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When do children begin to care for others? The ontogenetic growth of empathic concern across the first two years of life

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ABSTRACT

Empathic concern for others plays a central role for human cooperation and is proposed to be key in moral development. Developmental theories disagree on the age of emergence of empathic concern in human ontogeny and the factors supporting its early development. To assess different theoretical views, the current study longitudinally assessed infants' (N = 127) reactions towards an experimenter and their mothers simulating pain at 6, 10, 14, and 18 months. As an emotional control condition, infants' reactions towards a laughing experimenter were assessed. Maternal sensitivity, children's temperamental emotionality, and self-recognition were included as predictors. True intraindividual change models were applied to capture the growth of empathic concern in early development. Overall, there were minor and inconsistent differences in children's responses to laughing and crying others in the first year of life, whereas clear differences emerged in the second year. At 6 months, scale values of empathic concern were significantly related to measures of infant distress suggesting that infants experience emotional contagion and not veridical empathic concern. At 18 months, children's concern towards the experimenter was related to their concern towards their mother. Maternal sensitivity, negative emotionality and self-recognition were related to children's empathic concern within the second year. These findings suggest that empathic concern emerges in the second year and point to a gradual emergence of concern for others in human ontogeny.

Concern for others is a key element in human life as it connects people through an emotional bond and supports social functioning (Brownell, 2016; Carpendale & Hammond, 2016; Hoffman, 2000). It is evident in a variety of forms of prosocial behavior (Dunfield, 2014) that emerge in the first years of life (e.g., Aitken et al., 2020; Brazzelli et al., 2022; Carpendale et al., 2013; Hammond, 2014) and gains breadth in the course of early childhood (Dahl & Paulus, 2019). A central aspect of concern for others is empathic concern (Brazzelli et al., 2021; Davidov et al., 2021; Eisenberg et al., 1996; Spinrad & Gal, 2018). Developmental science and moral psychology has therefore great interest in understanding how empathic concern emerges in human ontogeny (Eisenberg et al., 2006).

Empathic concern (sometimes also labeled sympathetic concern or concern for others) can be described as "an other-oriented emotional response congruent with the perceived welfare of someone in need" (Decety & Svetlova, 2012, p. 1). Empathic concern or sympathy does not describe the situation of having the same feeling as another, but rather describes someone having a feeling of

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sorrow or concern for the other (Eisenberg et al., 2006). Theoretical models propose that empathic concern builds on empathy that is described as an affective response resulting from the comprehension of another's state that is to some extent similar to what the other person is feeling (Eisenberg, 2000). Empathy thereby constitutes an affective state in which the individual understands the other person as being the source of its own state (Bischof-Köhler, 1989, 1994). Empathy is a multifactorial construct that includes both cognitive and affective facets (Eisenberg et al., 2006): Inquiry and apprehension of another's conditions or needs reflect the cognitive facet of empathy, whereas the ability to experience emotional resonance with another's emotions reflects the affective facet of empathy (Davis, 1983). Comprehending the other's state can give rise to feelings of concern that, in turn, can motivate prosocial behavior (Malti et al., 2009; Paulus et al., 2017).

In contrast, emotional contagion (or affective resonance) describes a state in which an individual shares the same affective state as another without understanding the other as being the source of one's own state. It is assumed that mere contagion or affective resonance rather leads to self-distress and subsequently an egocentric response without considering the other (Batson, 1991). From a developmental perspective, the tendency to be aroused (or affected) by others may constitute a first step or a building block in the development of true empathy and subsequently concern for others (Bischof-Köhler, 1989, 1994). Stress-feelings like disturbance or anxiety can also emerge at later ages if one is not able to shift the focus from oneself to the suffering person. This constitutes a self-focused distress response (Batson et al., 1987; Nichols et al., 2015; Roth-Hanania et al., 2011; Zahn-Waxler et al., 1992). Therefore, self-distress is not considered to be an empathic response and displays the absence of concern for the other. Self-distress rather leads to self-comforting behavior than to comforting behaviors towards the victim (Zahn-Waxler et al., 1992). Summing up, empathy differs from mere emotional contagion as it comes with the apprehension of the other's state. It can lead to empathic concern (or concern for the other), which in turn constitutes a motivation for prosocial behavior. Given its basis in genuine concern for the other, it is assumed to represent true altruism (Dahl & Paulus, 2019).

1. The onset of empathic concern

When exactly do empathy and empathic concern emerge in humans? Some researchers assume humans to be born with a disposition to feel for others. This disposition is proposed to constitute an evolutionary advantage that makes them better parents and social group members (Bazalgette, 2017; de Waal & Preston, 2017). Others challenge this assumption and claim empathy not to be present from early on but to develop over time (Heyes, 2018). Empirical research has attempted to speak to this debate. For example, studies demonstrated that new-borns react to another baby's crying sound with own crying (Sagi & Hoffman, 1976; Simner, 1971). Yet, Hoffman, (1984, 2000) has highlighted that this behavior constitutes a self-distress reaction as infants are overwhelmed by the other's emotion rather than real empathic concern. Similarly, recent research demonstrated the transfer of arousal based on physiological processes (Fawcett et al., 2016, 2017). Arousal is considered to be a building block in the emergence of concern for others, but is not equivalent with empathic concern. When does empathy then develop? One line of developmental theorizing proposed that empathic behavior emerges during the second year of life, based inter alia on the emergence of self-other differentiation (Bischof-Köhler, 2012; Hoffman, 1984, 2000; Zahn-Waxler & Radke-Yarrow, 1990). This theoretical view has received support by a set of empirical studies (Knafo et al., 2008; Nichols et al., 2009; Young et al., 1999; Zahn-Waxler et al., 1992).

