Psychiatry Research 200 (2012) 1062–1066

Contents lists available at SciVerse ScienceDirect

Psychiatry Research

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

Brief report

Behavioral and cognitive impulsivity in obsessive–compulsive disorder and eating disorders

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ARTICLE INFO

Article history:
Received 9 November 2011
Received in revised form
30 May 2012
Accepted 10 June 2012

Keywords:
Inhibition
Anxiety
Neuropsychology

ABSTRACT

This study compared self-reported impulsivity and neurocognitively assessed response inhibition in obsessive–compulsive disorder (OCD), eating disorder (ED), and healthy control participants. Participants completed the Barratt Impulsiveness Scale (BIS-11), stop-signal reaction time task, and measures of OCD and ED symptomatology (Yale-Brown Obsessive–Compulsive Scale and Eating Disorders Examination-Questionnaire). Compared to controls, both clinical groups reported higher levels of impulsivity on the BIS-11 however; only the OCD demonstrated increased stop-signal reaction time. Heightened levels of self-reported impulsivity may reflect the experience of anxiety in both OCD and ED populations whereas a lack of inhibitory control may represent a specific behavioral deficit in OCD.

1. Introduction

Research focused on investigating the relationship between obsessive–compulsive disorder (OCD) and eating disorders (EDs) has highlighted phenomenological and functional similarities between the two disorders (Altman and Shankman, 2009; Murphy et al., 2004), high levels of co-occurrence (Rubenstein et al., 1992) and patterns of familial aggregation (Bellodi et al., 2001; Strober et al., 2007). These similarities have led several authors to suggest shared etiopathogenic roots that would fall within an obsessive–compulsive spectrum (Bellodi et al., 2001; Robbins et al., 2012). Although these proposals have circulated for more than a decade, research directly examining the specific nature of this potential shared etiology is limited. Among the dispositional factors proposed linking OCD and EDs, impulsivity has garnered attention both because of its relationship to the proposed obsessive–compulsive spectrum and its association with the psychopathology of both disorders. Elevated levels of impulsivity have been frequently noted among individuals with EDs (Boisseau et al., 2009) but also have been reported in a subset of individuals with OCD (Ettelt et al., 2007). Indeed, some researchers have suggested that EDs are a more impulsive variant of OCD (Lochner et al., 2005; Lochner and Stein, 2006), while others have suggested that impulsivity may be a link between affect-regulatory binge-purge behavior and OCD-related compulsions (Altman and Shankman, 2009).

At a neurocognitive level, impulsivity is thought to arise out of a lack of inhibitory control linked to dysfunction in the prefrontal and sub-cortical systems (Chambers et al., 2009). Deficits in inhibition are commonly and consistently reported in OCD literature (Bannon et al., 2002; Morein-Zamir et al., 2010), leading some researchers to conclude that failures of cognitive inhibition (e.g., control over internal cognitions such as intrusive thoughts or mental rituals), and behavior inhibition (e.g., motoric activities or rituals manifested externally) are central to the neuropsychopathology of OCD (Chamberlain et al., 2005, 2007). Similar to OCD, deficits in behavioral and cognitive inhibition have been noted in ED patients when compared to controls (Galimberti et al., 2012; Marsh et al., 2009). Despite these similarities, research directly comparing manifestations of impulsivity across the two disorders remains sparse. Therefore, the current study aims to investigate response inhibition among individuals with OCD, EDs and healthy controls, and examines associations with self-report impulsivity. We expected that both clinical groups would demonstrate impaired response inhibition and report higher levels of impulsivity compared to controls.

