

Infant carrying: Associations with parental reflective functioning, parental bonding and parental responses to infant crying

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Abstract

Infant carrying may have beneficial effects on the parent-infant relationship but only limited research has been conducted in this area. Therefore, the main aim of the current study was to investigate whether infant carrying is associated with parental reflective functioning, parental bonding, and parental (emotional) and behavioral responses to infant crying, key elements within the parent-infant relationship, promoting infant development. Parents reporting high levels ($N = 389$) of infant carrying (six times a week or daily) and parents reporting low levels ($N = 128$) of infant carrying (less than once a week or not at all) who participated in an online survey about the developing parent-infant relationship in Germany were included in the present study. Standardized questionnaires were used to assess parental reflective functioning, parental bonding impairments, and emotional responses to infant crying. Further insensitive (non-responsive and hostile) behaviors in response to infant crying were assessed. Parents with high levels of infant carrying showed better parental reflective functioning, lower parental bonding problems, less negative emotions, and less insensitive behaviors in response to infant crying.

KEYWORDS

infant carrying, infant crying, mentalizing, parental bonding, parental reflective functioning, parent-infant relationship

1 | INTRODUCTION

Infant carrying is an ancient and cross-cultural practice (Berez et al., 2020). It offers a unique way to keep the infant in close physical contact offering numerous opportunities for direct interaction while having the hands free for other tasks. Its prevalence across societies suggests an evolutionary significance, indicating that it may serve fundamental functions in the developing parent-infant

relationship (Berez et al., 2020). However, in Western cultures, since industrialization, infants have been carried less and spent much time in strollers or infant seats involving little physical contact (Hewlett & Lamb, 2002; Little et al., 2019). In recent years, infant carrying through the use of slings, wraps, or a soft cloth carrier, that is, worn on the body is becoming more and more popular as an alternative, but only limited research has been conducted in the area of infant carrying on the developing parent-infant

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relationship (Grisham et al., 2023). One of the first studies on the beneficial effects of infant carrying was done by Anisfeld et al. (1990). They focused on the effect of infant carrying on maternal responsiveness during mother-infant interaction and infant attachment using a randomized-controlled trial. The findings revealed that infant carrying enhanced maternal responsiveness to infant cues and increased the likelihood for infants to develop a secure attachment pattern to their mothers. In line with these findings, Williams and Turner (2020) found that adolescent mothers who used an infant carrier for 3 months were more likely to have securely attached infants and less likely to have infants with disorganized attachment behaviors compared to a control group. These findings suggest that infant carrying may promote sensitive caregiving.

Parental responsiveness to their infants' needs, particularly during moments of distress, promotes the infant's social, emotional, and cognitive development (Sroufe et al., 2005). During the first months of life, infants communicate their needs and emotional states primarily through crying (Soltis, 2004). Infant crying elicits strong emotional reactions (Fairbrother et al., 2019, 2015; Lin & McFatter, 2012), and the valence and intensity of the parental emotional response have been shown to predict individual differences in caregiving quality (Leerkes, 2010; Leerkes & Qu, 2020; Leerkes et al., 2015). Infant-oriented parental emotions such as feelings of protectiveness in response to infant crying are more likely to evoke caregiving behavior that meets the needs of the infant compared to emotions such as frustration, anxiety, or amusement that have been associated with non-responsive or insensitive parental responses (Leerkes & Qu, 2020; Leerkes et al., 2011). Moreover, infant crying can also elicit strong negative emotions, which may even lead to hostile actions such as shaking to stop the infant's crying (Lee et al., 2007; Reijneveld et al., 2004). Insensitive and hostile parenting behaviors, particularly to infant's distress, in turn, have been shown to predict infant attachment development (De Wolff & van Ijzendoorn, 1997; van Ijzendoorn et al., 1999). Therefore, emotional responses to infant crying play an important role in parenting and early infant development. Previous neuroimaging studies on parental responses to infant crying show that exposure to infant crying activates the parental brain network, including the amygdala and prefrontal regions involved in emotional reactivity and emotion regulation (Feldman, 2015; Swain, 2011; Witteman et al., 2019). Riem et al. (2021) investigated in a randomized controlled trial whether carrying the infant in a soft baby carrier compared to using a baby seat for 3 weeks alters neural activity to infant crying in new fathers. The findings revealed that fathers in the infant carrying intervention condition had increased amygdala reactivity to infant crying compared to fathers in the baby seat condition. Riem et al. (2021) con-

KEY FINDINGS

- In the current study, infant carrying was positively associated with parental reflective functioning and parental bonding.
- Although infant carrying was not correlated with infant crying in general, parents with high levels of infant carrying reported fewer negative feelings in response to infant crying and less non-responsive or hostile behaviors in response to infant crying.
- The association between parental reflective functioning and negative emotional responses to infant crying as well as parental bonding highlights the important role of parental reflective functioning for sensitive parental caregiving.

