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Electrophysiology of facilitation priming in obsessive–compulsive and panic disorders

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HIGHLIGHTS

- We conducted the first electrophysiological investigation of repetition priming in obsessive–compulsive disorder (OCD) to include anxious and healthy controls and the first ERP study to consider OCD symptom subgroups.
- Repetition priming was exaggerated in both OCD and panic disorder, and related to atypical ERP topography and symptom severity.
- P2 amplitude to targets was significantly smaller in a non-washing/checking subgroup of OCD than all other groups.

ABSTRACT

Objective: Repeated experience with stimuli often primes faster, more efficient neuronal and behavioural responses. Exaggerated repetition priming effects have previously been reported in obsessive–compulsive disorder (OCD), however little is known of their underlying neurobiology or disorder-specificity, hence we investigated these factors.
Methods: We examined event-related potentials (ERPs) and behaviour while participants with OCD, panic disorder and healthy controls (20 per group) performed a Go/NoGo task which manipulated target repetition sequences.
Results: Both clinical groups showed stronger reaction time (RT) priming than HCs, which in OCD was greater in a checking, than washing, subgroup. Both clinical groups had similar RT deficits and ERP anomalies across several components, which correlated with psychopathology and RT priming. In OCD alone, N1 latency tended to increase to repeated stimuli, correlated with O–C symptoms, whereas it decreased in other groups. OCD-checkers had smaller target P2 amplitude than all other groups.
Conclusions: Enhanced neural priming is not unique to OCD and may contribute to salient sensory-cognitive experiences in anxiety generally. These effects are related to symptom severity and occur to neutral stimuli and in the context of overall RT impairment, suggesting they may be clinically relevant and pervasive. The results indicate overlapping information-processing and neurobiological factors across disorders, with indications of OCD-specific trends and subgroup differences.
Significance: This first electrophysiological investigation of OCD priming in OCD to include anxious controls and OCD subgroups allows for differentiation between overlapping and OCD-specific phenomena, to advance neurobiological models of OCD.

1. Introduction

Efficient selective attention requires both inhibition of irrelevant information and facilitation of task-relevant information (Ghatan et al., 1998; Harnishfeger, 1995; Wright et al., 2006).

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Much previous research has investigated whether OCD symptoms may be caused by failures in inhibiting irrelevant thoughts from entering consciousness. While inhibitory deficits are reported in OCD studies, results are inconsistent and OCD-specific deficits have yet to be identified. In addition to inhibitory deficits, undue facilitation of attention or actions could contribute to repetitive thoughts and behaviours in psychiatric disorders such as OCD (Bannon et al., 2008; Hartston and Swerdlow, 1999). It could be that due to facilitated priming processes, mental or motor acts in OCD have a greater initial activation, resulting in their atypical maintenance (Bannon et al., 2008; Hartston and Swerdlow, 1999; Moritz and von Muhlenen, 2005). This possibility has received little attention in the research literature, and physiological studies of priming processes in OCD are lacking.

1.1. Facilitation priming

Facilitation priming is defined as improved processing (in either reaction time [RT] or accuracy of responses), resulting from previous or simultaneous encounters with a stimulus (Posner and Snyder, 1975), and allowing more efficient responding to repeated stimuli (Bunzeck et al., 2006). Behavioural priming is usually accompanied by neural markers of priming, typically repetition-related reductions in hemodynamic activity in some cortical regions in fMRI studies (Bunzeck et al., 2006). Priming processes do not require conscious awareness but can be modulated by top-down processes such as subjective expectancy (Vervaeck and Boer, 1980).

Repeated experience with a stimulus may lead to a sharpening of the representation of stimulus features in the cortex accompanied by a smaller, more selective, neuronal response and a faster, more efficient, behavioural response (Grill-Spector et al., 2006). Additionally, repetition may lead to faster identification and processing of repeated stimuli accompanied by shorter durations of neural firing (Grill-Spector et al., 2006). This "repetition suppression" effect in cortical neurons constitutes a form of automatic perceptual learning allowing quick and efficient identification of previously encountered objects (Wiggs and Martin, 1998). Effects can accumulate over trials leading to higher-order effects including non-linear effects, such as plateaus or reversals in fMRI or ERPs (Grill-Spector et al., 2006).

In ERP studies, component amplitudes often show graded changes with higher-order stimulus repetitions (Friedman and Cycowicz, 2006; Rugg et al., 1994; Squires et al., 1976). Additionally, reduced ERP component latencies are reported in association with RT facilitation effects (Lobaugh et al., 2005; Taylor, 2002).

