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To cite this article: Aylin Aras, Peter Fonagy, Chloe Campbell & Camilla Rosan (2024) What do we know about parental embodied mentalizing? A systematic review of the construct, assessment, empirical findings, gaps and further steps, Attachment & Human Development, 26:6, 588-624, DOI: [10.1080/14616734.2024.2421432](https://doi.org/10.1080/14616734.2024.2421432)

To link to this article: <https://doi.org/10.1080/14616734.2024.2421432>



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# What do we know about parental embodied mentalizing? A systematic review of the construct, assessment, empirical findings, gaps and further steps

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## ABSTRACT

Before the maturation of higher-order cognitive functions, infants primarily communicate via bodily expressions. Their behavior adjustments are also shaped by caregiver reactions, which differ in timing, intensity, and nature. Although mentalizing, or reflective functioning, is thought to influence caregiver interactions, the literature has largely focused on mentalizing as an explicit, cognitive process. Given the inherently embodied nature of early parent-infant exchanges, this emphasis left a clear gap in capturing the implicit facets of parental mentalizing. Addressing this, the concept of “parental embodied mentalizing” (PEM) was developed, which pertains to a caregiver’s implicit capacity to discern and respond to an infant’s emotional states, thoughts, and intents through bodily movements, gauged via real-time, shared, kinesthetic interplays. This systematic narrative review explores the PEM construct, scrutinizing its theoretical foundations and empirical basis. We aggregate insights from relevant studies, review the current research landscape’s strengths and limitations, and pinpoint areas ripe for further investigation.

## ARTICLE HISTORY

Received 1 November 2023  
Accepted 22 October 2024


## KEYWORDS


Parental mentalizing; parental embodied mentalizing; attachment; maternal sensitivity; child development

## Introduction

Bowlby’s seminal work on attachment-related mind states has garnered significant research attention over several decades. While earlier studies investigated the relationship between maternal attachment representations and infant attachment style, with a focus on maternal sensitivity as the primary mechanism driving the dyad, subsequent research has identified a “transmission gap” wherein maternal sensitivity alone cannot fully account for the intergenerational transmission of attachment (van IJzendoorn, 1995; van IJzendoorn et al., 1995; Verhage et al., 2016).

Parental mentalizing, defined as parents’ ability to perceive both their own and their children’s actions as driven by underlying mental states (e.g. intentions, thoughts, and feelings), has been proposed as a mechanism linking parental

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 Supplemental data for this article can be accessed online at <https://doi.org/10.1080/14616734.2024.2421432>

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attachment-related cognitions to child attachment security (Fonagy et al., 1991, 2002; Meins, 1997; Slade et al., 2005; Zeegers et al., 2017). Although theoretically characterized as involving implicit and affective processes (Bateman & Fonagy, 2019; Lieberman, 2007), much of the existing literature approaches mentalizing from a predominantly cognitive perspective. Contemporary conceptualizations, such as reflective functioning (Slade, 2002), insightfulness (Oppenheim et al., 2001), and mind-mindedness (Meins et al., 2003), emphasize its semantic and verbal dimensions (Camoirano, 2017; Shai & Belsky, 2017). In response, Shai and Belsky (2011a, 2011b) introduced the concept of “parental embodied mentalizing,” highlighting the nonconscious, nonverbal aspects of parental mentalizing that are particularly relevant to the preverbal infant’s experience.

This paper seeks to examine the parental embodied mentalizing construct, exploring both its conceptualization and empirical measurements. The findings will be synthesized from relevant studies, discuss the contributions and limitations of existing research, and highlight areas warranting further exploration.

### *How does parental mentalizing support child development?*

Along with the child’s characteristics such as temperament and the influence of the broader social context, mentalizing theory underscores the key role of early parent-infant interactions and the parent’s mentalizing capacity in influencing child development (Luyten et al., 2020; Sharp & Fonagy, 2008). The parent’s ability to interpret their child’s behavior in light of their inferences about the child’s underlying mental states is seen as instrumental in fostering child attachment security and the child’s broader socio-emotional, cognitive, and emotional development (Luyten et al., 2020; Sharp & Fonagy, 2008; Zeegers et al., 2017). Indeed, parental mentalizing seems to provide a crucial context for the child’s acquisition of their own mentalizing abilities (Camoirano, 2017). Parental reflective functioning, for instance, has been linked to parenting quality, which subsequently influences the child’s emotion regulation, mentalizing capacity, and attachment security (for a review, see Luyten et al., 2020). Furthermore, a parent’s mentalizing aptitude is a noteworthy antecedent for the child’s development in areas like theory of mind, language, and executive functions (see McMahon & Bernier, 2017 for a detailed discussion).

Yet, as noted by Zeegers et al. (2017), the bulk of research connecting parental mentalizing to child developmental outcomes primarily relies on mind-mindedness measures. It remains contested whether these varied operationalizations tap into a consistent underlying mentalizing construct (Sharp & Fonagy, 2008). Additionally, the pronounced linguistic emphasis of these measures raises questions about their ability to encompass the full spectrum of human communication. Even in the earliest formulations of parent-infant attachment, Bowlby (1979) argued that “very young children are especially sensitive to the tone of voice and the facial expression of attachment figures, and these are powerful determinants of their behavior (pg. 133).” Given that parent-infant attachment typically forms during the child’s prelinguistic phase (Bowlby, 1969; Fonagy & Target, 2002; Trevarthen & Aitken, 2001), relying on language-centric measures might mean that we are failing to consider the physical/behavioral interactions intrinsic to this period. Given the predominantly linguistic framing of parental mentalizing and the tangible

nature of early dyadic interactions, it is essential to explore alternative methodologies that capture non-linguistically symbolized expressions of the child's inner states.

### ***Embodied mentalization***

Neuroscientific advances in social cognition have led to a reconceptualization of mentalization from a singular understanding to a multidimensional framework (Bateman & Fonagy, 2019; Fonagy & Luyten, 2009). This shift introduced the concept of automatic/implicit mentalizing to address unconscious facets of mentalizing that had been previously overlooked. This distinction between implicit and explicit forms is integral to mentalization theory (Bateman & Fonagy, 2019). Implicit mentalization captures intuitive, automatic, and nonverbal processes (Allen & Fonagy, 2006; Bateman & Fonagy, 2019; Fonagy & Luyten, 2009). Such implicit processes, believed to dominate everyday social interactions (Bateman & Fonagy, 2019), are crucial in therapeutic contexts (Bateman & Fonagy, 2004). Yet, the challenge lies in operationalizing these processes, as noted by Allen and Fonagy (2006): "To draw attention to the implicit... we must be explicit..." (p. 10).

Emphasizing embodied social exchanges is essential when considering the intertwined nature of mental and physical states. There is a longstanding belief that understanding the mind necessitates acknowledging it as a bodily phenomenon, with our mental states being expressed and interpreted through bodily experiences (Davidsen & Fosgerau, 2015; Zahavi, 2003). Nonverbal cues – like facial expressions, touch, and body movements – serve as rich sources of information about others' intentions and feelings, forming the bulk of our interactions (Guerrero & Floyd, 2006; Mehrabian & Ferris, 1967; Mehrabian & Wiener, 1967). For instance, touch velocity indicates emotional states and intentions (Kirsch et al., 2018), while interpersonal distance can hint at feelings of closeness or anxiety (Von Mohr et al., 2023). Emerging studies using artificial intelligence (AI) and computational neuroscience reveal how bodily gestures and expressions activate brain areas linked to mentalization (Vogeley, 2017). This intersection of bodily experiences and mentalizing processes has been termed "embodied mentalization" and is defined as the integration of multisensory bodily signals to understand one's own and others' mental states (Bateman & Fonagy, 2019, pp. 28–29; Luyten et al., 2012, p. 125).

### ***Embodied mentalization in the context of child development***

Embodied mentalization is vital in early infant development, serving as the primary mode for newborns to convey and understand their internal states. While language comprehension begins around 6 to 9 months, and expands thereafter (Bergelson, 2020; Bergelson & Swingley, 2015; Kartushina & Mayor, 2019), language production emerges later (Benedict, 1979; McCoy, 2008). As early as 2 to 3 months, infants learn that their actions are interpreted as communications and use nonverbal communication – gaze, vocalizations – and bodily cues like cry aversiveness and body tension to express needs (Northrup & Iverson, 2020; Trevarthen, 1979). By 9 months, with cognitive development, their repertoire of nonverbal skills expands, employing gestures and gaze to indicate objects (Crais

et al., 2004; Striano & Bertin, 2005; Tomasello et al., 2007). The caregiver's recognition and responsive engagement with these bodily signals are essential. Even with verbal communication, nonverbal undertones influence the infant's perception of the communication (Schachner et al., 2005). As infants mature, they similarly discern others' intentions via bodily cues: by 4 to 8 months, they distinguish emotional bodily expressions (Missana et al., 2015), and by 8 months, they are aware of congruence between facial and bodily emotions (Rajhans et al., 2016). Perinatally, touch becomes a key medium of communication, supporting affect regulation, self-awareness, and caregiver-infant bond formation (Bahrack, 2013; Fotopoulou & Tsakiris, 2017). For instance, infants anticipate and respond to maternal touch cues, adjusting their body tension and affect accordingly (Fantasia et al., 2016; Lamb & Malkin, 1986; Reddy et al., 2013). Variability in caregiver responses, influenced partly by their embodied mentalizing abilities, impacts infant-caregiver dynamics (Crucianelli et al., 2019).

In essence, infants predominantly interact through bodily expressions before higher-order capabilities develop. They adjust behaviors based on caregiver responses, which vary in timing, intensity, and quality. Reflective function, or mentalizing, is proposed to influence these variations in caregiver interactions (Fonagy et al., 2002). Given the embodied nature of early parent-infant interactions and the existing gap in measuring implicit dimensions of parental mentalizing, Shai and Belsky (2011a, 2011b) attempted to bridge this gap via the concept of parental embodied mentalizing (PEM).

