Empathy for others versus for one's child: Associations with mothers' brain activation during a social cognitive task and with their toddlers' functioning

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Abstract

Caregivers who are higher in dispositional empathy tend to have children with better developmental outcomes; however, few studies have considered the role of child-directed (i.e., "parental") empathy, which may be relevant for the caregiver–child relationship. We hypothesized that mothers' parental empathy during their child's infancy will be a stronger predictor of their child's social-emotional functioning as a toddler than will mothers' dispositional empathy. We further explored whether parental and dispositional empathy have shared or distinct patterns of neural activation during a social-cognitive movie-watching task. In 118 mother–infant dyads, greater parental empathy assessed when infants were 6 months old was associated with more social-emotional competencies and fewer problems in the children one year later, even after adjusting for dispositional empathy. In contrast, dispositional empathy was not associated with child functioning when controlling for parental empathy. In a subset of 20 mothers, insula activation was positively associated with specific facets of both dispositional and parental empathy, whereas right temporoparietal junction activation was associated only with parental empathy. Thus, dispositional and parental empathy appear to be dissociable by both brain and behavioral metrics. Parental empathy may be a viable target for interventions, especially for toddlers at risk for developing social-emotional difficulties.

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Introduction

Empathy is multifaceted, comprising affective (i.e., sharing or resonating with others' experiences), cognitive (i.e., understanding others' experiences), and motivational (i.e., wanting to improve others' states through one's own actions) processes (Davis, 1983; Zaki, 2014). In addition, these aspects of empathy may be *dispositional* (i.e., directed to others in general) or to specific individuals (Davis, 1996). *Parental* empathy is empathy directed specifically toward one's child (Stern, Borelli, & Smiley, 2014). Precisely how parental empathy differs from dispositional empathy in its associations with child development, however, is unknown. Given that parents are often children's primary caregivers and the main source of social experience in the first years of life, the level of empathy in this relationship may have significant implications for children's development. Specifically, parental empathy may facilitate parents' attention to and recognition of their child's needs and desires, potentially leading to engagement in higher quality caregiving behaviors that are linked to better social and emotional functioning in children (e.g., Pastorelli et al., 2016; Zhou, Eisenberg, & Fabes, 2002).

Higher levels of both dispositional and parental empathy have been associated with less negative and more positive caregiving behaviors (Miller et al., 2015; Perez-Albeniz & de Paul, 2003). Further, children of mothers with greater dispositional empathy have been found to have better social-emotional functioning in middle childhood and adolescence (Davidov & Grusec, 2006; Manczak et al., 2016; Meidan & Uzefovsky, 2020; Stern et al., 2015). Although fewer studies have been conducted in infancy and toddlerhood, greater dispositional empathy in mothers has been found to be associated with better attentional focus and less proneness to anger in their 7-month-old infants (Kochanska et al., 2004), and with greater physiological arousal in their infants at 12-15 months of age in response to another infant's emotions (Upshaw et al., 2015).

Despite evidence that caregiver empathy is important for child development, there are gaps in our understanding of its role in children's social and emotional functioning. In particular, researchers have not examined the differential associations of dispositional and parental empathy with children's early social-emotional development. Thus, we do not know whether caregivers' dispositional empathy towards others and their parental empathy specifically for their child are dissociable constructs that have distinct associations with child functioning. Determining the relative effects of parental and dispositional empathy on child functioning is important in informing interventions focused on improving children's caregiving environments, including whether dispositional or parental empathy should be targeted in efforts to support the caregiver–child relationship. In addition to determining whether these empathy constructs have distinct effects on child functioning, it is also important to examine whether dispositional and parental empathy have distinct neural substrates.

In this context, neuroimaging may be useful for investigating whether dispositional and parental empathy are dissociable constructs. Researchers have posited that caregiving behaviors are rooted in a "parental brain" network composed of neural regions that regulate social information, affective, and pain processing (Feldman, 2015; Kim et al., 2016; Young et al., 2017). Given the important role of empathy in caregiving, it is not surprising that these regions of the parental brain network overlap with areas that have been implicated in empathic processes. For example, Endendijk et al. (2020) found that higher self-reported nurturance in mothers was associated with greater activation in the amygdala and putamen in response to infant faces. Indeed, early motherhood may be a key window during which to assess the neural correlates of empathy, given that the first months of motherhood are characterized by alterations in brain structure and function (Dufford et al., 2019; Kim et al., 2010), some of which have been associated with positive maternal caregiving (Kim et al., 2010; 2011). For instance, at 3 months postpartum, mothers' amygdala response to images of their own infant displaying positive affect was correlated with more positive feelings about and attachment toward their infant (Barrett et al., 2012). Further, in the first year of motherhood, greater insula response to images of infants has been associated with mothers' greater use of cognitive empathy processes (Lenzi et al., 2009). Although researchers have assessed empathy-related brain activation in relation to measures of *dispositional* empathy in mothers (Ho et al., 2014; Zhang et al., 2020), they have not generally considered measures of *parental* empathy (although see Abraham et al., 2016, 2018; Swain, 2011). Tasks administered in the scanner that tap specific aspects of empathy, such as observing others experiencing pain or engaging in mentalizing, could help to identify patterns of neural activation that distinguish mothers who are higher and lower in levels of both dispositional and parental empathy.

