



# Executive function predicts cognitive-behavioral therapy response in childhood obsessive-compulsive disorder



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## ABSTRACT

Cognitive-behavioral therapy (CBT) is considered first-line treatment for childhood obsessive-compulsive disorder (OCD). Despite CBT's efficacy, too many children and adolescents do not fully respond to treatment, making the identification of predictors of treatment response highly relevant. Executive functions (EF) have been suggested to constitute such predictors, but studies with pediatric samples are scarce. In the present study, we investigated latent level EF test performance and ratings of daily life EF behavior as predictors of CBT response in pediatric OCD. We further examined the stability of EF from pre- to post-treatment and the association of EF changes with OCD severity change. EF test performance significantly predicted exposure-based CBT outcome. Patients with better EF test performance had significantly elevated risk of non-response relative to patients with poorer performance. Daily life EF behavior in OCD probands improved after treatment relative to controls. The findings suggest that EF performance impacts CBT outcome, and that exposure-based CBT is well-suited for children and adolescents with OCD and poorer EF test performance. This study supports the relevance of EF in CBT for childhood OCD and denotes a possible need for development of enhanced treatments for children and adolescents with OCD and superior EF performance.

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## 1. Introduction

Obsessive-compulsive disorder (OCD) often starts in childhood and can cause significant impairment in daily life (Canals, Hernandez-Martinez, Cosi, & Voltas, 2012; Piacentini, Bergman, Keller, & McCracken, 2003). Cognitive-behavioral therapy (CBT) is considered first-line treatment in pediatric OCD (Geller & March 2012; Ivarsson et al., 2015); however, programs may vary in content. The most widely investigated and recommended CBT programs for pediatric OCD emphasize exposure and response prevention as a core treatment component (Franklin et al., 2013; Geller & March 2012) and commonly also include components such as psychoeducation, creation of a symptom hierarchy, cognitive restructuring, and contingency management (Kircanski, Peris,

& Piacentini, 2011; Rosa-Alcázar et al., 2015). Despite the well documented efficacy of CBT, 30–50% of children and adolescents with OCD only respond partially or not at all to standard CBT (Franklin et al., 2015; Torp et al., 2015). Consequently, identifying those in need of adapted, enhanced, or augmented treatment strategies is of great importance, and requires identification of predictors of treatment response.

A range of factors have been suggested to predict treatment response in pediatric OCD, including executive functions (EF; Ginsburg, Kingery, Drake, & Grados, 2008). Executive functions are a set of general-purpose control processes that regulate thought and behavior reflecting both an underlying general ability (common EF) as well as specific functions (e.g., working memory, inhibition, and set shifting; Miyake et al., 2000). Executive functions can be assessed through the use of neuropsychological tasks (i.e., performance-based measures) or behavior ratings (i.e., rating-based measures). The two types of measures have been suggested to reflect different underlying constructs; that is, EF task performance is thought to reflect “processing efficiency” in a structured

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situation, whereas EF behavior ratings reflect “success in goal pursuit” in a daily life context (Toplak, West, & Stanovich, 2013).

Neurobiological OCD models suggest that dysfunction in fronto-striatal brain circuits associated with EF underlies OCD phenomenology (Brem et al., 2012; Menzies et al., 2008) making the case for EF as a potential endophenotype in OCD (Chamberlain, Blackwell, Fineberg, Robbins, & Sahakian, 2005; Olley, Malhi, & Sachdev, 2007; Taylor, 2012; Zhang et al., 2015). But whereas EF task underperformance has been documented in adult OCD samples (Abramovitch, Abramowitz, & Mittelman, 2013; Shin, Lee, Kim, & Kwon, 2014; Snyder, Kaiser, Warren, & Heller, 2014), the OCD EF endophenotype hypothesis has generally not been supported in children and adolescents (Abramovitch et al., 2015; Geller et al., 2017; Hybel, Mortensen, Lambek, Thastum, & Thomsen, 2016). By comparison, studies suggest that pediatric OCD patients might be significantly impaired in daily life EF-related behavior compared to typically developing children and adolescents (Hybel, Mortensen, Højgaard, Lambek, & Thomsen, 2017; McNamara et al., 2014; Zandt, Prior, & Kyrios, 2009).

