

The Moderating Role of Maternal Depression in the Relation Between Adolescent Behavioral Inhibition and Maternal Critical Expressed Emotion

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Abstract Behavioral inhibition is associated with a range of negative affective states and behaviors in adolescents which may elicit critical expressed emotion (EE-Crit) among mothers. Whether the relation between adolescent behavioral inhibition and maternal EE-Crit may depend on the presence of maternal depression is unknown. Therefore, a total of $N = 81$ biological mother/adolescent daughter dyads were recruited: mothers with a history of major depressive disorder ($n = 45$) and never-depressed mothers (non-depressed: $n = 36$). Structured clinical interviews were administered, daughters reported their behavioral inhibition and mothers reported daughter-directed maternal EE-Crit. Maternal depression was a moderator such that higher daughter behavioral inhibition was associated with greater EE-Crit among depressed mothers, specifically. There were no group differences for daughter behavioral inhibition or maternal EE-Crit. These findings highlight the significant role that maternal depression may play in relation to adolescent behavioral inhibition, EE-Crit, and risk for the development of adolescent psychopathology.

Keywords Adolescence · BIS/BAS · Girls · Major depressive disorder · Offspring

Introduction

Behavioral inhibition refers to the tendency “to react with fear and withdrawal in novel and/or unfamiliar social situations” [1]. As put forth by the work of Kagan and Snidman [2] and Kagan et al. [3] among others, behavioral inhibition has been shown to be strongly rooted in genetics, biology, and physiology. For these reasons, historically less emphasis has been placed on environmental factors (i.e., parenting) that may be influential [4]. While much research has investigated behavioral inhibition in youth, conceptual heterogeneity across studies, particularly in terms of nomenclature, has resulted in a seemingly cluttered body of work. For instance, there has been a tendency for labeling inhibition with terms that instead apply to the type of unfamiliarity in which the behavior occurs: For example, with unfamiliar environmental changes inhibited children are considered sensitive, with unfamiliar people inhibited children are considered shy, and so forth [5]. Thus, researchers have substituted closely-related constructs (i.e., shy) as proxies for behavioral inhibition yet discuss findings in terms of behavioral inhibition. One approach to mitigating some of these conceptual challenges is through the adoption of a well-defined, neurobiologically-based framework for studying behavioral inhibition.

As posited by the revised *reinforcement sensitivity theory* of personality and motivation, behavioral inhibition occurs through activation of the behavioral inhibition system (BIS), the neurobiological substrate underlying sensitivity to punishment, non-reward, and novelty [6]. In short, BIS activation delays approach, promotes withdrawal, and is associated with anxiety, fear, sadness, and frustration [7]. This framework for understanding behavioral inhibition has been applied in several children and adolescent studies in recent decades. Findings have revealed behavioral

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inhibition to be positively associated with off-task behavior in children [8] and passive avoidance [9], worry, anxiety and depression [1], and poor coping strategies in adolescents [10]. Thus, associations between behavioral inhibition and a range of psychopathology-related symptoms has emerged, particularly among adolescents. Although behavioral inhibition is thought to be maintained and/or increased through reciprocal parent–child processes [4, 11], few studies have investigated maternal attitudes or responses to child behavioral inhibition.

Theoretical models attempting to explain the familial nature of major depressive disorder (MDD) highlight the interplay between maternal depression and child characteristics including behavioral inhibition [12]. Namely that maternal depression may interact with such characteristics thereby increasing the potential for negative childhood outcomes, be it through biological or psychosocial mechanisms. Although behavioral inhibition is influenced by the environment, it is, as previously mentioned, highly heritable [13]. Importantly, children of depressed parents are twice as likely to be behaviorally-inhibited as compared to children of non-depressed parents [14]. Other studies across childhood that have examined risk factors for child psychopathology provide further support for the relation between child behavioral inhibition and maternal depression [15–17].

