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Research paper

The effects of mentalization and sensitivity of postpartum depression mothers after the circle of security-intensive intervention on the social-emotional development of three-year-old children

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ABSTRACT

Objective: Postpartum depression (PPD) significantly impacts mothers and their children, making relationship-building interventions necessary for prevention. The Circle of Security-Intensive (COS-I) is a specialized approach designed to enhance parental sensitivity and mentalization, with the objective of promoting the child's social-emotional development. This study is based on data from a previously conducted randomized controlled trial and aims to evaluate the effectiveness of COS-I in mothers with postpartum depression (PPD) exhibiting reflective functioning (RF), pre-mentalization (PM), and sensitivity, as determined by a mediation model, following intervention. The hypothesis is that COS-I have a positive effect on a child's social-emotional development. It is predicted that RF, PM, and sensitivity will mediate this effect compared to Treatment-as-usual (Tau).

Method: A sample of 44 PPD mothers and their children participated in the model testing. Subsequent to the intervention, at 16–18 months of child age, RF was measured using the Adult Attachment Interview, PM with the Parental Reflective Functioning Questionnaire, and sensitivity with the Mini-Maternal Behavior-Q-Sort. At 36 months of age, the child's social-emotional development was assessed using the Functional Emotional Assessment Scale (FEAS). Baseline socio-demographic and clinical characteristics were controlled for.

Results: At age three, COS-I showed equal FEAS for the children compared to Tau. There were no differences in interventions regarding the mediators (RF, PM, sensitivity). Exploratory analyses suggest that, in children, PM adversely affects their social-emotional development, regardless of intervention.

Conclusions: This underscores the necessity for more focused attention on PM in mothers with postpartum depression for clinical intervention purposes and improving the efficacy of COS-I on subsequent child development.

1. Introduction

Postpartum depression (PPD) affects 12 % to 15 % of women and can result in a depressive episode within the first year of the child's life (Le Strat et al., 2011; Liu et al., 2022; Vesga-Lopez et al., 2008). The course of depressive symptoms following childbirth varies significantly, with symptoms persisting beyond the postpartum period (Putnick et al., 2020). In addition to the suffering experienced by the mother, PPD has been demonstrated to impose a considerable strain on the development of the mother-child relationship, thereby potentially contributing to the manifestation of behavioral and emotional problems in early childhood (Goodman et al., 2020; Lahtela et al., 2024; Madigan et al., 2018; Maggi et al., 2010).

The extant research on attachment has demonstrated the significance of maternal sensitivity to infant emotional regulation and mental development (Bureau et al., 2009; Field, 2010; Leerkes et al., 2009; Salomonsson et al., 2015; Slade, 2023a). Maternal sensitivity is defined as responding promptly and appropriately to a child's needs, providing

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comfort, soothing, and nurturing (Ainsworth et al., 1978; Bretherton, 2013). Consequently, improving maternal sensitivity is crucial for early intervention and attachment-based programs (Bakermans-Kranenburg et al., 2003; Fonagy et al., 2016b; Juffer et al., 2018; Lavallée et al., 2021; Mountain et al., 2017; Toth et al., 2018).

In addition to sensitivity, the mother brings her own mentalization to the relationship with her child (Luyten et al., 2020). Adults use mentalization to understand their own and others' thoughts, feelings, plans, and goals, and to adapt their behavior accordingly. This capacity has been conceptualized as "reflective functioning" (RF) (Fonagy et al., 1998b). RF measures an adult's capacity to anticipate and reflect on their own and others' mental states (Fonagy et al., 2016a).

The concept of parental reflective functioning (PRF; Luyten et al., 2009; Slade, 2023b) refers to adults' ability to understand their children's experiences as influenced by their own mental states. This ability may contribute to the intergenerational transmission of attachment by fostering sensitivity (Slade et al., 2005; Slade and Sleed, 2024).

Luyten et al. developed the PRF Questionnaire (PRF-Q; Luyten et al., 2017; Luyten et al., 2009) to measure PRF. The PRF-Q is grounded in three subscales: interest and curiosity about mental states, certainty about mental states, and pre-mentalization (Edler et al., 2023; Luyten et al., 2017; Wendelboe et al., 2021). The pre-mentalization (PM) subscale is defined as a non-mentalizing stance of parents that may indicate pathological PRF. When parents engage in PM, their ability to recognize and interpret their child's behavior is compromised, distorted, or absent. Recent studies have demonstrated a positive association between a high score on the PM scale and maternal depression (Georg et al., 2023) and postpartum depression and anxiety (Krink and Ramsauer, 2021), as well as a negative association with maternal sensitivity (Grienenberger et al., 2005; Krink et al., 2018), and not significantly associated with maternal RF (Krink and Ramsauer, 2021). Furthermore, PM has been negatively linked to children's social-emotional development (Edler et al., 2023; Madsen et al., 2023), including emotion regulation (Keleynikov et al., 2024).

Therefore, in addition to sensitivity, PRF has become a target for change in attachment- and mentalization-based interventions. It is also examined as a mediating variable in efficacy studies investigating the transgenerational effect of the intervention on child outcomes (Barlow et al., 2021; Jin et al., 2023; Letourneau et al., 2015; Lo and Wong, 2022).

The present study is grounded in data from a previously conducted randomized controlled trial (RCT; Ramsauer et al., 2014) that examined the efficacy of the Circle of Security-Intensive (COS-I) as a 20-week group-based intervention for mothers experiencing postpartum depression and their children. Evidence of the COS-I has previously been demonstrated for a sample of clinically referred parents and their children (Huber et al., 2015a; Huber et al., 2015b; Ramsauer et al., 2020).

The theoretical framework underpinning the COS-I posits a model of intergenerational transmission of parental attachment to the child. This model underscores the significance of parental mentalization and the provision of sensitive parenting for the prevention of behavioral problems and psychopathology in children (Hawkins et al., 2025). Consequently, a range of intervention strategies have been employed. These strategies encompass the use of COS graphics, psychoeducation, video exemplars, and individualized video analysis of the parent's strengths and struggles in the group, as identified by the therapist, in relation to the child's needs as depicted on the Circle of Security graphic. Additionally, joint reflection and discussion are encouraged, and 'Shark music' is known to promote self-reflection (Powell et al., 2014).

