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Maternal Depression and Anxiety, Social Synchrony, and Infant Regulation of Negative and Positive Emotions

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Maternal postpartum depression (PPD) exerts long-term negative effects on infants; yet the mechanisms by which PPD disrupts emotional development are not fully clear. Utilizing an extreme-case design, 971 women reported symptoms of depression and anxiety following childbirth and 215 high and low on depressive symptomatology reported again at 6 months. Of these, mothers diagnosed with major depressive disorder ($n = 22$), anxiety disorders ($n = 19$), and controls ($n = 59$) were visited at 9 months. Mother-infant interaction was microcoded for maternal and infant's social behavior and synchrony. Infant negative and positive emotional expression and self-regulation were tested in 4 emotion-eliciting paradigms: anger with mother, anger with stranger, joy with mother, and joy with stranger. Infants of depressed mothers displayed less social gaze and more gaze aversion. Gaze and touch synchrony were lowest for depressed mothers, highest for anxious mothers, and midlevel among controls. Infants of control and anxious mothers expressed less negative affect with mother compared with stranger; however, maternal presence failed to buffer negative affect in the depressed group. Maternal depression chronicity predicted increased self-regulatory behavior during joy episodes, and touch synchrony moderated the effects of PPD on infant self-regulation. Findings describe subtle microlevel processes by which maternal depression across the postpartum year disrupts the development of infant emotion regulation and suggest that diminished social synchrony, low differentiation of attachment and nonattachment contexts, and increased self-regulation during positive moments may chart pathways for the cross-generational transfer of emotional maladjustment from depressed mothers to their infants.

Keywords: maternal depression, maternal anxiety, mother−infant synchrony, emotion regulation, negative and positive emotions

Maternal postpartum depression (PPD) is a major health concern affecting approximately 13% to 18% of all women within 12 months after childbirth (Burt & Stein, 2002; Gavin et al., 2005; Serretti, Olgiati, & Colombo, 2006). Of special alarm are data indicating that rates of PPD increase each decade (Halbreich & Karkun, 2006), and PPD is the most underdiagnosed disorder in the community (Howard et al., 2014; Ko, Farr, Dietz, & Robbins, 2012). PPD has long been known to exert significant negative effects on children; offspring of depressed mothers show increased susceptibility to psychopathology (Gotlib, Joormann, & Foland-Ross, 2014; Murray et al., 2011), difficulties in regulating emotions (Silk, Shaw, Forbes, Lane, & Kovacs, 2006), problems in interpersonal relationships (Carter, Garrity-Rokous, Chazan-Cohen, Little, & Briggs-Gowan, 2001), and disruptions to physiological support systems that underpin stress management and social affiliation (Feldman, 2012; Thompson, Parker, Hallmayer, Waugh, & Gotlib, 2011; Thompson, Hammen, Starr, & Najman, 2014). It has been suggested that exposure to maternal depression is most detrimental during the first months of life, when dependence on the mother is maximal and the infant's brain and social behavior are shaped by patterns of maternal care (Feldman, 2015a; Goodman et al., 2011; Gotlib et al., 2014). Yet, no study, to our knowledge, has used a microlevel observational approach to test the effects of maternal depression across the first months of life on both patterns of mother−infant interaction and infant regulation of negative and positive emotions in the presence of mother and stranger, targeting the infant's emotional functioning in the attachment context as well as within the general social world of unfamiliar adults.

In this study, we followed a low-risk birth cohort to detail the effects of maternal depressive mood across the infant's first year on mother-infant interaction and the infant's ability to manage negative and positive emotional moments vis-à-vis mother or stranger. We observed and microcoded mother-infant interaction in the home environment and focused on mother's and infant's social behavior and patterns of synchrony. Infants were then observed in four contexts eliciting negative (anger) and positive (joy) emotions, each assessed once with the mother and once with a stranger. These paradigms were microcoded for the expression of negative and positive affect and self-regulatory behavior, consis-

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tent with perspectives that view the expression and regulation of emotions as distinct and central components of emotion regulation (Cole, Martin, & Dennis, 2004; Rothbart, Sheese, Rueda, & Posner, 2011). Observing infants with mother and stranger tapped the uniqueness of the attachment context for infants' emotional outcomes and whether PPD affects such differentiation. Finally, for further specificity, we included a group of mothers diagnosed with anxiety disorders (AD) to separate outcomes specific to PPD from those generally linked with an affective disorder, making this study the first to integrate microlevel observations of relational patterns and ER markers in mothers diagnosed with both depression and anxiety disorders.

Maternal Depression, Social Behavior, and Mother−Infant Synchrony

PDD has long been associated with disruptions to the mother−infant relationship, expressed in reduced maternal behavior and diminished synchrony (Goodman et al., 2011; Stein et al., 2012). Depressed mothers exhibit lower sensitivity and responsiveness (Bansil et al., 2010; Parsons, Young, Rochat, Kringelbach, & Stein, 2012) and less maternal behavior in the gaze, affect, vocal, and touch modalities (Broth, Goodman, Hall, & Raynor, 2004; Feldman & Eidelman, 2003, 2007; Goodman et al., 2011; Stein et al., 2012). These maternal behaviors, which appear in a species-specific repertoire across mammals, provide critical environmental inputs for maturation of the social brain and serve as building blocks for the infant's social−emotional competencies (Feldman, 2015a; Feldman, 2015b; Meaney, 2010). Here, we focused on two fundamental maternal behaviors; touch and gaze. Maternal touch is a mammalian-general behavior that is expressed immediately after birth, triggered by the release of oxytocin during parturition. In rats, maternal touch (licking-and-grooming) was found to shape the infant's brain oxytocin and glucocorticoid systems (Szyf, McGowan, & Meaney, 2008), supporting the lifetime capacity to form affilitive bonds, manage stress, and use close relationships for stress reduction (Champagne & Meaney, 2001; Cirulli et al., 2009). Although maternal touch received less attention in human research, affectionate touch—human touch aimed solely for the expression of love—is a central component of early relationships, functions to regulate stress and emotions, and is linked online with physiological support systems, such as cortisol production or heart rate variability (Feldman, Singer, & Zagoory, 2010; Stack, 2001; Weinberg & Tronick, 1998). Mother's depressive symptoms have been associated with diminished maternal physical contact and touch (Feldman & Eidelman, 2003, 2007; Feldman, Keren, Gross-Rozval, & Tyano, 2004; Murray, Halligan, Goodyer, & Herbert, 2010; Righetti-Veltema, Conne-Perréard, Bousquet, & Manzano, 2002). Furthermore, maternal touch is linked with peripheral and genetic biomarkers of the oxytocinergic system (Feldman, Gordon, Schneiderman, Weisman, & Zagoory-Sharon, 2010; Feldman et al., 2012), which are disrupted in cases of depression (Apter-Levy, Feldman, Vakart, Ebstein, & Feldman, 2013; Mah, Van Ijzendoorn, Smith, & Bakermans-Kranenburg, 2013; Stuebe, Grewen, & Meltzer-Brody, 2013), suggesting that PPD may be associated with dysfunction in the biological substrate that supports affectionate touch.

In contrast to maternal touch, which appears immediately after birth in all mammals, the coordination of social gaze between mother and child is exclusively human and emerges in the third month of life (Feldman, 2007b). The ability to coordinate social gaze with another human provides the basis for social communication and is disrupted in conditions associated with social dysfunction, such as autism (Preti et al., 2014), schizophrenia (Matsumoto, Takahashi, Murai, & Takahashi, 2015), or depression (Radke, Güths, André, Müller, & de Bruijn, 2014). Altered patterns of maternal gaze during interactions have similarly been found in conditions involving high-risk parenting, such as prematurity (Eckerman, Hsu, Molitor, Leung, & Goldstein, 1999; Harel, Gordon, Geva, & Feldman, 2011) or maternal trauma (Ionio & Di Blasio, 2013; Steuwe et al., 2014), and mother−infant gaze coordination predicts infant self-regulation, visual attention, and behavior problems (Feldman & Eidelman, 2004, 2007; Harel et al., 2011; MacLean et al., 2014). During the second 6 months of life, patterns of gaze coordination become more mutual and gaze synchrony no longer depends on the mother following the infant's gaze direction (Feldman, 2007b); thus, in this study we targeted moments of mother-infant shared social gaze, whether initiated by mother or child. During this period human mothers also begin to integrate affectionate touch into moments of mutual gaze and from this stage, humans, unlike other mammals, can impact the physiological systems of the attachment partner via the coordination of visuo-affective social cues with or without physical contact (Feldman, 2016; Feldman, Dollberg, & Nadam, 2011a; Schneiderman, Kanat-Maymon, Zagoory-Sharon, & Feldman, 2014).

In addition to maternal behavior, PPD disrupts the mother's capacity to create a mutual-regulatory synchronous exchange with her infant, describing deficiencies in the process by which mother and infant match each other's behavior and affect during social interaction (Tronick, 2007). Through synchronous moments, infants learn to detect and respond to emotional signals, acquire the rules of social dialogue, and practice strategies to regulate moments of heightened arousal (Feldman, 2006, 2007a; Trevarthen, 1993). Disruptions to mother−infant synchrony in cases of PPD are expressed in various forms: There are fewer episodes of mutual social gaze (Beebe et al., 2008; Feldman & Eidelman, 2007), durations of vocal switch-pauses are longer and less predictable (Jaffe, Beebe, Feldstein, Crown, & Jasnow, 2001; Zlochower & Cohn, 1996), and mothers tend to quickly terminate moments of shared gaze (Feldman, 2007b).

Synchrony experienced during the sensitive period between two and nine months carries lasting effects on infant social-emotional development (Feldman, 2015a). Synchrony has been shown to predict attachment security, better regulation of negative and positive emotions, symbol use, physiological regulation, and the capacity for empathy across childhood and adolescence (Feldman, 2007a; Feldman, Eidelman, & Rotenberg, 2004; Feldman, Greenbaum, & Yirmiya, 1999; Jaffe et al., 2001; Moore & Calkins, 2004). Inasmuch as synchrony provides a key experience for the development of self-regulation (Tronick, 2007), the diminished synchrony and reduced maternal behavior in the gaze, vocal, and touch modalities place infants of depressed mother at a higher risk for later regulatory difficulties.

Emotional Expression, Self-Regulation, and Maternal Depression

Emotion regulation (ER), the focus of much developmental research, addresses the ability to manage states of increased arousal to facilitate adaptation or goal-directed activity (Cole et al., 2004; Thompson, 2011). ER is a multifactorial construct, including biological, behavioral, attentional, and cognitive components that hierarchically organize in response to external or internal events (Cole et al., 2004; Fox & Calkins, 2003). Developmental research on ER highlights the expression of emotions and the regulatory behavior used in emotional contexts as distinct and fundamental components of children's ER (Garber & Dodge, 1991). Greatest strides in the development of ER occur during the first years of life (Eisenberg, Spinrad, & Eggum, 2010; Feldman, 2009). During the second half-year, infants learn to use regulatory behavior with more flexibility and context-specificity and become more proficient in using putative regulatory behaviors, behaviors that clearly display the child's self-regulatory effort, as well as in utilizing behaviors which are not inherently regulatory but serve a regulatory function during moments of distress, such as attention diversion (Kopp, 2009). Putative regulatory behaviors are part of the infant's regulatory repertoire since birth, serve an adaptive survival function, and reduce negative emotions in stressful contexts (Adamson & Frick, 2003; Buss & Goldsmith, 1998; Stifter & Braungart, 1995). During the second 6 months, infants also begin to display distinct ER behaviors with mother versus stranger as observed in both levels of expressed affect and the use of self-regulatory effort (Feldman et al., 2011b; Grolnick, Bridges, & Connell, 1996; Kochanska, Tjebkes, & Forman, 1998), suggesting they have internalized the attachment context and are able to use its provisions for regulating emotions.

Parents play a key role in supporting emergent ER skills (Hirschler-Guttenberg, Golan, Ostfeld-Etzion, & Feldman, 2015; Morris et al., 2011). A sensitive maternal style characterized by positive affect and responsiveness increases self-regulation and reduces negative emotions (Bernier, Carlson, & Whipple, 2010; Feldman et al., 1999; Halligan et al., 2013; Kim & Kochanska, 2012; Kochanska, Aksan, Prisco, & Adams, 2008), whereas overwhelming and intrusive parenting increase dysregulation and negative affect (Eiden, Edwards, & Leonard, 2007; Johnson et al., 2002; Wood, 2006). The experience of synchrony supports the infant's ability to manage negative and positive emotions in distinct ways. With regard to negative emotions, as synchrony oscillates between episodes of coordination and miscoordination, with amount of miscoordinated states increasing from 3 to 9 months (Pratt, Singer, Kanat-Maymon, & Feldman, 2015; Tronick & Cohn, 1989), synchrony enhances the infant's capacity to tolerate momentary frustration, particularly when mother is present. As to positive emotions, unlike negative emotions, which can be experienced in alone states since birth, infants can express positive affect only in social contexts and require the adult's assistance to both build positive affect and maintain it through moment-by-moment synchrony (Feldman, 2003). Thus, the reduced synchrony between depressed mothers and their infants may lead to impairments in the ability to modulate negative emotions, maintain positive affect, or use appropriate self-regulatory behavior in negative and positive contexts. Moreover, since interactions with a depressed mother contain less of the elements that support ER skills, the attachment context may be less unique for such infants and less differentiation would be observed between infants' ER behavior with mother and stranger, particularly during negative moments.