### ***Parental embodied mentalizing (PEM)***

Shai and Belsky (2011a, 2011b) conceptualized mutual, moment-to-moment kinaesthetic exchanges between caregiver and infant as parental embodied mentalizing (PEM). This is understood as the caregiver's ability to implicitly recognize and react appropriately to the infant's emotions, thoughts, and intentions as manifested through bodily movements (Shai & Belsky, 2011a, 2011b; Shai & Fonagy, 2014). Unlike micro-analytic measures of dyadic communication which emphasize head movements, gaze, and vocalizations (Beebe et al., 2010), PEM primarily highlights bodily, kinaesthetic expressions. Moreover, while other assessments focus on discrete body-based elements of parent-infant communication (e.g. distance, touch, posture), PEM evaluates the breadth and quality of behaviours within whole-body continuous parent-infant interactions (Shai & Belsky, 2011a, 2017; Shai & Meins, 2018; Shai et al., 2022).

Central to this approach is the idea (Shai & Belsky, 2011a, 2017; Shai & Meins, 2018; Shai et al., 2022) that understanding the quality of dyadic exchange involves more than assessing individual behaviors in isolation. For instance, a caregiver's directionality and tempo, when paired with the infant's bodily response, offers deeper insights into interaction quality than a single, unidirectional touch would. Emphasizing the dyad, the PEM framework considers the meaning of a caregiver's embodied reaction in the context of the infant's response (Shai & Belsky, 2011a). The core objective is to discern the caregiver's capacity to align their embodied responses with the infant's inner state, and if misalignments occur, their ability to realign and repair (Shai et al., 2024; Shai & Belsky, 2011a, 2017; Shai & Fonagy, 2014).

PEM coding begins by identifying the start and end of specific interaction cycles, termed Embodied Circles of Communication (ECC). These cycles are considered physical

representations of underlying interactive mental processes. Throughout the entire video recording, every ECC is detected within the flow of dyadic bodily interaction. Frequent pauses and rewinds are required for a nuanced, moment-by-moment depiction of the quality of the action-reaction sequences (Shai & Belsky, 2011a, 2017; Shai & Meins, 2018; Shai et al., 2024).

Each ECC is described based on observed movement qualities of both the parent and infant and include Directionality, Pacing, Tempo, Space, Pathway, and Tension flow (Shai & Belsky, 2011a, 2017; Shai et al., 2024). *Directionality* (growing vs. shrinking) describes the contrast between stretching and opening versus pulling back, as when being tickled. *Pacing* describes how quickly behaviour changes within a specific time frame. Movements can transition smoothly and progressively, or they can shift rapidly, abruptly, and unexpectedly. *Tempo* (fast, intermediate or slow) refers to the speed at which a movement takes place at a given moment, ranging from slow to fast. For instance, a child shaking a toy could do so at a moderate or rapid pace. *Space* refers to the distance of movement relative to the infant's body, either by the caregiver or the child. This movement can occur within a personal or interpersonal space, ranging from close proximity to farther away. *Pathways* is a movement quality that characterizes the patterns of movements connecting reference points in specific shapes. These patterns can be direct, straight, and linear or rounded and curvy. *Tension flow* is a movement quality that describes the muscle tension during movement. This tension can range from stiff, bound, and rigid to more relaxed and freer in the muscles of the entire body or specific parts (see Shai et al., 2024; Shai & Belsky, 2011a, 2017; Shai & Fonagy, 2014; Shai & Meins, 2018, for more detail). These qualities are not labelled or rated as mentalizing or non-mentalizing but are used to describe the quality of each ECC segment and interpreted in the context of the child's responses (Shai & Belsky, 2011a). PEM coding is selective, focusing on evident moments of mental convergence where a meaningful bodily dialog occurs (Shai & Belsky, 2017; Shai & Meins, 2018).

For instance, an ECC might capture a parent lifting the infant abruptly, and unexpectedly, then bouncing the baby up and down in the air in high tempo and linear movements and the infant's subsequent highly stiff bodily tension and shrinkage. The parent's abrupt and high-tempo movements and the child's bodily response can indicate a disruption in maternal mentalizing capacity. The parent's insistence on repeating the same bodily interaction for a while with a high tempo, despite the infant's shrinking and bound bodily tension, implies a lower PEM level. In other instances, the same parental movement might indicate better PEM capacity if it includes brief, frequent pauses to observe the infant's responses, and the infant's indication to continue the interaction with moving limbs in excitement with high tempo and free tension when the parent stops.

The length of each ECC segment varies from brief moments to several seconds, depending on the duration of the ongoing meaningful bodily conversation unit (Shai et al., 2024). Once ECCs are identified and described, each is rated for the degree of parental embodied mentalizing it reflects, on a scale from 1 (very low mentalizing) to 7 (very high mentalizing). This rating considers factors such as the clarity of the child's intentions, the caregiver's accuracy in perceiving these intentions, and their contingent

responsiveness to these embodied signals with appropriate movement qualities (Afek et al., 2022; Gagné et al., 2021, 2023; Ierardi et al., 2022). Each ECC is then classified into one of five themes: embodied holding, body ownership, transitions, promoting exploration, and connectivity (Afek et al., 2022; Gagné et al., 2021, 2023; Ierardi et al., 2022; Shai et al., 2024). Body ownership is further divided into three subthemes: investigation, manipulation, and stimulation (see Afek et al., 2022; Gagné et al., 2021, 2023; Ierardi et al., 2022, Væver et al., 2020 for more details).

A cumulative PEM rating is assigned to represent the caregiver's overall ability to discern and respond to the infant's inner states through bodily expressions, rated again on a scale from 1 to 7. The mean of ECC scores, the speed of transitions between ECC events, the presence of extremely low ECC scores, and the higher prevalence of ECC events demonstrating parental interruption of the child's ongoing activity are all considered when assigning the global PEM rating. For detailed explanations of the PEM measure, training, and reliability processes, see Shai and Belsky (2011a, 2017), Shai and Fonagy (2014), and Shai and Meins (2018).

Parental Embodied Mentalizing (PEM) has a cogent theoretical underpinning and has generated a significant and growing body of empirical research, which merits exploration. Therefore this study systematically synthesizes empirical studies on PEM, assessing its correlations with verbal mentalizing measures, maternal sensitivity, child attachment security, child development, and contextual factors. It examines how PEM is defined and measured, reviews the reliability and validity of these assessments, and identifies key areas for further investigation.

## Methods

### *Search strategy*

This systematic review followed the PRISMA guidelines (Moher et al., 2009) and was registered with PROSPERO (CRD42021262254). Comprehensive literature searches were conducted across four databases: PsycINFO (Ovid), Embase (Ovid), Medline (Ovid), and Web of Science. Studies published up to 26 March 2024, were included. A combination of search terms was used, including "embodi\* AND mentali\*," "embodied mentalizing," and terms related to parental and child demographics such as "parent," "father," "mother," "infant," "toddler," "child," and "baby." Search terms were adjusted to fit each database's title and abstract search protocols.

Only peer-reviewed research articles in English that included a measure of parental embodied mentalizing capacity were considered. Reviews, theoretical papers, in-preparation work, and book chapters were excluded from the analysis.

### *Study selection*

The initial screening of article titles from the systematic literature search was carried out by the first author, AA. The selection process, including the screening of titles, abstracts, and full-text reviews of potentially eligible studies, was conducted by two independent reviewers, AA and CC. Any disagreements or uncertainties during the selection process were resolved through discussion with the senior researcher, PF.



From the studies included in the review, we extracted key variables such as author, publication year, journal, study design, and the country where the research was conducted. Additionally, we documented demographic information, including the gender of the parent, the mean ages of parents and children, sample size, mental health status, and recruitment criteria. We also recorded information about the study hypotheses, outcome variables, measurement tools, observation characteristics (e.g. setting and duration), and reliability scores for parental embodied mentalizing assessments.

For studies involving interventions, we collected details about the treatment and control groups, the type, format, and duration of the intervention, and whether randomization was employed.

### ***Risk of bias assessment***

Two authors (AA and CC) assessed the risk of bias for each study included in the review using the JBI Checklist for Analytical Cross-Sectional Studies (Moola et al., 2020). This checklist examines whether studies provide a clear description of inclusion criteria, setting and sample, strategies for addressing confounders, the reliability and validity of outcome measures, and the appropriateness of statistical methods. An additional question was included specifically for this review to assess the quality of the observational context, asking whether the observational setting and observation duration were detailed sufficiently. Each criterion was rated as “yes,” “no,” “unclear risk of bias,” or “not applicable.” In cases of disagreement between the two reviewers, the senior researcher (PF) resolved inconsistencies.

The risk of bias assessment results indicated that, except for one study (Shai & Meins, 2018) not providing clear information on the inclusion criteria, all studies clearly defined their inclusion criteria, sample characteristics, settings, observational context, and observation length. Furthermore, they utilized reliable and valid outcome measures and appropriate statistical analyses. However, the psychometric properties of the PEM measure were less consistent because Shai and Belsky’s (2017) paper was the first to introduce and validate this tool, with subsequent studies serving to further validate it.