In this study, maternal RF, PM, and sensitivity following the intervention and at the child's initial follow-up assessment are used to determine the effect of the intervention on the child's social-emotional outcome at three years of age. The COS-I intervention is expected to positively impact the child's social-emotional development compared to the Tau treatment (total effect). Additionally, it is hypothesized that COS-I will enhance social-emotional outcomes through RF, PM, and sensitivity (mediation effect). Within the primary mediation model, RF is predicted to be positively associated with sensitivity, while PM is expected to be negatively associated with sensitivity, thereby influencing the child's social-emotional development (Fig. 2). The extent to which RF or PM influences the child's social-emotional development via sensitivity as a mediator will be further investigated in an exploratory approach (Figs. 3, 4) to gain new insights that can then be tested in a confirmatory manner.

2. Method

2.1. Recruitment

This study was conducted at the Department of Child and Adolescent Psychiatry, Psychotherapy and Psychosomatics, University Medical Center Hamburg-Eppendorf, Germany. The local ethics committee of the Hamburg Medical Council approved the study in August 2009 (reference number PV3269). The study was administered from 2010 to 2015. The baseline assessment (T1) included mothers with a DSM-IV diagnosis of postpartum mood disorder (PPD) and their infants, randomized to COS-I or Tau (Ramsauer et al., 2014). The parents were informed and gave consent. After the intervention, a follow-up (T2) was carried out when the child was between 16 and 18 months, and a subsequent follow-up (T3) was executed when the child was approximately 3 years. All parents provided informed consent for the second follow-up.

2.2. Participants

The sample for the study was defined as follows: mothers with infants aged 2–10 months, attending treatment at the outpatient clinic, proficient in German, and diagnosed with mood disorders according to DSM-IV criteria. According to the DSM-IV, all mothers met the diagnostic criteria for depressive disorders (major depression, dysthymia, or adjustment disorder with depressive symptoms; Ramsauer et al., 2020). The flow of study participants across the three time points is shown in Fig. 1. Time Points 2 and 3 were for confirmation and exploration; Time Points 1 were for control.

2.3. Procedures

All data were collected by research psychologists and graduate psychology students. The T2 assessment included self-reports on sociodemographic variables, clinical characteristics, treatment history outside the scope of this study, and the Parental Reflective Function Questionnaire (PRF-Q) to assess maternal pre-mentalizing (PM). To assess maternal sensitivity, a five-minute video recording of a mother-child interaction during free play was obtained in the outpatient video laboratory. To assess maternal reflective functioning (RF), the Adult Attachment Interview (AAI; George and West, 2001) was conducted.

At the age of three, mothers with children were invited to complete the T3 survey. The semi-structured three-bag procedure was used as an interaction task (Network, 2005). Mothers were instructed to engage in play with their children for a duration of five minutes, utilizing the following items contained within the bag: A children's coffee set, a children's book (Good Night, Gorilla by Peggy Rathman), and a soap bubble. During each designated play period, which included pretend play, book reading, and bubble blowing, the mothers were encouraged to engage with their children, providing support as they interacted with the age-appropriate toys (Vandell, 1979). Play observations were videotaped to assess the child's level of social-emotional functioning.

2.4. Description of intervention

2.4.1. Circle of security-intensive intervention

The Circle of Security-Intensive (COS-I) is a multifaceted approach based on attachment, object relations, and mindfulness-based theories.

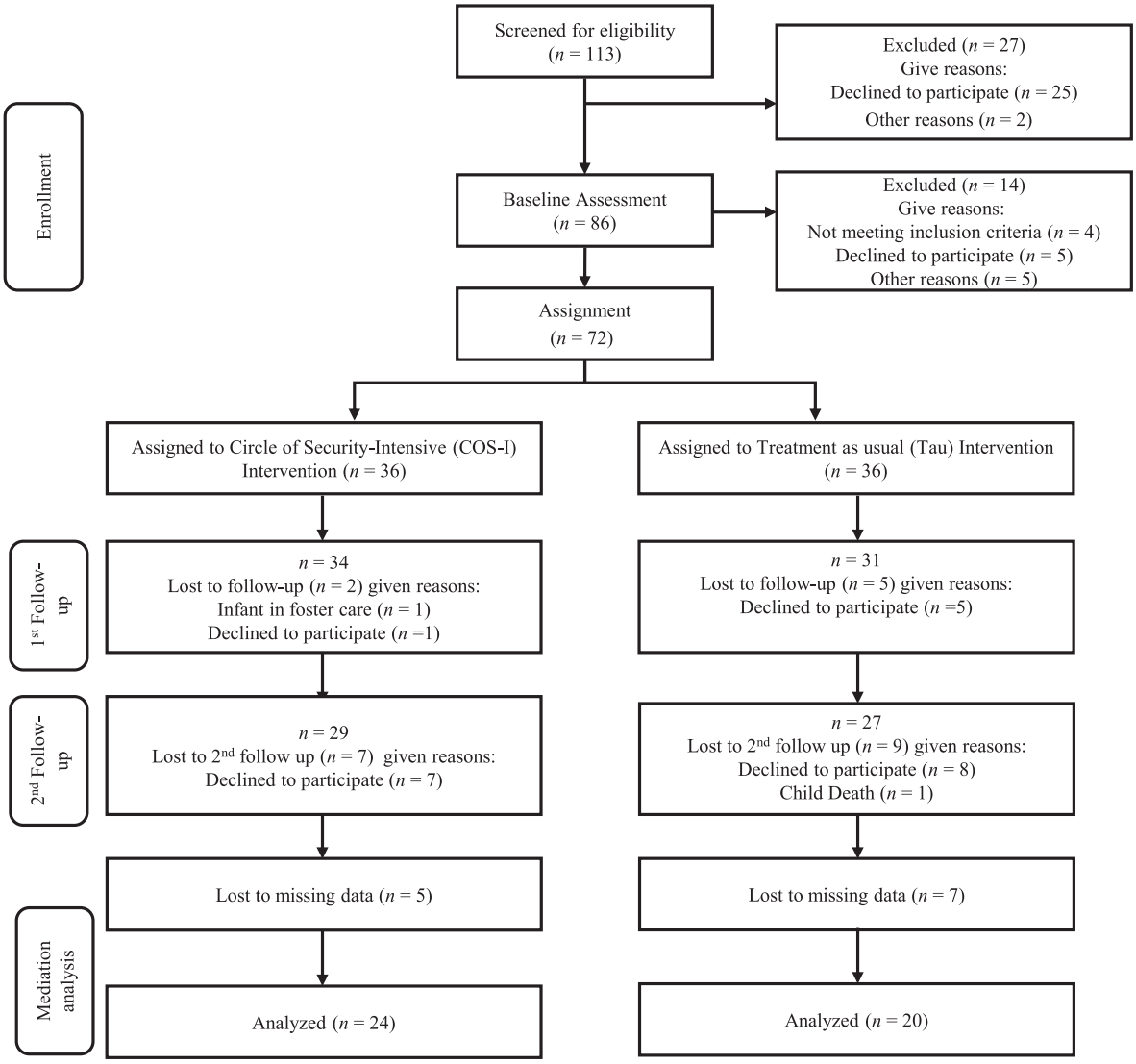

Fig. 1. Study participant flow.

