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Negative Priming for Obsessive–Compulsive Checkers and Noncheckers

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Negative priming—the slowing of a response to an item that was recently ignored—was investigated in three groups: obsessive–compulsive disorder (OCD) checkers, OCD noncheckers, and nonclinical control participants. All groups performed both a standard negative priming task, selecting targets based on a perceptual feature (i.e., color), and a modified negative priming task, selecting targets based on a semantic feature (i.e., referent size). All three groups demonstrated significant negative priming in both tasks, although the negative priming was much larger in the novel, semantic task than in the common, perceptual one. The findings suggest that patients with OCD do not demonstrate impairments in negative priming, contrary to earlier claims (Enright & Beech, 1990, 1993a, 1993b; Enright, Beech, & Claridge, 1995).

With the growth of cognitive psychology over the past 30 years, there has been an explosion of cognitive paradigms. Recently, these paradigms have been used increasingly to investigate cognitive processing in patient populations. One of the paradigms that has been adopted as a tool in the arsenal of the clinical researcher is the negative priming task.

Negative Priming

Negative priming refers to a delay or an increase in errors when responding to an item that was previously ignored (see Fox, 1995; May, Kane, & Hasher, 1995, for reviews). In a typical negative priming study, a participant selects a target item from among one or more distractors on a first trial (i.e., the prime trial). This selection task is then normally repeated on a second trial (i.e., the probe trial). The crucial factor is the relation between the targets and distractors on the successive trials. In the control condition, normally no relation exists between the targets and distractors on the consecutive trials (e.g., the distractor TREE on the prime trial followed by the target DESK on the probe trial). This condition serves as a baseline in terms of latency and error rate for performing the task. The ignored repetition condition is the critical experimental condition. Here, the distractor from the prime reappears as the target on the probe (e.g., the distractor TREE on the prime followed by the target TREE on the probe). In this condition, responses to the probe target are normally slower and more error prone than are responses to the probe target in the control condition. This is the standard negative priming phenomenon.

Inhibition Account of Negative Priming

The inhibition account (Houghton & Tipper, 1994; Neill, 1977; Tipper, 1985) provided the earliest explanation of negative priming. According to this view, negative priming is produced by a dual-process selective attention mechanism that activates targets and inhibits distractors. In the negative priming task, the distractor on the prime trial is inhibited, the goal being to facilitate processing and responding to the target. Negative priming occurs in the ignored repetition condition because the prime distractor subsequently reappears as the target on the probe trial, carrying with it its previous inhibition. It takes time for this residual inhibition to dissipate, hence the delay in responding. This is the central premise of all versions of the inhibition account.

Obsessive–Compulsive Disorder

Obsessive–compulsive disorder (OCD) is classified in the *Diagnostic and Statistical Manual of Mental Disorders,* 4th edition (*DSM–IV;* American Psychiatric Association, 1994), as an anxiety disorder, characterized by recurrent and persistent obsessions or compulsions that are experienced as aversive or traumatic and that interfere with normal functioning (for reviews, see Swinson, Antony, Rachman, & Richter, 1998; Wilson, 1998). In particular, the intrusive and obsessive thoughts that occur seemingly against the patient's will appear consistent with a failure to inhibit irrelevant information. Could OCD symptoms be the product of im-

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paired cognitive inhibition? Some have claimed precisely this (Enright & Beech, 1990, 1993a, 1993b; Enright, Beech, & Claridge, 1995; Martinot et al., 1990).

Negative Priming and OCD

Enright and Beech (1990, 1993a, 1993b) investigated negative priming in OCD patients compared with patients with other anxiety disorders. Using various negative priming approaches (e.g., the Stroop procedure of interleaved green and red words), they found no negative priming (Enright & Beech, 1990, 1993b) or reduced negative priming (Enright & Beech, 1993a) for OCD patients relative to other anxious patients. The authors concluded that negative priming is eliminated because OCD patients fail to suppress distracting information.