More specifically, empathy has been claimed to be based on the ability to psychologically differentiate between oneself and the other person, accompanied by the ability to take the perspective of the other person. That is, related to the onset of self-other differentiation in the second year of life children should show a decrease in personal distress and an increase in empathic behaviors when seeing another person's suffering (Bischof-Köhler, 2012; Zahn-Waxler & Radke-Yarrow, 1990; Zahn-Waxler et al., 1992). Self-other differentiation is measured by the classical rouge test (Amsterdam, 1972). In this test, children are placed in front of a mirror with a red dot on their nose to see if they already recognize themselves – an ability that is indicated by their touching their nose. In one influential study, Zahn-Waxler and colleagues (1992) used this test in combination with different stress simulation conditions (like respiratory distress or pain induced by bumping one's foot or head) reported from home. Additionally, the researchers tested reactions towards strangers in simulated pain at 18, 21, and 24 months. The data indicated that the development of self-recognition is linked to empathic behavior like showing concern towards others' negative emotion or trying to help others.

However, two recent studies claim that first signs of empathic behavior are evident already before the second year (Davidov et al., 2021; Roth-Hanania et al., 2011) – long before children are able to show self-recognition. Davidov and colleagues (2021) analysed the reaction of 165 infants from 3 to 18 months in two classical conditions frequently used in empathy research: a simulated pain-suffering-condition by their mothers and by the experimenter, who hurt themselves by bumping their knee or hitting their finger with a block, and a peer distress simulation on video. They reported that infants showed subtle reactions to others in pain or distress, and interpreted these reactions as evidence for early empathic concern. Interestingly, in an impressive longitudinal assessment, the authors showed that individual differences in infants' reactions to suffering others were predictive for prosocial behavior at 18 months (Davidov et al., 2021), the development of externalizing behavior between 18 and 36 months (Paz et al., 2021) as well as positive developmental outcomes such as positive peer relations and affective knowledge (Paz et al., 2022). The authors argue that an implicit self-awareness – assumed to be present from very early on – seems to be sufficient in order to understand that the negative emotion is coming from another person and not from the self. Therefore, they reject developmental theories that propose that true empathic concern emerges in the second year of life and that an explicit self-concept plays a central role (e.g., Hoffman, 2000), and instead claim that empathic concern arises already within the first months of life.

Yet, a closer inspection of the coding strategy used by this line of empirical work reveals that these very early signs of empathy were mostly based on small facial changes (for concern) or attentional shifts (for inquiry behavior). For example, the presence of concern for victims was coded based on a "slight change in facial expression (usually at a low intensity), including sobering, brow furrow, or sad

expression“ (Davidov et al., 2021, p. 17). Yet, these signs are so subtle that they are subject to multiple interpretations. For example, brow furrows are unspecific facial reactions that are seen as established indicators of surprise reaction (e.g., based on raising the brows; Reisenzein et al., 2013). Similarly, sad expression could be the result of emotional contagion rather than empathic concern for the other (Hoffman, 2000). Thus, the question arises if those reactions are real indicators of empathic concern or if they are rather undifferentiated reactions to a surprising emotional situation or indicators of own negative emotional states. Taken together, it is not clear whether the subtle facial changes can be accepted as indicators of true empathic concern, or whether they rather detect general arousal or surprise reactions. Next to conceptual analyses, one possibility to advance this debate is to provide empirically data on the type of situations in which children show the different facial signs and reactions.

Indirect evidence that these early signs constitute surprise reactions or general arousal comes from other studies: Nichols and colleagues (2015) pointed out that 12-month-olds discriminated between a crying infant doll and a content, neutral one, but showed no particular interest in both before 18 months. Beyond that, there is little work comparing young children's responses to suffering others with their responses in control conditions. Davidov and colleagues (2021) used an emotionally neutral situation in which mothers read a book aloud as a control condition. Yet, this condition is not comparable in terms of emotionality or the presentation of a surprising event. Interestingly, Ruffman et al. (2019) characterized the responses of 2-year-olds to videos of crying babies as reactions to aversive stimuli rather than true empathy, because children's expressed extent of happiness in comparison to the extent of sadness did not differ to a control condition with a video of white noise. Moreover, the children showed significantly more happiness in the second control condition in which a laughing baby was presented. This study represents a first effort to tease apart true empathic concern to others' suffering from unspecific responses. However, the study lacks a perspective on early ontogeny of empathy and a specific coding of empathic concern. Finally, using a different setup, Walle et al. (2020) demonstrated that 16-, 19-, and 24-month-old toddlers hardly showed comforting towards a person who expressed joy and only the oldest age group showed noticeable comforting towards a sad other. Some of the younger children engaged in comforting towards an angry person. This suggests that young children react differently to different emotion displays (see also Walle et al., 2017) and suggests that a comparison to a laughing other is helpful to differentiate true empathic concern from other reactions. Overall, it remains an open question from what age children react with empathic concern, specifically towards a suffering other but not to an otherwise emotional other.

In particular with respect to the ontogenetic onset of empathic reactions, such as empathic concern, it would be interesting to explore the psychological factors that contribute to their emergence. In the following, we will focus on two factors that play a central role in developmental theorizing.

