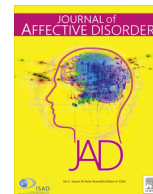




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Research paper

Executive function deficits associated with current and past major depressive symptoms

Keith Bredemeier^{a,b,*}, Stacie L. Warren^{a,c,1}, Howard Berenbaum^{a,1}, Gregory A. Miller^{a,d,1}, Wendy Heller^{a,1}^a University of Illinois at Urbana-Champaign, United States^b University of Pennsylvania, United States^c Palo Alto University, United States^d University of California, Los Angeles, United States

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ABSTRACT

Background: Although there has been extensive research showing that depression is associated with executive function (EF) deficits, the nature of these deficits is not clearly delineated. Specifically, previous reviews on this topic have yielded different conclusions about the particular domains of EF that are disrupted in depressed individuals. Further, research on whether these deficits persist after depressed mood has remitted is less prevalent and not consistent.

Methods: In two independent samples of college students, we examined associations between clinical ratings of current and past symptoms of a Major Depressive Episode (MDE) and difficulties in two domains of EF: inhibition and shifting. In Study 1 (n = 162), EF was measured using behavioral tasks shown to index these two domains. In Study 2 (n = 95), EF was measured using a self-report questionnaire believed to capture EF difficulties experienced in daily life.

Results: In both studies, past MDE symptoms were associated with worse shifting. In contrast, current MDE symptoms were associated with worse inhibition, though only on the behavioral measure (in Study 1).

Limitations: Both studies used college samples and retrospective assessments of past symptoms. Further, only two domains of EF were examined, and the EF measures employed in each study have their own unique methodological limitations.

Conclusions: Findings suggest that inhibition deficits vary as a function of current symptoms and thus may be a by-product of distress rather than a causal contributor. In contrast, shifting deficits associated with depression appear to be more enduring, suggesting that they could contribute to risk for depression.

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1. Introduction

Major depressive disorder (MDD) is among the most common mental disorders; the lifetime prevalence of MDD is approximately 17% (Kessler et al., 2005). Depression is associated with poor quality of life, which in turn is associated with poor work performance and social adjustment (Goldberg and Harrow, 2005;

Rapoport et al., 2005). In fact, major depression has been deemed a leading cause of disability worldwide (e.g., based on years lived with severe impairment; Lopez and Murray, 1998).

Cognitive deficits may play a key role in understanding the impairment associated with depression, and possibly its etiology. Difficulties with concentration and/or decision-making are diagnostic features of MDD (APA, 2013), and research has shown that people experiencing depression display a wide range of deficits in cognitive performance, including difficulties with attention, memory, and problem-solving (see Levin et al. (2007), Hammar and Ardal (2009), and Rock et al. (2014), for reviews). Given the breadth of these deficits, some have argued that depression is characterized by a general depletion in cognitive resources (e.g., Mathews and MacLeod, 1994). However, the results of numerous studies suggest that depressed individuals have sufficient resources but have difficulty initiating efficient cognitive strategies (e.g., Hertel and Gerstle, 2003; Marx et al., 1992; see Hertel (1994))

* Correspondence to: University of Pennsylvania, 3535 Market Street, Room 2043, Philadelphia, PA 19104, United States.

E-mail address: kbred@mail.med.upenn.edu (K. Bredemeier).

¹ K. Bredemeier and S.L. Warren developed the study concept and design, with Study 1 conceived and executed under the primary mentorship of H. Berenbaum and Study 2 drawing on a larger project conceived and executed by W. Heller, G.A. Miller, and others not directly involved with this manuscript. Bredemeier performed the literature search and data analyses. Bredemeier drafted the initial version of the manuscript, which was revised by all the authors. All authors approved the final version of the manuscript for submission.

and/or appropriately allocating these resources (e.g., Levens et al., 2009; Yee and Miller, 1994; see Ellis and Ashbrook (1989)).

Executive function (EF) involves the effortful guidance of behavior towards a goal state. EF regulates other, non-executive cognitive processes (e.g., perception, motor responses), is particularly important in non-routine situations, and relies heavily on prefrontal cortex (Banich, 2009). In light of evidence for structural and functional abnormalities in prefrontal cortex associated with depression (e.g., Davidson et al., 2002), coupled with findings inconsistent with the general resource depletion hypothesis (e.g., Hertel and Gerstle, 2003), some have argued that the broad range of cognitive deficits observed in depressed individuals could be driven by deficits in EF (e.g., Levin et al., 2007). In line with this proposal, there is now ample evidence that depressed individuals show impaired performance on tasks that require EF (see Austin et al. (2001), Fossati et al. (2002), Ottowitz et al. (2002), Rogers et al. (2004), and Snyder (2013), for reviews). However, research suggests that EF is multi-dimensional (e.g., Burgess et al., 1998; Fisk and Sharp, 2004; Miyake et al., 2000). In the context of such findings, the nature of the EF deficits associated with depression remains unclear. Some reviews conclude that these impairments might be specific to the domain of shifting (i.e., switching between tasks or mental “sets” Austin et al., 2001), some suggest they are unique to inhibition (i.e., avoiding/suppressing habitual or “pre-potent” responses; Fossati et al., 2002), and still others conclude that EF is broadly impaired in depressed individuals (e.g., Rogers et al., 2004; Snyder, 2013; see also Snyder et al. (2015)).

