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Shorter communication

Obsessive–compulsive tendencies are associated with a focused information processing strategy

Assaf Soref[a], Reuven Dar[a,*], Galit Argov[a], Nachshon Meiran[b]

[a] Department of Psychology, Tel Aviv University, Tel Aviv 69978, Israel
[b] Department of Psychology, Ben-Gurion University of the Negev, Israel

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The study examined the hypothesis that obsessive–compulsive (OC) tendencies are related to a reliance on focused and serial rather than a parallel, speed-oriented information processing style. Ten students with high OC tendencies and 10 students with low OC tendencies performed the flanker task, in which they were required to quickly classify a briefly presented target letter (S or H) that was flanked by compatible (e.g., SSSSS) or incompatible (e.g., HHSHH) noise letters. Participants received 4 blocks of 100 trials each, two with 50% compatible trials and two with 80% compatible trials and were informed of the probability of compatible trials before the beginning of each block. As predicted, high OC participants, as compared to low OC participants, had slower overall reaction time (RT) and lower tendency for parallel processing (defined as incompatible trials RT minus compatible trials RT). Low, more than high OC participants tended to adjust their focused/parallel processing including a shift towards parallel processing in blocks with 80% compatible trials and in trials following compatible trials. Implications of these results to the cognitive theory and therapy of OCD are discussed.

Introduction

Obsessive–compulsive disorder (OCD) has a lifetime prevalence of 2–3% (Karno, Golding, Sorenson, & Burnam, 1988) and is often chronic and debilitating (Leon, Portera, & Weissman, 1995). Despite recent advances in psychological and pharmacological therapy, response to treatment is typically incomplete (Kaplan & Hollander, 2003). Efforts to improve the understanding and treatment of OCD have led to extensive research in the past two decades. Specifically, research on the neuropsychology of the disorder documented a variety of cognitive tasks in which the performance of OCD patients appears to be deficient, in comparison to other clinical populations (i.e., panic disorder, Tourette's syndrome) and non-clinical participants. These tasks assess a wide array of cognitive functions including attention, set-shifting, response inhibition, memory, planning and decision making (reviewed by Chamberlain, Blackwell, Fineberg, Robbins, & Sahakian, 2005).

One way to organize many of these findings is to view them as reflecting obsessive–compulsive (OC) individuals' processing style of focusing on relatively local, rather than global, levels of stimuli. For example, OCD patients had impaired performance on the Rey complex figure test (Osterrieth, 1944), in which participants copy a complex line diagram from a stimulus card and later re-draw it from memory (Savage et al., 1999). This deficit appeared to stem from the tendency of OCD patients to attend to and encode small details of the figure rather than larger organizing features. In the same vein, Cabrera, McNally, and Savage (2001) found that OCD patients exhibited a lower degree of integration of semantic units in complex sentences as compared to non-OC control participants. A study using Navon's (1977) global/local hierarchical letters paradigm, in which participants process large letters made of small letters, found that obsessive–compulsive personality disorder tendencies were associated with excessive visual attention to the small letters (Yovel, Revelle, & Mineka, 2005).

Among normal, healthy adults, serial and focused information processing characterizes performance in the early stages of practice, while proficient performance is characterized by parallel processing (e.g., Anderson, 1982; Logan, 1988). In contrast, OCD patients "attempt to monitor closely and take control over processes that would otherwise operate in automatic and well-practiced ways" (Salkovskis, 1998; p. 40), a tendency that is likely to be associated with focused and serial processing. Moreover, normal individuals adapt their processing style to situational constraints based on the relative utility of a given processing approach (e.g., Gratton, Coles, & Donchin, 1992). Specifically, they will shift between *focused* and *parallel* processing depending on the relative utility of these processing modes. In contrast, the observation cited above suggests that the processing style of OC patients may be more rigid and less responsive to situational changes.

* Corresponding author. Tel.: +972 3 6408624; fax: +972 3 6409547.
E-mail address: ruvidar@freud.tau.ac.il (R. Dar).