Statement of relevance

The current findings extend previous research showing that infant carrying may have beneficial effects on the developing parent-infant relationship. Interestingly, parental reflective functioning, which has been shown to play an important role in parental responsiveness to infant cues, may also positively be influenced by infant carrying. Therefore, infant carrying may be a promising intervention—and considering the relatively low costs of an infant carrier and the easy integration into daily life—a wider implementation might be warranted and should be investigated in future studies.

cluded that increasing physical contact through the use of an infant carrier may promote attention to and accurate perception of infant distress signals. However, to sensitively respond to infants' needs, caregivers must also take the infants' point of view to interpret the infant's signal adequately (Ainsworth et al., 1978).

Mentalizing, also known and measured as reflective functioning refers to an individual's capacity to understand and make sense of their own and others' emotional experiences, thoughts, intentions, and behaviors (Fonagy et al., 2018; Katznelson, 2014). In other words, reflective functioning involves the ability to reflect upon mental states—both one's own and those of others—and to understand the underlying reasons and motivations behind

behaviors. Parental reflective functioning is an extension of the concept of reflective functioning, specifically applied to the context of the parent-infant relationship. It refers to a parents' ability to understand and interpret their child's behavior in terms of the child's emotional and mental states (Luyten, Nijssens et al., 2017; Slade, 2005). Parental reflective functioning is assumed to be expressed in an active interest and curiosity in mental states, which goes along with an active search for understanding of their child's feelings, thoughts, and behaviors, while also acknowledging the opacity of mental states (Luyten, Mayes et al., 2017). Parental reflective functioning has, therefore, been measured on three dimensions: pre-mentalizing modes (i.e., parental maladaptive or malevolent attributions about a child's mental state), certainty about mental states (i.e., certainty about a child's mental state, while acknowledging the opacity of mental states), and interest and curiosity in mental states (i.e., active search and interest in understanding the infant's state of mind). Lower scores on the pre-mentalizing modes scores and higher scores on the interest and curiosity in mental states subscale indicate better levels of parental reflective functioning and have been associated with infant attachment security (Luyten, Mayes et al., 2017). For the certainty about mental states medium scores might represent better PRF than very low or very high certainty scores (Luyten, Mayes et al., 2017). Further, higher levels of interest and curiosity in mental states have been associated with the neural response to infant cries, which was interpreted as increased attention to infant's distress signals (Rutherford et al., 2017). High levels of interest and curiosity in mental states and low levels of pre-mentalizing modes might, therefore, help parents to empathize with their child's feelings and thoughts and thereby enhancing sensitive and attuned caregiving, and aiding in recognizing and preventing dysfunctional behaviors in response to infant crying (Camoirano, 2017; Ensink et al., 2019; Pazzagli et al., 2022; Rutherford et al., 2015, 2013; Stuhmann et al., 2022). Previous studies have shown that interventions focusing on the parent-child relationship may enhance parental reflective functioning (Barlow et al., 2021). However, to date, there is no study exploring the association between infant carrying and parental reflective functioning. Previous studies have shown that close physical infant contact stimulates oxytocin release (Feldman et al., 2007, 2010) and have found an association between oxytocin levels and mother-child synchrony (Atzil et al., 2011; Gordon et al., 2017). Synchronous dyadic interactions on the other hand have been suggested to underlie the formation of the emotional bond between parent and child (Feldman, 2012). Further, oxytocin may improve the capacity to mentalize (Feeser et al., 2015; Wu et al., 2020) suggesting that close bodily contact through the use of an

infant carrier may also facilitate (aspects of) parental mentalizing and parental sensitive responsiveness to infant crying.

