

# Capacity to Delay Reward Differentiates Obsessive-Compulsive Disorder and Obsessive-Compulsive Personality Disorder

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**Background:** Although the relationship between obsessive-compulsive disorder (OCD) and obsessive-compulsive personality disorder (OCPD) has long been debated, clinical samples of OCD (without OCPD) and OCPD (without OCD) have never been systematically compared. We studied whether individuals with OCD, OCPD, or both conditions differ on symptomatology, functioning, and a measure of self-control: the capacity to delay reward.

**Methods:** Twenty-five OCD, 25 OCPD, 25 comorbid OCD + OCPD, and 25 healthy control subjects completed clinical assessments and a validated intertemporal choice task that measures capacity to forego small immediate rewards for larger delayed rewards.

**Results:** OCD and OCPD subjects both showed impairment in psychosocial functioning and quality of life, as well as compulsive behavior, but only subjects with OCD reported obsessions. Individuals with OCPD, with or without comorbid OCD, discounted the value of delayed monetary rewards significantly less than OCD and healthy control subjects. This excessive capacity to delay reward discriminates OCPD from OCD and is associated with perfectionism and rigidity.

**Conclusions:** OCD and OCPD are both impairing disorders marked by compulsive behaviors, but they can be differentiated by the presence of obsessions in OCD and by excessive capacity to delay reward in OCPD. That individuals with OCPD show less temporal discounting (suggestive of excessive self-control), whereas prior studies have shown that individuals with substance use disorders show greater discounting (suggestive of impulsivity), supports the premise that this component of self-control lies on a continuum in which both extremes (impulsivity and overcontrol) contribute to psychopathology.

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**Key Words:** Delay discounting, impulsivity, obsessive-compulsive disorder, obsessive-compulsive personality disorder, self-control, temporal discounting

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The relationship between obsessive-compulsive disorder (OCD) and obsessive-compulsive personality disorder (OCPD) has long been debated, yet clinical samples of OCD (without OCPD) and OCPD (without OCD) have never been systematically compared. Prevalence and familiarity data support a relationship between the disorders: elevated rates of OCPD (23% to 35%) in subjects with OCD (1–3) (in comparison with rates of OCPD of 1% to 7% in community samples) (1,4,5) and greater frequency of OCPD in first-degree relatives of OCD probands compared with relatives of control probands (6,7). The overlap in some symptom presentations of OCD (e.g., incompleteness symptoms/not just right experiences) with perfectionism in OCPD can make it difficult to differentiate these disorders based on phenotype alone. A clinical guideline that has traditionally been used to distinguish the disorders is based on patients' experience of their symptoms: in OCD, obsessions are considered intrusive, distressing, and generally ego-dystonic; OCPD traits and symptomatic behaviors are generally considered ego-syntonic and are viewed by affected individuals as

appropriate and correct. Advances in cognitive neuroscience now make it possible to evaluate the relationship between these disorders based on domains of neural functioning.

One core distinction between OCD and OCPD may be in the domain of self-control. Self-control has been defined as "the ability to evaluate and subsequently respond flexibly in search of a specific goal or outcome under changing environmental conditions" (8). Diminished self-control (i.e., impulsivity) is thought to have several potentially dissociable cognitive dimensions: 1) an inability to forego an immediate smaller reward in favor of a delayed larger reward (delay discounting); 2) an inability to use available information to reflect on the consequences of actions; and 3) a deficit in suppressing prepotent motor responses (9,10). Much has been learned about impulsivity and its role in mental disorders such as substance use disorders, pathological gambling, attention-deficit/hyperactivity disorder, and borderline personality disorder. Excessive self-control (or overcontrol) has also been linked to negative outcomes, including social isolation, poor interpersonal functioning, perfectionism, rigidity, and lack of emotional expression (11). However, research has not focused on how excessive self-control contributes to the development and maintenance of psychopathology.

