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Cognitive flexibility differentiates young adults exhibiting obsessive-compulsive behaviors from controls

Sarah K. Francazio*, Christopher A. Flessner

Department of Psychological Sciences, Kent State University, 600 Hilltop Drive, Kent, OH 44240, USA

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ABSTRACT

The National Institute of Mental Health has proposed a shift toward classifying clusters of disorders on the basis of underlying biomarkers and neurological correlates. The present study sought to determine whether cognitive flexibility represents one such construct underlying obsessive-compulsive behaviors (OCBs), a cluster of behaviors characteristic of OCD and other body-focused repetitive behaviors (BFRBs), including trichotillomania, pathological skin picking, nail biting, and tic disorders. One-hundred and twenty-four undergraduate students completed the Depression Anxiety and Stress Scales, Padua Inventory—Washington State University Revision, Massachusetts General Hospital—Hairpulling Scale, Skin Picking Scale, and an Intradimensional/Extradimensional Shift (IDED) Test. Analyses were performed using a subsample of participants who met criteria for inclusion in the OCB group and a control group ($N=56$). Results indicated that young adults in the OCB group demonstrated significantly poorer performance on the IDED compared to controls. However, hierarchical regression analyses revealed that increased deficits in cognitive flexibility failed to predict worsened OCB severity—as assessed via a composite score. These results suggest that while cognitive flexibility differentiates those exhibiting OCBs from controls, it does not appear to be related to OCB severity. Future research is needed to replicate these results in larger clinical samples.

1. Introduction

Obsessive-compulsive behaviors (OCBs) are repetitive, habitual, compulsive behaviors characteristic of obsessive-compulsive disorder (OCD) and other psychiatric disorders including body-focused repetitive behaviors (BFRBs; e.g., trichotillomania (TTM), pathological skin picking, and nailing biting), generalized anxiety disorder (GAD), tic disorders, eating disorders, substance abuse, impulsive control, as well as autism spectrum disorders. It is estimated that between 0.60% and 2.64% of adults will develop at least one of these disorders in their lifetime (Keuthen et al., 2010; Kim et al., 2011; Schlander et al., 2011; Galimberti et al., 2012; Knight et al., 2012; Roberts et al., 2013) and can result in significant impairment in day-to-day functioning. For example, the bald spots, tissue damage, and skin lesions that may result from TTM and pathological skin picking, the stereotyped behavior patterns associated with autism spectrum disorders (Levy and Perry, 2011), and the excessive doubting and ritualized behaviors characteristic of OCD and GAD can lead to a variety of negative outcomes including embarrassment, pain, poor health outcomes, interpersonal, and occupational difficulties (Arnold et al., 2001; Stein et al., 2010; Mackenzie et al., 2011). Recently, the National Institute of Mental Health (NIMH) proposed the Research Domain Criteria (RDoC) initiative to shift from the current classification of disorders on the basis of presenting signs and symptoms toward an emphasis on classifying clinical phenomena by shared biomarkers and neurological correlates between clusters of disorders (Insel et al., 2010). Despite the high prevalence of disorders characterized by OCBs, few studies have examined the relationship between potential neurocognitive factors and shared behavioral phenotypes amongst these disorders. To address the lack of research in this domain, the current study seeks to examine the relationship between cognitive flexibility and OCBs (i.e., obsessions, compulsions, hair pulling, and skin picking) in young adults as compared to controls.

Cognitive flexibility is defined as the ability to switch attention from one task to another or change behaviors after receiving negative feedback and has been linked to many psychiatric disorders including attention-deficit/hyperactivity disorder (ADHD; Sergeant et al., 2003; Willcutt et al., 2005; Rommelse et al., 2007), obsessive-compulsive and related disorders (e.g., OCD, TTM, pathological skin picking; Deckersbach et al., 2000; Okasha et al., 2000; Kuelz et al., 2004; Bohne et al., 2005; Chamberlain et al., 2005; Bannon et al., 2006; Chamberlain, et al., 2006; Lawrence et al., 2006; Chamberlain et al., 2007a; Chamberlain et al., 2007b; Britton et al., 2010; Odlaug et al., 2010; Ornstein et al., 2010), anorexia nervosa and bulimia nervosa (Tchanturia et al., 2004; Gillberg et al., 2007; Tchanturia et al., 2011; Galimberti et al., 2012), and depression (Marazziti et al.,

* Corresponding author. Tel.: +1 330672 2200.
E-mail address: sfrancaz@kent.edu (S.K. Francazio).