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In the present study, we examined whether OC tendencies are related to a reliance on a focused, rather than a parallel information processing style. The study employed a sub-clinical sample (high and low scores on a measure of OCD), an approach that has produced valuable insights regarding many aspects of this disorder (e.g., Amir, Freshman, Ramsey, Neary, & Brigidi, 2001; Rachman & de Silva, 1978; Salkovskis & Harrison, 1984). Following Gratton et al. (1992), we used the noise compatibility paradigm or "flanker task" (Eriksen & Eriksen, 1974) because this paradigm offers unique advantages in assessing focused and serial vs. parallel processing mode. To the best of our knowledge, this is the first study which examined the relationship between OC tendencies and performance in this paradigm.

In the flanker paradigm, participants are required to quickly classify a letter (H or S) flanked by compatible (SSSSS or HHHHH) or incompatible (HHSHH or SSHSS) noise letters. The basic behavioral finding is that reaction times and error rates are higher in incompatible trials, presumably because compatible stimuli allow relying on fast parallel processing in which the flanking noise stimuli are processed in addition to the target stimulus, whereas incompatible stimuli require a focused, slower strategy for a correct response to be made because processing the noise stimuli would lead one to choose the wrong response. In order to simplify the interpretation of the results, we used a parallel processing index which was calculated as reaction time (RT) for correct responses in incompatible trials minus RT for correct responses in compatible trials. A higher score means more extensive use of parallel processing of the noise letters and the target. Because we hypothesized that OCD is associated with a bias towards reliance on focused information processing strategy, we predicted that participants with high OC tendencies, compared to low OC participants, would have lower parallel processing scores.

Our hypothesis states that high OC tendencies are associated with a focused, serial processing style. In contrast, low OC tendencies are not associated with any specific style, meaning that individuals can flexibly adjust their processing mode when the relative utility of focused vs. serial processing modes changes. In order to examine the extent to which participants can strategically and flexibly adapt their processing to changing contextual demands we manipulated two types of context. An important distinction in the literature on cognitive control is between block-wide tonic control adjustments and trial-wide phasic control adjustments (e.g., Botvinick, Braver, Carter, Barch, & Cohen, 2001; Braver, Reynolds, & Donaldson, 2003; Los, 1996). Accordingly, we examined two types of context: block-wide, tonic and explicit context and trial-wide, less explicit and phasic context. To promote block-wide tonic changes in processing mode, we included, in addition to the more standard blocks in which 50% of the trials were congruent, blocks in which 80% of the trials were congruent. In these 80% compatible blocks it is beneficial to process the noise letters in parallel with the target because the noise letters indicate the correct response, and our participants were informed of these benefits. Gratton et al. (1992) found that higher probability of compatible noise was associated with increased reliance on a parallel strategy, as expressed in higher parallel processing index (also referred to as "noise effects" in Gratton et al., 1992). We predicted that low OC participants would demonstrate a greater shift than high OC participants towards parallel processing in blocks with 80% compatible trials.

To assess the influence of phasic contextual changes we examined performance as a function of the compatibility status of the preceding trial. Previous studies examined phasic control adjustments made in response to encountering a trial characterized by a high demand for cognitive control (with incompatible noise) as compared with trials involving lesser demand for control (compatible noise). Studies with young healthy adults found that they show reduced parallel processing following incompatible as compared with compatible trials, suggesting sharper focusing on the target stimuli, which enables less interference from flankers (Gratton et al., 1992). Some authors attributed these sequential modulations to low-level priming processes (e.g., Mayr, Awe, & Laurey, 2003) as opposed to changes in control, as argued by Gratton et al. (1992). Nonetheless, more recent studies, which showed these adaptations under conditions without priming, clearly support the control interpretation (e.g., Freitas, Bahar, Yang, & Banai, 2007; Kerns et al., 2004). We therefore predicted that low OC participants' parallel processing, as compared to that of high OC participants, would be more strongly influenced by the compatibility status of the preceding trial.

