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Parental embodied mentalizing: Associations with maternal depression, anxiety, verbal mentalizing, and maternal styles of interaction

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ABSTRACT

Background: Maternal depression and anxiety in the perinatal period affect the quality of maternal sensitivity and mentalizing abilities. Few studies analyzed implicit mentalizing in relation to maternal distress. The aims of the study were: to examine the relation between nonverbal mentalizing - parental embodied mentalizing (PEM) - and maternal depression and anxiety, verbal mentalizing, and maternal styles of interaction; and to test PEM as a mediator of the effect of maternal distress on styles of interaction.

Method: 81 mother-infant dyads have been recruited. At infant three months, maternal depression was assessed using the Edinburgh Postnatal Depression Scale, anxiety with State Trait Anxiety Inventory, and reflective functioning with Reflective Functioning Scale. Mother–infant interactions were coded with various approaches: PEM for nonverbal mentalizing, Mind-mindedness coding system for Mind-mindedness, and CARE-Index for maternal styles of interaction.

Results: Maternal depression and state anxiety were negatively correlated with PEM. PEM was also negatively correlated to maternal controlling style. Mothers with psychopathological problems (vs. mothers with no psychopathological problems) had lower PEM and sensitivity and more controlling style. Moreover, maternal depression and anxiety had direct effects on maternal sensitivity and had indirect effects mediated by PEM on controlling style.

Limitations: The study evaluates interactions at three months; longitudinal studies will be able to examine maternal mentalizing and sensitivity in various stages and identify the effect on the child's attachment.

Conclusions: PEM is associated to maternal anxiety and depression and mediates the effects of depression and anxiety on mother controlling style. These results emphasize the importance of early prevention programs for mothers focused also on implicit mentalizing.

1. Introduction

In the perinatal period, anxiety and depression, often in comorbidity, are the most significant disorders which affect mothers (Cameron et al., 2016; Kessler et al., 2005). Maternal depression and anxiety can have a negative effect on the quality of maternal parenting and the mother-infant interaction, since mothers with postpartum depression and anxiety tend to respond with less sensitivity to their infants' needs (Bernard et al., 2018; Granat et al., 2017). Several studies, in fact, show that maternal depression is associated with maternal intrusiveness or/and unresponsiveness, maternal withdrawal, emotional detachment, and lower maternal structuring behavior (Feldman et al., 2009; Hakanen et al., 2019; Ierardi et al., 2019). Moreover, depressed mothers, that are often characterized with negative or flattened mood states, are less likely to comment appropriately on their infants' thoughts and feelings, and they tend to react to the infant in intrusive way, e.g., high levels of attention-seeking and touching the infant (Pawlby et al., 2010). Similar results were found also in interactions of anxious mothers and their infants, since maternal anxiety is associated with inadequate mother-infant emotion regulation, negative behavior on the part of both mother and infant and mismatches involving one of the partners being negative (Ierardi et al., 2019; Murray et al., 2007; Riva Crugnola et al., 2016b). The behavior of anxious mothers is described in terms that reflect exaggerated, and often inappropriate responses to their infant

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and typically marked by over-reactivity in the form of intrusiveness, overprotection, and overcontrol (Kaitz and Maytal, 2005).

Maternal postpartum depression and anxiety may also have a negative effect on the mother's mentalizing abilities (Bigelow et al., 2018). Maternal mentalizing refers to the mother's ability to comprehend her and her infant's mental state, and to treat her infant as a psychological agent with its own desires and feelings (Yatziv et al., 2018). Maternal mentalizing can be measured by different ways: for example, by an interview, in which the mother's reflective thinking about her infant's mental state is verbally expressed (Slade, 2005); by the "Mind-mindedness" (MM) coding system which evaluates the mother's comments regarding the infant's mental and emotional state (Meins, 1999); by Reflective Functioning Scale which examine the capacity to understand one's own and others in terms of intentional mental states, such as feelings, desires, wishes, goals, and attitudes (Fonagy et al., 1998). However, previous studies have found mixed results. For example, Cordes et al. (2017) and Stephanie and Brigitte (2021) reported no significant relation between Reflective Functioning (RF) and maternal postpartum depression, whereas other studies found that more severe depressive symptoms in high-risk samples was associated with low RF (Taubner et al., 2011; Fischer-Kern et al., 2015). Concerning the association between maternal depression and MM, Pawlby et al. (2010) found no significant correlation, whereas Bigelow reported that mothers who indicated depression risk at the infant age of six weeks showed less appropriate mind-mindedness at the infant age of four months (Bigelow et al., 2018).

These measurements evaluate only verbal mentalizing ability, which require involving of the mother's awareness and an explicit metacognition of the mentalizing abilities. Thus, it is possible that the focus on the explicit and verbal processes of mentalizing fail to fully capture the mentalizing processes, especially in observing the interaction of depressed and anxious mothers, which psychopathological distress might affect their nonverbal communication.

