Cognitive Neuroscience of Obsessive-Compulsive Disorder

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KEYWORDS

• Error monitoring • Conflict monitoring • Response inhibition • Switching
• Decision making • Reward • Default mode network • Perseverative cognition

KEY POINTS

- Cognitive neuroscientific studies of obsessive-compulsive disorder (OCD) can be used to identify specific targets for treatment.
- The most consistent neuroimaging findings related to symptoms of OCD are hyperactivation in response to errors and hypoactivation during switching tasks, both occurring predominantly in the prefrontal cortex.
- This article proposes an additional model of OCD characterized by inflexible and inappropriate internally focused cognition, subserved by abnormal default mode network (DMN) activity.
- Given the complexity of the brain in general and OCD in particular, no single model is likely to fully explain the disorder.
- Together, the paradigms used in the cognitive neuroscientific study of OCD provide powerful probes that have already shed light on the underlying mechanisms of the disorder.

INTRODUCTION

For the past several decades, neuroimaging techniques such as functional magnetic resonance imaging (fMRI) and positron emission tomography have been used to investigate neurocircuit functioning in obsessive-compulsive disorder (OCD). Although early

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Abbreviations	
dACC	Dorsal anterior cingulate cortex
DAN	Dorsal attention network
DLPFC	Dorsolateral prefrontal cortex
DMN	Default mode network
EF	Externally focused
fMRI	Functional magnetic resonance imaging
FPN	Frontal-parietal network
IF	Internally focused
IFG	Inferior frontal gyrus
MFC	Medial frontal cortical
MID	Monetary incentive delay
OCD	Obsessive-compulsive disorder
OFC	Orbitofrontal cortex
rACC	Rostral anterior cingulate cortex
SMA	Supplemental motor area
VMPFC	Ventromedial prefrontal cortex

studies examining neural responses to symptom provocation in OCD are relevant for the disorder, they do not address whether basic cognitive-emotional mechanisms are impaired in the absence of direct symptom exacerbation. This article discusses findings from cognitive neuroscientific studies probing basic cognitive-emotional processes potentially at the core of OCD, focusing on those constructs for which there have been 3 or more studies comparing adults with OCD with a control group. It discusses results from studies examining conflict and error monitoring, response inhibition, task switching and reversal, decision making, reward processing, and emotional face processing in OCD. It concludes by proposing a model of OCD involving inflexibility of internally focused cognition, in which patients have difficulty disengaging from internally generated negative information. Several approaches not discussed here, such as correlations between neural activity and symptoms, effects of treatment, neurodevelopmental effects, and resting state functional connectivity, have substantially contributed to the understanding of OCD but are beyond the scope of this article.

A cognitive neuroscientific approach to the study of OCD has yielded critical insights into the neural mechanisms of the disorder, and these insights can be used to improve treatment. The most direct connection between cognitive neuroscientific studies of OCD and treatment development comes from the ability of neuroimaging studies to identify specific targets for treatment. Deep brain stimulation and transcranial magnetic stimulation have been used to correct abnormal neural functioning in psychiatric and neurologic disorders,[1] including OCD,[2–6] and investigation of cognitive-emotional processes in OCD has the potential to identify novel targets for these approaches. In addition, neurobiological targets can be modulated using real-time fMRI, which is a developing technology that trains individuals to modify activity in specific brain regions using neurofeedback of the fMRI blood oxygen level–dependent signal.[7] In addition, cognitive neuroscientific studies of OCD can help clarify the neurocircuit mechanisms underlying symptoms of the disorder in order to refine or develop pharmacologic and psychological interventions.

CONFLICT AND ERROR MONITORING

Much research into the cognitive neuroscience of OCD has focused on conflict monitoring and error detection. This approach is based on the proposal that