Enright et al. (1995) again investigated negative priming in patients with OCD, this time distinguishing between patients who scored high or low on the checking subscale of the Maudsley Obsessive Compulsive Inventory (MOC). They also manipulated stimulus presentation duration, examining durations of 250 and 300 ms in addition to the 100-ms presentation duration used in Enright and Beech (1990, 1993a, 1993b). They found more comparable negative priming for the OCD group and the other-anxiety-disorders group when stimuli remained on the screen for 250 or 300 ms on the prime and the probe. At the 100-ms duration, the negative priming for the OCD patients (7 ms) was less than that of the other-anxiety-disorders group (38 ms). Comparing checkers and noncheckers, however, revealed that this significant difference at the 100-ms duration may have been due to the absence of negative priming for the OCD checkers (n = 16; −2 ms) despite negative priming for OCD noncheckers (n = 16; 16 ms). Even at the 250- and 300-ms durations, checkers demonstrated less negative priming. They concluded that the inhibitory deficit, affecting checkers more than noncheckers, occurs at a preattentive level of processing and that at longer presentation durations "attended strategies of information processing appeared to mask the effects of the inhibition associated with pre-attentive selection" (Enright et al., 1995, p. 541). This explanation, however, does not fit with the inhibition account of negative priming to which Enright et al. ascribed; moreover, it is inconsistent with the negative priming literature in general.

According to the inhibition view, distracting information only becomes inhibited below baseline after selection has occurred, quite late in processing, and certainly not in the first 100 ms (Houghton, Tipper, Weaver, & Shore, 1996). Further, negative priming occurs despite changes in the physical form of the critical repeated stimulus from prime to probe (e.g., Dalrymple-Alford & Budayr, 1966; Tipper & Driver, 1988), it persists across different response modalities (Neill, Lissner, & Beck, 1990; Chiappe & MacLeod, 1995), and it has been observed for semantically related items (Tipper & Driver, 1988; but see Chiappe & MacLeod, 1995). These findings suggest that distractors are processed beyond physical features, refuting the claim that they are normally inhibited preattentively. Strayer and Grison (1998) found no differences at perceptual stages of processing (i.e., P300) in event-related brain potentials between the ignored repetition and the control conditions. Differences appeared only at the response stage in the lateralized readiness potential. Further, MacDonald, Joordens, and Seergobin (1999) present direct evidence that the negative priming mechanism does not act to block out distractors. In a variant of the negative priming procedure that required participants to attend to both targets and distractors, selecting targets on the basis of a semantic feature, the effect was quadrupled to approximately 100 ms. Contrary to the suggestion of Enright et al. (1995), attending to distractors and processing them deeply does not eliminate negative priming but rather enhances it. Clearly, manipulations at the early perceptual stages of processing should only affect negative priming indirectly, if at all.

So how can we explain the findings of Enright et al. (1995) given the implausibility of the preattentive inhibition explanation? Perhaps rather than acting directly on the negative priming mechanism, the short presentation duration undermined the early processing of distractors, causing information to be unavailable for processing at later and more critical stages for negative priming. The encoding of distractors, although sufficient to interfere with online processing (i.e., Stroop performance) for all groups, was insufficient to consistently influence processing on trial $n + 1$ (i.e., on the probe trial), particularly for the OCD group. This is plausible given that the Stroop effect is large, robust, and quite insensitive to attentional manipulations (MacLeod, 1991, 1998) whereas standard negative priming is small, somewhat inconsistent, and sensitive to procedures that affect distractor processing (Malley & Strayer, 1995). Stimulus presentation duration should influence negative priming, albeit indirectly, more than Stroop interference.

But why would this perceptual processing limitation differentially affect OCD patients? The negative priming was not entirely consistent across experiments for the other-anxiety groups, either. Clearly, though, the OCD group was most disadvantaged. Some evidence suggests that OCD patients are deficient in sensory input gating (Swerdlow, Benbow, Zisook, Geyer, & Braff, 1993), and saccadic eye movement programming (Sweeney, Palumbo, Halper, & Shear, 1992; Tien, Pearlson, Machlin, Bylsma, & Hoehn-Saric, 1992), consistent with abnormalities in the basal ganglia and orbitofrontal cortex that were noted in imaging studies during symptom provocation (Breiter et al., 1996; McGuire et al., 1994; Rauch et al., 1994). Although speculative, these impairments in aspects of visual attention may have disadvantaged the OCD group at short stimulus presentations in particular, explaining the absence of negative priming at these durations despite normal negative priming at longer presentation durations. The claim is that a deficit in visual attention coupled with a peculiar methodology, rather than an impairment in the negative priming mechanism per se, produced the results.

