

Parental reflective functioning affects maternal sensitivity

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Parental Reflective Functioning Affects Sensitivity to Distress in Mothers with Postpartum Depression

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in press: *Journal of Child and Family Studies*.

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Abstract

Parental reflective functioning (PRF) refers to the capacity of caregivers to reflect upon their children’s internal mental states and intentions, which is seen as crucial for parental sensitivity, defined as the adequate behavioral response to an infant’s signals. In this study, the effect of maternal PRF on sensitivity during the mother-infant interaction was examined in a clinical sample of 50 mothers who were experiencing postpartum depression and their infants aged three to ten months. Mother and infant were exposed to emotional distress using the still-face procedure. It was hypothesized that low levels of PRF are associated with a decrease in maternal sensitivity in response to distress.

Maternal PRF was assessed using the Parental Reflective Functioning Questionnaire (PRF). The subscales measured interest and curiosity in mental states, certainty about mental states (i.e., the recognition of the opacity of mental states), and pre-mentalizing modes (i.e., non-mentalizing modes), whereas sensitivity was evaluated using the Maternal Behavior Q-Sort (Mini-MBQS-V). The results revealed a significant overall decrease in maternal sensitivity. As expected, the higher the scores on the pre-mentalizing modes, which indicated low levels of mentalizing through the mothers’ repudiation or defense against it, the greater the decreases in sensitivity. No effects with respect to the interest and curiosity in mental states or the certainty about mental states were found. Our findings determined that the pre-mentalizing modes are predictive of sensitivity to distress in mothers with postpartum depression.

Keywords: postpartum depression, parental reflective functioning, maternal sensitivity, still-face procedure.

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Introduction

Parental reflective functioning (PRF) refers to the parents' capacity to think about their own as well as their children's mental states, thereby allowing the parents to create an experience of comfort and safety for the child (Slade, 2005). Normally, parents use mentalizing to understand their children, to explain their children's behaviors and to engage in their children's needs.

It is stated that impairments in reflective functioning lead, especially in emotionally charged interactions, to the re-emergence of modes of thinking that antedate full mentalizing, that is, non- or pre-mentalizing modes (Luyten et al., 2009). With respect to PRF, difficulties in mentalizing may hinder parents from recognizing that their infants have subjective inner worlds of feelings and thoughts that influence their behaviors (Rutherford, Booth, Luyten, Bridgett, & Mayes, 2015). If parents engage in pre-mentalizing modes, they exhibit difficulties recognizing their infants' limited sense of self and behavior and tend to make inaccurate or hostile attributions towards their infants (Burkhart, Borelli, Rasmussen, Brody, & Sbarra, 2017; Rutherford et al., 2015). It is argued that parents might engage in pre-mentalizing modes as a defensive strategy to avoid being overwhelmed by their infant's distress (Burkhart et al., 2017).

There is evidence that impairments in the mothers' PRF are associated with the development of insecure attachment in their infants and increased vulnerability for psychological disorders in childhood, adolescence and adulthood (Bouchard et al., 2008; Carlson, 1998; Ensink, Normandin, Plamondon, Berthelot, & Fonagy, 2016; Fonagy et al., 1996; Lyons-Ruth et al., 2013; Slade, Grienberger, Bernbach, Levy, & Locker, 2005). Furthermore, impairments in PRF have also been associated with problems in the development of reflective functioning in children (Fonagy & Target, 2006).

An important capacity in which PRF is assumed to be involved is maternal sensitivity (Fonagy, 2000; Fonagy & Target, 1997). Traditionally, maternal sensitivity is defined as the adequate, prompt, appropriate and contingent behavioral responses to the infants' needs and signals and can be considered the mechanism by which a mother's understanding of the child's mental states is communicated to the child (Ainsworth, Blehar, Waters, & Wall, 1978; Grienberger, Kelly, & Slade, 2005). Maternal sensitivity has been found to be related to the development of attachment security in children as well (De Wolff & van Ijzendoorn, 1997). A growing body of evidence indicates that maternal sensitivity is significantly influenced by PRF. For example, in a parenting intervention study, improvements in PRF in substance-abusing mothers corresponded with improvements in maternal behaviors towards their 12- to 36-month-old toddlers (Suchman, DeCoste,

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1 Castiglioni, Legow, & Mayes, 2008; Suchman et al., 2010). In another study, middle to upper class mothers
2 who showed lower levels of reflective functioning exhibited higher levels of disrupted communication, e.g., not
3 offering comfort when an infant falls, criticizing the infant, or not acknowledging the infant after a separation)
4 with their 14-month-old infants in the Strange Situation procedure, in which the mother and infant are separated
5 for one minute. This procedure is used to determine the quality of the infant's attachment to his mother
6 (Grienenberger et al., 2005). In a socioeconomically diverse sample, PRF was found to be positively related to
7 maternal sensitivity (Stacks et al., 2014). Taken together, the results indicate the crucial role PRF plays in
8 influencing maternal behavior.