Parental Embodied Mentalizing (PEM) was developed in the effort to investigate the implicit level of mentalizing, through the meeting of parent and infant's minds from an embodied relational perspective and nonverbal communication (Shai and Belsky, 2011). The nonverbal communication is bidirectional with mutual influence, as the parent and the infant react to each other through their body movements (Beebe, 2000), and it can occur outside of awareness, for both the parent and the infant (Shai and Fonagy, 2014). The PEM coding system strives to evaluate the parent's embodied mentalizing capacity to recognize and respond to the infant's mental state from his or her own body movements (Shai and Belsky, 2017; Shai and Fonagy, 2014). Since the parental embodied mentalizing is examined in the dyadic context, the parent's and infant's body movements are considered as one unit, rather than being assessed separately. This joint unit refers the interaction as an embodied communicative chain, a micro embodied narrative, where the focus is not on who did what, but on how one responded to the other (Shai and Belsky, 2017). However, a full and perfect match between the parent's and infant's minds is relatively rare. According to Tronick (2017), mismatch in the parent-infant interaction is highly critical to the infant's development. Although a mismatch evokes negative affect and stress, the repair that follows the interactive errors is essential to the development of infants' sense of self and the emotional quality of their relationship with their partners. Therefore, PEM regards the parents' ability to repair these dyadic mismatches, that can be reflected by the parents' capacity to modify their own kinesthetic patterns in response to their failures and to respond more accurately to the infant's mental state (Shai and Belsky, 2017).

Parental embodied mentalizing ability seems to have an influence on the course of infant development, since it was found that PEM can predict the child's cognitive and social-emotional development (Shai and Belsky, 2017) and that infants of mothers with high PEM rating were more likely to develop secure attachment (Gagné et al., 2021; Shai and Belsky, 2017; Shai and Meins, 2018). A positive correlation was also found between PEM and MM, as PEM was positively correlated with appropriate mind-related comments but not related to non-attuned mind-related comments (Gagné et al., 2021; Shai and Meins, 2018), as well as between PEM and parental RF (Shai et al., 2017). Therefore, it is reasonable to assume that the verbal (MM) and nonverbal (PEM) mentalizing assessments examine different aspects of the parental mentalizing capacity. While the assessment of MM thrives to capture the parents' verbal ability to reflect the infant's mental state and attribute parental mentalizing more as a declarative ability, involving explicit and conscious verbal comments, the measurement of PEM allows to examine the parents' mental ability through their body language, hence their nonverbal reaction and focuses more on the implicit, nonconscious, and automatic aspect of parental mentalizing (Shai and Belsky, 2011; Shai and Meins, 2018).

Only two studies have investigated the relationship between PEM and maternal depression, finding mixed results. Garset-Zamani et al. (2020) suggested that only mothers that meet the criteria for a postpartum depression diagnosis had difficulties in recognizing and understanding the infant's mental states from the infant's whole-body movements and demonstrated difficulties in modifying their own kinesthetic patterns according to the infant. Importantly, these findings were revealed only when controlling for the self-reported severity of depressive symptoms. According to the authors, these findings indicate that both a clinical diagnostic interview and the assessment of concurrent depressive symptoms (relaying on a self-report) are significant in revealing the negative impact of post-partum depression. Væver et al. (2020) did not find differences in PEM between the clinical group of depressed mothers and the non-clinical group of non-depressed mothers, although an exploratory analysis found that some behavioral components were yet compromised by postpartum depression, especially those related to the sensitivity composite. These embodied behaviors convey a low degree of emotional content, and more "instrumental" themes of embodied behavior, e.g., adjusting the child's seating position (Transition) and treating the infant as the owner of his/her own body (Body Ownership).

Interestingly, although maternal anxiety was found in previous studies as a great predictor of lower maternal sensitivity, even more than maternal and paternal depression (Ierardi et al., 2019) and that level of anxiety, even more than depression, increased the mother's lack of responsiveness to infant (Beebe et al., 2011), no study has examined the relation between PEM and anxiety.

Finally, some studies have investigated the relation between PEM and maternal sensitivity, finding that PEM and sensitivity are associated but the two constructs capture different aspects of the maternal behavior during the interaction and add a unique contribution. PEM examines only nonverbal aspects of interactive moments in which the infant signals the content of their mental states. In contrast, sensitivity captures also verbal aspects and the parents' responsivity to the behavioral and physical needs. In this regard, Shai and Belsky (2017) and Shai and Meins (2018) found a moderate positive correlation between PEM and sensitivity in mother-infant interactions, at infant's age of six months. Gagné et al. (2021) showed that maternal sensitivity, measured at infant's age of eight months, mediated the association between PEM and infant attachment. Another study (Vaever et al., 2020) found significant associations between PEM and maternal sensitivity at infant four months.

1.1. The current study

The first aim of the study is to investigate the associations between maternal depression and anxiety, maternal styles of interaction, and verbal and nonverbal maternal mentalizing. In this regard, we hypothesize that PEM will be negatively associated to maternal depression and anxiety and will be positively associated to maternal sensitivity. Moreover, we hypothesize that PEM will be associated to maternal MM. At an exploratory level we will examine the associations between PEM and RF.

The second aim, at the exploratory level, is to test whether PEM mediates the relationship between maternal anxiety and depression and maternal styles of interaction.

2. Method

2.1. Participants

The participants were 81 mother-infant dyads with mothers aged between 23 and 44 years (M = 33.42, SD = 5.04). The mothers' years of education ranged between 8 and 18 years (8.2% had left school at the age of 16, 52.1% had a high-school diploma and 39.7% had a university diploma). 4% of the mothers were single and 96% were married or lived with their partners. 83.3% of the mothers had jobs. The criteria include mothers who must have no diagnosed maternal psychotic psychopathology, or physical illness and must speak and understand Italian; infants had to be born full term without organic pathologies.

The mother-infant dyads were recruited in family centers and in hospitals of the 'Azienda Sanitaria Locale No. 2 Savonese' that are located in Northern Italy. The study protocol was approved by the institutional review board of the University of Milano- Bicocca. All participants gave their written informed consent.

