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Regular Article

Intergenerational transmission of depressive symptoms: Maternal socialization of infant positive affect as a mediator

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Abstract

Parenting behaviors play an important role in the transmission of depressive symptoms from mothers to children. Although reduced positive affect is a central feature of depression, models of intergenerational transmission have neglected maternal socialization of positive affect as a mediating mechanism. This study investigated whether maternal responses to infant positive affect mediate the link between mothers' and toddlers' depressive symptoms. A community sample of 128 mothers (58% White) and their infants ($M_{age} = 6.65$ months, $SD = 0.53$ at first visit) participated in 3 assessments over a 1-year period. Assessments included self-reports of postpartum depressive symptoms, observational measures of maternal responses to infant positive affect and maternal sensitivity, and mother report of toddlers' depressive problems. Mediation analyses revealed that mothers with elevated postpartum depressive symptoms displayed fewer supportive responses to their infants' positive affect. In turn, infants who received fewer supportive responses had more depressive problems in toddlerhood. The indirect effect of postpartum depressive symptoms on toddlers' depressive problems *via* maternal supportive responses remained significant after controlling for maternal sensitivity. Findings suggest that maternal responses to infant positive affect play a unique role in the intergenerational transmission of depressive symptoms. The theoretical and practical implications of these findings are discussed.

Keywords: depressive symptoms; emotion socialization; mother–infant interaction; positive affect; postpartum depression

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Introduction

The continuity of depressive symptoms across generations is well established, particularly within mother–child dyads (Goodman, 2020). Longitudinal studies demonstrate that exposure to maternal depression in the first year of life predicts child internalizing problems between 2 and 19 years of age – even after accounting for subsequent exposure to maternal depression (Bagner et al., 2010; Bureau et al., 2009; Essex et al., 2001; Fihrer et al., 2009; Hentges et al., 2020; Murray et al., 2011; Walker et al., 2020). Despite robust evidence for the prospective link between maternal and child depressive symptoms, questions remain concerning how this transmission occurs. Identifying mechanisms through which depressive symptoms are transmitted has important implications, not only for informing theory, but also because these mechanisms can be directly targeted in future prevention and intervention efforts.

Behavioral genetic studies (e.g., adoption and children-of-twins designs) do indicate a small genetic component in the transmission of depressive symptoms from mothers to children, though they also indicate that this transmission is primarily explained by environmental mechanisms (Cioffi et al., 2021; Lewis et al., 2011; McAdams et al., 2015; Rice et al., 2013; Silberg et al., 2010; Singh et al., 2011). In their seminal model of intergenerational transmission, Goodman and Gotlib (1999) proposed that symptoms of depression interfere with a parent's ability to meet their child's socioemotional needs, and that this compromised parenting puts the child at risk for depression and other adverse outcomes. Extant research supports the notion that parenting behaviors mediate the transmission of depressive symptoms across generations. For instance, Behrendt et al. (2019) found that mothers with elevated depressive symptoms displayed less sensitivity with their infants at 6 months postpartum, which in turn was associated with child emotional problems at 12–16 months. Similarly, Ulmer-Yaniv et al. (2018) found that depressed mothers exhibited more negativity when interacting with their children, which predicted child internalizing behavior at 10 years of age. Other studies have identified maternal criticism (Gravener et al., 2011), hostile parenting (Hentges et al., 2021), low maternal warmth (Harold et al., 2011), and impaired postpartum bonding (Fransson et al., 2020) as mediators of the relation between maternal depressive symptoms and child internalizing problems.

While researchers have examined various aspects of parenting among mothers with depressive symptoms, the literature has focused on global parenting dimensions (e.g., sensitivity) or general maternal characteristics (e.g., negativity), which characterize the broader emotional climate of the caregiving relationship (Morris et al., 2007). Greater specificity is needed to identify parenting mechanisms that may play a more direct role in the

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transmission of depressive symptoms. To date, models of intergenerational transmission have paid little attention to emotion-specific parenting practices (Eisenberg et al., 1998b; Thompson et al., 2020), particularly those that directly support children's positive affect. This gap is especially pressing because reduced positive affect is a central feature of depression (American Psychiatric Association, 2022). Indeed, both mothers and children with elevated depressive symptoms exhibit lower levels of positive affect, including difficulties *upregulating* (i.e., sustaining and enhancing) positive affective states (Fredrick et al., 2019; Moran et al., 2019; Morrow et al., 2021; Nelis et al., 2019; Olino et al., 2011; Raes et al., 2014; Sheeber et al., 2009). Low positive affect also discriminates depression from other forms of psychopathology (Anthony et al., 2002; Chorpita, 2002; Ebesutani et al., 2011; Lonigan et al., 2003; Phillips et al., 2002; Watson & Naragon-Gainey, 2010). Accordingly, maternal socialization of positive affect may pave a unique pathway for the transmission of depressive symptoms.

Maternal socialization of positive affect

Emotion socialization refers to parenting practices that influence a child's learning about the expression and regulation of emotions (Eisenberg et al., 1998a). One key component of emotion socialization involves how parents respond to their children's emotional displays. These responses provide immediate feedback regarding the shareability of emotions and are broadly categorized as *supportive* (encouraging) or *nonsupportive* (discouraging) of children's display of emotion (Eisenberg et al., 1998a). Mothers differ in the way they respond to children's positive affect. If mothers tend to respond in a supportive manner (e.g., by conveying interest or reciprocating positive affect), children are encouraged to share and savour their positive emotions, which fosters the development of strategies for upregulating positive affect (Fredrick et al., 2019; Katz et al., 2014; Nelis et al., 2019). In contrast, if mothers frequently provide nonsupportive responses (e.g., by ignoring or minimizing positive affect), children may learn to suppress their positive emotions and may struggle to acquire strategies for sustaining and enhancing positive affective states (Eisenberg et al., 1998a; Yap et al., 2008).

