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Maternal prenatal mood problems and lower maternal emotional availability associated with lower quality of child's emotional availability and higher negative affect during still-face procedure

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Abstract

Our aim was to study the effects of maternal perinatal mood and maternal emotional availability on child emotional availability and negative affect during the still-face procedure (SFP). The sample included 214 women who participated in a prospective study. We assessed maternal mood problems using the Mini International Neuropsychiatric Interview and PRAQ questionnaire during pregnancy and using STAI and EPDS questionnaires during pregnancy and at 6 months after delivery. Maternal and child emotional availability were studied using the Emotional Availability Scales during the SFP at 6 months. We observed and quantified child's negative affect during SFP episodes. We found that mothers with maternal mood problems (anxiety and/or depression) during pregnancy, but not postnatally, showed less optimal maternal structuring during the SFP, and the children showed lower involvement and responsiveness during interactions with their mothers. Furthermore, lower maternal emotional availability was related to the child's higher negative affect during the SFP. Our findings underline the independent roles of both prenatal stress exposure and maternal caregiving behavior in a child's socioemotional development.

1 | INTRODUCTION

The perinatal period is one of the most vulnerable times for the onset and/or exacerbation of mental health problems for women (Wenzel, 2011), with elevated depression and anxiety being the most common symptoms (Ngai & Ngu, 2015; Parfitt & Ayers, 2014; Skouteris et al., 2009; Teixeira et al., 2009). A large and growing body of evidence has indicated that anxiety and depression in pregnancy are important predictors of later problems in children's self-regulation and socioemotional well-being (Barker et al., 2011; Korja et al., 2017; O'Donnell & Meaney, 2017). Various models (genetic, physiological, and caregiving) have been proposed to explain these associations, and it seems likely that these different pathways act separately or together to increase the risk for offspring of women who are anxious and/or depressed in pregnancy. Although depression and anxiety are distinct conditions, comorbidity is typically high during the perinatal period (Field et al., 2010; Korja et al., 2017).

The genetic pathway suggests that children inherit a vulnerability to anxiety from their mother, and epigenetic processes are also likely to be involved (Glover et al., 2016). The early life programming model posits that overexposure to elevated maternal stress hormones (glucocorticoids) during pregnancy prompts changes in a developing infant's capacity for stress regulation and executive functioning (Barker et al., 2011; Glover, 2011; O'Donnell et al., 2009). Possible physiological mechanisms include the effect of circulating maternal glucocorticoids on the developing fetal HPA axis, impaired functioning of the placenta, and changes in the immunological milieu and nutritional blood supply (Egliston et al., 2007; O'Donnell et al., 2009; Van den Bergh et al., 2017). A third proposed pathway draws on research that demonstrated the stability of elevated anxiety and depressive symptoms across the transition to parenthood (Grant et al., 2008, 2010) and focuses on the negative impact of postnatal mood problems on caregiving quality (Field et al., 2010; Leerkes et al., 2009). According to this model, parents with perinatal mood problems are less able to provide the sensitive, responsive caregiving that supports the development of infants' emotion regulation (Tronick & Gianino, 1986).

The idea that sensitive, responsive caregiving acts as an external regulator of infants' arousal and behavior is central to attachment theory (Emde, 2000). In this study, we explored caregiving quality during interaction using the emotional availability construct, which focuses on the caregiver's ability to regulate interactions through synchronous attunement to the child's affective and behavioral states (Emde, 2000). The Emotional Availability Scales (EAS; Biringen, 2008; Biringen et al., 2014) assess the affect and behavior of the parent and child during dyadic interaction. Parent dimensions include positive (sensitivity, structuring) and negative indicators (intrusiveness, hostility). Child dimensions include children's responsiveness to adult interactive bids and children's involvement—the extent to which a child initiates or includes an adult in an interaction. The EAS have been shown to be a valid and sensitive measure of relational quality associated with and predictive of child and parent socioemotional adaptation and child–parent attachment (see Biringen et al., 2014, for a review).

In several previous studies, maternal prenatal and postnatal mood problems, such as anxiety and depression, have been shown to be negatively associated with mother–infant interaction quality. Elevated prenatal (Hakanen et al., 2019; Parfitt & Ayers, 2014) and postnatal (Stein et al., 2012) anxiety symptoms have been shown to predict higher maternal control and intrusiveness and infant passivity. Prenatal (Letourneau et al., 2017; Pearson et al., 2012) and postnatal (Easterbrooks et al., 2000) depressive symptoms have been linked with lower maternal responsiveness, sensitivity, and structuring of parent–infant interactions. We expected that elevated

prenatal and postnatal mood problems including anxiety and depression would be associated with lower maternal emotional availability during interactions.

We used the still-face procedure (SFP; Tronick et al., 1978) as the context for an assessment of infants' stress reactivity and parent–child interactions. The SFP was initially developed to test how infants respond to simulated parental depression, as the parent is instructed not to interact for a period of time, thereby withdrawing regulatory support. The paradigm has also proved useful in understanding individual differences in children's interactive behaviors and in children's reactivity and regulatory capacity and how parents support this. The parent's withdrawal from interaction has consistently been found to evoke changes in infants' behavior, typically including more gaze aversion, less smiling, and more negative affect during the still-face episode than during normal face-to-face interaction (see Mesman et al., 2009, for a narrative review and meta-analysis).

