character	Word category for checkers					*F*	*P*[*]
	OC positive (mean ± S.D.)	OC negative (mean ± S.D.)	Non-OCD emotional positive (mean ± S.D.)	Non-OCD emotional negative (mean ± S.D.)	Neutral (mean ± S.D.)		
Length	7.12 ± 1.8	5.87 ± 1.72	7.12 ± 1.80	6.75 ± 0.88	6.50 ± .53	1.02	0.41
Frequency	9.07 ± 1.33	9.48 ± 1.30	8.74 ± 1.42	8.95 ± 0.91	8.63 ± 1.19	0.56	0.69
Orthographic neighborhood	2.12 ± 2.58	2.50 ± 5.09	2.12 ± 4.82	1.37 ± 2.13	0.62 ± 1.06	0.36	0.83
	Word category for washers						
Length	5.50 ± 1.92	5.62 ± 1.68	4.87 ± 1.12	6.62 ± 1.30	5.37 ± 1.84	1.26	0.30
Frequency	9.13 ± 1.45	9.28 ± 1.01	9.58 ± 1.19	8.86 ± 0.81	9.33 ± 1.30	0.41	0.79
Orthographic neighborhood	4.75 ± 4.26	3.75 ± 5.49	6.62 ± 8.27	2.25 ± 2.81	8.12 ± 7.43	1.19	0.33

[$]Analysis of variance; $df=4,36$.
[*]P significant at <0.05.