This post hoc explanation is by no means incontrovertible. A potential flaw is that, following from this explanation, latencies overall should be longer for the OCD group (Neill, personal communication, August 21, 1998). In the studies in question, however, this was not consistently observed. Although an uncontestable explanation for this puzzling discrepancy is not forthcoming, we are convinced that it is not produced via direct action on the negative priming mechanism.

Memory-Based Accounts of Negative Priming

Although Enright and Beech (1990, 1993a, 1993b) and Enright et al. (1995) only entertained the inhibition view of negative priming in interpreting their findings, this is not the lone theoretical account. In light of current evidence (Chiappe & MacLeod, 1995; MacDonald & Joordens, in press; Milliken, Joordens, Merikle, & Seiffert, 1998), the inhibition view is not even the preferred

explanation. Memory-based alternatives better accommodate the empirical evidence. Had these views been considered, quite different conclusions about OCD would have been drawn.

According to the episodic retrieval theory (Neill, 1997; Neill & Valdes, 1992), negative priming results from a retrieval process during the probe that attempts to recover relevant information about the current target. On ignored repetition trials, a response is required on the probe for an item that was previously encoded without, or with conflicting, response information, delaying responding. The feature mismatch hypothesis (Lowe, 1979; MacDonald & Joordens, in press; Park & Kanwisher, 1994) attributes negative priming to incompatibilities in the stimulus features of the repeated item from prime to probe in the ignored repetition condition. For example, if selection is based on the color red, the repeated item will first appear in the nontarget color on the prime trial then in red on the probe. Most recently, Neill and Mathis (1998) combined these two accounts in their transfer inappropriate processing–transfer appropriate processing (TIP–TAP) approach. Negative priming is attributed to the retrieval of any conflicting or irrelevant information from previous processing episodes. Thus, retrieval of discrepant stimulus features or response information from prime to probe should yield negative priming.

Purpose of the Present Study

Given our claim that negative priming was eliminated for OCD patients because of a feature of Enright and colleague's methodology, the aim of the present study was to reinvestigate negative priming in patients with OCD in the absence of this confound. We were particularly interested in distinguishing between OCD checkers and noncheckers because checkers failed to demonstrate substantial negative priming even at longer stimulus presentation durations.

In addition to a more conventional measure of negative priming, we also tested participants using a variant of the negative priming procedure developed by MacDonald et al. (1999). Across many experiments, the negative priming obtained with this procedure has been large and consistent. Most importantly though, this task requires all participants to attend to both targets and distractors, explicitly testing Enright and colleagues' notion that OCD patients did not show negative priming because they failed to ignore and inhibit distractors.

Method

Participants

Three groups participated in the study: (a) 12 OCD patients demonstrating excessive checking (6 women, 6 men; mean age 33 yrs); (b) 12 OCD patients not showing excessive checking (4 women, 8 men; mean age 33 yrs); and (c) 12 nonclinical control participants (8 women, 4 men; mean age 20 yrs). The OCD participants were recruited from the Anxiety Disorders Clinic at the Clarke Institute of Psychiatry. All met *DSM–IV* criteria (American Psychiatric Association, 1994) for OCD as assessed by the Structured Clinical Interview for *DSM–IV* Axis I Disorders (SCID–IV; First, Spitzer, Gibbon, & Williams, 1996). Patients were divided into groups based on their scores on the Maudsley Obsessive Compulsive Inventory (MOC; Hodgson & Rachman, 1977), where scores range from 0 to 7. Those scoring ≥ 4 on the checking subscale of the MOC were assigned to the checking group; those scoring <4 were designated noncheckers (MacDonald, Antony, MacLeod, & Richter, 1997; Sher, Frost, Kushner, Crews, & Alexander, 1989).