From a theoretical standpoint, supportive responses to infants' positive affect (e.g., reciprocal smiling) may be particularly challenging for mothers with postpartum depression, who experience low levels of positive affect themselves. Physical and cognitive symptoms of depression (e.g., low energy, self-focused attention) may further compromise mothers' ability to recognize and engage in their infants' positive experiences. Moreover, infants might be particularly susceptible to maternal socialization of positive affect, as emotional development occurs most rapidly in the first year of life, and infants require support from caregivers to build and sustain positive affective states (Feldman, 2003; Goodman & Gotlib, 1999). For these reasons, we propose that maternal responses to infant positive affect mediate the relation between maternal postpartum depression and child depressive symptoms (see Figure 1). In the following sections, we review evidence for each path of this mediation model.

Path a: Maternal depressive symptoms predict maternal responses to positive affect

Despite extensive research on maternal socialization of negative affect (Eisenberg, 2020), to our knowledge, only two studies have directly examined whether depressive symptoms predict maternal responses to children's positive affect. Both studies were conducted in the U.S. and neither involved infants. In a sample of preschool children, Morgan et al. (2020) observed that depressed mothers were less likely than nondepressed mothers to match their children's positive affect (defined by maternal expression of positive affect 10 s later). Among Appalachian school age children, Morrow et al. (2021) observed that mothers with higher depression scores were more likely to ignore their children's positive affect statements during a discussion task. Self-report data further indicated that mothers with higher depression scores were less likely to display positive affect following children's positive events (Morrow et al., 2021). Thus, although sparse, existing research suggests that mothers with elevated depressive symptoms exhibit fewer supportive (e.g., matching) and more nonsupportive (e.g., ignoring) responses to their children's positive affect.

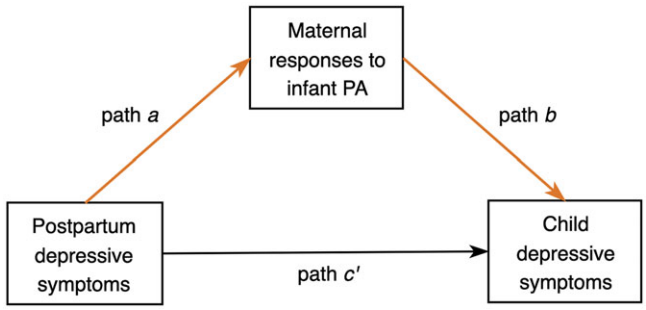

Figure 1. Proposed mediation model. *Note.* PA = positive affect.

Whether the preceding findings extend to infancy has not been explored in the current literature. However, observational studies of mother–infant interactions offer important insights. It is well established that depressed mothers, relative to nondepressed mothers, display less positive affect when interacting with their infants (Campbell et al., 1995; Field, 1984; Muzik et al., 2017). Depressed mothers and their infants are also less likely to exhibit mutually positive states (i.e., synchronous positive affect; Feldman, 2003; Field et al., 1990). Other observational studies have shown that mothers with elevated postpartum depressive symptoms are more disengaged during periods of mother–infant play (Goodman et al., 2022; Lovejoy et al., 2000) and are less responsive to their infants' cues (Bernard et al., 2018; Norcross et al., 2017). Although the authors did not distinguish between positive and negative infant cues, such findings imply that postpartum depression may hinder mothers' ability to reciprocate infants' positive affect, which is necessary for supportive responding.

Path b: Maternal responses to positive affect predict child depressive symptoms

There is considerable evidence that maternal responses to positive affect predict child depressive symptoms; however, existing research has focused on middle childhood and adolescence. Cross-sectional findings from Australia (Yap et al., 2008) and the U.S. (Katz et al., 2014) show that mothers who exhibit more nonsupportive responses have youth with higher rates of depressive symptoms and clinical depression, respectively. In another U.S. sample, Fredrick et al. (2019) found that maternal supportive responses during an interaction task were associated with adolescents' upregulation of positive affect, which in turn predicted fewer depressive symptoms. Notably, these results were

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obtained while controlling for maternal depressive symptoms, general-context parenting (i.e., maternal warmth and observed positive affect), and family positive expressiveness – none of which emerged as significant predictor variables (Fredrick et al., 2019). Not only do these findings highlight the need to discriminate emotion-specific parenting from general-context parenting, but they also highlight the unique association between maternal responses to positive affect and child depressive symptoms.

Three longitudinal studies from the U.S. (Moran et al., 2019), Belgium (Nelis et al., 2019), and India (Raval et al., 2019) assessed whether maternal responses to positive affect predict changes in youths' depressive symptoms over time. In line with previous research, all studies found significant *concurrent* associations between maternal responses (i.e., enhancing or dampening positive affect) and youths' depressive symptoms. However, only one study detected a significant longitudinal association, and concurrent associations where much larger in magnitude (Nelis et al., 2019). To explain this pattern of findings, Nelis et al. (2019) suggested that maternal socialization of positive affect, and its impact on child depressive symptoms, may have already occurred at a younger age. These findings are consistent with the notion that maternal support for positive affect might have a greater impact on child outcomes at earlier stages of development.

Currently, research investigating maternal responses to positive affect in infancy is limited. Prospective observational studies have shown that maternal matching or imitation of infant affect (i.e., supportive responses) predict increases in infants' positive affect over time (Malatesta et al., 1986; Nicely et al., 1999). Another longitudinal study found that maternal matching of infant positive affect was associated with fewer expressions of sadness in toddlerhood (Malatesta et al., 1989). Although the preceding studies did not examine child depressive symptoms as an outcome variable, reduced positive affect and elevated sadness are hallmark features of depression.