Infants' responses to the still-face interaction have been shown to be related to several different parental and infant factors, including maternal sensitivity, maternal depression, infant attachment, and a variety of other infant social and nonsocial behaviors (Mesman et al., 2009). Positive maternal interaction behaviors including positive affect, sensitivity, and mind-related language during the introductory play episode predict less negative affect during the still-face episode (McMahon & Newey, 2018). In addition, higher levels of maternal sensitivity or general positive behavior or affect have been shown to be related to less negative affect in infants during the still-face and reunion episodes (Braungart-Rieker et al., 2001; Mesman et al., 2009; Rosenblum et al., 2002). Further, maternal hostility has been shown to be related to a shorter latency to the child's looking at their mother during the still-face interaction and a longer latency of looking at their mother during the reunion (Kogan & Carter, 1996).

Studies have reported mixed findings regarding maternal depression and anxiety and infant behavior during the SFP (Mesman et al., 2009). Some studies (Field et al., 2010; Peláez-Nogueras et al., 1996) have found that infants with depressed mothers showed less distress during the still-face episode, indicating that perhaps these infants are more used to their mothers' being unresponsive, and others have reported no differences in infants' distress in relation to maternal mood (Moore et al., 2001). Still, other studies have shown variability in relation to infants' age and gender. Forbes et al. (2004) showed that infants of parents with previous depression presented a more negative affect than control infants at age 3 months but not at age 6 months. Weinberg et al. (2008) reported that infants of mothers with and without current depressive symptoms showed the classic still-face effect (a reduction in interactive behaviors). The combined effects of maternal interaction behaviors and maternal mood problems, including mood symptoms during pregnancy and postpartum, on children's interactive behaviors and negative affect during the SFP have not been previously studied. In particular, the moderating role of maternal interaction behaviors on any possible association between maternal prenatal and postnatal mood and children's negative affectivity during the SFP is not yet understood. In this study, we tried to fill this gap in the literature by exploring the associations and the possible moderations between perinatal mood problems, maternal emotional availability, and children's negative affect and interaction behaviors during the SFP.

Importantly, although compromised caregiving has been implicated as a contributor to children's emotion regulation difficulties in the context of maternal mood problems, maternal sensitive responsive interaction is well recognized as an external regulator of physiological arousal and behavior in young infants. Research with human infants (Baram et al., 2012; Bergman et al., 2008; Grant et al., 2010) and rat pups (Meaney et al., 1991) has shown that high-quality postnatal caregiving can have organizing effects on offspring behavior and offset the negative effects

of exposure to elevated maternal glucocorticoids in pregnancy. Bergman et al. (2008) presented three possible explanations. First, supportive and sensitive interaction behaviors may protect children from subsequent adverse psychosocial exposure in the postnatal period. Another explanation is that maternal mood problems during the perinatal period may negatively affect children's development through subsequent poor caregiving. Third, there may be no interaction between early and subsequent risk exposure; rather, risk exposure at the two time points may be cumulative, leading to worse outcomes. Overall, more emotionally available maternal interaction can be expected to diminish the adverse effects of prenatal stress exposure, whereas lower emotional availability in maternal interaction can be stressful for infants and consequently amplify the harmful effects of prenatal stress.

In their seminal work developing the SFP, Gianino and Tronick (1988) described a mutual regulation model of reciprocal influences, noting the importance of the infant's contribution to the caregiving relationship. Individual differences in infants' emotional reactivity, especially in negative reactivity, may also affect parenting capacity (Dopkins Stright et al., 2008). Unresponsive or fussy infant behavior or inconsolable crying may contribute to low self-efficacy or intrusive overregulation from the caregiver (Papousek & Von Hofacker, 1998). Therefore, the relationships between parental distress, parenting, and children's emotional reactivity and self-regulation are complex and multidirectional.

Our aim was to study whether maternal prenatal or postnatal mood problems (anxiety and depression) influenced maternal emotional availability, child emotional availability, and the extent of child's negative affect during the SFP at 6 months postpartum and whether maternal emotional availability moderated any such associations. We expected that mothers with (a) elevated prenatal and/or (b) elevated postnatal mood symptoms would show lower maternal emotional availability (Hypothesis 1, H1) and that their infants would be less responsive, initiate less interaction, and show more negative reactivity during the SFP (Hypothesis 2, H2). Furthermore, we expected that maternal emotional availability would (a) associate with the lower amount of negative affect and (b) moderate any effect of maternal prenatal and perinatal mood symptoms on child's emotional availability or the amount of negative affect (Hypothesis 3, H3).

2 | METHOD

2.1 | Participants and procedure

The present study was conducted according to guidelines laid down in the Declaration of Helsinki, with written informed consent obtained from a parent or guardian for each child before any assessment or data collection. All procedures involving human subjects in this study were approved by the Human Research Ethics Committee at the Macquarie University, Sydney, Australia. For this study, we recruited 214 women in their third trimester of pregnancy from antenatal classes and clinics at three large obstetric hospitals in Sydney, Australia. Inclusion criteria included healthy singleton pregnancies and adequate English literacy to complete study questionnaires. Women with documented alcohol or substance abuse were excluded. After receiving ethics approval, all women who took part in the study provided informed written consent. Of the 214 women recruited during pregnancy, 196 (92%) participated in the 6-month postnatal follow-up. Women who completed the study were more likely to be employed than those who did not continue ($\chi^2 = 10.20$, $p = .001$). No other significant demographic differences were found ($ps > .05$).