Behavioral inhibition among youth may elicit a range of responses in mothers including expressed emotion [18, 19]. Specifically, positive components of expressed emotion include warmth and positive remarks, whereas negative components of expressed emotion include emotional over-involvement, criticism, and hostility [20]. Expressed emotion originally emerged as a construct of interest in the familial environment as a means to better understand onset and relapse in adult psychiatric disorders [21, 22] but has since been extensively studied in the context of parent–child relations [23]. Critical and hostile expressed emotion (EE-Crit) has been identified by several studies as the component most related to maternal psychopathology and child symptoms and psychiatric outcomes both cross-sectionally and longitudinally for a range of disorders including major depression, anxiety disorders, attention-deficit/hyperactivity-disorder, and disruptive behavior disorders among others [24–30].

Children high in behavioral inhibition may be particularly at risk for experiencing EE-Crit if their mother has a history of major depression. While depression directly affects the mother, it also has negative effects on parenting style and the quality of parent–child interactions [31, 32]. Depressed mothers are more disengaged from their children and make more negative comments towards their children [33, 34]. As such, several studies have found depressed mothers to be significantly higher in EE-Crit,

meaning they make more hostile and critical child-directed remarks than healthy mothers [25, 35–37]. Whether the relation between child behavioral inhibition and maternal EE-Crit may depend on the presence or absence of maternal depression has yet to be examined; however, investigations of other maternal psychopathology suggest that is the case [18, 19].

Against this background, the primary aim of the present study was to examine the potential moderating role of maternal depression in the relation between child behavioral inhibition and maternal EE-Crit. We therefore recruited two groups of mothers, those with a history of maternal depression and those with no depression history, as well as their adolescent daughters. Daughters were specifically recruited given that girls have been found to have greater behavioral inhibition than boys [1, 39]. Moreover, girls have been shown to be more susceptible to EE-Crit [40]. Given that behavioral inhibition is positively associated with both maternal EE-Crit and maternal depression [18, 19] and the many findings of high maternal EE-Crit among depressed mothers [25, 36–38], our primary hypothesis was that there would be a significant maternal depression \times daughter behavioral inhibition interaction. Specifically, high behavioral inhibition would be associated with significantly greater maternal EE-Crit among depressed mothers specifically. As stated, depressed mothers have been found to make more negative child-directed comments and we expect that such comments, in the form of EE-Crit, would be associated with adolescent behavioral inhibition. Our secondary hypothesis, consistent with prior findings, was that depressed mothers would show higher levels of maternal EE-Crit compared to non-depressed mothers. Though cross-sectional by design, positive findings could shed light on an important previously unexamined dynamic that may help further understanding of familial risk for major depression. Given the high co-occurrence of depression and anxiety [41], we aimed to control for maternal anxiety. Consistent with Hirshfeld et al. [19], we also sought to control for child psychiatric disorder given that several childhood disorders have been related to EE-Crit.

Methods

Participants

Participants responded to community advertisements and were recruited from local inpatient and outpatient clinics for adolescents. From these sources, a total of 167 biological mother/adolescent daughter dyads responded to advertisements to participate in the study. Forty-seven percent of participants were recruited through clinics, 36 %

through online craigslist postings, and 17 % through flyers and word of mouth. To be eligible for the study, participants were required to possess English fluency, girls were required to be between 10 and 16 years-old and possess adequate academic skills as determined by the Wide Range Achievement Test 4 (WRAT4; [42]), mothers had to meet appropriate psychiatric criteria for group assignment, and lastly all daughters had to be free from any current or lifetime diagnosis of MDD. If participants failed to meet full criteria, had a psychotic disorder or any learning disability or mental retardation, they were excluded.

Following these inclusion and exclusion criteria, 12 dyads were ineligible to participate in the study due to psychosis or a failure to attend scheduled appointments, 33 did not meet inclusion criteria following structured clinical interviews, and 41 had incomplete self-report data. Thus, a final sample of $N = 81$ dyads were included to comprise two groups who differed in maternal depression diagnostic status: mothers with a history of MDD and their daughters (MDD: $n = 45$), and never-depressed mothers and their daughters (Non-depressed: $n = 36$). Comorbidity among mothers within the MDD group included social phobia ($n = 5$), specific phobia ($n = 6$), obsessive–compulsive disorder ($n = 2$), generalized anxiety disorder ($n = 2$), anxiety disorder not otherwise specified ($n = 5$), and post-traumatic stress disorder ($n = 4$). No participants withdrew from the study after initiating participation.