Based on its phenotype of perfectionism, a desire to control one's environment and cognitive and behavioral inflexibility (12), OCPD appears to be characterized by excessive self-control. The aim of the present study was to compare individuals with OCD (without OCPD) with individuals with OCPD (without OCD) for the first time on symptomatology, psychosocial functioning, and one dimension of self-control: the capacity to delay reward (13). To assess the capacity to delay reward, we used a validated intertemporal choice task that measures capacity to forego small immediate rewards for larger delayed rewards. On this task, individuals have been shown to differ in the rate at which they discount future rewards (discount factor) (14), which is stable over

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time and trait-like (15). Greater delay discounting (lower discount factor) has been associated with impulsivity in psychiatric illnesses such as substance use disorders (16) and borderline personality disorder (17). Moreover, functional neuroimaging studies of delay discounting in healthy individuals have shown that limbic regions, including the ventral striatum and ventromedial prefrontal cortex, are preferentially activated by decisions involving immediately available rewards, whereas activations of the dorsolateral prefrontal cortex (DLPFC) and parietal cortex are associated with selections of larger, delayed rewards (18). We chose to focus on this component of impulsivity because a recent study (19) demonstrated excessive capacity to delay reward using a delay discounting paradigm in patients with the restricting subtype of anorexia nervosa, who are known to have high rates of OCPD (20). Given the descriptive phenotype of OCPD and our clinical experience with these patients, we hypothesized that individuals with OCPD, both with and without comorbid OCD, would show increased capacity to delay reward compared with both healthy control subjects and individuals with OCD. We also hypothesized that individuals with OCPD would show impairment in psychosocial functioning and quality of life, comparable with those with OCD.

## Methods and Materials

### Overview

The institutional review board of the New York State Psychiatric Institute/Columbia University approved the study, and subjects provided written informed consent before testing. Subjects were recruited by advertisements, our clinic website, clinician referral, and word of mouth. All study procedures occurred on 1 day.

### Participants

Participants were adult outpatients (ages 18 to 60) who presented to the Anxiety Disorders Clinic at New York State Psychiatric Institute/Columbia University. Eligible subjects had no significant medical problems and no current or past neurological disorder. Participants were excluded for prominent suicidal ideation, drug or alcohol abuse in the last 6 months, and lifetime mania, psychosis, and substance dependence. A total of 100 volunteers participated, grouped by principal diagnosis: 1) Twenty-five individuals who met DSM-IV OCD criteria with clinically significant symptoms (as defined by Yale-Brown Obsessive Compulsive Scale [Y-BOCS] total score  $\geq 16$ ) and had no history of OCPD. OCD subjects with principal hoarding symptoms were excluded. OCD was the only current Axis I diagnosis for 19 (76%) OCD subjects, while 3 had a comorbid depressive disorder (major depressive disorder, dysthymia) and 4 had a co-occurring anxiety disorder (generalized anxiety disorder, panic disorder, specific phobia). 2) Twenty-five individuals who met DSM-IV OCPD criteria and had no history of OCD. No current Axis I diagnosis was present in 13 (52%) OCPD subjects; 12 had a co-occurring anxiety disorder (generalized anxiety disorder, specific phobia, social phobia). OCPD was the only Axis II diagnosis for 18 (72%) OCPD subjects; 7 also met criteria for avoidant personality disorder. 3) Twenty-five individuals who met DSM-IV criteria for OCD with clinically significant symptoms (as defined by Y-BOCS total score  $\geq 16$ ) and OCPD. OCD + OCPD subjects with principal hoarding symptoms were excluded. OCD was the only current Axis I diagnosis for 22 (88%) OCD + OCPD subjects, while 3 had a co-occurring anxiety disorder (generalized anxiety disorder,

specific phobia). OCPD was the only Axis II diagnosis for 23 (92%) OCD + OCPD subjects; 2 also met criteria for avoidant personality disorder. 4) Twenty-five healthy control subjects (HC) with no current or lifetime DSM-IV Axis I or II diagnoses and no exposure to psychotropic medications; none reported a history of OCD or OCPD in first-degree relatives as assessed by the Family History Screen (21). Healthy control subjects were recruited who matched the other groups on age, sex, race, and years of education.

Across the patient groups ( $n = 75$ ), 25 (33.3%) were currently taking psychiatric medications (OCD: 52%, OCPD: 16%, OCD + OCPD: 32%); all were on a stable dose for at least 8 weeks (mean = 144.9, SD = 103.0): 18 were taking serotonin reuptake inhibitors (SRI), 6 were taking an SRI with a non-SRI (i.e., another antidepressant,  $n = 3$ ; benzodiazepine,  $n = 2$ ; other anxiolytic,  $n = 1$ ), and 1 was taking a benzodiazepine alone.