Dispositional and parental empathy are both comprised of various *facets* (e.g., cognitive and affective dimensions). Investigating the respective levels of cognitive and affective facets for both empathy forms (i.e., dispositional and parental) may uncover specific psychological processes driving potential associations between mothers' empathy and children's early social-emotional functioning, as well as what skills an intervention might target. Additionally, examining the neural correlates of cognitive and affective facets of dispositional and parental empathy may uncover distinct substrates underlying each form and thereby further disentangle the two forms of empathy. For instance, it may be the case that although dispositional and parental affective facets of empathy largely share neural correlates, distinct brain regions may underlie dispositional cognitive empathy, which involves taking others' perspectives generally, and parental cognitive empathy, which involves taking the perspective of one's own infant.

Evidence from neuroimaging work suggests that different aspects of empathy (e.g., cognitive and affective dimensions) have both shared and unique neural substrates. For example, social cognitive tasks activate the right temporoparietal junction (TPJ) (Cheng et al., 2010; Saxe & Powell, 2006), a region involved in dispositional cognitive empathy (e.g., mentalizing, perspective-taking) (Preckel et al., 2018; Schurz et al., 2014). In contrast, observing or imagining others in physical or emotional pain activates brain regions implicated in salience detection and arousal, such as the anterior cingulate cortex (ACC), insula, and amygdala (Lockwood, 2016; Marsh et al., 2013), which are related to affective facets of empathy. Greater dispositional affective empathy has been associated with greater ACC and insula response to a loved one receiving a painful stimulus (Singer et al., 2004). Both dispositional affective and cognitive empathy have also been associated with anterior insula response to observing others in painful situations (Li et al., 2020). Better mentalizing skills have been associated with greater right TPJ activation during theory of mind tasks; right TPJ activation, however, has also recently been found to be associated with greater affective empathy (Knight et al., 2019). In sum, whereas the insula and right TPJ have been implicated in cognitive and affective facets of empathy, the ACC and amygdala are more frequently associated with affective facets of empathy.

We had four aims in this study. First, we investigated the association between mothers' dispositional and parental empathy (in relation to the focal child) when their infants were six months of age. Based on previous research (e.g., Salo et al., 2020), we hypothesized that these two forms of empathy will be moderately intercorrelated. Second, we examined whether mothers' dispositional and parental empathy, assessed when their infant was 6 months old, were associated with their child's social-emotional functioning as a toddler (~12 months later). Although we expected that both forms of empathy will be associated with toddler functioning, we hypothesized that parental empathy will be more strongly positively associated with toddlers' social-emotional competencies and more strongly negatively associated with toddlers' social-emotional problems than will dispositional empathy. Third, we tested the relative contributions of specific *aspects* of mothers' dispositional and parental empathy (i.e., affective and cognitive facets) to toddlers' social-emotional functioning. Finally, with a subset of the mothers, we explored the neural correlates of dispositional and parental empathy, including the affective and cognitive facets of each form of empathy. We used a passive movie-watching task to assess mothers' neural activation in response to characters experiencing different belief states ("mentalizing" scenes)—related to cognitive empathy—and depictions of physical pain ("pain" scenes)—related to affective empathy. We focused our analysis on brain regions that have been linked to empathy in prior studies (Feldman, 2015; Kim et al., 2016; Young et al., 2017): right TPJ, bilateral ACC, insula, and amygdala.

Methods

Participants and Procedure

We recruited 155 mother and their infants (mean infant age=6.14 ± 0.43 months) to participate in the Brain and Behavior Infant Experiences Study (BABIES), an observational longitudinal study of the association between perinatal experiences and infant and toddler psychobiological development (Humphreys et al., 2018; King et al., 2021). For the current study, dyads with complete mother-reported data were included in the analyses of mothers' empathy and toddlers' social-emotional outcomes (N=118). Further, we scanned a subset of these mothers (N=20 with usable data) to conduct our functional magnetic resonance imaging (fMRI) analyses of mothers' empathy. Detailed participant characteristics are presented in **Table 1**.

Time 1. At Time 1, when infants were approximately 6 months of age, 142 of the 155 mothers who were recruited reported their dispositional and parental empathy (see below). Mothers who expressed interest in participating in the MRI scan session were screened for eligibility and excluded for MRI contraindications, left-handedness, certain medical diagnoses or events (i.e., cancer, stroke, head injury with loss of consciousness or concussion, untreated migraine headaches, diabetes requiring insulin treatment, chronic kidney or liver disease, or neurological disorders), use of psychotropic, glucocorticoid, or hypolipidemic medications, and conditions affecting cerebral blood flow and metabolism (e.g., hypertension). Eligible mothers were asked to refrain from caffeine consumption and pain relievers 24 hours prior to the scan. MRI data were collected at the Lucas Center for Imaging at Stanford University.

Forty mothers participated in the MRI scan session. Mothers who were scanned did not differ from mothers who were not scanned in parental or dispositional empathy, toddler competencies or problems, infant negative emotionality, mothers' age, race, ethnicity, education, or income (*p*s≥.053); however, mothers who were scanned were more likely to have a male infant enrolled in the study (p=.010). Of the 40 mothers who were scanned, 11 were excluded from the neuroimaging analyses due to scanner technical difficulties, 6 for poor quality data, 1 for having previously seen the short movie, 1 for falling asleep during the task, and 1 for being left-handed. Scanned mothers with usable neuroimaging data did not significantly differ from scanned mothers without usable neuroimaging data in mother/infant race, ethnicity, age, mothers' education, annual income, dispositional empathy, parental empathy, or infants' temperament (i.e., negative emotionality) (ps>.176).