To summarize, this is the first study which examined the relationship between OC tendencies and serial vs. parallel processing in the flanker task. We predicted that high OC tendencies would be associated with lower parallel processing scores. We also predicted that high OC tendencies would be associated with lesser adjustment of parallel processing both at the tonic level (blocks with 80% compatible trials) and at the phasic level (following compatible vs. incompatible trials).

Method

Participants and measures

We screened 171 Tel Aviv University psychology students using the Obsessive–Compulsive Inventory-Revised (OCI-R; Foa et al., 2002). This inventory includes 18 items representing characteristic symptoms of OCD. Responders are asked to rate the extent to which each symptom was distressing or bothersome to them in the past month on a 5-point scale. The Cronbach's alpha of the OCI-R in our sample was .88, which is identical to the figure reported in a previous study with a college sample (Hajcak, Huppert, Simons, & Foa, 2004). We invited students who scored at the top and bottom quartiles of the distribution for participation in this study. The scores ranged in the upper quartile between 20 and 53 ($M = 31.3$, $SD = 7.4$), and in lower quartile between 0 and 10 ($M = 6.5$, $SD = 2.3$). The final sample included 20 students (16 women and 4 men) with an age range of 20–32 years ($M = 22.8$, $SD = 2.52$). The high OC participants had a mean OCI-R score of 40.60 ($SD = 7.17$) as compared to 4.90 ($SD = 2.33$) in the low OC group, $t(18) = 14.97$, $p < .001$. Participants received study credits for their participation. All participants reported normal or corrected to normal vision.

Flanker task

The experiment was run on personal computers with a 19-inch VGA color monitor. The participants were seated at a distance of 60 cm from the screen. The visual angle subtended by each letter was approximately .5°, and the angle subtended by the whole array was approximately 2.5°.

The stimuli consisted of a target (central) letter ("H" or "S") flanked by either four compatible (SSSSS or HHHHH) or incompatible (HHSHH or SSHSS) noise letters (flankers). The probability of each target letter was 50% throughout the experiment. Each trial started with a fixation point in the middle of the screen that stayed on for 500 sec and was followed by one of the 5-letter arrays. The stimuli remained on the screen for 2000 sec and were followed by a black screen for 500 sec.

Procedure

The procedure was based on Gratton et al.'s (1992). Each participant received 4 blocks of 100 trials each in a single experimental session. Two blocks had 50% noise compatible trials and two had 80% compatible trials. The order of the blocks was counterbalanced across participants. In the first exposure to the first block of each probability participants received 20 additional practice trials to stabilize their performance. The 20 practice trials were not analyzed. As in the original study by Gratton et al. (1992), participants were informed of the probability of compatible trials before the beginning of each block. Half of the participants were asked to press the "Z" key in response to the target letter "H" and to press the "?" key in response to the target letter "S"; for the other half, the requirements were reversed. The participants were instructed in both conditions to maximize both speed and accuracy. In addition, in the 50% compatible blocks, participants were encouraged to focus on the target letter, as there was no connection between the target letter and the flankers. In the 80% compatible blocks participants were encouraged to rely on the flankers, as the target letter would be identical to the flankers in 80% of the trials, and so responding according to the flankers would produce correct responses in most cases. Responses with a latency exceeding 3 standard deviations from the group mean correct trials' RT were excluded from the analysis. All participants signed an informed consent and were fully debriefed immediately following the procedure.