9 With respect to distressful mother-infant contexts, it is theoretically assumed that PRF may enable
10 caregivers to respond to infants in a sensitive way. Furthermore, there is some evidence that psychosocial
11 distress reduces the mother's ability to be sensitive towards her infant in general (Leerkes, 2011; Mills-Koonce
12 et al., 2011; Pereira et al., 2012). Psychosocial stress can be elicited through the mother's own mental or
13 physical state or by the infant's signs of distress, e.g., whining, crying, and fussing), as the distress may be
14 induced experimentally by the still-face paradigm (SFP), in which the mother must remain completely
15 unresponsive to the infant for one or two minutes (Tronick, Als, Adamson, Wise, & Brazelton, 1978). The SFP
16 was designed to observe the face-to-face interaction as a response to a brief interruption of an interaction
17 between mothers and infants aged three to nine months (Tronick et al., 1978). As prior research has found, the
18 unresponsiveness in the still-face episode typically elicits considerable psychosocial distress in both the
19 caregivers and the infants (Haltigan, Leerkes, Supple, & Calkins, 2013; Haley & Stansbury, 2003; Mayes,
20 Carter, Egger, & Pajer, 1991; Moore et al., 2009; Moore & Calkins, 2004).

21 The few still-face studies in which maternal sensitivity was assessed twice, namely, before and after the
22 still-face episode, revealed inconsistent results concerning the impact of emotional distress on maternal
23 sensitivity. In two studies, decreases in maternal sensitivity due to the still-face episode were reported (Conradt
24 & Ablow, 2010; Smaling et al., 2016). At the same time, in a third study, increases in sensitivity after the still-
25 face episode and a decrease after a second still-face episode were found (Haley & Stansbury, 2003). However,
26 as none of these studies investigated the effect of the SFP on sensitivity as a main hypothesis, they provide no
27 information about the significance of pre-post differences in sensitivity or the potential role of PRF on maternal
28 sensitivity in highly distressing situations.

29 In addition to PRF, another important factor that may influence maternal sensitivity is postpartum
30 depression (PPD). PPD is prevalent among 10 to 15 % of all new mothers (Reck, 2007). Meta-analytic studies

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1 have confirmed a negative impact of PPD on mother-child interactions, maternal behavior and maternal
2 sensitivity (Beck, 1995; Crockenberg & Leerkes, 2003, Field, 2010; Lovejoy et al., 2000; Trapolini, Ungerer, &
3 McMahon, 2008).

4 The long-term consequences of PPD on child behavior and development through infancy and childhood
5 are numerous. For example, children of mothers with PPD exhibit less engagement with objects, reveal less
6 positive and more negative effects even at two months of age, demonstrate depressive and withdrawn behavior
7 styles from the age of three months, and display frequent avoidant attachment and decelerated development at
8 one year of age (Campbell & Cohn, 1991; Cummings & Davies, 1994; Lyons-Ruth, Zoll, Connell, &
9 Grunebaum, 1986). Furthermore, PPD at four months postpartum has been linked to children's behavior
10 problems at three years and at eight years (Closa-Monasterolo et al., 2017; Ghodsian, Zajicek, & Wolkind,
11 1984). Hence, it is evident that PPD has a significant impact on maternal sensitivity and on the development of
12 the child.

13 While the negative association of PPD with maternal and infant behavior has been confirmed several
14 times, the association between PPD and PRF is not as clear. Luyten et al. (2017) reported a trend for pre-
15 mentalizing modes to correlate positively with symptomatic distress (i.e., depression, anxiety) and a small trend
16 for interest and curiosity in mental states to correlate negatively with symptomatic distress. Studies on the
17 relation between depression and reflective functioning (RF), defined as the capacity to reflect upon one's own
18 and others behavior in terms of underlying mental states, have revealed a significantly lower RF capacity in
19 adult female inpatients experiencing major depression compared to non-depressed controls (Fischer-Kern et al.,
20 2013; Fonagy et al, 1996; Fonagy, Target, Steele, & Steele, 1995). Additionally, significantly lower scores of
21 maternal insightfulness, defined as the capacity to see things from the child's perspective, and of perspective
22 taking in depressed mothers compared to non-depressed mothers were reported (Ramsauer, Lotzin, Quitmann, et
23 al., 2014; Trapolini, Ungerer, & McMahon, 2008).

24 However, there are studies that have reached contrary conclusions. For example, Cordes et al. (2017)
25 found no differences in RF in mothers with PPD compared to a non-depressed control group. In a study with
26 chronically depressed outpatients, RF was found to be unrelated to symptoms as well (Taubner, Kessler,
27 Kächele, Buchheim, & Staun, 2011). Accordingly, the authors have concluded that the association between
28 depression and RF may depend on the severity of illness (inpatient vs. outpatient; Taubner et al., 2011).

29 The current evidence suggests that PRF may play a critical role in maternal sensitivity, especially in
30 mothers with PPD who are exposed to highly distressing situations, and may impact child attachment security,

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1 reflective functioning capacity and mental health. Furthermore, the evidence also suggests that PRF may depend
2 on the severity of depressive symptoms. To the best of our knowledge, no studies to date have addressed the
3 association between PRF and PPD severity or the potential role of PRF on maternal sensitivity in highly
4 distressing situations.