Maternal depression has been associated with emotion-regulatory problems in children, observed in both children of clinically depressed mothers and children of mothers with elevated depressive symptoms (Ashman, Dawson, Panagiotides, Yamada, & Wilkinson, 2002; Blandon, Calkins, Keane, & O'Brien, 2008; Feng et al., 2008; Field, Diego, & Hernandez-Reif, 2006; Maughan, Cicchetti, Toth, & Rogosch, 2007; Murray et al., 2011, 2010). Infants of depressed mothers show difficulties in tasks that require ER, for instance, reducing the frequency and intensity of negative affect or expressing positive emotions (Cohn, Campbell, & Ross, 1992; Forbes, Cohn, Allen, & Lewinsohn, 2004). Importantly, poor ER abilities are observed across psychopathological conditions, including depression (Garber, Braafladt, & Weiss, 2009; Silk, Steinberg, & Morris, 2003), anxiety (Rubin, Coplan, Fox, & Calkins, 1995), aggression (Marsee & Frick, 2007; Melnick & Hinshaw, 2000; Shields & Cicchetti, 1998), and behavior problems (Cole, Teti, & Zahn-Waxler, 2003; Gilliom, Shaw, Beck, Schonberg, & Lukon, 2002), and show stability over time (Feldman, 2009; Halligan et al., 2013). It is thus likely that regulatory difficulties would be observed in infants of anxious mothers, possibly in different ways from those observed in infants of depressed mothers.

The Current Study

The current study aimed to target mechanisms embedded in the mother–infant relationship that may be implicated in the cross-generational transfer of affective vulnerability by utilizing a microlevel observational approach focused on both mother–infant interaction and infants' regulation of negative and positive emotions. To further specify the effects of maternal depression, we included a group of clinically anxious mothers. Children of anxious parents are 3.5 times more likely to develop anxiety disorders compared to children of nonsymptomatic parents and are more likely to develop anxiety disorders compared to offspring of depressed parents (Merikangas, Avenevoli, Dierker, & Grillon, 1999), pointing to specificity in the cross-generational transfer. Although anxiety disorders are more prevalent and chronic than depressive disorders (Kessler, Keller, & Wittchen, 2001; Kessler et al., 2005), their effects on children received much less attention (Stein et al., 2012). Very few studies examined the effects of maternal anxiety during the first year of life (Beebe et al., 2011; Feldman, Greenbaum, Mayes, & Erlich, 1997; Murray et al., 2008; Stein et al., 2012), with most studies assessing maternal anxiety symptoms, not clinical anxiety, and none integrating observations of interactions with ER paradigms.

Anxious mothers are more controlling (Stein et al., 2012), display more fearful responses (Murray et al., 2008), show less positive emotions (Nicol-Harper, Harvey, & Stein, 2007; Stein et al., 2012), and are more intrusive (Feldman et al., 1997; Weinberg & Tronick, 1998; Wijnroks, 1999). Similarly, anxious mothers are less attuned (Murray, Cooper, Creswell, Schofield, & Sack, 2007) and are less likely to follow the infant's lead (Stein et al., 2012) or act sensitively (McLeod, Wood, & Weisz, 2007; Nicol-Harper et al., 2007; Stein et al., 2012). At the same time, anxious mothers are not withdrawn and tend to express adequate or even higher levels of maternal behavior compared to controls, such as "motherese" vocalizations and positive facial expressions (Murray et al., 2008). As to mother−infant synchrony, Biringen (1990) reported lower dyadic harmony, but the study did not include microlevel observations. To our knowledge, only one study explored microlevel synchrony between anxious mothers and their infants (Beebe et al., 2011). Anxiety symptoms predicted high synchrony in the touch modality, greater frequencies of gaze to infant, and low affect synchrony. Beebe and colleagues (2011) suggested that anxious mothers are "trying too hard" due to their own hyper-vigilance. This interpretation accords with their "optimal midrange" model (Beebe et al., 2008; Jaffe et al., 2001), which suggests that both excessive and insufficient amount of synchrony indexes a distressed relationship. Yet, this study did not assess clinical levels of anxiety.

We formulated four hypotheses related to maternal behavior, mother−infant synchrony, infant ER, and maternal depression chronicity. The issue of depression chronicity is of interest as it is a component of the disorder that uniquely affects child outcomes (Barker, 2013). Because the parameters of mother−infant synchrony and infant ER behavior undergo significant development during the first nine months of life (Feldman, 2007b; Kopp, 2009), we sought to observe affective expression and self-regulatory behavior in infants growing up in the context of maternal depressed mood from birth to nine months. Our hypotheses were as follows:

- Maternal social behavior: Depressed mothers would express less maternal behavior in the gaze and touch modalities compared to healthy controls. In contrast, anxious mothers would display similar or even higher levels of gaze and touch.
- Mother−infant synchrony: Lower levels of gaze and touch synchrony would be observed between depressed mothers and their infants, whereas anxious mothers, being overly vigilant, may increase the level of synchrony.
- Infant emotional expression and self-regulation: Infants of depressed and anxious mothers would express more negative affect and would be less able to self-regulate in negative emotional contexts. We also expected infants to use mothers to manage negative moments and to display less negative affect when mother is present, compared to stranger. Such ability to use the mother as an "external regulator" (Hofer, 1994) of negative episodes would be more pronounced in the healthy group.
- Maternal depression chronicity and infant self-regulation: Elevated maternal depressive symptoms from birth to 9 months would be associated with greater infant difficulty to manage negative and positive emotions, leading to increased self-regulation in positive moments and insufficient regulation in negative moments. We further hypothesized that mother-infant synchrony would moderate these effects. Specifically, maternal depression chronicity would predict more self-regulation in positive contexts and less self-regulation in negative contexts under conditions of high synchrony but not when synchrony is low. This prediction was based on the assumption that by nine months, infants who are highly attuned to their depressed mothers may increase self-regulation to match their mother's affective state.

Method

Participants. The initial sample included 971 mothers who completed measures of depressive symptoms (Beck Depression Inventory [BDI]; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) and anxiety symptoms (State–Trait Anxiety Inventory [STAI]; Spielberger, Gorsuch, & Lushene, 1970) symptoms on the second day after birth. We used an extreme case design in which mothers at the upper and lower ends of the depressive symptom continuum are repeatedly chosen for further participation from a large community cohort that represents the entire distribution of maternal depressive symptoms. This led to a final sample of 100 mother−infant dyads in the observational arm of the study, which included both mothers with clinical diagnoses and control mothers who reported no elevated symptoms of depression or anxiety across the first 9 months of the infant's life and had no lifetime history of depression, anxiety, or other psychiatric disorder. We chose a community cohort and an extreme case design to understand how maternal depression in of itself affects infant social−emotional development, apart from the effects of typical comorbid conditions which are often not teased apart in research on PPD. Thus, all mothers recruited for the study were physically healthy, above 21 years, married or cohabiting with the infant's father, above the poverty line, not substance abusing, and gave birth to a full-term (>37 weeks gestation), singleton, and healthy infant.

At the first wave of data collection (on the second day after birth), research assistants visited the maternity wards of two tertiary care hospitals in a large metropolitan area and invited women who were physically healthy by their own account; delivered a healthy, full-term, singleton infant (excluding genetic disorders and infants requiring specialized medical care or NICU hospitalization), completed at least 12 years of education, were above the poverty line, and were cohabiting with the infant's father to participate in a study on maternal postpartum mood. Women completed questionnaires related to demographic information, birth experience and perception of infant, and the BDI and STAI questionnaires. Recruitments were conducted twice a week in each ward and 40.1% of the women approached refused participation (women approached: $N = 1619$; women who completed questionnaires: $N = 971$). Hospital records showed no systematic differences on demographic variables between participating and declining women or between women in the two hospitals.

At the second wave of data collection (6 months postpartum), we mailed questionnaires of depression (BDI), anxiety (STAI), and parenting to 360 mothers from the 971 who completed questionnaires at birth (180 at the top of the depressive symptom continuum at birth with BDI scores between 9 and 24 and 180 at the bottom of the depressive symptoms continuum at birth) when infants were approximately 6 months. A BDI score of 9 and above indexes elevated depressive symptoms and an increased risk for MDD (Kendall, Hollon, Beck, Hammen, & Ingram, 1987). As to the low end of the continuum, although we intended to recruit the 180 women who scored at the low end of the BDI continuum as long as they scored below 9, BDI scores at birth of those at the low end were between 0 and 3. From the 360 mailed questionnaires, 215 questionnaires were returned (59.7%) and no significant differences in BDI scores at birth between those who returned and those who did not. Among the nonreturned questionnaires, 55 were returned for wrong address and 90 mothers (25%) declined further participation. Data collected at birth showed no differences in demographic, medical, or mood variables between those who returned questionnaires at 6 months and those who did not.

At the third wave of data collection (9 months postpartum) we contacted 150 mothers from those who returned questionnaires at 6 months, we contacted 150 mothers (75 in the upper end of the depressive symptom continuum at 6 months with BDI scores between 9 and 21 and 75 in the lower end of the depressive symptoms continuum at 6 months with BDI scores between 0 and 2) when infants were 9 months. Of the 150 mothers contacted at 9 months, 110 (73.3%) agreed to participate in a home visit, were living at a close distance to the university, and reported that both mother and infant were physically healthy since birth. We visited the home of 110 families when the infant was approximately 9 months. The final sample at 9 months included 100 dyads; 10 mothers were excluded due to diagnosis of schizoaffective disorders, bipolar disorder, or subclinical anxiety or depression. The final sample consisted of 41 mothers with a clinical diagnosis according to the SCID-I (see Procedure section): 22 diagnosed with a major depressivedisorder (MDD) and 19 diagnosed with an anxiety disorder (GAD, social phobia, specific phobias, or panic disorder). Seven mothers in the MDD group and 3 in the anxiety group were treated by medications and these did not differ on any maternal or infant measure from members of their respective groups. One mother (4.5%) in the MDD group also had an anxiety disorder (GAD), and five (26.3%) mothers in the anxiety group had a history of depression but not during pregnancy or in the 9 month since birth. Fifty-nine mothers, who were similar to the clinical group in age, education, parenting experience (prima/multipara), and infant birth weight and gender were included as controls. These mothers reported low anxiety and depressive symptoms on all three assessments (BDI scores 0–3, STAI T scores = 16–36), had no lifetime history of depression or anxiety, and were free of any Axis I psychopathology. Mothers in the final sample (53 boys) were on average 30.7 years (SD = 3.4), completed 15.8 years of education (SD = 2.6), and 45% were first-time mothers. Table 1 presents demographic information for each of the diagnostic groups.

Procedure. During the 9-month home visit, all mothers (with and without high depressive symptoms) were diagnosed using the SCID-I (First, Spitzer, Gibbon, & Williams, 1995). Following, mother−infant interaction was videotaped, infants were tested in several emotional paradigms with mother and stranger, and mothers completed self-report measures. Saliva for cortisol was also collected from mother and infant, and these data are reported elsewhere (Feldman et al., 2009). In two control families, infants became fussy and the emotional paradigms could not be carried out properly and these families were not included in the following analyses.

Table 1
Demographic Information for Mothers and Infants in the Three Study Groups

Demographic information	MDD (N = 22)		AD (N = 19)		Control (N = 59)		
	n	%	n	%	n	%	$\chi^2(2)$
Infant gender (% male)	12	54.5	8	42.1	33	57.9	.05
First child (% first)	10	45.5	8	42.1	25	43.9	1.43
	M	SD	M	SD	M	SD	$F(2, 95)$
Mother's age (yrs)	30.66	3.07	30.89	3.45	30.77	3.98	.02
Mother's education (yrs)	15.73	2.25	15.79	3.57	15.95	2.25	.07
Birth weight (kg)	3.19	.55	3.02	.52	3.27	.47	1.76
Gestational age (weeks)	39.77	1.57	38.95	1.68	39.68	1.62	1.72

Note. MDD = major depressive disorder; AD = anxiety disorders.

Measures.

Diagnostic interview. Mothers were interviewed using the SCID (First et al., 1995) by a clinical psychologist with reliability with a senior clinician exceeding 85%. The SCID is a semistructured, clinician-administered diagnostic interview that includes modules corresponding to major *DSM–IV–R* (American Psychiatric Association, 2000) psychiatric classes.

Beck Depression Inventory (BDI; Beck et al., 1961). The BDI is a 21-item self-report questionnaire that assesses depressive symptoms, rated on a scale from 0 to 3, with higher scores indicating more severe depression. Scores of above 9 indicate elevated depressive symptoms and a risk for MDD. In the present sample, the internal consistency reliability of the BDI was acceptable (α = .77).

STAI (Spielberger et al., 1970). The STAI is a 40-item self-report measure that consists of two 20-item scales, the first scale measures state anxiety, defined as a transitory emotional state or condition, and the second measures trait anxiety. The present study used the Trait Anxiety subscale. Scores of 43 or above are considered a risk indicator for anxiety disorders. In the present sample, the internal consistency reliability of the STAI is good (α = .91).