Results

In general, high OC participants had significantly slower overall reaction times in comparison to low OC participants ($M = 651.1$, $SD = 84.8$, and $M = 589.2$, $SD = 45.8$, respectively), two-tailed $t(18) = 2.03$, $p = .029$. We conducted one-tailed t-tests to examine the hypothesis that high OC participants would have overall lower parallel processing index, in comparison to low OC participants. This hypothesis was confirmed in both the 50% compatible noise blocks, $t(18) = 2.14$, $p = .023$, and the 80% compatible noise blocks, $t(18) = 2.65$, $p = .008$ (Tables 1 and 2, respectively). We also calculated the number of errors for each participant. The overall accuracy rate was 98.8% for the low OC participants and 99.0% for the high OC participants, $t(18) < 1$; ns.

Our second hypothesis was that high OC participants would be relatively rigid in their employment of a focused processing mode and would change it less in conditions known to promote parallel processing. This hypothesis had two parts, one referring to tonic changes in processing mode and the other referring to phasic changes. We tested the hypothesis concerning tonic changes using a one-tail t-test on the difference score between the parallel processing indexes in the 80% and the 50% compatible blocks blocks. As predicted, high OC participants displayed a smaller increase in parallel processing when the probability of compatible stimuli increased from 50 to 80% ($M = 37.4$, $SD = 38.5$) as compared to low OC participants ($M = 65.3$, $SD = 30.3$), $t(18) = 1.80$, $p = .044$ (Fig. 1).

The second part of our hypothesis concerned phasic changes in processing mode. In order to test this aspect of the hypothesis, we entered the noise compatibility status of the preceding trial (Compatibility$_{N-1}$) as well as that in the current trial, Compatibility$_N$, into an ANOVA which included Group as an additional independent variable. Replicating Gratton et al. (1992), we found that the parallel processing index was reduced following incompatible trials, as indexed by the 2-way interaction between Compatibility$_N$ and Compatibility$_{N-1}$, $F(1,18) = 22.64$, $p < .001$, with a similar effect found for errors, $F(1, 18) = 17.84$, $p < .001$. The latter effect was modulated by Group as indexed by a significant triple interaction between Group, Compatibility$_N$ and Compatibility$_{N-1}$, $F(1,18) = 4.95$, $p = .04$. To probe the source of this triple interaction we computed the simple 2-way interaction between Compatibility$_N$ and Compatibility$_{N-1}$ separately for each group (Fig. 2). This simple interaction was significant in the control group, $F(1, 18) = 20.79$, $p < .001$, but not in the OCD group, $F(1, 18) = 2.00$, $p = .17$ (note that in examining this simple interaction term we used the same pooled error term in both groups, so that the pattern of significant vs. non-significant interaction was not due to a greater heterogeneity among the high OC group).

Table 1
Means and standard deviations of reaction time by group and compatibility, at the 50% compatible noise blocks condition

	Compatibility					
	Compatible		Incompatible		Parallel processing index	
	Mean	*SD*	Mean	*SD*	Mean	*SD*
Low OC	566.20	48.50	635.20	47.70	69.00	22.10
High OC	633.10	89.70	682.80	87.60	49.70	17.90

Table 2
Means and standard deviations of reaction time by group and compatibility in the 80% compatible noise blocks condition

	Compatibility					
	Compatible		Incompatible		Parallel processing index	
	Mean	*SD*	Mean	*SD*	Mean	*SD*
Low OC	553.10	48.30	687.40	58.60	134.30	37.50
High OC	626.20	90.40	713.30	85.00	87.10	42.00

Discussion

The goal of the present study was to examine the hypothesis that OC tendencies are related to a serial and focused processing style as opposed to parallel, speed-oriented processing style. We predicted that participants with high OC tendencies, compared to low OC participants, would tend to use less parallel processing overall and would be less responsive to contexts that encourage shifting to parallel processing. Both of these predictions were borne out. High OC individuals showed lower scores on the parallel processing index, indicating that they focused on the target stimuli and were less inclined to process the flankers in parallel with the target. The lesser responsiveness of high OC participants to changing contexts was evident in two findings. First, high OC participants showed lesser increase in parallel processing in conditions that explicitly promoted parallel processing (80% compatible trials). Second, the error analysis indicated that for low OC individuals, the