The pregnancy and 6-month follow-ups involved a laboratory visit including a diagnostic interview regarding mood disorders for mothers during pregnancy ($M = 29.92$ weeks' gestation, $SD = 1.59$) and a video recording of mother–infant interaction using the SFP (Tronick et al., 1978) at 6 months ($M = 27.80$ weeks, $SD = 3.82$). Participants completed questionnaires to assess maternal mood symptoms (anxiety and depressive) at two time points: during the third trimester of pregnancy and 6 months postpartum. Family socioeconomic and medical background factors were recorded during pregnancy and updated at 6 months. Child temperament was considered a confounding variable and was assessed with the Short Temperament Scale for Infants (Oberklaid et al., 1986) at 6 months.

2.2 | Maternal mood problems (anxiety and depression)

As noted above, symptom checklists and diagnostic interviews were used to assess mood problems and to determine clinical significance. Mothers were interviewed using the Mini International Neuropsychiatric Interview (MINI plus V5; Sheehan et al., 1998) during the third trimester of pregnancy to evaluate the clinical significance of anxiety and depression. The following modules were administered: Major Depressive Episode (MDE), MDE with melancholic features, Dysthymia, Panic Disorder, Agoraphobia, Social Phobia, Specific Phobia, Obsessive–Compulsive Disorder, Post-traumatic Stress Disorder, Generalized Anxiety Disorder, Adjustment Disorders, and Mixed Anxiety-Depressive Disorder.

The State subscale of Spielberger State–Trait Anxiety Inventory (STAI; Spielberger, 1983), a reliable and valid measure also validated in pregnant women (Grant et al., 2008), was used to assess anxiety symptoms during the third trimester of pregnancy and at 6 months postpartum. The State subscale consists of 20 questions that explore current feelings of anxiety, nervousness, and tension and was completed at each contact. Good internal consistency was observed, with Cronbach's alpha values of .91 in pregnancy and .92 at 6 months postpartum. In a previous study of pregnant women, Grant et al. (2008) validated the symptom checklist with a diagnostic interview demonstrating that scores of 40 or above on the STAI indicated likely clinically significant anxiety. The 10-item Pregnancy-Related Anxiety Questionnaire (Rini et al., 1999) is a validated measure designed to assess anxiety symptoms related to problems specific to pregnancy or childbirth.

The Edinburgh Postnatal Depression Scale (Cox, 1996; Cox et al., 1987) was administered on each occasion. The measure consists of 10 items that explore feelings of low mood in the last 7 days. The measure is widely used and has been validated for use in pregnancy (Boyce et al., 1993; Chaudron & Wisner, 2014). Good reliability was demonstrated on each occasion with Cronbach's alpha coefficients of .82 and .85 in pregnancy and at 6 months postpartum, respectively. Scores of ≥13 have been shown to indicate likely clinically significant depression (Cox, 1996; Cox et al., 1987).

2.3 | Maternal and child behaviors during the still-face procedure

2.3.1 | Still-face procedure

The SFP was used to assess mothers' and infants' interactive behaviors and infants' negative affect in response to stress. The Haley–Stansbury modification (Haley & Stansbury, 2003) was

used such that there were five 2-min episodes: an initial face-to-face interaction episode, a first still-face episode in which the mother was instructed to remain unresponsive with a neutral gaze for 2 min, a reunion episode in which the mother attempted to resume play, a second still-face episode, and a second reunion episode. The experimenter verbally prompted the mother to transition between phases. The Haley–Stansbury modification was used to maximize variability in response to stress based on previous research with a different sample of infants in the same age range using this procedure (see Grant et al., 2010) and to enable a longer sample of play for the coding of Emotional Availability (Biringen et al., 2014).

2.3.2 | Infants' negative affect

Infants' negative affect (vocalizations, fussing, crying) was coded during each episode using the vocalization component of the Infant Negative Affect scale (Braungart-Rieker & Stifter, 1998). Intensity of negative vocalizations was assessed for each 5-s interval of the observation using a 4-point scale: 0 (*no negative vocalizations*), 1 (*mildly fussy*), 2 (*clearly crying*), and 3 (*screaming*; *crying intensely*). The highest intensity of negative affect was rated for each interval. Average negative intensity scores were then calculated for each episode (sum of intensity ratings/number of completed 5-s intervals) and summed to give a total negative affect score. Twenty percent of cases were double coded, and intraclass correlations for agreement on average negative affect intensity ratings for each episode ranged from .85 to .98.