We posit that there are two prominent reasons for this lack of clarity. First, most of the existing work on this topic uses classic but problematic EF tasks (e.g., Wisconsin Card Sorting, Tower of London). Although these measures are generally well-validated, they typically require the use of multiple aspects of EF, as well as other, non-executive abilities (for a detailed discussion of this “task impurity” problem, see Miyake et al. (2000)). As a result, impaired performance is difficult to interpret. An alternative approach is to use tasks that have been shown to measure specific dimensions of EF (e.g., inhibition, shifting). Second, most of the existing work in this area has focused on current symptoms. However, depression is typically an episodic phenomenon (see Kessler et al. (1997)). Thus, it is important to consider whether participants have experienced depression in the past as well, as this may be indicative of vulnerability to depression. In fact, there is some evidence to suggest that EF deficits associated with depression can persist even after depressed mood has remitted (e.g., Clark et al., 2005; Paelecke-Habermann et al., 2005). However, relatively few studies have explored this, and there have been mixed findings amongst those that have (see Hasselbalch et al. (2011) and Rock et al. (2014)).

The goal of the present research was to test contrasting hypotheses about EF deficits in depression. Clarifying the nature and time-course of EF deficits associated with depression may have important practical and clinical implications. For example, if EF deficits contribute to depression risk, interventions aimed at remediating these deficits could be used in effort to treat (or even prevent) depression. In contrast, if EF deficits in depressed individuals are simply a by-product of their distress, there is reason to assume that they will resolve when their symptoms improve, either naturally or through treatment. Further, conclusive evidence about whether these deficits are unique to (or simply stronger in) a particular domain of EF would be helpful for honing initiatives to address EF in clinical applications. For example, such evidence might provide a clearer sense of the daily tasks on which depressed individuals are likely to struggle and what to target in remediation efforts.

2. Study 1

To test contrasting hypotheses from reviews regarding the nature of EF deficits associated with depression, we administered performance tasks that have been shown to measure the EF dimensions of inhibition and shifting (Miyake et al., 2000). This approach tested whether depression is associated with deficits that are specific to shifting or inhibition (as suggested by Austin et al. (2001) and Fossati et al. (2002), respectively) or a general EF deficit (evidenced by impaired performance on both tasks, consistent with the conclusions of Rogers et al. (2004) and Snyder (2013)). We did not plan to examine the EF dimension of updating/working memory, because reviews have not concluded that depression is uniquely associated with deficits in this domain and because working memory data from this sample are presented in Bredemeier and Berenbaum (2013). Motor and processing speed was also measured, to ensure that impaired performance on the EF tasks is not due to psychomotor retardation (a symptom of MDD documented on behavioral tasks; see APA (2013) and Snyder (2013)).

To address the episodic nature of depression, we assessed participants' past as well as current symptoms. This approach should prove helpful in identifying deficits that could confer vulnerability to depression, as opposed to those that are simply a by-product of the individual's current symptoms/distress. In order to provide an even stronger test of the latter possibility, measures of mood at the time of study participation were also administered.

2.1. Methods

2.1.1. Participants

One hundred and sixty-two college students (57% female), ranging in age from 18 to 26 years ($M=19.7$), participated in the study.² The sample was predominantly European-American and Asian American. Of these individuals, 128 (79%) were recruited through the University of Illinois Psychology participant pool and received course credit. The remaining 34 were recruited using flyers targeting individuals who had experienced problems with depression and/or anxiety (either recently or in the past) and were paid \$10/hour. The latter recruitment strategy was used to obtain better representation of individuals with elevated levels of distress in the sample. Given the nature of the performance tasks (see below), only individuals who reported normal or corrected-to-normal vision and no significant hearing problems were eligible. The same sample was used in other papers (Bredemeier and Berenbaum, 2013, and Study 2 in Bredemeier and Simons (2012)), but the questions addressed in those papers are distinct from those addressed in this one, and the data and analyses reported here were not part of those papers.

2.1.2. Materials

2.1.2.1. Mood measures. Current and past symptoms of a Major Depressive Episode (MDE) were assessed using the mood module of the Structured Clinical Interview for DSM-IV Disorders, Non-patient Edition (SCID-NP; First et al., 2002). Interviews were conducted by the lead author, who has extensive experience conducting diagnostic assessments. In line with SCID guidelines, “current” was operationalized as symptoms experienced in the past month, each diagnostic criterion was rated on a three-point scale (0=absent, 1=subthreshold, 2=threshold), and additional

² Initially, 173 students participated in the study. However, 11 participants reported that they were taking anti-depressants and/or stimulant medications. In light of evidence that these types of medication can, for better or worse, influence cognitive performance (e.g., Kempton et al., 1999; McClintock et al., 2010), these participants were excluded from analysis.

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