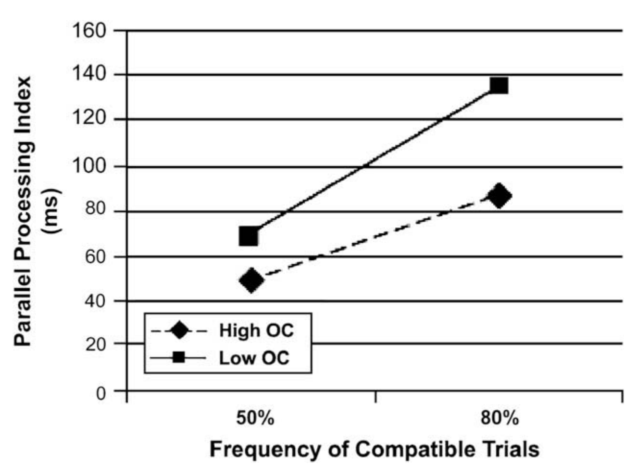

Fig. 1. Parallel processing index as a function of group and noise compatibility condition.

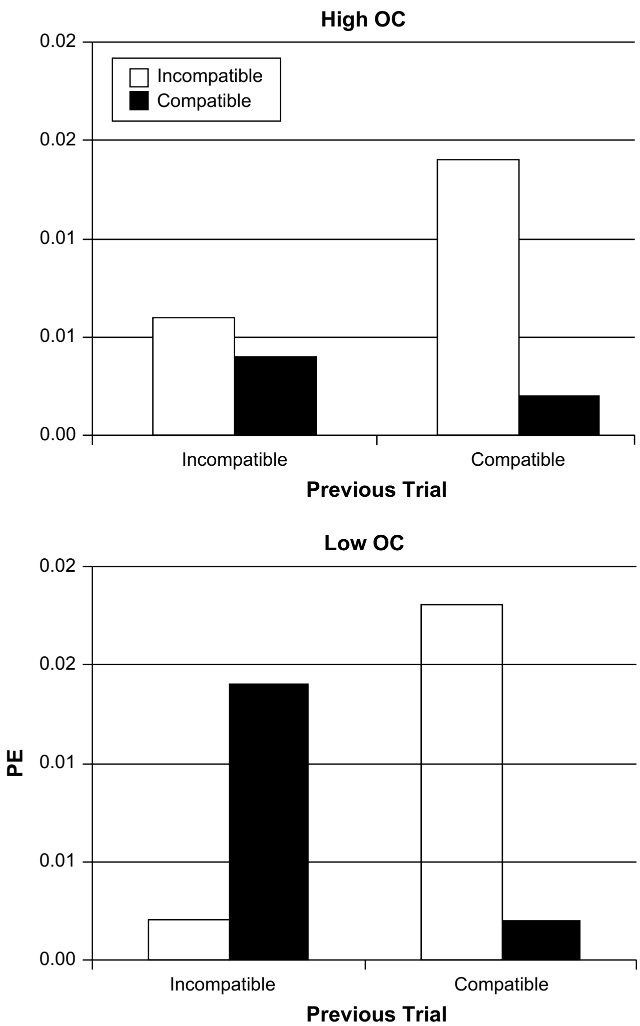

Fig. 2. Proportion of errors (PE) as a function of group, noise compatibility in the current trial and noise compatibility in the previous trial.

compatibility effect was relatively large after compatible trials and was reversed after incompatible trials. This trend was less pronounced and non-significant among high OC individuals, indicating less phasic adjustment of their focused vs. parallel processing mode.

The lower parallel processing scores of high as compared to low OC participants could suggest that high OC individuals have better inhibitory abilities and are therefore more efficient in filtering out irrelevant information. This interpretation, however, is inconsistent with the observation that OCD patients exhibit significant deficits in other tasks that assess inhibitory abilities, such as the Stroop (Cohen, Lachenmeyer, & Springer, 2003; Penades, Catalan, Andres, Salamero, & Gasto, 2005) and the go-no go task (Aycicegi, Dinn, Harris, & Erkmen, 2003; Chamberlain et al., 2005). A recent study that found a positive correlation between the OCI-R and measures of impulsivity in the general population also suggests that OCD is actually related to a deficit in inhibition.