Mother−infant free play. Mothers and infants were videotaped in a 6-min episode of free play. Mothers were instructed to play with their child as they normally do. Mothers and infants sat on the floor facing each other in a way that both their faces could be captured by the camera. A camera was placed on a stand at a distance of 1.2 m and focused on the faces of mother and child, consistent with prior work on synchrony measured in the home ecology (Atzil, Hendler, & Feldman, 2011; Feldman & Eidelman, 2004, 2007; Gordon, Zagoory-Sharon, Leckman, & Feldman, 2010). No toys were provided, but if mothers used the infant's own toys they were not disrupted.

Self-regulation in emotional contexts. Infants were videotaped in two positive and two negative emotional contexts. These included two joy-eliciting episodes and two anger-eliciting episodes and for each emotion, one episode was conducted with the mother and once with a stranger. Mothers were present during all episodes and were instructed to remain neutral. If the infant became too distressed, the episode was terminated and mother was encouraged to comfort the infant.

- **Joy with mother: Peek-a-boo.** This game, adapted from the LAB-TAB (Goldsmith & Rothbart, 1996), involves six trials each lasting approximately 10 s. Mother sat in front of her child who was placed in a highchair and was given a piece of cloth to cover her smiling face. Mother said: "Daniel, where's Mommy?" After a brief pause, mother took out the cloth, showed her smiling face, and said "There's Mommy!" this procedure was repeated six times.

- **Joy with stranger: Puppets.** In this procedure, again from the LAB-TAB, the infant sits in a highchair while the assistant enacts a brief animated dialogue between two colorful hand puppets. In the course of the dialogue, the puppets first separately and then together tickle the infant. Finally, the assistant puts the puppets in front of the infant for 30 s.
- **Anger with mother: Toy removal.** We used a procedure adapted from Stifter and Braungart (1995). Infants were placed in a highchair and mothers were seated toward the side of the highchair facing the infant. After mother and infant played with an attractive toy for 90 s, mothers were cued to remove the toy from the infant's hands and hold the toy out of reach but within sight for 2 min (or up to 20 s of intense crying). Mothers were instructed to assume a neutral expression and remain unengaged. Following, mother returned the toy to the infant but remained noninteractive for 1 min and then resumed normal play.
- **Anger with stranger: Arm restraint.** In this procedure, again from the LAB-TAB, infant sits in a highchair in front of a table and is given an attractive toy to play. After playing for 30 s, the assistant gently removes the toy, while a second assistant stands behind the infant and gently holds his or her arms for two 30-s trials, separated by 30 s during which the infant can play with the toy. Following the procedure, the infant can play freely with the toy.

Coding.

Mother−infant synchrony. Microanalysis of mother−infant synchrony was conducted for the free play interaction using a computerized system (Noldus Co, Waggeniggen, The Netherlands) with the Synchrony Coding Scheme (Feldman, 2002). The coding addresses microlevel behaviors of each partner in the critical modalities of nonverbal communication in humans (Feldman, 2012, 2015a), and codes within each category are mutually exclusive. Coding was conducted for mother's behavior and infant's behavior separately and synchrony was determined by computer computations after the coding was completed. Coding was done when the tape is running at normal speed, and when a behavior change is detected, the tape is returned and switched to slow motion to determine the exact timing of behavior onset (system is set to .01-s accuracy). Several cycles are required to complete coding and maternal and infant behaviors are coded at separate passes. The coding scheme has been validated in multiple studies of healthy and high-risk dyads (Feldman & Eidelman, 2004, 2007; Feldman, Gordon, & Zagoory-Sharon, 2010; Feldman, Singer, et al., 2010).

The following categories and codes were used for mothers: *Mother Gaze*—to infant, to object, gaze aversion. *Mother Affect*—positive, neutral, negative-angry, and negative-withdrawn. *Mother Vocalization*—"motherese", adult speech, none. *Mother Touch*—no touch, affectionate touch (defined as touch that serves no functional purpose and intends only to express affection, such as stroking, kissing, poking, light touch, etc.), moving extremities (e.g., touching infant arms or legs), proprioceptive (e.g., pull to sit, throwing infant in air), functional (e.g., wiping infant's face), touching infant with object (e.g., touching with soft doll). The following codes were used for the infant: *Infant Gaze*—to partner, to object, gaze aversion. *Infant affect*—positive, neutral, negative, and fussy. *Infant Vocalizations*—none, fussy-cry, positive. Uncodable code was entered to all categories in cases Reliability between two coders was computed on 20 mother−infant interactions and the average was 91.11% (κ = .88). Here, we focused on the gaze and touch modalities and for each code we computed durations (percentage of time mother/infant engaged in a specific behavior), frequencies (number of times each behavior occurred during the interaction), and latencies (time in seconds from beginning of the interaction until the first appearance of a specific behavior).

Mother−infant synchrony. Two types of synchrony were computed as conditional probabilities (i.e., proportion of time mother in behavior *X* given infant in behavior *Y*).

Gaze synchrony was indicated when mother and infant coordinated their social gaze (mother looks at infant given infant looks at mother). Touch synchrony is implied when mother touches the infant affectionately while both mother and child are looking at each other, indicating moments when affectionate touch is integrated into the synchronous dialogue. For each type of synchrony we computed durations, frequencies, and latencies.

Infant self-regulation. Microanalysis of infant affect and behavior during the four episodes (puppets, arm restraint, peek-a-boo, and toy removal) was conducted using the same computerized system and affect and behavior were coded at different passes. Several categories of infant affect and regulatory behavior were coded and codes within each category were mutually exclusive, consistent with our previous research using the same paradigms (Feldman et al., 2011a; Feldman, 2009; Hirschler-Guttenberg et al., 2015; Pratt et al., 2015). The following categories and codes were used for the joy episodes (puppets, peek-a-boo game): Infant gaze—to mother, to assistant, to target object, gaze aversion. Affect—positive, negative, neutral. Vocalization—none, laughing, positive vocalizations, fuss, cry. Behavior—positive motor acts (e.g., clapping, reaching, banging hands on table), avoidant behavior (e.g., twisting, turning, attempting to get out of the chair), self-soothing behavior (e.g., thumb sucking, heavy breathing, feeling strap of chair, with or without gaze aversion), none. The following codes were used for the anger episodes (arm restraint, toy removal): Gaze—to mother, to assistant, to target object, gaze aversion; Affect—positive, negative, neutral; Vocalization—none, laughing, positive vocalizations, fuss, cry. Behavior—positive motor acts (e.g., clapping, reaching), avoidant behavior (e.g., twisting, turning, attempting to get out of the seat), discrete anger behavior (e.g., pulling, kicking, banging table, pushing), self-soothing/self-regulatory behavior (e.g., thumb sucking, feeling strap of chair, putting head down), none. Reliability between two coders was computed for 20 observations in each episode, with the following reliability: puppets = 96.44%, arm restraint = 95.66%, peek-a-boo = 93.54%, toy removal = 93.8% (κ = .82−.95).

Three variables were used here: Negative affect—proportion of time infant expressed negative affect and negative vocalizations (fuss and cry); Positive affect—proportion of time infant expressed positive affect and positive vocalizations; Self-regulatory behavior—indexed by the number of times (frequencies) infant engaged in self-soothing behavior during the episode. We previously found that because regulatory behaviors are typically brief, the frequency code provides a better index of self-regulation effort than the duration code (Harel et al., 2011; Feldman, 2009).

Results

Results are reported in three sections. In the first, we examine group differences in maternal and infant social behavior (Hypothesis 1) and synchrony (Hypothesis 2). Next, we test group differences in infant emotional expression and self-regulation in negative and positive contexts (Hypothesis 3). Finally, regression models test the moderating role of synchrony on the relationship between maternal depression chronicity and infant self-regulation (Hypothesis 4). Prior to analysis of group differences, Table 1 presents demographic information for each group and chi-square/analysis of variance (ANOVA) tests for group differences. As seen, no differences were found between group in child gender, gestations age, birth weight, birth order, maternal age, and maternal education.

Part 1: Group differences in maternal and infant social behavior and synchrony. To test the first hypothesis—that mothers with MDD will display less maternal behavior and those with AD more maternal behavior in the gaze and touch modalities compared to controls—a series of two-way ANOVAs were conducted, with maternal diagnostic group (MDD, AD, controls) and infant gender as independent factors. Significant effects were followed by least significant difference (LSD) post hoc tests. Mother Gaze—No group differences emerged for durations and latencies. Mothers in the MDD group exhibited more frequent gazes to their infant compared to mothers with AD or controls, with no differences between the latter two groups; $F(2, 92) = 4.90$, $p < .05$, $\eta^2 = .10$. Because no group differences were found in the overall durations of social gaze, these higher frequencies suggest that mothers with MDD display a pattern of frequent gazes each of shorter duration. Mother Touch—No group differences were found.

Similar ANOVAs were used to test the hypothesis that infants of mothers with MDD would display less social behaviors compared to controls. Infant Gaze—Results presented in Table 2 indicate that infants of mothers with MDD showed lower social gaze durations and more gaze aversion compared to the other two groups, with no differences found for frequencies or latencies.

To test the second hypothesis—that gaze and touch synchrony would be reduced in MDD and increased in AD compared to controls—we computed a series of two-way ANOVAs with maternal diagnostic group and infant gender as independent variables. Gaze synchrony—Means and standard deviations of the synchrony components (durations, frequencies, latencies) and the univariate tests and LSD post hoc test for group differences appear in Table 2. As seen, the overall durations of social gaze coordination between depressed mothers and their infants were significantly lower compared with the AD and control groups, with no differences between the latter two groups. As to latencies, it took more than double the time for a depressed mother to engage in the first episode of gaze synchrony compared to the other groups. Although anxious mothers displayed longer durations and shorter latencies to gaze synchrony compared with controls, as expected, these differences did not reach statistical significance (see Figure 1). Touch synchrony—No group differences emerged for touch synchrony durations. Anxious mothers displayed the highest frequencies of touch synchrony, depressed mothers the lowest, and controls scored at midlevel (see Figure 1). For latencies, significant differences between the three groups emerged; mothers with MDD took the longest to reach the first episode of touch synchrony, control mothers scored between the two clinical groups, and anxious mothers were the quickest to enter the first episode of touch synchrony with their infants.

Part 2: Infants' emotional expression and self-regulation in negative and positive contexts. Descriptive statistics for infants' negative and positive affective expression and self-regulatory behavior in the four emotional contexts are presented in Table 3.

Negative emotional context. To test the third hypothesis—that infants of depressed and anxious mothers would show less self-regulation in negative emotional contexts and that this differ-

Table 2
Infant Gaze and Mother−Infant Gaze and Touch Synchrony Parameters During Mother−Infant Interaction in the Three Study Groups

Group	MDD		AD		Control			
	M^a	SD	M	SD	M	SD	$F(2, 92)$	η^2
Infant gaze								
Gaze to mother[b]	19.72_a	14.21	31.96_b	13.05	27.29_b	13.82	4.55*	.09
Gaze aversion[b]	37.06_a	21.45	21.85_b	16.07	24.84_b	22.03	3.64*	.07
Gaze aversion[c]	12.73_a	5.73	9.00_{ac}	3.23	9.32_{bc}	5.61	4.54*	.09
Gaze synchrony								
Duration[b]	19.90_a	13.88	31.19_{bc}	13.08	25.86_{ac}	14.22	3.62*	.07
Frequency[c]	7.86	3.55	10.21	2.59	9.07	4.95	1.47	
Latency[d]	19.08_a	28.2	2.82_{bc}	4.08	8.51_{bc}	16.5	3.75*	.08
Touch synchrony								
Duration[b]	5.98	8.52	8.48	7.46	5.16	5.13	2.18	
Frequency[c]	2.64_a	2.38	4.89_b	2.51	3.37_a	2.3	4.64*	.09
Latency[d]	132.31_a	138.14	60.20_b	82.29	68.62_c	86.65	3.91*	.08

Note. MDD = major depressive disorder; AD = anxiety disorders.
[a] Means with different subscript, for instance, a, b, c are statistically different at $p < .05$. [b] Numbers represent the percentages of time out of the entire interaction this behavior occurred. [c] Numbers represent number of episodes this behavior occurred during the interaction. [d] Numbers represent the length of time (in s) from beginning of interaction until the first appearance of this behavior.
* $p < .05$.

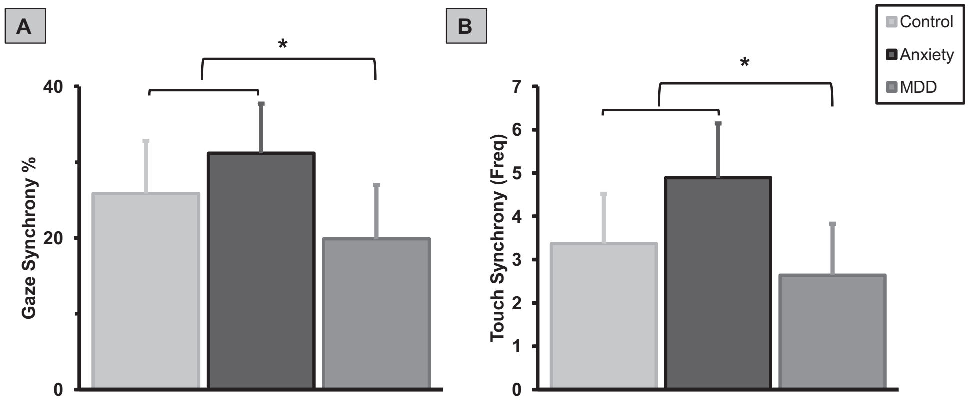

Figure 1. Panel A: Durations of mother-infant gaze synchrony in mothers with clinical depression, clinical anxiety, and controls. Panel B: Frequencies of mother-infant touch synchrony in mothers with clinical depression, clinical anxiety, and controls. * $p < .05$.

ence would be more pronounced when mother is present—we conducted a mixed-model ANOVA with Person (stranger, mother) as within-subject variable, and group (MDD, AD, control) and gender (male/female) as between-subject factors. Results indicated a significant effect for person, $F(1, 89) = 46.17$, $p < .001$; $\eta^2 = 0.34$. Across groups, infants exhibited more self-regulatory behavior in the presence of their mother ($M = 1.47$, $SD = 1.44$) compared with stranger ($M = 0.16$, $SD = 0.44$). No other main or interaction effects were found (all $ps > .09$).

