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Brief Report: Executive Functions in Adolescent Offspring of Mothers with a History of Depression

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Abstract

Deficits in executive functions (EFs) have been documented among individuals with unipolar depression, but controversy exists as to whether such deficits are state-dependent or are trait markers that precede disorder onset. The present study examined whether maternal history of unipolar depression was associated with deficits in EFs in early adolescent offspring, a finding that would support a trait marker conceptualization of EF deficits.

Participants were a diverse sample (N = 493) of adolescents and their mothers recruited through local schools. Measures included semi-structured diagnostic interviews of mother and adolescent, mother-report forms assessing demographic information, and tests of executive function. Hierarchical linear regression analyses were conducted to examine the association between maternal depression diagnosis and adolescent offspring performance on tests of EF. Maternal lifetime history of depression was not associated with offspring EF task performance. Findings are not consistent with the conceptualization of impaired executive functions as trait markers of unipolar depression.

Keywords

Executive functions; depression; adolescents; maternal depression

Executive functions (EFs) are separable but interrelated skills (Asato, Sweeny, & Luna, 2006; Miyake et al., 2000) necessary to purposeful, goal-directed activity and behavior (Anderson, 1998; Welsh, Pennington, & Groisser, 1991). Major depressive disorder is characterized by deficits in EFs in adulthood (Snyder, 2013; Wagner et al., 2011). A sparser and less consistent literature likewise has documented deficits in EFs in children and adolescents with unipolar depressions (Baune, Fuhr, Air, & Hering, 2014). However, debate

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Conflict of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

exists as to whether EF deficits are trait markers of unipolar depression, which precede first onset of the disorder and persist following remission, or are state-dependent, arising as a consequence of depressive episode onset (Hasselbalch, Knorr, & Kessing, 2011). Deficits in executive functions in individuals at high risk for depression prior to disorder onset have been proposed to support a trait-marker conceptualization of EF deficits in depression (Micco et al., 2009), whereas lack of such evidence would be consistent with a state-dependent conceptualization.

The few studies examining this question to date have yielded little evidence of deficits in EF in offspring of parents with a lifetime history of depression. Micco and colleagues (2009) compared executive functions and processing speed in a sample of offspring (age 6–17) of parents with a history of MDD and/or panic disorder to those with parents without a history of mood or anxiety disorders or psychiatric treatment. Controlling for child diagnostic status, parental diagnosis of depression was associated with *fewer* offspring perseverative errors on the Wisconsin Card Sorting Test (WCST), but did not predict performance on measures of attention verbal learning, or working memory. Examining performance on tests of EF in a sample of adolescent offspring (mean age = 15.6) of mothers with MDD, bipolar disorder, and parents without psychopathology, Klimes-Dougan, Ronsaville, Wiggs, and Martinez (2006) found no deficits in neuropsychological task performance (e.g., WCST, set shifting, or sustained attention) among children of mothers with MDD. Other research comparing EF in high risk youth compared with healthy controls has obtained no evidence of behavioral performance differences on a working memory (verbal n-back) task in a sample of late adolescents (age 16–20), but neuroimaging results suggesting greater allocation of processing resources to obtain comparable levels of working memory task performance in late adolescents (Mannie, Harmer, Cowen, & Norbury, 2010), or evidence of selective attention difficulties in high risk children (age 6–10) only under conditions of affective challenge (Perez-Edgar et al., 2006).

This research has been conducted primarily in samples who are of relatively high socioeconomic status (SES) or the majority of whom are Caucasian, and has selected children of parents with a history of mental health treatment for depression, factors which limit interpretability of findings (Klimes-Dougan et al., 2006). Moreover, this question has not been examined in a well-defined sample of early adolescents, who are at a period of high risk for emergence of depression and are simultaneously undergoing ongoing protracted development of cognitive competencies and pre-frontal cortex maturation necessary for executive functions.

This study examined the association between maternal history of unipolar depression and offspring deficits in executive functions using a large, racially and socioeconomically diverse community sample of mothers and their early adolescent offspring. It was hypothesized that offspring of mothers with a lifetime history of unipolar depression would exhibit deficits in EFs relative to those with no maternal history of unipolar depression.