Measures

Diagnostic Interviews

The Structured Clinical Interview for DSM-IV TR Axis I disorders (SCID-I; [43]) was conducted to determine whether mothers had a history of MDD during their daughter's lifetime. For the assessment of MDD and comorbid psychiatric disorders, all modules were used. Moderate to excellent inter-rater reliability has been found for the SCID-I (mean kappa = 0.71) [44]. Inter-rater reliability on audiotaped SCID-I interviews used for the present study, with raters blind to the diagnosis of the mother, found Kappa to be 1.00 for current diagnosis of depression and 0.81 for past diagnosis of depression [45].

The NIMH Diagnostic Interview Schedule for Children-Version IV (DISC-IV; [46]) was conducted with daughters. The DISC-IV is a structured and comprehensive interview for use with children and adolescents ages 9 to 17. The computer-based interview consists of “yes/no” questions and determines whether DSM-IV diagnostic criteria are met algorithmically, and therefore inter-rater reliability is not required. High test–retest reliability for diagnoses on the DISC-IV has been evidenced in clinical samples, i.e., MDD, $\kappa.92$ [46].

Behavioral Inhibition

Daughters completed the BIS/BAS scales [7], a self-report measure of behavioral approach and inhibition. For the present study, we only utilized the revised BIS scale which consists of four items: “Criticism or scolding hurts me quite a bit,” “I feel worried or upset when I think or know somebody is angry at me,” “I feel worried when I think I have done poorly at something,” and “I worry about making mistakes.” Responses are made on a four-point scale from *Very True* = 1 to *Very False* = 4. Convergent and discriminant validity has been demonstrated for the BIS/BAS scales [47] and the reliability of the revised BIS factor has received supported [48]. In the current study, internal consistency, as measured by Chronbach's α , was 0.62 for BIS. For a scale of this length, this reliability is considered adequate [49].

EE-Crit

Mothers completed the Family Attitudes Scale (FAS; [50]), a self-report measure of EE-Crit directed towards the child by the respondent. The FAS was developed in line with the Camberwell Family Interview (CFI; [51]); however, unlike the CFI, the FAS only measures EE-Crit and thus excludes other components of expressed emotion, such as emotional over-involvement and positive comments. Thirty items comprise the FAS asking how frequently each statement applies, *Everyday* = 4 to *Never* = 0. Sample items include: “She is really hard to take,” “I lose my temper with her,” and “I feel that she is becoming harder to live with.” Reliability and validity for the FAS has been supported [50, 52], as has convergent validity for the FAS and CFI [50, 53]. In the current study, the FAS had a Chronbach's α of 0.94.

Procedures

This study was approved by the appropriate institutional review board. Those interested in the study were required to complete phone screens, and if eligible were invited to participate. Mothers were administered structured clinical interviews to determine dyad group assignment. MDD group membership required mothers to have a lifetime diagnosis or recurrent MDD since their daughter's birth, and Non-depressed mothers were required to be free of any history of MDD (current or lifetime). Mothers and daughters were administered structured clinical interviews and self-report measures separately in private. All interviews were conducted at the university psychology services clinic by doctoral graduate students and clinical research assistants whom had completed training under the supervision of the principal investigator.

Data Analytic Strategy

All statistical analyses were performed using SPSS version 19.0 (Chicago, IL). Bivariate Pearson correlations were first examined to determine relations among primary variables of interest. Moderation analyses were performed regardless of whether bivariate relations reached statistical significance as this does not preclude a significant interaction effect [54]. Chi-square tests of independence and independent samples Student's *t* tests were performed to compare groups on sociodemographic and clinical variables. Any significant group differences that emerged would be statistically controlled for in subsequent analyses. Hierarchical linear regression was performed for moderation analyses following a standard methodology [55]. Specifically, continuous variables were centered prior to forming interaction terms and covariates were entered into the hierarchical model first before entering primary variables of interest. Effect sizes were indicated by Cohen's *d* and partial-eta squared (η^2) using traditionally accepted standards of interpretation [55].

Results

Bivariate Correlations

Before conducting analyses, we examined the bivariate relations among primary study variables (see Table 1). While the correlations between behavioral inhibition and maternal EE-Crit, $r = .17$, $p = .171$, and maternal MDD and EE-Crit, $r = .20$, $p = .074$, were non-significant, Maternal MDD and maternal anxiety disorder were significantly correlated, $r = .27$, $p = .016$, as were maternal

EE-Crit and daughter psychiatric disorder, $r = .26$, $p = .018$.