2. Impact of maternal sensitivity on children's empathy development

According to Hoffman's developmental theory (1984, 2000) and attachment theoretical considerations (Stern & Cassidy, 2018; Thompson, 2019), the development of empathy is supported by maternal behaviors, most notably by sensitive and attuned caregiving. This view is encouraged by a wealth of research focusing on how the experiences in early caregiving relationships promote children's' developing abilities to show empathic behavior towards others (Brownell, 2013).

From an attachment theory perspective, Ainsworth et al. (1978) defined maternal sensitivity primarily as the ability to notice the child's signals, interpret those correctly and respond appropriately. Biringen (2008) enriched the concept of sensitivity with the aspects of warmth and proper reactions to emotional cues of the infant. From experiences of receiving sensitive care, infants develop secure internal working models of their caregiver (expectations of responsiveness when needed), which then generalize to other social partners (Bowlby, 1969; Stern & Cassidy, 2018). Current approaches suggest that a core component of secure internal working models are "secure based scripts" – a set of if-then contingencies regarding how distress is responded to in close relationships (Waters & Waters, 2006). Children with insecure internal working models are claimed to have experienced insensitive or inconsistent caregiving, an expectation that others may not be available when needed. Indeed, sensitive caregiving and attachment security have been linked to appropriate affective arousal and adequate regulation of one's own emotions in stressful situations, which predicts toddlers' and preschoolers' empathic responses (Brett et al., 2020; Daniel et al., 2016; Kestenbaum et al., 1989; Kiang et al., 2004; Murphy & Laible, 2013; Panfile & Laible, 2012; Spinrad & Stifter, 2006).

A considerable amount of literature has supported the link between maternal sensitivity or maternal warmth and empathic behavior (Barnett, 1987; Kiang et al., 2004; Spinrad & Stifter, 2006; Zahn-Waxler & Radke-Yarrow, 1990) as well as emotion regulation in children. In longitudinal studies, Kiang et al. (2004) and Spinrad and Stifter (2006) provided evidence for the influence of maternal behavior on children's later empathy from 18 to 24 months. Yet, despite theoretical claims (Hoffman, 2000; Stern & Cassidy, 2018), little is known on whether maternal sensitivity affects the emergence of empathic reactions in early ontogeny before the second year of life. Knowledge on this issue would be particularly interesting as it could help to reveal when in ontogeny empathy emerges. Consequently, our study aimed to investigate the influence of maternal sensitivity on infants' empathy development across the first two years of life.

3. Impact of infants' temperament on empathy development

In addition to sensitive parental behavior developmental research has highlighted the role of infant temperament in the development of empathy (Moreno et al., 2008). More specifically, child temperament is proposed to affect the transmission from parents' caring for their children to children's learning to care for others. Research has thereby focused on individual differences in children's reactivity and self-regulation (Mervielde & de Pauw, 2012; Rothbart, 2012). The negative form of reactivity (negative emotionality) can be characterized as the child's tendency to react with discomfort, fear, or distress in new, stressful, or frustrating situations

(Rothbart, 2012). This characteristic could lead to children being more easily overwhelmed by another person's distress and therefore lead to non-empathic behavior (Eisenberg et al., 1996; Sagi & Hoffman, 1976). Several studies confirmed an association between temperamental aspects of children and a lower empathic response in toddlers (Young et al., 1999; Zhai et al., 2020), insecurely attached girls (van der Mark et al., 2002), pre-schoolers (Findlay et al., 2006), 5–7 year-olds (Kienbaum et al., 2019). Interestingly, recent studies showed a significant change of temperamental influence over time (Abramson et al., 2019): Infants who showed negative reactivity at 9 months reacted with more empathy later at 18 months if they had achieved sufficient regulation abilities in the meantime.

According to Kochanska (1997), temperament influences empathy not only directly but also by moderating the impact of parenting on empathy development. This idea is supported by longitudinal data showing that maternal responsiveness promoted prosocial behaviors especially in fearful 4-year-olds (Kochanska, 1997) or empathy in inhibited toddlers (Wagers & Kiel, 2019). Yet, instead of a moderating effect, Kiang and colleagues (2004) showed that temperament mediated the effect of parenting on children's empathy. Thus, recent empirical evidence is inconclusive and there is considerable lack of studies focusing on the impact of temperament on the early ontogeny of empathy.

Given the shortage of data from infancy, the question remains which role temperament plays individually or in interaction with maternal sensitivity in early development of empathy. Since maternal sensitivity should improve infants' self-regulation abilities, and self-regulation abilities are necessary in order to react with empathic concern instead of personal distress (Daniel et al., 2016; Kiang et al., 2004; Spinrad & Gal, 2018; Spinrad & Stifter, 2006), maternal sensitivity should lead to higher empathic responses in children. Additionally, sensitive mothers should be even more beneficial for children with higher negative emotionality tendencies. Thus, we aimed to clarify the interaction between infant temperament and maternal sensitivity in the early ontogeny of empathy.

4. Present study

Taken together, current empirical evidence does not allow for clear conclusions about the ontogenetic onset of empathic concern. This study intends to clarify whether empathic concern occurs before or in the course of the second year of life and whether maternal sensitivity and child's temperament predict the development of empathy within the first two years. The current study speaks to these questions by presenting data from mother-child dyads and empathy-related situations, and including an appropriate emotional control condition, at multiple time points over the first and second year of life.

