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Longitudinal relations among maternal depressive symptoms, maternal mind-mindedness, and infant attachment behavior

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ABSTRACT

The relations among maternal depression risk, maternal mind-mindedness, and infants' attachment behavior were longitudinally examined in a community sample of mother-infant dyads. Maternal self-reported depression risk was measured at the infant ages of 6 weeks, 4 months, and 12 months. Maternal mind-mindedness, assessed from mothers' comments about infants' mental states (e.g., infants' thoughts, desires, or emotions), was measured during mother-infant interactions when infants were 4 months. Infants' attachment behavior was assessed at one year. Mothers' depression risk decreased over the infants' first year, with the sharpest decline between 6 weeks and 4 months. Mothers at risk for depression when infants were 6 weeks showed less appropriate mind-mindedness at 4 months. Mind-mindedness was not related to maternal depression risk at the infant age of 4 months or 12 months. Infants' degree of disorganized attachment behavior at one year was positively associated with maternal depression risk at 6 weeks and negatively associated with maternal appropriate mind-mindedness at 4 months. Mothers who are at risk for depression in their infants' early lives may be hampered in their capacity to respond appropriately to their infants' mental states. Infants with mothers who have difficulty responding appropriately to their mental states, as suggested by low appropriate mind-mindedness, may feel less known and recognized by their mothers, a key theme in the origins of disorganized attachment.

1. Introduction

Maternal depression is associated with risks to infants' social, emotional, and cognitive development, whether depression is defined by clinically-based diagnoses or self-reports (Gitlin & Pasnau, 1989; Murray & Cooper, 1997). Depressed mothers tend to be either more withdrawn or intrusive, and are generally less responsive and less optimally engaged with their infants than non-depressed mothers (Beebe et al., 2008; Field, 2010; Lovejoy, Graczyk, O'Hare, & Neuman, 2000). These differences in maternal behavior between mothers with and without depressive symptoms are found across a variety of cultures (Cooper et al., 1999; Danaci, Dinç, Deveci, Sen, & Içelli, 2002; Goldbort, 2006).

Maternal depression affects infants in multiple ways indicative of disturbances in social-emotional development. Infants of

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depressed mothers tend to be less positive, more distressed, less active, and more gaze aversive (Cohn, Campbell, Matias, & Hopkins, 1990; Cohn & Tronick, 1989; Field, 1995; Feldman et al., 2009; Murray, Kempton, Woolgar, & Hooper, 1993). Maternal depression reduces mother-infant dyadic coordination and emotional regulation (Reck et al., 2011; Riva Crugnola et al., 2016). In interactions between mothers with high self-reported depressive symptoms and their 4-month-old infants, dyads show lower gaze coordination, heightened affective vigilance, and an "infant approach-mother withdraw" touch pattern (Beebe et al., 2008). By six months, infants of depressed mothers show elevated heart rate and cortisol levels (Field, 1995; Murray & Cooper, 1997); by one year, they are less likely to have secure attachments and more likely to have disturbed interactions with their mothers (Campbell & Cohn, 1991; Field, 1995).

One avenue by which maternal depression may affect infants' emotional development is by hampering mothers' ability to recognize and respond appropriately to infants' mental states, that is, infants' thoughts, desires, and emotions. This ability is an important component of maternal sensitivity (Ainsworth, Bell, & Stayton, 1974), is hypothesized to be crucial to infants' early emotional self-knowledge (Gergely & Watson, 1999), and has been shown to be associated with subsequent infant attachment security (Meins et al., 2012; Meins, Fernyhough, Fradley, & Tuckey, 2001).

Maternal sensitivity is considered the underlying basis for secure attachment (Ainsworth et al., 1974). However, Meins and colleagues (Meins et al., 2001) propose that measures of maternal sensitivity often confound two distinct characteristics: (1) warmth and attentive caregiving, and (2) mother's ability to treat her infant as a mental being. The latter characteristic requires different mental processes in the mother than the former; it requires the mother to reflect upon the mental states of her infant by using information from the infant's behavior to make accurate inferences about the mental states governing the behavior, and thus goes beyond the demonstration of affection and concern. Theorists propose that this is an ability critical to optimal emotional development and secure attachment (Fonagy, Gergely, Jurist, & Target, 2002; Fonagy, Steele, Steele, Higgitt, & Target, 1994; Gergely & Watson, 1999; Meins et al., 2001).

Meins and colleagues' (Meins et al., 2001) measure of mind-mindedness assesses mothers' capacity to treat their infants as mental beings. Mind-mindedness measures mothers' mental state comments when talking to their infants. Mental state comments are comments about the infants' thoughts, desires, or emotions as expressed in infant behavior. Mind-mindedness is a multidimensional construct. Appropriate mind-minded comments are judged to be accurate reflections of what infants might be thinking or feeling. Non-attuned mind-minded comments are judged to misinterpret infants' thoughts, desires, or emotions. These two types of mind-minded comments are unrelated (Arnott & Meins, 2007; Meins et al., 2002, 2012) and occur with different frequencies in maternal discourse, with appropriate mind-minded comments being more frequent (Meins et al., 2012).

The mother's ability to treat her infant as a mental being allows the infant reciprocally to feel known by the mother (Beebe et al., 2010). Lyons-Ruth (1999, 2008) argues that the organization of intimate relating is at stake in early mother-infant interactions. Intimate relating entails the fundamental issue of how the infant comes to know, and be known by, another's mind. Lyons-Ruth (1999, 2008) suggests that coming to know and be known by another's mind is dependent on whether the partner is capable of close attention to the other's initiatives, is open to the other's state across the range of positive to negative emotions, and attempts to comprehend the state of the other and to respond in a way that acknowledges that state. These dimensions are similar to those of the mind-mindedness construct.