5 The primary aim of this study was to investigate how PRF in mothers with PPD influences their changes
6 in sensitivity following an emotionally distressing situation.

7 Based on the literature review, we examined the following hypotheses. (1) Maternal sensitivity changes,
8 i.e., decreases and increases, between the play and the reunion episodes due to the distress induced by the still-
9 face procedure. (2) Impairments in PRF as measured on the pre-mentalizing subscale are negatively associated
10 with sensitivity during the play and reunion episodes, whereas positive features of PRF, i.e., moderate to high
11 scores on the interest and curiosity in mental states subscale and moderate to low scores on the certainty about
12 mental states subscale, are positively related to sensitivity during play and reunion. (3) Impairments in PRF are
13 positively related to changes in sensitivity subsequent to still-face episodes with respect to lower PRF levels,
14 thus indicating greater decreases in sensitivity. (4) Impairments in PRF are positively related to levels of PPD,
15 whereas positive features of PRF are negatively related to levels of PPD. With respect to hypothesis (4), prior
16 studies indicate that an association to RF was found in inpatients with more severe depressive symptoms,
17 whereas this association was not identified in outpatients with less severe depressive symptoms.

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Method

20 **Participants**

21 The study was conducted at the University Medical Center of Hamburg as part of an intervention study
22 aimed at evaluating mother-infant treatment in the context of PPD (for more details, see Ramsauer, Lotzin,
23 Mühlhan et al., 2014). Fifty mothers with a primary ICD-10/DSM-IV-Axis-I diagnosis of mood disorders and
24 their infants were included in this study. Mother-child dyads were recruited from the outpatient unit at the
25 Department of Child and Adolescent Psychiatry, Psychotherapy and Psychosomatics at the University Medical
26 Center of Hamburg. Inclusion criteria for mothers included a current psychiatric diagnosis of a mood disorder
27 (e.g., major depression, dysthymia, anxiety disorders) and the ability to speak fluent German. Exclusion criteria
28 included a primary ICD-10/DSM-IV diagnosis of substance abuse, schizophrenia psychosis, intellectual
29 impairments (esteemed IQ < 80), and acute suicidality. The inclusion criterion for the infant was to be between
30 three and ten months of age, whereas early retardation served as the exclusion criterion (Ramsauer, Lotzin,

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1 Mühlhan et al., 2014). Informed consent was obtained from both parents, and the ethics committee of the
2 Medical Association of Hamburg authorized the overall project.

3 The sample consisted of 50 mothers, 49 of whom were German and one who was Turkish, between the
4 ages of 20 and 44 ($M = 33.0$, $SD = 5.44$) and their infants, 26 boys and 24 girls, who were between three and ten
5 months old ($M = 5.86$, $SD = 1.86$). Of the mothers in the study, 80 % were first-time mothers, 84 % were living
6 with a partner, and 38 % were married. They were from urban, middle-class residential areas in and around
7 Hamburg. All mothers were diagnosed postpartum, i.e., infants under the age of one year, and mood disorders as
8 follows: 98 % ($n = 49$) suffered from a DSM-IV Axis I mood disorder and 2 % ($n = 1$) from an adjustment
9 disorder with depressed mood. The average severity of depressive symptoms as measured by the BDI was $M =$
10 18.24 , $SD = 10.68$ (range: 1 to 46). Socio-demographic and clinical data are provided in Table 1.

11 Procedure

12 The procedure included the completion of the PRFQ and the Beck Depression Inventory (BDI) by the
13 mothers (usually at home), the SCID-I interview, and the videotaping of the SFP in the video laboratory of the
14 outpatient unit. The video laboratory of the child psychiatric outpatient unit was equipped with a chair for the
15 mothers set approximately 40 cm from the baby seat and four cameras that were operated by remote control
16 from the next room (one focused on the infant, one on the caregiver and two on both). The details regarding the
17 SFP were explained to the mothers in accordance with Tronick et al. (1978).

18 The procedure involved three episodes, namely, (a) a three-minute face-to-face play interaction as the
19 pretest (play), (b) a one-minute still-face interaction as the manipulation condition (still-face), and (c) a three-
20 minute reunion interaction as the posttest (reunion). Prior to the video recording, the mothers were instructed to
21 play with the infants as they normally do, but without toys. For the still-face manipulation, the mothers were
22 instructed to pose and face their infants with an expressionless poker face, i.e., they were not to smile, talk, or
23 touch their infants. The beginning of each still-face episode was announced by a knocking signal. The mothers
24 were allowed to discontinue the still-face procedure at any time. All mothers completed the still-face procedure.
25 Maternal sensitivity was coded twice for exactly three minutes, i.e., 3:00:00 during pretest and three minutes
26 (3:00:00) during posttest, based on the video recording of each mother-infant dyad.