2.2. Procedure

At three months postpartum, the mothers were given self-reported questionnaires to assess depression, anxiety, parenting stress, and gathering sociodemographic information; mothers' RF was evaluated with the Adult Attachment Interview (AAI; George et al., 1985). Mother-infant dyads were video-recorded for five minutes in a laboratory consisting of a suitably furnished playroom. Mothers were instructed to interact with the infant as they would normally do at home. The behavior of the dyad was coded in various approaches.

2.3. Measures

2.3.1. Postpartum depression

The Edinburgh Postnatal Depression Scale (EPDS) (Benvenuti et al., 1999 for Italian version) is a 10-item self-report questionnaire that evaluates postpartum depression. In this study, the cutoff used to evaluate probable depression in mothers was ≥9. In our study, internal consistency for the EPDS was good (Cronbach's α = 0.80).

2.3.2. Anxiety

Maternal anxiety was assessed with the State Trait Anxiety Inventory Form Y (STAI-Y; Spielberger et al., 2012 for Italian version), a self-report questionnaire composed of 40 items grouped into two scales relating to State Anxiety, regarding the current state of anxiety, and Trait Anxiety, regarding the type of anxiety which is characteristic with the personality of the subject. In the current study, a cutoff >39 was used for evaluation of state anxiety and a cutoff >42 was used for trait anxiety. In our study, internal consistency for the State Anxiety scale (Cronbach's α = 0.90) and for Trait Anxiety was excellent (Cronbach's α = 0.90).

2.3.3. Parental embodied mentalizing

PEM capacities were assessed using the PEM Coding System (Shai and Belsky, 2017). PEM is coded during free interactions and the coding process is conducted while the sound is muted, therefore PEM coding focuses only on moment to-moment whole-body expressions. To assess PEM, the coder first identifies Embodied Circles of Communication (ECCs), a kinesthetic-manifested communicative exchange between infant and parent. An ECC is a nonverbal, movement-based, and interactive communicative exchange that includes at least three consecutive bodily based action– reaction sequences. The ECCs can be assigned in one of five themes to establish the main purpose or predominant action of the ECC: 1) Embodied Support refers to the parent's own body as a supportive environment for the infant's mental state, 2) Body Ownership, which is the way the parent is treating the infant as the owner of his/her own body and the appreciation of separateness between the infant's and mother's bodies and minds, 3) Transition is demonstrated when the parent moves the infant's entire body, 4) Promoting Exploration is the kinesthetic exchanges between the parent and infant; which specifically focuses on exploring the environment, 5) Connectivity refers to the interaction as mutual and playful, which involves elements of delight and interpersonal intimacy rather than 'functional' behavior. Score is assigned to each of the ECC, reflecting the mother's capacity to respond and adjust her kinesthetic qualities towards the infant's kinesthetic-manifested mental states. The quality of each ECC is rated based on an ordinal scale, with scores ranging from 1 (poor mentalizing and obvious hostility and distortion) to 7 (complex recognition and appreciation of the infant's mental states). Based on the individual PEM ratings, a global PEM score is assigned to the entire interaction, ranging from very low ("1") to very high ("7").

In this study we also use PEM-ECCs score 1 which corresponds to the frequency of extremely low PEM manifestations and indicates an extremely negative body-based communication or clear negative kinesthetic conflict between the parent and infant. These are incidents where the parent evidences a considerable difficulty to keep in mind their infant's mind, and instead, the parent's interactive behavior is led by their own mind only. Such instances could be expressed, for instance, through the parent treating the baby as an inanimate object rather than a subjective person; the parent's movement threatens to place the infant in physical danger; or the parent holds or moves the infant in a bizarre manner (Shai and Belsky, 2017).

All videos were coded by a graduate psychology student who was a trained reliable PEM coder. To assess interrater-reliability, 20% ($n = 16$) of the data was double coded by another trained reliable coder. ICC on global PEM level was 0.92 and ICC on PEM score 1 was 0.94.

2.3.4. Reflective functioning

The Reflective Functioning Scale (RFS) (Fonagy et al., 1998) was applied to the Adult Attachment Interview transcripts (AAI; George et al., 1985), a semi-structured interview designed to classify the state of mind with respect to early attachment experiences. RFS allows for an assessment of the mentalizing of the interviewee, understood as the capacity to give meaning to one's own and others' experiences in terms of mental states and emotions. RF is measured by means of a scale from −1 to 9. Negative RF (−1) covers interviewees who are confused or hostile and refuse all attempts on the part of the interviewer to get them to begin any reflection; Lacking in RF (1) covers interviewees in whom RF is totally or almost totally absent; Questionable or Low RF (3) covers interviewees who display some evidence of awareness of mental states, albeit at a rudimentary level. Ordinary RF (5) covers interviewees who possess some type of model of the mind for attachment figures and of their own mind which is relatively consistent if simple; Marked RF (7) covers interviewees who demonstrates an awareness of the nature of mental states for the entire interview and express efforts to reflect on the mental states underlying behavior; Exceptional RF (9) covers interviewees who are exceptionally sophisticated and surprising, adopting causal reasoning in which mental states are used. Interclass correlation coefficient was ICC = 0.80.