Longitudinal studies of maternal mind-mindedness indicate consistency of individual differences over the infant's first two years (Kirk et al., 2015; Meins et al., 2003; Meins, Fernyhough, Arnott, Turner, & Leekam, 2011). Mind-mindedness tends to be unrelated to maternal demographic variables of education (Meins et al., 2001, 2003), socioeconomic status (Meins, Fernyhough, Russell, & Clark-Carter, 1998), or number of previous children (Meins et al., 2002), or infant temperament (Meins et al., 2011). Thus, mind-mindedness may be tapping maternal characteristics that are independent of demographic variables or specific infant characteristics (Meins, 1999). Maternal mind-mindedness, however, does relate to maternal risk factors (e.g., Demers, Bernier, Tarabulsy, & Provost, 2010; Riva Crugnola, Ierardi, & Canevini, 2018; Schacht et al., 2017).

Maternal depression may dampen mothers' capacity for mind-mindedness. Although depression does not affect mothers' language complexity or syntax during mother-infant interaction, depressed mothers are less likely to talk about what their infants are experiencing or to acknowledge agency in their infants' behavior (Kaminer, Beebe, Jaffe, Kelly, & Marquette, 2007; Murray et al., 1993). Maternal depression may impair mothers' ability to move from a focus on their own mental states to reflect upon the mental states of their infants. Such reduced capacity for mind-mindedness might result in difficulties in infant emotional development and attachment security.

Studies investigating the relation between maternal depression and mothers' mind-minded speech to infants are few. Pawlby et al. (2010) examined the relation between maternal depression and mind-mindedness in mothers who were hospitalized with clinically diagnosed depression. They found that, compared to non-depressed control mothers, depressed mothers tended to make fewer appropriate mind-minded comments to their infants upon hospital admission, but there was no difference between depressed and non-depressed mothers in non-attuned mind-minded comments. Depression may reduce mothers' likelihood of verbally reflecting upon their infants' thoughts and feelings, but not necessarily affect mothers' misinterpreting their infants' mental states.

The studies examining the relation between mothers' depression and mind-mindedness in community samples during the infants' first year have had mixed results. Lundy (2003) found that mothers' self-reported depressive symptoms and appropriate thought-related mind-minded comments were negatively related and that appropriate mind-minded comments were positively related to infants' later attachment security as measured by the Attachment Q-sort (Waters, 1987). Rosenblum, McDonough, Sameroff, and Muzik (2008) found no relation between maternal self-reported depressive symptoms and appropriate mind-minded comments. Neither Lundy (2003) nor Rosenblum et al. (2008) reported non-attuned mind-mindedness. Meins et al. (2011) examined appropriate and non-attuned mind-mindedness and found that mothers' self-reported depressive symptoms correlated positively with their non-

attuned mind-mindedness, although the effect was small, and there was no relation between depressive symptoms and appropriate mind-mindedness. Thus, the relation between maternal depression and mind-mindedness among community sample mothers is unclear, as is the combined association of maternal depression and mind-mindedness with later infant attachment behavior.

Maternal depressive symptoms in low risk samples tend to decrease over the infants' first year, with the sharpest decline in the first two to three months (Beeghly et al., 2002; Bigelow, Power, MacLellan-Peters, Alex, & McDonald, 2012; Murray, Halligan, & Cooper, 2018). Yet adverse effects of early depressive symptoms can be evident even after the symptoms have dissipated (Murray, 1992; Murray, Fiori-Cowley, Hooper, & Cooper, 1996; Stein et al., 1991). To date the studies that have examined the relation between mothers' mind-mindedness during interactions with their infants under one year of age and maternal depressive symptoms have been conducted in the second half of the infants' first year and measured maternal mind-mindedness and depressive symptoms at the same point in time. Thus, maternal depression was measured after symptoms had likely decreased, and the effect of previous maternal depressive symptoms was not assessed. Moreover, mothers' depressive symptoms influence maternal behavior most when the depressive symptoms are severe (Murray et al., 2018). Studies examining the effect of depressive symptoms in community sample mothers tend to use self-report measures, which are not diagnostic tools. Yet high scores that are in the designated risk zones on these measures have good validity with clinical diagnostic ratings for depression (Radloff, 1977; Weissman, Scholomskas, Pottenger, Prusoff, & Locke, 1977). Previous studies assessing the relation between maternal mind-mindedness and mothers' depressive symptoms have used self-reported depressive symptom scores as a continuous variable. Examining mind-mindedness in mothers who do (vs. do not) score in the risk zone on these self-report measures may differentiate mothers whose depressive symptoms affect their mind-mindedness.

A number of studies have found that mind-mindedness in early infancy predicts infants' later attachment security (Demers et al., 2010; Laranjo, Bernier & Meins, 2008; Lundy, 2003; Meins et al., 2001, 2012). Securely attached infants tend to have mothers who are higher on appropriate mind-mindedness and lower on non-attuned mind-mindedness than their insecurely attached peers (Meins et al., 2012). Mind-mindedness has been found to be a stronger predictor of infants' attachment security than more global measures of maternal sensitivity (Meins et al., 2012).

1.1. Approach of the current study

The present study examined longitudinal associations among maternal depression risk, maternal mind-mindedness, and infants' attachment behavior in a community sample of mother-infant dyads. Maternal depression risk was measured at the infant ages of 6 weeks, 4 months, and 12 months. Maternal mind-mindedness was measured when the infants were 4 months. Infants' attachment behavior was assessed at one year.

The study had two aims. The first was to examine the relation between mothers' previous 6-week, as well as concurrent 4-month, depression risk and maternal mind-mindedness at 4 months. Maternal depressive symptoms tend to be highest during the infant's first two to three months (Beeghly et al., 2002; Bigelow et al., 2012; Murray et al., 2018). Yet mothers who were at risk for depression in their infants' early weeks, even though they are no longer at risk at 4 months, may be hampered in their ability to attune to their infants' mental states (Murray, 1992; Murray et al., 1996; Stein et al., 1991). This difficulty in attuning to their infants' mental states may manifest in lower appropriate mind-mindedness, but not necessarily affect non-attuned mind-mindedness. Depression appears to reduce mothers' capacity to verbally focus on their infants' experiences (Kaminer et al., 2007; Murray et al., 1993), but not to misinterpret those experiences (Pawlby et al., 2010). The first hypothesis was that, compared to mothers who did not indicate depression risk at the infant age of 6 weeks, mothers who indicated depression risk at 6 weeks would show less appropriate mind-mindedness at the infant age of 4 months, but not differ from non-risk mothers in non-attuned mind-mindedness.