Positive emotional context. As none of the infants displayed self-regulatory behavior during joy with stranger, we examined group differences using one-way ANOVA with group and gender as between-subject variables and self-regulation during the joy episode with mother as the dependent variable. A main effect for group emerged, $F(1, 89) = 4.19$, $p < .05$, $\eta^2 = 0.08$. Tukey post hoc tests showed that infants of anxious mother expressed more self-regulatory behavior during joy with mother compared to the other two groups.

Table 3
Infant Self-Regulation and Negative and Positive Affect in the Three Study Groups

Group	MDD		AD		Control	
	M	*SD*	*M*	*SD*	*M*	*SD*
Infant self-regulation						
Joy-stranger	.00	.00	.00	.00	.00	.00
Joy-mother[a]	.50	.86	.68	1.16	.16	.49
Anger-stranger	.15	.49	.28	.57	.12	.38
Anger-mother	1.65	1.04	.89	1.18	1.60	1.59
Infant NA						
Joy-stranger	21.08	27.52	18.24	16.24	17.56	22.23
Joy-mother	5.58	22.98	4.27	10.50	2.63	7.19
Anger-stranger	18.09	14.16	30.56	28.36	28.14	23.67
Anger-mother	27.29	30.43	21.67	16.86	17.84	17.32
Infant PA						
Joy-stranger	20.05	22.85	14.61	9.88	17.20	17.43
Joy-mother	44.80	39.46	31.60	26.67	41.53	30.55
Anger-stranger	8.74	17.05	8.08	16.32	6.96	11.02
Anger-mother	3.14	4.35	3.53	6.80	2.76	4.49

Note. Numbers represent the percentages of time out of the entire interaction each behavior was observed. MDD = major depressive disorder; AD = anxiety disorders; NA = negative affect; PA = positive affect.

Negative affect. To test the third hypothesis—that infants of depressed and anxious mothers would express more negative affect and that this difference would be more pronounced in the presence of the mother—we conducted a mixed-model ANOVA with person (stranger, mother) and emotional context (anger vs. joy) as within-subject variables, and group (MDD, AD, control), and gender (male/female) as the between-subject factors. The ANOVA revealed two main effects and two interactions. First, regardless of group, a main effect was found for emotional context, $F(1, 91) = 52.97$, $p < .001$, $\eta^2 = .37$; as expected, infants expressed less negative affect in the joy paradigms ($M = 11.74$, $SD = 1.69$) compared with the anger paradigms ($M = 24.15$, $SD = 1.89$). A main effect was found for person, $F(1, 91) = 31.88$, $p < .001$, $\eta^2 = .26$; infants expressed more negative affect in the presence of stranger ($M = 22.56$, $SD = 1.94$) than in the presence of mother ($M = 13.34$, $SD = 1.59$).

The main effect of person was qualified by two significant interactions. First, a significant Person × Emotional Context effect emerged, $F(1, 91) = 4.65$, $p < .05$, $\eta^2 = .05$. Two paired-sample *t* tests explored the source of effect, comparing negative affect between emotional contexts with mother and stranger separately. In the presence of mother, negative affect during the joy paradigms ($M = 4.38$, $SD = 1.48$) was significantly lower than in the anger paradigm ($M = 22.29$, $SD = 2.44$), $t(97) = 8.10$, $p < .001$, $d = 0.82$. Findings for stranger also showed differences between joy ($M = 19.10$, $SD = 2.64$) versus anger ($M = 26.02$, $SD = 2.62$) but the effect was of much smaller in magnitude, $t(96) = 2.48$, $p < .05$, $d = 0.25$.

Importantly, the second interaction that modified the Person effect was a Person × Group interaction, $F(2, 91) = 3.89$, $p < .05$, $\eta^2 = .08$. To explore this interaction, we conducted for each group a mixed-model ANOVA with person as the within-subject variable, and gender as the between-subjects variable. Results for controls revealed a significant effect for person, $F(1, 55) = 47.40$, $p < .001$, $\eta^2 = .46$; regardless of emotional context, infants expressed less negative affect in the presence of mother ($M = 10.24$, $SD = 1.85$) compared with stranger ($M = 22.89$, $SD =$

2.25). Children of anxious mothers similarly expressed less negative affect in the presence of mother (M = 12.85, SD = 3.27) compared with stranger (M = 24.95, SD = 3.98), $F(1, 17) = 16.50$, $p = .001$, $\eta^2 = .49$. However, infants of depressed mothers showed no difference in the degree of negative affect when mother was present (M = 16.92, SD = 2.96) than in the presence of stranger (M = 19.84, SD = 3.60), $F(1, 20) = 0.73$, *ns* (see Figure 2). No other effects were significant (all $ps > .09$).

Positive affect. To test the hypothesis that infants of depressed mothers would express less positive affect, particularly in mother's presence, we conducted a mixed-model ANOVA with person (stranger, mother) and emotional context (anger vs. joy) as within-subject variables and group (MDD, AD, controls) and gender (male/female) as between-subject factors. The ANOVA revealed two main effects and one interaction. First, a significant main effect was found for emotional context, $F(1, 92) = 100.37$, $p < .001$, $\eta^2 = .52$; regardless of group, infants expressed more positive affect in the joy (M = 28.28, SD = 2.35) compared with the anger paradigms (M = 5.71, SD = 0.88). Second, a main effect emerged for person, $F(1, 92) = 16.44$, $p < .001$, $\eta^2 = .15$; all infants expressed more positive affect in the presence of mother (M = 21.16, SD = 1.90) compared to stranger (M = 12.83, SD = 1.51). These two main effects were qualified by a significant Person × Emotional Context interaction, $F(1, 92) = 43.89$, $p < .001$, $\eta^2 = .32$. Two paired-sample t tests comparing positive affect in the different contexts with mother and stranger separately showed that the increase in positive affect in the joy versus anger context was greater in the presence of mother, $t(97) = 11.49$, $p < .001$, $d = 1.16$, compared with stranger, $t(97) = 5.49$, $p < .001$, $d = 0.55$, and there were no difference between groups. No other effects were significant (all $ps > .26$). No infant gender effects were found.

Part 3: Maternal depression chronicity and infant self-regulation: The moderating role of synchrony. To test the fourth hypothesis—that mother's depression chronicity (mean BDI scores across stages) would predict infant self-regulation as moderated by mother-infant synchrony—we conducted two regression models, one for gaze synchrony and one for touch synchrony. The dependent variable was infant self-regulation in each situation (joy, anger). Because synchrony durations and frequencies were highly correlated ($r = .43$ for gaze synchrony; $r = .67$ for touch synchrony) they were combined into a single score to reduce problem of collinearity.

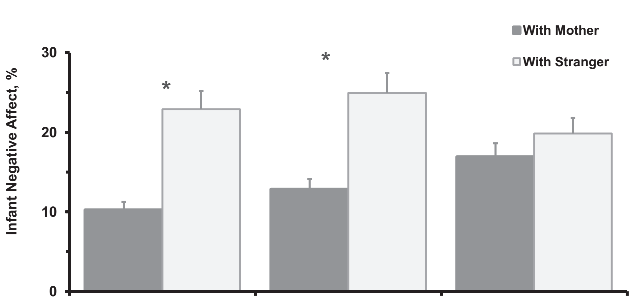

Figure 2. Infant negative affect in anger-eliciting episodes vis-à-vis mother or stranger among infants of depressed, anxious, and control mothers. * $p < .05$.

Joy contexts. When predicting self-regulation in joy contexts from depression chronicity, touch synchrony, and their interaction, the model was significant, $F(3, 94) = 9.32$, $p < .001$, $R^2 = .23$. Effect of maternal depression was positive and significant (B = 0.19, SE = 0.05, $t = 4.01$, $p < .001$), indicating that infants of mothers with higher depressive symptoms used more self-regulatory behavior in joy contexts. The effect of synchrony was not significant (B = 0.07, SE = 0.05, $t = 1.48$, *ns*). Importantly, the effect of maternal depression was moderated by a significant interaction of depression and touch synchrony (B = 0.23, SE = 0.06, $t = 4.10$, $p < .001$). Simple slope analysis showed that when touch synchrony was low, higher depressive symptoms did not predict self-regulation (B = −0.04, SE = 0.06, $t = -0.61$, *ns*). However, when touch synchrony was high, maternal depressive symptoms predicted greater infant self-regulation in joy contexts (B = 0.43, SE = 0.08, $t = 5.16$, $p < .001$). These findings are presented in Figure 3.

Anger contexts. The model predicting self-regulation in anger contexts from depression chronicity, touch synchrony, and their interaction was not significant, $F(3, 94) = 1.35$, *ns*, $R^2 = .04$.

Joy contexts. When predicting self-regulation in joy contexts from depression chronicity, gaze synchrony, and their interaction, the model was significant, $F(3, 94) = 2.85$, $p < .05$, $R^2 = .08$. The effect of maternal depressive symptoms was positive and significant (B = 0.14, SE = 0.05), $t = 2.73$, $p < .01$, the effect of synchrony was not significant (B = −0.03, SE = 0.06), $t = -0.54$, *ns*, and the interaction was similarly not significant (B = 0.03, SE = 0.06; $t = 0.55$, *ns*).

Anger contexts. The model predicting self-regulation in anger situations from depression chronicity, gaze synchrony, and their interaction was not significant, $F(3, 94) = 1.18$, *ns*, $R^2 = .04$).

Discussion

Results of the current study are the first to specify disruptions to both mother−infant interactive patterns and infant regulation of negative and positive emotions among infants of clinically depressed mothers as compared to infants of anxious mothers and healthy controls. We found subtle differences in mother-infant gaze and touch synchrony and in the infant's ability to employ regulatory behavior in negative and positive contexts, use mother's presence for stress reduction, and engage in positive moments without the need to self-soothe. Previous studies addressed the disruptions to the mother-infant relationship in cases of PPD and described their negative effects on children and our findings extend this literature in several aspects. First, this is the first study, to our knowledge, to recruit a large community cohort of low-risk educated mothers who are raising their infant within a partnered relationship, and thus, our findings reflect the effects of postpartum depression per se, independent of common comorbidities typically included in research on postnatal depression, such as single parenthood, poverty, or teenage parenting that likely intensify the effects in a "cumulative risk" fashion (Sameroff, Gutman, & Peck, 2003). Second, very few studies followed mothers since birth, and thus our results reflect outcomes for infants who are growing up in the context of elevated maternal depressive symptoms from birth to nine months, the "sensitive period" for the development of synchrony (Feldman, 2015a) and fine-tuning the "parental brain" (Feldman, 2015b). Third, most longitudinal stud-

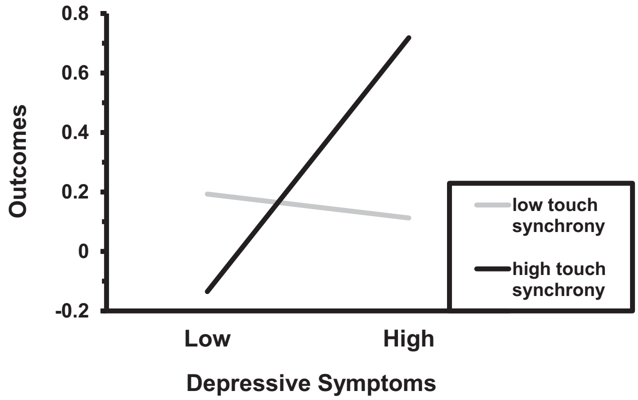

Figure 3. Predicting infant self-regulation in joy-eliciting episodes from maternal depression chronicity and mother-infant touch synchrony.

ies on sequalae of maternal depression tested global outcomes and few used a second-by-second observational approach. While large-scale studies chart a global path of developmental psychopathology, microlevel bottom-up studies highlight fine-grained behavioral patterns that support the infant's ability to enter social relationships and manage emotions online. Such patterns play a critical role in wiring the social brain (Sokolowski & Corbin, 2012), are disrupted in conditions involving social dysfunction, and may provide the first markers for later psychopathology in children of depressed mothers. Furthermore, few studies focused on mothers with clinical anxiety, particularly in relation to both healthy and depressed mothers, and our findings are the first to describe microlevel social patterns and ER behavior in this group. Finally, our study included, for the first time, infants' emotional expression and regulatory behavior in both negative and positive contexts, each tested with mother and stranger, to address how maternal affective disorder uniquely disrupts infants' ability to utilize the attachment context for regulating emotions. As such, our findings may help specify how PPD affects infants' emotional development and have clear implications for intervention.