2.3.5. Mind-mindedness

Maternal Mind-mindedness was assessed from a free-play session that is video-taped using Mind-mindedness coding system (Meins and Fernyhough, 2015). Mothers' speech during the sessions is transcribed verbatim, and all comments that include an internal state term that refers to the infant's mind or emotion (mind-related comments) were identified from the transcripts. Mind-related comments included references to wishes and desires, mental states, mental processes, emotions, and comments in which the mother spoke in the first person on the infant's behalf. Mind-related comments were coded dichotomously as

appropriate or non-attuned. Appropriate mind-related comments were coded if: (1) the coder agreed with the mother's reading of her infant's internal state, (2) the internal state comment linked the infant's current internal state to a relevant event in the past or future, (3) the internal state comment served to clarify how to proceed if there was a lull in the interaction, or (4) the mother voiced (using the first person) what the infant might say if he or she could speak. Comments were coded as non-attuned mind-related if: (1) the coder judged that the mother had misinterpreted her infant's internal state, (2) the internal state comment referred to a past or future event that had no obvious relation to the infant's current state, (3) the mother asked what the infant wants to do, or commented that the infant wants or prefers a different object or activity, when the infant was already actively engaged in an activity or showed a clear preference for a particular object, or (4) the referent of the mother's internal state comment was not clear. The MM score was the number of mental descriptors expressed as a proportion of the total number of descriptors used to control for differences in maternal verbosity. Inter-rater reliability was K = 0.92 for appropriate mind-related comments, and K = 0.90 for non-attuned mind-related comments.

2.3.6. Maternal styles of interaction

Styles of interaction were evaluated with the Child-Adult Relationship Experimental Index (CARE-Index) (Crittenden, 1998), a method which coded dyad interactions based on seven behavioral characteristics: facial expressions, vocal expressions, body position and contact, affection, turn-taking, control, and choice of activity. Parental styles of interaction were assessed on three scales: sensitivity with responsiveness towards the emotions and activities of the child, controlling with hostility and intrusiveness towards the activities of the child; and unresponsiveness with physical and emotional detachment. Inter-rater reliability was K = 0.75.

3. Data analysis

The SPSS Statistics 27 package was used for all analyses. Descriptive statistics were calculated with respect to demographic characteristics: *t*-tests and Pearson r correlations were applied. No socio-demographic characteristics had a significant association with the variables of the study. First, we used Pearson r correlation analysis for identify correlation between depression, anxiety, parental embodied mentalizing, MM, RF, and maternal style of interaction. Second, we used *t*-test for independent samples, subdividing the groups to clinical and non-clinical subjects based on the cut-offs of maternal depression and anxiety, to identify significant differences in PEM, MM, RF, and maternal style of interaction. Finally, we tested a mediation analysis models to examine whether PEM mediated the relationship between maternal psychopathological problems and maternal style of interaction.

4. Results

4.1. Correlations

Pearson r correlation was conducted to analyze the associations between maternal depression and anxiety, PEM, RF, MM, and maternal styles of interaction. The results showed that maternal depression was positively correlated to maternal state and trait anxiety. Maternal state anxiety was positively correlated to maternal trait anxiety. Maternal depression and state anxiety were negatively correlated to PEM global score. There were no significant correlations between PEM global score and RF scale or MM attuned mind-related comments and MM non-attuned mind-related comments. Moreover, PEM global score was negatively correlated to maternal controlling style. PEM-ECCs score 1 was positively correlated to state anxiety and maternal controlling and was negatively correlated to sensitivity. Maternal depression and state anxiety were also positively correlated to maternal controlling style and negatively correlated to maternal sensitivity style. State and trait anxiety were positively correlated to MM non-attuned mind-related comments (see Table 1).

4.2. Psychopathological problems

A new variable was created based on the presence\absence of exceeding at least one cut-off in respect to the risk of anxiety (state and trait) and depression. Therefore, two groups were created, which 32% of the sample were in the group with psychopathological problems and 68% of the sample were in the group with no psychopathological problems.

Through an independent-samples *t*-test it was found that mothers with psychopathological problems have lower PEM global score and they are less sensitive and have more controlling style, compared to mothers with no psychopathological problems.

No significant differences were found regard the verbal mentalizing at the RF and MM levels (see Table 2).

4.3. Mediation analysis

Based on the significant correlation between maternal psychopathological problems, PEM, and maternal style of interaction, we decided to test whether the relationship between maternal anxiety and depression and maternal style of interaction was mediated by PEM global score. Thus, four mediation analysis was conducted. In first mediation, maternal depression was predictive of less maternal sensitivity (b = −0.18; $t = -2.38$; $p = .019$) and this relationship was direct and not mediated by PEM global score (b = 0.33; $t = 0.80$; $p = .42$; 95% CI: −0.52, 1.21). Maternal depression was also predictive of higher controlling style (b = 0.28; $t = 3.68$; $p = .000$) and this relationship was partially mediated by PEM global score (b = −0.87; $t = -2.11$; $p = .038$; 95% CI: −1.78, −0.05) (see Fig. 1).

Maternal state anxiety was predictive of less maternal sensitivity (b = −0.09; $t = -2.37$; $p = .020$) and this relationship was direct and not mediated by PEM global score (b = 0.34; $t = 0.80$; $p = .42$; 95% CI: −0.48, 1.13). Maternal state anxiety was also predictive of higher controlling style (b = 0.10; $t = 2.49$; $p = .015$) and this relationship was totally mediated by PEM global score (b = −1.02; $t = -2.38$; $p = .020$; 95% CI: −2.02, −0.09) (see Fig. 2).

5. Discussion

This study examined the relation between different levels of maternal mentalizing, embodied and verbal, and maternal sensitivity and controlling behaviors with maternal psychopathological distress in early mother-infant interaction at three months postpartum. In line with our first hypothesis, maternal distress in the postpartum period was negatively correlated with PEM. Specifically, higher maternal depression score was associated with difficulties in embodied mentalizing. These results are in line with those of previous studies (Garset-Zamani et al., 2020; Vaever et al., 2020) which found a negative effect of maternal depression on PEM. Moreover, maternal anxiety, both state and trait, was also negatively associated with PEM and state anxiety was associated with score 1 in PEM's ECCs. In PEM, a score 1 reflects the lower score of embodied mentalizing, indicating an extremely negative body communication and clear negative kinesthetic conflict between the parent and infant. The current results suggest that higher maternal state anxiety was associated with higher frequency of extremely negative ECC events (i.e., with score 1), and lower PEM global score.