2.3.3 | Maternal emotional availability and infants' interactive behaviors

Maternal emotional availability and infants' interactive behaviors were assessed from the video-recorded face-to-face interaction during the SFP using the EAS, fourth edition (Biringen, 2008). The EAS include four parental scales—Sensitivity, Structuring, Non-intrusiveness, and Non-hostility—and two child scales—Involvement and Responsiveness (Biringen, 2008; Biringen et al., 2014). Sensitivity captures the mother's attunement to the child's affective state and accurate assessment of the child's emotional and behavioral cues. Structuring captures the mother's ability to scaffold and extend the infant's play and impose appropriate limits. Non-intrusiveness refers to the extent to which the mother can remain involved in play without overdirecting or intruding on the infant's physical space. Non-hostility refers to the absence of overt criticism, demeaning remarks, or signs of boredom during play. The children's interactive behaviors were assessed by a Child Responsiveness scale which captures the extent to which a child responds emotionally or behaviorally to their parent's interactive bids, emotionally and behaviorally, and a scale of Child Involvement which captures the extent to which the child seeks to initiate or involve the parent in interaction.

Each parent and child scale is coded with reference to seven subscales describing discrete behaviors (Biringen, 2008). Subscale scores are combined as recommended in the coding manual to yield an overall score ranging from 7 to 29. An average score for each of the mother's scales (Sensitivity, Non-intrusiveness, Structuring, Non-hostility) and the scale of Child Responsiveness was calculated across the three interactive episodes (not during still-face episodes). An average score for Child Involvement was coded only during the two still-face episodes. (Initiating behaviors were quite rare in the young infants when their mothers were interacting, but striking, if present, during the episodes in which the parent did not interact and the child tried to initiate). These average scores were used as continuous variables in data analyses.

Coders were trained at Biringen's laboratory and blind to study hypotheses; 28 cases were double coded, and ICC single measure coefficients were as follows for the mothers: .85, Sensitivity; .85, Structuring; .86, Non-intrusiveness; and .87, Non-hostility. For infants, the ICC single coefficients were .77, Child Responsiveness, and .75, Child Involvement. Disagreements were resolved through conferencing.

2.4 | Descriptive statistics and variables used in the analyses

Participants' mean age was 32.15 years (SD = 4.42; range = 21–47 years). The women were predominantly from Caucasian backgrounds (83%), partnered (97.3%), and tertiary educated (73.4%). The majority were primiparous (90.5%). Regarding the infants' gender, 104 (52.5%) were male and 94 (47.5%) were female. Mean gestational age was 39.47 weeks (SD = 1.57). Infants were aged 22–38 weeks (M = 28.1 weeks, SD = 5.6) at the 6-month follow-up.

EPDS scores, STAI State scores during pregnancy and at 6 months, and PRAQ scores during pregnancy were significantly skewed toward more positive adjustment.

To aggregate the mood data for analyses, categorical variables of *caseness* were derived, which accounted for anxiety and depression symptom severity as well as information from the prenatal diagnostic interview. Mothers were assigned to a "prenatal anxiety case" group if they reported a score over 40 in the STAI questionnaire for State (n = 42, 19.3%) anxiety, reported pregnancy-specific anxiety over 1 SD above the mean (n = 42, 19.3%), and/or met criteria for at least one anxiety diagnosis in the diagnostic MINI (n = 28, 12.7%). Seventy-eight mothers (36%) met at least one of these caseness criteria of anxiety in pregnancy. The mothers were assigned to a "prenatal depression case" group if they reported a score of 13 or higher (n = 13, 5.6%) on the EPDS questionnaire and/or met criteria for at least one depression diagnosis in the diagnostic MINI (n = 6, 2.8%). Thirteen women (5.6%) met these caseness criteria for depression in pregnancy. For the final regression model analyses, the groups of prenatal depression and anxiety caseness were combined (mood problems group) due to the strong overlap between cases of anxiety and depression ($\chi^2 = 24.32$, $p < .001$, 12 [92%]), and the small number of depression cases.

Mothers were assigned to a "postnatal anxiety case" group if they scored above 40 on the STAI questionnaire for state anxiety (n = 42, 21.4%) at 6 months after delivery and to a "postnatal depression case" group if they reported a score of 13 or higher (n = 9, 4.1%) on the EPDS questionnaire. The categorical variables of prenatal and postnatal depression and anxiety caseness were used separately in the preliminary analyses.

The EAS were normally distributed, with nonsignificant Shapiro–Wilk statistics. In the preliminary analyses, the sum scores of each separate maternal emotional availability variable (Sensitivity, Structuring, Non-intrusiveness, and Non-hostility) and child emotional availability (Child Responsiveness and Child Involvement) were used as continuous variables (range = 7–29). For the final multiple regression analyses testing hypotheses 2 and 3, given moderate to high correlations between the individual scales, a composite maternal emotional availability variable (a sum score of maternal Sensitivity, Structuring, Non-intrusiveness, and Non-hostility), and a composite children's interactive behavior variable (a sum score of Responsiveness and Involvement) were calculated. This reduced the number of tests. However, the EA scales were used separately in those analyses where a significant association was found only for the individual maternal EA scales, for example, for the association between maternal structuring and prenatal mood problems.

The Infants' Negative Affect scores were positively skewed ($p < .001$), with a skewness of 2.28 and kurtosis of 6.12. For analyses, we constructed a categorical variable to capture the maximum degree of negative affect with three levels, as described in Grant et al. (2010): (0 = *no fussing at all*, $n = 23$ [10.5%]; 1 = *low fussing*, $n = 128$ [58.8%]; 2 = *crying and/or screaming*, $n = 44$ [20%]). Due to the low number of infants who did not fuss at all, the scores were dichotomized for analyses: no negative vocalizations or mild fussing ($n = 151$) versus clearly crying and/or screaming intensely ($n = 44$).