Nonclinical control participants were recruited from the University of Toronto at Scarborough introductory psychology participant pool. They received bonus credit in exchange for their participation. All failed to meet criteria for OCD according to the *DSM–IV* as assessed by the OCD portion of the SCID–IV.

Measures

Maudsley Obsessive Compulsive Inventory (MOC). All participants completed the MOC, a 30-item questionnaire assessing OCD severity on four types of OCD symptoms (Hodgson & Rachman, 1977): checking, cleaning, slowness, and doubting. The test has demonstrated adequate levels of internal consistency, stability, and concurrent validity (Hodgson & Rachman, 1977). This questionnaire was used to classify patients as checkers or noncheckers.

Yale–Brown Obsessive Compulsive Scale (Y–BOCS). The self-report version of the Y–BOCS (Baer, Brown-Beasley, Sorce, & Henriques, 1993) was administered only to OCD patients as a measure of OCD severity. This version has been shown to be comparable to the original interview version (Steketee, Frost, & Bogart, 1996). Because only the psychometric properties of the first 10 items are secure, OCD participants were asked to answer Questions 1–5, pertaining to severity of obsessions, and Questions 6–10, pertaining to severity of compulsions.

State–Trait Anxiety Inventory—State version (STAI–S). The STAI–S (Spielberger, 1983) is a popular instrument designed to measure the extent to which an individual feels anxious, nervous, and worried at a given point in time. It consists of 20 statements for which individuals rate how they feel on a four-point scale. The STAI–S has been shown to have good internal consistency and construct validity (Spielberger, 1988). All participants completed the STAI–S.

Beck Depression Inventory (BDI). The BDI (Beck, Rush, Shaw, & Emery, 1979) is a widely used measure of depressive symptomology, created in 1961 (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) and revised in 1979. It is a 21-item scale derived from clinical observations and appears to be a reliable and valid measure of depression (Beck, Steer, & Garbin, 1988). The BDI evaluated participants' levels of depression, obtaining a severity rating from 0 to 3 for each of the items. All participants completed the BDI.

Shipley Institute of Living Scale—Vocabulary portion (SILS). All participants completed the vocabulary portion of the SILS (Shipley, 1940), which uses a multiple-choice format in which participants are asked to choose the synonyms of target words. This was used to assess verbal ability of participants in the study, with scores potentially ranging from 0 to 40.

Procedure

The experiment was a direct replication of MacDonald et al. (1999) with the addition of the OCD checker and nonchecker groups. The procedure, stimuli, and apparatus were identical. All participants completed two blocks of trials, with the order of blocks counterbalanced across participants. Within both blocks, each trial included a prime display and a probe display. The displays consisted of presenting the names of two animals in lower case in the center of the computer screen. One name was in white, the other was in red. In one block of trials, participants were asked to read the animal name printed in red. This color-selection task is an instance of the typical negative priming procedure (cf. May et al., 1995). In the other block, participants were instructed to name the larger animal in the pair according to a preset size continuum. In this referent size-selection task, participants compared the referents of the two animal names before selecting and responding to targets. This task required processing both items to the semantic level. Much larger negative priming has been demonstrated using this referent size-selection procedure (MacDonald et al., 1999).

Each trial consisted of a prime display followed by a probe display and proceeded as follows: (a) a focal point consisting of four plus signs appeared in the center of the screen for 600 ms, (b) a blank screen was presented for 500 ms, (c) the prime words appeared and remained on the

screen until the participant responded, (d) the word "Ready?" appeared until the experimenter input the participant's accuracy on the prime trial, (e) a blank screen was presented for 500 ms, (f) the probe words appeared and remained on the screen until the participant responded, (g) the word "Ready?" appeared until the experimenter input the participant's accuracy on the probe trial, and (h) a blank screen was presented for 600 ms before the initialization of the next trial. The prime and probe stimuli remained on the screen until participants made an oral response, speaking into the microphone. Participants received 10 practice trials before each block of the experiment.

Apparatus

An IBM-486 compatible microcomputer with a 14-in color VGA monitor was used for all testing. The controlling program was written in QuickBASIC 4.5 using the routines given by Graves and Bradley (1987, 1988) to achieve millisecond timing accuracy. Response times were measured as the interval between the stimulus onset and the participant's vocal response into a microphone, which caused a voice key to send an interrupt to the computer. Accuracy was also scored on-line by the experimenter.