Specifically, we assessed different components of empathy at 6, 10, 14, and 18 months. We assessed infants' expressed empathic concern in facial expressions, gestures or vocalizations, infants' inquiry behavior as an indicator of the intention to understand what is happening in the distress situation, as well as infants' display of self-distress. Additionally, we assessed children's explicit self-recognition at 18 months given proposals that it supports the emergence of empathy (Hoffman, 2000). Lastly, in order to compare our findings with previous infant studies, we measured prosocial behavior as a potential consequence and expression of empathy.

Children's responses were not only tested in a situation in which another person expressed suffering, but also in a control condition with a laughing person. This situation constitutes an arousing emotional situation that does not require empathic concern. Usually, empathic concern is measured by coding facial expressions for concern while someone is simulating pain. To our knowledge, no study compared a pain simulation to another emotional control condition in an infant sample. Thus, it remained unclear whether the facial expressions (or looking and pointing behavior as indicator of inquiry) reported in previous infant studies (e.g., Davidov et al., 2021) really reflected empathic concern or whether infants' responses would be similar to other kinds of emotional stimuli. Through introducing this control condition, we aimed to distinguish between true empathic responses and rather undifferentiated, general reactions to sudden, arousing, emotional stimuli.

Moreover, we compared children's responses to the distress of a familiar person (mother) and an unfamiliar person (experimenter). Since empathy is proposed to be a general skill, it should be present in different contexts. Thus, one would hypothesize to see a relation between both situations as soon as empathy has emerged. There might be mean level differences as infants might on average be more likely to respond empathically to their mother than to a stranger. Yet, the proposal of a general ability would predict relations despite mean differences. That is, those children who are empathic in one context should (on average) also be the more empathic ones in the other context. Frameworks assuming an early emergence of empathic reactions (Davidov et al., 2013) would therefore predict that already in the first year, infants' reactions towards mother and unfamiliar persons should relate to each other. Yet, if empathy emerges in the second year of life (Hoffman, 2000), one would hypothesize to see this relation in the second year of life only.

In order to allow for a large sample, our study design followed a planned missingness design (PMD). In PMD, partial data is intentionally collected only from a part of the sample. Without confounding the analysis result, PMD uses multiple imputation (MI) to deal with missing data points (Wu & Jia, 2021). For the first measurement points at 6 months and the last one at 18 months, we collected data from all participants. Regarding the two middle measurement points, we randomly split the sample and tested half the children at 10 and the other at 14 months. Given the collection of data from the full sample at two measurement points and a random allocation of the sample to the two measurement points in between, PMD allows for a reliable estimation of effects (Wu & Jia, 2021).

By choosing an early first assessment at 6 months and three following measurement points in four-month intervals, including assessments of empathic reactions towards familiar and unfamiliar others as well as an emotional control condition, the study aimed at providing an empirical touchstone for current developmental theories on the emergence of empathy. If empathy is an inborn or very early emerging ability (e.g., Davidov et al., 2013), infants at 6 months should show empathic concern, and thus, react with concern to someone crying but not to someone laughing. Consequently, we would expect to see unequivocal indicators of empathic concern at 6 months. Moreover, we would expect to see more empathic concern and inquiry behavior for a suffering than for a laughing other at 6 months. On the other hand, if empathy develops in the second year of life, around the age of 18 months as proposed by Hoffman's

developmental theory (2000), we should observe more enhanced empathic concern and inquiry behavior towards a suffering than towards a laughing other by 14–18 months. Additionally, we would expect the growth of concern, inquiry behavior and prosocial behavior from 6 months to 18 months to be significantly higher for the crying condition than for the laughing condition. Finally, we assessed theoretical claims that the emergence of self-other differentiation is necessary for the development of empathic concern (Hoffman, 2000). We thus hypothesized a positive relation between children's self-recognition around 18 months and their empathic concern towards others.

In order to assess to which extent young infants show subtle signs towards others in need and in order to investigate the hypothesis that these subtle signs constitute indicators of empathic concern, we adopted the coding scheme and coding strategy by Davidov and colleagues (2021). This allowed us to investigate at which age children's responses to others in need are clearly distinguishable from their responses to other emotional displays, at determining the age range in which the subtle signs prevail before more conclusive indicators of empathic concern are apparent, and to assess at which age the proposed indicators of empathic concern are distinguishable from mere arousal and distress reactions.

Developmental theories on individual differences in infants' emerging empathy, more particularly empathic concern, highlighted two factors: caregiver sensitivity and child temperament. By relying on a longitudinal assessment starting in early infancy, we investigated to which extent these factors support the early emergence of empathic concern. The longitudinal design allowed not only assessing when these factors affect this crucial aspect of empathic behavior, but also investigating a truly developmental question, that is, how they influence the growth of empathic concern in early development. To this end, the current study investigated the dynamics of developmental changes by applying True Intraindividual Change (TIC) Models (Steyer et al., 2000).