To our knowledge, this is the first study identifying a relationship between PEM and maternal anxiety and might provide new information about the association between anxiety and mother's behavior during dyadic interaction. The study suggest that high state anxiety is associated with difficulties in recognizing and understanding the infant's mental states from the infant's body movements and expressing

Table 1
Correlation between PEM, postpartum depression, anxiety, RF, MM, and styles of interaction.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
PEM (1)	–	−0.61***	−0.31**	−0.30**	−0.12	−0.01	0.02	−0.16	0.18	−0.31**	0.19
PEM-ECC score 1 (2)		–	0.19	0.24*	0.06	0.01	−0.09	0.20	−0.22*	0.27*	−0.10
Depression (3)			–	0.65***	0.65***	−0.03	−0.04	0.23	−0.26*	0.39***	−0.16
State anxiety (4)				–	0.79***	0.02	0.00	0.30*	−0.26*	0.27*	−0.03
Trait anxiety (5)					–	−0.05	−0.08	0.25*	−0.19	0.17	0.02
RF (6)						–	0.11	0.04	0.21	−0.27	0.03
MM attuned (7)							–	−0.01	−0.06	0.02	0.06
MM non-attuned (8)								–	−0.20	0.07	0.13
Sensitivity (9)									–	−0.59***	−0.38***
Controlling (10)										–	−0.47***
Unresponsive (11)											–

* p < .05.
** p < .01.
*** p < .001.

Table 2
Differences between group with psychopathological problems and group with no psychopathological problems.

	Mothers with psychopathological problems	Mothers with no psychopathological problems	t	*p*	d
PEM-global score	2.24 (0.72)	2.73 (0.75)	2.84	0.006**	0.68
PEM-ECC score 1	1.32(1.72)	0.74(1.22)	1.71	0.09	
RF	3.46 (1.50)	4.00 (1.14)	−1.25	0.21	
MM attuned	0.05(0.04)	0.06(0.05)	−0.54	0.58	
MM non-attuned	0.02(0.02)	0.01(0.02)	1.07	0.28	
Sensitivity	7.24(3.01)	9(2.52)	−2.69	0.009**	0.65
Controlling	5.08 (3.06)	3.26 (2.69)	2.65	0.01*	0.64
Unresponsive	1.68 (2.19)	1.75 (2.63)	−0.12	0.90	

* p < .05.
** p < .01.

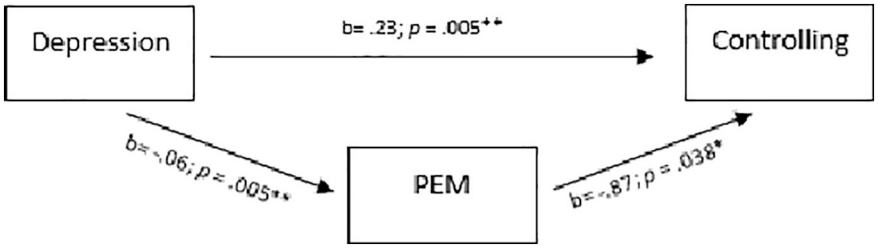

Fig. 1. Direct and indirect effects of PEM and Maternal Depression on Maternal Controlling behaviors.
*p < .05, **p < .01.

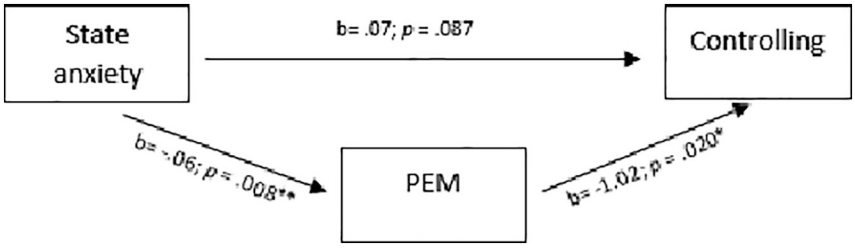

Fig. 2. Direct and indirect effects of PEM and Maternal Sate Anxiety on Maternal Controlling behaviors.
*p < .05, **p < .01.

difficulties in adjusting own body movements in accordance with the infant. In fact, many studies indicate that maternal anxiety affected the quality of parenting with low sensitivity, greater intrusiveness, and low engagement towards their infants (Ierardi et al., 2019; Warren et al., 2003). Our study underlines how anxiety also influences the parent's ability to consider and treat the child's mind, as it is expressed through his or her body movements.

Regarding the relation between maternal styles of interaction and PEM, it was found that maternal controlling style had a negative correlation with PEM global score. In CARE-Index, maternal controlling style is profiled as low maternal sensitivity that involves an 'at risk level' interaction. Mothers with maternal controlling style are described with a rigid facial expression, a strained or exaggerated tone of voice, intrusive poking, manipulation of the infant's body, and acting in a covertly angry way (Kemppinen et al., 2006). Moreover, the results indicate on a positive correlation between maternal controlling style and score 1 in PEM's

ECCs. These findings are in line with the theoretical basis of both measures. In CARE-Index, dyads at high risk can be identified by low maternal sensitivity and high maternal control (Kemppinen et al., 2006). In PEM, a score 1 reflects a lower score of embodied mentalizing, which is described as: the parent presents a difficulty in acknowledging the infant separate mind; the infant seems to be an inanimate object rather than a subjective person; the parent's movement threatens to place the infant in physical danger; the parent holds or moves the infant in a bizarre manner; there is evidence of a physical, muscular conflict between parent and infant, where the parent actively overrides the infant's mental state (Shai and Belsky, 2017). These variables, separately and together, serve as an alarm for detecting risk behavior that might require intervention.