27 Measures

28 **SCID-I.** The German version of the Structured Clinical Interview for DSM-IV Axis I disorders
29 (American Psychiatric Association, 1994; Wittchen, Wunderlich, Gruschwitz & Zaudig, 1997) was used for

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1 diagnosis. In this study, mothers with primary mood disorders were included. The SCID interviews were
2 conducted by psychologists well-trained in the conduction and evaluation of the SCID interview.

3 **BDI.** The Beck Depression Inventory was used to assess the severity of depressive symptoms (BDI-I;
4 Beck & Steer, 1987; Beck, Steer, & Garbin, 1988). The BDI is a self-report questionnaire that is widely used to
5 screen for depressive symptoms in clinical and nonclinical samples. It consists of 21 items that assess how the
6 subject has been feeling during the last week. The four possible responses ranging in intensity and are scaled
7 from 0 (e.g., "I do not feel sad") to 3 (e.g., "I am so sad or unhappy that I cannot stand it"). The responses are
8 then summed to compute a global score. The BDI has demonstrated good internal consistency (Cronbach's $\alpha =$
9 0.84 for psychiatric patients and 0.81 for non-psychiatric patients) and good convergent validity (Beck et al.,
10 1988).

11 **Parental Reflective Functioning Questionnaire (PRFQ).** To assess parental reflective functioning,
12 the German translation of the PRFQ was used for the first time in a sample of German mothers (Luyten et al.,
13 2009). The PRFQ evaluates PRF levels up to the children's age of five years and provides a time- and cost-
14 savings evaluation of child-related PRF that is easy to administer to parents of varied socioeconomic and
15 educational backgrounds (Luyten et al., 2009; Luyten et al., 2017; Rutherford, Goldberg, Luyten, & Bridgett,
16 2013). The questionnaire consists of 18 items, and each item belongs to one of the three subscales, namely, pre-
17 mentalizing modes, certainty about mental states, or interest and curiosity in mental states. Each item of the
18 PRFQ is scaled on a 7-point Likert scale between 1 (*strongly disagree*) to 7 (*strongly agree*).

19 The interest and curiosity subscale captures the interest and curiosity that parents exhibit towards their
20 children's mental states. For instance, "I am often curious to find out how my child feels," "I try to see situations
21 through the eyes of my child" and "I like to think about the reasons behind the way my child behaves and feels."
22 The certainty about mental states subscale assesses the inability to recognize that mental states are not
23 transparent. Items include, "I always know why my child acts the way he or she does," "I can always predict
24 what my child will do" and "I always know what my child wants." The pre-mentalizing modes subscale captures
25 non-mentalizing modes and includes items such as, "My child sometimes gets sick to keep me from doing what
26 I want to do," "When my child is fussy, he or she does that just to annoy me" and "My child cries around
27 strangers to embarrass me." The three-factor structure of the PRFQ was supported by exploratory and
28 confirmatory factor analyses and has demonstrated good internal consistencies for the three subscales (Luyten et
29 al., 2017). The internal consistencies of the subscales in the current study were as follows: Cronbach's $\alpha = .47$

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1 for interest and curiosity in mental states; Cronbach's $\alpha = .77$ for certainty about mental states; and Cronbach's
2 $\alpha = .52$ for pre-mentalizing modes.

3 **Still-face paradigm.** Tronick et al. developed the still-face paradigm (SFP) to investigate the face-to-face
4 interactions and emotion regulatory capacities between mothers and their three- to nine-month-old children
5 (Tronick et al., 1978). The SFP represents an experimental pre-/post-design that consists of three episodes: a
6 pretest (play episode), a manipulation (a still-face procedure to induce separation distress on the relationship
7 with the child), and a posttest (reunion episode and play). In our study, maternal sensitivity was evaluated
8 during the pretest (play) and the posttest (reunion) to gain more insight into how maternal PRFQ may affect the
9 mother's response to emotional distress (still-face) by means of sensitivity.

10 **Maternal Behavior Q-Set (Mini-MBQS-V).** Maternal sensitivity was captured separately during two
11 episodes, i.e., the play episode (before manipulation) and the reunion episode (after manipulation), and was
12 assessed using a short (25-item) version of the Maternal Behavior Q-Set, the Mini-MBQS-V for video coding
13 (Moran, 2009a). The original (90-item) MBQS version is based on the Ainsworth scales and captures different
14 aspects of maternal behavior in response to children (Ainsworth et al., 1978; Pederson et al., 1990; Pederson,
15 Moran, & Bento, 2009). It includes affect (e.g., "Display of affect does not match baby's display of affect"),
16 attentiveness (e.g., "Arranges her location so she can perceive baby's signals"), interaction style (e.g., "Points to
17 and identifies interesting things in baby's environment"), and communication skills (e.g., "Speaks to baby
18 directly") (Pederson et al., 1990, p. 1977). The raters describe the mothers' behaviors by sorting the items based
19 on the similarity between the description of the item and the observed behaviors into five categories (*very like*,
20 *like*, *neither*, *unlike* and *very unlike mother*). The mother's sensitivity score is calculated using the correlation
21 between the descriptive sort and a criterion sort of a prototypically sensitive mother. Correlation scores vary
22 from -1.0 (least sensitive) to 1.0 (prototypically sensitive).