The questions regarding the exposure to risk and use of validated assessments of exposed conditions were not evaluated for five (Afek et al., 2022; Gagné et al., 2023; Shai & Belsky, 2017; Shai & Meins, 2018; Shai et al., 2017) and six papers (Afek et al., 2022; Gagné et al., 2021, 2023; Shai & Belsky, 2017; Shai & Meins, 2018; Shai et al., 2017), respectively. These questions were deemed relevant only to at-risk or clinical samples. Of six papers examined, four studies assessed the mental health risk by using a valid and reliable tools (Garset-Zamani et al., 2020; Ierardi et al., 2022; Shai et al., 2022; Væver et al., 2020), one study did not use psychometrically valid tools for assessing the condition (Shai et al., 2024), and there were unclear information in one paper (Gagné et al., 2021). Regarding the evaluation of the condition, among five studies evaluated, one did not use a validated assessment of exposed conditions (Shai et al., 2024), while four utilized objective criteria such as a standard clinical interview or a cut-off score from a reliable measure (Garset-Zamani et al., 2020; Ierardi et al., 2022; Shai et al., 2022; Væver et al., 2020). Regarding the confounding factors, five studies identified confounding factors (Gagné et al., 2021; Garset-Zamani et al., 2020; Shai et al., 2017; Shai & Meins, 2018; Væver et al., 2020) and four did not mention any confounders (Afek et al., 2022; Gagné et al., 2023; Ierardi et al.,



2022; Shai & Belsky, 2017) and two studies provided unclear information (Shai et al., 2022, 2024). Strategies for handling confounders were outlined in two of the 11 studies (Garset-Zamani et al., 2020; Væver et al., 2020). While four studies did not describe the strategies for handling confounding variables (Afek et al., 2022; Gagné et al., 2023; Shai & Belsky, 2017; Shai et al., 2022), this information was unclear in five papers (Gagné et al., 2021; lerardi et al., 2022; Shai & Meins, 2018; Shai et al., 2017, 2024).

## Results

The initial literature search generated 112 records. After the removal of duplicates, 65 studies underwent title and abstract screening. Of these, 48 were excluded, and 17 underwent full-text assessment. In the full-text assessment, 6 papers were excluded for not meeting the pre-set inclusion criteria. Consequently, 11 research articles were included in the narrative syntheses (see Figure 1).

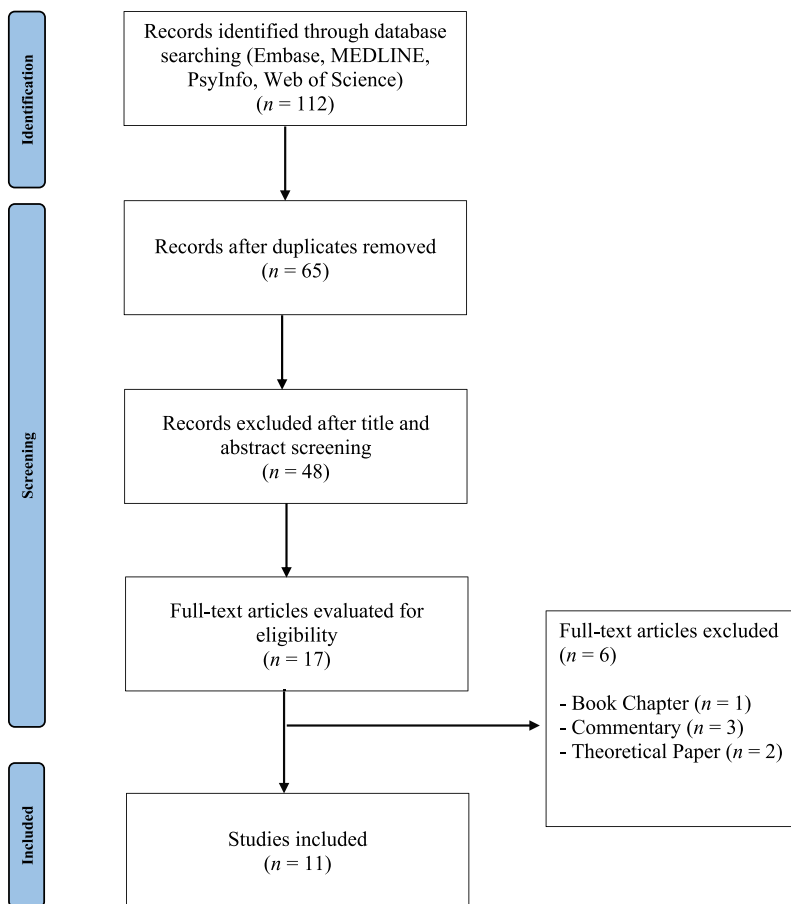


Figure 1. Prisma diagram.

## *Narrative review*

Since the introduction of the Parental Embodied Mentalizing (PEM) construct in 2011, 11 empirical studies have been published, with all studies utilizing the PEM tool as their method of assessment. These studies primarily explored PEM's association with maternal sensitivity and verbal parental mentalizing measures, alongside its predictive validity in relation to child attachment security and developmental outcomes. Few studies have explored PEM's relationship with varied parenting domains or its significance within mental health contexts, and only one study gauged the change in PEM capacity after a parenting intervention.

## *Sample characteristics*

The studies in this review, spanning from 2017 to 2023, primarily emanated post-2020, with eight papers published in or after that year. Most of the research was undertaken in western nations: the USA (Shai & Belsky, 2017), Canada (Gagné et al., 2021, 2023), Italy (Ierardi et al., 2022), the United Kingdom (Shai & Meins, 2018; Shai et al., 2022), and Denmark (Shai et al., 2024). Two studies utilized the same Danish longitudinal sample of mother-infant dyads (Garset-Zamani et al., 2020; Væver et al., 2020). Additionally, two studies hailed from Israel (Afek et al., 2022; Shai et al., 2017).

Mothers were exclusively assessed in all but one study, with Afek et al. (2022) examining mothers' and fathers' PEM capacities. Sample sizes demonstrated considerable variation, spanning from 24 to 206 parent-infant dyads. Half of these studies included fewer than 100 participants. The selected study samples displayed notable heterogeneity: six drew on community samples (Afek et al., 2022; Ierardi et al., 2022; Shai & Belsky, 2017; Shai & Meins, 2018; Shai et al., 2017, 2024); two, which shared a sample, targeted a moderate-risk demographic characterized by reduced age, education, and income levels (Gagné et al., 2021, 2023). Two investigations involved clinically depressed mothers compared against their non-symptomatic peers (Garset-Zamani et al., 2020; Væver et al., 2020), while Shai et al. (2022) analyzed longitudinal data from at-risk mothers facing heightened adversity, including mental health challenges (refer to Table 1).

## *Reliability of parental embodied mentalizing assessment (PEM)*

All studies using the PEM coding manual ensured tool reliability by evaluating inter-rater agreement between two independent coders. Typically, 20% of each study's sample was double-rated, with one exception in the recent study by Shai et al. (2024), where 40% of the sample ( $n = 8$ ) was double-coded due to the main coder being unblinded to group status in the trial. Shai and Belsky (2017) reported high reliability with intraclass correlation coefficients (ICCs) of .92 and .97 for the frequency and length of Embodied Communication and Coordination (ECC) events, respectively, and an ICC of .87 for the global PEM rating.

Væver et al. (2020) reported a global PEM ICC of .85 (Cronbach's  $\alpha = .85$ ) and an average ICC of .99 for each ECC event (Cronbach's  $\alpha = .99$ ). Shai et al. (2024) achieved ICC agreement of .98 ( $p < .001$ ) for global PEM and .78 ( $p < .001$ ) for the frequency of

Table 1. Characteristics of included studies.

Author, Year of Publication	Characteristics of the Baseline Video Assessment								
	Country	Study Sample	Recruitment	Parent Age	Child age at the time of video assessment	Duration	Setting	Interactional Context	Construct Coded from the Videos
Afek et al. (2022)	Israel	105 parent-infant dyads	Community	Mothers M = 30.82, SD = 3.63; Fathers M = 32.41, SD = 4.01 Parent range: 23-42	6-months	10- minutes	Laboratory	Free Play with toys	PEM
Gagné et al. (2021) Gagné et al. (2023)	Canada	110 mother-infant dyads	At moderate risk * The sample was driven from a large longitudinal study and mothers were psychosocially at-risk in a moderate level due to low education, income and younger maternal age.	M = 21.8, SD = 1.87 range 15-25	8 months	8-minutes	Home	Free play (With toys: 5 minutes; Without toys: 3 minutes)	PEM Mind-mindedness
Garset-Zamani et al. (2020)	Denmark	80 mother-infant dyads (29 mothers with PPD; 51 no clinical diagnoses)	Clinical & Nonclinical * Data was driven from a broader longitudinal study. Mothers with (PPD) was selected based on a screening score of 10 or higher on EPDS. Apart from the clinical status of some of the mothers, the group was composed of low-risk sample.	-	4-months	10- minutes	Laboratory *Infant is sitting on the chair	Free Play without toys	PEM
Ierardi et al. (2022)	Italy	81 mother-infant dyads	Mothers were invited to participate from the family centres in some of the hospitals of Italy.	M = 33.42 SD = 5.04 Range = 23-44	3-months	5-minutes	Laboratory	Free play in a playroom	PEM Mind-mindedness Maternal styles of interaction

(Continued)



Table 1. (Continued).

Author, Year of Publication	Characteristics of the Baseline Video Assessment								
	Country	Study Sample	Recruitment	Parent Age	Child age at the time of video assessment	Duration	Setting	Interactional Context	Construct Coded from the Videos
Shai et al. (2024)	Denmark	24 mother-infant dyads	Low-risk mothers with struggles in parenting chosen from a community sample	M = 33 SD = 3.46 Range = 28–41	8.79 months	10-minutes	Home	Free play	PEM
Shai et al. (2022)	England	39 mother-infant dyads	At high risk * Data driven from a large RCT based on a sample of at-risk mothers with high levels of adversity including mental health problems, and psychosocial risks.	–	3-months	10-minutes	Home or Clinics that participants were referred to study	Free play	PEM Maternal Sensitivity
Shai and Belsky (2017)	USA	200 mother-infant dyads	Community * To include equal number of dyads in each attachment classification, 200 dyads were randomly selected from a large sample of mother-infant dyads representing the demographic characteristics of the general sample	M = 28.9 SD = 5.62	6 months	10-minute	Home	Free play	PEM
Shai et al. (2017)	Israel	68 mother-infant dyads	Community * Data were driven from a longitudinal study where the mothers with high and low risk pregnancies were tracked until the 3-months of child age. As the two groups were statistically similar other than the risk status, they were treated as one sample in this study.	M = 30.59 SD = 4.22 range: 21–43	3-months	10-minutes	Home	Free play	PEM

(Continued)

Table 1. (Continued).