Time 2. Approximately 1 year after Time 1, 118 of the 142 mothers from whom we obtained empathy data at Time 1 completed an online follow-up assessment in which they reported on their toddlers' social-emotional functioning. Mothers who participated at Time 2 did not differ significantly from mothers who did not participate in toddler age or sex, or mothers' age, ethnicity, education, income, or dispositional or parental empathy (ps>.093); however, mothers who participated at Time 2 were more likely to identify as White (p=.033) and to have infants who were lower in negative emotionality at Time 1 (p=.026).

Measures

Dispositional Empathy

At Time 1, mothers completed the Interpersonal Reactivity Index (IRI) to assess dispositional empathy (Davis, 1983). The IRI has good test-retest reliability and converges well with other empathy measures (Davis, 1980). We used the perspective-taking (e.g., "I sometimes find it difficult to see things from the other guy's point of view" [reverse-scored]) and empathic concern (e.g., "I often have tender, concerned feelings for people less fortunate than me") subscales to assess dispositional cognitive and affective empathy, respectively. Participants rated each of the statements on a scale from 0 (*Does not describe me very well*) to 4 (*Describes me very well*). Each subscale includes seven items that were summed to yield scores for dispositional cognitive and affective empathy. We summed the perspective-taking and empathic concern subscale scores to generate a total dispositional empathy score. In our sample internal reliability was acceptable for both dispositional empathy subscales and for the total score (Cronbach's αs=.73-.78).

Parental Empathy

Mothers reported their parental empathy using the Parental Empathy Measure (PEM; Stern et al., 2015). The PEM consists of 25-items concerning participants' feelings and thoughts about their child. Mothers rated items on a scale ranging from 1 (*Not true at all*) to 5 (*Very true*). The measure includes a 14-item subscale assessing parental cognitive empathy (e.g., "When my child is happy, I can understand why") and an 11-item subscale assessing parental affective empathy (e.g., "When my child is upset, I feel concern for him/her") as well as a total parental empathy score (the sum of the two subscale scores). In our sample, internal reliability was acceptable for the parental empathy subscales and for the total score (Cronbach's αs =.73-.81).

Infant Temperament

Mothers reported on their infant's temperament using the Infant Behavior Questionnaire-Revised Short Form (IBQ-R-SF), a caregiver report measure of infant temperament validated for infants 3-12 months of age (Gartstein & Rothbart, 2013; Putnam et al., 2014). The IBQ-R-SF consists of 91 items on which parents rate the extent to which their infant exhibited various behaviors over the past 7 days on a Likert scale ranging from 1 (*Never*) to 7 (*Always*) and a separate choice for *Does not apply*. The IBQ-R-SF includes subscales of surgency/extraversion, negative emotionality, and orienting/regulatory capacity. In the present study we focused on the domain of negative emotionality (e.g., "When tired, how often did the baby show distress?") to include as a covariate in regression analyses given the documented associations of this domain with psychopathology in later life (Kostyrka-Allchorne et al., 2020). In our sample internal reliability was acceptable for the IBQ-R-SF negative emotionality subscale (Cronbach's α=.83).

Toddler Social-Emotional Competencies and Problems

Mothers completed an abbreviated version of the Infant–Toddler Social and Emotional Assessment (ITSEA; Carter et al., 2003). The ITSEA includes several subscales across four domains (internalizing, externalizing, dysregulation, and competence) and asks parents to rate the extent to which their child exhibits behaviors on a scale from 0 (*Not true/rarely*) to 2 (*Very true/often*). In the present study, we administered eight of the ITSEA subscales and computed a total score for social-emotional *problems* by summing the mean scores for internalizing (depression/withdrawal, general anxiety), externalizing (activity/impulsivity, aggression, defiance), and negative emotionality. We computed a total score for social-emotional *competencies* by summing the mean scores for the play, social-relatedness, and empathy subscales. Twenty-one percent of toddlers in our sample met the age- and gender-normed cutoffs for clinical concern. In our sample internal reliability was acceptable for the social-emotional problems and competencies variables (Cronbach's αs=.88 and .78, respectively).

Passive Animated Movie fMRI Task

Participants watched the animated short movie "Partly Cloudy" (Pixar Animation Studios) while undergoing functional MRI (fMRI) scanning (total movie time=5 min 36 sec). This short movie has been used to localize brain regions implicated in social cognitive processes (Jacoby et al., 2016), and movie events have been coded into 4 categories: "Control," "Mental," "Social," and "Pain"). Briefly, "Control" events were characterized by scenes without specific character-related events (e.g., scenes with birds flying; 3 events, 24 seconds total); "Mental" events induced the viewer to think about a character's thoughts (e.g., a character falsely believing he has been abandoned by his companions; 4 events, 44 seconds total); "Social" events involved characters interacting without engaging mental/emotional representation (e.g., stork and cloud playing; 5 events, 28 seconds); and "Pain" events depicted a character experiencing physical pain (e.g., character bitten by crocodile; 7 events, 26 seconds total). The remainder of the movie was not coded for scenes and, therefore, was not included in analyses, resulting in a total of 122 seconds of coded scenes.

fMRI Acquisition, Preprocessing, and Cluster Correction

MRI scans were conducted on a GE Discovery MR750 scanner (GE Medical Systems, Milwaukee, WI) equipped with a 32-channel head coil (Nova Medical). We collected fast spoiled gradient echo (FSPGR) T1-weighted sagittal anatomical images (repetition time [TR]=8.2 ms, slice thickness=1, scan time=5 min 6 sec) to be used for alignment and registration of functional images. Task-based blood oxygen level dependent (BOLD) fMRI data were acquired using T2*-weighted oblique slices aligned to the anterior and posterior commissure (TR=2000 ms, echo time [TE]=30 ms, flip angle=77°, voxel size=.90 mm^3, slices=32, slice thickness=4.0 mm, scan time=4 min 50 sec). We applied higher-order shims prior to the movie-watching task to decrease magnetic field inhomogeneities (Kim et al., 2002).