23 The revised Mini-MBQS, which was validated by Tarabulsky et al. (2009), includes 25 items and was
24 developed to provide a less time-consuming method of observing mother-infant interactions than the 90-item
25 sort (Moran, 2009b). The reliability ($r = .94$) of the Mini-MBQS was confirmed in ten-minute mother-child play
26 interactions with ten-month-old children. The convergent validity with the 90-item MBQS, which was
27 conducted four months prior to the mother-infant dyads, was confirmed ($r = .35$). In a further step, the Mini-
28 MBQS was adapted by the author to more limited, brief segments of interaction (as in the video laboratory
29 condition of the present study). Two of the Mini-MBQS items that involved references to interactions with a
30 visitor and one item that was related to the environment of the home were replaced by items selected on the

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1 basis of their appropriateness for describing more limited segments of interactions and their weighting in the
2 prototypical sensitivity sort relative to those items that were removed. The three items were item 55 ("Able to
3 accept baby's behavior"), item 78 ("Plays social games"), and item 87 ("Actively opposes baby's wishes") (Mini-
4 MBQS-V, Moran, 2009a).

5 In the present study, maternal sensitivity was coded by three independent raters (female psychology
6 students), all of whom were blind to any information about the mother and the infant and blind to the pre-/post-
7 state of the video sequences. The raters received intensive MBQS training that was conducted by a clinician and
8 an expert in behavior ratings and used the manual developed by the authors (Pederson et al., 2009). The training
9 was spread out over five months and included 33 test sequences. To assess interrater reliability, the three raters
10 rated independently 35 video sequences of the play episode and the reunion episode. According to the ICC
11 classification (Cicchetti, 1994), the interrater reliability was excellent ($ICC = .877, p < .001$, Cronbach's $\alpha =$
12 $.955, p < .001$).

13 **Data analyses**

14 Statistical analyses were conducted using the Statistical Package for Social Science (IBM SPSS
15 Statistics, version 24). Because MBQS scores are correlations and correlation scores are not interval scaled (e.g.,
16 a correlation of $r = .80$ does not display double the correlation of $r = .40$ but rather almost three times the
17 correlation), their means, variances and relationships cannot be interpreted (Bortz & Schuster, 2010). Therefore,
18 the MBQS data were Fisher-Z transformed to allow for the interpretability of their means, variances and
19 relationships, i.e., using the Fisher-Z transformation, an $r = .40$ becomes a $Z = .42$ and an $r = .80$ becomes a $Z =$
20 1.10 . To compare the mother's sensitivity during the pretest with the posttest (hypothesis 1), a two-tailed t -test
21 for paired samples was conducted.

22 To examine the relationship between the PRF-dimensions in pre-mentalizing modes, interest and curiosity
23 in mental states, certainty about mental states, and sensitivity (hypothesis 2), Pearson correlations were
24 calculated. To examine whether a lower PRF capacity indicates greater decreases in sensitivity due to the still-
25 face episode (hypothesis 3), difference scores (Δ) in sensitivity were calculated by subtracting pretest-sensitivity
26 (play) from posttest-sensitivity (reunion) scores. Negative differences indicated decreases and positive
27 differences indicated increases in sensitivity due to the still-face procedure. Subsequently, correlations between
28 the PRFQ subscale scores and the sensitivity difference scores (Δ) were calculated. To test whether lower PRF
29 levels were associated with higher depression scores (hypothesis 4), we calculated correlations between the
30 PRFQ subscale scores and the BDI scores.

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Results

Demographic and clinical characteristics of mothers and infants are shown in Table 1.

Table 2 presents the changes in maternal sensitivity due to the still-face procedure. Mothers exhibited decreases ($n = 30$), increases ($n = 19$), and no differences ($n = 1$) in sensitivity in the post-still-face episode, with a mean difference in sensitivity between pre- and post-still-face of $M = -0.12$ ($SD = 0.30$). The mean sensitivity score in the reunion episode following the still-face was significantly lower ($M = 0.62$, $SD = 0.31$) compared to the play episode that preceded the still-face ($M = 0.74$, $SD = 0.21$), $t(49) = 2.70$, $p = .010$, $d = 0.40$, thus indicating a significant overall decrease in sensitivity as a still-face effect.

Contrary to expectations, no significant correlations between the three PRF dimensions and sensitivity in the pretest (play) episode or between the three PRF dimensions and sensitivity in the posttest (reunion) episode were found (see Table 3).

As expected, the analysis revealed a significant negative correlation between pre-mentalizing modes and changes in sensitivity ($r = -.24$, $p = .048$). Specifically, the higher the pre-mentalizing modes in terms of an impaired PRF, the stronger the decreases in sensitivity (see Table 4). No correlations were found between certainty about mental states and changes in sensitivity ($r = .03$, $p = .430$) or between interest and curiosity in mental states and changes in sensitivity ($r = .02$, $p = .437$; see Table 3).