Based on attachment theoretical considerations (e.g., Stern & Cassidy, 2018; Thompson, 2019), we hypothesized that children with more sensitive mothers would not only display more empathic concern at 18 months but also show increased growth of empathic concern across early development. Additionally, Kochanska (1997) proposed that children low in negative emotionality show more empathic behavior in response to distress of another person. Therefore, we expected lower negative emotionality to predict greater growth of empathic concern. Furthermore, as one could hypothesize that sensitive mothers should be especially beneficial for children with higher negative emotionality, we explored the interaction between both factors. We assessed both predictors at 6 months in order to explore their impact from early in development. Taken together, previous studies have investigated the relation between caregiver sensitivity, self-recognition, temperament, and empathic behavior at single ages. Yet, a development model exploring the ontogenetic growth over infancy including these predictors has not yet been tested. Through our longitudinal design with four equidistant assessments from 6 to 18 months, we were able not only to explore the outcome on single specific ages, but also to investigate when empathic concern arises, how it grows and what predictors influence the ontogenetic growth.

5. Methods

5.1. Participants

The final sample consisted of 127 mothers and 127 infants (57 female). Infants were born within 4 weeks of their expected due dates. Families were recruited from birth records in a large city in Europe. The majority of the sample was of middle socioeconomic status and most children were White. For the first assessment (T1), infants participated at 6 months (M= 6;2 months;weeks, SD=1 week). Mothers' mean age at T1 was 34;3 years;months (range 23–45 years). A randomly selected half of the sample participated at the second assessment (T2) at 10 months of age ($N = 61$, M=10;2 months;weeks, SD=1 week), the other half at the third assessment (T3) at 14 months ($N = 58$, M=1;2 year;months, SD=0 month). For the final assessment (T4), all remaining children were tested at 18 months ($N = 97$; M=1;6 year;months, SD=1 month). Sample size was based on previous work that used TIC models to assess the impact of maternal emotional availability on developmental growth in early childhood (Paulus et al., 2018). Parents gave written and informed consent. The local ethics committee approved the study. Parents were reimbursed for their travel costs and infants received a toy for their participation.

5.2. Longitudinal procedure

At each visit, the experimenter explained the study procedure and had a brief warm-up period with the infants. The study was part of a larger and ongoing study on infant social development. Emotion simulation tasks were continuously tested at all four assessments and temperament was assessed via questionnaires. Maternal sensitivity was assessed at 6 and 18 months, infants' self-recognition was assessed at 18 months.

5.3. Measures

Children participated in two different distress simulation conditions, one relying on the mother and one relying on the experimenter. This design follows established procedures for the assessment of empathy in young children (for instance, Knafo et al., 2008; Zahn-Waxler et al., 1992). Additionally, we introduced a laughter condition as control condition. The two distress simulations were tested the same way on each measurement point. In a pilot study, we learned that authentic laughing was too difficult to simulate for many mothers. Thus, the laughing condition was only run with the experimenter as actor. Given the statistical requirements of the correlational approach, tasks were administered in a standardized order to exclude the impact of variance coming from position effects in the explanation of variance. In other words, task order was kept constant in order to avoid variance introduced by task order

(Robertson et al., 1999).

5.3.1. Experimenter's distress simulation

The child sat on the mother's lap on the floor facing the experimenter, so that approach behavior was possible. After securing the child's attention, the experimenter pretended to retrieve something. Following Roth-Hanania et al. (2011), she bumped her foot in approximately 2 m distance from the child and simulated pain for one minute. This simulation contained 30 s of whining and 30 s of whimpering and slowly calming down. Afterwards, the experimenter dissolved the simulation by turning to the child and smilingly telling them that she feels better now. During the simulation, the experimenter avoided direct eye contact with the child, while the facial expression was clearly visible. Experimenters were individually trained ahead of the study and only allowed to run the study if their performance was very good.

5.3.2. Maternal distress simulation

The condition was constructed the same way as the distress simulation of the experimenter, except that the child sat on the experimenter's lap. Mothers' instructions closely followed Roth-Hanania et al. (2011). Mothers prentended to hit their finger with a building brick and were asked to avoid eye contact with their child in order to not invite a response. Since the experimenter in a previous situation displayed pain in a similar way, we asked mothers to show their pain in the same way the experimenter did approximately 20 min before. This provided a role model for the mothers and helped them to appreciate the instruction. For standardized timing of the stimulation, the experimenter gave subtle time hints by harrumphing after 30 s and 60 s.

5.3.3. Experimenter's laughing simulation

In the control condition, the setting was the same as in the experimenter's distress condition. The experimenter sat on the floor, pretended to read a funny book, and started to laugh out loudly and continuously for 60 s. Piloting revealed that a phase of 60 s continuous laughing seemed more natural than a calming down of laughing in the past 30 s (as done in the distress simulation). Similar to the distress simulation, direct eye contact was avoided, and the facial expression was visible.

5.3.4. Coding children's responses

Based on coding schemes of Zahn-Waxler and colleagues (1992) as well as Davidov and colleagues (2021) children's behavior was coded for emotional, cognitive, and behavioral aspects of empathy on 4 point-scales (see below for overview), in which 0 represented the absence of the requested reaction. 25% of the sample at each time point were randomly chosen and coded by a second trained coder who was blind to the hypotheses of the study. The intraclass correlation coefficient (ICC) for all empathy scales at every time point ranged from .76 to 1.00 for the experimenter's crying simulation, from .77 to 1.00 for the maternal crying simulation and from .80 to .96 for the experimenter's laughing simulation.

Notably, although we expressed hesitations concerning the interpretation of the low scale values as indicating true empathic concern (see discussion in the introduction), we decided to rely on the coding scheme by Davidov and colleagues (2021) in order to allow for comparisons with previous findings and in order to allow for an assessment whether and to which extent infants' reactions to crying and laughing others differ from each other. In the discussion section, we will elaborate on the interpretation of the scale values.