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2010; Meiran et al., 2011; Lee et al., 2012), among others. From a clinical perspective, cognitive flexibility may be particularly beneficial in helping to explain the development of OCBs. For example, patients presenting with symptoms of OCD—a disorder characterized by OCBs—may exhibit persistent, repetitive hand washing despite negative feedback such as bleeding and chapped hands. Similarly, patients who pull their hair or pick their skin continue to do so despite the resulting bald spots, bleeding, scarring, and negative social feedback. Evidence from neuroimaging studies of OCD and TTM suggests that performance on tests of cognitive flexibility may be mediated by the dorsolateral prefrontal cortices and frontal–striatal circuitry (Britton et al., 2010; Snorrason et al., 2012). These same brain regions have been implicated as potential areas of dysfunction in disorders characterized by OCBs. For example, a study of patients with OCD found that performance on tests of cognitive flexibility is associated with decreased frontal–striatal circuitry (Britton et al., 2010). The small number of neuroimaging studies in TTM have produced mixed findings (Snorrason et al., 2012), though there is evidence for abnormalities in the striatum, several cortical regions (both linked to cognitive flexibility deficits) and the amygdalo–hippocampal complex (Swedo et al., 1991; Grachev, 1997; O'Sullivan et al., 1997; Keuthen et al., 2007; Chamberlain et al., 2008; Chamberlain et al., 2010; Lee et al., 2010). These findings suggest that—from a biological and phenotypic perspective—cognitive flexibility may represent an important construct for understanding the etiology of OCBs.

Apart from inhibitory control, cognitive flexibility represents the neurocognitive domain that has received the greatest degree of empirical attention among OCBs and yet has also produced the most discrepant findings. Some studies have found that participants with OCD have impaired performance on tasks of cognitive flexibility (Deckersbach et al., 2000; Okasha et al., 2000; Kuelz et al., 2004; Bannon et al., 2006; Lawrence et al., 2006; Britton et al., 2010) while others find they perform similarly to healthy controls (Abbruzzese et al., 1995; Abbruzzese et al., 1997; Moritz et al., 2001, 2002). Though less prevalent, research examining cognitive flexibility in patients with TTM (Stanley et al., 1997; Bohne et al., 2005; Chamberlain et al., 2006; Chamberlain et al., 2007a; Grant et al., 2011; Grant et al., 2012) and pathological skin picking (Odlaug et al., 2010; Grant et al., 2011) have yielded mixed findings though the majority of these studies do appear to support the importance of cognitive flexibility in understanding the etiology of these disorders. A potential explanation for the discrepant findings from studies of cognitive functioning in OCBs, as noted above, may be the absence of a standardized method of assessing cognitive flexibility. For example, cognitive flexibility has been assessed using both computerized and paper-and-pencil methods of assessment, including the Object Alternation Test (Bohne et al., 2005), Trails B (Stanley et al., 1997), the computerized IDED task (Chamberlain et al., 2006; Britton et al., 2010; Odlaug et al., 2010; Grant et al., 2011; Grant et al., 2012), and the Wisconsin Cart Sorting Test (Ornstein et al., 2010). The multitude of potential methods for assessing cognitive flexibility, and the resultant lack of standardization creates difficulty in comparing results across studies. In addition, unstandardized approaches may lead to an increased potential for experimenter error or bias. The current study will attempt to remedy this limitation by utilizing a standardized, automated set-shifting task to examine cognitive flexibility in a more reliable manner and utilizing a novel, transdiagnostic approach to these behaviors.