Participant Characteristics

For participant characteristics, please see Table 2. Participants were compared on socio-demographic and clinical characteristics, using Chi-square tests of independence and independent sample *t*-tests, with no significant group differences found. Of note, groups did not differ on level of daughter behavioral inhibition, $t(79) = 1.21$, $p = .228$, $d = .272$, or maternal EE-Crit, $t(79) = 1.81$, $p = .074$, $d = .413$.

Moderation Analyses

Hierarchical multiple regression analyses were performed to examine whether the presence or absence of maternal depression moderated the relation between daughter behavioral inhibition and maternal EE-Crit, controlling for the presence or absence of maternal anxiety disorder and any child psychiatric disorder as determined by structured clinical interviews. Continuous variables were centered prior to forming interaction terms [56], and Variance Inflation Factor (VIF, $Mdn = 1.021$) and Tolerance ($Mdn = .979$) indices revealed no threat of multicollinearity among predictors [57]. In step 1, maternal anxiety and child psychiatric disorders were entered with EE-Crit as the dependent variable. The model was non-significant, $R^2 = .07$, $F(2, 80) = 2.96$, $p = .058$, $\eta^2 = .075$, accounting for 7 % of the variance in EE-Crit. In step 2, maternal depression and daughter behavioral inhibition were entered as predictors and the model was significant, $R^2 = .14$, $F(4, 80) = 3.03$, $p = .022$, $\eta^2 = .163$, accounting for 14 % of the variance in EE-Crit; however, child psychiatric disorder was the only significant predictor, $\beta = 0.28$, $SE = 0.11$, $t = 2.60$, $p = .011$; maternal depression, $\beta = 0.18$, $SE = 0.11$, $t = 1.64$, $p = .105$; BIS, $\beta = 0.17$, $SE = 0.11$, $t = 1.56$, $p = .124$. In step 3, the maternal depression x daughter behavioral inhibition interaction term was added and the model remained significant, $R^2 = .20$, $F(5, 80) = 3.67$, $p = .005$, $\eta^2 = .25$, accounting for an additional 6 % of the variance in EE-Crit. The maternal depression x daughter behavioral inhibition interaction was significant, $\beta = 0.40$, $SE = 0.17$, $t = 2.35$, $p = .022$, as was child psychiatric disorder, $\beta = 0.28$, $SE = 0.10$, $t = 2.64$, $p = .010$. This significant interaction is presented visually in Fig. 1. There was a differential effect of maternal depression such that higher daughter behavioral inhibition was associated with greater EE-Crit among depressed mothers and lower EE-Crit among non-depressed mothers.

Table 1 Pearson correlations among primary study variables

	1	2	3	4	5	6	7
1. Daughter age	–						
2. Mother age	.31**	–					
3. Daughter BI	.06	–.02	–				
4. Maternal EE-Crit	.15	.01	.17	–			
5. Maternal MDD	–.01	–.07	.14	.20*	–		
6. Maternal ANX	–.11	–.16	.02	.04	.27**	–	
7. Daughter Dx	.01	–.02	–.08	.26**	–.01	.10	–

Daughter BI behavioral inhibition, *maternal MDD* presence of maternal major depression from SCID-I, *maternal ANX* presence of maternal anxiety disorder from SCID-I, *daughter Dx* presence of any daughter psychiatric disorder from C-DISC

** $p \leq .05$; * $p \leq .10$

Table 2 Participant characteristics and group comparisons

	MDD (<i>n</i> = 45)	Non-depressed (<i>n</i> = 36)	<i>T</i>	<i>p</i>	<i>d</i>
Mother age	39.45 (7.13)	40.43 (7.03)	.607	.546	.138
Daughter age	12.71 (2.00)	12.75 (2.05)	.086	.932	.020
Maternal EE-Crit	25.81 (17.03)	19.83 (11.35)	1.81	.074	.413
Daughter BIS	11.71 (2.66)	11.03 (2.32)	1.21	.228	.272
Maternal MDD # of episodes	3.68 (3.08)	–	–	–	–
Mother age of 1st episode	29.00 (8.99)	–	–	–	–
Family income	45.90 K (3.86 K)	59.93 K (5.03 K)	1.20	.236	–
Race			$\chi^2 = 1.89$.861	–
Black	7 (15.55 %)	7 (19.44 %)			
White	18 (40 %)	17 (47.22 %)			
Hispanic	12 (26.67 %)	11 (31 %)			
Asian	1 (.02 %)	0			