The overall aim of the current study was to investigate the potential beneficial effects of infant carrying on the parent-infant relationship. To this end, we examined the association between infant carrying, parental reflective functioning, parental (emotional) responses to infant crying, and parental bonding. We hypothesized that parents with high levels of infant carrying report higher parental reflective functioning and parental bonding and experience more positive infant-oriented emotions (such as feelings of sympathy or protection for their infant) in response to infant crying, report less negative or hostile emotions (such as feelings of anger or frustration) in response to infant crying, and report less non-responsive or hostile calming behaviors. As previous studies (e.g., Esposito et al., 2015; Hunziker & Barr, 1986) have shown that infant carrying may also reduce infant crying, we also assessed infant crying.

2 | METHODS

2.1 | Participants and data collection

Mothers and fathers with infants up to 12 months of age were invited to take part in the study via social media, flyers, and mailing lists by midwives and babywearing consultants in Germany. Data were collected via an online survey using LimeSurvey (LimeSurvey GmbH, Hamburg) from December 1, 2022 until March 28, 2023. Infant carrying was assessed by asking how often parents carried their infant using slings, wraps, or soft baby carriers in the last 2 weeks (possible answers: not at all, once or less in a week, two to three times a week, four to five times a week, six times a week or daily). From $N = 723$ participants who filled in the survey and gave information about their infant-carrying behavior in the last 2 weeks, we identified parents with low levels ($N = 128$) of infant carrying (less than once a week or not at all) and parents ($N = 389$) with high levels of infant carrying (six times a week or daily) who were included in the present study to answer the main research questions.

Parents ($N = 519$, mean age: 32.6 years, range: 20–49 years) who were included in the current study were mainly mothers (97.9%), living in a partnership (97, 5%), and currently on parental leave (86%). Parents with low levels of carrying and high levels of carrying did not differ with respect to socioeconomic variables such as age, income, education, or parental role (see Table 1). However, parents with low levels of carrying were more often first-time parents (73.4%) compared to parents with

TABLE 1 Sociodemographic characteristics of participants.

	Infant carrying		
	Low-level carriers	High-level carriers	
<i>n</i>	128	389	
Infant age	6.91 (3.34)	6.59 (3.24)	<i>p</i> > .05
Parental age	33.02 (4.31)	32.24 (5.07)	<i>p</i> > .05
Infant gender			<i>p</i> > .05
Female	48.4%	49.9%	
Male	51.6%	49.5%	
Divers	0%	0.5%	
Parental identity			<i>p</i> > .05
Father	3.1%	1.8%	
Mother	96.9%	98.2%	
Partnership			
Yes	98.4%	97.2%	
No	1.6%	2.8%	
First-time parent			<i>p</i> < .001
Yes	73.4%	51.2%	
No	26.6%	48.8%	
Education level			<i>p</i> > .05
University-level	47.7%	57.6%	
Not	52.3%	42.4%	
Parental leave			<i>p</i> > .05
Yes	86.9%	85.1%	
No	13.1%	14.9%	
Income			<i>p</i> > .05
Low	10.5%	15.5%	
Middle	46.3%	50.5%	
High	43.1%	34.0%	

Note: Income was classified as low if the monthly net household income was less than 2500 euros, middle if the monthly net income was between 2500 and 4500 euros, and high if the monthly net income was over 4500 euros.

high levels of carrying (51.2%) ($\chi^2 = 19.47$, $p < .001$). Demographic characteristics can be found in Table 1.

The current study was performed in accordance with the Declaration of Helsinki and adhered to all relevant guidelines and regulations. The current study was reviewed and approved by the local Ethics Committee (approval number: AZ 2022-03). All participants provided informed consent before study participation. No minors or illiterates were enrolled in the study. Participants did not receive any compensation for participating in the survey.

2.2 | Measures

2.2.1 | Infant crying and insensitive responses to infant crying

Parents were asked to indicate the average time in hours per day that their child had cried in the last 2 weeks. Fur-

ther, they were asked to indicate which of the following actions they have used so far to stop their infant's crying (response options: cradling, carrying, singing, breastfeeding, going for a walk, shaking, ignoring, and/or yelling at) as in previous studies (e.g., Reijneveld et al., 2004). We computed the category "insensitive behaviors" for parents reporting shaking, ignoring, and/or yelling at their infant to calm their crying infant.