It aims to address the needs of parents and children and the risks in their relationship (Powell et al., 2014). The intervention's goals are: Creating a foundation for parents to reflect on their parenting; offering a user-friendly representation of attachment theory (the "Circle of Security" graphic); facilitating a reflective dialogue, and supporting parents' transition from defensiveness to empathy by enhancing communication with their children (Marvin et al., 2002; Powell et al., 2014). COS-I encourages positive mother-child interactions and social-emotional development (Cooper et al., 2005; Huber et al., 2015a). The group-based approach consists of twenty sessions of 90 min each, conducted on a weekly basis. There are six groups of six mothers with infants each. The groups follow the treatment manual (Powell et al., 2002). Bert Powell, a COS-I developer, supervised weekly adherence to treatment.

2.4.2. Treatment as usual

Treatment as usual (Tau) included case management services and/or regular mother-infant psychotherapy in the child psychiatric outpatient clinic. Child psychiatrists and/or psychotherapists not familiar with the COS-I provided treatment. The therapeutic approach used a combination of supportive, psychodynamic, and behavioral techniques with varying emphases on the specific needs and requirements of each mother-infant dyad. Each session, which was recorded in the clinic's electronic documentation system, lasted 50 min. On average, Tau included eight mother–child sessions, weekly or at longer intervals. Mothers were given medication, offered individual adult psychotherapy, or given inpatient adult psychiatric treatment outside of the trial (Ramsauer et al., 2020).

2.5. Measures

2.5.1. Maternal psychopathology

The Beck Depression Inventory-I (BDI-I; Beck et al., 1987; Beck et al., 1988; Hautzinger, 1991) was applied to validate mothers' depressive symptom burden. The BDI-I is a 21-item self-report scale from 0 to 3. Higher scores indicate greater depressive symptoms. Relevant scores are "absent to minimal" (0–9), "mild to moderate" (10–29), and "clinically significant" (30+). Meta-analyses of BDI-I psychometric properties found Cronbach's alpha = 0.86 for people with psychiatric disorders. The present study found high internal consistency for T2 (Cronbach's alpha = 0.92) and T3 (Cronbach's alpha = 0.90).

The Symptom Checklist-90-Revised (SCL-90-R) (Derogatis, 1983; Franke, 2002) was used to validate maternal psychopathological distress. Mothers rated the severity of their symptoms using a five-point Likert scale ranging from 0 (not at all) to 4 (extremely severe) over the previous week. The Global Severity Index (GSI), a mean sum of 90 items, indicated maternal psychopathology. GSI scores greater than 60 are

defined as an indication of significant psychological distress. The inpatient psychotherapy subscales demonstrated satisfactory reliability, with internal consistency ranging from 0.74 to 0.88 (Franke, 2002). The GSI had excellent internal consistency (Cronbach's alpha = 0.97) in a normative clinical sample, and the SCL-90-R scales had satisfactory to excellent construct and convergent validity (Franke, 2002). In the present study, the internal consistency for the GSI score at T2 and T3 was 0.98.

2.5.2. Maternal reflective functioning

The Reflective Functioning (RF) scale of the mother is based on the coding manual for raters to use with the Adult Attachment Interview (AAI) transcript (Fonagy et al., 1998a). The RF scale is regarded as an operationalization of predominantly self-referential mentalization, capturing a mother's capacity to understand her own and others' behavior in terms of underlying mental states. RF ratings are on a nine-point scale from 1 (low RF) to 9 (high RF). A − 1 indicates resistance/non-integration. Two raters, blinded to treatment, coded identified AAI passages, particularly demand questions, and arrived at a final global rating. 19 AAIs were coded twice to assess reliability, resulting in a tau of 0.42 (p = .019), indicating moderate to high reliability (Cicchetti, 1994).

2.5.3. Maternal pre-mentalization

The pre-mentalization (PM) subscale of the Parental Reflective Functioning Questionnaire (PRF-Q; Luyten et al., 2017) was used to assess mothers' capacity to discern their children's mental states. The PM subscale comprises six items on a 7-point Likert scale, e.g., 'My child sometimes gets sick to keep me from doing what I want to do' and 'My child cries in front of strangers to embarrass me.' Scores on this subscale indicate low parental pre-mentalization, with an internal consistency estimate (Cronbach's alpha) of 0.70 (Luyten et al., 2017). This study's internal consistency for the PM subscale (Cronbach's alpha = 0.59) is comparable to that of the German adaptation of the PRFQ (Wildner et al., 2024).

2.5.4. Maternal sensitivity

Maternal sensitivity was measured using the Mini-Maternal Behavior Q-Sort for Video Coding (Mini-MBQS-V; Moran, 2009; Moran et al., 2009). A five-minute free-play interaction scene was videotaped for subsequent analysis. The Mini-MBQS-V, a 25-item abridged version of the original 90-item Maternal Behavior Q-Set, was utilized in the study (Moran et al., 2009; Pederson et al., 1990; Pederson et al., 2009). The Mini-MBQS-V is a method for describing maternal behavior. It involves sorting 25 items into five categories based on how they match the observed behavior. The five categories are: 'very like', 'like', 'neither', 'unlike', and 'very unlike mom' The sensitivity score is derived from the correlation between a descriptive and a prototypical sensitive mother. The range of correlation scores is from −1.0 (least sensitive) to 1.0 (most sensitive). Tarabulsy et al. (2009a) validated the Mini-MBQS-V. The Mini-MBQS-V's reliability was established via 10-min play interactions when the child was 10 months old, yielding a high correlation of $r = 0.94$ ($p < .0001$). Convergent validity was demonstrated by comparison with the 90-item MBQS administered at 6 months, with a correlation of r = 0.35 (Tarabulsy et al., 2009b, p. 134).

Two independent psychology students who were trained raters used the Mini-MBQS-V to assess maternal sensitivity. To ensure the study's integrity, the raters were required to remain blind to all information concerning each mother-child dyad. Both raters underwent extensive training using the manual developed by the authors (Pederson et al., 2009) and took an interrater reliability test on 35 sequences. The intraclass correlation coefficient (ICC) showed excellent reliability (ICC = 0.877, $p < .001$). Cronbach's alpha also showed high internal consistency ($\alpha = 0.96$, $p < .001$).