2. Methods

2.1. Participants

Participants were diagnosed with OCD (n=19) or an ED (n=21) according to *DSM-IV* criteria using the Mini-International Neuropsychiatric Inventory

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0165-1781/$ - see front matter © 2012 Elsevier Ireland Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.psychres.2012.06.010

(Sheehan et al., 1998). Healthy controls ($n=21$) had no lifetime diagnosis of a psychiatric illness, were within the normal weight range, and were not taking any psychiatric medication. All participants were female and native English speakers. To reduce overlap between the two clinical groups, four women reporting lifetime history of both disorders were excluded. Other exclusion criteria included: (1) psychotic disorder, bipolar disorder, or substance dependence and (2) history of traumatic brain injury or neurological disease. Participants with primary compulsive hoarding were excluded because of research supporting the separation of hoarding from OCD in DSM-5 (Mataix-Cols et al., 2010).

Our intent was to include a heterogeneous group of participants with ED symptoms and diagnoses. However, participants with a body mass index (BMI) <17.5 were excluded due to the confounding effects of malnutrition on task performance (Kingston et al., 1996); therefore the ED sample was limited to individuals with bulimia nervosa (BN; $n=12$) and eating disorder not otherwise specified (EDNOS; $n=9$). Of the nine participants with current EDNOS, three had a symptom presentation most similar to the restricting subtype of anorexia nervosa (AN), one was descriptively similar to a diagnosis of AN-binge eating/purging type, and four had symptoms characteristic of subthreshold BN. It is well known that there is overlap between DSM-IV ED diagnostic categories, diagnostic crossover is common, and that individuals with EDNOS are equality as severe as their full-syndrome counterparts (Agras et al., 2009; Eddy et al., 2008; Fairburn et al., 2007). For example, eight of the participants (four BN; four EDNOS) in this study reported meeting the weight threshold for AN at some point during the course of their ED. There were no significant differences between BN and EDNOS participants in severity of cognitive ED symptoms, disorder onset, or duration of illness.

Eleven of the clinical participants (five OCD; six ED) were taking psychiatric medication, including antidepressants ($n=9$), anxiolytics ($n=4$), and atypical neuroleptics ($n=2$). The groups were matched for age, handedness, education level, and general intellectual ability as measured by the National Adult Reading Test-Revised (NART-R; Blair and Spreen, 1989). All participants gave written and informed consent; the study was approved by the Institutional Review Board at Boston University.

2.2. Self-report measures

Severity of obsessive and compulsive symptoms was assessed using the Yale-Brown Obsessive–Compulsive Scale and Symptom Checklist (Y-BOCS; Goodman et al., 1989) and ED severity was assessed using the Eating Disorders Examination-Questionnaire (EDE-Q; Fairburn and Beglin, 1994). The YBOCS and EDE-Q total scales demonstrated good internal consistency overall and across the three groups (Cronbach's $\alpha=0.71$–0.88 and 0.88–0.96 respectively). Impulsivity was assessed using the Barratt Impulsiveness Scale (BIS-11; Patton et al., 1995), a 30-item questionnaire consisting of three subscales: attentional impulsiveness (rapid, unstable thoughts and lack of cognitive patience); motor impulsiveness (a tendency for impetuous action); and nonplanning impulsiveness (lack of future orientation). Cronbach's α for the BIS-11 total score was 0.89 in the overall sample and ranged from 0.68 to 0.92 across the three groups; internal consistency was also acceptable for the BIS-11 subscales with Cronbach's $\alpha=0.71$–0.83 (overall), 0.77–0.86 (ED), 0.64–0.85 (OCD), and 0.60–0.75 (controls).

2.3. Response inhibition

Response inhibition was assessed using a stop-signal paradigm (Verbruggen et al., 2008). On the two practice blocks and three experimental blocks, the participant is required to discriminate between a square and a circle. On no-signal trials (75% of the trials), only the primary-task stimulus is presented, and participants are instructed to respond to the stimulus as fast and accurately as possible. On stop-signal trials (25% of the trials), the primary-task is to inhibit responding following the sound of a tone. The dependent variables in this task include the length of the inhibitory process, or stop signal reaction time (SSRT) as well as measures of executive control including mean reaction time and percent of omitted responses. Higher SSRTs reflect worse inhibitory control (slower inhibitory processes).