The present study

We propose a mediation model linking postpartum depressive symptoms to toddlers' depressive problems *via* maternal responses to infant positive affect. A review of existing research suggests that mothers with elevated depressive symptoms exhibit fewer supportive responses to positive affect (path *a*) and that children who receive less support for positive affect have higher rates of depressive symptoms (path *b*). Despite emerging evidence for paths *a* and *b*, no studies to our knowledge have tested whether they mediate the transmission of depressive symptoms from mothers to children. Moreover, research investigating paths *a* and *b* has focused on middle childhood and adolescence, even though infants are more susceptible to caregiving influences relative to older children (Goodman & Gotlib, 1999). Evidence also suggests that depressive problems can emerge as early as 18 months of age (Achenbach & Rescorla, 2000; Gartstein & Bateman, 2008; Luby & Belden, 2012), underscoring the need to incorporate toddlers within this line of research. Identifying the earliest age at which depressive symptoms are transmitted is an important goal, not only because depressive symptoms in early life often precede more severe psychopathology (Luby et al., 2014), but also because earlier intervention may allow for greater therapeutic benefit. Finally, given that reduced positive affect is directly implicated in depressive symptomatology, examining how mothers socialize positive affect may provide greater clarity on the mechanisms underlying depression transmission.

To address these gaps in the literature, the present study investigated the transmission of depressive symptoms from mothers to toddlers, focusing on maternal socialization of infant positive affect as a mechanism of transmission. We hypothesized the following:

1. Mothers with elevated depressive symptoms in the first year postpartum would display fewer supportive responses to their infants' positive affect (path *a*).
2. Infants who receive less support for positive affect would exhibit more depressive problems in toddlerhood (path *b*).
3. Maternal responses to infants' positive affect would mediate the relation between postpartum depressive symptoms and toddlers' depressive problems (indirect effect).

To test the specificity of our mediation model, we added maternal sensitivity as a covariate in a follow-up analysis. Maternal sensitivity is a global parenting dimension that encompasses prompt, contingent, and appropriate responding to *all* infant cues, not merely positive affect. This allowed us to evaluate whether maternal responses to positive affect uniquely mediate the transmission of depressive symptoms or whether they are simply a marker of general responsivity.

Method

Participants

The sample consisted of 128 mother–infant dyads, recruited as part of a larger longitudinal study on early childhood development. Participants were recruited through presentations at community centres and parenting events, social media posts, and flyer postings across Toronto, Canada. Dyads were eligible for participation if (a) the mother had English proficiency, (b) the mother was at least 18 years of age, (c) the dyad had no major medical conditions, and (d) the infant weighed more than 2500 g at birth. All procedures were approved by the institutional Research Ethics Board.

Data were collected at three time points: early infancy (Time 1; $M = 6.65$ months, $SD = 0.53$), late infancy (Time 2; $M = 12.71$ months, $SD = 1.02$), and toddlerhood (Time 3; $M = 19.87$ months, $SD = 1.67$). Of the 128 dyads who were seen at Time 1, 103 (80%) participated at Time 2, and 90 (70%) participated at Time 3. Thus, 38 dyads (30%) were lost to attrition by the final assessment. This high attrition rate was related to the onset of the COVID-19 pandemic midway through data collection. Prior to the pandemic, all data were collected during in-person home visits. The transition to an online format significantly disrupted data collection and involved the loss of 25 dyads. Pre-pandemic, participants were lost because they relocated outside of Toronto ($n = 7$) or were unresponsive/disinterested ($n = 6$).

At Time 1, mothers were between 18 and 49 years of age ($M = 34.18$, $SD = 4.37$; 98% were between ages 25 and 41). Almost all mother–infant dyads ($n = 127$, 99%) were biologically related, and there were slightly more male (55%) than female infants. Mothers reported the racial/ethnic status of their biological parents and were classified into the following groups based on visible minority status (Statistics Canada, 2021): White (58%), Asian (27%), Black (7%), Latinx (6%), and Middle Eastern (2%). Racial composition of the current sample approximates that of the Toronto population. Most mothers were university educated (79%) and either married or in a common-law relationship (90%). Annual family income before tax ranged from under 5,000 to over 250,000 CAD (median 100,001 – 150,000 CAD). When data were

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collected, the median family income in Toronto was 106,900 CAD per year (Statistics Canada, 2019).

Procedure

Data collection

Written informed consent was obtained from all mothers prior to participation. Data were collected between June 2018 and August 2021. At the onset of the COVID-19 pandemic in March 2020, all dyads had completed the first home visit (Time 1); however, data collection was still ongoing for a minority of dyads at Time 2 ($n = 22$, 21%) and half of the dyads at Time 3 ($n = 47$, 53%). Due to discontinuation of home visits following the pandemic onset, these dyads provided questionnaire data remotely.

At each time point, mothers completed a series of questionnaires in Qualtrics, an online survey platform. The questionnaires used in the present study assessed postpartum depressive symptoms (Times 1 and 2) and toddlers' depressive problems (Time 3). At Times 1 and 2, observational data were also collected during the home visits. Specifically, mother–infant dyads were video recorded for 30 minutes of play. Each dyad was given a standardized set of toys (i.e., musical phone, musical drum, toy car, sensory ball), and mothers were instructed to interact with their infant as they normally would. The interaction consisted of three 10-min episodes. In the first episode, mothers completed questionnaires on an iPad while their infant played freely. In the second episode, mothers interacted with their infant using the provided toys, and in the final episode, they interacted without use of toys. The rationale for these three episodes is provided elsewhere (Dryer et al., 2022). Dyads were permitted to move around their home during the recording since they could be followed with the camera. This procedure was designed to maximize ecological validity relative to static observations and split-screen laboratory methods, but it also meant that at times, facial expressions were obscured. When both the mother and infant's faces could not be recorded in the same frame, the infant's face was prioritized.