### Procedures

**Clinical Assessment.** Independent evaluators (clinical researchers with extensive experience in OCD and OCPD and trained to reliability) conducted patient assessments. Psychiatric and personality disorder diagnoses were confirmed by the Structured Clinical Interview for DSM-IV Axis I Disorders–Patient version (22) and the Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II) (23), respectively. OCPD severity was operationalized as the total number of DSM-IV OCPD symptoms coded as present and clinically significant on the SCID-II. Standardized reading tests [Wechsler Test of Adult Reading (24); North American Adult Reading Test (25)] were used to provide an estimate of verbal IQ (exclusion if IQ  $\leq 85$ ).

The 17-item Hamilton Depression Rating Scale (26) was administered to assess depressive severity. For subjects with OCD, current symptoms and symptom severity were evaluated using the Y-BOCS (27) (range 0–40 with higher scores representing greater severity). In all groups, dimensional scores of obsessive-compulsive behaviors were obtained with the Obsessive-Compulsive Inventory-Revised (OCI-R) (28). In addition to the total score, six subscale scores were calculated: washing, obsessing, checking, ordering, hoarding, and neutralizing. The total score ranges from 0 to 72, and each subscale ranges from 0 to 12. The subscales have been shown to be valid indicators of severity of each behavioral dimension (29). Psychosocial functioning was assessed using the Social Adjustment Scale–Self-Report (SAS-SR) (30). The overall adjustment scale provides a total score based on six life domains: work, social and leisure, extended family, primary relationship, parental, and family unit. Quality of life was assessed using the Quality of Life Enjoyment and Satisfaction Questionnaire–Short Form (Q-LES-Q-SF) (31). The total score is expressed as a percentage of the maximum possible score of 70. Higher scores on the SAS-SR and lower scores on the Q-LES-Q-SF indicate poorer functioning and quality of life, respectively.

The demographics questionnaire provided self-report information on education, employment, and household income. Because a primary outcome measure in this study assesses decision making around monetary choices, socioeconomic status was assessed in several ways: household income, employment status, and degree of education. Household income was measured on a scale with the following categories, 1 =  $< \$25,000$ , 2 =  $\$25,000$  to  $44,999$ , 3 =  $\$45,000$  to  $69,999$ , 4 =  $\$70,000$  to  $100,000$ , 5 =  $> \$100,000$ . Employment status was categorized as unemployed, employed part-time, or employed full-time. Education level was assessed both as years of education and highest level of

education achieved (high school or less, college degree, graduate degree).

**Intertemporal Choice Task.** We assessed participants' discount factor, defined as the magnitude of reduction in the present value of a future reward, using a valid and reliable intertemporal choice titration procedure (32). On a questionnaire, participants were asked to make a series of binary choices between an amount of money available immediately (smaller-sooner) versus a larger amount offered later in time (larger-later); they did not receive the chosen outcomes. The time frame was the same for each choice (now or 3 months from now) and the discount factor was derived by determining the switch point or indifference point (see below). The context or order in which delay of reward is presented to a subject has been shown to modulate delay discounting (32). Specifically framing a delayed reward in terms of accelerating its arrival reduces delay discounting (higher discount factor), whereas framing in terms of delaying its arrival increases delay discounting (lower discount factor). Therefore, two sets of 13 choices (accelerate-framing versus delay-framing) were administered to each participant, resulting in a total of 26 binary choices. In the accelerate set, participants were instructed that they would receive a gift certificate of \$80 in 3 months (larger-later) but that they could instead choose to receive a gift certificate for a smaller amount of money immediately (smaller-sooner); the larger-later amount was fixed, while the smaller-sooner amount increased from \$25 to \$80 in \$5 increments, resulting in a total of 13 accelerate binary choices. In the delay set, participants were instructed that they would receive a \$45 gift certificate immediately (smaller-sooner) but that they could choose to receive a larger amount of money in 3 months (larger-later); the smaller-sooner was fixed, while larger-later increased from \$45 to \$100 in \$5 increments, resulting in a total of 13 delay binary choices. The discount factor for each set was derived by participants' indifference point: when they switched from larger-later to smaller-sooner in the accelerate set or from smaller-sooner to larger-later in the delay set. Discount factor was calculated as  $\delta = (x_1/x_2)^{(1/(t_2-t_1))}$  (32), where the amount to be received immediately was  $x_1$  and the amount to be received in 3 months was  $x_2$  and  $t_2 - t_1$  referred to the difference in time to receive the amount, which in this study was 3 months. If there is no discounting, the discount factor is 1. Values closer to 0 (smaller values) indicate greater discounting, which can be understood as a greater tendency to choose the immediate reward. To illustrate, larger numbers, such as a discount factor of .99, indicate that the individual assesses the present value of a delayed reward as closer to its numeric value than those with a lower discount factor. This procedure for assessing a discount factor is independent of hyperbolic modeling or area under the curve analyses, as the task does not assess across a range of time frames.