Stimuli

The stimulus words in the experiment, from smallest to largest referent, were *flea, mouse, turtle, pig, goat, donkey, bear,* and *camel.* Before participants performed the referent size-selection task, they were informed of this ordering. The stimuli were always presented in pairs, one above the other at the center of the computer screen.

There were two tasks in the experiment: the referent size-selection task and the color-selection task. In each of these tasks, there were two conditions: control and ignored repetition. However, due to the constraints of the referent size-selection task (i.e., that the target always be larger than the distractor), the ordering and pairing of stimuli differed between the two tasks. Given this, the ordering and pairing of stimuli will be described separately for each task.

The stimulus assignment was straightforward for the color-selection task. All stimuli occurred equally often as targets and distractors, and at the top and the bottom of the display. On a control trial, all four items making up a trial were different. The only change on ignored repetition trials was that the distractor on the prime trial matched the target on the probe trial.

The stimulus assignment was more complex for the referent size-selection task. The complications arose primarily due to the special statuses of *flea* and *camel. Flea,* the smallest animal in the set, could never serve as a target; *camel,* the largest animal, could never serve as a distractor. This created a special challenge on ignored repetition trials where an item must serve as both a distractor on the prime trial and a target on the probe trial. These constraints were dealt with in the following manner.

In the control condition of the size-selection task, all stimuli other than *flea* and *camel* appeared equally often as targets and distractors. Because it could never be a target, *flea* served as a distractor twice as often as the other stimuli. Analogously, *camel* served as a target twice as often as the other stimuli. In all other respects, stimulus assignment in the control condition of the size-selection task matched that of the color-selection task.

In the ignored repetition condition, all stimulus words appeared a total of 8 times as prime distractors, except for the words *camel* and *flea,* which never appeared as prime distractors. The word *camel* appeared a total of 12 times as the prime target, whereas the words *bear, donkey,* and *goat* each appeared a total of 8 times as prime targets. The words *pig* and *turtle* appeared 6 times as prime targets and *mouse* and *flea* did not appear at all as prime targets. The word *flea* appeared as the probe distractor 12 times, whereas *mouse, turtle,* and *pig* each appeared 8 times as probe distractor. The words *goat* and *donkey* each appeared 6 times as probe distractors, whereas *camel* and *bear* did not appear at all as probe distractors. Finally all stimuli appeared a total of 8 times as probe targets, except for *flea* and *camel,* which never appeared as probe targets. Once again, this unequal assignment of stimuli was made necessary by the constraints for the referent size-selection task in general, and for ignored repetition trials especially.

To make the referent size-selection and the color-selection tasks as similar as possible, one word appeared in red and the other appeared in white on both the prime and the probe displays. The target appeared equally often in red and in white, with top–bottom location randomized.

Results

Analyses of Questionnaire Measures

The group means and standard deviations on the OCD-related questionnaires (i.e., MOC and Y–BOCS) appear in Table 1. Simple one-factor analyses of variance (ANOVAs) and a priori contrasts were conducted on MOC scores with group as the factor; the results of these analyses also appear in Table 1. OCD patients scored higher than nonclinical controls on the MOC overall and on all subscales, except the cleaning scale. Checkers scored higher than noncheckers on the MOC overall as well as on the checking and slowness subscales. The OCD groups did not differ in terms of their Y–BOCS scores. Both checkers and noncheckers demonstrated moderate levels of OCD severity, comparable to participants in other studies (e.g., MacDonald et al., 1997).

The group means and standard deviations for measures unrelated to OCD severity are also presented in Table 1. Simple one-factor ANOVAs, with group as the factor, were followed by planned contrasts, the results of which appear in the table. OCD checkers and noncheckers did not differ significantly with regard to age, although both patient groups were older than nonclinical controls. Similarly, both OCD groups were statistically equivalent in terms of their BDI scores, but they revealed higher levels of depression than did nonclinical controls. The OCD patients were more anxious at the time of test as measured by the STAI–S than were the nonclinical controls. Further, checkers scored higher on the STAI–S than noncheckers did, reflecting higher levels of anxiety and tension at the time of the test. Finally, all groups were equivalent in their verbal abilities as measured by the SILS vocabulary portion.