The apparent discrepancy between the performance of high OC individuals in the present study and findings suggesting disinhibition in OCD may be related to a crucial difference between the flanker task and tasks such as the Stroop and the go-no go task. In the flanker task, focusing on the spatial location of the target stimulus provides sufficient means to effectively ignore the noise letters that occupy different locations than the target (see Bundesen, 1990, for a formal model). In contrast, the Stroop and the go-no go tasks require participants to suppress the interference further downstream in the process. The attention literature refers to these two types of information selection under the heading of early (based on visual focusing) vs. late selection (Lavie, 1995; Pashler, 1998). The hyper focusing which characterizes OC tendencies may be beneficial in situations in which early selection strategies are optimal, such as the 50% condition of the flanker task. In other cases, such as in the 80% condition of the flanker task, the same tendency for hyper focusing interferes with optimal performance. Studies showing enhanced latent inhibition (LI) in OCD (Kaplan et al, 2006; Swerdlow, Hartston, & Hartman, 1999) provide another demonstration of the disadvantages of hyper focusing. In LI procedures, a stimulus that is irrelevant in the pre-exposure phase becomes the target stimulus in the test phase. One interpretation of the enhanced LI in OCD is that, in the pre-exposure phase, these patients focus rigidly on the target stimulus and ignore the initially irrelevant stimulus, which created a particularly strong inhibition when this stimulus became the target stimulus in the test phase (Kaplan et al., 2006).

The finding that OC individuals gravitate towards a focused processing style may be related to the fact that they experience the cost of committing an error as greater than the benefit of faster performance. Indeed, the contents of the typical concerns of OCD patients—safety, security, moral responsibility—are characterized by high error cost. A single event of compromising safety could have disastrous outcomes and a single moral transgression is enough to render a person immoral. In our study, error rates were very low (around 1%) and virtually identical for the two groups, suggesting that the present task was too easy to detect significant effects of strategy on errors. While the present task could not demonstrate a tradeoff between speed and accuracy, such tradeoff is present in many real life tasks and OCD patients clearly pay a price for holding on to a vigilant, harm avoidant strategy. This is exemplified in many symptoms and behaviors common in OCD, including slowness, rigidity, lack of spontaneity, anxious vigilance, incessant checking and repeating, difficulty in making decisions and inability to tolerate change.

The present study is the first to find a relationship between OC tendencies and serial processing style in the flanker task and as such, our results and conclusions should be considered tentative until replicated and extended. Moreover, our findings have several limitations. First, they are based on a non-clinical student sample and their generalization to OCD requires replication with a clinical sample. Second, the predicted lesser phasic responsiveness among the high OC participants was found for error rates but not for reaction time. Third, as mentioned above, the low error rate in our task allowed only limited examination of error rate as a dependent measure. Finally, the task we chose examines only one type of focused vs. parallel information processing strategy. Future studies using other tasks, such as dual task paradigms in which there are clear indices for serial vs. parallel processing (Luria & Meiran, 2005), would bolster our findings and could provide further support for the observation that OCD patients "attempt to monitor closely and take control over processes that would otherwise operate in automatic and well-practiced ways" (Salkovskis, 1998; p. 40).