The second aim of the study was to investigate the relations among mothers' previous (6-week and 4-month) and concurrent (12-month) depression risk and previous (4-month) mind-mindedness on infants' attachment behavior at one year. It was expected that mothers' depression risk early in the infants' life at 6 weeks, when maternal depressive symptoms are likely most prevalent, and mothers' ability to attune to their infants' mental states, as manifested in appropriate mind-mindedness at 4 months, would both be associated with infants' subsequent attachment behavior. Attachment behavior was assessed by the Strange Situation (Ainsworth et al., 1974; Ainsworth, Blehar, Waters, & Wall, 1978; Solomon, 1986, 1990;), which, in addition to the attachment classifications, includes a 9-point degree of disorganized attachment behavior scale. The scale, developed by Main and Solomon (1990), globally codes infants in both organized and disorganized classifications for degree of disorganized attachment behavior. The scale allows infant behavior within the Strange Situation to be assessed along a continuum, which increases the power of analyses, and has been reported in past research in addition to the attachment classifications (Beebe et al., 2010). The second hypothesis was that (1) maternal depression risk at the infant age of 6 weeks was negatively associated with infants' secure attachment and positively associated with infants' degree of disorganized attachment behavior at one year; and (2) maternal appropriate mind-mindedness at 4 months was positively associated with infants' secure attachment and negatively associated with infants' degree of disorganized attachment behavior at one year. It was expected that maternal appropriate mind-mindedness at the infant age of 4 months would mediate the effect of maternal depression risk at the infant age of 6 weeks on infants' secure attachment and/or degree of disorganized attachment behavior at one year.

2. Method

2.1. Participants

Participants were 87 mother-infant dyads originally recruited from Columbia University Medical Center for a larger study of infant social development.[4] Mothers were primiparous, 18 years or older, and married or living with a partner. Mothers had a mean age of 29.4 years (*SD* = 6.5 years). The mothers' ethnicity was 56.3% White, 18.4% Black, and 25.3% Hispanic. Completion of some college/university or more characterized 88.4% of the mothers' education: 3.8% were without a high school diploma, 7.7% had only a high school diploma, 25.6% had some college/university, 33.3% had a college/university degree, 29.5% had post college/university education. Infants (40% female) were healthy, full-term singletons without major complications. Mothers provided informed consent.

Mothers were contacted when the infants were 6 weeks. The dyads made lab visits when the infants were 4 and 12 months. For the 12-month visit, only 53 of the dyads returned. Mothers' ethnicity and infants' sex ratio did not differ between dyads who returned at the infant age of 12 months and those who did not. Returning mothers were slightly older (*M* age = 30.6 years, *SD* = 6.3 years) and more educated (94% completed some college/university or more) than the non-returning mothers (*M* age = 27.7 years, *SD* = 6.4 years; 77% completed some college/university or more). The main reason mothers gave for not attending the 12-month lab visit was that they had returned to work.

2.2. Procedure

When infants were 6 weeks, the mothers were telephoned and administered the Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977). The CES-D is a self-report measure of depressive symptoms. The scale consists of 20 statements; the mothers indicate how frequently, on a scale of 0–3, they had the thoughts or feelings described in the statements during the past week. The scores can range from 0 to 60. Mothers with scores of 16 or more are considered at risk for depression. The CES-D is a screening device, not a diagnostic tool for clinical depression (Campbell & Cohn, 1991). The scale has high reliability in community samples and good validity with clinical diagnostic ratings for depression (Radloff, 1977; Weissman et al., 1977).

When the infants were 4 months, mothers were videotaped with their infants in face-to-face interaction in the lab. After the videotaping, the mothers completed the CES-D for the second time. For the videotaping, the infant sat in an infant seat on a table and the mother sat facing the infant at eye level. A special effects generator created a split-screen view from the input of two synchronized cameras, one focused on the mother and one on the infant. Mothers were instructed to play with their infants as they would at home, but without toys, for 10 min (necessary to obtain vocal rhythm data for a separate report). Mothers' speech in the first uninterrupted two and a half minutes was transcribed verbatim. The transcripts of maternal speech, originally used in Kaminer et al. (2007), were reanalyzed in conjunction with concurrent examination of the videotapes for mind-mindedness using the Mind-Mindedness Coding Manual (Meins & Fernyhough, 2015). Mind-minded comments were comments on the infant's mental states: (a) comments on the infant's mental processes, e.g., "do you think something is different?"; (b) comments on the infant's emotions, e.g., "are you excited?"; (c) comments on the infant's desires or preferences, e.g., "you like your shoes"; (d) comments on the infant's attempts to manipulate others' thoughts, e.g., "are you teasing me?"; or (e) comments that speak for the infant, e.g., "where are we, mama?" Mind-minded comments were further coded as appropriate or non-attuned mind-minded comments. Appropriate mind-minded comments were judged by the coder to be consistent with the infant's videotaped behavior, comments that expanded on the infant's behavior by linking it to past or future behaviors (e.g., "you like to play with the buckle on your car seat too"), or comments that clarified how to proceed after a lull in the interaction (e.g., "do you want to make funny faces?", when the infant is staring at the mother and not engaged in an activity). Non-attuned mind-minded comments were judged to be attributions of infants' mental states (thoughts, desires, emotions) not implied in the infant's behavior as observed on the video (e.g., "you are bored", when the infant is actively engaged), comments that referred to a past or future activity unrelated to the infant's current activity (e.g., "do you want to see grandma after this?"), comments suggesting the infant wanted a new activity when the infant was currently actively engaged with something (e.g., "you want to play with your feet", when the infant is actively playing with the chair buckle), comments that appeared to be the mother's projection of her own internal states onto the infant (e.g., "are you thinking about Daddy?"), or comments in which the referent was unclear (e.g., "you like that" when the infant is not attending to any particular object). As noted in the Mind-Mindedness Coding Manual (Meins & Fernyhough, 2015), relying on transcripts alone was not sufficient for coding mind-minded comments as appropriate or non-attuned; maternal speech was examined in the context of the infants' videotaped behavior.