### Statistical Analysis

Data analyses were conducted using IBM SPSS Statistics Version 20 (IBM Corporation, Armonk, New York). Statistical tests were two-tailed with level of significance set at  $p = .05$ . Demographic and clinical characteristics were compared across groups (OCD, OCPD, OCD + OCPD, HC) using analysis of variance (ANOVA) for continuous variables (age, years of education, verbal IQ estimate, Y-BOCS, OCPD severity, Hamilton Depression Rating Scale, SAS-SR, Q-LES-Q-SF, OCI-R scores). Significant effects of group were explored further using protected least significant difference (LSD) tests. Gender, marital status, and race were compared using  $\chi^2$  analyses. Nonparametric tests (Kruskal-Wallis H tests) were used to compare ordinal variables (household

income employment status, level of education). Principal OCD symptoms on the Y-BOCS checklist were categorized according to five previously identified symptom dimensions (taboo thoughts, contamination/cleaning, doubt/checking, symmetry/ordering, and hoarding) (33,34). The primary analysis was a repeated-measures ANOVA with discount factor as the dependent variable, group (OCD vs. OCPD vs. OCD + OCPD vs. HC) as a between-subjects variable, and framing (accelerate vs. delay) as a within-subjects variable, followed by protected LSD tests as appropriate. Given the known relationship between substance abuse and delay discounting (35), this analysis was repeated with substance abuse history as a covariate. Although substance abuse within 6 months was an exclusion criterion, 8 of the 100 participants had a prior history of substance abuse (alcohol, cannabis, cocaine). The presence of the OCPD miserliness criterion (in 6 of the 100 participants) and current psychiatric medication status were also included as covariates in these sensitivity analyses. To determine the extent to which the mean discount factor (across framing conditions) can discriminate between OCD and OCPD, we conducted a receiver operator characteristic analysis, which uses the association between sensitivity and specificity of the measure at different cutoff scores to derive an area under the curve (AUC), an index for how well overall a measure distinguishes between diagnostic groups. A value of .50 of the AUC indicates chance level and 1.0 indicates a perfect diagnostic tool.

In addition, we explored associations between mean discount factor and psychosocial functioning (SAS-SR) and quality of life (Q-LES-Q-SF) in patients using Pearson correlations. To explore the impact of individual OCPD criteria (SCID-II) on delay discounting, a series of *t* tests were conducted to compare patients with versus without each criterion on mean discount factor. Given the exploratory nature of these analyses, we used a more conservative significance level of  $p < .01$ , without correcting for multiple comparisons.

### Results

Demographic characteristics for the four groups are presented in Table 1. There were no significant group differences on age, gender, marital status, race, number of years of education, estimate of verbal IQ, household income, employment status, and highest level of education. All participants scored in the average range or higher on the estimate of verbal IQ.

Clinical characteristics were compared across the four groups (Table 2). Both OCD and OCPD subjects showed significant impairment in psychosocial functioning and quality of life on the SAS-SR and Q-LES-Q-SF relative to HC subjects. The patient groups did not differ in terms of depressive severity (all in the nondepressed range).

Patients with OCD, with or without OCPD, presented with OCD symptoms in the markedly ill range. All five OCD symptom dimensions were represented (i.e., taboo thoughts, contamination/cleaning, doubt/checking, symmetry/ordering, and hoarding), and each patient with OCD had symptoms in more than one dimension with three exceptions: two had only taboo thoughts symptoms and one had only doubt/checking symptoms. In the OCD group, the most commonly reported principal symptom was taboo thoughts (40%), followed by contamination/cleaning (24%), doubt/checking (24%), and symmetry/ordering (12%). In the OCD + OCPD group, the most commonly reported principal symptom was symmetry/ordering (52%), followed by

