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The semantic Simon effect in Tourette's syndrome and obsessive-compulsive disorder

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Abstract

Core symptoms of Tourette's syndrome (TS) and obsessive-compulsive disorder (OCD) may be attributed to an impairment in inhibitory control. Neuropsychological studies have addressed inhibition in both disorders, but findings have been inconsistent. The aim of this study was to examine cognitive inhibition, using a semantic Simon effect paradigm, in patients with TS and OCD. Furthermore, to address comorbidity a group of TS + OCD patients was also examined. Results indicated that patients with TS and OCD were affected by the inhibitory components of the task. TS groups performed similarly to controls on simple and choice RT tasks, but were particularly compromised as increasingly complex inhibitory demands were imposed. OCD patients were slower and committed more errors than controls, especially in the more cognitively demanding conditions, and were particularly disadvantaged by incongruent stimulus-response compatibilities. Findings implicate possible fronto-striatal dysfunction, are consistent with previously reported inhibitory deficits in TS and OCD, and support the theory that comorbid TS + OCD is more closely linked to pure TS than OCD.

Keywords: Inhibition; Simon effect; TS; OCD

1. Introduction

Tourette's syndrome (TS) is a childhood onset movement disorder that is characterised by an array of motor and vocal tics that wax and wane in severity. Tics are defined as sudden, repetitive movements or vocalisations and may be simple or complex in nature (American Psychiatric Association, 1994). In addition to tics, patients also often present with comorbid emotional, cognitive and behavioural problems, including obsessive-compulsive disorder (OCD). Neuroimaging studies in TS and OCD typically implicate fronto-striatal pathways, indicating the possibility of similar neuropathologies (Baxter et al., 1987; Demirkol, Erdem, Inan, Yigit, & Guney, 1999; George et al., 1992; Perani et al., 1995; Peterson et al., 1993). However, the caudate is primarily affected in OCD, whereas the putamen is usually noted as the main site of impairment in TS (Rauch & Baxter, 1998). Therefore, OCD may be the cognitive counterpart to TS, which is predominantly a disturbance of motor function (Sheppard, Bradshaw, Purcell, & Pantelis, 1999).

It has been suggested that many of the core symptoms of both TS and OCD may be attributed to impairment in inhibitory control. For example, TS can be characterised by an array of disinhibited symptoms, such as repetitive stereotyped movements, echolalia, and echopraxia. Likewise, the recurrent, intrusive nature of obsessions and the repetitive compulsive behaviours of OCD may reflect an inability to inhibit certain stimuli and prepotent responses, respectively (Bannon, Gonsalvez, Croft, & Boyce, 2002). Various experimental paradigms have been employed to investigate inhibition in TS, with evidence for and against such deficits.

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Baron-Cohen, Cross, Crowson, and Robertson (1994) investigated the ability of children with TS (with and without comorbid disorders) to inhibit a verbal and motor prepotent response. Children with TS made considerably more errors than controls on verbal and motor tasks, indicating a central inhibitory deficit, rather than domain specific deficit. More recently, Hershey et al. (2004) examined eight adults with TS (with and without comorbid OCD or attention deficit hyperactivity disorder; ADHD) and reported no performance difference on a Go-No/Go task, compared to controls. However, it may be argued that the findings from these studies were confounded by sample heterogeneity and a lack of control of comorbid disorders. Ozonoff, Strayer, McMahon, and Filloux (1994) reported that pure TS children performed as well as controls on a Go-No/Go paradigm, but TS children with comorbid OCD or ADHD performed more poorly. Similarly, deGroot, Yeates, Baker, and Bornstein (1997) reported that many of the deficits described in TS may reflect the influence of comorbid disorders, such as OCD, rather than the effect of TS.