Observational coding

The video recordings at Time 2 were coded for maternal responses to positive affect in BORIS software (Friard & Gamba, 2016). This involved a two-step coding process: (a) identifying infant displays of positive affect and (b) classifying subsequent maternal responses. Given that infant initiations or changes in behavior are critical for eliciting maternal responses (Nicely et al., 1999; Van Egeren et al., 2001), positive affect was only coded if it represented a clear change in the infant's affective state. Coders watched the videos in real time and marked the onset (i.e., start time) of infant positive affect. Following the onset of a positive display, a corresponding maternal response was coded within a latency window of 3 s. Prior research investigating maternal response latencies suggests that most mothers respond to infant cues within 1 – 2 s and nearly all responses occur within 3 s (Nicely et al., 1999; Van Egeren et al., 2001). The video recordings at Time 1 were coded for maternal sensitivity, a covariate measure.

Observational measures

Infant positive affect

Indicators of positive affect were selected based on existing measures of observed infant affect (Davis et al., 2019; Feldman, 2003; Izard, 1995; Olino et al., 2011). Specifically, positive affect was coded each time the infant displayed one or more of the following: a smile; a laugh or chuckle; a positive vocalization (e.g., squeal of excitement); an open mouth or gasp in surprise. Positive affect was identified by a team of four independent coders (i.e., one graduate student and three undergraduate research assistants). To establish initial reliability, 20% of videos were randomly selected and blindly coded by all team members. The remaining videos were blindly coded by two team members (assigned randomly) to minimize the possibility of overlooking any positive affect displays. Kappa coefficients for each coder pairing ranged from .75 to .89. Coding differences were resolved by consensus during weekly team meetings. The mean number of positive affect displays identified per video was 13.60 ($SD = 7.13$). To control for frequency of infant positive affect, the total number of positive displays was included as a covariate in the main analyses.

Maternal responses to infant positive affect

Maternal responses to positive affect were categorized using a coding system derived from prior measures (e.g., Lavelli & Fogel, 2013; Martins et al., 2018; Nicely et al., 1999) and modified for infant age. Each response was broadly categorized as either *supportive* or *nonsupportive* of the infant's positive display. The supportive response category consisted of three subcodes: *emotion-focused response* (emotional labeling, narration, or praise); *matching response* (reciprocal smiling or laughter); and *emotion amplification* (exaggerated facial or vocal expressions). The nonsupportive category consisted of four subcodes: *intrusive response* (interrupting or redirecting); *minimization* (responding with minimal engagement or restricted affect); *ignoring* (no response); and *not attending* (unawareness of infant positive affect). If a mother's response was not visible to coders, it was classified as *unobservable* and excluded from analysis. The median percentage of unobservable responses per video was 7 (interquartile range = 0% – 13%).

Maternal responses were coded by two undergraduate research assistants who were blind to the study hypotheses. Given that there were eight mutually exclusive codes, most of which were selected infrequently, Kappa coefficients were unstable when only 20% of videos were used to assess interrater reliability. Thus, all videos were double coded to ensure reliability estimates were stable. Kappa coefficients for each code ranged from 0.69 – 0.89. Coding differences were reviewed on a weekly basis and resolved by consensus. Due to variation in the number of infant positive displays and thus maternal responses coded per dyad, proportion scores were computed for analysis. Specifically, the number of supportive responses was divided by the total number of observed responses (i.e., supportive plus nonsupportive). Possible scores ranged from 0% – 100%, with higher scores indicating a greater proportion of supportive responses (and a lower proportion of nonsupportive responses) to infant positive affect. Consistent with prior research (e.g., Denham & Kochanoff, 2002; Moran et al., 2019), subcategories of supportive and nonsupportive responses were not analyzed separately due to insufficient variability.

Maternal sensitivity

To evaluate the specificity of our mediation model – that is, whether maternal responses to infant positive affect uniquely mediate the transmission of depressive symptoms – we added maternal sensitivity as a covariate in a follow-up analysis. The video recordings at Time 1 were coded using the Emotional Availability Scales (4th edition; Biringen, 2008), a well-validated coding system that includes four parent-related scales: sensitivity, structuring, nonintrusiveness, and nonhostility (Biringen et al., 2014). We focused on the sensitivity scale because it is a broader

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measure of maternal responsiveness that is not limited to infants' positive affect cues. Whereas supportive responses to positive affect are a specific emotion socialization behavior, maternal sensitivity is a global parenting dimension, reflecting a mother's ability to accurately perceive and respond to all infant cues (whether positive, negative, or neutral) as well as the appropriateness and authenticity of her affect. Maternal sensitivity was coded by two graduate students who were trained and certified by the scale's developer (Biringen). To establish interrater reliability, 25% of videos were randomly selected for double coding (ICC = .75).

Coders watched the full 30-min interaction before assigning mothers a single sensitivity rating encompassing all episodes. Each mother was assigned a direct sensitivity score ranging from 1 – 7, with higher scores indicating greater levels of sensitivity.

Questionnaire measures

Postpartum depressive symptoms

At 6 and 12 months postpartum (Times 1 and 2), mothers rated their depressive symptoms using the Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987). The EDPS is a 10-item self-report questionnaire specifically designed to assess depressive symptomatology during the postpartum period. Items focus on cognitive and emotional symptoms of depression (e.g., sadness, hopelessness) rather than physical symptoms (e.g., appetite changes, fatigue), since these overlap with typical postpartum experiences (Cox et al., 1987). Each item is rated on a 4-point Likert scale ranging from 0 – 3, with varying response anchors relating to frequency of symptoms (e.g., 0 = *no, not at all*, 3 = *yes, most of the time*). Higher scores indicate more depressive symptoms over the past week. Internal consistency in the present sample was strong ($\alpha = 0.85$ and 0.88 for Times 1 and 2, respectively).