Social behavior and synchrony. Maternal and infant social behavior in the gaze and touch modalities and their temporal coordination within the dyad showed subtle disruptions, particularly in the depressed group. Depressed mothers displayed more frequent gaze at the infant and, while we did not measure the length of each look, the fact that similar overall durations were divided into more discrete gazes suggests that depressed mothers engaged in frequent short looks that do not give infants sufficient time to synchronize. This is consistent with our findings that depressed mothers break mutual gaze within a lag of 1 to 2 s (Feldman, 2007b), and with the current results that durations of gaze synchrony were lower in this group. Consequently, infants of depressed mothers tended to look less at their mothers and displayed more gaze aversion, indicating social withdrawal. Because infant social withdrawal is a risk marker for later internalizing and externalizing problems (Guedeney et al., 2014), this maternal style should raise concern and become a focus for dyadic interventions. Reduction of social gaze during the critical period for social growth may chart one pathway for the interpersonal difficulties observed in children of depressed mothers (Hammen, Shih, Altman, & Brennan, 2003) and may be one mechanism by which depression is transmitted to offspring.

The coordination of social gaze—gaze synchrony—provides the basis not only for later adjustment (Beebe et al., 2008; Feldman & Eidelman, 2004, 2007; Trevarthen, 1993; Tronick, 2007) but also plays a key role in everyday social communication between humans and conspecifics. In comparison, touch synchrony—the coordination of affectionate touch with moments of mutual gaze—is preserved for intimate relationships, activates the infant's oxytocin system, and underpins the capacity to form close relationships throughout life (Feldman, 2012). Importantly, no group differences were found in the amount of touch, only in its coordination with moments of mutual gazing. Minimal experiences of gaze and touch synchrony in infancy may impair both the infant's global social skills and the capacity for intimacy, but this hypothesis requires much further research in longitudinal studies. Recent conceptualizations of synchrony highlight it as a form of interpersonal coordination that is optimal at midrange levels, with too much or too little synchrony reflecting relationship difficulties. Lower levels of synchrony may index interpersonal withdrawal, whereas higher levels mark hypervigilance and intrusiveness (Beebe et al., 2011). Our findings are consistent with such models and show that maternal depression was associated with lower gaze and touch synchrony, indicating maternal withdrawal (Murray et al., 2011), whereas anxiety correlated with higher frequencies of synchrony, consistent with research linking maternal anxiety with intrusiveness (Feldman et al., 1997; Wood, McLeod, Sigman, Hwang, & Chu, 2003). In both the gaze and touch modalities synchrony was higher in mothers with anxiety and lower in mothers with depression, with controls scoring at midpoint between the two clinical groups. Although this pattern of results was consistent, it did not always reach statistical significance and showed the strongest effect in the latency component (time in seconds from beginning of the interaction to the first episode of synchrony). It took depressed mothers twice as long to reach the first episode of gaze synchrony. Similar findings emerged for touch synchrony: Anxious mothers were the fastest, depressed mothers slowest, and controls were in the middle to reach the first episode of touch synchrony. Thus, across both social behavior and synchrony and in the various components of synchrony (durations, frequencies, latencies), infants of depressed mothers seem to experience less coordination, which may lead to greater avoidance within close relationships. Such avoidance may impede the formation of close relationships throughout life, with friends, partners, and eventually with own children, further augmenting the risk for depression (Katz, Conway, Hammen, Brennan, & Najman, 2011) and possibly charting a cross-generational cycle of interpersonal avoidance.

As to the contribution of increased synchrony to the cross-generation transmission of anxiety, it is possible that children of anxious mothers learn to be more vigilant and apprehensive in the context of intimate relationships. Such hypervigilance may lead to interpersonal avoidance due to overload or insecurity (Rinck et al., 2010). Tronick and Cohn (1989) found that mothers and infants spend most of their time in miscoordinated states, a pattern likely supporting the infant's autonomy and sense of freedom during the tightly matched mother−infant social interaction, and the increased coordination of anxious mothers may impinge on this emerging autonomy. Of note, our results differ from the only other study assessing synchrony in relation to maternal anxiety.

Whereas, Beebe et al. (2011) found that anxious mothers show greater synchrony in some modalities (e.g., gaze) and less synchrony in others (e.g., affect), findings in our study were more consistent. One possible explanation is that we included mothers with clinical anxiety disorders, whereas Beebe et al. (2011) examined mothers with anxiety symptoms and another possibility is that we focused only on gaze and touch. Much further research is needed to shed light on the effects of maternal anxiety on processes of mother−infant synchrony and their impact on the infant's emotional development.

Emotional expression and self-regulation. Problems in self-regulation are found in both depression and anxiety (Aldao, Nolen-Hoeksema, & Schweizer, 2010), suggesting that precursors of regulatory difficulties may be observed in offspring of depressed and anxious mothers already in the first year of life, particularly in the second half-year when infants make great strides in expressing emotions and acquiring a regulatory repertoire (Kopp, 2009). Overall, we found that in anger-eliciting situations, all infants displayed more self-regulation in the presence of their mother compared to stranger. Infants of control and anxious mothers expressed less negative affect in the anger-with-mother situation. This is consistent with research in humans and animals highlighting the buffering effect of maternal presence on the infant's lifetime ability to modulate stress (Feldman et al., 2010; Hofer, 1994).

Interestingly, children of depressed mothers showed comparable attempts to self-regulate in anger-eliciting contexts; yet, compared with the other two groups these attempts were ineffective in reducing negative affect when the mother was present. Thus, whereas maternal presence buffered infants' negative affect in the control and anxiety groups, the presence of a depressed mother did not have the typical "external regulatory" (Hofer, 1994) effect, which is found in all mammals. These findings are in line with previous research indicating that infants of depressed mothers are less able to reduce the frequency and intensity of negative affect in contexts that elicit negative arousal (Burkhouse, Siegle, & Gibb, 2014; Cohn & Campbell, 1992; Forbes et al., 2004).

As to the effect of maternal depression chronicity on infant self-regulation, we found that infants of mothers with high depressive symptoms across the first year increased their self-regulatory behavior during the joy-eliciting episodes. This effect was specific to the positive contexts and was not observed in the anger-eliciting episodes, suggesting that these infants tend to increase regulation only during positive moments. Furthermore, an interaction effect of depression chronicity and synchrony indicated that the associations between maternal depression and increased regulation of positive moments emerged when mother-infant touch (but not gaze) synchrony was high but not when it was low. These findings are in line with previous research which suggests that in cases of maternal psychopathology increased synchrony may not be optimal, as the experience may lead to increased infant attunement to the mother's negative mood (Beebe et al., 2011). It is possible that infants who are more synchronized with their mothers are more attuned to the mother's difficulty to tolerate positive affect and exert more self-regulation during positive moments. Such tendencies can lead to the child's greater susceptibility to anhedonia, depression, and social difficulties later in life (Kam et al., 2011; Maughan et al., 2007), but this hypothesis requires much further research.

Uniqueness of the attachment context and maternal affective disorder. The availability of negative and positive emotional paradigms each tested with mother and stranger provided a rare opportunity to examine what is unique about the attachment context for infant emotionality. Overall, it appears that maternal presence supports infant emotionality in three main ways. First, mothers adjust the emotional dial toward better adaptation and social involvement. In negative contexts, mothers provide a regulatory buffer and infants express less negative affect with mother; in positive contexts mothers enhance the positive mood and infants express more positive affect in mother's presence. Second, infants use putative regulatory behavior more readily with mother. In negative contexts, infants self-regulate more with mother, whereas in positive contexts infant do not self-regulate at all in the presence of a stranger, only with mother. The reasons for this require much further research but it is possible that infants acquire these simple regulatory strategies within the attachment context and some subtle signals, such as maternal smell, movements, or facial expressions, trigger the activation of these regulatory behaviors. Finally, mother's presence supports the differentiation of emotions. Differences between the expression of negative affect in anger versus joy contexts were greater with mother than with a stranger. Possibly, the moment-by-moment shifts between coordination and miscoordination, the synchrony experienced with mother but not with a stranger, sensitize infants to the differences between online episodes of different valance and enable an external regulatory framework where such differences can be safely expressed.

Two main disruptions to this "uniquely mother" effect were found among infants growing in the context of maternal affective disorder. First, presence of a depressed mother failed to buffer infant negative affect in anger situations, although attempts to self-regulate were comparable. Possibly, the minimal synchrony with a depressed mother does not enable infants to establish the maternal presence as a regulatory framework that can filter negative emotions. Second, infants of anxious mothers increased their self-regulatory effort during joy with mother. This may result from the mother's overstimulatory style and inability to leave sufficient room for miscoordination. Infants of anxious mothers may learn to defend against the overload by self-soothing when mother "tries too hard" to build positive affect. Both types of disruption may have long-term consequences for the infant's ability to manage emotions within close relationships.

Clinical implications. Our findings indicate that disruptions to mother-infant synchrony in cases of maternal affective disorder have important implications for infant emotional outcomes and highlight the need for early dyadic interventions. In our clinical work, we find that depressed mothers are unaware of their tendency to terminate moments of mutual gaze and minimize physical intimacy. Using video feedback and a novel 8-week synchrony-focused therapy, we help mothers practice synchrony and detect moments when they do not reciprocate the infant's social bids or prematurely terminate mutual gaze. Depressed mothers' difficulties with touch and physical contact often stem from early trauma or intimacy issues and these are explored. We found that depressed mothers can learn to synchronize quickly and markedly improve their behavior in a short period of interaction-focused therapy (Feldman, 2016). We also help mothers understand the importance of the attachment context for the development of infant ER and explore ways by which they can assist the infant during highly arousing moments. With anxious mother therapy takes a different focus. Anxious mothers must learn that infants need space and interactions need not be "perfect." We find that when anxious mothers learn that social interactions contain more "miscoordination" than "coordination" and moments of mismatch are critical for the infant's sense of autonomy, interactions become free, fluid, and synchronous.

Study limitations. Several study limitations should be remembered in the interpretation of the findings. First, all infants in our study were raised within a two-parent family. Since the impact of maternal depression is stronger in single-parent families (Goodman et al., 2011), it is likely that the effects found here would be different in a more heterogeneous sample. Additionally, we did not include fathers to assess the moderating effects of fathering on infant emotional development and this is an important study limitation that should be addressed in future research, particularly as fathering offers another attachment relationship that may mitigate to some extent the maternal effects. We also did not examine mothers during pregnancy and although mothers reported on their anxiety and depression during pregnancy this report was only retrospective. Clinical diagnosis with the SCID-I took place at 9 months and future research should include psychiatric diagnosis at earlier time points in the infant's life. Similarly, we did not assess important factors that may moderate the effects of maternal depression and anxiety on infants' social outcomes, including maternal prenatal state (Davis et al., 2007) or genetic influences (Gotlib et al., 2014). Another set of limitations relates to the emotion-eliciting paradigms. We tested infant affect and regulation in situations that elicit anger and joy and much further research is needed to examine other relevant emotions, such as sadness or fear. Second, although we tried to match the paradigms for mother and stranger, they are not identical and it is possible that differences in some component of the procedure contributed to the findings. Finally, our sample collection process focused on detecting mothers with high and low depressive symptoms at each time-point and the same was not done for anxiety. Unlike previous studies on maternal depression (Goodman et al., 2011) and anxiety (Murray et al., 2008), we did not find significant gender effects and it is possible that gender effects emerge later in childhood, highlighting the need for longer follow-up. Finally, we assessed the effects of depression and anxiety separately. Yet, comorbidity of these disorders is high (Lamers et al., 2011) and future studies are needed to address the separate and combine effects of anxiety and depression.

Overall, our findings underscore the utility of a microlevel approach for understanding early relationships and pinpointing their contribution to emotional development. It appears that parameters of the "interpersonal dance" are both important and sensitive. Subtle differences in gaze and touch engagement and disengagement in infancy may translate into significant and impactful differences later in life that may shape the individual's capacity to develop interpersonal intimacy, manage emotions, tolerate stress, experience empathy, and maintain an engaged approach to social life.

References

Adamson, L. B., & Frick, J. E. (2003). The still face: A history of a shared experimental paradigm. *Infancy, 4,* 451–473. http://dx.doi.org/10.1207/S15327078IN0404_01

Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review, 30,* 217–237. http://dx.doi.org/10.1016/j.cpr.2009.11.004

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders: DSM–IV–TR*. Washington, DC: American Psychiatric Association.

Apter-Levy, Y., Feldman, M., Vakart, A., Ebstein, R. P., & Feldman, R. (2013). Impact of maternal depression across the first 6 years of life on the child's mental health, social engagement, and empathy: The moderating role of oxytocin. *The American Journal of Psychiatry, 170,* 1161–1168. http://dx.doi.org/10.1176/appi.ajp.2013.12121597

Ashman, S. B., Dawson, G., Panagiotides, H., Yamada, E., & Wilkinson, C. W. (2002). Stress hormone levels of children of depressed mothers. *Development and Psychopathology, 14,* 333–349. http://dx.doi.org/10.1017/S0954579402002080

Atzil, S., Hendler, T., & Feldman, R. (2011). Specifying the neurobiological basis of human attachment: Brain, hormones, and behavior in synchronous and intrusive mothers. *Neuropsychopharmacology: Official Publication of the American College of Neuropsychopharmacology, 36,* 2603–2615. http://dx.doi.org/10.1038/npp.2011.172

Bansil, P., Kuklina, E. V., Meikle, S. F., Posner, S. F., Kourtis, A. P., Ellington, S. R., & Jamieson, D. J. (2010). Maternal and fetal outcomes among women with depression. *Journal of Women's Health, 19,* 329–334.