2.2.2 | Emotional responses to infant crying

The My Emotions Questionnaire (Leerkes & Qu, 2020) was used to measure parents' emotional responses to infant crying. Parents rate how frequently they feel certain ways when their infant is crying on a 5-point scale ranging from never (1) to always (5). The 20-item questionnaire includes five subscales: amusement (e.g., I feel like laughing), anxiety (e.g., I feel nervous, like I won't know how

to respond), frustration (e.g., I feel irritated by the sound), sympathy (e.g., I feel sad for the baby) and protectiveness (e.g., I feel a strong desire to make my baby feel better). All scales demonstrated adequate internal consistency reliability and significant stability from 6 months to 1 year (Leerkes & Qu, 2020). Higher amusement, anxiety, and frustration were associated with non-responsiveness or harsh parenting behaviors whereas higher protectiveness and sympathy were associated with sensitive caregiving behaviors (Leerkes & Qu, 2020). For reliability analysis, Cronbach's alpha was calculated to assess the internal consistency of the subscales, which was good—particular given the low number of items included in each subscale—for the negative emotional responses to infant crying (amusement ($\alpha = .76$), anxiety ($\alpha = .75$) and frustration ($\alpha = .72$)) but less satisfying for the positive emotional subscales (sympathy $\alpha = .62$) and protection ($\alpha = .55$).

2.2.3 | Parental bonding

Parental bonding with their infant was assessed using the Postpartum Bonding Questionnaire. The Postpartum Bonding Questionnaire (PBQ) was originally developed by Brockington et al. (2006). In the present study, we used the abridged 16-item German version of the PBQ, which has been shown as a reliable screening instrument for bonding impairment. (Reck et al., 2006). Items such as “I feel close to my baby” or “My baby irritates me” are rated on a 6-point Likert scale from 0 (“never”) to 5 (“always”). High values on the PBQ-16 indicate lower levels of bonding. Cronbach's alpha in this study was $\alpha = .79$.

2.2.4 | Parental reflective functioning

The parental reflective functioning questionnaire (PRFQ) (Luyten, Mayes et al., 2017) is an 18-item self-report questionnaire that measures three dimensions of PRF: pre-mentalizing modes, certainty about mental states, and interest and curiosity in mental states. The pre-mentalizing modes subscale assesses a parent's tendency to make negative attributions about their child's behavior (e.g., “My child cries around strangers to embarrass me”). The certainty about mental states subscale assesses a parent's ability to recognize the opacity of their child's mental states (e.g., “I can completely read my child's mind”). The interest and curiosity in mental states subscale assess a parent's level of genuine interest in their child's mental states (e.g., “I like to think about the reasons behind the way my child behaves and feels”). Items are rated on a 7-point Likert scale and a mean score for every subscale is computed. Lower scores on the pre-mentalizing modes scores

and higher scores on the interest and curiosity in mental states subscale indicate better levels of parental PRF. For the certainty about mental states medium scores might represent better PRF (i.e., very low certainty and very high certainty are both problematic) (Luyten, Mayes et al., 2017). Therefore, this variable was transformed (transformed score = $[y - \text{mean}]^2$), so that scores closer to the mean are lower on the linear scale (Anis et al., 2020). Both the transformed and untransformed scores are included for comparison. Previous findings found the PRFQ to be valid and reliable for use with parents with children 0–5 years of age (Carlone et al., 2023; Luyten, Mayes et al., 2017). In the current study, internal consistency was adequate for the different subscales: certainty about mental states ($\alpha = .78$), interest and curiosity in mental states ($\alpha = .71$), and pre-mentalizing modes ($\alpha = .65$).

2.3 | Statistical analysis

Data analysis was conducted using IBM SPSS Statistics 27.0. First, the issue of missing data was addressed. Complete data was available for 84% of the participants. Concerning the outcome variables missing data ranged between 4.9% and 15.9%. A non-significant Little's MCAR test, $\chi^2 = 206.62$, $p > .05$, revealed that missing data was missing completely at random concerning the outcome variables. Therefore, missing values were handled using multiple imputations implemented in SPSS (Cummings, 2013). An average dataset—in which each missing value was replaced by the average of the $n = 20$ imputed values—was computed for further analyses. Before the final analyses, correlational analyses were carried out between sociodemographic characteristics and parenting measures to identify possible confounding variables. Child age and parental age were both correlated with outcome measures (see Table 2) and therefore included as a covariate in the final analyses to enhance precision and accuracy. Further, analyses of sociodemographic characteristics showed that first-time parents were less likely to carry their children ($\chi^2 = 19.47$, $p < .001$). and therefore, first-time parenthood was also included as a possible confounding variable. All other sociodemographic characteristics were not associated with the level of infant carrying (see Table 1). Univariate or multivariate analysis of covariance with levels of infant carrying (low vs. high) as a between-subjects factor and child age, parental age, and first-time parent as a covariate on parental bonding, parental depression, emotional responses to infant crying, and parental reflective functioning were run. Chi-square tests were used to assess whether hostile or non-responsive caregiving behaviors in response to infant crying were more likely to be present in parents with low levels of