PRF, with respect to the pre-mentalizing modes subscale, was significantly and positively related to BDI scores in mothers ($r = .44$, $p = .001$), indicating that higher levels of pre-mentalizing are associated with higher levels of PPD. PRF and BDI were not significantly related in terms of the interest and curiosity in mental states subscale ($r = .01$, $p = .463$) or in terms of the certainty about mental states subscale ($r = -.21$, $p = .082$).

Discussion

The current study provided new findings concerning the impact of PRF on maternal sensitivity to distress among 50 mothers experiencing postpartum depression. First, as expected, decreases as well as increases in maternal sensitivity to distress were found, with a significant overall decrease in sensitivity caused by the still-face episode. Second, contrary to our prediction, no significant relationships between PRF and sensitivity during the play episode or the reunion episode were found. Third, as expected, high levels of pre-mentalizing modes, indicating impaired mentalizing, were significantly associated with an overall decrease in sensitivity to distress, whereas contrary to our prediction, the subscales interest and curiosity in mental states and certainty about

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1 mental states showed no significant relationship with changes in sensitivity. Fourth, the assumption that PRF
2 was correlated with the severity of PPD was confirmed in terms of the pre-mentalizing modes.

3 **Sensitivity changes during the still-face procedure**

4 As expected, the mothers in the current study exhibited decreases as well as increases in sensitivity to
5 distress as a result of still-face manipulation, with a significant overall decrease. The finding of decreases and
6 increases is consistent with previous research that reported decreases and increases in sensitivity due to still-face
7 manipulation, however, prior studies provided no information about the significance of pre-post differences in
8 sensitivity (Conradt & Ablow, 2010; Haley & Stansbury, 2003; Smaling et al., 2016)). The finding of a
9 significant overall decrease in maternal sensitivity due to still-face manipulation points to a decreased ability of
10 the mother to meet her infant's needs for safety and comfort in highly distressing mother-infant interactions.
11 This, in turn, may impede the development of secure attachment in the child (De Wolff & van Ijzendoorn, 1997;
12 Leerkes, 2011). Further studies with larger samples are needed to confirm the current findings, validate their
13 importance, e.g., for child attachment development, and explore potential predictors for increases and decreases
14 in maternal sensitivity in stressful mother-infant interactions.

15 **PRF and sensitivity changes during the still-face procedure**

16 Contrary to our expectation, no significant associations between PRF and maternal sensitivity during the
17 pretest (play) or the posttest (reunion) of the still-face procedure were found. This result undermines theoretical
18 considerations of an association between online mentalization as observable parent-child-interactions and
19 offline mentalization as inner representations of the relationship with the child proposed by Sharp and Fonagy
20 (2008), and it is not consistent with the aforementioned research that indicates a positive impact of PRF on
21 maternal behavior.

22 Regarding the impact of PRF on changes in sensitivity, the results indicate a significant association with
23 pre-mentalizing modes, but not with interest and curiosity in mental states or with certainty about mental states.
24 Thus, the higher the levels of pre-mentalizing modes, the stronger the overall decrease in sensitivity following
25 the still-face episode. This finding demonstrates the importance of pre-mentalizing modes for the sensitivity in
26 mothers with postpartum depression, especially when they are under emotional distress.

27 As a subscale of the PRFQ, pre-mentalizing modes capture non-mentalizing stances, which
28 developmentally antedate mentalizing and thus reject the regulating of one's own behaviors and those of one's
29 child while also refusing to acknowledge the mental states of both oneself and one's child (Luyten et al., 2009;

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1 Rutherford et al., 2013). Typically, pre-mentalizing modes include the attribution of the child's behavior as
2 intentional against one's self, e.g., "My child sometimes gets sick to keep me from doing what I want to do",
3 "When my child is fussy, he or she is just trying to annoy me" or "My child cries around strangers to embarrass
4 me." Following Weiner's attributional theory (1985), such distorted causal attributions may lead to negative
5 affect, such as anger and inhibited sensitive responses towards the infant.

6 The PRFQ subscales interest and curiosity in mental states (i.e., interest in and curiosity about the child)
7 and certainty about mental states (i.e., the capacity to see the variability of mental states) were not related to
8 changes in maternal sensitivity. Hence, these PRF domains were not as relevant as pre-mentalizing modes in
9 predicting sensitivity to distress in mothers with PPD. Rutherford et al. (2013) found that lower levels of interest
10 and curiosity in mental states were associated with poorer maternal tolerance towards infant distress. That study
11 differs on several points from the current study, however, with regard to the sample included (community vs.
12 clinical), the operationalization of distress (crying baby to simulate infant distress vs. still-face procedure
13 eliciting distress in the mother and child), and design (one-time measurement of infant distress tolerance vs. pre-
14 post-assessment of maternal sensitivity to distress). Each of these factors may have the potential to explain the
15 differences in the results.

16 Overall, the present findings that maternal sensitivity is not associated with PRF in general but rather that
17 sensitivity change under distress is associated with pre-mentalizing modes highlights the harmful effects of pre-
18 mentalizing modes on maternal sensitivity in emotionally stressful mother-infant interactions.