Barker, E. D. (2013). The duration and timing of maternal depression as a moderator of the relationship between dependent interpersonal stress, contextual risk and early child dysregulation. *Psychological Medicine, 43,* 1587–1596. http://dx.doi.org/10.1017/S0033291712002450

Beck, A. T., Ward, C. H., Mendelson, M., Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry, 4,* 561–571. http://dx.doi.org/10.1001/archpsyc.1961.01710120031004

Beebe, B., Jaffe, J., Buck, K., Chen, H., Cohen, P., Feldstein, S., & Andrews, H. (2008). Six-week postpartum maternal depressive symptoms and 4-month mother-infant self- and interactive contingency. *Infant Mental Health Journal, 29,* 442–471. http://dx.doi.org/10.1002/imhj.20191

Beebe, B., Steele, M., Jaffe, J., Buck, K. A., Chen, H., Cohen, P., . . . Feldstein, S. (2011). Maternal anxiety symptoms and mother-infant self- and interactive contingency. *Infant Mental Health Journal, 32,* 174–206. http://dx.doi.org/10.1002/imhj.20274

Bernier, A., Carlson, S. M., & Whipple, N. (2010). From external regulation to self-regulation: Early parenting precursors of young children's executive functioning. *Child Development, 81,* 326–339. http://dx.doi.org/10.1111/j.1467-8624.2009.01397.x

Biringen, Z. (1990). Direct observation of maternal sensitivity and dyadic interactions in the home: Relations to maternal thinking. *Developmental Psychology, 26,* 278–284. http://dx.doi.org/10.1037/0012-1649.26.2.278

Blandon, A. Y., Calkins, S. D., Keane, S. P., & O'Brien, M. (2008). Individual differences in trajectories of emotion regulation processes: The effects of maternal depressive symptomatology and children's physiological regulation. *Developmental Psychology, 44,* 1110–1123. http://dx.doi.org/10.1037/0012-1649.44.4.1110

Broth, M. R., Goodman, S. H., Hall, C., & Raynor, L. C. (2004). Depressed and well mothers' emotion interpretation accuracy and the quality of mother−Infant interaction. *Infancy, 6,* 37–55. http://dx.doi.org/10.1207/s15327078in0601_2

Burkhouse, K. L., Siegle, G. J., & Gibb, B. E. (2014). Pupillary reactivity to emotional stimuli in children of depressed and anxious mothers.

Journal of Child Psychology and Psychiatry, and Allied Disciplines, 55, 1009–1016. http://dx.doi.org/10.1111/jcpp.12225

Burt, V. K., & Stein, K. (2002). Epidemiology of depression throughout the female life cycle. *The Journal of Clinical Psychiatry, 63,* 9–15.

Buss, K. A., & Goldsmith, H. H. (1998). Fear and anger regulation in infancy: Effects on the temporal dynamics of affective expression. *Child Development, 69,* 359–374. http://dx.doi.org/10.1111/j.1467-8624.1998.tb06195.x

Carter, A. S., Garrity-Rokous, F. E., Chazan-Cohen, R., Little, C., & Briggs-Gowan, M. J. (2001). Maternal depression and comorbidity: Predicting early parenting, attachment security, and toddler social-emotional problems and competencies. *Journal of the American Academy of Child & Adolescent Psychiatry, 40,* 18–26. http://dx.doi.org/10.1097/00004583-200101000-00012

Champagne, F., & Meaney, M. J. (2001). Like mother, like daughter: Evidence for non-genomic transmission of parental behavior and stress responsivity. *Progress in Brain Research, 133,* 287–302. http://dx.doi.org/10.1016/S0079-6123(01)33022-4

Cirulli, F., Francia, N., Berry, A., Aloe, L., Alleva, E., & Suomi, S. J. (2009). Early life stress as a risk factor for mental health: Role of neurotrophins from rodents to non-human primates. *Neuroscience and Biobehavioral Reviews, 33,* 573–585. http://dx.doi.org/10.1016/j.neubiorev.2008.09.001

Cohn, J. F., & Campbell, S. B. (1992). Influence of maternal depression on infant affect regulation. In D. Cicchetti & S. L. Toth (Eds.), *Developmental perspectives on depression* (pp. 103–130). Rochester, NY: University of Rochester Press.

Cohn, J. F., Campbell, S. B., & Ross, S. (1992). Infant response in the still-face paradigm at 6 months predicts avoidant and secure attachment at 12 months. *Development and Psychopathology, 3,* 367–376.

Cole, P. M., Martin, S. E., & Dennis, T. A. (2004). Emotion regulation as a scientific construct: Methodological challenges and directions for child development research. *Child Development, 75,* 317–333. http://dx.doi.org/10.1111/j.1467-8624.2004.00673.x

Cole, P. M., Teti, L. O., & Zahn-Waxler, C. (2003). Mutual emotion regulation and the stability of conduct problems between preschool and early school age. *Development and Psychopathology, 15,* 1–18. http://dx.doi.org/10.1017/S0954579403000014

Davis, E. P., Glynn, L. M., Schetter, C. D., Hobel, C., Chicz-Demet, A., & Sandman, C. A. (2007). Prenatal exposure to maternal depression and cortisol influences infant temperament. *Journal of the American Academy of Child and Adolescent Psychiatry, 46,* 737–746. http://dx.doi.org/10.1097/chi.0b013e318047b775

Eckerman, C. O., Hsu, H. C., Molitor, A., Leung, E. H., & Goldstein, R. F. (1999). Infant arousal in an en-face exchange with a new partner: Effects of prematurity and perinatal biological risk. *Developmental Psychology, 35,* 282–293. http://dx.doi.org/10.1037/0012-1649.35.1.282

Eiden, R. D., Edwards, E. P., & Leonard, K. E. (2007). A conceptual model for the development of externalizing behavior problems among kindergarten children of alcoholic families: Role of parenting and children's self-regulation. *Developmental Psychology, 43,* 1187–1201. http://dx.doi.org/10.1037/0012-1649.43.5.1187

Eisenberg, N., Spinrad, T. L., & Eggum, N. D. (2010). Emotion-related self-regulation and its relation to children's maladjustment. *Annual Review of Clinical Psychology, 6,* 495–525. http://dx.doi.org/10.1146/annurev.clinpsy.121208.131208

Feldman, R. (2002). *Micro-coding of social behavior and synchrony*. Unpublished manuscript, Department of Psychology, Bar-Ilan University, Ramat-Gan, Israel.

Feldman, R. (2003). Infant-mother and infant-father synchrony: The co-regulation of positive arousal. *Infant Mental Health Journal, 24,* 1–23. http://dx.doi.org/10.1002/imhj.10041

Feldman, R. (2006). From biological rhythms to social rhythms: Physiological precursors of mother-infant synchrony. *Developmental Psychology, 42,* 175–188. http://dx.doi.org/10.1037/0012-1649.42.1.175

Feldman, R. (2007a). On the origins of background emotions: From affect synchrony to symbolic expression. *Emotion, 7,* 601–611. http://dx.doi.org/10.1037/1528-3542.7.3.601

Feldman, R. (2007b). Parent–infant synchrony: Biological foundations and developmental outcomes. *Current Directions in Psychological Science, 16,* 340–345. http://dx.doi.org/10.1111/j.1467-8721.2007.00532.x

Feldman, R. (2009). The development of regulatory functions from birth to 5 years: Insights from premature infants. *Child Development, 80,* 544–561. http://dx.doi.org/10.1111/j.1467-8624.2009.01278.x

Feldman, R. (2012). Parent-infant synchrony: A bio-behavioral model of mutual influences in the formation of affiliative bonds. *Monographs of the Society for Research in Child Development, 77,* 42–51. http://dx.doi.org/10.1111/j.1540-5834.2011.00660.x

Feldman, R. (2015a). Sensitive periods in human social development: New insights from research on oxytocin, synchrony, and high-risk parenting. *Development and Psychopathology, 27,* 369–395. http://dx.doi.org/10.1017/S0954579415000048

Feldman, R. (2015b). The adaptive human parental brain: Implications for children's social development. *Trends in Neurosciences, 38,* 387–399. http://dx.doi.org/10.1016/j.tins.2015.04.004

Feldman, R. (2016). The neurobiology of mammalian parenting and the biosocial context of human caregiving. *Hormones and Behavior, 77,* 3–17. http://dx.doi.org/10.1016/j.yhbeh.2015.10.001

Feldman, R., Dollberg, D., & Nadam, R. (2011a). The expression and regulation of anger in toddlers: Relations to maternal behavior and mental representations. *Infant Behavior and Development, 34,* 310–320. http://dx.doi.org/10.1016/j.infbeh.2011.02.001

Feldman, R., & Eidelman, A. I. (2003). Skin-to-skin contact (kangaroo care) accelerates autonomic and neurobehavioural maturation in preterm infants. *Developmental Medicine and Child Neurology, 45,* 274–281. http://dx.doi.org/10.1111/j.1469-8749.2003.tb00343.x

Feldman, R., & Eidelman, A. I. (2004). Parent-infant synchrony and the social−emotional development of triplets. *Developmental Psychology, 40,* 1133–1147. http://dx.doi.org/10.1037/0012-1649.40.6.1133

Feldman, R., & Eidelman, A. I. (2007). Maternal postpartum behavior and the emergence of infant−mother and infant−father synchrony in preterm and full-term infants: The role of neonatal vagal tone. *Developmental Psychobiology, 49,* 290–302. http://dx.doi.org/10.1002/dev.20220

Feldman, R., Eidelman, A. I., & Rotenberg, N. (2004). Parenting stress, infant emotion regulation, maternal sensitivity, and the cognitive development of triplets: A model for parent and child influences in a unique ecology. *Child Development, 75,* 1774–1791. http://dx.doi.org/10.1111/j.1467-8624.2004.00816.x

Feldman, R., Gordon, I., Schneiderman, I., Weisman, O., & Zagoory-Sharon, O. (2010). Natural variations in maternal and paternal care are associated with systematic changes in oxytocin following parent-infant contact. *Psychoneuroendocrinology, 35,* 1133–1141. http://dx.doi.org/10.1016/j.psyneuen.2010.01.013

Feldman, R., Gordon, I., & Zagoory-Sharon, O. (2010). The cross-generation transmission of oxytocin in humans. *Hormones and Behavior, 58,* 669–676. http://dx.doi.org/10.1016/j.yhbeh.2010.06.005

Feldman, R., Granat, A., Pariente, C., Kanety, H., Kuint, J., & Gilboa-Schechtman, E. (2009). Maternal depression and anxiety across the postpartum year and infant social engagement, fear regulation, and stress reactivity. *Journal of the American Academy of Child and Adolescent Psychiatry, 48,* 919–927. http://dx.doi.org/10.1097/CHI.0b013e3181b21651

Feldman, R., Greenbaum, C. W., Mayes, L. C., & Erlich, S. H. (1997). Change in mother−infant interactive behavior: Relations to change in the mother, the infant, and the social context. *Infant Behavior and*

Development, 20, 151–163. http://dx.doi.org/10.1016/S0163-6383(97)90018-7

Feldman, R., Greenbaum, C. W., & Yirmiya, N. (1999). Mother−infant affect synchrony as an antecedent of the emergence of self-control. *Developmental Psychology, 35,* 223–231. http://dx.doi.org/10.1037/0012-1649.35.1.223

Feldman, R., Keren, M., Gross-Rozval, O., & Tyano, S. (2004). Mother-Child touch patterns in infant feeding disorders: Relation to maternal, child, and environmental factors. *Journal of the American Academy of Child and Adolescent Psychiatry, 43,* 1089–1097. http://dx.doi.org/10.1097/01.chi.0000132810.98922.83

Feldman, R., Magori-Cohen, R., Galili, G., Singer, M., & Louzoun, Y. (2011b). Mother and infant coordinate heart rhythms through episodes of interaction synchrony. *Infant Behavior and Development, 34,* 569–577. http://dx.doi.org/10.1016/j.infbeh.2011.06.008

Feldman, R., Rosenthal, Z., & Eidelman, A. I. (2014). Maternal-preterm skin-to-skin contact enhances child physiologic organization and cognitive control across the first 10 years of life. *Biological Psychiatry, 75,* 56–64. http://dx.doi.org/10.1016/j.biopsych.2013.08.012

Feldman, R., Singer, M., & Zagoory, O. (2010). Touch attenuates infants' physiological reactivity to stress. *Developmental Science, 13,* 271–278. http://dx.doi.org/10.1111/j.1467-7687.2009.00890.x

Feldman, R., Zagoory-Sharon, O., Weisman, O., Schneiderman, I., Gordon, I., Maoz, R., . . . Ebstein, R. P. (2012). Sensitive parenting is associated with plasma oxytocin and polymorphisms in the OXTR and CD38 genes. *Biological Psychiatry, 72,* 175–181. http://dx.doi.org/10.1016/j.biopsych.2011.12.025

Feng, X., Shaw, D. S., Kovacs, M., Lane, T., O'Rourke, F. E., & Alarcon, J. H. (2008). Emotion regulation in preschoolers: The roles of behavioral inhibition, maternal affective behavior, and maternal depression. *Journal of Child Psychology and Psychiatry, and Allied Disciplines, 49,* 132–141.