2.4. Statistical analysis

Statistical analyses were carried out using SPSS 18.0 for Windows. The majority of the data obtained from the individual measures was continuous in nature and conformed to the requirements for parametric analysis using analysis of variance (ANOVA) with Scheffe's post-hoc tests. Non-normal data were transformed prior to analysis using Box–Cox transformations, a maximum likelihood method for determining optimal power transformation (Box and Cox, 1964). In all cases, data are presented as untransformed means. Categorical data were analyzed using Pearson's χ^2 analyses. Pearson's correlations were conducted between BIS-11 subscales and SSRT. All statistical tests were two-tailed.

3. Results

The three groups did not differ significantly with respect to age, BMI, education, or estimated verbal IQ (Table 1). Clinical groups[1] reported no significant differences in duration of illness, disorder onset, or likelihood of being in treatment or taking psychiatric medication. Both clinical groups evidenced greater levels of overall impulsivity than the control group. While there were no significant differences in motoric impulsivity, both clinical groups reported higher levels of attentional impulsivity compared to the control group. The ED group reported significantly higher levels of non-planning than the control group. After participants who inhibited significantly more or less than 50% of the time were removed from analyses,[2] the probability of inhibition (p[inhib]) converged at approximately 50% in each group (OCD=47.0%, ED=49.4%, controls=46.9%). However, because there was still a small difference in p(inhib) it was included as a covariate in the ANOVA of SSRT. In the stop-signal task the OCD group was significantly slower inhibiting responses compared to the control group and more likely to make errors of omission compared to the ED group. There were no significant group differences in mean reaction time. Results on the stop-signal task remained consistent in separate analyses including only unmedicated participants. No significant correlations were found between age of onset, duration of illness, estimated verbal IQ, and performance on the stop signal task (all $p>0.05$). Across groups, SSRT and omission errors were not significantly correlated with attentional impulsivity, motor impulsivity, or nonplanning impulsivity (all $ps>0.28$) Association between these variables remained non-significant in separate analyses by disorder.

4. Discussion

The purpose of this investigation was to examine the nature of impulsivity in OCD and EDs using self-report and a neurocognitive measure of response inhibition. Both OCD and ED participants reported significantly higher overall levels of impulsivity compared to controls and no significant differences were found between the two clinical groups on any of the BIS-11 subscales. While heightened impulsivity is consistent with ED research, it is at odds with widely held conceptualizations of anxiety disorders (Barlow, 2002). The overall elevation in impulsivity in the OCD group relative to controls can primarily be attributed to a significant difference in only one BIS subscale: attentional impulsivity. Attentional impulsivity indexes distractibility, inattention, and the awareness of extraneous cognitive activity (Patton et al., 1995). Thus, heightened impulsivity on this subscale may reflect the experience of intrusive, uncontrollable preoccupations (Summerfeldt et al., 2004). Indeed, attentional impulsivity in OCD participants was positively correlated with scores on the

[1] Analyses remained consistent after removing the three individuals with an EDNOS presentation characterized primarily by restriction. We report the results from our full sample here, consistent with the heterogeneity frequently noted in EDs.

[2] Five participants (two controls, three OCD) were dropped from the SSRT analyses because they inhibited significantly more or less than 50% of the time. These staircase failures may be due to inconsistent performance, excessive distraction or because of strategic slowing of the go reaction time. This invalidates an assumption of the horserace model—that go-and stop-related processes are independent—needed to calculate SSRT (Logan, 1994). In addition data from three control participants were lost due to technical failure. Consequently, these participants were excluded; the final groups for response inhibition analysis (with inhibition rates approximating 50%) were 16 controls, 16 OCD participants, and 21 ED participants.

Table 1
Impulsivity and response inhibition in obsessive–compulsive disorder (OCD), eating disorder (ED), and healthy control (HC) groups.