Author, Year of Publication	Characteristics of the Baseline Video Assessment								
	Country	Study Sample	Recruitment	Parent Age	Child age at the time of video assessment	Duration	Setting	Interactional Context	Construct Coded from the Videos
Shai and Meins (2018)	England	206 mother-infant dyads	Community * 90 mothers had low SES	M = 28.1 SD = 5.48, range 16–41	8 months	20-minute	Laboratory	Free play	PEM Mind-mindedness Maternal sensitivity
Væver et al., (2020) * The same sample with Garset-Zamani et al. (2020)	Denmark	71 mother-infant dyads n = 44 nonclinical group n = 27 clinical group.	Clinical & Nonclinical * Data was driven from a broader longitudinal study. All mothers were assessed with a structured clinical interview and EPDS. Those with a score of 10 and higher, and the ones meeting criteria for depression on the structured interview were included on the clinical group of the study. The ones that does not fulfil any criteria were included in the nonclinical group.	Mothers with PPD: M = 30.63 SD = 3.92 Mothers without PPD: M = 30.57 SD = 4.20	4 months	10-minutes	Laboratory *Infant is sitting on the chair	Free Play without toys	PEM Maternal sensitivity (3-minute of the whole video is used)

ECC events. Similarly, Ierardi et al. (2022) reported an ICC of .92 for global PEM reliability.

Studies using certified PEM coders and measuring additional observational metrics or group statuses recorded the following ICCs for global PEM ratings: .89 (Shai et al., 2017), .83 (two-way random absolute agreement ICC; Shai & Meins, 2018), .95 (Gagné et al., 2021, 2023), .85 (Garset-Zamani et al., 2020), and .85 (Afek et al., 2022). However, inter-rater reliability results were not reported in Shai et al. (2022).

### *Convergent validity of parental embodied mentalizing on the relationship with verbal measures of parental mentalizing*

Mind-mindedness and PEM, underpinned by shared theoretical foundations, are perceived as the verbal and nonverbal facets of parental mentalizing, respectively. Shai and Meins (2018) suggested that PEM acts as the behavioral analog of mind-mindedness. Only five studies, across diverse mother-infant dyad samples, have investigated this hypothesis. Notably, two samples consisted of higher-risk mother groups characterized by younger age, lower educational attainment, reduced income, and in one instance, mental health challenges (Gagné et al., 2021; Shai et al., 2022) – further details can be found in Table 2.

While three out of five studies exploring the nexus between these verbal and non-verbal mentalizing domains reported modest associations between PEM and appropriate mind-related comments (AMRC) —.25 (Gagné et al., 2021) and .28 (Shai & Meins, 2018) – and parental reflective functioning—.29 (Shai et al., 2017) – two studies revealed no significant relationship between PEM and verbal mentalizing measures such as mind-mindedness and parental reflective function (Ierardi et al., 2022; Shai et al., 2022). Furthermore, no discernible link was identified between PEM and “non-attuned mind related comments” (NAMRC) across the studies examined (Gagné et al., 2021; Ierardi et al., 2022; Shai & Meins, 2018).

### *Investigating divergent validity on the association between parental embodied mentalizing and parental sensitivity*

Parental embodied mentalizing is hypothesized to reflect the parent’s overarching mentalizing ability in the context of their child and has been linked to congruent and contingent parenting behaviors (Luyten et al., 2020). Zeegers et al. (2017) addressed this proposition in a comprehensive meta-analysis, reporting a modest pooled correlation of .24 (ranging from  $r = -.04$  to .41) between verbal parental mentalizing measures and sensitivity. This implies that embodied mentalizing occupies a unique niche, which is distinct from the construct of sensitivity.

Six studies probed the overlap between PEM and maternal sensitivity, exclusively utilizing mother-infant dyads. Independently of the child’s mean age during the PEM assessment, context, setting, or the duration of video observations, five out of the six studies identified moderate correlations between PEM and maternal sensitivity: .47 (Gagné et al., 2021), .37 for CIB attunement and .27 for EA scales (Shai et al., 2022), .39 (Shai & Belsky, 2017), .36 (Shai & Meins, 2018), and .36 (Væver et al., 2020). Notably, within Shai et al. (2022), a modest correlation ( $r = .27$ ) was observed with the Emotional Availability Scales’ sensitivity subscale (Biringen et al., 1993) in contrast to a higher correlation with the Coding Interactive Behavior (CIB) attunement scale (Feldman, 1998)

**Table 2.** Is PEM significantly associated with maternal sensitivity?

Authors, Year of Publication	Sample Size	Sample Characteristics	Child Mean Age	PEM Measurement Context & Video Length	Measure of Maternal Sensitivity	Main Outcome
Gagné et al. (2021)	110	At moderate risk (social inequalities, mental health problems)	8-months	Free Play at Home: - 8-minutes - With Toys: 5 min. - Without Toys: 3 min.	Maternal Behaviour Q-Sort * The assessment is based on a 2-hr. home-based observation	A positive, significant correlation was found between PEM and observer-rated measure of maternal sensitivity ( $r = .47$ ).
Ierardi et al. (2022)	81	Community sample	3-months	Free Play in Laboratory - 5-minutes	The Child-Adult Relationship Experimental Index (CARE-index)	Of the three subscales of CARE-index, PEM was significantly associated with controlling style of parenting ( $r = .31$ ), but not with parenting sensitivity and responsiveness. PEM significantly correlated with CIB attunement ( $r = .37$ ) and Emotional Availability Scales sensitivity subscale ( $r = .27$ ).
Shai et al. (2022)	39	High risk sample (social inequalities, mental health problems)	3-months	Free Play at Home - 10-minutes	Coding Interactive Behavior (CIB) Emotional Availability (EA) Scales sensitivity subscale	A significant, positive correlation was found between PEM and maternal sensitivity ( $r = .39$ ).
Shai and Belsky (2017)	200	Community sample	6 months	Free Play at Home - 10-minutes	HOME Maternal Sensitivity Scale * based on the composite scored of observations at 6 and 15-months child behaviours, while PEM assessment is based on 6-month video observations	
Shai and Meins (2018)	206	Community sample	8-months	Free Play in Laboratory - 20-minutes	Ainsworth Maternal Sensitivity Scales	A significant, moderate relation was obtained between PEM and maternal sensitivity in this sample representative of community ( $r = .36$ ).
Væver et al., (2020)	71	Mothers with ( $n = 27$ ) and without ( $n = 44$ ) a diagnosis of postpartum depression	4-months	Free Play in Laboratory - 10-minutes - Infant sits in a chair during the interaction	Coding Interactive Behavior (CIB)	A positive, significant correlation ( $r = .36$ ) was detected between maternal sensitivity and PEM, with no significant group difference between mothers with and without depression.



( $r = .37$ ). This disparity persisted when juxtaposed with other studies employing alternate sensitivity metrics. Væver et al. (2020) recorded a moderate correlation ( $r = .36$ ) that was consistent across both depressed and non-depressed mothers. In contrast, Ierardi et al. (2022) found a moderate correlation between PEM and maternal controlling interaction style ( $r = .31$ ), with no significant link to sensitive or unresponsive parenting. However, they did identify a significant relationship between a high frequency of extremely low ECCs scored as 1—indicative of greatly diminished parental embodied mentalizing capacity – and both maternal sensitivity ( $r = -.22$ ) and controlling style ( $r = .27$ ) (refer to Table 3).

### *Establishing the construct validity of PEM in relation to infant attachment security*

Theoretical underpinnings suggest that parental embodied mentalizing capacity plays a crucial role in shaping a child's attachment style (e.g. 2007; Fonagy & Target, 1997; Fonagy et al., 2002; Kim et al., 2014). Moreover, an empirically identified moderate correlation ( $r = .30$ ) between verbal parental mentalizing and child attachment security supports this proposition (Zeegers et al., 2017). Therefore, we sought to investigate to what extent studies using the PEM assessment tool report that embodied mentalizing significantly predicts infant attachment style.

Shai and Belsky (2017) initially examined whether higher PEM could differentiate securely attached children from insecure ones. Their findings indicated that enhanced PEM significantly predicted child attachment security over attachment avoidance and disorganization at 15 months. Mothers with elevated PEM rating at baseline were less likely to have children with any form of insecure attachment style (ie., avoidance, resistance, and disorganization) at 36 months. Interestingly, this relationship between PEM and attachment security remained robust even when accounting for maternal sensitivity. Similarly, Shai and Meins (2018) observed significant variations in PEM ratings across attachment groups (disorganized, secure, resistant, avoidant). Regression analyses revealed that only the children manifesting attachment avoidance at 15 months showed significant differences from securely attached peers based on initial maternal PEM ratings. Further analyses found that higher PEM ratings solely differentiated attachment resistance from avoidance.

Gagné et al. (2021) explored the role of maternal sensitivity in mediating the relationship between two mentalization levels, namely mind-mindedness and parental embodied mentalizing, and infant attachment security among a moderate-risk mother cohort. While direct correlations between PEM and child attachment security were not significant, a mediation model, adjusted for SES, highlighted maternal sensitivity as a partial mediator between PEM and child attachment security. Conversely, Væver et al. (2020) examined the interplay among maternal sensitivity, PEM, and infant attachment security in postpartum depressed mothers vis-à-vis a control group. Intriguingly, neither PEM nor maternal diagnosis, nor their interaction, were significantly associated with child attachment style at 13 months (see Table 4).

### *Discriminant validity: relationship between parental embodied mentalizing and sociodemographic & child characteristics*

Six studies have investigated the link between PEM and sociodemographic or child-related attributes. Notably, associations between PEM and socioeconomic status (SES)

Table 3. Is PEM significantly associated with verbal measures of parental mentalizing?