In order to control for mothers' verbosity, mothers' scores for mind-mindedness were calculated as a proportion of the total number of maternal comments made. Comments could be a discrete single word, e.g., "yes", or utterance, e.g., "hmm", or a sentence, e.g., "you are okay". Run-on sentences were separated into comments by change in topic.

A coder blind to other maternal and infant data coded the mothers' speech for mind-minded comments and total number of comments; mind-minded comments were then further coded as appropriate or non-attuned. For reliability, a second coder

[4] The larger study included 152 mothers who were contacted and given the CES-D when their infants were 6 weeks. Of these, 132 were videotaped with their infants in the lab when their infants were 4 months, but only 87 of the dyads' videos had sound quality that allowed for the coding of mind-mindedness. At the infant age of 12 months, 84 of the original dyads participated in the Strange Situation, and reliability was conducted on 40% of these dyads chosen at random. Of the dyads who returned at 12 months and participated in the Strange Situation, 53 were among the 87 whose 4-month videos could be coded for mind-mindedness.

Table 1
Mothers' Mean CES-D Scores at 6 Weeks, 4 Months, and 12 Months for the Whole Sample and for Mothers Who Scored in the Risk and Non-Risk Groups.

	6 weeks (n = 87)	4 months (n = 87)	12 months (n = 53)
CES-D scores	12.66 (9.23)	9.18 (8.96)	7.79 (7.64)
Range	0–41	0–35	0–32
Risk group			
Scores	24.28 (6.88)	25.50 (5.48)	24.50 (6.92)
Number	27 (31%)	16 (18%)	6 (11%)
Non-risk group			
Scores	7.47 (3.99)	5.51 (4.21)	5.66 (4.45)
Number	60 (69%)	71 (82%)	47 (89%)

Note: Risk group had CES-D scores of 16 or more. Numbers in parentheses for scores are standard deviations, for number are percentages of the sample.

independently coded 22% of the mothers. Intra-class correlations, absolute type with subjects random and raters fixed, for mind-minded comments was 0.97, for appropriate mind-minded comments was 0.93, for non-attuned mind-minded comments was 0.92, and for total number of comments was 0.99 (all *ps* < 0.01).

When the infants were 12 months, 53 of the dyads returned and participated in the separation-reunion paradigm known as the Strange Situation (Ainsworth et al., 1974, 1978; Solomon, 1986, 1990;), after which the mothers completed the CES-D for the third time. Infants were coded into the four standard classifications: secure (B), avoidant (A), resistant (C), and disorganized (D) by a certified trainer for coders of the Strange Situation. As part of the coding, the infants' degree of disorganized behavior was assessed on a 9-point scale (Main & Solomon, 1990). Disorganized behaviors include displays of contradictory behaviors toward the parent (e.g., approaches by backing toward the parent), misdirected movements (e.g., moving away from the parent when distressed), stereotyped anxiety behaviors in the presence of the parent (e.g., extended rocking), freezing, apprehension, or fear of the parent. Ratings range from 1 (no signs of disorganization) to 9 (disorganization is strong, frequent, and extreme). Ratings above 5 indicate assignment to the disorganized classification. A certified coder of the Strange Situation performed reliability coding for the A, B, and C classifications on 40% of the infants, randomly selected from the original larger sample (Kappa = 0.55, $p < 0.01$).[4] Reliability for the D classifications was conducted by a second certified coder on the same subset, yielding 88% agreement. Codes used were from the original coder.

3. Results

3.1. Preliminary analyses

Table 1 shows the mean maternal CES-D scores at the infant ages of 6 weeks, 4 months, and 12 months. The table also shows the number and mean scores of the mothers scoring in the risk zone (scores of 16 or more) and the non-risk zone at each of these infant ages.

Table 2 shows the mothers' mind-mindedness at the infant age of 4 months. The table includes the mothers' mean number of appropriate and non-attuned mind-minded comments, mean total number of comments, and mean appropriate and non-attuned mind-minded comments calculated as percentages of total number of comments. The table shows the data for the whole sample and for the mothers in the CES-D risk and non-risk groups at the infant ages of 6 weeks and 4 months. In order to control for mothers' verbosity, the appropriate and non-attuned mind-mindedness scores used in all analyses were appropriate and non-attuned mind-minded comments calculated as percentages of the total number of comments. Appropriate and non-attuned mind-mindedness scores were unrelated ($p = 0.80$). As a check for whether the mothers in the CES-D risk and non-risk groups at the infant age of 6 weeks and 4 months differed in their total number of comments at 4 months, two analyses of variance (ANOVAs) with the between factor CES-D group (risk, non-risk) at 6 weeks and at 4 months were conducted on mothers' total number of comments. Results of both ANOVAs were non-significant (*ps* > 0.07), indicating mothers in the CES-D groups did not differ in their total number of comments.

The coding of the Strange Situation when the infants were one year indicated that 28 infants were classified as secure (B), 12 were

Table 2
Maternal Mind-Mindedness Means for the Whole Sample and by CES-D Risk Group at 6 Weeks and 4 Months.

	Whole sample	CES-D risk group		CES-D non-risk group	
	N = 87	n = 27 6 weeks	n = 16 4 months	n = 60 6 weeks	n = 71 4 months
Appropriate mind-minded comments (total)	3.85 (3.61)	2.89 (2.89)	4.63 (5.39)	4.28 (3.84)	3.68 (3.10)
Appropriate mind-minded comments (%)	5.41 (4.99)	3.83 (3.85)	6.42 (7.71)	6.13 (5.30)	5.19 (4.19)
Non-attuned mind-minded comments (total)	3.24 (3.69)	3.04 (3.49)	2.56 (4.02)	2.12 (2.49)	2.37 (2.55)
Non-attuned mind-minded comments (%)	2.40 (2.85)	3.90 (4.06)	3.33 (4.58)	2.94 (3.50)	3.22 (3.49)
Total number of comments	73.48 (16.09)	78.07 (15.62)	76.31 (15.85)	71.42 (15.99)	72.85 (16.19)

Note: Standard deviations are in parentheses.