**Table 1.** Demographic Characteristics of OCD, OCPD, OCPD + OCD, and Healthy Control Subjects

	OCD (n = 25)		OCPD (n = 25)		OCD + OCPD (n = 25)		HC (n = 25)		F	p	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD			
Age (Years)	30.4	8.23	35.6	11.17	33.7	9.12	33.7	10.76	1.17	.325	
Education (Years)	15.4	2.4	16.6	2.33	16.8	2.36	16.8	2.01	2.23	.089	
IQ Estimate	114.5	9.51	112.0	5.21	113.6	7.24	111.5	6.72	.89	.449	
	n	%	n	%	n	%	n	%	$\chi^2$	p	
Female	10	40	16	64	12	48	15	60	3.65	.301	
Married	8	32	9	36	8	32	2	8	6.24	.100	
Caucasian	17	68	13	52	17	68	14	56	2.14	.543	
	n	%	n	%	n	%	n	%	H <sup>a</sup>	p	
Household Income <sup>b</sup>	1	6	24	9	36	10	40	7	28	1.77	.621
	2	6	24	3	12	5	20	8	32		
	3	5	20	3	12	2	8	7	28		
	4	3	12	3	12	5	20	1	4		
	5	5	20	7	28	3	12	2	8		
Level of Employment	None	7	28	5	20	12	48	4	16	4.91	.179
	Part Time	4	16	4	16	1	4	3	12		
	Full Time	14	56	16	64	12	48	18	72		
Highest Level of Education	High School	8	32	5	20	6	24	4	16	4.27	.234
	College	12	48	10	40	6	24	12	48		
	Graduate	5	20	10	40	13	52	9	36		

HC, healthy control subjects; OCD, obsessive-compulsive disorder; OCPD, obsessive-compulsive personality disorder.

<sup>a</sup>Kruskal-Wallis H test.

<sup>b</sup>Defined as 1 = <\$25,000, 2 = \$25,000 to 44,999, 3 = \$45,000 to 69,999, 4 = \$70,000 to 100,000, 5 = >\$100,000.

contamination/cleaning (32%), taboo thoughts (8%), and doubt/checking (8%).

Patients with OCPD, with or without OCD, did not differ in terms of OCPD severity. On clinical interview, none of the OCPD subjects (without OCD) endorsed intrusive, repetitive thoughts or images experienced as distressing or unpleasant (i.e., obsessions) but they did report ritualized/methodical behaviors, such as list making, organizing belongings, or checking/editing written work, though these behaviors were not described as being aimed at preventing or reducing distress or preventing some dreaded event. When compared on the OCI-R, a dimensional measure of

obsessive-compulsive behaviors, those with OCD were more likely to endorse washing and obsessing; those with OCPD were more likely to endorse ordering and hoarding behaviors.

The repeated-measures ANOVA yielded a significant effect for group ( $F_{3,96} = 5.11, p = .003$ ) regardless of framing (Figure 1). In post hoc LSD tests, discount factor was greater in OCPD relative to both OCD ( $p = .003$ ) and HC ( $p = .002$ ) and greater in OCD + OCPD relative to both OCD ( $p = .025$ ) and HC ( $p = .020$ ). There was no difference in discount factor between OCPD and OCD + OCPD ( $p = .444$ ) or between OCD and HC ( $p = .928$ ). There was a significant effect of framing ( $F_{1,96} = 75.46, p < .001$ ) in that the