Authors, Year of Publication	Sample Size	Sample Characteristics	Child Mean Age	PEM & MM/PRF Measurement Context & Video Length	Tool Used to Assess Verbal Parental Mentalizing	Main Outcome
Gagné et al. (2021)	110	At moderate risk (social inequalities, mental health problems)	8-months	Free Play at Home: 8-minutes - With Toys: 5 min. - Without Toys: 3 min.	Mind-Mindedness Coding System	While a significant positive relation was obtained between PEM and appropriate mind-related comments subscale ( $r = .25$ ), no significant correlation was found between PEM and NAMRC subscale of MM coding system.
Ierardi et al. (2022)	81	Community sample	3-months	Free Play in Laboratory - 5-minutes	Mind-Mindedness Coding System The Reflective Functioning Scale (RFS) on the Adult Attachment Interview (AAI)	No significant relation between any verbal measure of parental mentalizing (PRF or MM) and PEM was obtained.
Shai et al. (2017)	68	Integrated sample of high and low risk mothers	3-months	Free Play at Home - 10-minutes	Reflective Functioning (PRF) Scoring Manual on the Parent Development Interview-Revised-Short Form (PDI-R2-5)	A significant moderate correlation was found between PRF and PEM ( $r = .29$ ).
Shai et al. (2022)	39	High risk sample (social inequalities, mental health problems)	3-months	Free Play at Home - 10-minutes	Reflective Functioning (PRF) Scoring Manual on the Parent Development Interview-Revised-Short Form (PDI-R2-5)	No significant ( $r = .11$ ) association between PEM and PRF was found.
Shai and Meins (2018)	206	Community sample	8-months	Free Play in Laboratory - 20-minutes	Mind-Mindedness (MM) Coding System	A significant moderate correlation was found between maternal appropriate mind-related comments (AMRC) and PEM ( $r = .28$ ), but no significant relation was found between PEM and non-attuned mind-related comments (NAMRC) subscale of MM coding system.



**Table 4.** Does maternal PEM predict later child attachment security?

Authors, Year of Publication	Sample Size	Sample Characteristics	Child Mean		Tool Used to Assess Infant Attachment Security	Statistical Analysis	Main Outcome
			Age at Baseline PEM Assessment	Child Age At Attachment Measurement			
Gagné et al. (2021)	110	At moderate risk (social inequalities, mental health problems)	8-months	16 months	The Strange Situation Procedure	Bivariate correlation Mediation analysis	Bivariate correlation analysis revealed no relation between PEM and infant attachment security. Maternal sensitivity partially mediated the link between PEM and infant attachment security.
Shai and Belsky (2017)	200	Community sample	6 months	15 months 36 months	The Strange Situation Procedure at 15- months. At 36-months, a modified version of this attachment paradigm was used and mother-child attachment was coded with the MacArthur Working Group on Attachment system.	Two separate multinomial regression analyses	PEM found to be a significant predictor of infant attachment security compared to attachment avoidance ( $b = -0.28$ ) and disorganization ( $b = -0.52$ ) at 15 months, but did not significantly predict attachment resistance. The possibility of having any insecure attachment style [attachment avoidance ( $b = -0.40$ ), resistance ( $b = -0.38$ ) and disorganization ( $b = -0.99$ ) at 36 months was less likely for the mothers with higher baseline PEM ratings. Scores were also significant when maternal sensitivity was controlled for.

(Continued)

Table 4. (Continued).

Author's, Year of Publication	Sample Size	Sample Characteristics	Child Mean Age at Baseline PEM Assessment	Child Age At Attachment Measurement	Tool Used to Assess Infant Attachment Security	Statistical Analysis	Main Outcome
Shai & Meins, 2018	206	Community sample	8 months	15 months	The Strange Situation Procedure	One-way ANOVA to see the attachment group differences in the constructs (PEM, sensitivity, MM, SES) Multinomial logistic regression	A main effect of PEM on infant attachment, as each attachment subgroup (secure, resistant, avoidant, disorganized) significantly differed from each other in PEM ratings ( $F = 3.00, p < .03$ ). The results of the regression analysis also revealed that only those children with attachment avoidance ( $\beta = -.63$ ) significantly differed from their secure counterparts at 15 months based on the mother's initial PEM ratings. When the difference between insecure subgroups was investigated as a response to PEM ratings, higher scores on PEM only distinguished attachment resistance from attachment avoidance ( $\beta = 1.24$ ).
Væver et al. (2020)	71	Mothers with ( $n = 27$ ) and without ( $n = 44$ ) a diagnosis of postpartum depression	4 months	13 months	The Strange Situation Procedure	Hierarchical linear regression * Infant attachment is assessed as a continuous score	Neither the main effect of PEM nor its interaction between the maternal PPD were found on infant attachment security.

were identified in studies by Gagné et al. (2023) ( $r = .29$ ), Shai and Belsky (2017) ( $r = .13$ ), and Shai and Meins (2018) ( $r = .26$ ). Gagné et al. (2023), however, noted that the strength of this connection fluctuated based on the observational context, with correlations of  $r = .37$  during free play with toys and  $r = .19$  without toys.

Examining maternal correlates, Shai and Belsky (2017) found a significant correlation between PEM and maternal marital status ( $r = .15$ ), but this was absent in a subsequent study involving at-risk mothers (Shai et al., 2022). PEM's relationship with maternal age rendered mixed results: significant in some cases (PEM\_total:  $r = .32$ , PEM\_toys:  $r = .36$ , PEM\_no toys:  $r = .20$ , Gagné et al., 2023;  $r = .31$ , Shai & Belsky, 2017) and nonsignificant in others (Shai et al., 2017, 2024).

Four studies exploring the link between PEM and maternal education yielded varied outcomes, ranging from nonsignificant (Shai et al., 2017, 2024) to low ( $r = .16$ , Shai & Belsky, 2017) and moderate correlations (PEM\_total:  $r = .37$ , PEM\_toys:  $r = .43$ , PEM\_no toys:  $r = .32$ , Gagné et al., 2023;  $r = .35$ ; Shai et al., 2022). Significant associations were also documented between PEM and factors such as maternal ethnicity ( $r = .41$ , Shai et al., 2022) and verbal IQ ( $r = .26$ , Shai & Belsky, 2017). In an isolated study that explored the relationship with the number of children, PEM did not display any significant correlation; however, a notable association with PRF ( $r = -.42$ ) emerged (Shai et al., 2022).

Turning the focus to child attributes, PEM did not manifest any significant associations with variables such as birth order, temperament, age, gender, birth week, or birth date (Shai & Belsky, 2017; Shai et al., 2017, 2022, 2024) (see Table 5).

### *Predictive validity: associations between parental embodied mentalizing and child developmental outcomes*

To elucidate the potential impact of parental embodied mentalizing on optimal child development trajectories, two longitudinal studies were conducted with mother-infant dyads. Shai and Belsky (2017), examining a sample of 200 dyads and assessing several developmental outcomes at 54 months. They found that children of mothers possessing a higher PEM capacity exhibited enhanced social ( $r = .15$  and  $r = .23$ ), language ( $r = .17$ ), and academic development ( $r = .14$ ), alongside reduced behavioral issues (internalizing:  $r = -.23$ , externalizing:  $r = -.19$ ).

Shai et al. (2022) recruited a sample comprising 39 mothers with adverse social backgrounds, mental health challenges, and bonding difficulties with their offspring. Their study evaluated the relationship between PEM at 3 months and child cognitive and language development a year later. Findings showed that PEM was a significant predictor of both cognitive ( $B = .31$ ) and language ( $B = .21$ ) development at 12-month follow-up, even after accounting for other sensitivity measures, PRF, and various sociodemographic elements.

Moreover, a study by Afek et al. (2022) investigating the mediating role of PEM on the long-term relationship between prenatal spousal support and toddlers' ability to recognize emotions, identified modest yet significant correlations between maternal PEM measured at 6 months of age and the infant's emotion recognition capabilities at age 2 ( $r = .27$ ). Interestingly, this association was not found for paternal PEM (for the further details, see Table 6).





**Table 6.** Does PEM predict optimum developmental outcomes in the child?

Authors, Year of Publication	Sample Size	Child Mean Age at Baseline PEM Assessment	Child Age		Tool Used to Assess Child Development	Statistical Analysis	Main Outcome
			At Measurement of the Developmental Outcome	Outcome			
Afek et al. (2022)	105	6 months	24 months		Emotion Recognition Task	Multiple Regression Analysis	Maternal PEM assessed at 6-months of child age, but not paternal PEM, significantly predicted infant emotion recognition at 2-years of age ( $r = .27$ ).
Shai et al. (2022)	39	3 months	12 months follow-up (around 15 months of child age)		Bayley Scales of Infant Development, Third Edition (BSID-III)	Stepwise Linear Regression Analysis	PEM significantly predicted child cognitive ( $\beta = .31$ ) and language development ( $\beta = .21$ ) at 12-months follow-up when all other measures of sensitivity, PRF and various sociodemographic factors were controlled for.
Shai and Belsky (2017)	200	6 months	54 months		Social Skills Questionnaire from the Social Skills Rating System California Preschool Social Competency Scale (CPSCS) Preschool Language Scale Teacher Report Form Two subscales of Woodcock Johnson Achievement and Cognitive Batteries (for assessing academic development)	Multiple Regression Analysis	Young children of mothers with high capacity for embodied mentalizing showed greater social development in two scales ( $r = .15$ , Social Skills Questionnaire from the Social Skills Rating System; $r = .23$ , California Preschool Social Competency Scale), language ( $r = .17$ , Preschool Language Scale) and academic development ( $r = .14$ ) and fewer behavioural problems (internalizing: $r = -.23$ , externalizing: $r = -.19$ , Teacher Report Form) at 54 months follow-up.