2.5 | Approach to data analysis

First, associations among study variables and demographic and birth variables were examined to identify potential covariates using correlations for continuous variables, *t* tests, and chi-square tests for categorical variables. Next, associations between prenatal and postnatal anxiety and depression caseness, maternal emotional availability, children's interactive behaviors, and infants' negative affect were explored using *t* tests for continuous outcome variables (maternal emotional availability and infants' interaction behaviors) and chi-square tests for categorical outcome variables (negative affect).

Multiple regression models followed. Covariates were selected based on the significant findings in preliminary analyses (parity and language background), previous literature and theoretical assumptions (child temperament and postnatal anxiety and depression symptom scores). These covariates were used in all models. The combined categorical variable of anxiety and depressive cases was derived to distinguish women who met criteria for caseness for either anxiety or depression (or both) during pregnancy (as described above). This predictor variable of prenatal mood problems was used in all multiple regression models.

Multiple regression models using the general linear model (GLM) were conducted to test hypotheses. First, the GLM was used to analyze the effects of maternal prenatal mood problems on maternal structuring during the SFP (H1). Composite variable of maternal emotional availability was not used in this analysis as only the variable of maternal structuring was affected by prenatal mood problems (anxiety or depression). Next, GLM was used to analyze the effect of maternal prenatal mood problems (H2) as well as the possible interactive effects of maternal mood problems and maternal emotional availability (H3) on children's interactive behavior. In this model, composite maternal emotional availability and child's emotional availability (as described above) were used due to the high correlation between the maternal (rs = .64–.78) and child scales (rs = .81). A logistic regression model was used to examine the association of maternal emotional availability and children's negative affect during the SFP (H3). In this model, the composite maternal emotional availability variable was used.

3 | RESULTS

3.1 | Associations between the study, demographic, and birth variables

Associations between the study variables and the demographic and birth variables were explored to identify potential covariates. Language background was associated with all EAS (ps < .05) with the exception of the maternal Non-hostility scale. Mothers from a non-English

speaking background and their infants had lower scores compared to English-speaking mothers. Furthermore, parity was associated with infants' Responsiveness ($p < .05$). Firstborn children had higher scores. Maternal education, maternal age, marital status, child gender, gestational age, and child age at the postnatal assessment were not associated with any of the study variables. In addition, as expected, all variables of maternal emotional availability were moderately to strongly correlated with the children's scales of Involvement and Responsiveness during the SFP (rs ranged from .37 to .71, ps $< .01$).

3.2 | Associations between maternal prenatal and postnatal anxiety and depression and mothers' and children's emotional availability

First, maternal emotional availability using the scales of Sensitivity, Structuring, Non-intrusiveness, and Non-hostility and children's interaction behaviors using the scales of Involvement and Responsiveness were examined in relation to prenatal and postnatal caseness (anxiety and/or depression; Table 1). Findings indicated that Child Involvement and Child Responsiveness and Maternal Structuring during the SFP were lower in the groups where mothers were classified as either anxiety or depression cases during pregnancy compared to noncases (see Table 1). Maternal postnatal caseness (depression and/or anxiety) was not associated with any maternal or child interactive variables (Table 1).

Second, the effects of maternal emotional availability and maternal prenatal and postnatal caseness on children's negative affect during the SFP were assessed (Table 2). Maternal Structuring was lower and maternal Non-hostility was higher across episodes during the SFP in the group of children who showed high negative affect during the SFP compared to the children with a low negative affect (Table 2). No other significant associations were found between maternal emotional availability and children's negative affect during the SFP. Furthermore, maternal prenatal and postnatal anxiety and depression caseness were not associated with children's negative affect.

3.3 | Linear and logistic multivariable regression models

Next, multiple regression models were conducted based on the significant associations. Covariates in all models included language background, parity, children's difficult temperament, and maternal postnatal anxiety and depressive symptom scores.

First, to test H1, we used a GLM to explore the effects of maternal prenatal mood problems (anxiety and/or depression caseness) on maternal structuring. Our results indicated that maternal prenatal mood problems predicted lower scores for maternal structuring during the SFP, after the effects of potential covariates were controlled (see Table 3).

Next, to test Hypotheses 2 and 3, multivariate regression models were conducted to study the direct and indirect associations between maternal prenatal mood problems, maternal emotional availability, children's emotional availability and children's negative affect. Composite variables for the emotional availability variables for mothers (a combined variable of maternal Sensitivity, Structuring, Non-intrusiveness, and Non-hostility) and children (a combined variable, Child Interactive Behavior, of Child Responsiveness and Child Involvement) were used in the analyses. Results indicated that maternal prenatal mood problems independently predicted lower child

TABLE 1 Differences in maternal and child emotional availability between the groups of high and low maternal anxiety and depressive symptoms