2.5.5. Child social-emotional functioning

At the age of three, the child's social-emotional functioning was assessed using the Functional Emotional Assessment Scale (FEAS; Greenspan et al., 2001). The FEAS is a coding system for assessing children's social-emotional development. It is used with children ages 7 months to 4 years. The FEAS evaluates a range of behaviors and associated cognitive, motor, and sensory capacities within the caregiver-child relationship. The FEAS is applicable to children and parents from a variety of adverse situations for clinical and research purposes (Greenspan et al., 2001).

The 15-minute videotaped mother-child interaction is scored with the research-based FEAS coding scheme from the FEAS manual (Greenspan et al., 2001). The Age-Related Child Scale 3–4 Years is used, covering six domains of emotional development. Domains include: (1) self-regulation and interest in the world (0–3 months; items 1–8), (2) relationship forming, attachment, and engagement (2–7 months; items 9–16), (3) two-way, purposeful communication (3–10 months; items 17–20), and (4) behavioral organization, problem solving, and internalization (a complex sense of self; 9–18 months; items 21–22), (5) representational capacity (elaboration) (18–30 months; items 23–29), and (6) representational differentiation (building bridges between ideas and emotional thinking) (30–48 months; items 30–34). All items are scored on a 3-point Likert scale. N/O is assigned if a behavior could not be observed. The subtest scores were aggregated to derive the child's total test score. If the children are younger than the specified age range for a given domain at the time of assessment, that domain will not be included in the FEAS score. The total score is determined by the number of domains a child is theoretically capable of reaching for their age. At T3, when all children were three years old, all domains were included in the total score. At T1, the total score exclusively included age-appropriate domains. According to Greenspan et al. (2001), a three-year-old child with a total score between 48 and 66 is considered normal. A score between 46 and 47 is considered at risk, while a score of 0 to 45 is considered deficient.

Two independent female psychology students scored the FEAS coding scheme. Inter-rater reliability was assessed using the weighted kappa coefficient (Cohen, 1968). This is a common method for assessing inter-rater reliability for ordinal scales (Vanbelle, 2016). The raters were trained to code the FEAS on videotapes of healthy and mentally ill mothers and children. The procedure was demonstrated to be reliable (weighted kappa = 0.81). Then, the master's student scored all videos. Inter-rater reliability was assessed by having both raters code 20 % of the videos, which resulted in substantial agreement (weighted kappa = 0.78). The FEAS demonstrated internal consistency in this study (Cronbach's alpha = 0.89; Schellhas, 2017).

2.6. Data analysis

The data were analyzed using IBM SPSS Statistics version 27.0.1.0 and the PROCESS macro version 4.1, which facilitates the implementation of dichotomous independent variables and the evaluation of complex mediation models. The PROCESS macro reports a total effect, the regression effect of the independent variable on the dependent variable, without consideration of other variables, except covariates. A direct effect is also reported, the regression coefficient when all other variables are controlled for. The indirect effect, also called the mediation effect, is determined using the PROCESS macro bootstrap intervals for smaller sample sizes (Hayes, 2022). The PROCESS mediation effects were tested using bootstrapped confidence intervals. The statistical analysis was conducted employing two-tailed confidence intervals with an alpha level of 10 % (90 % CI). This approach reduces the risk of Type II errors and increases the power to detect potential effects. However, it also raises the probability of Type I errors (Cohen, 1988). The reported regression coefficients were not estimated using bootstrapping.

Thorough examination of the model data revealed no violations of the assumptions underlying multiple linear regression analysis, such as

linearity, the absence of autocorrelation, homogeneity of variance, normal distribution of the residuals, and the absence of multicollinearity. These conditions were met for the model.

The main model was calculated using the PROCESS macro Model No. 80 (Hayes, 2022, p. 643) with 10,000 iterations. The main model includes the dichotomous independent variable X = Random, which codes intervention group membership (COS-I vs. Tau), and the parallel mediators (M) are maternal RF_T2 (M1) and PRFQ_PM_T2 (M2). The serial mediator (M3) is maternal sensitivity (MBQS_T2). The dependent variable is the child's social-emotional development (Y = FEAS_CD_T3).

To account for potential confounding, maternal age, education, income, and child age at time T1 are controlled for in the model (Bollen and Bauldry, 2011). Maternal PPA at time T2 was controlled for using the SCL-90 anxiety score. Since PPD and PPA share common risk factors, controlling for postpartum anxiety is necessary to ensure an accurate assessment of the intervention's effectiveness (Heron et al., 2004). Furthermore, baseline values for RF_T1, MBQS_T1, and FEAS_CD_T1 were controlled for, but PRFQ_PM_T1 was not. Model sample size is determined by the variable with the fewest data points. Bootstrapping efficacy depends on sample size. Maternal PM_T1 lacks sufficient data points, so including it would compromise model reliability (Gediga, 2010).

Two sub-models of the main mediation model examine the relationship between RF_T2 (sub-model 1) and PRFQ_PM_T2 (sub-model 2) with sensitivity as a mediator of the child's social-emotional development (FEAS_CD_T3). Both sub-models were calculated using Model No. 4 (Hayes, 2022, p. 622) with a 10,000-iteration bootstrap interval. Sub-model 1 consists of independent variable X = RF_T2, mediator M = MBQS_T2, and dependent variable Y = FEAS_CD_T3 (Fig. 3). Sub-model 2 consists of X = PRFQ_PM_T2, M = MBQS_T2, and Y = FEAS_CD_T3 (Fig. 4). Sub-models 1 and 2 control for T1 maternal age, education, income, child age, T2 maternal anxiety, and T1 child FEAS scores. To examine the effect of RF and PM independently, sub-model 1 controls for PRFQ_PM_T2 and sub-model 2 controls for RF_T2.

3. Results

3.1. Sample description

Table 1 shows the sociodemographic and clinical characteristics. Mothers reported mild-to-moderate symptoms and severity of depression. The means of the mediators (T2) across interventions were as follows. Reflective functioning (RF_T2): $M = 4.2$ ($SD = 1.3$); Pre-mentalization (PRFQ_PM_T2): $M = 1.7$ ($SD = 0.8$); Sensitivity (MBQS_T2): $M = 0.7$ ($SD = 0.1$). Across interventions, the mean FEAS score of children's social-emotional development (FEAS_CD_T3) was $M = 46.2$ ($SD = 10.7$).

A correlation matrix was included to summarize the relationships among the key variables (see Table 2).