Methods

Participants and procedure

Participants were a community sample of early adolescents and their mothers recruited as part of an NIMH-funded longitudinal study of the development of depressive disorders in adolescence. Inclusion criteria for adolescents included age 12–13, English fluency, and the absence of disability (developmental, cognitive, and emotional) that would prevent understanding of measures. Screening for study eligibility was conducted via telephone-based interviews of mothers during the recruitment phase of the study. Participants meeting study inclusion criteria were invited to complete the baseline assessment, two consecutive 3-hour sessions during which the following relevant information was collected.

Lifetime history of *DSM-IV-TR* Axis I psychopathology was assessed via semi-structured diagnostic interview. Adolescents were assessed based on integration of parent and child report on The Kiddie-Schedule for Affective Disorders and Schizophrenia-Epidemiological Version (K-SADS-E; Orvaschel, 1995). Mothers were assessed via an expanded version of the SADS-L (Endicott & Spitzer, 1978). Adolescents' working memory was assessed via the Digit Span subtest of the Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV; Wechsler, 2003). Components of attention were assessed via subtests from the Test of Everyday Attention for Children (TEA-Ch; Manly et al., 2001). The TEA-Ch offers a number of advantages over other frequently employed measures of attention: it is theory-driven, assesses all three components of attention, uses multiple modalities, uses ecologically valid tasks that simulate real-world demands, and minimizes confounding with motor speed, verbal comprehension and expression. Demographic information was obtained via parent questionnaire. Details of sample recruitment and methods can be found in Alloy et al. (2012). Mothers and children completed informed consent and assent, respectively, and were reimbursed for their time. The current study was comprised of adolescents and their mothers ($N = 439$) who completed both Time 1 sessions including diagnostic assessments, excluding 24 mothers with a history of bipolar spectrum disorders or psychosis.

Measures

Demographic Information—Demographic information was assessed via parent self-report questionnaire. Mothers reported child eligibility for school lunch, age, race and ethnicity.

Executive Functions—Working memory was assessed via the Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV; Wechsler, 2003) Digit Span Subtest, a test of auditory-verbal working memory standardized and normed for children age 6 to 18.

Attentional capacities were assessed via the Test of Everyday Attention for Children (TEA-Ch; Manly et al., 2001), which has demonstrated satisfactory test-retest reliability ($r_s .64-.92$; Manly et al., 2001) and convergent and discriminant validity (Manly et al., 2001). The TEA-Ch has demonstrated a 3-factor structure across multiple studies and cultural contexts. Specifically, 3 latent factors corresponding to the theoretical constructs of sustained and

selective attention and attentional control/switching have been identified through confirmatory factor analysis (Chan et al., 2008; Manly et al., 2001). The test has demonstrated satisfactory test-retest reliability in Western samples (r_s .4–.92; Manly et al., 2001) and Chinese samples over a 4-week interval (r_s .045–.79; Chan et al., 2008). It also has demonstrated satisfactory convergent validity (correlating with established measures of selective attention such as the Stroop task) and discriminant validity (lack of correlation with WISC and WRAT subtests; Manly et al., 2001). Raw scores for each of the following subtests were transformed to age and gender-scaled scores with a mean of 10 and a standard deviation of 3 (higher scores = better performance). Creature Counting is a subtest assessing ability to shift attention. Children count the number of “creatures in their burrow,” and count visually presented pictures, alternating between counting forwards and backwards in response to visual cues. Sky Search is a timed visual search task requiring selective attention. Children view an array of 128 pairs of space ships and find and circle targets (pairs of matching space ships) while ignoring similar distracters. This subtest yields an Attention score, which subtracts the ratio of targets found to time elapsed in a motor control condition (containing no distractors) from the selective attention condition (containing distractors). Score is a test of auditory sustained attention, which consists of a 5.5 minute audiorecording of identical tones (ranging from 9 to 15) presented at irregular intervals in 10 trials of variable length. Children count silently the scoring sounds and tell the experimenter how many sounds they heard when a siren sound signals the end of a trial. Sky Search Dual Task is a cross-modal dual task test requiring divided attention, which yields a dual task decrement score.

Diagnosis—*The Kiddie – Schedule for Affective Disorders and Schizophrenia – Epidemiological Version* (K-SADS-E; Orvaschel, 1995a) is a semistructured diagnostic interview of parent and child that assesses current and lifetime Axis I disorders in youth based on *DSM-IV-TR* criteria (American Psychiatric Association, 2000). Inter-rater reliability (based on 120 pairs of ratings consisting of 5 raters for each of 24 diagnoses from 10 K-SADS interviews) was $\kappa = .85$.