Data = mean (SD); *EE-Crit* Familial Attitude Scale total score; *BIS* behavioral inhibition total score on BIS/BAS; not all families chose to identify race or family income, *d* was not calculated due to missing data

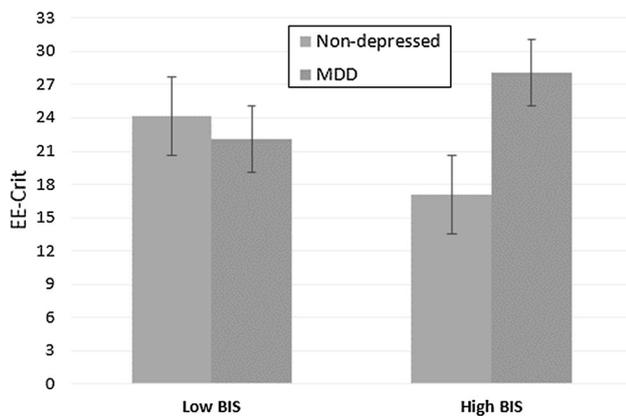


Fig. 1 Maternal depression moderates the relation between daughter behavioral inhibition and maternal EE-Crit. *Note* median split used to calculate high and low behavioral inhibition. EE-Crit = mean Familial Attitude Scale total score. BIS = mean behavioral inhibition total score on BIS/BAS scales. Interaction between maternal MDD x daughter behavioral inhibition significant at $p < .05$

Discussion

This study was the first to examine the moderating role of maternal depression in the relation between adolescent behavioral inhibition and maternal EE-Crit. Our primary finding supported our hypothesis that maternal depression would significantly interact with daughter behavioral inhibition. Greater behavioral inhibition was associated with higher EE-Crit among depressed mothers specifically, while in contrast, high behavioral inhibition was associated with less EE-Crit among non-depressed mothers. Thus, the presence of maternal depression was associated with a differential EE-Crit response to adolescent behavioral inhibition. This finding may help inform understanding of the dynamics between child characteristics and maternal

depression in the context of familial risk for major depression.

Whereas healthy mothers have been found to facilitate their child's approach to unfamiliar social situations, depressed mothers were less likely to do so and were more likely to respond with hostility and criticism towards the child [58]. Given that high daughter behavioral inhibition is associated with a range of negative affective states (i.e., sadness, fear, anxiety, and frustration) [7], it may in turn elicit negative emotionality and subsequent EE-Crit among depressed mothers. Though we were unable to further investigate the behavioral inhibition-EE-Crit relationship, it is likely transactional in nature such that behavioral inhibition among daughters and maternal EE-Crit dually influence one another. Moreover, the sheer presence of maternal depression, aside from potential genetic contribution, may itself pose vulnerability to child behavioral inhibition [58]. For instance, depressed mothers may model withdrawn and inhibited behavior for their children, and are less actively engaged during parent-child interactions [59].

Our primary finding is consistent with that observed among anxious mothers whereby the relation between child behavioral inhibition and EE-Crit was moderated by the presence of a maternal anxiety disorder history [19]. However, Hirshfeld et al. [19] did not statistically control for maternal depression despite more than 40 % of anxious mothers in their study meeting criteria for major depression. Thus, comorbid depression may have partially accounted for their observed moderating effect. In turn, we were careful to control for maternal anxiety disorder. If indeed both maternal anxiety and maternal depression are moderators, then perhaps the overarching presence of negative affect present among both disorders plays an

instrumental role in eliciting maternal EE-Crit in response to behaviorally-inhibited children.