All functional images were preprocessed and analyzed in AFNI (Cox, 1996). Preprocessing included slice timing and motion correction, alignment to anatomical images, removal of first 5 TRs to allow for magnet stabilization (blank screen before start of movie), spatial normalization (MNI 152T1), spatial blurring (5mm FWHM isotopic Gaussian kernel), and censoring volumes with head motion greater than 0.5 mm from the previous volume. Any participant with more than 20% of their volumes censored would be dropped from analyses; however, no participant met this cutoff threshold.

Regions of Interest

We examined associations of the empathy measures with BOLD fMRI signal during mentalizing (Mental>Control) and pain (Pain>Control) contrasts in regions of interest (ROIs) based on previous findings (i.e., ACC, right TPJ, insula, and amygdala) (Decety, 2015; Lockwood, 2016). We created the amygdala ROI mask using the Brainnetome atlas (Fan et al., 2016), the ACC and insula masks using the Eickhoff-Zilles macro labels N27 atlas (Eickhoff et al., 2005, 2006, 2007), and the right TPJ mask using the MNI Glasser HCP atlas (Glasser et al., 2016) by combining the three temporo-pariento-occipital junction ROIs. We resampled ROIs to subject space prior to analyses and used AFNI's *3dmaskave* to extract beta parameters from each ROI for both contrasts of interest. ROI masks are presented in **Figure 1**.

Data Analysis

First, we conducted Pearson's correlations to examine the associations among mothers' total dispositional and parental empathy scores and toddlers' social-emotional competencies and problems. Second, we conducted ordinary least squares (OLS) regression analyses to test whether mothers' empathy was associated with toddlers' social-emotional outcomes (i.e., competencies and problems) after adjusting for covariates. In the first set of linear regression models, we included dispositional and parental empathy to test whether one form of empathy was significantly associated with toddlers' outcomes after controlling for the other form. We included infant temperament (negative emotionality) as a covariate. In the second set of models, we included all four empathy subscales in the model (i.e., parental cognitive empathy, parental affective empathy, dispositional cognitive empathy, dispositional affective empathy) along with infant temperament to examine whether specific aspects of empathy were associated with toddler functioning. We corrected for multiple comparisons by setting the threshold for statistical significance for these analyses at $p<.025$ (.05/2) to account for the two *a priori* tests. Finally, we conducted Pearson's correlations to explore potential associations between ROI activations (i.e., bilateral ACC, amygdala, insula, and right TPJ) during the two movie contrasts probing cognitive and affective empathy (i.e., Mental>Control, Pain>Control), respectively, and mothers' dispositional and parental empathy and their facets. All statistical tests were performed in R v. 4.0.3 (R Core Team, 2020).

Results

Correlations Among the Measures of Maternal Empathy and Offspring Functioning

Correlations among measures of mothers' empathy, infant temperament, and toddler social-emotional competencies and problems are presented in **Table 2**. As we hypothesized, mothers' dispositional empathy was significantly correlated with their parental empathy (r=.44, p<.001, 95%CI[0.28, 0.58]). Higher self-reported dispositional and parental empathy in mothers at Time 1 was associated with more social-emotional competencies (r=.21, p=.022, 95%CI[0.03, 0.38], and r=.29, p=.001, 95%CI[0.12, 0.45], respectively) and fewer social-emotional problems in toddlers at Time 2 (r=-.21, p=.023, 95%CI[-0.38, -0.03], and r=-.34, p<.001, 95%CI[-0.49, -0.17], respectively).

Mothers' Total Dispositional and Parental Empathy and Toddlers' Social-Emotional Functioning

After controlling for mothers' dispositional empathy and infant temperament at Time 1, OLS linear regressions revealed that higher parental empathy in mothers was significantly associated both with more social-emotional competencies (β=.233, p=.025) and with fewer problems (β=-.028, p=.012) in toddlers at Time 2. In contrast, when controlling for mothers' parental empathy and infant temperament, dispositional empathy was not significantly associated with either toddlers' competencies or problems (ps>.05). See **Table 3** for detailed statistics of these analyses.

Mothers' Cognitive and Affective Empathy and Toddlers' Social-Emotional Outcomes

We conducted exploratory linear regression analyses to examine whether cognitive or affective facets of parental and dispositional empathy were associated with toddler outcomes by including all four empathy subscales, assessed at Time 1 (and infant temperament as a covariate), in two models: one examining toddlers' social-emotional competencies and the other examining toddlers' problems. No dispositional empathy subscale was associated with either toddlers' competencies or problems following multiple comparisons correction (ps≥.033). Higher self-reported *parental cognitive* empathy in mothers predicted fewer social-emotional problems in toddlers (β=-.060, p<.001); no other parental empathy subscale was associated with either competencies or problems (ps>.05). Scatterplots of the unadjusted correlations between mothers' parental empathy and toddlers' social-emotional competencies and problems are presented in **Figure 2**. Detailed statistics from these models are presented in **Table 4**.