Field, T., Diego, M., & Hernandez-Reif, M. (2006). Prenatal depression effects on the fetus and newborn: A review. *Infant Behavior and Development, 29,* 445–455. http://dx.doi.org/10.1016/j.infbeh.2006.03.003

First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. (1995). *Structured Clinical Interview for DSM–IV Axis I Disorders (SCID-I).* New York, NY: Columbia University.

Forbes, E. E., Cohn, J. F., Allen, N. B., & Lewinsohn, P. M. (2004). Infant affect during parent−infant interaction at 3 and 6 months: Differences Between mothers and fathers and influence of parent history of depression. *Infancy: The Official Journal of the International Society on Infant Studies, 5,* 61–84. http://dx.doi.org/10.1207/s15327078in0501_3

Fox, N. A., & Calkins, S. D. (2003). The development of self-control of emotion: Intrinsic and extrinsic influences. *Motivation and Emotion, 27,* 7–26. http://dx.doi.org/10.1023/A:1023622324898

Garber, J., Braafladt, N., & Weiss, B. (2009). Affect regulation in depressed and nondepressed children and young adolescents. *Development and Psychopathology, 7,* 93. http://dx.doi.org/10.1017/S0954579400006362

Garber, J., & Dodge, K. A. (1991). *The development of emotion regulation and dysregulation*. New York, NY: Cambridge University Press. http://dx.doi.org/10.1017/CBO9780511663963

Gavin, N. I., Gaynes, B. N., Lohr, K. N., Meltzer-Brody, S., Gartlehner, G., & Swinson, T. (2005). Perinatal depression: A systematic review of prevalence and incidence. *Obstetrics and Gynecology, 106*(Part 1), 1071–1083. http://dx.doi.org/10.1097/01.AOG.0000183597.31630.db

Gilliom, M., Shaw, D. S., Beck, J. E., Schonberg, M. A., & Lukon, J. L. (2002). Anger regulation in disadvantaged preschool boys: Strategies, antecedents, and the development of self-control. *Developmental Psychology, 38,* 222–235. http://dx.doi.org/10.1037/0012-1649.38.2.222

Goldsmith, H. H., & Rothbart, M. K. (1996). *The laboratory temperament assessment battery*. Madison, WI: University of Wisconsin, Department of Psychology.

Goodman, S. H., Rouse, M. H., Connell, A. M., Broth, M. R., Hall, C. M., & Heyward, D. (2011). Maternal depression and child psychopathology: A meta-analytic review. *Clinical Child and Family Psychology Review, 14,* 1–27. http://dx.doi.org/10.1007/s10567-010-0080-1

Gordon, I., Zagoory-Sharon, O., Leckman, J. F., & Feldman, R. (2010). Oxytocin and the development of parenting in humans. *Biological Psychiatry, 68,* 377–382. http://dx.doi.org/10.1016/j.biopsych.2010.02.005

Gotlib, I. H., Joormann, J., & Foland-Ross, L. C. (2014). Understanding familial risk for depression: A 25-year perspective. *Perspectives on Psychological Science, 9,* 94–108. http://dx.doi.org/10.1177/1745691613513469

Grolnick, W. S., Bridges, L. J., & Connell, J. P. (1996). Emotion regulation in two-year-olds: Strategies and emotional expression in four contexts. *Child Development, 67,* 928–941. http://dx.doi.org/10.2307/1131871

Guedeney, A., Pingault, J. B., Thorr, A., & Larroque, B., & the EDEN Mother-Child Cohort Study Group. (2014). Social withdrawal at 1 year is associated with emotional and behavioural problems at 3 and 5 years: The Eden mother−child cohort study. *European Child & Adolescent Psychiatry, 23,* 1181–1188. http://dx.doi.org/10.1007/s00787-013-0513-8

Halbreich, U., & Karkun, S. (2006). Cross-cultural and social diversity of prevalence of postpartum depression and depressive symptoms. *Journal of Affective Disorders, 91,* 97–111. http://dx.doi.org/10.1016/j.jad.2005.12.051

Halligan, S. L., Cooper, P. J., Fearon, P., Wheeler, S. L., Crosby, M., & Murray, L. (2013). The longitudinal development of emotion regulation capacities in children at risk for externalizing disorders. *Development and Psychopathology, 25,* 391–406. http://dx.doi.org/10.1017/S0954579412001137

Hammen, C., Shih, J., Altman, T., & Brennan, P. A. (2003). Interpersonal impairment and the prediction of depressive symptoms in adolescent children of depressed and nondepressed mothers. *Journal of the American Academy of Child and Adolescent Psychiatry, 42,* 571–577. http://dx.doi.org/10.1097/01.CHI.0000046829.95464.E5

Harel, H., Gordon, I., Geva, R., & Feldman, R. (2011). Gaze behaviors of preterm and full-term infants in nonsocial and social contexts of increasing dynamics: Visual recognition, attention regulation, and gaze synchrony. *Infancy, 16,* 69–90. http://dx.doi.org/10.1111/j.1532-7078.2010.00037.x

Hirschler-Guttenberg, Y., Golan, O., Ostfeld-Etzion, S., & Feldman, R. (2015). Mothering, fathering, and the regulation of negative and positive emotions in high-functioning preschoolers with autism spectrum disorder. *Journal of Child Psychology and Psychiatry, and Allied Disciplines, 56,* 530–539. http://dx.doi.org/10.1111/jcpp.12311

Hofer, M. A. (1994). Early relationships as regulators of infant physiology and behavior. *Acta Paediatrica, 397,* 9–18. http://dx.doi.org/10.1111/j.1651-2227.1994.tb13260.x

Howard, L. M., Molyneaux, E., Dennis, C.-L., Rochat, T., Stein, A., & Milgrom, J. (2014). Non-psychotic mental disorders in the perinatal period. *Lancet, 384,* 1775–1788. http://dx.doi.org/10.1016/S0140-6736(14)61276-9

Ionio, C., & Di Blasio, P. (2013). Post-traumatic stress symptoms after childbirth and early mother–child interactions: An exploratory study. *Journal of Reproductive and Infant Psychology, 32,* 163–181. http://dx.doi.org/10.1080/02646838.2013.841880

Jaffe, J., Beebe, B., Feldstein, S., Crown, C. L., & Jasnow, M. D. (2001). Rhythms of dialogue in infancy: Coordinated timing in development. *Monographs of the Society for Research in Child Development, 66,* 1–132.

Johnson, A. L., Morrow, C. E., Accornero, V. H., Xue, L., Anthony, J. C., & Bandstra, E. S. (2002). Maternal cocaine use: Estimated effects on mother-child play interactions in the preschool period. *Journal of Developmental and Behavioral Pediatrics: JDBP, 23,* 191–202. http://dx.doi.org/10.1097/00004703-200208000-00001

Kagan, J., Snidman, N., Kahn, V., & Towsley, S. (2007). The preservation of two infant temperaments into adolescence. *Monographs of the Society for Research in Child Development, 72,* 1–75.

Kam, C.-M., Greenberg, M. T., Bierman, K. L., Coie, J. D., Dodge, K. A., Foster, M. E., . . . the Conduct Problems Prevention Research Group. (2011). Maternal depressive symptoms and child social preference during the early school years: Mediation by maternal warmth and child emotion regulation. *Journal of Abnormal Child Psychology, 39,* 365–377. http://dx.doi.org/10.1007/s10802-010-9468-0

Katz, S. J., Conway, C. C., Hammen, C. L., Brennan, P. A., & Najman, J. M. (2011). Childhood social withdrawal, interpersonal impairment, and young adult depression: A mediational model. *Journal of Abnormal Child Psychology, 39,* 1227–1238. http://dx.doi.org/10.1007/s10802-011-9537-z

Kendall, P. C., Hollon, S. D., Beck, A. T., Hammen, C. L., & Ingram, R. E. (1987). Issues and recommendations regarding the use of the Beck Depression Inventory. *Journal of Abnormal Psychology, 11,* 289–299.

Kessler, R. C., Berglund, P., Demler, O., Jin, R., Merikangas, K. R., & Walters, E. E. (2005). Lifetime prevalence and age-of-onset distributions of *DSM–IV* disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry, 62,* 593–602. http://dx.doi.org/10.1001/archpsyc.62.6.593

Kessler, R. C., Keller, M. B., & Wittchen, H. U. (2001). The epidemiology of generalized anxiety disorder. *The Psychiatric Clinics of North America, 24,* 19–39. http://dx.doi.org/10.1016/S0193-953X(05)70204-5

Kim, S., & Kochanska, G. (2012). Child temperament moderates effects of parent−child mutuality on self-regulation: A relationship-based path for emotionally negative infants. *Child Development, 83,* 1275–1289. http://dx.doi.org/10.1111/j.1467-8624.2012.01778.x

Kim, S., & Soeken, T. a, Cromer, S. J., Martinez, S. R., Hardy, L. R., & Strathearn, L. (2014). Oxytocin and postpartum depression: Delivering on what's known and what's not. *Brain Research, 1580,* 219–232. http://dx.doi.org/10.1016/j.brainres.2013.11.009

Ko, J. Y., Farr, S. L., Dietz, P. M., & Robbins, C. L. (2012). Depression and treatment among U.S. pregnant and nonpregnant women of reproductive age, 2005–2009. *Journal of Women's Health, 21,* 830–836. http://dx.doi.org/10.1089/jwh.2011.3466

Kochanska, G., Aksan, N., Prisco, T. R., & Adams, E. E. (2008). Mother−child and father−child mutually responsive orientation in the first 2 years and children's outcomes at preschool age: Mechanisms of influence. *Child Development, 79,* 30–44. http://dx.doi.org/10.1111/j.1467-8624.2007.01109.x

Kochanska, G., Tjebkes, T. L., & Forman, D. R. (1998). Children's emerging regulation of conduct: Restraint, compliance, and internalization from infancy to the second year. *Child Development, 69,* 1378–1389. http://dx.doi.org/10.2307/1132272

Kopp, C. B. (2009). Emotion-focused coping in young children: Self and self-regulatory processes. *New Directions for Child and Adolescent Development, 2009,* 33–46. http://dx.doi.org/10.1002/cd.241

Lamers, F., van Oppen, P., Comijs, H. C., Smit, J. H., Spinhoven, P., van Balkom, A. J. L. M., . . . Penninx, B. W. J. H. (2011). Comorbidity patterns of anxiety and depressive disorders in a large cohort study: The Netherlands Study of Depression and Anxiety (NESDA). *The Journal of Clinical Psychiatry, 72,* 341–348. http://dx.doi.org/10.4088/JCP.10m06176blu

Lovejoy, M. C., Graczyk, P. A., O'Hare, E., & Neuman, G. (2000). Maternal depression and parenting behavior: A meta-analytic review. *Clinical Psychology Review, 20,* 561–592. http://dx.doi.org/10.1016/S0272-7358(98)00100-7

MacLean, P. C., Rynes, K. N., Aragón, C., Caprihan, A., Phillips, J. P., & Lowe, J. R. (2014). Mother−infant mutual eye gaze supports emotion regulation in infancy during the Still-Face paradigm. *Infant Behavior and Development, 37,* 512–522. http://dx.doi.org/10.1016/j.infbeh.2014.06.008

Mah, B. L., Van Ijzendoorn, M. H., Smith, R., & Bakermans-Kranenburg, M. J. (2013). Oxytocin in postnatally depressed mothers: Its influence on mood and expressed emotion. *Progress in Neuro-Psychopharmacology & Biological Psychiatry, 40,* 267–272. http://dx.doi.org/10.1016/j.pnpbp.2012.10.005

Marsee, M. A., & Frick, P. J. (2007). Exploring the cognitive and emotional correlates to proactive and reactive aggression in a sample of detained girls. *Journal of Abnormal Child Psychology, 35,* 969–981. http://dx.doi.org/10.1007/s10802-007-9147-y

Matsumoto, Y., Takahashi, H., Murai, T., & Takahashi, H. (2015). Visual processing and social cognition in schizophrenia: Relationships among eye movements, biological motion perception, and empathy. *Neuroscience Research, 90,* 95–100. http://dx.doi.org/10.1016/j.neures.2014.10.011

Maughan, A., Cicchetti, D., Toth, S. L., & Rogosch, F. A. (2007). Early-occurring maternal depression and maternal negativity in predicting young children's emotion regulation and socioemotional difficulties. *Journal of Abnormal Child Psychology, 35,* 685–703. http://dx.doi.org/10.1007/s10802-007-9129-0

McLeod, B. D., Wood, J. J., & Weisz, J. R. (2007). Examining the association between parenting and childhood anxiety: A meta-analysis. *Clinical Psychology Review, 27,* 155–172. http://dx.doi.org/10.1016/j.cpr.2006.09.002

Meaney, M. J. (2010). Epigenetics and the biological definition of gene x environment interactions. *Child Development, 81,* 41–79. http://dx.doi.org/10.1111/j.1467-8624.2009.01381.x

Meaney, M. J., & Szyf, M. (2005). Environmental programming of stress responses through DNA methylation: Life at the interface between a dynamic environment and a fixed genome. *Dialogues in Clinical Neuroscience, 7,* 103–123.