The Expanded Schedule for Affective Disorders and Schizophrenia – Lifetime Version (Endicott & Spitzer, 1978) is a semi-structured diagnostic interview administered to mothers during the Time 1 second session. It assesses lifetime *DSM-IV-TR* and RDC Axis I diagnoses over the lifetime and has demonstrated good inter-rater reliability for diagnoses of major depressive episodes (κ 's > .95) and all unipolar depression diagnoses (κ 's > .90) based on 80 jointly rated interviews (Alloy et al., 2000). In addition to lifetime history of mood disorders (unipolar depressive disorders and bipolar spectrum disorders) and psychosis, this interview assessed presence of *DSM-IV* and/or RDC diagnosis of other Axis I disorders, including lifetime history of obsessive compulsive disorder, generalized anxiety disorder, panic disorder, phobic disorders, PTSD, substance abuse and dependence, eating disorders, and attention deficit hyperactivity disorder (ADHD). Based on maternal diagnosis, dummy variables were created representing presence of any maternal depression diagnosis (1 = any history of depression, 0 = no history of psychopathology) and presence of other Axis I disorders in mothers without history of depression (1 = Axis I disorders other than depression, 0 = no history of psychopathology). To differentiate between DSM and

RDC definite major depressive disorder and other depressive disorders, an additional set of dummy variables were created representing definite *DSM-IV* or RDC MDD (1 = MDD, 0 = no history of psychopathology) and other depressive disorders (1 = *DSM-IV* Dysthymia, RDC IDD, or DNOS, or subsyndromal probable or subthreshold major depression, 0 = no history of psychopathology).

Results

Cross-tabs and chi-square analyses (for categorical variables) and independent samples t-tests (for continuous variables) were used to explore whether demographic characteristics varied by mother diagnostic status. Sample characteristics and significant bivariate associations are presented in Table 1. A series of hierarchical linear regression analyses were conducted to examine whether maternal history of depression predicted greater difficulties with EF among adolescents relative to offspring of women without history of psychopathology. Adolescent demographic variables were entered in Step 1, adolescent depression diagnosis was entered in Step 2, and maternal diagnosis variables were entered as predictors in Step 3. In the first series of regression analyses (Table 2A), dummy coded predictor variables in Step 3 included (1) any history of maternal depression and (2) any history of maternal psychopathology in the absence of depression history. In the second series of regression analyses (Table 2B), dummy coded predictor variables in Step 3 included (1) history of MDD, (2) history of other depressive disorders, and (3) history of other psychopathology in the absence of depression history. A Bonferroni correction was used to correct for familywise error (criterion alpha = .005). Results are presented in Table 2. Maternal lifetime history of depression was not significantly associated with performance on measures of adolescent EFs relative to adolescents with no maternal history of depression.

Discussion

The current study examined whether maternal lifetime history of unipolar depression was associated with early adolescent offspring performance on tests of executive functions. Strengths of this study included its use of a large, socioeconomically and racially diverse community sample of mothers and offspring and assessment of executive functions in early adolescents of a circumscribed age range. No support was obtained for the hypothesis that high-risk youth would exhibit impairments in EF. Findings should be interpreted in light of study limitations including the cross-sectional research design and lack of extensive information on familial risk for depression. The incidence of maternal depression and other psychiatric disorders in the present sample also was high, and may limit generalizability of findings. Prospective longitudinal research is needed to examine how the timing and severity of maternal depressive episodes and exposure to maternal depression may impact the subsequent development of offspring executive functions. The present study employed emotionally neutral tests of EF. It is possible that findings might have differed had we used emotionally valenced tasks or tasks placing greater demands on executive processing. It is noteworthy that no significant group differences were obtained despite use of multiple measures of EF in a large sample of mothers and their offspring. Reporting such findings is an important means of avoiding publication bias. Findings are consistent with a growing

body of literature that has not obtained evidence of impaired performance on emotionally neutral tests of executive functions in offspring of mothers with depression diagnoses (Klimes-Dougan et al., 2006; Mannie et al., 2010; Micco et al., 2009; Perez-Edgar et al., 2006). Deficits may not exist in high-risk youth prior to disorder onset, may be too subtle to detect with behavioral tasks (Mannie et al., 2010), or may be specific to emotionally-valenced contexts (e.g., Perez-Edgar et al., 2006). Findings are not consistent with the conceptualization of impaired executive functions as trait markers of unipolar depression. To the extent that such impairments characterize MDD in youth, the present findings suggest that they may be state dependent.

