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Did I turn off the stove? Good inhibitory control can protect from influences of repeated checking

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ABSTRACT

Background and objectives: Obsessive-compulsive disorder (OCD) is an anxiety disorder characterized by compulsions aimed at reducing anxiety associated with intrusive cognitions. However, compulsive behaviors such as repeated checking were found to increase rather than decrease uncertainty related to obsessive thoughts (e.g., whether the gas stove was turned off). Some recent studies illustrate that OCD patients and their family members have inhibitory deficits, often demonstrated by the stop-signal task. The current study aims to investigate relations between inhibitory control and effects of repeated checking.
Methods: Fifty-five healthy participants carried out a stop-signal task followed by a repeated-checking task. Additionally, participants were asked to complete self-report questionnaires measuring OCD, anxiety and depression symptoms.
Results: Confirming our hypothesis, participants with poor inhibitory capabilities demonstrated greater uncertainty and memory distrust as a consequence of repeated checking than participants with good inhibitory control.
Limitations: Our findings concern an initial investigation on a sample of healthy participants and should be replicated and extended to clinical populations.
Conclusions: These results suggest that deficits in inhibitory control may underlie cognitive vulnerability in OCD. An updated model integrating neuropsychological findings with current OCD models is suggested.

1. Introduction

Obsessive-compulsive disorder (OCD) is a highly debilitating anxiety disorder with a lifetime prevalence of 2%–3% (Huppert, Simpson, Nissenson, Liebowitz, & Foa, 2009; Weismann et al., 1994). There are efficacious psychological and pharmacological interventions for OCD (Rosa-Alcázar, Sánchez-Meca, Gómez-Conesa, & Marín-Martínez, 2008) yet the majority of patients still suffer from symptoms even after undergoing treatment (e.g., Fisher & Wells, 2005), indicating that there is still much room for improvement. Moreover, many potential patients do not receive suitable therapy due to the overload of public mental health clinics or geographical distance of patients from such clinics (Kazdin, 2010). Therefore, understanding factors affecting individual proneness to developing OCD is paramount to improving OCD treatment, particularly since knowledge of etiological factors underlying OCD is lacking (for reviews see Gava et al., 2007; Grabill et al., 2008).

OCD is characterized by the occurrence of unwanted and disturbing intrusive thoughts, images or impulses (obsessions), followed by repetitive behaviors or mental acts (compulsions) aimed at reducing distress or preventing feared events related to obsessions from occurring (Diagnostic and Statistical Manual of Mental Disorders-IV [DSM-IV]; American Psychiatric Association [APA], 2000). However, behaviors that OCD patients typically perform tend to inflict paradoxical effects of increasing rather than decreasing the anxiety caused by obsessions, effectively perpetuating compulsions (Salkovskis, 1999). Compulsive checking is the most prominent outcome of such paradoxical effects characterizing OCD patients (Foa et al., 2005). Rachman (2002) suggested that

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heightened personal responsibility, perceived probability of harm, and the perceived seriousness of harm interact to cause patients to engage in preventive checking that in turn heightens these three factors and reduces confidence in memory, thus perpetuating compulsive checking. This latter segment of the process (i.e., repeated checking causing a reduction in memory certainty in OCD patients) is illustrated by van den Hout's seminal work on healthy participants, demonstrating that compulsive-like behaviors such as checking or staring are enough to induce memory distrust in healthy participants (van den Hout, Engelhard, de Boer, du Bois, & Dek, 2008; van den Hout & Kindt, 2003). Radomsky, Gilchrist, and Dussault (2006) replicated these effects using a real checking procedure rather than a virtual computerized task. These findings suggest a descriptive maintenance model of the vicious circle of doubt, uncertainty and compulsive behaviors that underlie OCD. However, these studies do not explain why some people are more prone to engage in these behaviors and become entangled in this circle.

Though some studies did not find differences in executive functions between OCD patients and healthy controls (e.g., Moritz et al., 2008; Moritz, Kloss, & Jelinek, 2010), most neuropsychological studies of OCD indicated that these patients show various difficulties in executive functions tasks (e.g., Abramovitch, Dar, Schweiger, & Hermesh, 2011a; Lucey et al., 1997; Meiran, Diamond, Toder, & Nemets, 2011; Penades, Catalan, Andres, Salamero, & Gasto, 2005). The most robust and stable differences between OCD patients and healthy controls were found on tasks that required response inhibition (Bannon, Gonsalvez, Croft, & Boyce, 2002; Penades et al., 2007). Abramovitch, Dar, Schweiger, and Hermesh (2011b) suggested that continuous attempts to control obsessive thoughts cause an overload and impairment in executive control and inhibition. These researchers suggested that the inhibitory control deficit is an epiphenomenon of OCD symptoms. On the other hand, other studies found cognitive control impairments to be a core symptom of OCD (for a review see Muller & Roberts, 2005). Furthermore, Huyser, Veltman, Wolters, de Haan, and Boer (2011) found increased activation of the anterior cingulate cortex (ACC; which is known to play a significant role in cognitive control) in OCD patients, which was only partially affected by cognitive-behavioral therapy, even though therapy successfully reduced patients' obsessive tendencies. These findings support the notion that deficits in inhibitory control may explain why intrusive thoughts, which are not pathological per se (Rachman & de-Silva, 1978), are so hard to ignore and harmful for individuals with OCD. There is still a debate in the literature regarding the direction of the influences of obsessive thoughts and inhibitory control.