Melnick, S. M., & Hinshaw, S. P. (2000). Emotion regulation and parenting in AD/HD and comparison boys: Linkages with social behaviors and peer preference. *Journal of Abnormal Child Psychology, 28,* 73–86. http://dx.doi.org/10.1023/A:1005174102794

Merikangas, K. R., Avenevoli, S., Dierker, L., & Grillon, C. (1999). Vulnerability factors among children at risk for anxiety disorders. *Biological Psychiatry, 46,* 1523–1535. http://dx.doi.org/10.1016/S0006-3223(99)00172-9

Moore, G. A., & Calkins, S. D. (2004). Infants' vagal regulation in the still-face paradigm is related to dyadic coordination of mother−infant interaction. *Developmental Psychology, 40,* 1068–1080. http://dx.doi.org/10.1037/0012-1649.40.6.1068

Morris, A. S., Silk, J. S., Morris, M. D. S., Steinberg, L., Aucoin, K. J., & Keyes, A. W. (2011). The influence of mother-child emotion regulation strategies on children's expression of anger and sadness. *Developmental Psychology, 47,* 213–225. http://dx.doi.org/10.1037/a0021021

Murray, L., Arteche, A., Fearon, P., Halligan, S., Goodyer, I., & Cooper, P. (2011). Maternal postnatal depression and the development of depression in offspring up to 16 years of age. *Journal of the American Academy of Child and Adolescent Psychiatry, 50,* 460–470. http://dx.doi.org/10.1016/j.jaac.2011.02.001

Murray, L., Cooper, P., Creswell, C., Schofield, E., & Sack, C. (2007). The effects of maternal social phobia on mother-infant interactions and infant social responsiveness. *Journal of Child Psychology and Psychiatry, and Allied Disciplines, 48,* 45–52. http://dx.doi.org/10.1111/j.1469-7610.2006.01657.x

Murray, L., de Rosnay, M., Pearson, J., Bergeron, C., Schofield, E., Royal-Lawson, M., & Cooper, P. J. (2008). Intergenerational transmission of social anxiety: The role of social referencing processes in infancy. *Child Development, 79,* 1049–1064. http://dx.doi.org/10.1111/j.1467-8624.2008.01175.x

Murray, L., Halligan, S. L., Goodyer, I., & Herbert, J. (2010). Disturbances in early parenting of depressed mothers and cortisol secretion in offspring: A preliminary study. *Journal of Affective Disorders, 122,* 218–223. http://dx.doi.org/10.1016/j.jad.2009.06.034

Nicol-Harper, R., Harvey, A. G., & Stein, A. (2007). Interactions between mothers and infants: Impact of maternal anxiety. *Infant Behavior and Development, 30,* 161–167. http://dx.doi.org/10.1016/j.infbeh.2006.08.005

Oberlander, T. F., Grunau, R. E., Fitzgerald, C., Papsdorf, M., Rurak, D., & Riggs, W. (2005). Pain reactivity in 2-month-old infants after prenatal and postnatal serotonin reuptake inhibitor medication exposure. *Pediatrics, 115,* 411–425. http://dx.doi.org/10.1542/peds.2004-0420

O'Hara, M. W., Stuart, S., Gorman, L. L., & Wenzel, A. (2000). Efficacy of interpersonal psychotherapy for postpartum depression. *Archives of General Psychiatry, 57,* 1039–1045. http://dx.doi.org/10.1001/archpsyc.57.11.1039

Parsons, C. E., Young, K. S., Rochat, T. J., Kringelbach, M. L., & Stein, A. (2012). Postnatal depression and its effects on child development: A review of evidence from low- and middle-income countries. *British Medical Bulletin, 101,* 57–79. http://dx.doi.org/10.1093/bmb/ldr047

Paulson, J. F., Dauber, S., & Leiferman, J. A. (2006). Individual and combined effects of postpartum depression in mothers and fathers on parenting behavior. *Pediatrics, 118,* 659–668. http://dx.doi.org/10.1542/peds.2005-2948

Posne, M. I., & Rothbart, M. K. (2000). Developing mechanisms of self-regulation. *Development and Psychopathology, 12,* 427–441. http://dx.doi.org/10.1017/S0954579400003096

Pratt, M., Apter-Levi, Y., Vakart, A., Feldman, M., Fishman, R., Feldman, T., . . . Feldman, R. (2015). Maternal depression and child oxytocin response: Moderation by maternal oxytocin and relational behavior. *Depression and Anxiety, 32,* 635–646. http://dx.doi.org/10.1002/da.22392

Pratt, M., Singer, M., Kanat-Maymon, Y., & Feldman, R. (2015). Infant negative reactivity defines the effects of parent-child synchrony on physiological and behavioral regulation of social stress. *Development and Psychopathology, 27,* 1191–1204. http://dx.doi.org/10.1017/S0954579415000760

Preti, A., Melis, M., Siddi, S., Vellante, M., Doneddu, G., & Fadda, R. (2014). Oxytocin and autism: A systematic review of randomized controlled trials. *Journal of Child and Adolescent Psychopharmacology, 24,* 54–68. http://dx.doi.org/10.1089/cap.2013.0040

Radke, S., Güths, F., André, J. A., Müller, B. W., & de Bruijn, E. R. A. (2014). In action or inaction? Social approach-avoidance tendencies in major depression. *Psychiatry Research, 219,* 513–517. http://dx.doi.org/10.1016/j.psychres.2014.07.011

Righetti-Veltema, M., Conne-Perréard, E., Bousquet, A., & Manzano, J. (2002). Postpartum depression and mother-infant relationship at 3 months old. *Journal of Affective Disorders, 70,* 291–306. http://dx.doi.org/10.1016/S0165-0327(01)00367-6

Rinck, M., Rörtgen, T., Lange, W.-G., Dotsch, R., Wigboldus, D. H. J., & Becker, E. S. (2010). Social anxiety predicts avoidance behaviour in virtual encounters. *Cognition and Emotion, 24,* 1269–1276. http://dx.doi.org/10.1080/02699930903309268

Rothbart, M. K., Sheese, B. E., Rueda, M. R., & Posner, M. I. (2011). Developing mechanisms of self-regulation in early life. *Emotion Review, 3,* 207–213. http://dx.doi.org/10.1177/1754073910387943

Rubin, K. H., Coplan, R. J., Fox, N. A., & Calkins, S. D. (1995). Emotionality, emotion regulation, and preschoolers' social adaptation. *Development and Psychopathology, 7,* 49–62. http://dx.doi.org/10.1017/S0954579400006337

Sameroff, A., Gutman, L. M., & Peck, S. C. (2003). *Adaptation among youth facing multiple risks: Prospective research findings* (pp. 364–391). New York, NY: Cambridge University Press.

Schneiderman, I., Kanat-Maymon, Y., Zagoory-Sharon, O., & Feldman, R. (2014). Mutual influences between partners' hormones shape conflict dialog and relationship duration at the initiation of romantic love. *Social Neuroscience, 9,* 337–351. http://dx.doi.org/10.1080/17470919.2014.893925

Serretti, A., Olgiati, P., & Colombo, C. (2006). Influence of postpartum onset on the course of mood disorders. *BMC Psychiatry, 6,* 4. http://dx.doi.org/10.1186/1471-244X-6-4

Shields, A., & Cicchetti, D. (1998). Reactive aggression among maltreated children: The contributions of attention and emotion dysregulation. *Journal of Clinical Child Psychology, 27,* 381–395. http://dx.doi.org/10.1207/s15374424jccp2704_2

Silk, J. S., Shaw, D. S., Forbes, E. E., Lane, T. L., & Kovacs, M. (2006). Maternal depression and child internalizing: The moderating role of child emotion regulation. *Journal of Clinical Child and Adolescent Psychology: The Official Journal for the Society of Clinical Child and Adolescent Psychology, American Psychological Association, Division 53, 35,* 116–126.

Silk, J. S., Steinberg, L., & Morris, A. S. (2003). Adolescents' emotion regulation in daily life: Links to depressive symptoms and problem behavior. *Child Development, 74,* 1869–1880. http://dx.doi.org/10.1046/j.1467-8624.2003.00643.x

Sokolowski, K., & Corbin, J. G. (2012). Wired for behaviors: From development to function of innate limbic system circuitry. *Frontiers in Molecular Neuroscience, 5,* 55.

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. (1970). *State-trait anxiety inventory*. Palo Alto, CA: Consulting Psychologists Press.

Stack, D. (2001). The salience of touch and physical contact during infancy: Unraveling some of the mysteries of the somasthetic sense. In G. Bremner & A. Fogel (Eds.), *Blackwell handbook of infant development: Handbooks of developmental psychology* (pp. 351–378). Malden, MA: Blackwell.

Stein, A., Craske, M. G., Lehtonen, A., Harvey, A., Savage-McGlynn, E., Davies, B., . . . Counsell, N. (2012). Maternal cognitions and mother-infant interaction in postnatal depression and generalized anxiety disorder. *Journal of Abnormal Psychology, 121,* 795–809. http://dx.doi.org/10.1037/a0026847

Steuwe, C., Daniels, J. K., Frewen, P. A., Densmore, M., Pannasch, S., Beblo, T., . . . Lanius, R. A. (2014). Effect of direct eye contact in PTSD related to interpersonal trauma: An fMRI study of activation of an innate alarm system. *Social Cognitive and Affective Neuroscience, 9,* 88–97. http://dx.doi.org/10.1093/scan/nss105

Stifter, C. A., & Braungart, J. M. (1995). The regulation of negative reactivity in infancy: Function and development. *Developmental Psychology, 31,* 448–455. http://dx.doi.org/10.1037/0012-1649.31.3.448

Stuebe, A. M., Grewen, K., & Meltzer-Brody, S. (2013). Association between maternal mood and oxytocin response to breastfeeding. *Journal of Women's Health, 22,* 352–361.

Szyf, M., McGowan, P., & Meaney, M. J. (2008). The social environment and the epigenome. *Environmental and Molecular Mutagenesis, 49,* 46–60. http://dx.doi.org/10.1002/em.20357

Thompson, R. A. (2011). Emotion and emotion regulation: Two sides of the developing coin. *Emotion Review, 3,* 53–61. http://dx.doi.org/10.1177/1754073910380969

Thompson, R. J., Parker, K. J., Hallmayer, J. F., Waugh, C. E., & Gotlib, I. H. (2011). Oxytocin receptor gene polymorphism (rs2254298) interacts with familial risk for psychopathology to predict symptoms of depression and anxiety in adolescent girls. *Psychoneuroendocrinology, 36,* 144–147. http://dx.doi.org/10.1016/j.psyneuen.2010.07.003

Thompson, S. M., Hammen, C., Starr, L. R., & Najman, J. M. (2014). Oxytocin receptor gene polymorphism (rs53576) moderates the intergenerational transmission of depression. *Psychoneuroendocrinology, 43,* 11–19. http://dx.doi.org/10.1016/j.psyneuen.2014.01.012

Trevarthen, C. (1993). The self born in intersubjectivity: The psychology of an infant communicating. In U. Neisser (Ed.), *The perceived self: Ecological and interpersonal sources of self-knowledge* (pp. 121–173). New York, NY: Cambridge University Press.

Tronick, E. Z. (2007). *The neurobehavioral and social-emotional development of infants and children*. New York, NY: WW Norton & Company.

Tronick, E. Z., & Cohn, J. F. (1989). Infant−mother face-to-face interaction: Age and gender differences in coordination and the occurrence of miscoordination. *Child Development, 60,* 85–92. http://dx.doi.org/10.2307/1131074

Weinberg, M. K., & Tronick, E. Z. (1996). Infant affective reactions to the resumption of maternal interaction after the still-face. *Child Development, 67,* 905–914. http://dx.doi.org/10.2307/1131869

Weinberg, M. K., & Tronick, E. Z. (1998). The impact of maternal psychiatric illness on infant development. *The Journal of Clinical Psychiatry, 59,* 53–61.

Wijnroks, L. (1999). Maternal recollected anxiety and mother-infant interaction in preterm infants. *Infant Mental Health Journal, 20,* 393–409. http://dx.doi.org/10.1002/(sici)1097-0355(199924)20:4%3C393::aid-imhj3%3E3.0.co;2-i

Wood, J. J. (2006). Parental intrusiveness and children's separation anxiety in a clinical sample. *Child Psychiatry and Human Development, 37,* 73–87. http://dx.doi.org/10.1007/s10578-006-0021-x

Wood, J. J., McLeod, B. D., Sigman, M., Hwang, W.-C., & Chu, B. C. (2003). Parenting and childhood anxiety: Theory, empirical findings, and future directions. *Journal of Child Psychology and Psychiatry, and Allied Disciplines, 44,* 134–151. http://dx.doi.org/10.1111/1469-7610.00106

Zlochower, A. J., & Cohn, J. F. (1996). Vocal timing in face-to-face interaction of clinically depressed and nondepressed mothers and their 4-month-old infants. *Infant Behavior and Development, 19,* 371–374. http://dx.doi.org/10.1016/S0163-6383(96)90035-1

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