5.3.4.1. Concern for victim. Children's affective concern was rated based on gestural, facial, and verbal expression. 0 indicated no other-oriented concern, 1 indicated slight concern (e.g. sad expression or brief vocalization), 2 represented moderate concern (e.g. eyebrows or lips down, gestures towards the victim) and 3 great concern (compassionate facial expression, that is, clearly sad but other-oriented facial expression combined with sympathetic vocalization and gestures) (Zahn-Waxler et al., 1992). Based on the definition of empathy discussed above (Davis, 1983; Decety & Jackson, 2004; Decety & Svetlova, 2012) and following the coding schemes of Zahn-Waxler et al. (1992) and Davidov et al. (2013), empathic concern was coded 0, when the affective expression occurred simultaneously to crying due to self-distress.

5.3.4.2. Inquiry behavior. Inquiry behavior was coded based on children's attentional and cognitive reaction. 0 was defined as absent, 1 was given for quite simple inquiry behavior (e.g., intense looking), whereas 2 represented a combination of vocal and non-vocal behavior (e.g., a single vocalization with questioning intonation combined with intense looking for several seconds). Children received a 3 for repeated, sophisticated attempts to understand the suffering of the victim (Zahn-Waxler et al., 1992).

5.3.4.3. Personal distress. A score of 0 was given for children who displayed no self-related distress. A score of 1 was coded if the personal distress was expressed by non-vocal facial expressions or gestures (e.g., high body tension, that is, a tense body), a score of 2 if children showed whimpering and a score of 3 was coded for full blown crying.

5.3.4.4. Prosocial behavior. Children with a 0 displayed no prosocial behavior. Attempts of the child to console the victim were coded with 1 for a short, simple support (e.g. one pat), 2 for repeated or more long-lasting attempts to help (e.g. hugging for 3–5 s), whereas 3 represented ongoing support for more than 5 s (Zahn-Waxler et al., 1992).

5.3.5. Self-recognition

At 18 months, self-recognition was assessed using the well-established rouge paradigm (Amsterdam, 1972; Lewis et al., 1989).

Mothers were asked to put a red dot on the nose of their child with a lipstick as unnoticeably as possible during their play. Subsequently, the experimenter moved the child in front of a big mirror and pointed on the reflection of the child asking, "Look at that! Who is that?" for three times. If children touched their nose within one minute, they received a score of 1, otherwise a 0 (Lewis et al., 1989). 30% of videos were coded by a second coder, which resulted in a Kappa of 0.83. Due to fussiness some children were not tested in this task ($n = 24$).

5.3.6. Maternal sensitivity

5.3.6.1. Procedure. Mothers and infants were engaged in an 8 min video-recorded free-play task with standardized, age-appropriate toys. They included plush toys, building blocks, rattles, and a glove puppet. Interactions were recorded on a 2×2m picnic blanket. This is comparable to other empirical studies that used the Emotional Availability (EA) - Scales to code parent-child interactions lasting between 5 to 15 min (for a review, see Biringen et al., 2014). Mothers were asked to play naturally with their infants while the experimenter left the room. The interaction was videotaped with two hand cameras. Due to fussiness, some children were not tested in this task ($n = 5$).

5.3.6.2. Coding. All videos were coded using the fourth edition of the Infancy/Early Childhood Version of the Emotional Availability Scales (Biringen, 2008). The EA scales are well established and empirically validated measures of adult-child relationship quality assessing verbal and non-verbal indicators (see Biringen et al., 2014). The scale *sensitivity* is coded on a 7-point Likert Scale, in which the upper end scores represent an optimal level of sensitivity. A second trained coder coded 25% of the sample at each time point. Both coders were certified as reliable after completing the online training. The intra-class reliability coefficient (ICC) for the sensitivity-scale was .77.

5.3.7. Temperament

Infants' negative emotionality was measured using the short version of the revised Infant Behavior Questionnaire (IBQ-R-VsF) (Putnam et al., 2014, German translation by Kristen, Eisenbeis, Thoermer and Sodian (2007), shortened by Fuchs and Pillhofer (2013)). The IBQ-R is a parent report measuring temperament in infants from three months to one year of age. It assesses the frequency of several behaviors of the child in the previous week on a 7-point scale. The IBQ-R-VsF consists of 37 items, grouped into three dimensions: Positive Affectivity/Surgency (PAS), Orienting/Regulatory Capacity (ORC) and Negative Emotionality (NEG) (cfr. Rothbart and Bates (1998)). In our study, we used only the NEG-subscale, for which Cronbach's Alpha ranged from .72 to .88 (Putnam et al., 2014).

5.4. Data analyses

In the present study, missing data was handled by multiple imputations (500 imputed data sets), using the mice package in R (van Buuren & Groothuis-Oudshoorn, 2011). Because of the sample size and power issues, data were imputed separately for each set of analyses.