Cognitive inhibition in OCD has also been studied using similar experimental paradigms. Enright and Beech (1993) used a semantic negative priming task with OCD patients, as well as other anxiety disorder patients (e.g., agoraphobia, monophobia, panic disorder, generalised anxiety disorder, post-traumatic stress disorder, and social anxiety). The OCD group failed to exhibit priming effects in a negative priming condition, a pattern that was not displayed by any other anxiety disorder group. More recently, Bannon et al. (2002) administered a Go-No/Go and Stroop task in attempt to elucidate whether the inhibitory deficits exhibited by OCD patients were cognitive or behavioural in nature. It was reported that patients performed more poorly than the comparison group on both tasks, suggesting impairments in behavioural and cognitive inhibition.

Simon effect paradigms are also commonly used to investigate cognitive inhibitory processes. Traditional Simon effect paradigms require a spatial response based on a non-spatial stimulus attribute (Lu & Proctor, 1995). For example, participants may be required to press a left button in response to the presentation of a red figure and a right button in response to the presentation of a green figure, irrespective of the location of presentation (i.e., left or right side of screen). Therefore, in a typical Simon effect paradigm the irrelevant stimulus feature (i.e., side of screen on which stimulus is presented) and the relevant response feature (i.e., the left or right button-press) are spatially related (DeHouwer, 1998).

To date, no studies have investigated cognitive inhibition in OCD using a spatial Simon effect paradigm. However, Georgiou, Bradshaw, Phillips, Bradshaw, and Chiu (1995) used a traditional Simon effect paradigm in adult TS patients and Huntington's disease (HD) patients. Participants were required to respond to left and right pointing arrows displayed on the left and right side of a computer screen. Inhibition was invoked by spatial congruency and/or conditionality. Spatial congruency (Simon effect) was manipulated by asking participants to respond to the direction the arrow was pointing and inhibit the more prepotent response of responding to the side of screen where the stimulus was presented. Inhibition through Conditionality was invoked by pairing each arrow with a symbol, either a "x" or "=" sign. If an "=" sign was paired with the stimulus, participants were required to maintain cognitive set and respond to the direction the arrow was pointing. However, if the stimulus was paired with a "x" sign, participants were required to change cognitive set and respond in the opposite direction to which the arrow was pointing. Both TS and HD patients were considerably more impaired than their matched controls by the Simon effect and the manipulation of Conditionality. Therefore, under increasingly difficult conditions, adult TS patients showed evidence of a cognitive inhibitory deficit. However, the comorbidity status of the TS patients was not documented. Therefore, it is possible that the deficits reported were a consequence of comorbidity. Moreover, the task required inhibition of directional motor responding, as well cognitive inhibition. Therefore, it is also possible that the deficits reflected an impairment in motor inhibition, or a central inhibitory deficit, rather than a specific difficulty in cognitive inhibition.

DeHouwer (1998) developed a modified Simon effect paradigm in which the irrelevant stimulus feature and the relevant response feature were related semantically, rather than spatially, and required a speeded verbal response, rather than a speeded motor response. Removing the spatial element, and consequently the motor component, allows an investigation of cognitive inhibition, without being largely confounded by spatial and motor abilities. DeHouwer presented a list of animal and occupations names, written in Dutch or English, to first year University students. Participants were required to respond "Animal" to all English words and "Occupation" to all Dutch words, irrespective of their semantic meaning. Therefore, trials were either congruent (the correct response corresponded to the semantic category of the presented word) or incongruent (the correct response did not correspond to the semantic category of the presented word). Faster reaction times (RTs) were reported on congruent trials compared to incongruent. The irrelevant semantic relationship between the stimulus and the response had an effect on response speed. Therefore, the semantic Simon effect allows an examination of cognitive inhibitory processing, without a confounding directional motor effect.

The purpose of this study was to assess cognitive inhibition, under increasingly difficult task demands, using a semantic Simon effect paradigm in TS and OCD. Furthermore, to investigate the impact of comorbidity, a comorbid TS + OCD group was also examined. The task was an adaptation of Georgiou et al. (1995) study, but incorporated the semantic Simon effect. The experiment consisted of 6 Levels that progressively increased in processing load and complexity (see Fig. 1). Participants were required to make a verbal response (e.g., "plonk," "plant" or "beast") to the presentation of a stimulus word (eg "cat," "dog," "horse," "rose," "tulip," "daisy"), based on a predeter-