Neural Correlates of Mothers' Empathy During Mentalizing and Pain Scenes

Higher *total parental* empathy in mothers was associated with greater right TPJ activation during pain scenes (r=.59, p=.006, 95%CI[0.19, 0.99]); no other association between mothers' total dispositional or parental empathy and ROI activation during mentalizing or pain scenes was significant (*r*s≤.38, *p*s>.05).

When we examined specific facets of each form of empathy, we found that higher *dispositional cognitive* empathy was associated with greater activation during mentalizing scenes in the bilateral ACC (*r*=.50, *p*=.025, 95%CI[0.07, 0.93]) and insula (*r*=.45, *p*=.048, 95%CI[0.00, 0.89]). In addition, higher *parental affective* empathy was associated with greater bilateral insula activation during mentalizing scenes (*r*=.51, *p*=.021, 95%CI[0.09, 0.94]) and with greater bilateral insula (*r*=.48, *p*=.034, 95%CI[0.04, 0.91]) and right TPJ (*r*=.58, *p*=.008, 95%CI[0.17, 0.98]) activation during pain scenes. No other empathy subscale was associated with ROI activation during either contrast (rs≤.42, *p*s>.05).

Discussion

The present study was designed to investigate whether mothers' parental (child-specific) empathy is dissociable from mothers' dispositional (other-specific) empathy by examining whether the two constructs have distinct effects on children's social and emotional functioning and whether they are supported by distinct neural correlates. In a sample of 118 mother–infant dyads, we found that dispositional and parental forms of empathy in mothers are moderately intercorrelated. Mothers' parental empathy when their infants are 6-months-old predicts toddlers' social-emotional functioning one year later, controlling for dispositional empathy and infant temperament. Higher levels of mothers' parental cognitive empathy, specifically, predicts fewer social-emotional problems. Finally, dispositional and parental empathy have both unique and shared patterns of brain activation in the bilateral insula, ACC, and right TPJ during a passive movie-watching task involving mentalizing and pain scenes.

Prior studies have found that individual differences in mothers' empathy and empathy-related constructs are associated with children's social-emotional outcomes (e.g., Kochanska et al. 2004; Manczak et al., 2016); however, much of this research has focused on mothers' dispositional empathy and has not distinguished this general form of empathy from mothers' (parental) empathy towards their own child. Our findings indicate that empathy specific to one's child is a stronger predictor of toddlers' social-emotional outcomes than is dispositional empathy. Although both higher dispositional and parental cognitive empathy were initially associated with fewer social-emotional problems, only the latter survived multiple comparisons correction and had a larger effect (dispositional cognitive empathy: β=-.045; parental cognitive empathy: β=-.060). Our results highlight the role that parental cognitive empathy, in particular, plays in protecting toddlers from developing social-emotional difficulties, and, as such, may represent a specific target for early interventions.

It is important to ask why mothers' parental empathy is associated more strongly with toddlers' social-emotional outcomes than is their dispositional empathy. Consistent with past work (Salo et al., 2020), we found that dispositional and parental empathy are only moderately correlated. One clear distinction is the target of empathy—by definition, parental empathy focuses on one's own infant, which requires sensitivity and attunement to infant cues. In contrast, dispositional empathy calls for one to empathize with others more generally, which may require different psychological processes. Caregivers must accurately identify and address an infant's interests, desires, or needs; those who are more sensitive to these needs (e.g., who are able to take the perspective of the infant) may be more likely to meet the infant's needs and foster a relationship that benefits the child's social-emotional development (Leerkes, 2010; van den Boom, 1994).

With respect to parental empathy, we found that after controlling for infant temperament, mothers' parental cognitive empathy was more strongly associated with toddler outcomes (i.e., social-emotional problems) than was mothers' parental affective empathy. In previous work, researchers have found that mothers' "parental mind-mindedness," or tendency to view their child as a mental agent with thoughts, feelings, and desires during the first several months of life (Meins et al., 2003), is associated with better executive functioning at 18 and 26 months (Bernier et al., 2010) and with fewer behavioral difficulties at 44 and 61 months (Meins et al., 2013). Cognitive empathy processes are posited to be one of the key mechanisms supporting caregiving behaviors across different relationships (Batson, 1991). Parenting styles and behaviors that are implicated in early social-emotional development, such as mothers' sensitivity to infant distress (Leerkes et al., 2009), may distinguish mothers who regularly engage in theorizing about the minds of their infants at this early age from mothers who do not; however, this hypothesis would require explicit testing. Finally, parents who reflect on the thoughts, feelings, and motives that underlie their infant's behaviors may also be more likely to have securely attached children (Meins et al., 2001; Stern et al., 2015; Symons & Clark, 2000), which may mediate the relation between parental cognitive empathy and subsequent social-emotional adjustment. Taken together, our findings build on previous research to underscore the distinct and important role of parental empathy during an infant's first year of life in promoting healthy social-emotional development in toddlerhood.