TABLE 2 Correlational analyses.

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1 Parental bonding impairment ^a	—											
2 Interest and curiosity in mental states ^b	-.15***	—										
3 Pre-mentalizing modes ^b	-.22***	-.19***	—									
4 Certainty about mental states ^b	-.35***	.16***	-.20***	—								
5 Amusement ^c	.06	-.09*	.02	-.08*	—							
6 Anxiety ^c	.33***	-.05	.24***	-.29***	-.02	—						
7 Frustration ^c	.54***	-.13**	.21***	-.30***	.11**	.44***	—					
8 Sympathy ^c	-.04	.21***	-.02	-.05	-.16**	.43***	.06	—				
9 Protection ^c	-.12**	.15***	-.02	-.06	-.07	.36***	-.02	.63***	—			
10 Infant crying	.17***	-.02	.11**	-.13***	-.01	.24***	.21***	.04	.03	—		
11 Infant age	.18**	-.01	-.18**	.06	.03	-.13**	.14**	-.05	-.13**	-.14**	—	
12 Parental age	-.08*	-.13**	-.02	.01	.12**	-.23**	-.15**	-.12**	-.12**	-.09*	.04	—

^aParental bonding impairment was assessed by the Postpartum Bonding Questionnaire.

^bInterest and curiosity in mental states, pre-mentalizing modes and certainty about mental states were assessed by the Parental Reflective Functioning Questionnaire.

^cAmusement, anxiety, frustration, sympathy, and protection in response to infant crying were assessed by the My Emotions Questionnaire.

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

infant carrying compared to parents with high levels of infant carrying. To evaluate correlations between measures Pearson's r were used.

3 | RESULTS

3.1 | Correlations between parental reflective functioning, emotional responses to infant crying, and parental bonding

Correlational analyses showed significant correlations between parental bonding, emotional responses to infant distress, and parental reflective functioning. Pre-mentalizing modes were positively correlated with parental bonding problems and negative emotions in response to infant crying (frustration and anxiety), whereas the non-transformed certainty about mental states score was negatively correlated with parental bonding problems and negative emotions in response to infant crying (amusement, anxiety, and frustration). Interest and curiosity in mental states score was also negatively correlated with parental bonding problems and negative emotions in response to infant crying (frustration) and positively correlated with positive emotions in response to infant crying (sympathy and protection). No correlations were found for the transformed certainty about mental states score. Statistics are presented in Table 2.

3.2 | Differences in parental reflective functioning, parental responses to infant crying, and parental bonding between parents with low-level and high-level of infant carrying

3.2.1 | Emotional responses to infant crying

Multivariate analyses of covariance with infant carrying (low vs. high) as a between-subject factor and child age, parental age, and first-time parent as covariates showed a main effect of infant carrying on the combined variables of emotional responses to infant crying ($F[5, 508] = 2.37, p < .05$, partial $\eta^2 = .023$, Wilk's $\Lambda = .977$). Post-hoc univariate ANOVAs were conducted for every dependent variable. Results showed a statistically significant difference between levels of infant carrying for frustration ($F[1, 512] = 5.21, p < .05$, partial $\eta^2 = .01$) but not for amusement ($F[1, 512] = 1.21, p > .05$, partial $\eta^2 = .002$), anxiety ($F[1, 512] = 2.42, p > .05$, partial $\eta^2 = .005$), sympathy ($F[1, 512] = 2.03, p > .05$, partial $\eta^2 = .004$) and protection ($F[1, 512] = .07, p > .05$, partial $\eta^2 = .000$), revealing that parents with high-levels of infant carrying feel less frustration in

response to their infant's crying. Descriptive statistics can be found in Table 3.