**Table 2.** Clinical Characteristics of OCD, OCPD, OCPD + OCD, and Healthy Control Subjects

	OCD (n = 25)	OCPD (n = 25)	OCD + OCPD (n = 25)	HC (n = 25)	F	p
Y-BOCS	25.7 (3.79) <sup>1</sup>	—	27.4 (4.36) <sup>1</sup>	—	2.11	.152
OCPD Severity <sup>a</sup>	.4 (.50) <sup>2</sup>	4.8 (1.07) <sup>1</sup>	4.6 (.87) <sup>1</sup>	0 (0) <sup>2</sup>	319.93	<.001
HAM-D	5.4 (5.10) <sup>1</sup>	3.4 (4.28) <sup>1</sup>	5.8 (4.59) <sup>1</sup>	.3 (.80) <sup>2</sup>	9.35	<.001
SAS-SR Overall Adjustment <sup>b</sup>	2.3 (.51) <sup>1</sup>	2.2 (.50) <sup>1</sup>	2.2 (.46) <sup>1</sup>	1.5 (.31) <sup>2</sup>	15.29	<.001
Q-LES-Q-SF	62.5 (15.73) <sup>1</sup>	60.6 (18.98) <sup>1</sup>	60.7 (18.91) <sup>1</sup>	83.2 (12.63) <sup>2</sup>	10.60	<.001
OCI-R Total Score	21.2 (10.39) <sup>1</sup>	24.0 (16.31) <sup>1</sup>	34.6 (10.42) <sup>2</sup>	2.1 (3.50) <sup>3</sup>	36.97	<.001
Washing	4.4 (4.16) <sup>1</sup>	2.5 (3.25) <sup>2</sup>	5.4 (3.55) <sup>1</sup>	.3 (1.06) <sup>3</sup>	12.31	<.001
Obsessing	6.3 (3.94) <sup>1</sup>	3.3 (3.52) <sup>2</sup>	5.8 (3.93) <sup>1</sup>	.2 (.52) <sup>3</sup>	17.63	<.001
Checking	3.0 (2.89) <sup>1</sup>	3.6 (3.82) <sup>1</sup>	6.6 (3.24) <sup>2</sup>	.2 (.52) <sup>3</sup>	20.43	<.001
Ordering	3.0 (3.17) <sup>1</sup>	7.8 (3.70) <sup>2</sup>	8.5 (2.90) <sup>2</sup>	.7 (1.14) <sup>3</sup>	42.59	<.001
Hoarding	2.4 (3.17) <sup>1</sup>	4.2 (3.80) <sup>2</sup>	5.2 (4.02) <sup>2</sup>	.6 (1.19) <sup>3</sup>	9.84	<.001
Neutralizing	2.0 (2.58) <sup>1</sup>	2.6 (3.59) <sup>1</sup>	3.0 (2.61) <sup>1</sup>	.1 (.28) <sup>2</sup>	6.26	.001

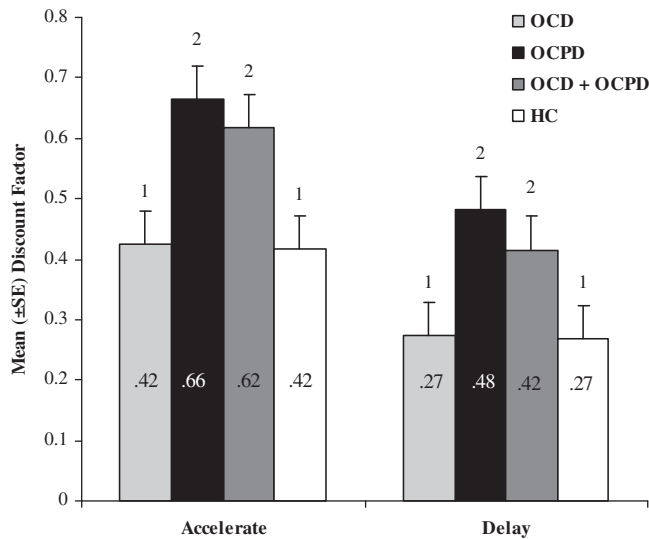
Results by group are presented as mean (standard deviation) for ANOVA. Different numerical superscripts indicate significant group differences in post hoc protected least significant difference tests.

ANOVA, analysis of variance; HAM-D, Hamilton Depression Rating Scale; HC, healthy control subjects; OCD, obsessive-compulsive disorder; OCI-R, Obsessive Compulsive Inventory-Revised; OCPD, obsessive-compulsive personality disorder; Q-LES-Q-SF, Quality of Life Enjoyment and Satisfaction Questionnaire-Short Form; SAS-SR, Social Adjustment Scale-Self Report; Y-BOCS, Yale-Brown Obsessive Compulsive Scale.

<sup>a</sup>OCPD severity = number of clinically significant DSM-IV OCPD criteria met (out of eight). Clinically significant OCPD criteria were not present at all in 60% of OCD subjects and 100% of HC.

<sup>b</sup>OCD, n = 12.





**Figure 1.** Discount factor across groups. The groups differed in delay discounting ( $F_{3,96} = 5.11, p = .003$ ). Individuals with obsessive-compulsive personality disorder (OCPD) ( $n = 25$ ) or obsessive-compulsive disorder (OCD) + OCPD ( $n = 25$ ) discount the value of delayed reward significantly less than individuals with OCD ( $n = 25$ ) or healthy control subjects (HC) ( $n = 25$ ) in choices that allow them to accelerate receipt of money and in choices that allow them to delay receipt. Discount factor group means: accelerate, OCD =  $.42 \pm .33$  versus OCPD =  $.66 \pm .30$  versus OCD + OCPD =  $.62 \pm .33$  versus HC =  $.42 \pm .30$ ; delay, OCD =  $.27 \pm .25$  versus OCPD =  $.48 \pm .25$  versus OCD + OCPD =  $.42 \pm .23$  versus HC =  $.27 \pm .21$ . Higher discount factor scores indicate a greater tendency to choose the larger delayed reward. Different numerical superscripts in the figure indicate significant group differences in post hoc protected least significant difference tests.

accelerate (vs. delay) framing condition was associated with a higher discount factor (i.e., less discounting) across all groups. There was no significant interaction between framing and group ( $F_{3,96} = .42, p = .741$ ). There was no effect on discount factor for substance abuse history, miserliness, or current psychiatric medication status and none of these covariates interacted significantly with framing.