3.2. Main mediation model

The investigation showed that COS-I has no substantial positive effect on the child's social-emotional development ($p = .296$). Concurrently, no mediating effects of COS-I on the child's social-emotional development was found. Additionally, no significant direct effect of COS-I on the child's FEAS_CD_T3 scores was observed ($p = .271$). However, a significant relationship was identified between PRFQ_PM_T2 and MBQS_T2 ($p = .001$) (see Fig. 2).

3.3. Exploratory analysis

3.3.1. Sub-model 1: RF_T2 as the independent variable

The investigation revealed that RF_T2 did not demonstrate a significant positive effect on the child's FEAS_CD_T3 scores ($p = .477$). Additionally, the analysis revealed no indirect effect of RF_T2 on FEAS_CD_T3 via MBQS_T2, with a standardized 90 % bootstrap interval ranging from −0.076 to 0.187. Furthermore, no significant direct positive effect of RF_T2 on the child's FEAS_CD_T3 scores was identified ($p = .431$) (see Fig. 3).

3.3.2. Sub-model 2: PRFQ_PM_T2 as the independent variable

A significant total negative effect of PRFQ_PM_T2 on FEAS_CD_T3 scores was identified ($p = .004$): b = −6.576. In standardized form, $\beta = -0.465$. No significant indirect effect of PRFQ_PM_T2 on FEAS_CD_T3 scores via MBQS_T2 was identified, with a standardized 90 % bootstrap interval of [−0.213, 0.216]. Conversely, a negative direct effect of

Table 1
Means and Standard Deviations of Scores on Baseline (T1) and Follow-up Measures (T2, T3), as well as clinical and sociodemographic characteristics.

	Tau ($n = 20$)		COS-I ($n = 24$)	
	M	*SD*	*M*	*SD*
BDI-I Total Score_T2	12.38	10.41	14.69	9.72
SCL-90-R GSI Score_T2	50.45	11.41	54.04[b]	11.02
BDI-I Total Score_T3	11.45	8.95	13.59[b]	9.56
SCL-90-R GSI Score_T3	51.45	10.59	54.45[b]	10.82
RF_T1	4.48	1.26	3.81	1.21
RF_T2	4.30	1.31	4.06	1.13
PRFQ_PM_T1	1.04	0.11	1.05	0.12
PRFQ_PM_T2	1.63	0.68	1.85	0.81
MBQS_T1	0.52	0.29	0.44	0.35
MBQS_T2	0.66	0.07	0.67	0.09
FEAS_CD_T1	18.9	3.89	19.46	3.98
FEAS_CD_T3	44.50	11.04	47.67	10.39
FEAS_Domain 1	12.7	3.15	13.67	1.88
FEAS_Domain 2	10.85	3.07	12.00	2.70
FEAS_Domain 3	7.30	2.00	7.38	2.02
FEAS_Domain 4	2,15	1,18	2.50	0.93
FEAS_Domain 5	7.0	2.70	7.33	2.81
FEAS_Domain 6	4.50	2.28	4.79	2.43
Infant age_T1 (*months*)	5.90	3.18	5.75	2.59
Maternal age_T1 (*years*)	33.10	4.55	33.25	4.79
Maternal SCL-90-R Anxiety_T2	4.20	6.11	5.42	7.03
	f	%	*f*[b]	%
Infant male	11	55.0	13	54.2
Income_T1(Euro)				
Income <1500	3[a]	15.8	5	22.8
Income 1500–300	13[a]	68.4	7	31.9
Income 3000–5000	3[a]	15.8	9	0.41
Income >5000	0[a]	0.00	1	4.54
Maternal Education_T1				
In vocational training	1[a]	5.26	1	4.2
No vocational qualification	1[a]	5.26	3	12.5
Completed company-based vocational training (apprenticeship)	3[a]	15.79	9	37.5
Completed training at a technical school or similar institution	4[a]	21.05	2	8.3
University of Applied Sciences degree	8[a]	42.11	3	12.5
University degree			3	12.5
Another type of educational qualification	1[a]	5.26	3	12.5

Note. The gray-shaded variables signify the covariates that have been controlled for in the respective models; Tau = Treatment as usual; COS-I = Circle of Security-Intensive intervention BDI-I = Beck Depression Inventory; SCL-90- R = Symptom Checklist-90-Revised; GSI = Global severity Index; RF = Reflective Functioning Scale; PRFQ = Parental Reflective Functioning Questionnaire; PM = Pre-mentalization subscale of the PRFQ; CD = child; MBQS = Maternal Behavior Q-sort; FEAS = Functional Emotional Assessment Scale: Domain 1: self-regulation and interest in the world (0–3 months), Domain 2: relationship forming, attachment, and engagement (2–7 months), Domain 3: two-way, purposeful communication (3–10 months), Domain 4: behavioral organization, problem solving, and internalization (a complex sense of self; 9–18 months), Domain 5: representational capacity (elaboration) (18–30 months), and Domain 6: representational differentiation (building bridges between ideas and emotional thinking) (30–48 months).

[a] $n = 19$.

[b] $n = 22$.

Table 2
Correlations among study variables.

Variable	1	2	3	4	5	6	7	8	9	10	11[a,b]	12[a,c]	13
Var1	–	−0.27	0.19	0.14	0.09	−0.02	0.39**	−0.08	0.20	−0.15	0.29	−0.01	−0.14
Var2		–	−0.49**	−0.41**	−0.03	0.05	−0.29	−0.26	−0.04	0.12	0.05	−0.27	0.13
Var3			–	0.43**	−0.18	0.12	0.12	0.16	−06	0.04	0.06	0.39*	0.10
Var4				–	0.05	−0.15	0.26	0.05	0.08	30*	−0.12	0.17	0.18
Var5					–	0.09	0.28	0.24	0.14	−0.13	0.09	0.16	0.00
Var6						–	−0.11	0.22	0.10	−0.31*	−0.07	0.04	0.00
Var7							–	0.21	0.35*	0.26	0.24	0.22	−0.28
Var8								–	0.12	−0.34*	0.12	0.18	−0.11
Var9									–	0.01	0.35*	0.23	−0.03
Var10										–	−0.11	−0.26	0.03
Var11[a,b]											–	0.13	−0.20
Var12[a,c]												–	0.19
Var13													–

Note. $N = 44$.
[a] Spearman's rho correlation was used instead of a Pearson's rho correlation.
[b] $n = 43$.
[c] $n = 41$. Var1 = The Reflective Functioning scores (RF) at first follow-up (T2). Var2 = The Parental Reflective Functioning Pre-mentalizing subscale scores (PRFQ_PM) at first follow-up (T2). Var3 = Maternal sensitivity scores (MBQS) during free-play at first follow-up (T2). Var4 = Functional Emotional Assessment Scale global scores of the child (FEAS) at second follow-up (T3). Var5 = maternal age at baseline (T1). Var6 = child age at baseline (T1). Var7 = RF at baseline (T1). Var8 = MBQS at baseline (T1). Var9 = FEAS at baseline (T1). Var10 = maternal anxiety at first follow-up (T2). Var11 = maternal education at baseline (T1). Var12 = maternal income at baseline (T1). Var13 = COS-I/Tau = dichotomous variable coded with 0 = Tau/Treatment as usual, 1 = COS-I/Circle of Security-Intensive group intervention;
* $p^* < 0.05$.
** $p^* < 0.01$.