Contrary to our hypothesis, PEM was not associated with maternal sensitivity in the global score. However, we found a significatively positive association between higher frequency of extremely negative ECC events with score 1 and low maternal sensitivity. In this regard, previous studies (Shai and Belsky, 2017; Shai and Meins, 2018; Vaever et al., 2020) suggest the notion that PEM and sensitivity capture different aspects of caregiving behavior and the two variables have a moderate association. The measurement of maternal sensitivity through CARE-Index identifies different modalities of mothers' responding to signals of the child, including appropriate affect, play, controlling, vocalization, and facial expressions. PEM examine the nonverbal and embodied parental reactions to the infant's mental states measured as kinesthetic interactive patterns. Based on the data analysis, we can hypothesize that the aspects of low maternal embodied mentalizing, reflected by high frequency of extremely negative ECC event, better capture the connection with maternal low sensitivity and high intrusiveness.

No significant associations were found between PEM and RF and MM. A possible explanation for this might be since these measures examine different aspects of maternal mentalizing. The reflective functioning scale assesses in general the subject's awareness of the nature of mental states, awareness of the presence of mental states underlying behavior and the ability to reflect on one's own and others' emotional mental states (Fonagy et al., 1998). MM evaluates mentalizing comments that the mother expresses verbally during interactions with the infant. On the contrary PEM, however, emphasize the implicit level of mentalizing, thorough the nonverbal dialogue and the meeting of parent's and infant's minds from an embodied relational perspective (Shai and Belsky, 2011).

In addition, it is interesting to note that dividing the sample by maternal distress, mothers who had at least a psychopathological problem – depression or anxiety - had a lower capacity of parental embodied mentalizing, lower sensitivity, and higher controlling behaviors, compared to mothers who had no psychopathological problems. These results confirmed the effect of postpartum depression and anxiety on maternal parenting and on the mother-infant relationship.

The other aim of the study was to identify whether PEM was a mediating factor with respect to the relationship between maternal distress and maternal styles of interaction. The results indicated that PEM is as a mediator of the relation between maternal distress, both depression and anxiety, and controlling behavior of the mothers. High levels of maternal state anxiety and maternal depression were mediated by low levels of PEM in negatively affecting more maternal intrusive behaviors towards the infant in interactions at three months. On the other hand, the effect of maternal anxiety and depression on maternal sensitive style was direct and not mediated by PEM. We can hypothesize that low levels of implicit mentalizing amplifies the effect of maternal anxiety and depression to a greater extent on the aspect of negative emotionality, involved by controlling and intrusive behaviors, than on sensitivity, explained by terms of general competence.

5.1. Limitations

The study had several limitations. First, the sample of this study is small and limits the generalizability of the results. Second, anxiety and postpartum depression were assessed with questionnaires rather than with clinical interviews, which may be more precise to make a diagnosis. Another limitation of our study is that we did not consider several factors, such as the quality of a couple's relationship, parenting stress, and social support which might serve as risk or protective factors. Lastly, the study evaluates only interactions at three months; longitudinal studies will be able to examine the quality of maternal mentalizing and sensitivity in various stages and identify the effect on the infant's attachment.

6. Conclusions

Our study found significant associations between maternal depression, anxiety and embodied mentalizing, examining how they can influence the quality of maternal interaction styles with three-months-old infants. Specifically, the negative effect of depression and anxiety on maternal intrusive and controlling behaviors was mediated by difficulties in implicit mentalizing. These findings can provide clinical indications for intervention programs aimed at promoting embodied mentalizing in mothers with postpartum depression and anxiety. The mother and the psychologist can analyze together the mother-infant interaction, specifying positive moments and moments that require further work and discussion, to reinforce maternal implicit mentalizing. Video-feedback technique was already found as an effective technique to be used in early interventions, for mother-infant dyads with maternal depressive showing an improvement of maternal sensitivity, and a significant decrease of maternal controlling behavior (Olhaberry et al., 2015). Video-feedback intervention was also found to be useful for mothers at risk, in improving maternal MM and sensitivity and infant cooperative behavior (Riva Crugnola et al., 2016a, 2018, 2021).

Finally, the study highlights the importance of monitoring the mental health of mothers after delivery and of providing them a psychological support. Promoting the mother's well-being is a key factor of also promoting the infant's well-being and can prevent future behavioral problems, of both the mother and the infant.

Conflict of interest

The authors declare that they have no conflict of interest.

CRediT authorship contribution statement

Elena Ierardi: Conceptualization, Formal analysis, Methodology, Writing – original draft. **Adi Dascalu:** Conceptualization, Data curation, Writing – original draft. **Dana Shai:** Conceptualization, Writing – review & editing. **Rose Spencer:** Writing – review & editing. **Cristina Riva Crugnola:** Conceptualization, Methodology, Project administration, Writing – review & editing.

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References

Beebe, B., 2000. Coconstructing mother–infant distress: the microsynchrony of maternal impingement and infant avoidance in the face-to-face encounter. Psychoanal. Inq. 20, 421–440. https://doi.org/10.1080/07351692009348898.