The stop-signal task (Logan, 1994; Logan & Cowan, 1984) is perhaps the most common task demonstrating response inhibition differences between control participants and OCD patients or their families (Chamberlain, Fineberg, Blackwell, Robbins, & Sahakian, 2006; Menzies et al., 2007; Morein-Zamir, Fineberg, Robbins, & Sahakian, 2010). It examines the ability to suppress an already initiated action or thought (a pre-potent response) that is no longer appropriate. In this task a go signal is presented and in one-third of the trials, is followed by a stop-signal. The duration between the go signal and the stop signal is referred to as the stop-signal delay (SSD) and is submitted to a tracking procedure. This allows one to estimate the stop-signal reaction time (SSRT), which is the time needed for successful inhibition. SSRT has proven to be an important measure of cognitive control (Verbruggen & Logan, 2008).

To date, no studies have examined individual differences in a repeated-checking task. The aim of the current study was to examine whether individual differences in inhibitory control could offer an etiological explanation for the proneness of certain individuals to develop pathological doubt as a result of checking. Integrating basic cognitive science and applied clinical research would enable us to shed light on inhibition of a pre-potent response as an etiological factor of OCD. In order to do this we used the stop-signal task (Logan & Cowan, 1984), followed by van den Hout's repeated-checking task (van den Hout & Kindt, 2003). We predicted that participants with poor inhibition would exhibit more uncertainty on tasks inducing repeated checking than participants with good inhibition capabilities. Additionally, participants were administered a set of questionnaires measuring OCD, depression and anxiety. This enabled us to control for various clinical symptoms and overview their influence on behavioral results.

2. Method

2.1. Participants

Fifty-five undergraduate students (32 females and 23 males) of Ben-Gurion University of the Negev (Israel) participated in the current study for a small monitory payment. The proportion of males was .42 in the experimental group and .54 in the control group. No age ($F(1,49) < 1$) or gender differences were found between the groups. All participants had normal or corrected-to-normal vision, reported no history of attention deficit or dyslexia, were native Hebrew speakers and were naive as to the purpose of the experiment. Participants were randomly allocated to the two groups: the relevant-checking group (i.e., experimental group) vs. the irrelevant-checking group (i.e., control group), with the restriction that three quarters of participants should be allocated to the experimental condition. This was done because the control group was only used in order to replicate van den Hout and Kindt's (2003) results. Moreover, all main assumptions of the current study addressed the experimental group. Eventually, 42 participants were allocated to the experimental group, and 13 participants were allocated to the control group. Two participants failed to complete the set of tasks and were excluded from further analysis. Additionally, two participants didn't meet the criteria for valid SSRT (both had more than 60% of erroneous responses to the stop-signal task; for more details see Verbruggen, Logan, & Stevens, 2008) and were also excluded from further analysis (all excluded participants were from the experiment group). The mean age of valid participants was 25.05 years ($SD = 2.51$).

2.2. Procedure

Participants were presented with two computerized tasks and a set of four questionnaires. Task order was constant: stop-signal task, questionnaires and repeated-checking task. This was done in order to prevent possible influence of the repeated checking on inhibitory capabilities and obsessive beliefs and behavior. Participants were obligated to take a 2-min break after each task.

2.2.1. Stop-signal task

We used the "Stop-it" program (Verbruggen et al., 2008). The go signals were a white square and circle on a black background. The stop signal was an auditory tone (750 Hz, 75 ms). The task included one practice block of 32 trials and three experimental blocks of 64 trials each. Each trial started with a 250 ms fixation (a white plus sign in the center of a black screen), followed by a visual go stimulus. Response keys were "z" for square and "/" for circle. Stickers with corresponding shapes were pasted on the keys. Participants were asked to respond with the index finger of both hands. Instructions stated to press the correct key as fast and accurately as possible and emphasized not to wait for a potential stop signal. The visual stimulus stayed in view for 1250 ms regardless of the latency of the response. Reaction time (RT) was calculated from the