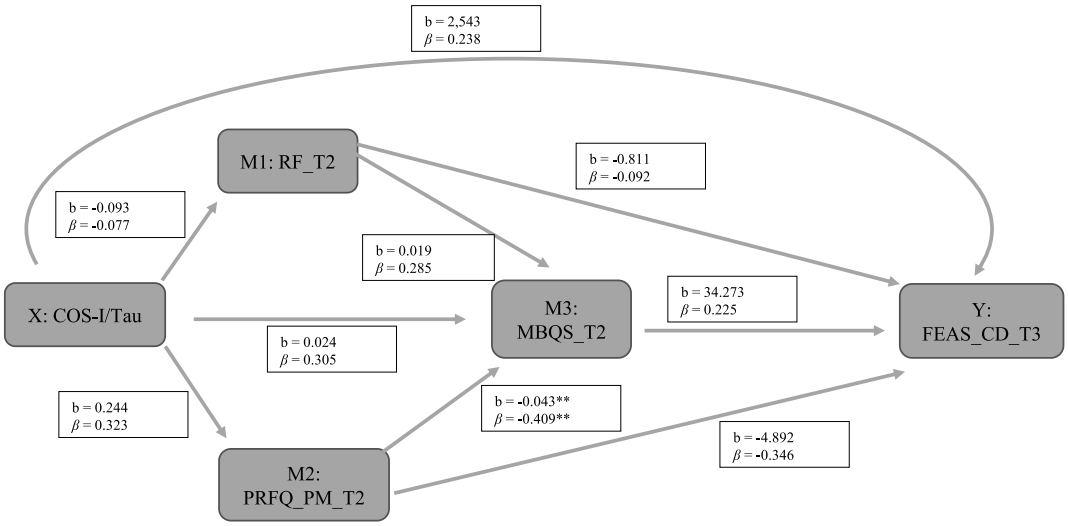

Fig. 2. The main model.
Note. $N = 44$. b = regression coefficient; β = standardized regression coefficient; COS-I/Tau = dichotomous variable coded with 0 = Tau/Treatment as usual, 1 = COS-I/Circle of Security-Intensive intervention group; RF_T2 = The Reflective Functioning scores at first follow-up (T2); PRFQ_PM_T2 = The Parental Reflective Functioning Pre-mentalizing subscale scores at first follow-up (T2); MBQ_S_T2 = Maternal sensitivity scores during free-play at first follow-up (T2); FEAS_CD_T3 = Functional Emotional Assessment Scale global scores of the child at second follow-up (T3); for the sake of readability, the following covariates are not displayed; however, they were also controlled for: baseline maternal age_T1, education_T1, income_T1, RF_T1, MBQS_T1; child age_T1, FEAS_CD_T1; postintervention maternal anxiety_T2;. *$p < .05$. **$p < .01$. ***$p < .001$.

PRFQ_PM_T2 on the child's FEAS_CD_T3 scores was found ($p = .023$). A regression effect between PRFQ_PM_T2 and MBQS_T2 was identified ($p = .011$) (see Fig. 4).

The effect of PRFQ_PM_T2 on the FEAS_CD_T3 and its relationship with sensitivity is also examined to see which FEAS domain is influenced by PRFQ_PM_T2 regarding sensitivity. PRFQ_PM_T2 has a substantial total effect on each FEAS domain, except domain_5 'representational capacity.' This significant effect disappears when sensitivity is included in the prediction model for domains 3, 4, and 6. The investigation identified no significant indirect effect of PRFQ_PM_T2 on sensitivity (Table 3).

4. Discussion

The objective of the present study was to investigate whether COS-I has a beneficial effect on the social-emotional development of children aged three years. Maternal RF, PM, and sensitivity at postintervention served as mediators of the effect of the intervention. The mediators were controlled for baseline maternal age, education, income, RF, sensitivity, and postintervention level of PPA, as well as baseline child age and FEAS. A consecutive sample of clinically diagnosed mothers with postpartum depression and children aged 2–10 months at enrollment was studied. The effects of RF and PM on the child's social-emotional functioning were also examined, with sensitivity serving as the mediating

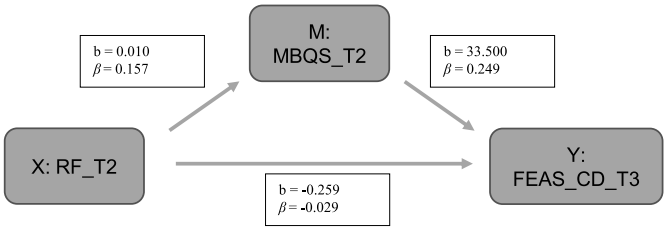

Fig. 3. The 1st sub-model.
Note. $N = 44$. b = regression coefficient; β = standardized regression coefficient; RF_T2 = The Reflective Functioning scores at first follow-up (T2); MBQS_T2 = Maternal sensitivity scores during free-play at first follow-up (T2). FEAS_CD_T3 = Functional Emotional Assessment Scale global scores of the child at second follow-up (T3). For the sake of readability, the following covariates are not displayed; however, they were also controlled for: baseline maternal age_T1, education_T1, income_T1, RF_T1, MBQS_T1; child age_T1, FEAS_CD_T1; post-intervention maternal anxiety_T2;. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

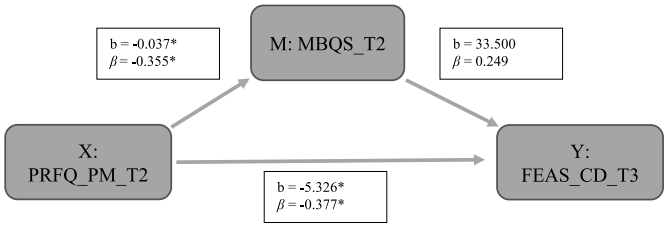

Fig. 4. The 2nd sub-model.
Note. $N = 44$. b = regression coefficient; β = standardized regression coefficient; PRFQ_PM_T2 = The Parental Reflective Functioning Pre-mentalizing subscale scores at first follow-up (T2); MBQS_T2 = Maternal sensitivity scores during free-play at first follow-up (T2). FEAS_CD_T3 = Functional Emotional Assessment Scales global scores of the child at second follow-up (T3); for the sake of readability, the following covariates are not displayed; however, they were also controlled for: baseline maternal age_T1, education_T1, income_T1, RF_T1, MBQS_T1; child age_T1, FEAS_CD_T1; postintervention maternal anxiety_T2;. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 3
Results of mediation analysis for maternal pre-mentalization through sensitivity on the child's FEAS domains of social-emotional functioning at the age of three (T3).