	Maternal caretaking								Infant's interaction		Infant's interaction	
	Sensitivity ($n = 50$, $n = 140$)		Structuring ($n = 9$, $n = 181$)		Non-intrus. ($n = 39$, $n = 152$)		Non-hostility ($n = 9$, $n = 182$)		Involvement		Responsiveness	
	MD (*SD*)	*t*	*MD* (*SD*)	*t*	*MD* (*SD*)	*t*	*MD* (*SD*)	*t*	*MD* (*SD*)	*t*	*MD* (*SD*)	*t*
Prenatal anxiety		−1.36		−2.22*		−1.08		−.26		−2.80**		−2.65**
Over cutoff	24.04 (1.79)		23.05 (2.39)		25.30 (2.59)		27.46 (1.16)		23.08 (3.26)		21.42 (3.91)	
Under cutoff	24.70 (1.80)		24.48 (2.37)		25.76 (2.58)		27.51 (1.29)		24.18 (1.99)		22.85 (1.99)	
Prenatal depression		.27		−2.28		−.56		.96		−3.32**		−2.41**
Over cutoff	24.56 (2.04)		24.39 (1.55)		25.17 (0.31)		27.89 (0.33)		21.33 (6.47)		19.89 (6.86)	
Under cutoff	24.33 (2.40)		24.53 (1.82)		25.66 (2.56)		27.48 (1.28)		24.02 (2.00)		22.61 (3.05)	
Postanatal anxiety		−1.45		−1.01		−1.71		−.57		−1.09		−1.67
Over cutoff	23.86 (2.58)		24.27 (1.82)		25.02 (2.79)		27.40 (1.28)		23.51 (2.93)		21.67 (4.36)	
Under cutoff	24.48 (2.32)		24.60 (1.81)		25.81 (2.51)		27.53 (1.24)		23.99 (2.28)		22.68 (2.99)	
Postnatal depression		.62		1.35		0.55		0.82		−1.67		−.20
Over cutoff	24.83(1.52)		24.61 (1.27)		26.11 (2.76)		27.83 (.04)		21.67 (4.36)		22.25 (3.49)	
Under cutoff	24.33 (2.41)		24.53 (1.83)		25.62 (2.58)		27.94 (1.28)		22.68 (2.99)		22.49 (3.33)	

*$p < .05$.

**$p < .01$.

TABLE 2 Differences in maternal emotional availability between children expressing high versus low negative affect during the SFP

Child's negative affect during the SFP	High ($n = 42$) *M* (*SD*)	Low ($n = 150$) *M* (*SD*)	*t*
Maternal caregiving			
Sensitivity across episodes	23.94 (2.72)	24.47 (2.27)	1.29
Structuring across episodes	23.84 (2.05)	24.73 (1.69)	2.86**
Non-intrusiveness across episodes	25.04 (2.76)	25.84 (2.51)	1.80
Non-hostility across episodes	27.11 (1.42)	27.61 (1.18)	2.28*

Abbreviations: *M*, Mean; *SD*, standard deviation; SFP, Still-face procedure.

*$p < .05$.

**$p < .01$.

emotional availability after the effects of the covariates and maternal emotional availability were controlled (Table 4). There was no significant interaction effect of maternal prenatal mood problems and maternal emotional availability on the child's emotional availability ($B = .08$, $SE = .10$, $t = 0.82$, $p = .40$).

Next, the association between maternal emotional availability and children's negative affect across SFP episodes (categorical variable) was studied using a logistic regression model (H2). Our findings indicated that lower maternal emotional availability across episodes was associated with higher negative affect in children during the SFP after the effects of covariates were controlled (Table 5). Maternal prenatal mood problems or postnatal anxiety and depression symptoms did not have any effects on children's negative affect during SFP at 6 months.

4 | DISCUSSION

In this study, we explored whether maternal prenatal and postnatal mood problems (elevated anxiety and depression symptoms) were associated with maternal emotional availability, child emotional availability, and children's negative affect during the SFP at 6 months. In addition, we studied whether maternal emotional availability either independently or together with maternal mood problems predicted child emotional availability and negative affect.

We found that mothers with maternal mood problems (anxiety and/or depression) during pregnancy, but not postnatally, showed less optimal maternal structuring during the SFP, and the children showed lower involvement and responsiveness during interactions with their mothers. These effects were significant after the effects of potential confounding variables (including postnatal symptoms) were controlled. We also found that less optimal maternal emotional availability during the SFP was concurrently associated with a higher negative affect in children. Interestingly, and contrary to our expectations, maternal postnatal depression and anxiety caseness were not associated with maternal emotional availability, with children's interactive behaviors, or with children's negative affect during the SFP. Furthermore, maternal emotional availability did not moderate the effect of maternal prenatal mood symptoms on the quality of child's emotional availability.

Thus, our findings partly support our hypotheses and are to some extent consistent with previous research. The associations between maternal prenatal mood problems and children's lower

TABLE 3 The association between maternal mood problems and maternal structuring during the SFP

Variables	*B* (*SE*)	*F*	R^2 (adj.)	ΔR^2	Partial η^2
Model 1		2.54	.05	.09	
Language background					
English ($n = 151$)	7.66 (3.26)*	.031			
Non-English ($n = 38$)	0				
Parity					
Firstborn	−1.33 (1.27)*	.024			
Not firstborn	0				
Child's temperament at 6 months	−.365 (.251)				
Maternal anxiety at 6 months	0.12 (.371)				.001
Over cutoff ($n = 39$)					
Under cutoff ($n = 151$)					
Maternal depression at 6 months	−.287 (.644)				.001
Over cutoff ($n = 8$)					
Under cutoff ($n = 181$)					
Maternal prenatal mood problems	5.96 (2.92)*				.024
Over cutoff ($n = 66$)					
Under cutoff ($n = 123$)					

Abbreviation: SFP, Still-face procedure.