Analyses of Negative Priming Data

Table 2 presents the latency and error data for each of the three groups of participants. Negative priming was evident for all groups in both blocks of the experiment. That is, participants were consistently slower to respond to probe items in the ignored repetition condition than in the control condition. As anticipated, the negative priming was considerably larger for the referent size-selection task than for the color-selection task. In Figure 1, the ignored repetition minus control difference scores are plotted. Statistical analyses confirm these observations.

A 3 × 2 × 2 mixed ANOVA was performed on the latency data. The between-subjects factor was group (OCD checker vs. OCD nonchecker vs. nonclinical control), and the within-subject variables were task (color-selection vs. referent size-selection) and condition (control vs. ignored repetition). Only latencies for correctly named probe targets that followed correctly named prime targets were included in the analysis. The main effects of task, $F(1, 33) = 332.26$, $MSE = 56{,}587.65$, $p < .001$, and condition, $F(1, 33) = 70.12$, $MSE = 2{,}024.30$, $p < .001$, were significant. Participants were much slower in the referent size-selection task than

Table 1
Means (and Standard Deviations) for Measures of OCD Severity and Other Clinical Measures (n = 12 per Group)

Measure	OCD checker	OCD nonchecker	Control	*F*	Contrast 1 *F*	Contrast 2 *F*
MOC total[a]	18.0	9.6	7.8	14.18***	9.02**	24.05***
	(4.9)	(3.8)	(3.5)			
MOC check[b]	5.2	1.5	1.3	30.12***	9.22**	67.09***
	(1.0)	(1.2)	(0.9)			
MOC clean[c]	4.3	2.9	2.8	1.91		
	(2.8)	(2.1)	(2.3)			
MOC slow[d]	4.4	2.1	1.6	7.98**	7.17*	15.02**
	(1.6)	(1.3)	(1.5)			
MOC doubt[e]	5.1	4.1	2.8	5.01*	10.15**	1.79
	(1.6)	(2.1)	(1.0)			
Y-BOCS[f]	20.1	18.8		<1		
	(8.1)	(4.0)				
Age[g]	37.2	35.4	20.7	13.19***	27.15***	<1
	(10.3)	(9.6)	(4.7)			
BDI[h]	17.5	19.0	8.6	3.27*	6.43*	<1
	(12.8)	(13.2)	(4.5)			
STAI-S[i]	50.1	39.1	36.9	5.82**	4.16*	7.40*
	(12.1)	(8.8)	(9.2)			
SILS[j]	32.5	31.9	29.3	1.74		
	(3.7)	(4.4)	(4.9)			

Note. There were 33 degrees of freedom for the error term for all analyses of variance. *F* = omnibus, comparison of all groups; Contrast 1 = a comparison of scores in the two OCD groups to those in the control group; Contrast 2 = a comparison of scores in the OCD checker group to those in the OCD nonchecker group. OCD = obsessive-compulsive disorder; MOC = Maudsley Obsessive Compulsive Inventory; Y-BOCS = Yale–Brown Obsessive Compulsive Scale; BDI = Beck Depression Inventory; STAI-S = State–Trait Anxiety Inventory—State version; SILS = Shipley Institute of Living Scale—Vocabulary portion.
[a] The values are mean scores out of 30. [b] The values are mean scores out of 7. [c] The values are mean scores out of 11. [d] The values are mean scores out of 7. [e] The values are mean scores out of 7. [f] The values are mean scores out of 40 composed of a score for obsessions and a score for compulsions. [g] The values are means in years. [h] The values are mean scores out of 63. [i] The values are mean scores out of 40. [j] The values are mean scores out of 80.
* $p < .05$. ** $p < .025$. *** $p < .001$.

in the color-selection task and appreciably slower on ignored repetition trials than on control trials. The Task × Condition interaction was also significant, $F(1, 33) = 27.93$, $MSE = 1{,}304.82$, $p < .001$, reflecting larger negative priming in the referent size-selection task than in the color-selection task. The main effect of group, $F(2, 33) = 2.05$, $MSE = 92{,}139.80$, $p > .12$, and the Group × Task, $F(2, 33) = 2.08$, $MSE = 56{,}587.65$, $p > .12$, Group × Condition, $F(2, 33) < 1$, and Group × Task × Condition, $F(2, 33) = 1.47$, $MSE = 1{,}304.82$, $p > .20$, interactions were not significant. Thus, OCD checkers, OCD noncheckers, and nonclinical control participants all demonstrated the same pattern of negative priming for both tasks.