19 **PRF and postpartum depression**

20 The assumption of an association between PRF and the level of PPD was confirmed regarding the pre-
21 mentalizing subscale. However, interest and curiosity in mental states and certainty about mental states were not
22 significantly related to level of PPD, indicating that their interest in the mental states of their infants as well as
23 their awareness of the opacity of their infants' mental states is independent on the severity of their PPD, while
24 the inability to mentalize as displayed by the pre-mentalizing modes subscale increases with the severity of their
25 PPD. The current finding is consistent with research reviewed herein and supports the assumption of Taubner et
26 al. (2011) that the association of depression and RF depends on the severity of the illness.

27 At the same time, the finding that not all aspects of PRF are affected by PPD, deserves closer
28 examination. As suggested by Luyten and Blatt (2012), in depression, modes of thinking that antedate
29 mentalizing occur. For example, in the so-called pretend mode, thoughts and feelings are assumed to be
30 unrelated to reality and characterized by, for example, the blaming of others. This is represented by items on the

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1 pre-mentalizing modes subscale such as, "When my child is fussy, he or she does that just to annoy me." In the
2 teleological mode, only observable behaviors are perceived as real (PRFQ item, "The only time I am certain my
3 child loves me is when her or she is smiling at me"). The present findings underpin the theoretical assumptions
4 of a relation between depression and modes that antedate mentalizing, as captured by the pre-mentalizing modes
5 subscale.

6 However, replication studies are needed to confirm the present results, and further research might examine
7 the relative importance of PRF and depression with respect to maternal sensitivity during stressful mother-infant
8 situations. Hence, as PRF seems to be the more impaired, the more severe the PPD symptoms are, the treatment
9 of mothers experiencing severe PPD should focus on the promotion of fully mentalizing modes as a crucial
10 factor in maintaining maternal sensitivity during stressful mother-infant interactions. Moreover, if further
11 studies confirm the present results, early prevention and intervention approaches may explore typical
12 emotionally stressful mother-infant situations and promote the capacity to reflect upon and consider the child's
13 internal mental states and intentions.

14 **Strengths and Limitations**

15 The present study contributes to the understanding of the interplay among PRF, sensitivity, and emotional
16 distress in mothers with PPD and emphasizes the importance of PRF in decreasing the mother's sensitivity via
17 still-face manipulation. Nevertheless, some limitations of the study must be acknowledged. First, to ensure that
18 the results were PPD-specific, a non-depressed control group should have been included for comparison
19 purposes. However, the study was part of an intervention study aimed at evaluating mother-infant treatment in
20 the context of PPD without a non-depressed control group.

21 To ensure that the changes in sensitivity to distress were due to the still-face manipulation and not, for
22 example, a result of increasing distress in the infants, such as restlessness and whining due to sitting in the baby
23 seat, a control condition, i.e., no still-face manipulation, should have been incorporated. Thus, replication
24 studies with larger sample sizes are needed that include a non-depressed control group, further samples of
25 mothers with different clinical diagnoses, and a control condition without the still-face episode to obtain more
26 clarity about the validity and importance of the present findings.

27 Furthermore, the sample size did not allow for controlling possibly confounding sociodemographic
28 variables. In the present study, we found that older infants had more sensitive mothers, reporting more interest
29 and curiosity in the mental states of their infants than infants of younger mothers. In addition, older mothers
30 showed less sensitivity in free play and lower decreases in sensitivity due to the still-face, but no differences in

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1 PRF compared to younger women. The results concerning PRF are not in line with findings that PRF does not
2 correlate with age of infants, but with age of mother in a socially diverse sample (Luyten et al., 2017). Boys had
3 less sensitive mothers in free-play than girls, which is in line with findings that mother-son-pairs showed
4 smaller mutual engagement than mother-daughter pairs (Braungart-Rieker, Garwood, Powers, & Notaro, 1998).
5 Thus, replication studies with larger sample sizes are needed to analyze the impact of sociodemographic
6 characteristics on the present results.

7 A limitation of internal validity can be seen in the one-time-/pre-measurement of PRF. Based on
8 theoretical considerations and current results, the consideration of PRF as a trait seems obvious (Fonagy,
9 Gergely, & Target, 2007; Fonagy & Target, 1997). Nevertheless, some authors proposed changes in PRF under
10 stress conditions, depending on attachment status (biobehavioral switch model; Fonagy, Luyten, & Strathearn,
11 2011). Strictly speaking, the PRF measurement should have been re-assessed after still-face.

12 Another restriction concerning internal validity is in the low reliabilities of the PRF subscales pre-
13 mentalizing modes and interest and curiosity in mental states, whereby the small number of items must be
14 considered (Cortina 1993). In an additional item analysis, the reversed interest and curiosity item, "I believe
15 there is no point in trying to guess what my child feels," revealed negative inter-item correlations, perhaps
16 indicating an unfavorable, double negative wording, i.e., German translation: "*Ich glaube, es bringt nichts, zu*
17 *erraten, wie mein Kind sich fühlen mag*". If this item is deleted, Cronbach's Alpha increases from $\alpha = .47$ to α
18 $= .68$, indicating acceptable internal consistency. Nevertheless, further calculations without this item did not
19 change the significance of the results.