	OCD M (S.D.)	ED M (S.D.)	HC M (S.D.)	F (2, 58)	
Age	22.32 (4.24)	23.48 (4.37)	24.24 (3.47)	1.14	
Body mass index (kg/m^2)	24.82 (4.70)	22.30 (3.75)	22.22 (2.28)	2.98	
Estimated Verbal IQ (NART)	115.79 (6.27)	117.81 (5.33)	118.91 (5.90)	1.95	
Education (years)	14.63 (2.67)	14.86 (2.67)	16.00 (1.41)	2.12	
Race/ethnicity (% Caucasian)	14 (73.7)	18 (85.7)	16 (76.2)	$\chi^2(2)=0.98$	
Duration of illness (years)	6.74 (4.92)	6.65 (4.49)	–	t (38)=0.06	
Age of OCD/ED onset	12.47 (7.33)	16.18 (2.98)	–	t (38)=2.02	
Psychiatric medication (% on med)	5 (26.3)	6 (28.6)	–	$\chi^2(1)=0.03$	
Treatment (% in treatment)	8 (42.1)	9 (42.9)	–	$\chi^2(1)=0.00$	
Comorbid diagnosis[c]	7 (36.8)	6 (28.6)		$\chi^2(1)=0.21$	
	OCD M (S.D.)	ED M (S.D.)	HC M (S.D.)	F (2, 58)	η^2
Y-BOCS total score	22.53 (3.92)[a]	3.33 (4.39)[b]	0.57 (0.84)[b]	237.20****	0.89
EDE-Q total Score	1.24 (1.25)[a]	4.16 (1.03)[b]	0.44 (0.47)[a]	86.86****	0.75
BIS impulsivity					
Attention	17.68 (4.79)[a]	18.52 (4.92)[a]	13.16 (2.88)[b]	9.45***	0.24
Motor	21.32 (4.63)	23.38 (5.12)	20.95 (3.80)	1.76	0.06
Non-planning	23.63 (6.30)[a,b]	25.86 (7.07)[a]	21.33 (3.85)[b]	3.86*	0.12
Overall	62.63 (13.36)[a]	67.76 (15.62)[a]	55.45 (6.84)[b]	5.15**	0.15
Response inhibition[d]					
SSRT	305.33 (44.27)[a]	283.43 (33.49)[a,b]	270.29 (31.27)[b]	4.46*	0.14
MRT go	516.52 (94.53)	493.05 (98.80)	579.96 (158.77)	2.58	0.09
P(inhib)	47.01 (2.60)	49.39 (4.57)	46.88 (4.53)	2.45	0.08
Omissions[e]	3.64 (6.28)[a]	0.74 (2.62)[b]	1.41 (2.86)[a,b]	6.14*	0.10

Note: All comparisons in demographic variables non-significant.
NART=National Adult Reading Test, Y-BOCS=Yale-Brown Obsessive–Compulsive Scale, EDE-Q=Eating Disorder Examination Questionnaire, BIS=Barratt Impulsiveness Scale, SSRT=Stop Signal Reaction Time, MRT=Mean Response Time, p (inhib)=Probability of inhibition.

[a,b] Means with different subscripts differ significantly at the $p<0.05$ level in post-hoc analyses.

[c] Means with different subscripts differ significantly at the $p<0.05$ level in post-hoc analyses. In the OCD group, one participant had major depressive disorder, one had major depressive disorder and social phobia, one had panic disorder, generalized anxiety disorder; in the ED group, one participants had generalized anxiety disorder, and five had major depressive disorder.

[d] Sixteen controls, 16 OCD participants, and 21 ED participants provided valid data for the response inhibition task.

[e] Kruskal–Wallis/Mann Whitney U.

* $p<0.05$.

** $p<0.01$.

*** $p<0.001$.

**** $p<0.0001$.

Y-BOCS Obsessions subscale ($r=0.44$, $p<0.05$). Heightened levels of attentional impulsivity therefore may not be orthogonal to anxiety; rather, it may be a manifestation of it.