For each scale representing children's responses (empathic concern, inquiry behavior, prosocial behavior, distress) four measurement points were available: at 6, 10, 14, and 18 months. To use the full potential of the longitudinal data set and to investigate the developmental changes and dynamics of children's responses, we applied True Intraindividual Change (TIC) Models (Steyer et al., 2000), relying on neighbor models for manifest variables. Thus, we specified a latent intercept depicting the children's response at time point 1 (at 6 months) on the respective variable and timepoint-specific latent change variable (6–10 months; 10–14 months; 14–18 months). In all models, the precedent time point was used as reference category for change over time (neighbor models), resulting in the control for the T-1 measure in the dependent variable. All analyses were conducted using the ML estimator implemented in the Lavaan package in R (Rosseel, 2012). In a first step, we compared changes in empathic concern (6–10 months; 10–14 months; 14–18 months) between experimental conditions (distress, laughter), testing hypothesis one. In a second step, we tested whether the changes in empathic concern (6–10 months; 10–14 months; 14–18 months) – as the most central aspect of empathy – could be predicted by maternal sensitivity, negative emotionality, the interaction maternal sensitivity x negative emotionality, and self-recognition, testing hypothesis two. Separate analyses were for the conditions (experimenter vs. mother). All tests were conducted two-sided with exception of the test on the impact of self-recognition on empathic concern as the hypothesis on this factor was clearly directional. The data are available at https://osf.io/85yhn/.

As some children had to be excluded due to fussiness or experimenter error, see Table 1 for the specific number of children included

Table 1
Descriptive statistics (mean, standard deviation, range) of predictor variables.

Variables	*n*	*M*	*SD*	Range
Maternal Sensitivity (6 m.)	121	5.41	1.12	2-7
Child Negative Emotionality (6 m.)	117	4.68	0.96	2.1-6.6
Child Negative Emotionality (10 m.)	54	4.85	0.68	3.0-6.3
Child Negative Emotionality (14 m.)	49	4.78	0.74	2.8-6.7
Child Self-Recognition (18 m.)	73	0.45	0.5	0-1

in each task. Within each measurement point, children who were excluded due to fussiness from any measure (Experimenter Distress, Mother Distress, Experimenter Laughing) did not differ regarding gender and temperament from children who completed all measures (T1: *ps* > .664, T2: *ps* > .233; T3: *ps* > .055; T4: *ps* > .710).

6. Results

6.1. Descriptives

Table 1 depicts descriptive statistics of predictor variables. Descriptive statistics of children's responses at each measurement point are provided in supplementals (Table S1).

For a zero-order correlational matrix of children's reactions within one measurement point, see Table 2. There were significant associations between children's responses predominantly in the maternal distress condition. Empathic concern and inquiry behavior correlated from 10 months onward, yet only in the maternal distress condition. Table 3 shows the relation between children's responses towards the crying experimenter and the crying mother. Most importantly, children's responses towards the experimenter were unrelated to those towards the mother until the age of 18 months. At 18 months, however, several indicators correlated significantly between the two conditions.

For zero-order correlation matrices of children's reactions in the distress conditions and the predictors (maternal sensitivity, negative emotionality, self-recognition, degree, gender), see Table S2 and Table S3 in supplementals.

6.2. Change models

To test whether and when children's responses towards the crying and the laughing experimenter differ, we specified separate change models for the different responses in both conditions. This allowed us to compare the amount of change in infants' behavior and to investigate the factors that predict ontogenetic growth. In Table 4 and Fig. 1 the means at 6 months as well as the changes between neighboring time points are presented. We compared changes relative to the preceding assessment within one condition. Beyond that, we compared the changes for each assessment also between conditions (see Fig. 1 and Table 4). Since prosocial behavior could not be measured at 6 months (see Table 2) and variance was minimal at 10 months, this variable could not be included in these analyses.

6.2.1. Concern

At 6 months, concern was significantly higher in the crying condition than in the laughing condition (Δ_{Mean} =.17, *s.e.* =.05, $z = 3.24$, $p < .01$). In the crying condition, empathic concern increased significantly from 10 to 14 months and from 14 to 18 months. Moreover, there were no significant increases in the laughing condition at any timepoint (see Table 4). There was no significant difference in the change of concern between 6 and 10 months between conditions (Δ_{Change} =.01, *s.e.* =.09, $z = 0.16$, $p = .87$). Afterwards, there were significant differences of the change between both conditions from 10 to 14 months (Δ_{Change} =.60, *s.e.* =.09, $z = 6.59$, $p < .01$) and 14 to 18 months ($\Delta_{Change} = 0.37$, *s.e.* =.12, $z = 3.13$, $p < .01$), with greater increase in the crying condition (see Fig. 1 and Table 4).

6.2.2. Inquiry

At 6 months, inquiry behavior towards the laughing and the crying experimenter showed no statistically significant difference (Δ_{Mean} =.01, *s.e.* =.03, $z = 0.46$, $p = .64$). In the crying condition, inquiry behavior increased continuously. In the laughing condition, children's inquiry behavior only increased from 6 to 10 months and decreased from 14 to 18 months (see Table 4). Between 6 and 10 months, children showed a significantly stronger increase in inquiry behavior towards the laughing experimenter than towards the

Table 2
Correlations (Spearman) between children's responses in the experimenter distress condition and maternal distress condition.