*$p < .05$.

involvement and responsiveness during an interactive stress situation are in line with several studies that showed children's prenatal stress exposure can independently predict their socio-emotional development, especially in the area of stress regulation (Glover, 2011; Korja et al., 2017; O'Donnell et al., 2014). However, to our knowledge, this is the first study showing that children of mothers with negative mood symptoms in pregnancy interact differently with their mothers. In our study, both elevated anxiety and depressive symptoms predicted children's outcomes, which may be explained by the high comorbidity between depression and anxiety in our sample. Thirty-four percent of mothers in our study reported prenatal mood problems including higher prenatal general anxiety, and/or pregnancy-related anxiety and/or depressive symptoms. This prevalence is in line with previous studies showing prevalence rates of 5–30% for different forms of prenatal mood symptoms (Korja et al., 2018; Parfitt & Ayers, 2014; Vänskä et al., 2011; Skouteris et al., 2009; Teixeira et al., 2009).

There are several possible explanations. The early life programming model could explain our findings. Maternal prenatal depression or anxiety has been suggested to affect children mainly through different intrauterine processes, including impacts of glucocorticoids on the developing HPA axis, effects of maternal mood symptoms on the functioning of the placenta, and changes in the immunological milieu or nutritional supply (Egliston et al., 2007; O'Donnell et al., 2009; Van Batenburg-Eddes et al., 2013). Another possible explanation is that prenatal mood problems are a marker for vulnerability in parenting capacity, supported by our findings linking prenatal mood problems and lower maternal structuring during the SFP. Several previous studies have shown that prenatal maternal mood can independently negatively influence maternal emotional

TABLE 4 The associations between maternal mood problems and children's emotional availability

Variables	*B* (*SE*)	*F*	R^2 (adj.)	ΔR^2	Partial η^2
Model 1		15.74***	.41	.38	
Language background					
English ($n = 151$)	0.59 (.81)				.003
Non-English ($n = 38$)	0				
Parity					
Firstborn	13.63 (3.09)**				.098
Not firstborn	0				
Child's temperament at 6 months	−0.238(.61)				.002
Maternal depression at 6 months	−.008(.099)				.000
Maternal anxiety at 6 moths	.583 (.966)				.002
Maternal prenatal mood problems	1.847 (0.75)*				.032
Over cutoff ($n = 66$)					
Under cutoff ($n = 123$)					
Maternal emotional availability	0.426 (.047)***				.308

TABLE 5 The associations between maternal emotional availability and children's negative affect during the SFP

Variables	χ^2 (*df*)	*B*	*SE*	Exp. (*B*)	CI 95%	
Model 1	9.09					
Language background			.45	.83	.35	2.00
English ($n = 152$)		−.19				
Non-English ($n = 38$)						
Parity		−22.81	.51	3.39	1.25	9.18
Firstborn						
Not firstborn						
Child's temperament at 6 months		.35	.36	.99	.76	2.31
Maternal prenatal mood problems		−.01	.43	.98	.42	2.30
Over cutoff ($n = 67$)						
Under cutoff ($n = 123$)						
Maternal postnatal anxiety		−.01	.03	.99	.94	1.03
Maternal postnatal depression		.07	.06	1.07	.95	1.21
Maternal emotional availability		−.06*	.03	0.94	.89	.99

*$p < .05$.

**$p < .01$.

availability, controlling for postnatal mood symptoms (Hakanen et al., 2019; Letourneau et al., 2017; Parfitt & Ayers, 2014; Pearson et al., 2012). Our result showing that mothers with prenatal mood problems demonstrated less optimal structuring with the infant suggests these mothers

were less able to regulate their children (Hakanen et al., 2019; Lovejoy et al., 2000). Structuring involves the caregiver's capacity to judge what support the infant needs, to extend the infant's interaction and play, and to scaffold the child in a way that enhances adaptive behavior in the situation (Biringen et al., 2014). It has been shown that maternal mood problems during the perinatal period can compromise maternal executive functioning (Kataja et al., 2017; Roca et al., 2015), skills central for structuring, which may be one possible explanation for these results. Another possibility is that the mother who is depressed and/or anxious is inclined to over-regulate or under-regulate the child's activity (Papousek & Von Hofacker, 1998). It seems that not only the emotional aspect of behavior is affected by maternal prenatal mood but also more cognitive aspects such as structuring.

Interestingly, however, we found maternal prenatal mood problems had a direct effect on children's interactive behavior, including lower involvement and responsiveness, but not on a higher negative affect during the SFP. The classic still-face effect is characterized by a decrease in gaze and positive affect and an increase in negative affect from the baseline to the still-face episode and (partial) recovery during the reunion episode (Mesman et al., 2009; Tronick et al., 1978). Our findings indicate that infants of prenatally depressed and/or anxious mothers showed low gaze and positive affect, but they did not show greater negative affect compared to infants of mothers who did not have prenatal mood problems.