EPDS scores between time points were highly correlated ($r = .65$, $p < .001$) and were averaged to create a measure of maternal depressive symptoms across the first year postpartum. Research indicates that persistent rather than transient depressive symptoms during the postpartum period are most predictive of child internalizing problems (Hentges et al., 2020; Prenoveau et al., 2017; van der Waerden et al., 2015). Moreover, given that the EPDS asks mothers to report on their symptoms "in the past 7 days," we wanted to avoid capturing transient depressive states, and averaging the scores produced a more reliable estimate of longer-term depression. Due to attrition, 19% of mothers had missing EPDS values at Time 2. Prior to averaging EPDS scores, missing values at Time 2 were handled using multiple imputation (van Buuren, 2018).

Toddler depressive problems

At Time 3, mothers rated their toddler's depressive problems using the Child Behavior Checklist for Ages 1½–5 (CBCL; Achenbach & Rescorla, 2000), a 99-item parent report inventory of children's behavioral problems. The present study focused on the 10-item Depressive Problems subscale. Sample items include "Shows little interest in things around him/her" and "Looks unhappy without good reason." Each item is rated on a 3-point Likert scale ranging from 0 (*not true*) to 2 (*very true or often true*). Higher scores indicate more depressive behaviors over the past 2 months. Internal consistency of the Depressive Problems subscale was lower in the current sample ($\alpha = .56$) compared to the standardization sample ($\alpha = .69$), which included 1.5– 5-year-olds. Studies limited to toddlerhood (1.5–3 years) similarly report lower internal consistency (α = .51–.65), likely due to reduced variability in scores (Gartstein & Bateman, 2008; de la Osa et al., 2016).

Missing data

Seven dyads (5%) were excluded from further analysis due to compromised video recordings at Time 2. Specifically, one infant did not display positive affect during the interaction, which precluded maternal responses from being coded. Six additional infants had fewer than four positive displays because the interaction was cut short ($n = 4$) or the infant's face was not consistently observable ($n = 2$). This reduced the analytic sample to 121 dyads.

Missing data across study variables ranged from 0 to 40%. Missingness was particularly high (40%) for observational data at Time 2 since home visits were discontinued following the pandemic onset (i.e., only half of these dyads dropped out of the study; the other half provided questionnaire data remotely). Little's MCAR test was not statistically significant, $\chi^2(33) = 40.73$, $p = .17$, providing no evidence of systematic missingness. However, mothers who were lost from attrition had lower family income compared to mothers who completed Time 3, $t(113) = 2.91$, $p = .004$, $d = .60$. In the main analyses, missing data were estimated with full information maximum likelihood (FIML). Six auxiliary variables were used to enhance precision of FIML because they significantly predicted missingness or analysis variables containing missingness (Enders, 2008): mothers' perceived stress, perceived social support, pathological worry, daily parenting hassles, and benevolent childhood experiences.

Results

Descriptive information and preliminary analyses

Descriptive statistics for study variables are presented in Table 1. At each postpartum assessment, 22% of mothers obtained an EPDS score ≥11, the recommended cut-off for detecting clinical depression (Levis et al., 2020). This approximates the provincial prevalence rate of postpartum depression (e.g., 18%; Lanes et al., 2011). On average, mothers displayed a greater proportion of supportive (67%) than nonsupportive (33%) responses to their infant's positive affect. Postpartum depressive symptoms and observed supportive responses were normally distributed. Toddlers' scores on the CBCL-Depressive Problems scale were positively skewed due to a floor effect; 37% of the observed scores were 0 (skew value = 6.07). This is consistent with the population distribution of depressive problems in toddlerhood (Achenbach & Rescorla, 2000).

Maternal responses to positive affect did not significantly differ based on infant sex, $t(70) = 0.97$, $p = .33$, $d = .23$. Similarly, there were no significant differences in toddlers' depressive problems based on infant sex, $t(80) = 0.36$, $p = .72$, $d = .08$, or between dyads who completed Time 3 in person (i.e., pre-pandemic) verses remotely (i.e., following the pandemic onset), $t(80) = 0.38$, $p = .71$, $d = .08$. Maternal education was negatively correlated with postpartum depressive symptoms ($r = -.29$, $p = .001$) and toddlers' depressive problems ($r = -.29$, $p = .009$); thus, it was included as a covariate in all subsequent analyses. No other demographic factors significantly correlated with study variables. Bivariate correlations among analytic variables are shown in Table 2.

Main analyses: the mediation model

To address our hypotheses, we conducted a mediation analysis in RStudio 2022.02.0 using structural equation modeling (*lavaan* package; Rosseel, 2012) and the MLR estimator, which is robust to non-normality. In the first equation, path *a* was estimated by regressing maternal supportive responses ("*M*") on postpartum depressive symptoms ("*X*"). In the second equation, paths *b* and *c*'

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Table 1. Descriptive statistics for study variables

Variable	*M*	*SD*	Min.	Max.
EPDS T1 & T2	6.99	4.03	0.00	17.40
Infant positive affect displays T2	13.60	7.13	4.00	42.00
Maternal supportive responses T2	67.08	22.18	14.29	100.00
CBCL-Depressive Problems T3	1.42	1.63	0.00	8.00
Maternal education T1[a]	4.12	0.92	1.00	5.00
Maternal sensitivity T1	4.13	1.39	1.00	7.00

Note. T1 = Time 1; T2 = Time 2; T3 = Time 3; EPDS = Edinburgh Postnatal Depression Scale; CBCL = Child Behavior Checklist.
[a]Educational attainment was coded as follows: 1 = primary school, 2 = secondary school, 3 = college diploma, 4 = undergraduate degree, 5 = postgraduate degree.