The receiver operator characteristic curve of mean discount factor for discriminating OCD and OCPD samples is depicted in Figure 2. The AUC was .73;  $p = .005$  (95% confidence interval = .59–.88). These results indicate that the continuous measure of discount factor can reliably distinguish OCD from OCPD cases.

Across the three patient groups, mean discount factor was not associated with either psychosocial functioning ( $r_{62} = -.19, p = .138$ ) or quality of life ( $r_{75} = .06, p = .597$ ). Among the patients, the presence of clinically significant perfectionism and rigidity, as per interviewer rating, were each associated with greater capacity to delay reward (Table 3).

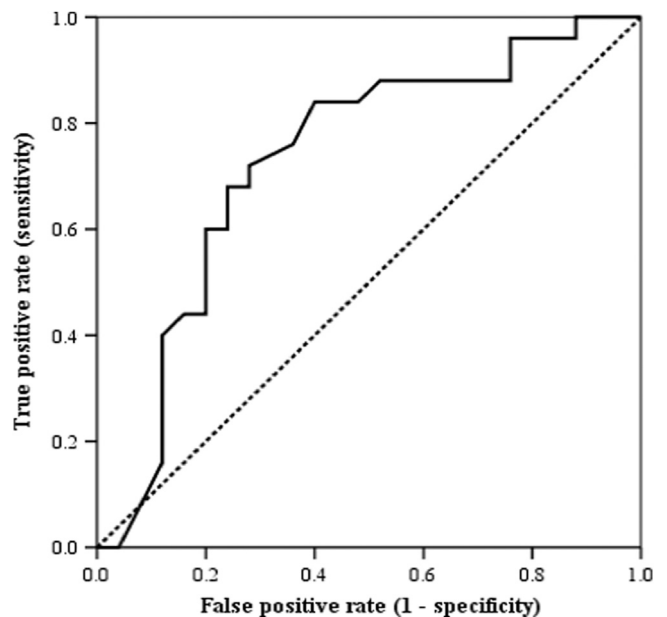
**Discussion**

This is the first study to systematically compare clinical samples of OCD (without OCPD) and OCPD (without OCD) on symptomatology, functioning, and on a dimension of self-control: the capacity to delay reward. Our findings show that OCPD, like OCD, is an impairing disorder. In our sample, individuals with OCPD reported comparable impairment in psychosocial functioning and quality of life as those with OCD and consistent with the degree of impairment found in prior studies of OCD (36–39). Our finding of impairment in a clinical sample of OCPD is consistent with a

prior study of treatment-seeking patients with personality disorders that found OCPD, along with borderline personality disorder, is associated with the highest economic burden of all personality disorders in terms of direct medical costs and productivity losses (40).

While both OCPD and OCD are marked by ritualized behaviors, they were distinguished by the presence of obsessions in OCD and not in OCPD. We also found that these disorders differ on a well-validated task of self-control linked to brain systems. Specifically, on an intertemporal choice task, individuals with OCPD, either with or without comorbid OCD, discounted the value of delayed monetary rewards significantly less (i.e., higher discount factors; greater capacity to delay reward) than OCD and HC (with no difference between OCD and HC). Furthermore, the OCPD groups reported higher discount factors regardless of framing condition (the order in which delay of reward is presented), suggesting that this group effect is robust and not mediated by context. The excessive capacity to delay reward reliably discriminated OCPD from OCD and was associated with the presence of particular OCPD traits, perfectionism and rigidity, which are core components of the disorder (41,42).