20 Another possibility for the low reliability could be explained by the homogeneity of the sample, which
21 implicated lower variances and, in turn, lower inter-item correlations. As the German version of the PRFQ was
22 used for the first time in this study, and as the use of the PRFQ is not yet validated for clinical samples of
23 mothers with PPD, the results are valuable for validation and further use of the PRFQ.

24 The present study has several strengths. The homogeneity of the sample allowed for statements about a
25 group of mothers with clinical PPD, as this is the most prevalent postpartum psychological disorder. In addition,
26 the pre-post design that captures changes in sensitivity to distress, and the high interrater reliability of the
27 sensitivity measurement (Cronbach's $\alpha = .955$) are strengths of this study. Furthermore, this study provided
28 important findings concerning the validity of different components of mentalizing, thereby identifying pre-
29 mentalizing modes as a significant predictor of the mother's sensitivity to distress.

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(a) Conflict of Interest

The authors declare that they have no competing interests.

(b) Ethics Statement

The ethics committee of the Medical Association of Hamburg authorized the overall project (reference number PV3269).

(c) Informed Consent Statement

Informed consent was obtained from both parents.

Authors' Contributions

SK: assisted with the sensitivity rating, performed the statistical analyses, and prepared the manuscript. CM: assisted with the statistical analyses. PL: participated in the preparation of the manuscript. GR: participated in the preparation of the manuscript. BR: principle investigator of the study prepared the manuscript. All authors read and approved the final manuscript.

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Tables

Table 1

Demographic and clinical information

	Minimum	Maximum	<i>M (SD)</i>
Age of mother (years)	20	44	33.0 (5.44)
Age of infant (months)	3	10	5.86 (1.86)
	<i>n</i>		%
Sex of infant (male/female)	26/24		52.0/48.0
First child/second child	40/10		80/20
Final school degree low/middle/high ^a	3/13/33		6.1/26.5/67.4
Years of education ($\leq 9/10/12/13$)	4/13/7/26		8/26/14/52
Household income (€ per month)			
$\leq 1.500/\leq 3.000/\leq 5.000/> 5.000$	7/27/13/1		14.6/56.3/27.1/2.1
Working hours 0/1-20/21-40/40	17/3/5/1s		65.4/11.4/19.0/3.8
Married/single/divorced	29/19/1		58/38/2
Living status with partner			80
Nationality German/Turkish	48/1		96/2
	Minimum	Maximum	<i>M (SD)</i>
Depression (BDI) ^b	1	46	18.24 (10.68)

Note. $N = 50$.

^a ISCED International Standard Classification of Education (UNESCO, 1997)

^b Beck Depression Inventory I (Beck & Steer, 1987; Beck et al., 1988).

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Table 2

Mean difference in maternal sensitivity before and after still-face

	Play (before)	Reunion (after)				
	<i>M (SD)</i>	<i>M (SD)</i>	<i>t</i>	<i>df</i>	<i>p</i>	Cohen's <i>d</i>
Sensitivity (MBQS) ^a	.74 (.21)	.62 (.31)	2.70	49	.010	0.40

Note. $N = 50$. ^aMini Maternal Behavior Q-Sort for video coding (Moran, 2009a), Fisher-Z transformed scores.

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Table 3

Ratings and correlations among parental reflective functioning (PRF), maternal sensitivity (MBQS), depression (BDI), and demographic feature for 50 mothers with infants between 3 and 10 months

	Score		Correlation (<i>r</i>)								
	Mean	SD	1	2	3	4	5	6	7	8	9
1 IC	5.87	0.84									
2 CMS	3.39	1.22	.14								
3 PM	1.80	0.73	-.03	-.17							
4 MBQS play	.74	0.20	-.04	-.16	.18						
5 MBQS reunion	.62	0.31	-.01	-.08	-.12	.34**					
6 MBQS Δ	-.12	0.30	.02	.03	-.24*	.33**	.77**				
7 BDI	18.24	10.68	.01	-.21	.44**	.03	-.19	-.21			
8 Age Mother ^a	33.04	5.44	.14	.22	-.08	-.24*	.13	.29*	-.22		
9 Age Infant ^b	5.86	1.86	.28*	-.05	.13	.28*	.36*	.17	.16	.05	
10 Sex Infant ^c			.23	-.15	-.03	.35**	-.12	-.35**	.04	-.11	.23

Note. *N* = 50. IC = PRFQ Interest and Curiosity in Mental States, CMS = PRFQ certainty about mental states, PM = PRFQ pre-mentalizing modes (PRFQ; Luyten et al., 2009; Rutherford et al., 2013, 2015). MBQS play = sensitivity in the play episode of the still-face procedure. MBQS reunion = sensitivity in the reunion episode following the still-face episode. MBQS Δ = change in sensitivity between play and reunion episodes. All MBQS scores were Fisher-Z transformed.

^a years. ^b months. ^c 1 = male, 2 = female

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

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