Table 3
Maternal Depression Risk, Appropriate Mind-Mindedness, Non-Attuned Mind-Mindedness, and Infant Degree of Disorganized Attachment Behavior for Each of the Attachment Classifications and for the Whole One-Year Sample.

	Avoidant n = 1	Secure n = 28	Resistant n = 12	Disorganized n = 12	Whole one-year sample N = 53
6 week CES-D score	13.00	10.85 (8.12)	10.69 (11.21)	13.57 (9.90)	11.47 (9.11)
6 week % CES-D risk[a]	0	25 (7)	25 (3)	42 (5)	28 (15)
4 month CES-D score	2.00	7.46 (8.99)	10.17 (11.08)	10.33 (8.53)	8.62 (9.28)
4 month % CES-D risk[a]	0	14 (4)	25 (3)	25 (3)	19 (10)
12 month CES-D score	1.00	7.89 (7.30)	7.67 (8.80)	8.25 (7.97)	7.79 (7.64)
12 month % CES-D risk[a]	0	14 (4)	8 (1)	8 (1)	11 (6)
Appropriate mind-mindedness[b]	0	6.47 (4.78)	8.49 (7.78)	2.93 (3.19)	6.00 (5.59)
Non-attuned mind-mindedness[c]	0	2.33 (3.24)	2.50 (3.07)	5.07 (3.32)	2.95 (3.35)
Degree of disorganized attachment behavior[d]	4.00	2.43 (1.26)	2.75 (1.76)	6.17 (0.83)	3.38 (2.00)

Note: Standard deviations are in parentheses, except parentheses in % CES-D risk are number of infants.
[a] Percentage of mothers with CES-D scores of 16 or more.
[b] Appropriate mind-minded comments divided by total number of comments.
[c] Non-attuned mind-minded comments divided by total number of comments.
[d] Scores on Main and Solomon's (1990) 9-point degree of disorganized attachment behavior scale.

classified as resistant (C), 1 was classified as avoidant (A), and 12 were classified as disorganized (D). Table 3 indicates, for each of the attachment classifications and for the whole one-year sample, (1) the mothers' mean CES-D scores at 6 weeks, 4 months, and 12 months, (2) the percentage of mothers in the CES-D risk group at 6 weeks, 4 months, and 12 months, (3) the mean appropriate and non-attuned mind-mindedness, and (4) the mean degree of disorganized attachment behavior on the 9-point scale.

Table 4 shows the correlations among (1) the mothers' CES-D scores and depression risk at 6 weeks, 4 months, and 12 months, (2) 4-month maternal appropriate mind-mindedness and non-attuned mind-mindedness, (3) one-year infant degree of disorganized attachment behavior and infant attachment classifications collapsed into secure vs. insecure/disorganized categories, and (4) the maternal and infant demographic variables. Maternal age was the only demographic that correlated with CES-D risk, correlating positively with maternal depression risk at 6 weeks. None of the demographics were associated with mind-mindedness, infants' degree of disorganized attachment behavior, or attachment classifications grouped as secure vs. insecure/disorganized.

As seen on Table 1, fewer mothers scored in the risk zone on the CES-D as their infants aged over the first year, with the largest decrease between the infant ages of 6 weeks and 4 months. Paired *t*-tests indicate CES-D risk significantly decreased from 6 weeks to 4 months, t (86) = 2.35, p = 0.021, and from 6 weeks to 12 months, t (52) = 2.27, p = 0.028, but not from 4 months to 12 months (p = 0.25). Table 4 indicates maternal CES-D risk correlated at the infant age of 6 weeks and 4 months, r (87) = 0.32, p = 0.001, but neither maternal CES-D risk at 6 weeks or 4 months were correlated with CES-D risk at 12 months (ps > 0.17).

Table 4
Correlations Among Maternal Variables at 6 Weeks, 4 Months, and 12 Months, Infant Variables at 1 Year, and the Demographics.

	1	2	3	4	5	6	7	8	9	10	11	12	13
Maternal variables													
At the infant age of 6 weeks													
1. CES-D scores													
2. CES-D risk	.84**												
At the infant age of 4 months													
3. CES-D scores	.48**	.41**											
4. CES-D risk	.36**	.32**	.87**										
5. Maternal appropriate mind-mindedness	−.05	−.22*	.09	.10									
6. Maternal non-attuned mind-mindedness	.07	.12	< −.01	.01	−.03								
At the infant age of 1 year													
7. CES-D scores	.33**	.23*	.57**	.34**	.18	−.02							
8. CES-D risk	.11	.04	.32*	.13	.21	−.05	.79**						
Infant variables at one year													
9. Infant degree of disorganized attachment behavior	.19	.24*	.16	.10	−.38**	.22	.14	.08					
10. Infant attachment security	.07	.08	.12	.12	−.08	.18	−.01	−.10	.51**				
Demographics													
11. Maternal age	−.31**	−.20*	−.18	−.11	.07	−.14	−.25*	−.08	−.20	−.10			
12. Maternal education	−.20**	−.09	−.19	−.14	.08	−.12	−.33**	−.18	−.08	−.14	.65**		
13. Maternal ethnicity	.09	.07	.07	.10	−.10	.15	.20	.13	.21	.07	−.59**	−.49**	
14. Infant sex	−.07	.01	−.14	−.03	−.11	.07	−.12	−.03	−.13	−.03	< .01	.08	.05

Note: Significant correlations are one-tailed because hypotheses predicted correlations in only one direction. Correlations with dichotomous variables are point biserial.
* p < 0.05.
** p < 0.01.

At the infant age of 4 months, ten mothers who had scored in the risk zone at the infant age of 6 weeks continued to score in the risk zone (six mothers scored in the risk zone at 4 months but not at 6 weeks). By the infant age of 12 months, only one mother continued to score in the risk zone at all three infant ages (one mother scored in the risk zone at 6 weeks and 12 months, one mother scored in the risk zone at 4 months and 12 months, and three mothers scored in the risk zone for the first time at 12 months).