Beebe, B., Steele, M., Jaffe, J., Buck, K.A., Chen, H., Cohen, P., Kaitz, M., Markese, S., Andrews, H., Margolis, A., Feldstein, S., 2011. Maternal anxiety symptoms and mother–infant self-and interactive contingency. Infant Ment. Health J. 32, 174–206. https://doi.org/10.1002/imhj.20274.

Benvenuti, P., Ferrara, M., Niccolai, C., Valoriani, V., Cox, J.L., 1999. The Edinburgh postnatal depression scale: validation for an italian sample. J. Affect. Disord. 53, 137–141. https://doi.org/10.1016/s0165-0327(98)00102-5.

Bernard, K., Nissim, G., Vaccaro, S., Harris, J.L., Lindhiem, O., 2018. Association between maternal depression and maternal sensitivity from birth to 12 months: a meta-analysis. Attach Hum. Dev. 20, 578–599.

Bigelow, A.E., Beebe, B., Power, M., Stafford, A.L., Ewing, J., Egleson, A., Kaminer, T., 2018. Longitudinal relations among maternal depressive symptoms, maternal mind-mindedness, and infant attachment behavior. Infant Behav. Dev. 51, 33–44. https://doi.org/10.1016/j.infbeh.2018.02.006.

Cameron, E.E., Sedov, I.D., Tomfohr-Madsen, L.M., 2016. Prevalence of paternal depression in pregnancy and the postpartum: an updated meta-analysis. J. Affect. Disord. 206, 189–203. https://doi.org/10.1016/j.jad.2016.07.044.

Cordes, K., Smith-Nielsen, J., Tharner, A., Katznelson, H., Steele, H., Vaever, M., 2017. Reflective functioning in postpartum depressed women with and without comorbid personality disorder. Psychoanal. Psychol. 34, 414–421. https://doi.org/10.1037/pap0000135.

Crittenden, P.M., 1998. CARE–index: coding manual. In: Unpublished Manuscript. Miami.

Feldman, R., Granat, A.D.I., 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. J. Am. Acad. Child Adolesc. Psychiatry 48, 919–927. https://doi.org/10.1097/CHI.0b013e3181b21651.

Fischer-Kern, M., Doering, S., Taubner, S., Hörz, S., Zimmermann, J., Rentrop, M., Schuster, P., Buchheim, P., Buchheim, A., 2015. Transference-focused psychotherapy for borderline personality disorder: change in reflective function. Br. J. Psychiatry 207, 173–174. https://doi.org/10.1192/bjp.bp.113.143842.

Fonagy, P., Target, M., Steele, H., Steele, M., 1998. Reflective Functioning Manual, Version 5.0, for Application to Adult Attachment Interviews. University College London, London.

Gagné, K., Lemelin, J.P., Tarabulsy, G.M., 2021. Non-verbal and verbal parental mentalization as predictors of infant attachment security: contributions of parental embodied mentalizing and mind-mindedness and the mediating role of maternal sensitivity. Infant Behav. Dev. 65, 101622 https://doi.org/10.1016/j.infbeh.2021.101622.

Garset-Zamani, S., Cordes, K., Shai, D., Spencer, R., Stuart, A.C., Køppe, S., Væver, M.S., 2020. Does postpartum depression affect parental embodied mentalizing in mothers with 4-months old infants? Infant Behav. Dev. 61, 101486 https://doi.org/10.1016/j.infbeh.2020.101486.

George, C., Kaplan, M., Main, M., 1985. Adult Attachment Interview. Unpublished Manual. University of California, Berkeley.

Granat, A., Gadassi, R., Gilboa-Schechtman, E., Feldman, R., 2017. Maternal depression and anxiety, social synchrony, and infant regulation of negative and positive emotions. Emotion 17, 11–27. https://doi.org/10.1037/emo0000204.

Hakanen, H., Flykt, M., Sinervä, E., Nolvi, S., Kataja, E.L., Pelto, J., Karlsson, H., Karlsson, L., Korja, R., 2019. How maternal pre-and postnatal symptoms of depression and anxiety affect early mother-infant interaction? J. Affect. Disord. 257, 83–90. https://doi.org/10.1016/j.jad.2019.06.048.

Ierardi, E., Ferro, V., Trovato, A., Tambelli, R., Riva Crugnola, C., 2019. Maternal and paternal depression and anxiety: their relationship with mother-infant interactions at 3 months. Arch. Womens Ment. Health. 22, 527–533. https://doi.org/10.1007/s00737-018-0919-x.

Kaitz, M., Maytal, H., 2005. Interactions between anxious mothers and their infants: an integration of theory and research findings. Infant Ment. Health J. 26, 570–597. https://doi.org/10.1016/j.janxdis.2019.102148.

Kemppinen, K., Kumpulainen, K., Raita-Hasu, J., Moilanen, I., Ebeling, H., 2006. The continuity of maternal sensitivity from infancy to toddler age. J. Reprod. Infant Psychol. 24 (3), 199–212. https://doi.org/10.1080/02646830600821249.

Kessler, R.C., Chiu, W.T., Demler, O., Walters, E.E., 2005. Prevalence, severity, and comorbidity of twelve-month DSM-IV disorders in the national comorbidity survey replication (NCS-R). Arch. Gen. Psychiatry 62, 617–627. https://doi.org/10.1001/archpsyc.62.6.617.

Meins, E., 1999. Sensitivity, security and internal working models: bridging the transmission gap. Attach Hum. Dev. 1, 325–342. https://doi.org/10.1080/14616739900134181.