An exploratory aim of this study was to leverage an fMRI movie-watching task to investigate the neural correlates of dispositional and parental empathy in mothers. Researchers have found that individual differences in mothers' empathy and empathy-related processes are associated with neural activation in regions implicated in salience processing and social cognition (Elmadih et al., 2016; Lenzi et al., 2009). Although most neuroimaging studies with mothers have focused on neural responses to infant cues, such as facial and vocalic expressions (Bornstein et al., 2017; Lenzi et al., 2009; Zhang et al., 2020), we implemented a movie-watching task that has previously been used as an empathy-localizer in order to assess neural responses to scenes that depicted mentalizing processes or physical pain to probe specific dimensions of empathy (i.e., cognitive and affective processes, respectively). Interestingly, we found that higher total parental empathy in mothers was associated with greater right TPJ activation during pain scenes, which appeared to be driven by parental *affective* empathy, given that activation in this ROI was not associated with cognitive empathy. Although the right TPJ is typically regarded as a region central to cognitive empathy, recent studies have also implicated right TPJ functioning in affective empathy processes (Knight et al., 2019; Miller et al., 2020). It is possible that right TPJ activation is related differentially to facets of empathy across development; that is, right TPJ activation may underlie *affective* empathy processes directed toward infants but, over time, may also contribute to *cognitive* processes as the target of empathy develops cognitive processes with which the empathizer might relate. Notably, right TPJ activation was not associated with total dispositional empathy or its facets in our sample.

During both mentalizing and pain scenes, greater bilateral insula activation was associated with higher *parental affective* empathy, and with higher *dispositional cognitive* empathy during mentalizing scenes. Given the involvement of this region in salience processing (Menon & Uddin, 2010), our results suggest that the insula broadly supports different forms and facets of empathy. This is consistent with research showing that mothers who demonstrated greater ability to represent others' mental states (i.e., cognitive empathy) also had greater insula activation in response to images of infants' emotional faces (Lenzi et al., 2009), implicating this structure in cognitive and affective processes when considering both others in general and infants specifically. Previous studies have also reported greater insula activation when observing others in pain (Lockwood, 2016; Singer et al., 2004). It is important to note, however, that the insula is a large structure, and different insular subregions may support these various forms and facets of empathy.

Finally, although researchers have found that the ACC responds when participants observe others in pain (Li et al., 2020; Marsh et al., 2013; Singer et al., 2004), we found that greater ACC activation was associated with empathy (dispositional cognitive empathy, specifically) only during *mentalizing* scenes. A recent meta-analysis found that the ACC was *not* involved in mentalizing but was implicated in "grasping and sharing others' emotional and sensory feelings," which the study authors referred to as 'empathy' (Arioli, Cattaneo, Ricciardi, & Canessa, 2021). Although the ACC (in an empathy context) is typically associated with experiencing and witnessing pain (Morrison, Lloyd, Di Pellegrino, & Roberts, 2004), others have also described the ACC in the context of mentalizing (Frith & Frith, 2021; Zaki & Ochsner, 2012). Similar to the insula, the ACC is a large structure with various subregions that are associated with different cognitive, affective, and motivational processes (Botvinick, Cohen, & Carter, 2004; Bush, Luu, & Posner, 2000; Holroyd & Yeung, 2012). Thus, a study with a larger neuroimaging sample may be able to better differentiate the involvement of specific insula and ACC subregions in various forms and facets of empathy processes.

Taken together, our findings suggest that some brain regions involved in both forms of empathy are functionally dissociable. Whereas right TPJ activation was specific to parental empathy, the bilateral ACC was specific to dispositional empathy, lending support to the formulation that dispositional and parental empathy can be meaningfully differentiated. Conversely, bilateral insula activation was associated with both parental and dispositional empathy; thus, this region may play an important role in processes that are shared across different forms of empathy. It is important to note that these associations involving neuroimaging data are based on a much smaller sample than our behavioral analyses of mothers' empathy and toddler social-emotional outcomes. Therefore, while informative, these neuroimaging findings and the corresponding interpretations should be viewed as preliminary.

We should note four limitations of this study. First, we used mother-report measures of parental empathy and toddler social-emotional outcomes, and shared method variance may have contributed to some of our findings; however, this would not explain stronger and weaker associations among these constructs in this study. Second, the participants in the sample were generally highly educated, high in socioeconomic status, and largely identified as White; it is not clear whether our findings generalize to more diverse samples, underscoring the need in future research to recruit diverse, representative study samples. Third, our study, like many others, focused on the mother as the primary caregiver of interest. Future research will benefit from considering other caregivers (e.g., fathers; childcare providers) in assessing the role of caregiver empathy in adult–infant relationships and subsequent child development. Finally, the relatively small sample size for our neuroimaging analysis limited our ability to detect more statistically robust links between mothers' empathy and neural activation.

Despite these limitations, however, our study also had several notable strengths. First, we recruited a large sample and assessed multiple forms and facets of empathy (i.e., dispositional and child-directed; cognitive and affective dimensions). Second, the longitudinal design of our study enabled us to test prospective associations between mothers' empathy when their infants were 6 months old with social-emotional competencies and problems in these children one year later, at 18 months of age. Third, we used multimodal approaches which largely converged with our hypothesis that dispositional and parental empathy in mothers are dissociable in terms of both behavioral outcomes in children and neural correlates of these forms of empathy. By using an empathy localizer fMRI task to examine relevant brain regions involved in social cognitive and affective processes, we were able to identify both shared and distinct neural correlates of dispositional and parental empathy in mothers. Finally, our findings raise the possibility of developing novel interventions. Specifically, although dispositional empathy has received considerable attention for its role in interpersonal relationships (e.g., Håkansson & Montgomery, 2003; Joireman, Needham, & Cummings, 2002; Reynolds & Scott, 1999), our findings underscore the importance of fostering infant-directed (parental) empathy, with an emphasis on cognitive dimensions, to promote healthy child development.