More specifically, in our sample, children exposed to elevated maternal distress in pregnancy were less responsive to their mother's interactive bids and showed less pleasure and positive affect during the interaction. In addition, they made fewer attempts to communicate with their mothers or draw them into interaction when they were unresponsive. This passivity in emotional interaction during a stress situation may be an early indication of avoidant (defensive) emotion regulation strategies, whereby a child internalizes the responsibility for self-soothing, rather than turning to their mother when distressed (Calkins & Leerkes, 2011; Nachmias et al., 1996). These emotion-regulation strategies are one form of non-optimal stress regulation that may predict avoidant attachment and internalizing of emotional difficulties at a later age (Calkins & Leerkes, 2011).

Previous studies (e.g., Field et al., 2010) have shown that infants with postnatally depressed mothers also showed less distress during the still-face episode, arguing that perhaps these infants have already adapted, expecting their mothers' behaviors to be unresponsive (e.g., Peláez-Nogueras et al., 1996). The lack of association between maternal prenatal mood problems and children's negative affect during a stress situation may be another indicator of child adaptation to what may be a pattern of maternal behavior: The child does not communicate their distress to their mother and does not rely on her to regulate negative affect during a stress situation. Again, this is consistent with an avoidant strategy of minimizing or not communicating emotional distress (Calkins & Leerkes, 2011; Nachmias et al., 1996).

Contrary to our expectations, nonoptimal maternal caregiving behavior, but not maternal prenatal or postnatal mood (anxiety and depression) symptoms, was related to infants' negative affect during the stress protocol. Those infants whose mothers showed lower maternal emotional availability, including lower sensitivity and structuring and higher intrusiveness and hostility, demonstrated more negative reactivity during the SFP compared to children of mothers with more optimal caregiving behavior. This is consistent with the emotional availability construct derived from attachment theory, which proposes that sensitive, responsive caregiving acts as an external regulator of infants' arousal and behavior (Biringen et al., 2014; Easterbrooks et al., 2000; Emde, 2000). In addition, this finding is consistent with previous studies that have shown that higher levels of maternal sensitivity or general positive behavior or affect are related to less

negative affect in infants during the still-face and reunion episodes (Braungart-Rieker et al., 2001; McMahon & Newey, 2018; Mesman et al., 2009; Rosenblum et al., 2002).

It is important to acknowledge, however, that individual differences in child's emotional availability during the SFP, especially negative affect, may also influence parenting behaviors (Dopkins Stright et al., 2008). It may be harder for parents to "look good" in an interaction if their child is upset, as the child will provide fewer interactive cues. Interestingly, in our study, parent reports of child temperament at 6 months were not related to maternal caregiving behavior nor children's negative reactivity during the SFP. This supports the interpretation that the association between nonoptimal caregiving behavior and higher negative affect during the SFP reflects parental or relationship characteristics rather than biological characteristics of child temperament.

Our study indicates two different patterns in children's reactions during the SFP. First, infants of prenatally anxious and/or depressed mothers showed lower involvement and responsiveness during the SFP. Second, lower maternal emotional availability but not maternal mood problems increased the amount of a children's negative affect during the SFP.

This study has several strengths and limitations. The use of several different measures in the evaluation of maternal mood problems increased the assessment's validity. We assume that by using several different assessment strategies, the mothers' mood problems were more likely to be detected, and the impact of distress over a longer frame was captured. Another strength was that maternal emotional availability and children's interactive behavior were assessed in a stress situation. Our findings truly reflect the stress regulation processes in mothers and in children, which are crucial predictors for later psychological well-being. The assessment of the children's behavior during the SFP using two different observational strategies (EAS and negative affect) and using different coders to evaluate each of these domains increases the validity of the evaluation of the children's behavior.

One limitation is the small group size with elevated depression symptoms. Therefore, the independent role of depression on caretaking and children's outcomes was not able to be studied reliably. Another limitation is that mothers' and children's emotional availability were not coded independently. Furthermore, another limitation is that maternal emotional availability as a possible moderator was measured concurrently with the child's emotional availability and negative affect, which were the outcome variables. Furthermore, effect sizes were relatively small. Effect sizes are in line with previous studies of the early life stress (Korja et al., 2017, review) and support the suggestion that origins of infants' socioemotional development are complex and that multiple factors are involved.

Our findings address the importance of screening for symptoms of anxiety and depression during pregnancy. Focused and targeted treatment for prenatal anxiety and depression should be widely available for pregnant women. Based on our findings, we stress that the effects of prenatal mood problems are not necessarily expressed through a child's having higher negative affect but through the child's lower emotional engagement in the interaction, which may have a negative effect on the child's later development and/or be an early indicator of insecure attachment with the mother. A child's ability to effectively approach and enlist the caregiver to help them to manage stress is a key marker of secure attachment, likely to predict adaptive emotion regulation and social relationships. Less involved and responsive infants may be more difficult to recognize in the clinical context compared to highly reactive children. Our findings address the importance of screening not only for higher negative affect but also a higher passivity or avoidance in children's emotional interaction.

To sum up, we found that maternal prenatal but not postnatal mood problems independently predict less optimal maternal structuring and children's lower social involvement and

responsiveness during the SFP situation. In addition, our study showed that low maternal emotional availability is concurrently related to greater infant negative affect during the SFP. Based on our findings, we underline that maternal prenatal psychological well-being and the quality of maternal caregiving are important contributors to infants' healthy emotional regulation and interaction.

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