Meins, E., Fernyhough, C., 2015. Mind-mindedness Coding Manual, Version 2.2 (Unpublished Manuscript). Durham University, Durham.

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. J. Child Psychol. Psychiatry 48, 45–52. https://doi.org/10.1111/j.1469-7610.2006.01657.x.

Olhaberry, M., León, M.J., Seguel, M., Mena, C., 2015. Video-feedback intervention in mother-baby dyads with depressive symptomatology and relationship difficulties. Res. Psychother. 18, 82–92. https://doi.org/10.7411/RP.2015.102.

Pawlby, S., Fernyhough, C., Meins, E., Pariante, C.M., Seneviratne, G., Bentall, R.P., 2010. Mind-mindedness and maternal responsiveness in infant–mother interactions in mothers with severe mental illness. Psychol. Med. 40, 1861–1869. https://doi.org/10.1017/S0033291709992340.

Riva Crugnola, C., Ierardi, E., Albizzati, A., Downing, G., 2016a. Effectiveness of an attachment based intervention program in promoting emotion regulation and attachment in adolescen mothers and their infants: a pilot study. Front. Psychol. 7, 195. https://doi.org/10.3389/fpsyg.2016.00195.

Riva Crugnola, C., Ierardi, E., Ferro, V., Gallucci, M., Parodi, C., Astengo, M., 2016b. Mother infant emotion regulation at three months: the role of maternal anxiety, depression and parenting stress. Psychopathology 49, 285–294. https://doi.org/10.1159/000446811.

Riva Crugnola, C., Ierardi, E., Canevini, M.P., 2018. Reflective functioning, maternal attachment, mind-mindedness, and emotional availability in adolescent and adult mothers at infant 3 months. Attach Hum. Dev. 20, 84–106. https://doi.org/10.1080/14616734.2017.1379546.

Riva Crugnola, C., Ierardi, E., Peruta, V., Moioli, M., Albizzati, A., 2021. Video-feedback attachment based intervention aimed at adolescent and young mothers: effectiveness on infant-mother interaction and maternal mind-mindedness. Early Child Dev. Care 191, 475–489. https://doi.org/10.1080/03004430.2019.1652172.

Shai, D., Belsky, J., 2011. When words just won't do: introducing parental embodied mentalizing. Child Dev. Perspect. 5, 173–180. https://doi.org/10.1111/j.1750-8606.2011.00181.x.

Shai, D., Belsky, J., 2017. Parental embodied mentalizing: how the nonverbal dance between parents and infants predicts children's socio-emotional functioning. Attach Hum. Dev. 19, 191–219. https://doi.org/10.1080/14616734.2016.1255653.

Shai, D., Fonagy, P., 2014. Beyond words: parental embodied mentalizing and the parent infant dance. In: Mikulincer, M., Shaver, P.R. (Eds.), The Herzliya Series on Personality and Social Psychology. Mechanisms of Social Connection: From Brain to Group. American Psychological Association, Washington DC, pp. 185–203.

Shai, D., Meins, E., 2018. Parental embodied mentalizing and its relation to mind-mindedness, sensitivity, and attachment security. Infancy 23, 857–872. https://doi.org/10.1111/infa.12244.

Shai, D., Dollberg, D., Szepsenwol, O., 2017. The importance of parental verbal and embodied mentalizing in shaping parental experiences of stress and coparenting. Infant Behav. Dev. 49, 87–96. https://doi.org/10.1016/j.infbeh.2017.08.003.

Slade, A., 2005. Parental reflective functioning: an introduction. Attach Hum. Dev. 7, 269–281. https://doi.org/10.1080/14616730500245906.

Spielberger, C.D., Pedrabissi, L., Santinello, M., 2012. STAI state-trait anxiety inventory forma Y: Manuale. Giunti OS Organizzazioni speciali, Firenze.

Stephanie, K., Brigitte, R., 2021. Various mentalizing concepts in mothers with postpartum depression, comorbid anxiety, and personality disorders. Infant Mental Health J. 42, 488–501. https://doi.org/10.1002/imhj.21914.

Taubner, S., Kessler, H., Buchheim, A., Kächele, H., Staun, L., 2011. The role of mentalization in the psychoanalytic treatment of chronic depression. Psychiatry 74, 49–57. https://doi.org/10.1521/psyc.2011.74.1.49.

Tronick, E., 2017. The caregiver–infant dyad as a buffer or transducer of resource enhancing or depleting factors that shape psychobiological development. Aust. N. Z. J. Fam. Ther. 38, 561–572. https://doi.org/10.1002/anzf.1274.

Væver, M.S., Cordes, K., Stuart, A.C., Tharner, A., Shai, D., Spencer, R., Smith-Nielsen, J., 2020. Associations of maternal sensitivity and embodied mentalizing with infant mother attachment security at one year in depressed and non-depressed dyads. Attach Hum. Dev. 1–18 https://doi.org/10.1080/14616734.2020.1861035.

Warren, S.L., Gunnar, M.R., Kagan, J., Anders, T.F., Simmens, S.J., Rones, M., Wease, S., Aron, E., Dahl, R.E., Sroufe, L.A., 2003. Maternal panic disorder: infant temperament, neurophysiology, and parenting behaviors. J. Am. Acad. Child Adolesc. Psychiatry 42, 814–825. https://doi.org/10.1097/01.CHI.0000046872.56865.02.

Yatziv, T., Kessler, Y., Atzaba-Poria, N., 2018. What's going on in my baby's mind? Mothers' executive functions contribute to individual differences in maternal mentalization during mother-infant interactions. PloS One. 13, e0207869 https://doi.org/10.1371/journal.pone.0207869.