Mothers' CES-D scores also decreased over the infants' first year, with a significant decrease between the infant ages of 6 weeks and 4 months. Paired *t*-tests indicate mothers' CES-D scores significantly decreased from 6 weeks to 4 months, t (86) = 3.48, $p = 0.001$, and from 6 weeks to 12 months, t (52) = 2.77, $p = 0.008$, but not from 4 months to 12 months ($p = 0.39$). As seen on Table 4, mothers' CES-D scores correlated across the three assessment times: 6 weeks to 4 months: r (87) = 0.48, $p < 0.001$; 6 weeks to 12 months: r (53) = 0.33, $p = 0.008$; 4 months to 12 months: r (53) = 0.57, $p < 0.001$. Thus, mothers retained their rank order of CES-D scores over the infants' first year, although they reduced their scores and consequently their depression risk.

3.2. Hypothesis 1

Compared to mothers who did not indicate depression risk at the infant age of 6 weeks, mothers who indicated depression risk at 6 weeks show less appropriate mind-mindedness at the infant age of 4 months, but do not differ from non-risk mothers in non-attuned mind-mindedness.

As seen on Table 4, mothers' CES-D risk at the infant age of 6 weeks was significantly negatively correlated with maternal appropriate mind-mindedness at 4 months, r (87) = −0.22, $p = 0.023$, whereas the correlation between mothers' CES-D risk at 6 weeks and maternal non-attuned mind-mindedness was non-significant ($p = 0.13$).

ANOVAs with the between variable CES-D group (risk, non-risk) at 6 weeks were conducted on maternal appropriate mind-mindedness and on maternal non-attuned mind-mindedness. The ANOVA on maternal appropriate mind-mindedness indicated a significant effect for group, F (1, 85) = 4.10, $p = 0.046$, $\eta_p^2 = 0.046$. Mothers in the risk CES-D group when their infants were 6 weeks had lower appropriate mind-mindedness ($M = 3.83\%$, $SD = 3.85\%$) when the infants were 4 months than mothers in the non-risk CES-D group ($M = 6.13\%$, $SD = 5.30\%$). There was no significant difference between the groups for non-attuned mind-mindedness ($p = 0.26$; risk group: $M = 3.90\%$, $SD = 4.06\%$; non-risk group: $M = 2.94\%$, $SD = 3.50\%$).[5]

As a check for whether concurrent maternal depression risk was associated with maternal mind-mindedness at 4 months, ANOVAs with the between variable CES-D group (risk, non-risk) at 4 months were conducted on maternal appropriate mind-mindedness and on non-attuned mind-mindedness. There was no significant difference between the groups for appropriate mind-mindedness ($p = 0.38$; risk group: $M = 6.42\%$, $SD = 7.71\%$; non-risk group: $M = 5.19\%$, $SD = 4.19\%$) or non-attuned mind-mindedness ($p = 0.92$; risk group: $M = 3.33\%$, $SD = 4.58\%$; non-risk group: $M = 3.22\%$, $SD = 3.49\%$). Additionally, Table 4 indicates that mothers' CES-D risk at the infant age of 4 months was not significantly correlated with maternal appropriate mind-mindedness ($p = 0.19$) or non-attuned mind-mindedness ($p = 0.46$).

3.3. Hypothesis 2

Maternal depression risk at the infant age of 6 weeks is negatively associated with infants' secure attachment and positively associated with infants' degree of disorganized attachment behavior at one year; and maternal appropriate mind-mindedness at 4 months is positively associated with infants' secure attachment and negatively associated with infants' degree of disorganized attachment behavior at one year. Maternal appropriate mind-mindedness at the infant age of 4 months mediates the effect of maternal depression risk at the infant age of 6 weeks on infants' secure attachment and/or degree of disorganized attachment behavior at one year.

As seen on Table 4, infants' attachment security (secure vs. insecure/disorganized) at one year was not significantly correlated with maternal appropriate mind-mindedness ($p = 0.27$) or non-attuned mind-mindedness ($p = 0.10$) at 4 months or mothers' CES-D depression risk at 6 weeks ($p = 0.29$) (or depression risk at 4 months, $p = 0.19$, or 12 months, $p = 0.24$). However, infants' degree of disorganized attachment behavior at one year was significantly positively correlated with maternal CES-D risk at 6 weeks, r (53) = 0.24, $p = 0.042$ (but not at 4 months, $p = 0.23$, or 12 months, $p = 0.28$), and was significantly negatively correlated with maternal appropriate mind-mindedness at 4 months, r (53) = −0.38, $p = 0.003$, but not with non-attuned mind-mindedness ($p = 0.06$).

An analysis was conducted to determine whether maternal appropriate mind-mindedness mediated the effect of mothers' CES-D depression risk at 6 weeks on infants' degree of disorganized attachment behavior at one year (a similar mediation analysis was not conducted on infants' attachment security (secure vs. insecure/disorganized) due to non-significant correlations among infants' attachment security, maternal depression risk at 6 weeks, and maternal appropriate mind-mindedness). The mediation analysis used the PROCESS macro for SPSS (Hayes, 2013). The confidence interval for the indirect effect was a bias-corrected bootstrapped confidence interval based on 1000 samples. Significance is concluded if the 95% Confidence Interval (CI) does not include zero. The indirect effect of CES-D depression risk at 6 weeks on infants' degree of disorganized attachment behavior through maternal appropriate mind-mindedness was not significant, b = 0.33, 95% CI: −0.02–1.02. When the analysis was conducted controlling for maternal age, which correlated with depression risk, the indirect effect also was not significant, b = 0.32, 95% CI: −0.01–0.86. Thus,

[5] The levels of appropriate mind-mindedness (appropriate mind-minded comments divided by total number of comments) and non-attuned mind-mindedness (non-attuned mind-minded comments divided by total number of comments) for the mothers with non-risk CES-D scores are comparable to the levels of appropriate and non-attuned mind-mindedness reported in other studies of non-risk samples (e.g., Meins et al., 2011, 2012).

Table 5
Linear Regression Predicting Infants' Degree of Disorganized Attachment Behavior at 12 Months.