### *Convergent validity: associations between parental embodied mentalizing and parental mental health*

To date, five studies have explored the capacity for parental embodied mentalizing within the context of parental psychopathology, particularly focusing on postpartum depression (Gagné et al., 2023, Garset-Zamani et al., 2020; Ierardi et al., 2022; Shai et al., 2022; Væver et al., 2020) and anxiety (Gagné et al., 2023; Ierardi et al., 2022). In a study involving a small sample of at-risk mothers ( $N = 39$ ), Shai et al. (2022) found no significant association between maternal depression and PEM. A similar lack of association between PEM and both maternal depression and anxiety was observed in a moderately at-risk cohort (Gagné et al., 2023). However, in specific observational contexts, PEM was found to be significantly associated with anxiety ( $r = .21$ ) in structured settings using toys (Gagné et al., 2023).

Contrastingly, Ierardi et al. (2022) identified a negative correlation between higher PEM and maternal depression ( $r = -.31$ ) and state anxiety ( $r = -.30$ ). When mothers were categorized based on psychopathology thresholds, the presence of psychopathology was negatively correlated with PEM levels ( $d = 0.68$ ). Furthermore, when considering the frequency of extremely low ECC scores (i.e. those rated as “1”), a significant positive relationship was observed with maternal state anxiety ( $r = 0.24$ ). Diverging results emerged in a study by Garset-Zamani et al. (2020) that differentiated mothers of 4-month-old infants based on clinical group status, determined by an EPDS score threshold and subsequent clinical diagnostic interview. No significant correlation was found between PEM and either group status or EPDS score levels. The only notable difference in PEM levels between the groups emerged when controlling for EPDS scores ( $b = 0.18$ ,  $p = .01$ ). Building upon this sample, Væver et al. (2020) sought to evaluate the relationship between PEM and maternal sensitivity based on clinical group status, but found no significant differences in PEM ratings between the clinical and nonclinical groups (see Table 7).

### *Additional correlates of parental embodied mentalizing*

Existing literature primarily focuses on the relationship between PEM and theoretically related constructs like child attachment, along with factors like mental health challenges and socio-economic disparities that can affect a parent’s capacity for embodied mentalizing with their child. However, exploring how PEM interacts with other possible influencers of parenting quality and the parent-child relationship is also crucial.

The scope of this inquiry remains narrow, with studies predominantly exploring the relationships between PEM, parenting stress, partner support, and inter-parental alliance. Two studies reported no significant relationship between parenting stress and PEM (Shai & Belsky, 2017; Shai et al., 2017). However, a connection between PEM and parental collaboration was identified ( $r = .26$ ). Furthermore, an indirect relationship between PEM and parenting stress emerged when cooperative alliance was considered as a mediator (Shai et al., 2017).

In a more recent examination of the correlation between paternal and maternal PEM and mutual partner support (Afek et al., 2022), paternal PEM did not correlate with any form of support (be it positive, negative, or overall dyadic). Yet, modest but significant



**Table 7.** Is parental psychopathology associated with reduced PEM?

Authors, Year of Publication	Sample Size	Sample Characteristics	Child Mean Age	Tool Used to Assess Parent Mental Health	Statistical Analysis	Main Outcome
Gagné et al. (2023)	107	At moderate risk (social inequalities, mental health problems)	8 months	Symptom Checklist-90-Revised (SCL-90-R) to assess maternal depression and anxiety at 4 and 8-months' child age	Correlational Analyses	PEM total video score was not associated with maternal depression and anxiety. When assessed in context involving toys in the interaction, PEM was found to be significantly linked with maternal anxiety ( $r = .21$ ). In the context of free play that did not involve any toys, PEM was found to be significantly correlated with maternal depression ( $r = .21$ ) and anxiety ( $r = .21$ ). - Having two groups of mothers with and without PPD did not result in any relation between PEM and group status or the level of EPDS score. - The groups only significantly differed from each other on PEM levels when the EPDS scores were controlled for ( $b = 0.18, p = .01$ ).
*Garset-Zamani et al., (2020)	80	Mothers with ( $n = 29$ ) and without ( $n = 51$ ) a diagnosis of postpartum depression	4 months	Edinburgh Postnatal Depression Scale (EPDS) Clinical diagnostic interview: Present State Examination (PSE)	Linear Regression Analysis	Significant negative associations were found between PEM and maternal depression ( $r = -.31$ ) and anxiety ( $r = -.30$ ). When the sample was divided between mothers with and without psychopathology based on a cut-off, the presence of psychopathology was found to be negatively linked with PEM level ( $d = 0.68$ ). - No significant relation was found between maternal depression and PEM capacity.
Ierardi et al. (2022)	81	Community sample	3 months	EPDS State Trait Anxiety Inventory Form Y (STAI-Y)	Bivariate Correlation Analysis T-test	
Shai et al. (2022)	39	High risk sample (social inequalities, mental health problems)	3 months	The Center for Epidemiological Studies Depression Scale (CES-D)	Zero-order correlation	
*Vaever et al., (2020)	71	Mothers with ( $n = 27$ ) and without ( $n = 44$ ) a diagnosis of postpartum depression	4 months	EPDS PSE	T-test	The clinical and nonclinical groups did not significantly differ from each other on maternal PEM level.

\*Two of the studies were based on the same sample.

relationships were observed between maternal PEM and both positive ( $r = .21$ ) and overall dyadic support ( $r = .23$ ), but not with negative dyadic support.

A recent study also assessed PEM in relation to mothers' self-perceptions in their parenting roles, specifically focusing on self-efficacy, perceived child impact, and perceptions of their own parenting behaviors, including warmth and overprotection (Gagné et al., 2023). The findings only indicated an association between perceived parental warmth and PEM ( $r = .24$ ). When analyzed in different contexts (structured and unstructured free play), the relationship between parental warmth and PEM persisted ( $r = .23$ ) in toy-inclusive settings alone. All other relationships were non-significant.

### *Stability and change in parental embodied mentalizing capacity in response to a parenting intervention*

A recent pilot study by Shai et al. (2024) examined PEM within the context of an attachment-based Circle of Security Parenting intervention (COS-P; Powell et al., 2013). A small community sample of mothers ( $N = 24$ ) who self-reported difficulties with parenting were divided into COS-P and waitlist control groups based on recruitment order. After eight weeks of the group-based COS-P intervention, pre- and post-test results showed a significant increase in PEM in the treatment group, with a moderate to high effect size ( $d = 0.74$ ). No significant change was observed in the control group.

The treatment group also exhibited a notable reduction in ECC frequency and a decrease in PEM within the group after the intervention, despite overall stability in PEM levels. In contrast, the control group experienced a nonsignificant increase in ECC frequency from pre- to post-intervention. No significant treatment effect was detected in terms of mothers' self-compassion, parenting-related stress, or competence.

Although these findings provide preliminary evidence for the potential stability and change in PEM following a brief group-based attachment intervention, they should be interpreted with caution due to several methodological issues. The study relied on a small sample size, and the stability observed in the control group was based on a relatively short time gap (two months) between assessments. Moreover, randomization and blinding were not optimal, as the data was collected by the second author, who also facilitated the intervention groups. This limitation was mitigated by engaging an independent PEM coder who was unaware of the group status, and the initial PEM ratings. The inter-rater agreement on the random selection of the 40% of the videos was high (PEM rating,  $ICC = .98$ ,  $p < 0.001$ ; ECC frequency = 0.78,  $p < 0.001$ ) (Shai et al., 2024).

### *Comparison of parental embodied mentalizing and verbal counterparts in relation to additional correlates*

Three of the five studies reviewed identified moderate correlations between PEM and verbal aspects of parental mentalizing capacity (Gagné et al., 2021; Shai & Meins, 2018; Shai et al., 2017). Although the shared variance suggests a common underlying factor, the variance unaccounted for may imply distinct dimensions within the broader mentalizing construct. Indeed, elucidating the role of parental mentalizing necessitates examining both the intersecting and unique features of verbal and non-verbal mentalizing in relation to additional correlates in the literature.

Five studies concurrently assessed PEM and verbal parental mentalizing indicators (mind-mindedness or PRF). However, findings in terms of their relationships with socio-demographic variables were inconsistent. Shai and Meins (2018) found positive correlations between both PEM and mind-mindedness and socioeconomic status. Conversely, Shai et al. (2017) reported that only PRF correlated with maternal education amidst other factors like infant temperament and maternal age. However, Shai et al. (2022) found a correlation between maternal education and PEM, but not with PRF, and also reported that having White ethnicity and a small number of children was correlated with better embodied and verbal reflective capacities in mothers.

Gagné et al. (2023) explored interactions between PEM and mind-mindedness associations with maternal demographics. Significant relationships with PEM were apparent, whether globally or within structured/unstructured contexts. In contrast, only NAMRC negatively correlated with income levels in specific contexts.

Regarding parenting quality, results were mixed. Shai et al. (2017) reported no direct correlation between either PEM or PRF and parenting stress. However, PEM did correlate with stress when considering parental alliance. Pertaining to parenting sensitivity, studies highlighted positive associations for both PEM and mind-mindedness, although the magnitude of findings varied based on the assessment tool (Gagné et al., 2021; Shai & Meins, 2018; Shai et al., 2022). Further, Gagné et al. (2023) found that PEM was associated with maternal warmth, while another study connected PEM with a controlling parenting attitude (Ierardi et al., 2022).

In examining PEM and mind-mindedness in relation to maternal mental health, findings were again mixed. While PEM was associated with depression and state anxiety, only NAMRC correlated with both state and trait anxiety (Gagné et al., 2023; Ierardi et al., 2022).

Lastly, concerning child attachment security, Shai and Meins (2018) showed that both mind-mindedness and PEM differently related to child attachment styles, with PEM offering additional predictability for secure versus avoidant attachment. Contrarily, Gagné et al. (2021) found that PEM, but not mind-mindedness, predicted attachment security when factoring in maternal sensitivity.