3.2.2 | Infant crying and insensitive responses to infant crying

Univariate analyses of covariance with infant carrying (low vs. high) as a between-subject factor and child age, parental age, and first-time parent as a covariate showed no main effect of infant carrying on infant crying ($F[1, 512] = .25, p > .05$, partial $\eta^2 < .001$).

Chi-square tests showed that parents with low levels of infant carrying were more likely to report hostile or non-responsive behaviors to calm their infant (11.3%) than parents with high levels of infant carrying (5.1%) ($X^2(1, N = 517) = 4.61, p < .05$). Descriptive statistics can be found in Table 3.

3.2.3 | Parental reflective functioning

Multivariate analyses of covariance with infant carrying (low vs. high) as a between-subject factor and child age, parental age, and first-time parent as a covariate showed a main effect of infant carrying on the combined subscales of parental reflective functioning ($F[4, 509] = 6.05, p < .001$, partial $\eta^2 = .045$, Wilk's $\Lambda = .955$). Post-hoc univariate ANOVAs were conducted for every dependent variable. Results showed a statistically significant difference between levels of infant carrying for the interest and curiosity in mental states subscale ($F[1, 512] = 22.47, p < .001$, partial $\eta^2 = .042$). No significant differences between carrying groups were found on the pre-mentalizing modes subscale ($F[1, 512] = 3.57, p > .05$, partial $\eta^2 = .007$) and the certainty about mental states subscale (untransformed score ($F[1, 512] = 3.7, p < .05$, partial $\eta^2 = .007$); transformed score ($F[1, 512] = .13, p > .05$, partial $\eta^2 < .001$)). These findings indicate that high-level carriers have higher levels of parental reflective functioning with respect to interest and curiosity in mental states. Descriptive statistics can be found in Table 3.

3.2.4 | Parental bonding

Univariate analyses of covariance with infant carrying (low vs. high) as between-subject factor and child age, parental age, and first-time parent as a covariate showed a main effect of infant carrying on parental bonding ($F[1, 511] = 4.28, p < .05$, partial $\eta^2 = .008$) indicating that high-level carriers describe lower levels of parental

TABLE 3 Group differences.

	Infant carrying		
	No/Low (<i>N</i> = 128)	High (<i>N</i> = 389)	
Infant crying (in hours per day)	1.25 (0.53)	1.30 (0.60)	<i>ns</i>
Parental reflective functioning			<i>p</i> < .05
Pre-mentalizing modes	1.79 (0.65)	1.69 (0.56)	<i>ns</i>
Interest and curiosity in mental states	5.37 (0.91)	5.69 (0.63)	<i>p</i> < .05
Certainty about mental states	3.98 (0.94)	4.18 (0.90)	<i>p</i> < .05
Parental bonding	13.39 (5.40)	12.38 (3.96)	<i>p</i> < .05
Emotional responses to infant crying			<i>p</i> < .05
Amusement	1.38 (0.55)	1.29 (0.50)	<i>ns</i>
Anxiety	2.22 (0.70)	2.08 (0.70)	<i>p</i> < .05
Frustration	2.10 (0.59)	1.97 (0.54)	<i>p</i> < .05
Sympathy	3.73 (0.69)	3.81 (0.72)	<i>ns</i>
Protection	4.20 (0.57)	4.19 (0.65)	<i>ns</i>
Insensitive behaviors			<i>p</i> < .05
Yes	13 (10.1%)	19 (4.9%)	
No	115 (89.9%)	370 (95.1%)	

Note: Data are mean (SD) or *N* (%). Parental bonding was assessed with the Postpartum Bonding Questionnaire. Parental reflective functioning was assessed with the parental reflective functioning questionnaire. Emotional responses to infant crying were assessed with the My Emotions Questionnaire. Multivariate and univariate analyses of covariance with infant carrying (low vs. high) as between-subjects factor on the continuous measures were conducted controlling for child age. Chi-square tests were used to compare presence of insensitive calming behaviors between groups.

bonding problems compared to low-level carriers. Descriptive statistics can be found in Table 3.