The planned contrast examining the latency data for the two OCD groups relative to the nonclinical controls revealed no sig-

Table 2
Mean Response Times (in Milliseconds), Error Rates (Proportions), and Standard Errors as a Function of Group, Task, and Condition

Group and selection	Ignored repetition				Control			
	RT	SE	Err	SE	RT	SE	Err	SE
OCD checker								
Color selection	616	47.36	.020	0.03	583	50.09	.011	0.01
Size selection	1,478	299.19	.114	0.09	1,394	299.95	.122	0.09
OCD nonchecker								
Color selection	612	91.05	.010	0.02	571	76.20	.010	0.01
Size selection	1,313	229.86	.091	0.05	1,225	226.29	.070	0.05
Nonclinical control								
Color selection	579	66.99	.011	0.02	560	68.76	.007	0.01
Size selection	1,280	272.00	.093	0.07	1,168	265.68	.102	0.07

Note. RT = response time; SE = standard error; Err = error rate; OCD = obsessive–compulsive disorder.

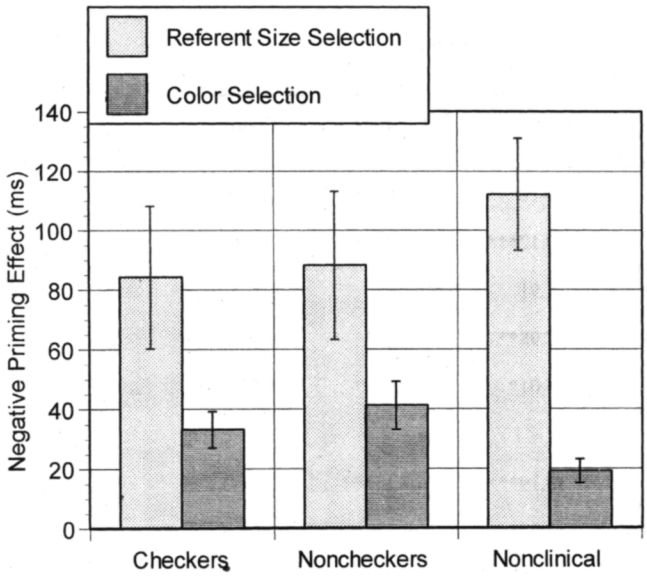

Figure 1. Negative priming difference scores in the referent size-selection task and the color-selection task for obsessive–compulsive disorder (OCD) checkers, OCD noncheckers, and nonclinical control participants. Error bars are standard errors.

nificant main effect of group nor any interactions involving group. Similar results were found when the two OCD groups were contrasted with each other. As there were no significant effects involving group, these ANOVA results are not reported here.

Upon investigating the negative priming scores separately for each task, we found marginally significant group differences in the color-selection task, $F(2, 33) = 2.86$, $MSE = 486.84$, $p = .07$, although this difference was not replicated in the referent size-selection task, $F(2, 33) < 1$. Contrasting the OCD patients' performance with that of the control group in the color-selection task revealed significantly larger negative priming for the patients, $F(1, 34) = 5.05$, $MSE = 482.67$, $p < .05$. No significant differences were detected in the magnitude of the negative priming for the OCD groups with respect to one another, $F(1, 22) < 1$. The claim that patients with OCD demonstrate impairments in negative priming is not supported. If anything, these results suggest that they reveal greater negative priming than controls.