We believe that our results may contribute to current cognitive therapy with OCD patients. Assuming that they demonstrate a general characteristic of high OC individuals, our findings support the potential usefulness of interventions aimed towards these general cognitive tendencies, in addition to those currently used to address cognitive and metacognitive beliefs. As part of the psycho-educational component of cognitive therapy for OCD, these findings can be used to demonstrate to patients how in their effort to exert control in order to avoid errors, they are using valuable cognitive resources non-efficiently. This has at least two important

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negative consequences: first, the strenuous mode of operation creates a cognitive overload, which eventually might lead to ironic effects of loss of control over thoughts and actions (e.g., Abramowitz, Whiteside, Kalsy, & Tolin, 2003). Second, as suggested also by the findings from the LI paradigm (Kaplan et al., 2006), overly intense focusing can lead to the loss of the 'big picture' and consequently to impaired performance and loss of confidence (Hermans et al., 2008). While this is clearly speculative, it may be worthwhile to develop and test therapeutic modules for modifying the information processing strategies of OCD patients to make them more efficient and flexible. This could be done, for example, by creating tasks which promote and reward global rather than local perspectives and acceptance of errors rather than accuracy.

References

Abramowitz, J. S., Whiteside, S., Kalsy, S. A., & Tolin, D. F. (2003). Thought control strategies in obsessive–compulsive disorder: a replication and extension. *Behaviour Research and Therapy, 41*, 529–540.

Amir, N., Freshman, M., Ramsey, B., Neary, E., & Brigidi, B. (2001). Thought-action fusion in individuals with OCD symptoms. *Behaviour Research and Therapy, 39*, 765–776.

Anderson, J. R. (1982). Acquisition of cognitive skill. *Psychological Review, 89*, 369–406.

Aycicegi, A., Dinn, W. M., Harris, C. L., & Erkmen, H. (2003). Neuropsychological function in obsessive–compulsive disorder: effects of comorbid conditions on task performance. *European Psychiatry, 18*, 241–248.

Botvinick, M. M., Braver, T. S., Carter, C. S., Barch, D. M., & Cohen, J. D. (2001). Evaluating the demand for control: anterior cingulate cortex and crosstalk monitoring. *Psychological Review, 108*, 624–652.

Braver, T. S., Reynolds, J. R., & Donaldson, D. I. (2003). Neural mechanisms of transient and sustained cognitive control during task switching. *Neuron, 39*, 713–726.

Bundesen, C. (1990). A theory of visual attention. *Psychological Review, 97*, 523–547.

Cabrera, A. R., McNally, R. J., & Savage, C. (2001). Missing the forest for the trees? Deficient memory for linguistic gist in obsessive–compulsive disorder. *Psychological Medicine, 31*, 1089–1094.

Chamberlain, S. R., Blackwell, A. D., Fineberg, N. A., Robbins, T. W., & Sahakian, B. J. (2005). The neuropsychology of obsessive compulsive disorder: the importance of failures in cognitive and behavioural inhibition as candidate endophenotypic markers. *Neuroscience and Biobehavioral Reviews, 29*(3), 399–419.

Cohen, Y., Lachenmeyer, J. R., & Springer, C. (2003). Anxiety and selective attention in obsessive–compulsive disorder. *Behaviour Research and Therapy, 41*, 1311–1323.

Eriksen, B. A., & Eriksen, C. W. (1974). Effects of noise letters upon the identification of target letters in a nonsearch task. *Perception & Psychophysics, 16*, 143–149.

Foa, E. B., Huppert, J. D., Leiberg, S., Langner, R., Kichic, R., Hajcak, G., et al. (2002). The obsessive–compulsive inventory: development and validation of a short version. *Psychological Assessment, 14*(4), 485–496.

Freitas, A. L., Bahar, M., Yang, S., & Banai, R. (2007). Contextual adjustments in cognitive control across tasks. *Psychological Science, 18*, 1040–1043.

Gratton, G., Coles, M. G. H., & Donchin, E. (1992). Optimizing the use of information: strategic control of activation of responses. *Journal of Experimental Psychology: General, 121*(4), 480–506.

Hajcak, G., Huppert, J. D., Simons, R. F., & Foa, E. B. (2004). Psychometric properties of the OCI-R in a college sample. *Behaviour Research and Therapy, 42*, 115–123.