4 | DISCUSSION

The current findings are consistent with the previous literature on the beneficial effects of infant carrying on the developing parent-infant relationship (Anisfeld et al., 1990; Williams & Turner, 2020). In line with our hypothesis, parents with high levels of infant carrying experienced less frustration in response to infant crying, and reported less insensitive calming behaviors than parents with low levels of infant carrying. Further, high levels of infant carrying were associated with lower levels of bonding impairments. In accordance with our hypothesis, parents reporting high levels of infant carrying showed higher parental reflective functioning with respect to interest and curiosity in mental states compared to parents reporting low levels of infant carrying.

The results of the present study represent the first demonstration of an association between infant carrying and parental reflective functioning. Parents reporting high levels of infant carrying had a higher interest and curiosity in mental states score compared to parents reporting low levels of infant carrying. No significant differences in the pre-mentalizing modes and certainty about mental states scores were found. Further, all dimen-

sions of parental reflective functioning were associated with emotional responses to infant crying. Pre-mentalizing modes were positively associated with negative emotions in response to infant crying and interest and curiosity in mental states were negatively associated with negative emotions in response to infant crying and positively associated with positive emotions to infant crying. This is in line with the idea that genuine levels of parental reflective functioning reflect lower scores on the pre-mentalizing modes subscale and higher scores on the interest and curiosity in mental states subscale (Luyten, Mayes et al., 2017). For the certainty about mental states subscale, it has been suggested that medium scores might represent better parental reflective functioning (Luyten, Mayes et al., 2017). However, in the current study sample, higher scores were associated with less negative emotions in response to infant crying. Thus, parents who feel more confident about their infant's state of mind may experience less anxiety and frustration when their infant is crying. This is in line with research showing that parental reflective functioning shapes parental responses to infant distress (Rutherford et al., 2015), a key element of sensitive and attuned caregiving. Previous studies have shown that particularly infant crying can elicit strong negative emotions (Lin & McFatter, 2012), which may be more easily regulated with high levels of parental reflective functioning (Schultheis et al., 2019). In the current study, low infant carrying was associated with higher feelings of frustration

in response to infant crying as well as insensitive calming behaviors. We therefore put forth two hypotheses. First, parents who often carry their infants may develop a better understanding of their infant's needs indexed by higher levels of parental reflective functioning. This heightened reflective functioning might lead to fewer feelings of anxiety, anger, and frightening behaviors in response to infant crying. Second, it may also be possible that parents with higher levels of reflective functioning better understand their infant's needs and therefore engage more often in infant carrying and experience less negative feelings in response to their infant's crying. It should be noted that the overall time of infant crying did not differ between groups, which is in line with some (St James-Roberts et al., 1995) but not all studies of infant carrying on general infant crying (Hunziker & Barr, 1986). In contrast to our expectations, no difference between groups was found for positive emotional responses to infant crying such as feelings of protection or sympathy suggesting that the negative feelings are better regulated in high-infant carriers, which could be associated with enhanced parental reflective functioning.

Infant carrying was also associated with parental bonding. Parents reporting high-level of infant carrying had fewer bonding impairments than parents reporting low levels of infant carrying. Parental bonding, the emotional connection from parent to child, has been shown to play an important role in postpartum mental health (Badr et al., 2018; Behrendt et al., 2016; Eitenmüller et al., 2022; Nakano et al., 2019; O'Dea et al., 2023) and to affect a child's socio-emotional development (Fuchs et al., 2016; Joas & Möhler, 2021; Le Bas et al., 2022). The association between parental reflective functioning and parental bonding is in line with previous findings (Pazzagli et al., 2022) suggesting that parental reflective functioning may have an important (mediating) role in the developing parent-infant bond. To date, there is only little research exploring the way infant carrying may influence the parent-infant relationship. The beneficial effects of infant carrying may be partly explained by the higher levels of infant physical contact. Little et al. (2019) showed that mother-infant physical contact immediately enhanced maternal responsiveness using an experimental task. Physical infant contact may facilitate parental responsiveness by the release of hormones such as oxytocin (Feldman et al., 2007, 2010). Previous studies suggest that oxytocin may shape caregiving behavior by enhancing parental reflective functioning (Feeser et al., 2015; Wu et al., 2020), parent-infant synchrony (Golds et al., 2022; Scatliffe et al., 2019) and altering responsiveness to infant distress signals (Riem et al., 2011; Witte et al., 2022). Further, infant carrying may influence neurobiological systems such as the amygdala (Riem et al.,

2021), which are important for the processing of infant cues (Swain, 2011). Therefore, infant physical contact may change parental responsiveness by shaping hormonal and neurobiological systems underlying parenting (Feldman, 2015, 2017). Most studies investigating the impact of close physical contact on physiological and behavioral parameters such as maternal sensitivity (Bigelow et al., 2010), postpartum mental health (Bigelow et al., 2012) have focused on skin-to-skin contact, therefore, further research is needed to explore the underlying mechanism of infant carrying on physiological, hormonal and neurobiological mechanisms and its relations with parenting such as parental reflective functioning, parental responsiveness and parental bonding.