Predictor Variable	β	*t*	*p*
Step 1			
Maternal age	−0.20	−1.46	0.151
F (1, 49) = 2.13, p = 0.151; R^2 = 0.042, Adjusted R^2 = 0.022			
Step 2			
Maternal age	−0.17	−1.30	0.200
Mothers' 6-week CES-D risk	0.15	1.11	0.274
Mothers' appropriate mind-mindedness	−0.34	−2.55	0.014
F (3, 47) = 3.80, p = 0.016; R^2 = 0.195, Adjusted R^2 = 0.144, R^2 change = 0.154			

maternal appropriate mind-mindedness at the infant age of 4 months did not mediate the effect of mothers' CES-D depression risk at the infant age of 6 weeks on infants' degree of disorganized attachment behavior at one year.

To further investigate the predictive relation of mothers' 6-week CES-D depression risk and 4-month appropriate mind-mindedness on infants' degree of disorganized behavior at one year, a linear regression analysis was conducted with mothers' CES-D depression risk at 6 weeks and maternal appropriate mind-mindedness at 4 months as predictor variables and infants' degree of disorganized attachment behavior at one year as the outcome variable. As a control, maternal age, the only demographic variable correlated with the predictor or outcome variables, was entered as a first step. Table 5 shows that maternal appropriate mind-mindedness was the only significant predictor of infants' degree of disorganized attachment behavior; together the predictor variables accounted for 15.4% of the variance.[6]

4. Discussion

The results of this longitudinal study indicate that mothers at risk for depression at the infant age of 6 weeks were less appropriately mind-minded during interactions with their infants at 4 months, even though mothers' depression risk had declined by this time. Mothers' appropriate mind-mindedness at 4 months, in turn, was negatively associated with infants' degree of disorganized attachment behavior during the Strange Situation at the infant age of one year.

The number of mothers who indicated risk for depression on the CES-D declined over the infants' first year, with the greatest reduction between the infant ages of 6 weeks and 4 months. As has been found in previous studies (Beeghly et al., 2002; Bigelow et al., 2012), mothers' CES-D scores were highest in the first postpartum weeks. Although mothers' CES-D scores showed a stable ranking over the three assessment times, consistent with Beeghly et al. (2002), as the scores declined from the peak at 6 weeks, fewer mothers' scores were in the risk zone for depression. In the first weeks of their infants' lives, mothers face many transitions: physically, hormonally, behaviorally, and socially (Christie, Pouton, & Bunting, 2008). Thus, the first weeks of an infant's life may be more emotionally demanding on the mother than when the infant is older. The mothers' decline in depression risk between 6 weeks and 4 months postpartum reflects this reality.

The results support the first hypothesis. Compared to non-risk mothers, mothers who indicated depression risk at the infant age of 6 weeks showed less appropriate mind-mindedness at the infant age of 4 months, but no difference in non-attuned mind-mindedness. Replicating previous findings (Meins et al., 2002, 2012), mothers' appropriate mind-mindedness and non-attuned mind-mindedness were unrelated, suggesting that these two indices of mind-mindedness tap different aspects of maternal relatedness. The association between maternal depression risk at 6 weeks and appropriate mind-mindedness is similar to the findings of Pawlby et al. (2010) who investigated clinically depressed mothers' mind-mindedness with their 2.5-month-old infants upon admission to the hospital. They found that, compared to non-depressed control mothers, the depressed mothers tended to have less appropriate mind-mindedness, but did not differ in non-attuned mind-mindedness. Depression appears to affect mothers' ability to tune into their infants' mental states with their comments, but does not necessarily lead to mothers misreading their infants' mental states.

However, at the infant age of 4 months, mothers at risk for depression did not differ from non-risk mothers in appropriate mind-mindedness or non-attuned mind-mindedness. Prior maternal depression risk at 6 weeks, rather than concurrent depression risk at 4 months, was associated with lower appropriate mind-mindedness. Maternal depression in infants' early life may be particularly detrimental to emerging mother-infant interactive patterns. Mother-infant interactions are transactional in that both partners influence each other, yet mothers are primarily responsible for establishing and maintaining interactions with their infants, particularly in the infants' early life (Henning & Striano, 2011; Kaye & Fogel, 1980). Around two months of age, major changes occur in infants' ability to notice, and be sensitive to, social overtures (Rochat, 2001). Infants with non-depressed mothers become more active and engaged social partners during this period (Henning, Striano, & Lieven, 2005; Fogel, 2002, 2005;), whereas infants with depressed mothers begin to reflect their mothers' depressed behavior (Field, 1987). Thus by 4 months, even though mothers who were

[6] To determine the specific contribution of maternal appropriate mind-mindedness to infants' degree of disorganized attachment behavior, a regression analysis was conducted post hoc in which maternal age was entered as a first step, CES-D depression risk at 6 weeks was entered as a second step, and maternal appropriate mind-mindedness was entered as a third step, with infants' degree of disorganized attachment behavior as the outcome variable. Maternal appropriate mind-mindedness was the only significant predictor of infants' degree of disorganized attachment behavior (β = −0.34, t = −2.55, p = 0.014), accounting for 11.1% of the variance, F (3, 47) = 3.80, p = 0.016; R^2 = 0.195, Adjusted R^2 = 0.144, R^2 change = 0.111.

previously at risk for depression may no longer be experiencing as many depressive symptoms, behavioral patterns may be in place that affect how infants respond to their mothers and how mothers relate to their infants. These patterns may extend to mothers' ability to engage in appropriate mind-mindedness.