The only clinical population to date to show increased capacity to delay reward relative to healthy control subjects (using the same intertemporal choice task) has been anorexia nervosa-restricting type (19). The current results suggest that individuals with OCPD and anorexia may share an abnormality in reward processing marked by a heightened capacity to delay receipt of reward, which may contribute to their pathologic behaviors. For example, the maladaptive behaviors in OCPD involve foregoing immediate rewards (e.g., efficiency, productivity) in favor of a future, potential reward (e.g., perfection) or the need to follow rigid rules or routines (e.g., rigidity). Our findings may also help explain the association between OCPD traits and suicide (43,44) in light of recent findings of more serious, premeditated suicidal acts in depressed older adults who show greater willingness to delay reward (45).



**Figure 2.** Receiver operator characteristic curve of mean discount factor for discriminating between obsessive-compulsive disorder and obsessive-compulsive personality disorder samples.

**Table 3.** Differences in Mean Discount Factor Based on Presence vs. Absence of Individual OCPD Criteria Across Patients with OCD, OCPD, OCD + OCPD ( $n = 75$ )

OCPD Criteria	Present		Absent		<i>t</i>	<i>p</i>
	<i>n</i>	<i>M</i> ( <i>SD</i> )	<i>n</i>	<i>M</i> ( <i>SD</i> )		
Preoccupation with Details	51	.53 (.26)	24	.37 (.29)	2.36	.021
Perfectionism	45	.55 (.26)	30	.38 (.27)	2.72	.008
Excessive Work Devotion	29	.55 (.26)	46	.44 (.28)	1.73	.088
Hypermorality	30	.48 (.26)	45	.48 (.29)	.10	.920
Inability to Discard	15	.61 (.21)	60	.45 (.28)	2.55	.016
Reluctance to Delegate	41	.51 (.28)	34	.44 (.27)	1.16	.249
Miserliness	6	.66 (.18)	69	.46 (.28)	1.70	.093
Rigidity and Stubbornness	29	.58 (.23)	46	.41 (.28)	2.69	.009

HC, healthy control subjects; OCD, obsessive-compulsive disorder; OCPD, obsessive-compulsive personality disorder.

The intertemporal choice task used in this initial study is time-efficient and easy to administer (paper and pencil) but only tests one indifference point (point at which participant switches preferences). A computerized version of the task has since been developed that allows for presentation of multiple time delays and amounts of money to more precisely characterize the indifference point (46). Our results need to be replicated on this new version.

Our findings have implications for future research. First, even though OCPD is the most common personality disorder in the US general population (4), leading to high rates of treatment utilization (47), there has been no systematic study of its underlying neural substrate and there is no empirically validated treatment for the disorder. Given that preference for delayed reward is associated with heightened activation of the DLPFC (18), our findings suggest potential brain-behavior relationships in OCPD, providing support for future imaging studies and the development of novel pharmacologic and psychosocial strategies to modulate excessive self-control. For example, transient disruption of left DLPFC with transcranial magnetic stimulation (46) and modulation of the serotonin system (via tryptophan depletion) (48) have both been shown to biologically reduce self-control in healthy control subjects, as measured by a delay discounting task. Such innovative strategies may offer a much needed treatment direction for OCPD and other difficult-to-treat conditions marked by excessive self-control such as anorexia nervosa-restricting type. Effective strategies for OCPD may also provide adjunctive treatments for those with OCD + OCPD who have been shown to have poorer outcomes from standard OCD treatments (3,49).

Second, our findings indicate that OCD and OCPD can be differentiated by their capacity to delay reward, one component of self-control. Research is needed on the other dimensions of self-control, including the ability to suppress prepotent (well-established) motor responses and the ability to flexibly use outcome expectancies to guide goal-directed behavior versus relying on stimulus-driven habits. Prior studies of OCD have shown motor impulsivity on the stop-signal task in patients and their unaffected first-degree relatives (50,51), as well as a deficit in goal-directed control and an overreliance on habits on an instrumental discrimination task (52). These paradigms have not yet been applied to OCPD. Since OCD and OCPD have often been confused in the literature, operationalizing the differences between these disorders has implications for classification and treatment, in addition to reducing heterogeneity in studies of mechanism.

Finally, that individuals with OCPD, along with individuals with anorexia nervosa-restricting type, show less temporal discounting (suggestive of excessive self-control), whereas individuals with substance use disorders and borderline personality disorder in previous studies show greater discounting (suggestive of impulsivity), supports the premise that this component of self-control may best be conceptualized along a transdiagnostic continuum, consistent with the National Institute of Mental Health Research Domain Criteria initiative (<http://www.nimh.nih.gov/research-funding/rdoc.shtml>), in which both extremes (impulsivity and overcontrol) can contribute to psychopathology.

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