4.1 | Limitations

The current findings should be interpreted in the light of the following limitations. First, due to the cross-sectional design of the study, we cannot infer whether infant carrying increases parental reflective functioning and parental bonding or whether prenatal parental reflective functioning or prenatal parental bonding increases the likelihood that parents carry their infants. Therefore, longitudinal and experimental studies are needed to enable a more in-depth analysis of the assessed associations and to establish causality. Second, the selection of participants might be biased as the survey was also promoted by midwives and babywearing consultants supporting infant carrying, leading to a high response rate of parents who carry their infants daily. Further, the sample constitutes a fairly homogenous low-risk group with a household income and educational level above the average German population and with relatively low scores on bonding impairments, negative feelings, and insensitive behaviors in response to infant crying and rather moderate to high levels of parental reflective functioning. Third, only 2.1% of parents in the current survey identified as fathers. Therefore, we could not investigate the differential effects of infant carrying for fathers and mothers. We repeated all analyses for mothers only, revealing comparable findings. Fourth, all variables were assessed using self-report measures which may be prone to social desirability and, in particular, underreport hostile or insensitive calming behaviors. Fifth, as the current study is based on self-report data common method variance may also be a problem for the internal validity of the current findings. Further, effect sizes for the current associations were relatively small. We therefore suggest that future studies should consider a more heterogenous sample including subjective and objective measures to enhance internal and external validity.

4.2 | Implications for practice and the field of infant mental health

The current findings and previous research point to the beneficial effects of infant carrying on the developing parent-infant relationship. Previous studies on infant carrying showed that infant carrying may have particularly positive effects on parents with adverse childhood experiences (Riem et al., 2021). Considering the relatively low costs of a baby carrier, a wider implementation might be warranted. Traditional parent-child intervention programs are often time-consuming and particularly parents at risk for critical parenting behaviors refuse to participate or drop out (Chablani & Spinney, 2011; Firk et al., 2021). Therefore, infant carrying may be a promising intervention—as it is easily integrated into daily life and allows to do other activities at the same time—for parents at risk for bonding impairments to promote parental bonding and sensitive responsiveness to infant needs. The current study shows that first-time parents are less likely to naturally engage in infant carrying. Parents with multiple children may carry their infants more often to maintain the routines of their older children. Previous studies have shown that non-Western cultures are more likely to engage in a proximal parenting style, a parenting strategy, that is, focused on keeping the infant in close physical contact compared to industrialized Western cultures (Keller et al., 2009; Lamm et al., 2015). Little et al. (2019) showed that US mothers having beliefs associated with proximal care cultures, such as immediately responding to infant distress signals by nursing or carrying and always keeping the infant in close physical contact, were more likely to carry their infants. Therefore, in Western societies with a distal parenting style facilitating the use of an infant carrying as a tool to enhance physical infant contact may positively influence the developing parent-infant relationship.

5 | CONCLUSION

This is the first study showing an association between infant carrying and parental reflective functioning as well as parental bonding and parental responses to infant crying. Although infant carrying was not associated with general infant crying, negative feelings such as frustration and insensitive calming behaviors in response to infant crying were lower in parents reporting high levels of infant carrying compared to parents with low levels of infant carrying. However, studies are still scarce and the causality of the assessed associations must be established by future research.

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CONFLICT OF INTEREST STATEMENT

The authors declare no competing interests.

HUMAN SUBJECTS APPROVAL

The current study was performed in accordance with the Declaration of Helsinki and adhered to all relevant guidelines and regulations. The current study was reviewed and approved by the local Ethics Committee (approval number: AZ 2022-03). All participants provided informed consent before study participation.

DATA AVAILABILITY STATEMENT

The current dataset is available from the corresponding author on reasonable request.

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