The few community sample studies that have investigated the association between mothers' depressive symptoms and their mind-minded speech to infants under one year of age have had mixed results. Lundy (2003) found an inverse association between mothers' depressive symptoms and appropriate mind-mindedness, whereas Rosenblum et al. (2008) and Meins et al. (2011) found no association. These studies assessed maternal depressive symptoms and mind-mindedness concurrently in the second half of the infants' first year. Thus, mothers' depressive symptoms in their infants' early infancy, when such symptoms are most prevalent, were not assessed. Moreover, these previous studies did not specifically examine depression risk. It is noteworthy that in the present study, mothers' CES-D scores treated as a continuous variable did not relate to maternal appropriate mind-mindedness, whereas the CES-D scores grouped for depression risk at 6 weeks did. Perhaps mothers who are at risk for depression or clinically diagnosed with depression, as in Pawlby et al.'s (2010) study, are particularly vulnerable to impaired appropriate mind-mindedness with their infants. Murray et al. (1993) found that, compared to non-depressed mothers, mothers who were depressed were less infant-focused in their speech when engaged with their infants and were less likely to assign agency to their infants' behavior. Kaminer et al. (2007) found that mothers with a self-critical type of depressive experience used more critical and less positive speech to their infants. The social withdrawal, self-focus, fatigue, irritability, or intrusion that tends to accompany depression may inhibit mothers' ability to attune to infants' internal states and engage in appropriate mind-minded discourse.

In support of the second hypothesis, infants who scored high on disorganized attachment behavior at one year were more likely to have mothers with depression risk when infants were 6 weeks, and less likely to have mothers with high appropriate mind-mindedness when infants were 4 months. However, neither maternal depression risk at 6 weeks nor maternal appropriate mind-mindedness at 4 months was associated with infants' later attachment classifications as secure vs. insecure/disorganized in the current study. Moreover, maternal appropriate mind-mindedness did not mediate the effect of maternal depression risk at 6 weeks on infants' degree of disorganized attachment behavior. When both maternal depression risk at 6 weeks and maternal appropriate mind-mindedness at 4 months were considered together, only maternal appropriate mind-mindedness predicted infants' degree of disorganized attachment behavior. Infant disorganized attachment behavior may be particularly reflective of infants' experience with lower levels of maternal appropriate mind-mindedness.

The association between lower maternal appropriate mind-mindedness at 4 months and higher degree of infant disorganized attachment behavior at one year reflects a central issue in the origins of disorganized attachment, which concerns disturbances in maternal recognition of the infant, resulting in difficulties in the infant's knowing, and feeling known by, the mother (Beebe et al., 2010). Maternal appropriate mind-mindedness addresses a similar issue: mothers' ability to recognize and respond appropriately to their infants' mental states as expressed in infant behavior.

In early dyadic interactions between infant and mother, patterns of intimate relating are being constructed. These patterns influence the infant's emotional experiences and expectations and form the basis of later attachment classifications (Bowlby, 1973; Bretherton, 1980; Bretherton & Munholland, 1999; Main, Kaplan, & Cassidy, 1985). In a microanalysis of mother-infant interaction, Beebe et al. (2010) found that 4-month patterns of self and interactive contingency (measured by time-series methods), as well as specific behavioral qualities, predicted infant disorganized attachment at one year. The findings identified early difficulties in the infant's ability to predict what would happen next, both in the self and the mother, as well as disturbances in the infant's experiences of recognition. For example, Beebe et al. (2010) proposed that the future disorganized infant has difficulty *feeling known* by the mother when the mother looks away repeatedly and unpredictably, so that the infant may not feel *seen*; when the mother does not contingently coordinate her facial-visual engagement with the infant's facial-visual engagement, so that the mother does not follow the overall *gestalt* of her infant; and when the mother does not coordinate her affectionate-to-intrusive touch patterns with the infant's frequency of touch, so that she does not seem to *read* the infant's state of arousal expressed in the infant's touch. In clinical observations, Beebe et al. (2010) noted that mothers of disorganized infants do not appear curious about, and make little effort to repair, communicative disruptions, suggesting maternal difficulty in thinking about the infant's mind and motivation (Fonagy et al., 2002). Thus, mothers of infants who later are judged to have disorganized attachments have difficulty recognizing and responding appropriately to their infants' behavioral states.

By studying a community sample, the present study sought to provide findings that were reflective of the general population rather than a demographic subgroup. However, a high number of infants in the sample were classified with disorganized attachment as well as insecure resistant attachment, which limits the generalizability of the findings. Although the reasons for the unusual attachment distribution are unknown, the findings illustrate that it cannot always be assumed that low risk exists in community samples. Dyads with high levels of infant disorganized attachment behaviors may easily go undetected in community samples.

The study had several limitations. First, the sample size was relatively small, which reduces the power of analyses, decreasing the likelihood of finding significant results. The size of the sample may have contributed to the lack of significant results relating to the infants' secure vs. insecure/disorganized attachment classifications. Yet despite the relatively small sample size, significant associations were documented among maternal 6-week depression risk, maternal 4-month appropriate mind-mindedness, and infants' one-year degree of disorganized attachment behavior, suggesting that the findings are robust. Second, the attrition rate between the 4-month and 12-month lab sessions was high, due primarily to mothers returning to work. The returning dyads at 12 months tended to be biased toward older, more educated mothers. Third, maternal mind-mindedness was assessed from a short mother-infant interaction of only two and a half minutes. However, several studies of mind-mindedness have used assessments only a few minutes longer (Licata et al., 2014; Slaughter, Peterson, & Carpenter, 2009), and at least one study used a shorter time-frame (Marcoux, Bernier, Séguin, Armerding, & Lyons-Ruth, 2017). Yet mind-mindedness assessed from a longer time period might have increased the

variability in the mothers' mind-minded comments. Fourth, maternal appropriate mind-mindedness accounted for a relatively small percentage of the variance in infants' degree of disorganized attachment behavior at one year. Certainly factors besides maternal appropriate mind-mindedness measured at 4 months contributed to infants' degree of disorganized attachment behavior at one year. Nevertheless, maternal appropriate mind-mindedness at 4 months was a significant predictor of infants' degree of disorganized attachment behavior 7.5 months later.

4.1. Conclusions

Mothers who are at risk for depression may be hampered in their capacity to move from their own negative or flattened mood states, or their intrusive behaviors, to recognize and respond appropriately to their infants' mental states, as reflected in lowered maternal appropriate mind-mindedness. Infants with mothers who have difficulty recognizing and responding appropriately to their mental states may have an impaired sense of feeling known and recognized. Difficulty in feeling known and recognized is a central theme in the origins of disorganized attachment (Beebe et al., 2010).

Conflicts of interest

None.

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