Our findings raise several possibilities for further studies, including testing hypotheses that investigate possible mechanisms linking mothers' parental cognitive empathy to reduced risk of social-emotional problems, which may include infant-directed language use during early life. Recognizing and taking young infants' perspectives likely plays an important role in supporting healthy social-emotional development during early life. In the present study we could not identify neural correlates that were specific to mothers' parental cognitive empathy; this finding should be replicated and expanded upon in a larger study examining broader neural circuitry.

Our behavioral and neuroimaging findings converge to suggest that although dispositional and parental empathy are related constructs that share neural correlates, they are also dissociable constructs that have different associations with children's early social-emotional development. Taken together, our findings underscore the potential role of parental cognitive empathy during the first year of an infant's life in protecting against social-emotional problems during toddlerhood, an important developmental period for the application of targeted interventions with young children at highest risk for social-emotional dysfunction.

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Tables

Table 1. Study Sample Characteristics

		Empathy analysis (*N*=118)	**Included in fMRI analysis (*N*=20)**
Demographics			
Mother age, mean ± *SD* years		33.51 ± 4.47	32.12 ± 3.91
Mothers' race			
	White	75	13
	Asian American	27	5
	Black/African American	3	0
	Native Hawaiian/Pacific Islander	3	0
	American Indian or Alaska Native	0	0
	Other/More than One Race	10	2
Mothers' ethnicity			
	Hispanic or Latina/x	17	4
	Not Hispanic or Latina/x	101	16
Mothers' education			
	Some high school	0	0
	High school diploma/GED	1	0
	Some college, no degree	7	1
	Associate degree	3	1
	Trade/technical school	3	0
	Bachelor's degree	38	9
	Graduate degree	66	9

Annual household income			
	Less than $5,000	0	0
	$5,001-15,000	1	0
	$15,001-30,000	4	1
	$30,001-60,000	14	2
	$60,001-90,000	9	1
	$90,001-150,000	32	4
	More than $150,000	57	12
	Decline to state/missing	2	0
Infant age, mean ± *SD* months		6.13 ± 0.43	6.04 ± 0.32
Infant race			
	White	71	12
	Asian American	24	5
	Black/African American	3	1
	Native Hawaiian/Pacific Islander	1	0
	American Indian or Alaska Native	0	0
	Other/More than One Race	91	2
Infant ethnicity			
	Hispanic or Latina/o/x	21	4
	Not Hispanic or Latina/o/x	96	16
	Decline to state	1	0
Infant sex			
	Male	57	11
	Female	61	9
Scales			
IBQ-R-SF			

	Negative emotionality	3.10 ± 0.74	3.03 ± 0.70
IRI			
	Perspective-taking	19.78 ± 3.91	19.40 ± 4.68
	Empathic Concern	21.55 ± 3.81	20.65 ± 3.95
	Dispositional Empathy	41.33 ± 6.20	40.05 ± 6.90
PEM			
	Cognitive empathy	63.31 ± 5.39	63.55 ± 5.42
	Affective empathy	47.79 ± 4.47	48.35 ± 4.46
	Total empathy	111.17 ± 8.10	111.85 ± 7.96
ITSEA			
	Competencies	4.10 ± 0.79	4.23 ± 0.74
	Problems	1.73 ± 0.91	1.43 ± 0.52

Table 2. Zero-Order Correlations Between Mothers' Empathy, Infant Temperament, and Toddler Outcomes Variables.

	2	3	4	5	6	7	8	9
1. Dispositional empathy (total)	**.81*****	**.80*****	**.44*****	**.35*****	**.42*****	**.21***	**-.21***	-.07
2. Dispositional cognitive empathy		**.29****	**.25****	.18	**.27****	.15	**-.22***	.04
3. Dispositional affective empathy			**.46*****	**.38*****	**.40*****	**.19***	-.11	-.15
4. Parental empathy (total)				**.84*****	**.85*****	**.29****	**-.34*****	**-.25****
5. Parental cognitive empathy					**.44*****	**.24****	**-.41*****	**-.31*****
6. Parental affective empathy						**.26*****	**-.20***	-.12
7. ITSEA competencies							-.14	-.11
8. ITSEA problems								**.26****
9. Infant negative emotionality								

Note. ****p*<.001, ***p*<.01, **p*<.05. Values reported are Pearson's correlation coefficients.

Table 3. Regression Models Testing Mothers' Dispositional and Parental Empathy at Time 1 Predicting Toddlers' Social-Emotional Competencies and Problems at Time 2

Model 1 Predicting Social-Emotional Competencies	B	SE	β	95%CI	*p*
Intercept	1.141	1.120	< .001	[-.18, .18]	> .999
Infant Negative Emotionality	-.043	.099	-.040	[-.22, .14]	.663
Dispositional Empathy	.014	.013	.106	[-.09, .30]	.290
Parental Empathy	.023	.010	.233	[.03, .44]	**.025**
Model 2 Predicting Social-Emotional Problems	**B**	**SE**	**β**	**95%CI**	***p***
Intercept	4.670	1.237	< .001	[-.17, .17]	> .999
Infant Negative Emotionality	.233	.109	.191	[.01, .37]	.035
Dispositional Empathy	-.012	.014	-.085	[-.28, .11]	.378
Parental Empathy	-.028	.011	-.253	[-.45, -.06]	**.012**

Note. B, unstandardized beta. SE, standard error associated with unstandardized beta. β, standardized beta. *p*, p-value. Bolded p-values indicate significant associations after correcting for multiple comparisons.