With respect to errors, only errors on probe trials that followed accurate prime trials were considered. The ANOVA performed on the proportion of errors was analogous to the latency analysis. Only the main effect of task, $F(1, 33) = 78.84$, $MSE = 0.003$, $p < .001$, was significant, reflecting more errors in the referent size-selection task relative to the color-selection task. The main effects of group and condition, and the Group × Task and the Task × Condition interactions, were nonsignificant, all Fs < 1. The Group × Condition interaction, $F(2, 33) = 1.28$, $MSE = 0.001$, $p > .20$, and the three-way Task × Condition × Group interaction, $F(2, 33) = 2.32$, $MSE = 0.001$, $p > .10$, were also nonsignificant. Negative priming was not evident in terms of errors for any group of participants.

Planned contrasts of errors committed by the two OCD groups relative to the nonclinical controls and of the two OCD groups compared with each other—again analogous to those performed on the latency data—revealed no reliable main effects of group or interactions involving group. Thus, these ANOVA results are not reported here.

Discussion

All groups demonstrated significant negative priming in both the referent size-selection and the color-selection tasks. Large negative priming, on the order of 80 to 110 ms, was observed in the referent size-selection task of the present experiment. The negative priming in the color-selection task was between 20 and 40 ms. The magnitude of negative priming for all groups in each task closely replicates that found in previous experiments (MacDonald & Joordens, in press; MacDonald et al., 1999). In contrast to the findings of Enright and Beech (1990, 1993a, 1993b) and Enright et al. (1995), these results are not suggestive of impairments in negative priming for OCD patients, whether the mechanism is inhibitory or memory-based.

In the color-selection task, in fact, the magnitude of the negative priming was greater for the OCD patients than for the nonclinical controls. This finding, however, was not replicated in the referent size-selection task and therefore it would be imprudent to exaggerate its significance. In the referent size-selection task, if anything, the control group showed larger negative priming than the OCD patients. Given this, despite greater power to detect group differences in the color-selection task,[1] we believe that the failure to replicate in the referent size-selection task was not attributable to low power. Taken together, these results suggest that OCD patients and nonclinical controls perform comparably on negative priming tasks.

Although it is generally less than ideal to contrast performance of patient populations with that of student controls rather than age-matched participants, we feel this does not compromise our conclusions. Given that negative priming has been shown to decrease with age (Hasher, Stoltzfus, Zacks, & Rympa, 1991), this confound should, if anything, increase the probability of noting discrepancies in the negative priming effect that favor the control group over the OCD groups.

The critical finding of this study is that significant negative priming arose for all groups—OCD checkers and OCD noncheckers included—when methodological confounds in the negative priming task were corrected. Investigating cognitive processing in patient populations could prove essential in understanding certain disorders. Unfortunately, many cognitive measures, the negative priming task included, are not amenable to straightforward interpretation, and too often a theory becomes wedded to a task

[1] Post hoc analyses as described by Cohen (1988) revealed that the power to detect between-groups differences in terms of the magnitude of the negative priming for the size-selection task was .1, and for the color-selection task was .6. The respective effect sizes were .1 and .4. Relatively low power is not an uncommon problem in studies that measure cognitive processing in different participant groups (e.g., Warrington & Weiskrantz, 1970). Compromise power, as suggested by Erdfelder (1984) for situations when conforming to the n suggested by a priori power analyses is prohibitive, was also calculated. This type of power analysis provides a rational compromise between maintaining a low Type I error rate and achieving adequate power. In the size-selection task, compromise power was .6; in the color-selection task it was .8. Even using the ajdusted alpha level of .20 suggested by the compromise power analysis, however, the group differences in the referent size-selection task were not significant.

prematurely. This seems to be particularly the case with the negative priming procedure and the cognitive inhibition account, as they have been applied to the study of clinical populations. As cognitive psychology advances, the goal is for these issues to be resolved and for clear-cut conclusions about cognitive processes to be achieved. In turn, these measures can then be related to clinical disorders. In the meantime, however, using cognitive tasks to study patient populations remains a useful and informative endeavor. When more than one interpretation of a task exists, however, as is the case for the negative priming paradigm, this must be addressed. Not to evaluate alternative meanings of patients' performance on cognitive tasks is to neglect potentially important information. Moreover, the adoption of erroneous conclusions about a patient group due to misinterpretation of task performance could seriously impact on diagnostic and treatment issues.

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