Table 2. Bivariate correlations between study variables

	n	1	2	3	4	5
1. Postpartum depression (EPDS)	121	—				
2. Infant positive affect displays	72	−.08	—			
3. Maternal supportive responses	72	−0.21†	.00	—		
4. Depressive problems (CBCL)	82	0.10	.00	−0.23†	—	
5. Maternal education	121	−0.29**	0.23†	.01	−0.29**	—
6. Maternal sensitivity	121	−0.24**	0.14	0.18	−0.12	0.33**

Note. Table presents bivariate correlations for observed data. In the main analyses, missing data were estimated using full information maximum likelihood with robust standard errors. EPDS = Edinburgh Postnatal Depression Scale; CBCL = Child Behavior Checklist. †$p < .09$. *$p < .05$. **$p < .01$.

were estimated by regressing toddlers' depressive problems ("*Y*") on *M* and *X*. Infant positive affect displays and maternal education were included as covariates in each equation. To test the indirect effect of *X* on *Y* through *M* (represented as *a***b*), we computed a bias-corrected bootstrap confidence interval using 10,000 bootstrap samples. An indirect effect was inferred if the 95% confidence interval did not incorporate zero (Hayes, 2022).

Regarding path *a*, postpartum depressive symptoms emerged as a significant predictor of maternal supportive responses. There was a negative association ($\beta = -0.23$, $p = .029$), indicating that mothers with higher depressive symptoms displayed a lower proportion of supportive responses to their infants' positive affect. Regarding path *b*, maternal supportive responses negatively predicted toddlers' depressive problems ($\beta = -0.33$, $p = .025$), such that infants who received more supportive responses had fewer depressive problems in toddlerhood. There was no evidence of a direct relationship between postpartum depressive symptoms and toddlers' depressive problems (path *c*'; see Table 3 for full results).

The bias-corrected bootstrap confidence interval of the indirect effect did not incorporate zero (*unstandardized estimate* = 0.031, 95% CI [0.001, 0.109]), indicating that the mediation model was significant. That is, postpartum depressive symptoms predicted toddlers' depressive problems through their effect on maternal supportive responses. Summary statistics for the full mediation model are presented in Figure 2. Because the model was fully saturated ($df = 0$), model fit indices are not reported.

Specificity analysis: adding maternal sensitivity

To assess the specificity of our mediation model, we sought to determine whether the indirect effect remained significant after controlling for maternal sensitivity. When maternal sensitivity was added as a covariate to each regression equation, the bias-corrected bootstrap confidence interval for the indirect effect did not incorporate zero, *unstandardized estimate* = 0.030, 95% CI (0.0001, 0.101). This indicates that the indirect effect of postpartum depressive symptoms on toddlers' depressive problems through maternal supportive responses (*a***b*) operated independently of maternal sensitivity. As shown in Figure 3, maternal sensitivity did not emerge as a significant predictor of either maternal supportive responses or toddlers' depressive problems.

Exploratory analysis: separating postpartum depression at 6 and 12 Months

In an effort to assess the independent roles of postpartum depression at 6 and 12 months, we tested an alternative mediation model in which depressive symptoms were not averaged across time points. Instead, EPDS scores at 6 and 12 months were included as separate predictors within the model. EPDS scores at 12 months were additionally regressed on EPDS scores at 6 months to account for the stability of postpartum depression over time ($r = .65$). This produced a serial mediation model as depicted in Figure 4. Given our limited statistical power, we did not include

Table 3. Regressions predicting maternal supportive responses and toddlers' depressive problems

Predictor Variable	*B*	*SE*	95% CI	*β*	*p*
Criterion: Maternal Supportive Responses ($R^2 = .09$)					
Postpartum depression (*a*)	−1.39	0.67	[−2.70, −0.07]	−0.23	.039
Infant positive affect displays	0.00	0.38	[−0.75, 0.76]	.00	0.992
Maternal education	2.07	3.48	[−4.76, 8.90]	.08	0.552
Criterion: Toddlers' Depressive Problems ($R^2 = .17$)					
Supportive responses (*b*)	−0.02	0.01	[−0.04, −0.003]	−0.33	.024
Postpartum depression (*c*')	0.00	0.05	[−0.10, 0.10]	.00	0.982
Infant positive affect displays	0.00	0.03	[−0.06, 0.06]	.01	0.968
Maternal education	−0.39	0.24	[−0.86, 0.08]	−.22	0.101

Note. $N = 121$.

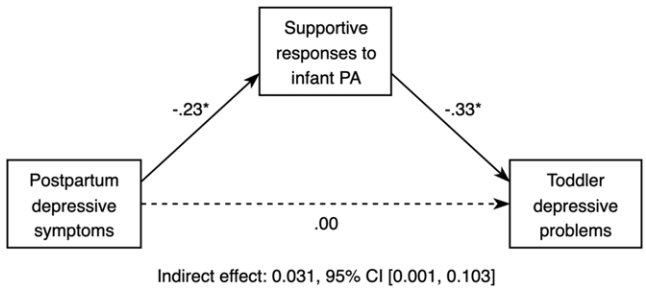

Figure 2. Summary of mediation model. *Note.* PA = positive affect. Figure presents standardized path coefficients for *a*, *b*, and *c*', and the unstandardized estimate of the indirect effect (*a***b*). All paths controlled for infant PA displays and maternal education. *$p < .05$.