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Table 1

Sample Demographic and Clinical Characteristics

A. Sample Characteristics				
Maternal Diagnosis				
Demographic/Clinical Variables	Depression (N = 186) N(%)	No Axis I (N =176) N(%)	Other Axis I (N = 76) N(%)	Total N(%)
Adolescent Gender				
Female	100 (53.8)	92 (52.3)	38 (50.0)	230 (52.5)
Male	86 (46.2)	84 (47.7)	38 (50.0)	208 (47.5)
Adolescent Age	12.93 (0.61)	12.82 (0.61)	12.90 (0.60)	12.88 (0.61)
Lunch Eligible	80 (45.7)	76 (44.4)	41 (57.7)	197(47.2)
Adolescent Race ***				
White	111 (59.7)	67 (38.1)	32 (42.1)	210(47.9)
African American, Biracial	75 (40.3)	109 (61.9)	44 (57.9)	228 (52.1)
Adolescent Depression Diagnosis **	37 (19.9)	11 (6.3)	13 (17.1)	61 (13.9)
Mother Age	42.31 (SD =6.73)	41.70 (SD = 8.60)	41.55 (SD = 7.27)	41.92 (7.63)
Mother Race ***				
White	115 (61.8)	69 (39.2)	36 (47.4)	220 (50.2)
African American, Biracial	71 (38.2)	107 (60.8)	40 (52.6)	218 (49.8)
B. Maternal Depression Clinical Characteristics				
Diagnosis	Depression Characteristics (N = 186)			
Any Depression	186 (42.5)	Age of Onset	M = 28.74 (SD = 9.65)	
Major Depressive Disorder	130 (29.7)	Depression Early Onset	38 (20.4)	
Recurrent MDD	54 (41.5)	<u>Depression Timing</u>		
Early Onset MDD	27 (20.8)	Child Exposed to Maternal Depression	153(82.3)	
Other Depression	56 (12.8)	Child Exposed to Maternal MDD	98 (75.4)	
Dysthymia/IDD/DNOS	17 (30.4)			
Minor RDC/Major Probable	39 (69.6)			

Note. N = 438; Other Depression includes participants meeting criteria for DSM-IV Dysthymia, RDC Intermittent Dysthymic Disorder, RDC Minor Depression, or subsyndromal major depression

*
 $p < .05$,

**
 $p < .01$,

 $p < .001$.

Lunch eligible % = out of those with complete data

Table 2**Maternal Diagnosis Predicting Offspring Executive Functions**

A. Maternal Depression Predicting Offspring Executive Functions				
Predictors	Outcome Variable			
	<u>Selective Attention</u>		<u>Sustained Attention</u>	
	β	p	β	p
Maternal Depression Diagnosis	0.02	0.765	0.03	0.646
Other Axis I Diagnosis	0.04	0.457	−0.03	0.550
	<u>Divided Attention</u>		<u>Set Shifting</u>	
	β	p	β	p
Maternal Depression Diagnosis	−0.02	0.789	0.06	0.789
Other Axis I Diagnosis	−0.05	0.832	0.02	0.832
	<u>Working Memory</u>			
	β	p		
	−0.02	0.765		
B. Maternal MDD and Other Depression Predicting Offspring Executive Functions				
Predictors	Outcome Variable			
	<u>Selective Attention</u>		<u>Sustained Attention</u>	
	β	p	β	p
Maternal MDD	0.01	0.863	0.01	0.934
Maternal Other Depression	0.02	0.701	0.05	0.359
Other Axis I Diagnosis	0.04	0.457	−0.03	0.554
	<u>Divided Attention</u>		<u>Set Shifting</u>	
	β	p	β	p
Maternal MDD	−0.03	0.551	0.05	0.347
Maternal Other Depression	0.01	0.838	0.04	0.505
Other Axis I Diagnosis	−0.05	0.345	0.02	0.680
	<u>Working Memory</u>			
	β	p		
Maternal MDD	0.04	0.470		
Maternal Other Depression	0.07	0.190		
Other Axis I Diagnosis	−0.02	0.769		

Note. N = 395.

[†]
 $p < .01$,

^{*}
 $p < .005$,

^{**}
 $p < .001$.

All analyses adjust for adolescent depression diagnosis, age, race, SES, and gender For all diagnostic predictor variables, reference group = offspring of mothers with no history of Axis I psychopathology Given low rates of missingness (less than 5%) and lack of significant associations between missingness and variables of interest, observations with missing data were excluded from analyses.