1.2. Priming in OCD

Excessive RT priming has been reported in people with OCD in visuospatial priming tasks (Hartston and Swerdlow, 1999), in terms of faster RTs to probes following earlier primes in the same visuospatial locations. These effects may indicate an exaggerated focus on already-experienced targets, possibly contributing to the automatic and repetitive nature of obsessions, whereby disturbing mental images become primed in OCD facilitating their own reoccurrence (Hartston and Swerdlow, 1999). Similarly, perseveration errors in OCD following previously correct responses in a delayed alternation task have been attributed to problems disengaging from previously occupied valid locations (Moritz et al., 2009). Thought suppression studies indicate enhanced priming of neutral words after attempts to suppress them in individuals with OCD (Tolin et al., 2002a). There has been one fMRI study of repetition priming in 12 young people with OCD versus healthy controls, which manipulated prime-target relationships. Participants with OCD had slower behavioural responses across conditions than healthy controls, interpreted as possible "obsessional slowness", and abnormal activation in parietal, temporal and precuneus regions in repetition trials (Viard et al., 2005). Because of the lack of a clinical comparison group the study was limited in determining the specificity of effects to OCD.

Some studies (Bannon et al., 2002; Herrmann et al., 2003) have reported faster RTs to Go stimuli in Go/NoGo tasks in OCD compared to normal or anxious controls. An intriguing possibility is that RTs become faster in OCD with stimulus repetition due to excessive priming effects. To test this possibility, it is necessary to analyse whether RTs to Go stimuli become faster with stimulus repetitions, however no previous studies have examined this issue.

There are some indications that mechanisms which are related to anxiety may also contribute to repetition priming. In healthy volunteers, behavioural and fMRI repetition effects are strongly attenuated with lorazepam, suggesting that GABAergic and cholinergic systems influence the neuronal plasticity necessary for repetition priming (Thiel et al., 2001). Conversely, facilitated processing of internal and external stimuli in anxiety has been linked to excessive excitability of cortical cholinergic inputs from the basal forebrain (Berntson et al., 1998). Benzodiazepine receptor agonists impede cognitive and attentional processing of a broad range of stimuli, and their anxiolytic effects may be due to a reduction in exaggerated cortical processing of anxiogenic stimuli (Berntson et al., 1998). Given the nature of these mechanisms, it is possible that exaggerated priming may occur in anxiety disorders generally rather than being specific to OCD, however comparisons across disorders are lacking in the literature.

1.3. OCD subgroups

The clinical heterogeneity of OCD symptoms has led to research into the neuropsychological characteristics between OCD subgroups. In several studies of attention and behaviour, those who primarily exhibit cleaning compulsions (washers) have been found to differ from those whose primary compulsions are not washing but checking or performing other rituals (termed non-washers or checkers; Ceschi et al., 2003; Foa et al., 1993; Matsunaga et al., 2002; Moritz and von Mühlenen, 2008; Nedeljkovic et al., 2009; Omori et al., 2007; Phillips et al., 2000; Summerfeldt et al., 1999; Van der Linden et al., 2005; Wahl et al., 2008). The heterogeneity of OCD can reduce the power of, and obscure, research findings unless sub-groups are considered (Hasler et al., 2007; Heyman et al., 2006). Although individuals with OCD may exhibit both behaviours, usually one type of ritual predominates, permitting individuals to be classified as a washer or checker (Fontenelle et al., 2005; Steketee et al., 1985). Presently, there is no one established method to identify OCD symptom subtypes (Julien et al., 2006) and previous studies use clinical interviews and a variety of OCD questionnaire measures with washing/checking subscales. The question of differences between symptoms subtypes and facilitation priming has rarely been investigated, however one study reported that visuospatial priming facilitation was most pronounced in OCD participants who reported a history of violent images, tics, "just right" obsessions, or checking compulsions (Hartston and Swerdlow, 1999). There are no previous ERP studies considering differences between OCD symptom subgroups.

In summary, several studies suggest the possibility of atypical priming in OCD, however direct examinations of brain activity are lacking, limiting conclusions about the physiological bases which may be involved. Additionally, it is necessary to compare brain activity accompanying priming in OCD with that of a clinical comparison group to determine the specificity of any effects to OCD.

We previously described an experimental task designed to separately examine both inhibitory and facilitatory aspects of selective

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