## Discussion

The implicit and embodied aspects of the mentalizing system between a parent and their infant have long been considered theoretically significant. Yet, empirical research focusing on the parent's role in this embodied communication only began around 2011. This review aimed to evaluate the current literature on parental embodied mentalizing (PEM).

The systematic literature search revealed that the evidence on PEM is still limited in its scope, and further studies are required. Broadly speaking, the reviewed studies have confirmed the reliability of the PEM tool through inter-rater reliability assessments, and suggest the rating system has construct validity. However, given the relatively limited number of studies, and some inconsistencies in the findings, further investigation into other reliability types, such as internal consistency and test-retest reliability, is necessary to establish the tool's robustness and utility.

A crucial step in validating non-verbal parental mentalizing is to assess its convergent and discriminant validity in relation to verbal measures of parental mentalizing and

maternal sensitivity, respectively. Three out of five studies reported modest correlations ( $r = .25$  to  $r = .29$ ) between PEM and verbal measures of parental mentalizing, suggesting partial support for convergent validity.

In terms of maternal sensitivity, PEM showed a slightly stronger correlation with maternal sensitivity in all six studies, reporting correlations in the range of .36 to .47, indicating a notable connection between PEM and parenting sensitivity. An exception for the modest association was observed when using the Emotional Availability Scales sensitivity subscale ( $r = .27$ ) (Shai et al., 2022). This alignment seems to support the theoretical proposition that enhanced parental mentalizing fosters more congruent and contingent parenting behaviors (Luyten et al., 2020). However, the lack of perfect correlations suggests that embodied mentalizing plays a unique role within the broader context of parenting. This is supported by the findings showing that PEM continued to be significantly associated with parental reflective function and mind-mindedness when maternal sensitivity was controlled for (Shai & Belsky, 2017; Shai & Meins, 2018). Further, PEM also continued to predict child attachment (Gagné et al., 2021; Shai & Belsky, 2017) and social, academic, and cognitive development when maternal sensitivity was accounted for (Shai & Belsky, 2017; Shai et al., 2022).

Although PEM exhibited a stronger correlation with maternal sensitivity than with verbal measures of parental mentalizing, this could be due to method variance, as both types of assessment focus on mother-infant interaction behaviors. It is crucial to distinguish whether the observed correlation between PEM and other constructs operationalized within the realm of observable dyadic behavioural context, such as maternal sensitivity, is the result of common method variance or the actual convergence of constructs. A possible metric to further explore in relation to PEM is the Atypical Maternal Behavior Instrument for Assessment and Classification (AMBIANCE; Bronfman et al., 1999), which evaluates disruptive, atypical, and frightening parenting behaviors. Prior research has shown a significant negative correlation between parental reflective capacity and these behaviors ( $r = -.48$ ,  $d = 1.1$ ), with an effect size even higher than the link between AMBIANCE and child attachment security ( $d = .72$ ) (Kelly et al., 2005).

While observational measures of parent-infant interaction tend to assess the general process or content of the ongoing interaction, the PEM tool focuses on the detailed description of the process in terms of the movement-based depiction of action-reaction sequences, namely ECCs. Instead of pinpointing directly what is happening, PEM considers how the observed mutual dialogue occurs (Shai & Belsky, 2017). The appropriate evaluation of parental embodied mentalizing capacity is contingent on the child's bodily reaction. While contingency is measured through time-lagged analyses in micro-analytic codings by assessing the degree of overlaps between individually assessed parent and child reactions (Beebe & Steele, 2013; Beebe et al., 2010), the aim here is to capture the parental mentalizing stance through the mere observation of the degree of ongoing embodied harmony between the dyad. Each incidence of embodied conversation can manifest in brief or long moments (Shai et al., 2024).

The advantages of this frame-by-frame approach include detecting nuances in the quality of the interaction and pinpointing and rating ECCs to capture the frequency, intensity, and duration of parental mentalizing stances in the mutual dialogue. This approach also encodes the often-neglected conversational unit of the dyadic interaction – the body – as a central meaning-generating unit. However, with such fine-grained coding

and detailed descriptions of process, the assessment process can be time consuming, in particular when learning the coding scheme or utilizing the tool in a large sample.

The PEM construct is one operationalization of the broad phenomenon of parental embodied mentalizing, which is presumed to encompass the exchange of mental and physiological, sensory states of the body in the self and others. As the easiest method of capturing the overall PEM capacity might be through observable behavior, an important question that remains is to what extent different operationalizations of parenting behaviors reflect the underlying parental mentalizing capacities. Future research is needed to explore the underlying mechanisms, considering both the similarities and differences in how these micro- and macro-behaviors are interpreted as embodied reflections of parental mentalizing.

Alternatively, it could be argued that PEM primarily captures nonverbal bodily responsiveness rather than a higher-level capacity for parental mental state attribution. If this is the case, the term “embodied mentalizing” may be problematic, as it conflates verbal and nonverbal processes. Some parents may excel in nonverbal responsiveness while others in verbal mentalizing, with many caregivers proficient in both, which could explain the observed overlap between PEM and verbal mentalizing in existing studies. This raises several conceptual questions: Does PEM truly reflect parental mentalizing capacity? How does it differ from maternal sensitivity? Could it represent a lower-level, reflexive cognitive process that does not require mental state attribution, even at an automatic or subconscious level? Current evidence supports both nonverbal bodily responsiveness and embodied mentalizing, and conceptually, PEM aligns with early infant development. However, further empirical research is required to differentiate PEM from nonverbal responsiveness and to establish whether PEM reflects higher-order cognitive processes.

Evidence for the construct validity of PEM in terms of child attachment security appears promising. Three studies with sample sizes of over 100 dyads have shown that PEM can differentiate between securely attached children and those who are insecurely attached (Shai & Belsky, 2017; Shai & Meins, 2018), or have identified the influence of PEM through sensitivity (Gagné et al., 2021), even when controlling for maternal sensitivity and/or parental mentalizing. Interestingly, Væver et al.’s (2020) study, with a smaller sample size, revealed no such relationship. The variance in these results could be influenced by the differing treatment of infant attachment as a continuous variable and the age of the child at PEM measurement. In the Væver et al. (2020) study, PEM was assessed when children were younger (at 4 months), which might have contributed to the lack of a clear connection. Coding PEM at 6 months is recommended due to the increased behavioral nuances displayed by infants at that age (Garset-Zamani et al., 2020; Væver et al., 2020). Although there is some preliminary support for PEM’s construct validity in terms of infant attachment, the relationship between PEM and child attachment outcomes is scarce and complex, suggesting that further research with varied samples and validated parent-infant attachment measures is necessary to draw more definitive conclusions.

This review also examined the extent to which parental mentalizing could explain the variability in infant attachment security beyond that accounted for by maternal sensitivity. Zeegers et al. (2017) meta-analysis on the verbal dimensions of parental mentalizing found that it contributed unique variance to infant attachment security ( $r = .24$ ). Similarly, Gagné et al. (2021) observed that sensitivity only partially mediated the relationship between PEM and infant attachment security. These findings suggest that PEM has

unique predictive power beyond that of maternal sensitivity, although the broader benefits of measuring PEM over sensitivity require further exploration.

Evidence on discriminant validity for PEM is sparse and inconclusive. No associations were found between PEM and child-specific factors such as gender, age, or temperament. Contextual variables related to parents, such as maternal age, education, ethnicity, marital status, and socioeconomic status, displayed unique results across studies. Despite small to moderate variations in effect sizes, socioeconomic status, maternal age, and education level tend to relate to PEM. However, the influence of parental mentalizing on child development may be mediated by adversity. For example, Brown et al. (2023) found that maternal mind-mindedness predicted child behavioral problems only in mothers with a history of maltreatment, echoing earlier studies (e.g. Meins et al., 2013, 2019). This suggests that the interaction between contextual factors and parental mentalizing could be more complex than previously understood.

In studies on PRF and socio-demographic factors, links were found only with one PRF dimension, pre-mentalizing modes (PM), which is considered a maladaptive form of mentalizing (Luyten et al., 2017). This indicates a need for further exploration of how adverse conditions affect parental embodied mentalizing capacity. It is also important to investigate the psychometric properties and dimensional structure of PEM to understand its function and how its various dimensions relate to key variables. Such studies would provide greater insight into the mechanisms that drive parental mentalization and its role in child development, especially under varying degrees of adversity.

Regarding predictive validity, early findings seem promising. Two studies have examined the relationship between PEM and child language development. Other aspects of child development – such as academic achievement, social skills, cognitive abilities, behavioral issues, and infant emotion regulation – have been explored individually, with low to moderate correlations. This points to the need for broader replication across different child development domains, diverse samples, and age groups, along with further exploration of the mechanisms through which PEM may affect child outcomes.

Four studies examined the impact of mental health status on parental embodied mentalizing (PEM). Two studies focusing on at-risk mothers found no link between depression and PEM (Gagné et al., 2023; Shai et al., 2022). Gagné et al. (2023) found a significant association between PEM and anxiety symptoms, though only when interactions involved toys. Ierardi et al. (2022), examining a community sample of mothers, identified moderate correlations between PEM and both depression and anxiety. When comparing clinical to non-clinical cases, psychopathology was identified as a significant risk factor for reduced PEM capacity. Although Garset-Zamani et al. (2020) found no direct relationship between symptom severity or clinical group status and PEM, they observed a correlation when EPDS levels were controlled for, suggesting a possible threshold effect where a certain level of clinical severity could lead to PEM impairment. Elsewhere, studies on mind-mindedness have noted inconsistent results, with statistical power and sample size impacting significance (McMahon & Bernier, 2017). A recent meta-analysis on the relationship between parental depression and mentalizing capacity revealed a weak correlation that disappeared when parental mentalizing was assessed through observational methods and interviews, but became more prominent in clinical contexts (Georg et al., 2023). Given the multifaceted nature of the relationship between parental mentalization



and mental health, future research should carefully evaluate the methods used to measure both parental mentalization and mental health, considering the duration and severity of mental illness.