FEAS	Total effect	Direct effect	Indirect effect[a]
Domain 1	$\beta = -0{,}435^{**}$	$\beta = -0.351^{*}$	[−∞, 0.229]
Domain 2	$\beta = -0{,}425^{*}$	$\beta = -0{,}356^{*}$	[−∞, 0.318]
Domain 3	$\beta = -0{,}347^{*}$	$\beta = -0{,}250$	[−∞, 0.188]
Domain 4	$\beta = -0{,}376^{*}$	$\beta = -0{,}291$	[−∞, 0.221]
Domain 5	$\beta = -0{,}258$	$\beta = -0{,}260$	[−∞, 0.287]
Domain 6	$\beta = -0{,}347^{*}$	$\beta = -0{,}241$	[−∞, 0.072]

Note. β = standardized regression coefficient.
[a] The standardized indirect effect bootstrap 95 % confidence intervals; FEAS = Functional Emotional Assessment Scale: Domain 1: self-regulation and interest in the world (0–3 months), Domain 2: relationship forming, attachment, and engagement (2–7 months), Domain 3: two-way, purposeful communication (3–10 months), Domain 4: behavioral organization, problem solving, and internalization (a complex sense of self; 9–18 months), Domain 5: representational capacity (elaboration) (18–30 months), Domain 6: representational differentiation (building bridges between ideas and emotional thinking) (30–48 months).
$^{*}p < .05$.
$^{**}p < .01$.

factor.

To date, the positive total effect of COS-I on children's social-emotional outcomes was not confirmed. There was also no evidence of mediating (indirect) effects through which COS-I affects the child's social-emotional development. The analyses revealed no statistically significant disparities between COS-I and Tau conditions on RF, PM, and sensitivity in maternal participants at the initial follow-up, which occurred when the child reached ages 16 to 18 months. This finding indicates that the effects of COS-I were not discernibly different from the Tau intervention.

Exploratory analyses suggest that maternal RF has no significant influence on maternal sensitivity and child social-emotional development, while maternal PM negatively affects both maternal sensitivity and child social-emotional development. A more detailed investigation found that maternal PM has a significant effect on all domains of a child's social-emotional development except domain_5 (representational capacity). The significant total effect of maternal PM is negated for domain_3 'two-way, purposeful communication,' domain_4 'behavioral organization, problem solving, and internalization,' and domain_6 'representational differentiation (building bridges between ideas and emotional thinking)' when maternal sensitivity is incorporated into the regression model. However, the bootstrap intervals for estimating such an indirect effect proved to be non-significant (see Table 3). The following discussion will address the implications of these findings and the potential methodological and theoretical explanations.

4.1. Children's social-emotional development

The FEAS manual (Greenspan et al., 2001) outlines cut-off scores for the social-emotional development of three-year-olds. According to these scores, children in the COS-I condition are considered "normal," while those in the Tau condition are identified as "at risk." This classification holds diagnostic significance when used with other tools, like the Child Behavior Checklist (CBCL; Achenbach and Ruffle, 2000), or the Diagnostic Infant and Preschool Assessment (DIPA; Scheeringa and Haslett, 2010). In clinical practice, "at risk" and "deficient" FEAS scores necessitate a differential diagnosis, particularly considering the moderately high stability of psychopathological symptoms observed between the ages of 3 and 6 years, which is similar to later age groups (Bufferd et al., 2012).

The present study found that maternal PM after intervention appears to be important for all FEAS domains except domain 5, 'representational capacity (elaboration).' This finding suggests a potential adverse effect of maternal PM on a child's level of social-emotional development up to the age of three. The findings indicate that maternal sensitivity is not the mediating variable by which maternal PM affects a child, especially regarding the infant's core emotional and social capacities in the initial stages of development (FEAS domains 1 and 2).

When maternal sensitivity was added to the regression models for FEAS domains 3, 4, and 6, the previously significant total effect of PM on FEAS was attenuated and no longer significant, and no mediating effect of maternal sensitivity was indicated by the bootstrap confidence intervals. Several statistical explanations may account for this pattern, including shared explained variance (consistent with full or near-full mediation; Baron and Kenny, 1986), collinearity between PM and sensitivity resulting in inflated standard errors (Marcoulides and Raykov, 2019), overadjustment when controlling for an intermediate variable (Schisterman et al., 2009), loss of statistical power in a small sample size (MacKinnon et al., 2002), suppression effects (Conger, 1974), and differences in measurement reliability (Spearman, 1961). There may be other reasons, especially for the observed reduction in the maternal PM effect. Further investigation is necessary to elucidate the underlying mechanisms in future studies.

The children in the COS-I group demonstrated higher social-emotional development, as indicated by mean scores and graphical analysis. This is due to the mean score reflecting the group's tendencies, unaffected by one-sided outliers. However, the mean difference was not significant according to the main model. To detect a potentially significant mean difference with a power of 95 % and an alpha error of 5 %, a sample size of $N = 176$ would have been required with $n = 88$ mother-

child dyads per intervention group.

Further studies are needed to understand how maternal PM and sensitivity affects children's social and emotional development. It is also important to observe maternal regulatory strategies (FEAS) and the influence of maternal PM on child development. Gender-related differences may be significant (Fransson et al., 2020).

This is the first clinical study to use the FEAS with children of mothers with PPD, showing good reliability. More research is needed on the FEAS's psychometric properties and validity in clinical populations.

4.2. Methodological considerations

A methodological explanation for the lack of a positive effect of COS-I could be the relatively modest sample size included (main model: $N = 44$; n(COS-I) = 24, n(Tau) = 20), which can compromise the ability to detect significant effects due to insufficient representativeness. This can result in a reduced likelihood of identifying true effects (Chernick, 2008).