Hermans, D., Engelen, U., Grouwels, L., Joos, E., Lemmens, J., & Pieters, G. (2008). Cognitive confidence in obsessive–compulsive disorder: distrusting perception, attention and memory. *Behaviour Research and Therapy, 46*, 98–113.

Kaplan, A., & Hollander, E. (2003). A review of pharmacologic treatments for obsessive–compulsive disorder. *Psychiatric Services, 54*(8), 1111–1118.

Kaplan, O., Dar, R., Rosenthal, L., Hermesh, H., Fux, M., & Lubow, R. (2006). Obsessive–compulsive patients display enhanced latent inhibition in a visual search task. *Behaviour Research and Therapy, 44*, 1137–1145.

Karno, M., Golding, J. M., Sorenson, S. B., & Burnam, M. A. (1988). The epidemiology of obsessive–compulsive disorder in five US communities. *Archives of General Psychiatry, 45*(12), 1094–1099.

Kerns, J. G., Cohen, J. D., MacDonald, A. W., III, Cho, R. Y., Stenger, V. A., & Carter, C. S. (2004). Anterior cingulated conflict monitoring and adjustments in control. *Science, 303*, 1023–1026.

Lavie, N. (1995). Perceptual load as a necessary condition for selective attention. *Journal of Experimental Psychology: Human Perception and Performance, 21*, 451–468.

Leon, A. C., Portera, L., & Weissman, M. M. (1995). The social costs of anxiety disorders. *The British Journal of Psychiatry, 27*, 19–22.

Logan, G. D. (1988). Toward an instance theory of automatization. *Psychological Review, 95*, 492–527.

Los, S. A. (1996). On the origin of mixing costs: exploring information processing in pure and mixed blocks of trials. *Acta Psychologica, 94*, 145–188.

Luria, R., & Meiran, N. (2005). Increased control demand results in serial processing: evidence from dual task performance. *Psychological Science, 16*, 833–840.

Mayr, U., Awe, E., & Laurey, P. (2003). Conflict adaptation effects in the absence of executive control. *Nature Neuroscience, 6*, 450–452.

Navon, D. (1977). Forest before trees: the precedence of global features in visual perception. *Cognitive Psychology, 9*(3), 353–383.

Osterrieth, P. (1944). Le test du copie d'une figure complex: contribution a l'etude de la perception et de la memoire. *Archives de Psychologie, 30*, 286–350.

Pashler, H. E. (1998). *The psychology of attention*. Cambridge: MIT Press.

Penades, R., Catalan, R., Andres, S., Salamero, M., & Gasto, C. (2005). Executive function and nonverbal memory in obsessive–compulsive disorder. *Psychiatry Research, 133*, 81–90.

Rachman, S., & de Silva, P. (1978). Abnormal and normal obsessions. *Behaviour Research and Therapy, 16*, 233–248.

Salkovskis, P. M. (1998). Psychological approaches to the understanding of obsessional problems. In R. P. Swinson, M. M. Antony, S. Rachman, & M. A. Richter (Eds.), *Obsessive–compulsive disorder* (pp. 33–50). New York: Guilford Press.

Salkovskis, P. M., & Harrison, J. (1984). Abnormal and normal obsessions: a replication. *Behaviour Research and Therapy, 22*, 549–552.

Savage, C. R., Baer, L., Keuthen, N. J., Brown, H. D., Rauch, S. L., & Jenike, M. A. (1999). Organizational strategies mediate nonverbal memory impairment in obsessive–compulsive disorder. *Biological Psychiatry, 45*, 905–916.

Swerdlow, N. R., Hartston, H. J., & Hartman, P. L. (1999). Enhanced visual latent inhibition in obsessive–compulsive disorder. *Biological Psychiatry, 45*, 482–488.

Yovel, I., Revelle, W., & Mineka, S. (2005). Who sees trees before forest? The obsessive–compulsive style of visual attention. *Psychological Science, 16*, 123–129.

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