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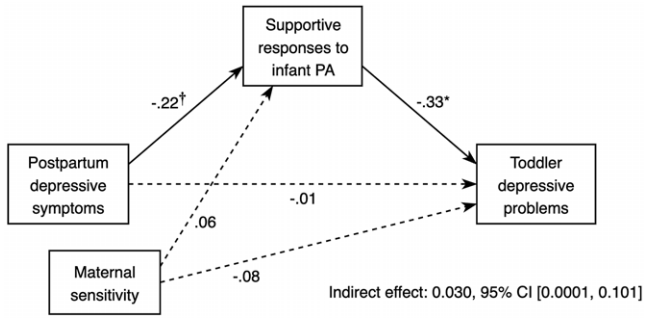

Figure 3. Summary of mediation model with maternal sensitivity as a covariate. *Note.* PA = positive affect. Figure presents standardized path coefficients and the unstandardized estimate of the indirect effect. All paths controlled for infant PA displays and maternal education. $^{\dagger}p = .06$. $^{*}p < .05$.

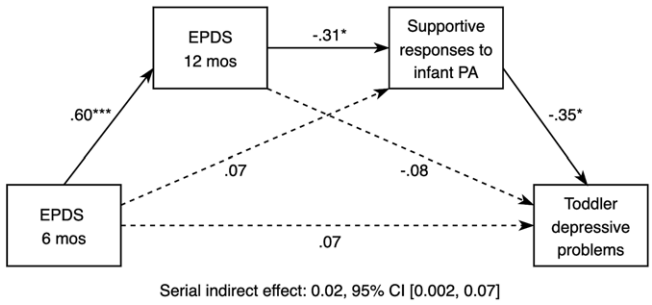

Figure 4. Post hoc serial mediation model. *Note.* PA = positive affect. Figure presents standardized path coefficients and the unstandardized estimate of the indirect effect. All paths controlled for maternal sensitivity and maternal education. $^{*}p < .05$. $^{***}p < .001$.

infant positive affect displays as a covariate because it accounted for no variance at all in the original model. Maternal sensitivity and maternal education remained covariates in each regression equation, and thus the model was fully saturated.

All paths involved in serial mediation (EPDS 6 months → EPDS 12 months → observed supportive responses → toddler depressive problems) were significant. The bias-corrected bootstrap confidence interval for the serial indirect effect did not contain zero, *unstandardized estimate* = 0.02, 95% CI [0.002, 0.07]. Notably, no other direct or indirect paths between EPDS scores at 6 months and toddlers' depressive problems were significant. These results suggest that maternal depressive symptoms at 6 months indirectly influenced toddlers' depressive problems *via* continued depressive symptoms at 12 months, followed by fewer supportive responses to infant positive affect.

Discussion

The intergenerational continuity of depressive symptoms among mother–child dyads is well documented (Goodman, 2020). However, the specific mechanisms underlying this association remain unclear. The present study investigated the transmission of depressive symptoms from mothers to toddlers, focusing on maternal socialization of infant positive affect as a mechanism of transmission. Mediation analyses supported our primary hypothesis: postpartum depressive symptoms indirectly predicted toddlers' depressive problems through their effect on maternal responses to positive affect. Specifically, mothers with elevated depressive symptoms in the first year postpartum displayed fewer supportive responses to their infants' positive affect, which in turn, was associated with more depressive problems in toddlerhood.

A notable finding is that the indirect effect of postpartum depressive symptoms on toddlers' depressive problems *via* maternal supportive responses remained after controlling for maternal sensitivity – a broader measure of responsiveness to infant cues that is not limited to positive affect. This indicates that the indirect effect was not simply a byproduct of the effects of maternal sensitivity. In fact, maternal sensitivity did not independently predict maternal supportive responses or toddlers' depressive problems. These results underscore the robustness of our mediation model and suggest that maternal responses to infant positive affect may play a unique role in the transmission of depressive symptoms.

As hypothesized, mothers with higher depressive symptoms in the first year postpartum displayed a lower proportion of supportive responses to their infants' positive affect (path *a*). To our knowledge, this was the first study to directly examine whether depressive symptoms predict maternal responses to positive affect during infancy. However, similar findings were reported among mothers of preschool (Morgan et al., 2020) and school age (Morrow et al., 2021) children. In both studies, maternal depression was associated with a lower propensity to display positive affect following children's positive experiences. Morrow et al. (2021) additionally found that mothers with higher depressive symptoms were more likely to ignore their children's positive affect statements. Thus, evidence suggests that maternal depressive symptoms interfere with supportive responding irrespective of child age. Our finding is also in line with the broader literature on maternal postpartum depression and observed parenting behavior. Studies consistently show that mothers with higher levels of postpartum depression are less responsive to their infants' cues in general (Bernard et al., 2018; Norcross et al., 2017), more disengaged during periods of play (Beebe et al., 2012; Lovejoy et al., 2000), and less affectively positive with their infants (Campbell et al., 1995; Feldman, 2003; Field et al., 1990; Muzik et al., 2017).

Also as hypothesized, infants who received a lower proportion of supportive responses to positive affect had more depressive problems in toddlerhood (path *b*). This association emerged while controlling for important covariates, including infant exposure to postpartum depression, infant positive affect displays, maternal education, and maternal sensitivity—none of which uniquely predicted toddlers' depressive problems. The preceding suggests that maternal responses to infant positive affect are a robust predictor of depressive problems in early life. Our results align with previous research involving school age children and adolescents: youth who receive fewer supportive or more nonsupportive responses to positive affect show higher rates of depressive symptoms and clinical depression (Fredrick et al., 2019; Katz et al., 2014; Moran et al., 2019; Nelis et al., 2019; Raval et al., 2019; Yap et al., 2008). The present study extended these findings to toddlerhood. Interestingly, the covariate measure of infant positive affect was not associated with toddlers' depressive problems, even at the bivariate level ($r = .00$). This observation is somewhat surprising given that reduced positive affect is a central feature of depressive symptomatology. However, it should be noted that positive affect is neglected in most measures of depression. In fact, the CBCL-Depressive Problems scale does not contain any items assessing positive affect (i.e., expressions or displays of positive emotion), which could explain the lack of correlation between toddlers' CBCL scores and observed positive affect in infancy.