Another potential explanation is the low and homogeneous risk status of the clinical sample in the study (Ramsauer et al., 2020). The study noted the underrepresentation of high-risk variables associated with early childhood psychopathology, including factors such as young maternal age, low socioeconomic status, parental substance abuse, child maltreatment, very low neonatal birth weight, and the presence of multiple regulatory problems (Cicchetti, 2013; Schlensog-Schuster and Kaess, 2024; Smaling et al., 2015). The circumstances under which COS-I has a positive effect on children's social-emotional development should be investigated further.

4.3. Limitations

This study is part of a formerly conducted clinical randomized controlled trial (RCT) of COS-I for mothers with postpartum depression (PPD) and their children. Previous reports detail the study's strengths and limitations (Ramsauer et al., 2020). In summary, the TAU was high quality, so the study was underpowered. It was not feasible to add a non-treatment or wait-list control group due to ethics. The small sample size of 44 participants limits the findings' generalizability and reduces statistical power. Consequently, a larger sample size is needed to replicate the study and strengthen the conclusions.

The present study identified a limitation in the form of the PM subscale's low internal consistency, indicated by a reliability coefficient of $\alpha = 0.59$ (Blanz, 2021). The anticipated internal consistency for the PM subscale was 0.70 (Luyten et al., 2017). One potential explanation for this discrepancy could be the calculation of Cronbach's α, which is contingent upon the number of items and the sample size. A larger sample size and number of items increases the probability of achieving Cronbach's α of 0.7 or higher, given a latent construct underlying the items (Bujang et al., 2018).

The PRFQ_PM is a 6-item scale used to measure pre-mentalization. The small sample size and limited number of PM items may explain the low Cronbach's alpha value. The subscale's diminished reliability affects its internal validity (Georg et al., 2018). A recent study of the German version of the PRFQ revealed differences in its structure compared with the original. The reliability of the PM subscale was low, with Cronbach's alpha of 0.54 and McDonald's omega of 0.61 (Wildner et al., 2024). The development of a new questionnaire to measure pre-mentalization with a more substantial number of items and enhanced reliability may be necessary.

A primary evaluation was conducted to assess the efficacy of COS-I in enhancing maternal mental health outcomes in mothers diagnosed with postpartum depression. This evaluation also examined the child's social and emotional development at the age of three. Mothers with infants received COS-I or mother-infant treatment as usual in a specialized outpatient clinic, in addition to standard adult psychiatric treatment outside the trial. This approach ensures ecological validity, and the study provides information on the intervention's effectiveness. FEAS provided an objective assessment of the child's social-emotional development. The low attrition rates suggest high acceptance of the intervention, particularly among the COS-I group (Moschner et al., 2018). A more thorough examination of the impact of maternal postpartum anxiety on the child's social-emotional development at the age of three is warranted. The present study found a statistically significant association between maternal post-intervention anxiety (T2) levels and the child's social-emotional development, when the anxiety was controlled for as a covariate ($p = .030$, $\beta = 0.397$).

5. Conclusion

The findings of this clinical evaluation study demonstrated that COS-I is as efficacious as Tau in promoting RF, PM, and sensitivity in mothers with postpartum depression. However, it is imperative to acknowledge the study's statistical limitations. Further research is necessary to ascertain the extent to which a latent beneficial effect of COS-I may promote age-appropriate social-emotional development in their children and the relevance that maternal PM has in this context. Beyond emphasizing the relevance of maternal PM as indicated by the study's findings, the inconsistent results underscore limitations in the construct's reliability. Accordingly, further studies and methodological advancements are required to establish reliable and valid measures of PM. This will enable a more robust evaluation of the role of maternal PM in children's socio-emotional development.

Irrespective of the nature of the intervention, maternal PM has been demonstrated to encourage maternal sensitivity and infant social-emotional development. The impact of maternal PM on infants' social-emotional development remains ambiguous; however, low PM has been associated with heightened maternal sensitivity. Future COS-I intervention studies should place greater emphasis on PM as a therapeutic strategy to promote positive social-emotional development in children, particularly in the context of PPD. In particular, maternal PM has been demonstrated to play a pivotal role in the social and emotional capacities of children during their preschool years. Therefore, when creating treatment for mothers with PPD and their children, it's crucial to consider PM and the child's development stage.

CRediT authorship contribution statement

Brigitte Sabine Ramsauer: Writing – original draft, Validation, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Justin Leonard Michaelsen:** Writing – review & editing, Methodology, Formal analysis. **Steffen Zitzmann:** Writing – review & editing, Methodology.

Author statement

All authors have seen and approved the final version of the manuscript being submitted. This work represents the authors' original contributions and has not been previously published, nor is it currently under consideration for publication elsewhere.

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Declaration of competing interest

The authors declare that they have no conflict of interest.

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Corrigendum

Corrigendum to "The effects of mentalization and sensitivity of postpartum depression mothers after the circle of security-intensive intervention on the social-emotional development of three-year-old children" [J. Affect. Disord. 396 (1) (2026) 120838 https://doi.org/10.1016/j.jad.2025.120838 (1–10)]

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The authors regret that Table 3 shows the bootstrap 95% confidence interval rather than the bootstrap 90% confidence interval.

Table 3
Results of mediation analysis for maternal pre-mentalization through sensitivity on the child's FEAS domains of social-emotional functioning at the age of three (T3).

FEAS	Total effect	Direct effect	Indirect effect[a]
Domain 1	$\beta = -0{,}435^{**}$	$\beta = -0.351^{*}$	[−0.242, 0.229]
Domain 2	$\beta = -0{,}425^{*}$	$\beta = -0{,}356^{*}$	[−0.216, 0.318]
Domain 3	$\beta = -0{,}347^{*}$	$\beta = -0{,}250$	[−0.257, 0.188]
Domain 4	$\beta = -0{,}376^{*}$	$\beta = -0{,}291$	[−0.247, 0.221]
Domain 5	$\beta = -0{,}258$	$\beta = -0{,}260$	[−0.149, 0.287]
Domain 6	$\beta = -0{,}347^{*}$	$\beta = -0{,}241$	[−0.298, 0.072]

Note. β = standardized regression coefficient; FEAS = Functional Emotional Assessment Scale: Domain 1: self-regulation and interest in the world (0–3 months), Domain 2: relationship forming, attachment, and engagement (2–7 months), Domain 3: two-way, purposeful communication (3–10 months), Domain 4: behavioral organization, problem solving, and internalization (a complex sense of self; 9–18 months), Domain 5: representational capacity (elaboration) (18–30 months), Domain 6: representational differentiation (building bridges between ideas and emotional thinking) (30–48 months).
[a] The standardized indirect effect bootstrap 90% confidence intervals
[*] $p < .05$.
[**] $p < .01$.

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