The comparable and high levels of attentional impulsivity between the OCD and ED groups are interesting in light of this conclusion. ED individuals may show elevations on this scale, in part, because of obsessional thinking around food, shape, and weight. Indeed studies have highlighted elevations in attentional impulsivity across the EDs (Rosval et al., 2006) and noted a link between impulsivity, obsessionality, and purging behavior (Hoffman et al., 2012). Alternatively, heightened levels of attentional impulsivity are present in a wide variety of psychiatric disorders (see Stanford et al., 2009). As such, it is possible that attentional impulsivity on the BIS-11 is a non-specific index of psychopathology. Future research on the nature of attentional impulsivity as it relates to intrusive cognitions, specific symptom manifestation, and trait anxiety in both ED and OCD populations is warranted.

In the stop-signal task, participants with OCD displayed difficulties with motor inhibitory control compared to controls (i.e. slower SSRTs) in the presence of intact psychomotor speed (go reaction time). These results are consistent with prior investigations showing impairment across a range of tests of inhibitory function in individuals with OCD (Morein-Zamir et al., 2010; Penades et al., 2007). Deficits in inhibitory control are consistent with the clinical manifestation of OCD, namely the inability to inhibit compulsive, repetitive behavior in the face of obsessional thoughts (Chamberlain et al., 2005). Although difficulty inhibiting ritualistic behavior is also frequently observed in EDs, no significant differences were found in response inhibition between ED and control participants in this investigation and the ED participants made less errors of omissions compared to OCD participants. Few studies have examined SSRT in EDs with one study finding no differences in response inhibition compared to controls (Claes et al., 2006) and the other finding impairment in AN, but not BN, participants (Galimberti et al., 2012).

Thus although EDs are associated with elevated impulsivity, the motor response inhibition aspect of impulsivity may not be universally impaired. Future research is needed to clarify if response inhibition deficits in EDs are a marker of state-dependent starvation, dependent on the specific task used (e.g. Lock et al., 2011; Marsh et al., 2009), differ between NOS and full-syndrome presentations, or are related to specific symptom constellation.

Stop-signal performance was not significantly related to self-reported impulsivity in this study, consistent with some prior investigations (Enticott et al., 2006; Galimberti et al., 2012; Liiffit et al., 2004), but inconsistent with others (Logan et al., 1997). The lack of association between self-reported impulsivity, motor inhibitory control and omission errors may represent the complex nature of impulsivity and a trait versus state distinction (Enticott and Ogloff, 2006). Namely impulsivity can refer to broad patterns of thinking, feeling and behaving that exist across situations or to the inability to inhibit a specific behavior. Alternatively, researchers argue that performance on the SSRT also indexes compulsivity, as it requires the inhibition of an initiated response (Robbins et al., 2012). Given the centrality of compulsivity to both OCD and EDs (Altman and Shankman, 2009) and the complex relationship of compulsivity to impulsivity (Robbins et al., 2012), there is a clear need for continued research in this area.

Limitations of this investigation also warrant consideration. First, this study was limited to women and most of the participants had a high level of educational attainment. While this helped maximize comparability between groups, future investigations are needed to delineate whether these results generalize to more diverse populations. Second, the exclusion of underweight individuals and those with primary compulsive hoarding precludes the generalization of these results to individuals with current AN or those for whom hoarding is a large part of the clinical picture. Third, this report did not take into consideration depression or general anxiety symptoms that may impact neuropsychological performance. Finally, this investigation was limited by a relatively small sample size that did not allow exploration of the heterogeneous nature of both OCD and EDs. Replication with a larger sample is needed to substantiate these findings and explore potential relationships between impulsivity and specific symptom constellation both within and between the disorders.

In conclusion, this study sought to characterize the nature of impulsivity in OCD and ED populations using both self-report and a neurocognitive measure of response inhibition. Results highlight the heterogeneous nature of current measures of impulsivity and underscore the need to consider how impulsivity is defined in future investigations of OCD and ED populations.

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