Though deficits in EF task performance do not seem to constitute core markers in the development of OCD in childhood, EFs might play a significant role as a predictor of response to CBT. Cognitive-behavioral therapy requires the child to carry out homework exercises, restructure thoughts, monitor reactions and emotions, and log progress (Kircanski et al., 2011; Piacentini, Langley, & Roblek, 2007). All of these activities rely on the recruitment of EFs such as the ability to plan, hold and manipulate materials in working memory, and inhibit automatized responses. Well-functioning EFs could therefore be a prerequisite for effective treatment (Mohlman & Gorman, 2005). Indeed, such an association has been suggested with respect to the impact of EFs on cognitive restructuring processes in CBT (Johnco, Wuthrich, & Rapee, 2014). However, as CBT for childhood OCD is largely based on exposure and response prevention, with relatively minor emphasis on cognitive restructuring compared to CBT for adults and CBT for other psychiatric conditions (such as generalized anxiety or depression), and as CBT is a highly structured treatment approach which has been said to promote or hone EF skills (Goodkind et al., 2016), a relationship where CBT is most effective in individuals with less optimally functioning EF might also be proposed. The role of EF in OCD treatment response has been examined in adults and, to a lesser extent, in children and adolescents, but with mixed findings. Seven studies have examined neuropsychological functions as predictors of CBT outcome in adult OCD, using performance-based measures. Three of these reported an association between EF and treatment outcome (D’Alcante et al., 2012; Moritz, 1999; Sieg, Leplow, & Hand, 1999), whereas the remaining studies reported no such association (Braga et al., 2016; Moritz et al., 2005; Vandborg, Hartmann, Bennedsen, Pedersen, & Thomsen, 2016; Voderholzer et al., 2013). In one of the studies, rating-based measures of neurocognitive functions (but not EF) were also applied (Moritz et al., 2005), but no association between self-reported neurocognitive function and treatment response was found.

To date, only two studies have investigated EFs as predictors of treatment response in pediatric OCD. Flessner et al. (2010) explored the impact of different aspects of neuropsychological functioning on treatment outcome after CBT, pharmacotherapy, or a combination of the two in a sample of children and adolescents with OCD. They found that impaired visuo-perceptual memory and organization strategy, as measured by the Rey-Osterrieth Complex Figure Test (RCFT; Lezak, Howieson, Bigler, & Tranel, 2012), predicted poorer treatment outcome, and most significantly so in the CBT condition. As the study was exploratory and the validity of the RCFT as an EF measure has been questioned (Weber, Riccio, & Cohen, 2013), replication of the findings is warranted. McNamara

et al. (2014) investigated the association between rating-based EFs and response to CBT plus medication or placebo. Executive function was measured with the Behavior Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000). They reported that only one EF aspect, emotional control, predicted outcome; that is, patients with poorer emotional control generally had poorer outcome across treatment conditions.

Whether based on adult or pediatric samples, nearly all of the above-mentioned studies included patients treated with psychotropic medication, making it difficult to single out the unique contribution of CBT. Also, the majority of studies did not exclude neuropsychiatric comorbidity (e.g., ADHD) associated with EF impairments (Snyder, Miyake, & Hankin, 2015), and such factors might confound OCD treatment effects (Olatunji, Davis, Powers, & Smits, 2013).

A further question is whether EF performance is state dependent and influenced by OCD symptoms or should be considered trait-like. Several studies investigating the stability of neuropsychological functions from pre- to post-treatment in adult OCD have been conducted, albeit with mixed results (Vandborg, Hartmann, Bennedsen, Pedersen, & Thomsen, 2015; Vandborg et al., 2012; Voderholzer et al., 2013). In adult OCD, no studies have investigated rating-based EF stability. The stability of EFs in children and adolescents with OCD has been investigated in three samples. In the study by McNamara et al. (2014), rating-based EF aspects were evaluated and it was reported that high scores on the BRIEF subdomains (shift, inhibit, planning/organizing, monitoring and initiating; indicating poorer EF behavior), were associated with higher degree of symptom severity during treatment. However, this study did not evaluate the EF changes in OCD compared to EF changes in typically developing children and adolescents by inclusion of a control group. Such a design was applied by Andres et al. (2008) who investigated neuropsychological test performance before and after six months of naturalistic treatment in children and adolescents with OCD and compared them with a typically developing control group. Neuropsychological performance, including performance on inhibition and set shifting tasks, generally improved and normalized relative to the control group after treatment, suggesting EFs in children and adolescents to be state-dependent. Likewise, in a functional magnetic resonance (fMRI) study, Huyser, Veltman, Wolters, de Haan, and Boer (2010) found performance on a planning task to improve after CBT. In a concurrent fMRI study with the same sample, however, the authors found no change relative to controls after CBT on a task measuring response inhibition (Huyser, Veltman, Wolters, de Haan, & Boer, 2011). In sum, though somewhat inconsistent, previous findings suggest that EFs in pediatric OCD are state-dependent. However, due to the limited sample sizes of the studies, and the restricted number of EF tasks applied, findings are in need of replication.

The primary aim of the present study was to investigate EF as a predictor of response to CBT in children and adolescents with OCD. A performance-based common EF latent variable measure and a rating-based general EF measure were applied. Based on the limited child and adolescent literature, we hypothesized that poorer EF performance, albeit not daily life EF behavior, would predict poorer treatment outcome. Secondary aims were to examine the stability of EFs from pre- to post-CBT treatment and to investigate whether possible changes in EFs were associated with OCD severity change. We hypothesized that both types of EFs would improve after treatment, and that changes in EFs would be associated with changes in OCD severity.

## 2. Methods

The present study was an add-on to the Nordic Long-term OCD

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