Table 4. Regression Models Testing Mothers' Cognitive and Affective Empathy at Time 1 Predicting Toddlers' Social-Emotional Competencies and Problems at Time 2

Model 3 Predicting Social-Emotional Competencies	B	SE	β	95%CI	*p*
Intercept	1.186	1.111	<.001	[-.18, .18]	> .999
Infant Negative Emotionality	-.045	.102	-.042	[-.23,.15]	.658
Dispositional Cognitive Empathy	.015	.019	.075	[-.11, .15]	.434
Dispositional Affective Empathy	.010	.022	.047	[-.16, .25]	.651
Parental Cognitive Empathy	.019	.016	.131	[-.08, .34]	.227
Parental Affective Empathy	.028	.019	.156	[-.05, .37]	.142
Model 4 Predicting Social-Emotional Problems	**B**	**SE**	**β**	**95%CI**	***p***
Intercept	5.349	1.178	< .001	[-.16, .16]	> .999
Infant Negative Emotionality	.209	.108	.171	[.00, .35]	.056
Dispositional Cognitive Empathy	-.045	.021	-.192	[-.37, -.02]	.033
Dispositional Affective Empathy	.026	.023	.110	[-.08, .30]	.256
Parental Cognitive Empathy	-.060	.017	-.355	[-.55, -.16]	**< .001**
Parental Affective Empathy	-.004	.020	-.017	[-.21, .18]	.859

Note. B, unstandardized beta. SE, standard error associated with unstandardized beta. β, standardized beta. *p*, p-value. Bolded p-values indicate significant associations after correcting for multiple comparisons.

Figures

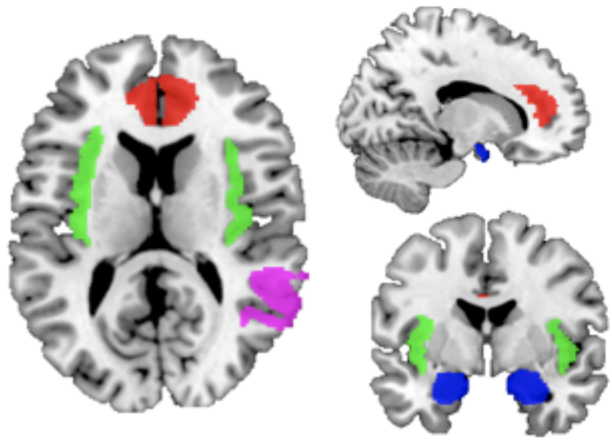

Figure 1. Regions of interest. Labels: red, anterior cingulate cortex; green, insula; violet, right temporoparietal junction; blue, amygdala.

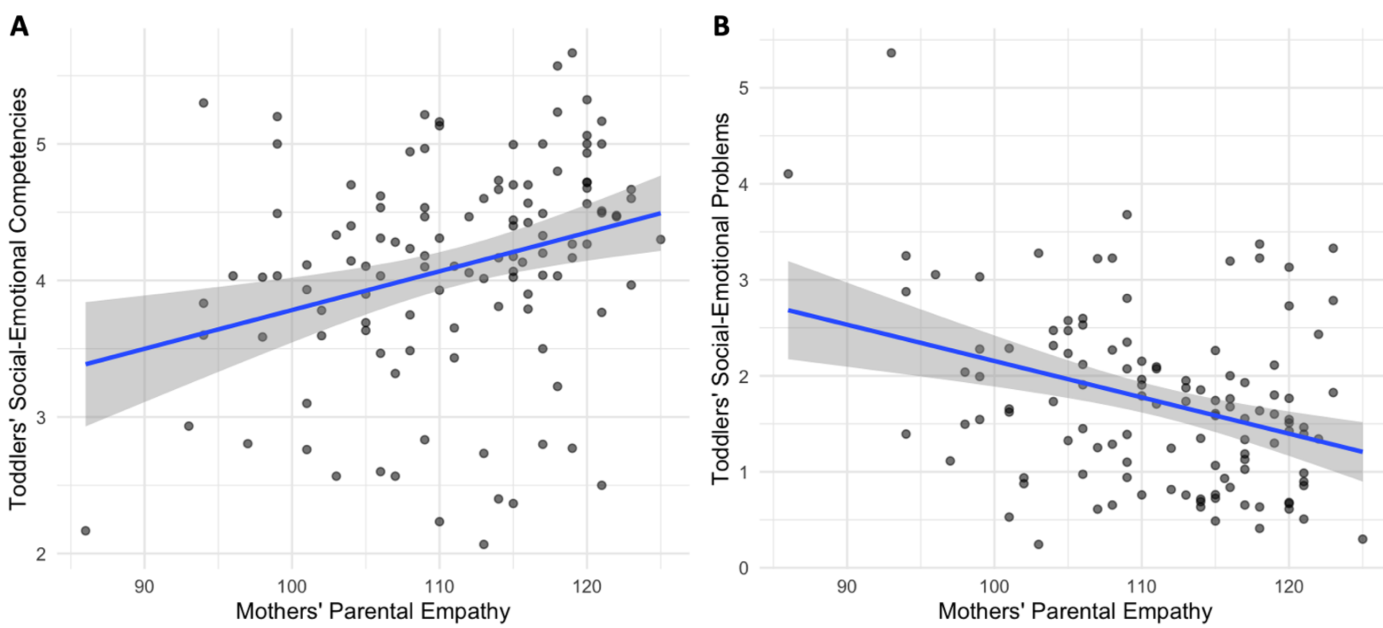

Figure 2. Scatterplots of mothers' total parental empathy at Time 1 and toddlers' social-emotional (a) competencies and problems (b) at Time 2.