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In a post hoc exploratory analysis, we separated maternal depressive symptoms at 6 and 12 months postpartum to examine their independent contributions to intergenerational transmission. This analysis provided evidence for serial mediation: maternal depressive symptoms at 6 months had an indirect effect on toddlers' depressive problems *via* continued symptoms at 12 months, followed by reduced support for infant positive affect. Although we did not initially propose a serial mediation model, these post hoc findings are consistent with our hypothesis that persistent depressive symptoms, as opposed to transient depressive states, are what predict young children's depressive problems. This much is consistent with the literature highlighting that persistent rather than transient depressive symptoms in the postpartum period are most predictive of mothers' parenting behaviors (NICHD Early Child Care Research Network, 1999) and subsequent child outcomes (Hentges et al., 2020; Prenoveau et al., 2017; van der Waerden et al., 2015).

Taken together, the results of this study add to existing literature in several noteworthy aspects. First, we extend previous findings on the intergenerational transmission of depressive symptoms back to infancy. Focusing on these formative years of emotional development is crucial for the effective prevention of depression transmission. Second, by controlling for important covariates, including maternal sensitivity, we provide evidence for the *specificity* of maternal responses to positive affect as a mechanism of transmission. This has implications for identifying maternal responses to positive affect as a unique marker of depressive caregiving and for the development of more targeted parenting interventions. Third, the adjunct serial mediation analysis highlights the complex mechanisms linking early maternal depressive symptoms to toddler depressive problems through continued depressive symptoms and, ultimately, fewer supportive responses. Finally, by employing a multimethod three-wave longitudinal design, this study attenuated bias from common method variance, addressing critical methodological limitations of previous research (e.g., Fredrick et al., 2019; Katz et al., 2014; Nelis et al., 2019).

Limitations and future directions

Several limitations of the present study are worthy of discussion. One limitation lies in the correlational nature of the data, precluding unambiguous certainty of causal effects. However, the variable interrelations were hypothesized a priori within a strong theoretical framework, thereby meeting interpretive standards (Hayes, 2022). In addition, the sample size was relatively small. This limited the complexity of our mediation model, such as the inclusion of moderators or parallel mediators (e.g., maternal responses to negative affect). Replication research is therefore needed to broaden the basic model presented here. Relatedly, we tested the specificity of our mediation model by introducing maternal sensitivity as a control variable at Time 1, rather than as a parallel mediator at Time 2. It is possible that the unique relation between maternal supportive responses and toddlers' depressive problems emerged because these variables were assessed closer in time than were maternal sensitivity and toddlers' depressive problems. Research investigating parallel mediation models may provide further insight into whether maternal responses to positive affect uniquely mediate the transmission of depression.

Another limitation is that mothers reported on both their own and their toddlers' depressive symptoms. While all significant findings in the present analysis were derived from multimethod data, it is noteworthy that some cross-sectional studies suggest a potential for depressed mothers to overreport their child's internalizing problems (Gartstein et al., 2009; van der Toorn et al., 2010). Thus, future studies should consider multi-informant or multimethod assessments of toddlers' depressive problems to mitigate potential bias from common method variance. Multimethod assessments of depressive behavior that include both caregiver reports and direct observations may be particularly advantageous during toddlerhood, as depressive symptoms in early childhood are less common and more difficult to reliably detect (Weiss & Garber, 2003).

In terms of sample demographics, most mothers in the current study were university educated, middle class, and co-parenting. The demographically low risk nature of the sample limits generalizability of findings to more diverse community populations. Replication studies may benefit from stratified sampling to ensure adequate representation of dyads from low socioeconomic backgrounds. Future research should also build upon the current findings to consider the role of other caregivers (e.g., fathers). Although the intergenerational transmission of depression appears strongest between mother–child dyads (Connell & Goodman, 2002; Harold et al., 2011; Tully et al., 2008), fathers and other caregivers undoubtably play an important role in children's emotional development. Evidence suggests that paternal depression may moderate the strength of the association between maternal depression and toddlers' internalizing problems (Letourneau et al., 2019; Pietikäinen et al., 2020). In the same vein, supportive emotion socialization from multiple caregivers may mitigate the adverse effects of postpartum depression on early development.

Lastly, it is important to recognize that emotion socialization occurs within a larger cultural context, and parents have different goals with respect to socializing positive affect (Eisenberg et al., 1998a; Halberstadt & Lozada, 2011). While Western cultures tend to value and promote high-arousal positive emotions (e.g., excitement), Eastern cultures often prefer low-arousal emotions (e.g., contentment; Lim, 2016). Maternal socialization of positive affect and its impact on child outcomes may differ among cultural groups (Raval et al., 2019; Reaume et al., 2022; Song et al., 2019) and thus is an important consideration for ongoing research.

Implications and conclusion

In the present study, we proposed and tested a novel developmental pathway through which maternal depressive symptoms are transmitted to toddlers. Findings suggest that maternal socialization of infant positive affect is an important mechanism in the intergenerational transmission of depressive symptoms. These results emphasize the need for preventative interventions early in development. Over the past decade, several interventions have been developed for teaching parents how to engage in supportive emotion socialization behaviors; however, they have primarily been implemented during the preschool and school age periods (England-Mason & Gonzalez, 2020). Moreover, existing interventions have generally focused on supportive responses to children's *negative* affect (Breaux et al., 2022). Perhaps these interventions would achieve greater success if they were implemented during infancy and included a focus on supporting children's positive affect. Finally, parenting programs specifically developed for mothers with perinatal depressive symptoms may be particularly fruitful for the prevention of young children's depressive problems, as well as programming that addresses

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societal factors that contribute to and perpetuate maternal depression. The considerations discussed above indicate the need for early, targeted intervention to disrupt the transmission of depressive symptoms from mothers to children.

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Competing interests. The authors declare none.

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