In common with other approaches to assessment of infant caregiver interactions, this review identifies a significant gap in the literature concerning validity in studies focusing on paternal samples, as most research has centered on mother-infant dyads. Mothers and fathers may exhibit different interaction patterns with their infants. A systematic review has emphasized the crucial role of fathers' mentalizing capacity in parenting quality, family dynamics, and child development (Charpentier Mora et al., 2023). However, studies have reported notable disparities in parental mentalization levels between mothers and fathers (Arnott & Meins, 2007; Foley et al., 2022; Luyten et al., 2017). Additionally, Luyten et al. (2017) highlighted differences in factor loadings for the PRF measure between the two groups.

A recent meta-analysis found variations in sensitive parenting behaviors between mothers and fathers, with these differences being less pronounced in Europe compared to the Middle East and North America (Deneault et al., 2022), suggesting potential cultural influences on parenting. Although comprehensive cross-cultural comparisons in parental mentalization are lacking, some studies indicate cultural differences in explicit verbal mentalizing but not in implicit aspects (Aival-Naveh et al., 2019; Fonagy & Campbell, 2019). Given the Western-centric nature of most PEM data, extending the generalizability of existing PEM validity evidence to diverse cultural contexts is crucial.

The contexts in which PEM is assessed could also be expanded. So far, most studies have evaluated PEM during free play. Only one study systematically examined the influence of the observational context – such as the presence or absence of toys – on PEM (Gagné et al., 2023). This study found that the strength and significance of correlations between PEM and related variables varied depending on the context, with differences in observation duration (5 vs. 3 minutes). Prior research has suggested that maternal and child behaviors, as well as the quality of their interactions, can differ based on the observational activity, whether it involves face-to-face interactions or free play with toys (Maas et al., 2013; Miller et al., 2002). Additionally, contextual factors, especially within dyadic attachment relationships, can impact the level and type of mentalizing. For example, heightened arousal might impair mentalizing by shifting from controlled processes to more automatic forms of mentalizing (Luyten et al., 2012).

In line with this argument, Gagné et al. (2023) found higher levels of PEM when toys were present, indicating that unstructured settings might induce more stress than structured settings. Examining maternal correlates of PEM in different contexts, the study observed increased maternal warmth and lower maternal anxiety in play scenarios with toys, which might reduce ambiguity and stress, leading to more positive parent-infant interactions. In contrast, in toy-free contexts, parental characteristics, particularly maternal education level, had a greater impact on the interaction dynamics. Given the implicit nature of PEM, it would be interesting to determine whether different observational contexts affect parental caregiving behaviors or activate the attachment system, potentially influencing the stability of PEM across situations. Further research into these contextual influences could offer a more nuanced understanding of how observational settings affect parental mentalizing capacity and related parent-child interactions.

In summary, parental embodied mentalizing (PEM) addresses a significant gap in the literature on parental mentalizing, offering a tangible way to measure long-standing theoretical claims about the nonverbal dynamics in early parent-infant interactions. This systematic review aimed to clarify the PEM concept, highlight research directions, and identify gaps in the literature. A limitation of this work is its reliance on a limited number of studies, often with small sample sizes. The majority of studies provide adequate information regarding the quality assessment indices and most of the studies tend to meet quality requirements. Yet, a potential weakness regarding the study quality arises from about half of the studies not identifying confounding variables and failing to report appropriate methods to address them, or providing unclear information that makes it difficult to infer this information. Additionally, a potential conflict of interest arises from the fact that much of the research involved the scale developer, and majority of the validity evidence for PEM comes from studies to which the developer of the scale contributed. As such, these findings should be viewed as preliminary and requiring further validation from a broader research base conducted by independent research groups. Given the cross-sectional and longitudinal study designs, caution is advised when making causal inferences.

Further research is needed to determine whether PEM represents a behavioral analog of mind-mindedness, as suggested by Shai and Meins (2018), which has been considered a relational construct (Meins et al., 2014), or if it reflects overall reflective capacity or is a distinct parental mentalizing capacity. McMahon and Bernier (2017) recommended comparing the discriminant validity of existing parental mentalizing constructs to better understand this question. It is likely that PEM overlaps with parental reflective functioning due to the impact of social adversity on both, unlike mind-mindedness, which is presumed to be independent of contextual factors (McMahon & Bernier, 2017). Addressing this conceptual ambiguity, particularly in terms of predictive validity, requires more research that isolates the unique predictive value of PEM when controlling for verbal measures of parental mentalizing.

Further research should compare various parental mentalizing constructs to understand their unique effects on child development. For example, Brown et al. (2023) found that parental mind-mindedness influenced children's behavioral issues at 28 months, but not at 13 months, suggesting that language comprehension skills may play a role. This indicates that implicit and explicit aspects of parental mentalizing might have different impacts on child development and the parent-infant relationship at different developmental stages.

Additionally, the age range of children assessed for PEM capacity varies from 3 to 48 months in the included studies. Concerns have been raised about the method's suitability for children less than 6 months old due to their limited flexibility and variety in movements, which might make it difficult to capture their mental states through bodily expressions (Garset-Zamani et al., 2020; Væver et al., 2020). Thus, further evidence is needed to clarify whether the tool provides consistent information for children with developed verbal expressive capacities.

Research has highlighted that disruptive or atypical parenting behaviors and non-attuned reflections on the child's mind are strong predictors of insecure infant attachment (Cooke et al., 2020; Lyons-Ruth et al., 1999; Madigan et al., 2006; McMahon & Bernier, 2017). Similarly, a high frequency of extremely low ECC scores on PEM suggests significant

parental failure to adjust their kinesthetic responses to the child's kinesthetically expressed mental states. These low-scoring ECCs reflect a parental incapacity to track the child's mind, leading to interactions dominated by the parent's perspective (Shai & Belsky, 2017).

Future research should not only include the frequency and scores of ECCs in statistical analyses to better understand their impact on child development and attachment security but also explore the mental and behavioral convergence between these intense and potentially risky patterns. Furthermore, studies should investigate the interplay between verbal and non-verbal mentalizing capacities, examining how they complement or differ from each other and their combined effects on the parent-child relationship. This comprehensive approach will help clarify the distinct and overlapping contributions of different parental mentalizing constructs to child development outcomes.

Moreover, different operationalizations that focus on explicit and implicit dimensions of parental mentalizing may create rigid distinctions that do not fully capture the complexity of human communication. Implicit and explicit aspects of mentalizing might be more intertwined in everyday interactions, as demonstrated by Jensen et al. (2021) in psychotherapy. For example, sudden or abrupt physical contact with an infant could result from both a conscious decision and an instinctive action. Empirical research should further investigate the dimensional assumptions underlying parental mentalizing constructs.

While this review focused on parental capacity to mentalize, future studies should consider factors from the child's perspective, such as temperament and developmental constraints. Additionally, there is limited evidence on the stability of PEM and its ability to change after intervention. More robust clinical trials and longitudinal studies are required to better understand these aspects. Continuing to conduct longitudinal research across diverse clinical and community samples, and in different child age groups, will be crucial. Also, initial efforts should focus on evaluating the tool's psychometric properties. Although evidence supports PEM's validity, much remains unclear about its characteristics, correlates, and antecedents. Furthermore, exploring other facets of embodied mentalizing, such as facial expressions, gaze, gestures, and touch, could offer deeper insights into the complexities of parent-child interactions.

The tool has valuable clinical applications, potentially aiding diverse populations by overcoming language barriers and facilitating video-feedback for parents facing parenting challenges. PEM's reliance on movement-based analysis adds a distinctive dimension to the existing array of nonverbal, micro-analytic assessment tools. Together these tools offer rich, nuanced clinical insights into the hard-to-detect embodied aspects of dyadic interaction. This was well-exemplified in a case study by Avdi et al. (2020), where the intricate layers of dyadic and triadic interactions during a parent-infant psychotherapy session were analyzed using various measures that assessed both verbal and embodied/nonverbal dimensions of interaction. The movement-based, bodily focused information provided by PEM, whether used independently or in conjunction with other tools, yielded unique information regarding often difficult to detect signals of rupture and repair (Avdi et al., 2020).

This review highlights several key limitations and areas for further research. Future studies should focus on strengthening the evidence for the reliability and validity of PEM, and clarify how it complements or differs from verbal measures of parental mentalizing, maternal sensitivity, and its relationship with child attachment style. The conceptual ambiguity surrounding PEM adds complexity to the field, as debates persist regarding whether PEM represents a distinct mentalizing capacity or overlaps with constructs such as mind-mindedness, parental reflective functioning, or nonverbal responsiveness. Additionally, more research on paternal samples is necessary to explore fathers' unique mentalizing capacities and interactions with infants, along with cross-cultural investigations where variations in parental mentalizing and sensitivity have been observed.

Currently, PEM is predominantly assessed in a narrow range of observational contexts, such as free play. Given that mentalizing may be influenced by environmental stressors, future studies should investigate how different settings impact PEM. Larger sample sizes, better control of confounding variables, and addressing conflicts of interest would enhance the methodological rigor of the field. Longitudinal research is also essential to examine the stability of PEM over time and its responsiveness to intervention.

Finally, there are concerns regarding the applicability of PEM at different developmental stages and its clinical utility. Future research should assess the appropriate child age range for the scale and prioritize studies evaluating PEM's clinical effectiveness. With these advancements, the field can gain a more comprehensive understanding of PEM's role in parent-child relationships and its potential as a valuable research and clinical tool.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

## Funding

This work was supported by the PhD scholarship received by the first author from the Ministry of National Education, Republic of Türkiye. This report is independent research supported by the National Institute for Health and Care Research ARC North Thames. The views expressed in this publication are those of the author(s) and not necessarily those of the National Institute for Health and Care Research or the Department of Health and Social Care.

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## Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article.

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