The RDoC has placed, as a central tenant of its goal, an emphasis on examining relationships between differing units of analysis (i.e., behavioral tasks of cognitive flexibility, self-report of repetitive or ritualistic behavior) within broader constructs (i.e., habit behaviors). In this vein, the RDoC endeavors to be transdiagnostic in relation to its stated goals. Given this fact and the aforementioned relationship posited to exist between cognitive flexibility and OCBs, the primary aim for the current study is to investigate whether greater cognitive flexibility deficits—assessed using a computerized measure—exist among young adults exhibiting OCBs (i.e., symptoms of OCD, TTM, or skin picking) compared to controls. To our knowledge, all prior research has sought to examine the role of cognitive flexibility within discrete disorders (i.e., OCD, subclinical symptoms of OCD, etc.), rather than utilizing a transdiagnostic approach. We predict that participants classified as part of the OCB group—via creation of a composite OCB variable—will exhibit greater deficits in cognitive flexibility compared to controls. This novel approach also provides the opportunity to explore a potential cumulative load hypothesis. That is, a secondary aim of this study is to identify whether poorer performance on a task of cognitive flexibility predicts worsened OCB severity—as assessed using a composite score obtained via the summation of standardized scores from three validated measures of OCD, hair pulling, and skin picking. We hypothesize that as the severity of cognitive flexibility deficits becomes greater, the severity of OCBs will also become greater (Chamberlain et al., 2005).

2. Methods

2.1. Participants

Data were obtained from an ongoing study designed to examine the link between neurocognitive functioning and repetitive behavior problems among college students. Participants were recruited via the SONA Experiment Management System website at Kent State University (KSU). Participants consisted of current KSU students ($N=132$) enrolled in psychology courses who were required to participate in ongoing research projects to receive course credit in entry-level psychology courses. Participants were required to be at least 18 years of age and provide complete data on all measures utilized in statistical analyses relevant to this study's primary and secondary aims. Of the 132 participants, 124 met these criteria and were used to construct subgroups (see description of subgroup construction in Data Analytic Plan). Demographic characteristics for the entire sample ($N=124$) as well as the two subgroups constructed for the purpose of this study are provided in Table 1.

2.2. Measures

2.2.1. Depression Anxiety and Stress Scales (DASS-21; Lovibond and Lovibond, 1995)

The DASS-21 is a 21-item version of the original 42-item self-report designed to measure depression, anxiety, and tension/stress. Items are scored from 0 to 3, with higher scores indicating increased frequency of symptoms. The DASS-21 consists of three subscales assessing depression ($\alpha=0.86$), anxiety ($\alpha=0.76$), and stress ($\alpha=0.77$). The scale has frequently been used in college student populations and has been shown to have high reliability and adequate divergent and discriminant validity (Ng et al., 2007).

2.2.2. Padua Inventory—Washington State University Revision (PI-WSUR; Burns, 1995)

The Padua Inventory—Washington State University Revision is a 39-item self-report measure of the degree of disturbance caused by obsessions and compulsions ($\alpha=0.94$ in the current sample). The scale consists of several subscales measuring contamination obsessions and washing compulsions, dressing/grooming compulsions, checking compulsions, obsessional thoughts of harm to self or others, and obsessional impulses to harm self or others. Items are scored on a range from 0 ("not at all") to 4 ("very much"). The scale has been used in diverse populations and displays good psychometric properties (Burns et al., 1996).

2.2.3. Massachusetts General Hospital—Hairpulling Scale (MGH-HS; Keuthen et al., 1995)

The MGH is a 7-item self-report that assesses repetitive hair pulling ($\alpha=0.97$). The MGH measures the severity of hair pulling, degree of resistance and control over hair pulling, and actual hair pulling. Items range from scores of 0 to 4, with higher scores indicating increased symptom severity. The MGH has been found to be internally consistent, demonstrate good test-retest reliability, significant convergent and divergent validity, and sensitivity to change in hair pulling symptoms (O'Sullivan et al., 1995).

2.2.4. Skin Picking Scale (SPS) (Keuthen et al., 2001)

The SPS is a 6-item self-report scale assessing skin picking behaviors ($\alpha=0.95$). Scale items measure the frequency of skin picking urges, intensity of urges, time spent on picking, interference due to picking, and distress and avoidance related to skin picking. Examinees are instructed to rate items on a 0–4 scale, with higher values indicating more severe symptoms. The SPS has been found to be a valid and reliable measure of skin picking severity (Keuthen et al., 2001).