Some interesting secondary findings also emerged. Although we expected mothers with a history of maternal depression to report higher levels of EE-Crit, we found no such evidence. This may in part be attributed to the fact that all daughters in the present study were non-depressed. While there have been reports of greater EE-Crit among depressed mothers, several of these studies included children with a history of major depression [28, 38, 60]. While high behavioral inhibition may be associated with MDD among adolescent girls [61], it may not be sufficient to elicit significantly greater EE-Crit among depressed mothers in the absence of adolescent MDD. Despite prior evidence of a positive relation between child behavioral inhibition and parental major depression [14] we found that daughters reported similar levels of behavioral inhibition regardless of maternal depression status. Whereas the aforementioned studies used observational methods to assess inhibition among young children, we employed self-report with an adolescent sample. Thus, notable differences in terms of measurement and population of interest may account for this discrepancy. Moreover, adult findings have shown that behavioral inhibition is not significantly elevated solely because individuals are at risk for a major depressive episode [62], as were the daughters of depressed mothers in the present study.

Though this study presents novel findings it is not without limitations. Given our cross-sectional design, we are precluded from making any causal inferences regarding the relation between daughters' behavioral inhibition and maternal EE-Crit. Also, moderation is best determined prospectively. Thus, our results lend support to the hypothesis and need to be confirmed using longitudinal data. Like much of the maternal depression-EE literature [27, 38], the depressed group in the present study was comprised of mothers with a lifetime history of MDD so we were therefore unable to parse out the effects of current versus past maternal depression. In other words, the extent to which the moderating effect of maternal depression may be attributed to current depression or the vulnerability to become depressed remains unknown.

We relied on self-report measurement for both behavioral inhibition and EE-Crit, which also may be considered limitations. While early childhood inhibition has best been measured through observational methods [63], the self-report BIS/BAS scales have frequently been used with adolescent samples [64]. With separate reporters for each construct, we aimed to mitigate reporter bias and shared method variance. Traditionally, expressed emotion has been captured through interviews such as the CFI and Five-Minute-Speech-Sample [65]. Though our measure of expressed emotion is reliable, valid and a practical

alternative to these interviews, it solely measures EE-Crit and thus other components of EE went unexamined [50, 52, 53]. While the expressed emotion component of emotional over-involvement has been implicated in the context of child behavioral inhibition [18], our focus lied on EE-Crit given its role in the context of depression. Finally, since our study was female-specific we are unsure how these findings may generalize. Though speculative, behaviorally-inhibited adolescent boys may elicit greater EE-Crit from depressed mothers because high behavioral inhibition among boys represents a further deviation from what is typical for males as compared to females [1, 39].

Many important studies have examined expressed emotion as a risk factor for childhood and adolescent MDD. Other highly informative studies have examined child characteristics in relation to parental expressed emotion; however, an emphasis has been placed on child and adolescent psychiatric disorders in eliciting expressed emotion. Future investigations may seek to further explore cross-cutting child characteristics such as behavioral inhibition as a means to inform multiple populations at risk for expressed emotion and the development of psychopathology.

Summary

Adolescent behavioral inhibition is associated with negative affective states and behaviors which may elicit a range of responses among mothers including EE-Crit. Adolescents' risk for maternal EE-Crit may be particularly elevated if their mother suffers from major depression. The present study recruited two types of biological mother/adolescent daughter dyads that differed in maternal depression diagnostic status to examine whether maternal depression moderated the relation between adolescent behavioral inhibition and maternal EE-Crit. Mothers and daughters were administered structured clinical interviews, daughters reported their behavioral inhibition and mothers reported daughter-directed maternal EE-Crit. As hypothesized, maternal depression was found to moderate the relation between adolescent behavioral inhibition and maternal EE-Crit, even after controlling for maternal anxiety and child psychiatric disorders. Specifically, there was a differential effect between dyads such that higher daughter behavioral inhibition was associated with greater EE-Crit among depressed mothers and lower EE-Crit among non-depressed mothers. No significant group differences were found in terms of level of daughter behavioral inhibition or maternal EE-Crit. While some prior studies have found elevated EE-Crit among depressed mothers we did not, which may have been due to differences in measurement. This study relied on self-report while the aforementioned studies employed interview-

based assessments. These collective findings suggest that maternal depression may play a significant role in relation to adolescent behavioral inhibition, EE-Crit, and risk for adolescent psychopathology. Future investigations may consider examining other cross-cutting child characteristics within this greater context.

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