		Crying Experimenter			Crying Mother		
Age	Variables	Concern	Inquiry	Distress	Concern	Inquiry	Distress
6 months	Inquiry	.02	-	-	-.02	-	-
	Distress	.42**	-.04	-	.26*	.01	-
	Prosocial	-	-	-	-	-	-
10 months	Inquiry	.21	-	-	.52**	-	-
	Distress	.01	-.11	-	.06	-.06	-
	Prosocial	-.11	.34**	-.05	.31*	.43**	-.33*
14 nonths	Inquiry	.27*	-	-	.58**	-	-
	Distress	.23	.03	-	-.08	-.18	-
	Prosocial	.00	.17	.10	.36*	.38**	-.35*
18 months	Inquiry	.56**	-	-	.60**	-	-
	Distress	.13	-.05	-	-.03	-.06	-
	Prosocial	.08	.12	-.03	.20	.25*	-.15

Notes. * $p < 0.05$, ** $p < 0.01$.
Note that due to physical setup requirements and limited motor skills, prosocial behavior was not present at 6 months.

Table 3
Correlations between children's responses towards the experimenter and towards the mother within each measurement points.

Age	Concern	Inquiry	Distress	Prosocial
6 months	.13	-.10	.17	-
10 months	.09	.21	.14	.22
14 months	.08	.17	.26^{+}	.04
18 months	.29**	.42**	21*	.19^{+}

Notes. $^{+}p < 0.1$, *$p < 0.05$, **$p < 0.01$. Note that due to physical setup requirements and limited motor skills, prosocial behavior was not present at 6 months.

Table 4
Estimates of the changes over the different assessments for the laughing and crying simulation of the experimenter.

		Laughing Experimenter				Crying Experimenter				Δ	
	Change	M	*s.e.*	*z*	*p*	*M*	*s.e.*	*z*	*p*	*M*	*p*
Concern	6 months	.15	0.03	4.70	.00	.32	0.05	7.14	.00	.17	.001
	6-10 months	.09	0.06	1.58	.11	.10	0.06	1.70	.09	.01	.871
	10-14 months	-.08	0.05	-1.41	.16	.52	0.08	6.72	.00	.60	.000
	14-18 months	-.09	0.04	-2.07	.04	.28	0.11	2.64	.01	.37	.002
Inquiry	6 months	.90	0.03	31.00	.00	.90	0.03	33.36	.00	.01	.644
	6-10 months	.33	0.06	5.63	.00	.11	0.06	2.00	.05	-.22	.001
	10-14 months	-.01	0.07	-0.11	.91	.17	0.06	2.91	.00	.18	.016
	14-18 months	-.17	0.08	-2.26	.02	.28	0.08	3.47	.00	.45	.000
Distress	6 months	.11	0.03	3.22	.00	.25	0.06	4.21	.00	.14	.021
	6-10 months	.06	0.06	0.89	.37	.00	0.08	0.05	.96	-.05	.597
	10-14 months	-.09	0.06	-1.61	.11	.29	0.08	3.73	.00	.39	.000
	14-18 months	-.00	0.05	-0.02	.99	-.43	0.08	-5.70	-.00	-.43	.000

Notes. M= latent means score of the intercepts (6 months) and change variables, s.e. = Standard Error, z = z-Value

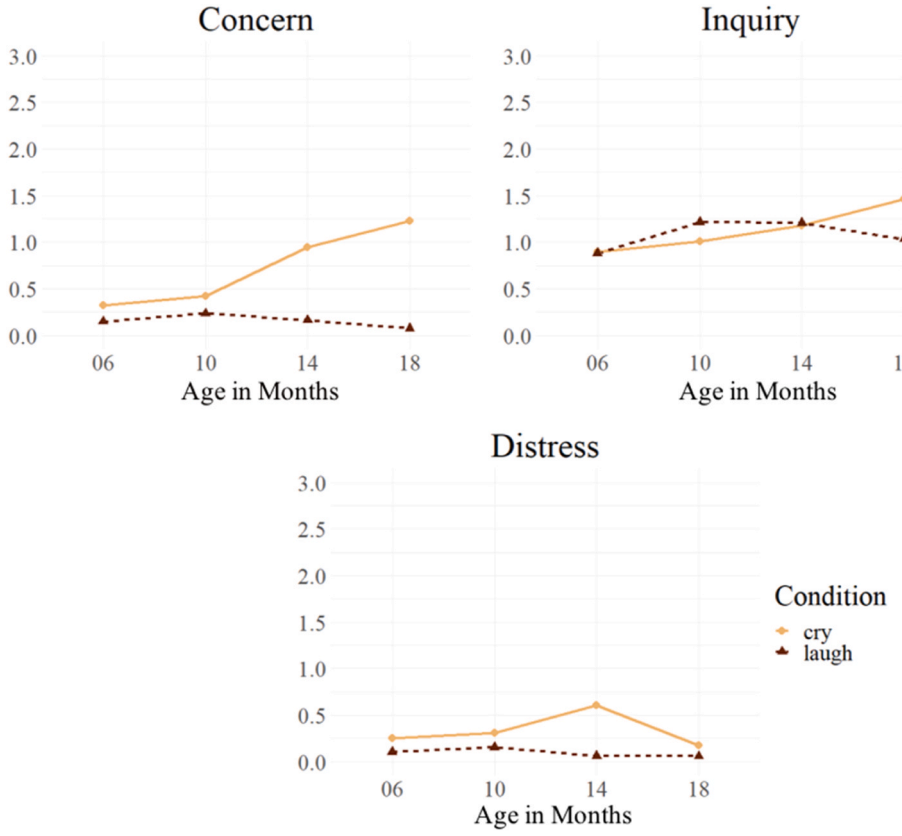

Fig. 1. Changes over time in empathic concern, inquiry behavior and distress in the laughing and crying condition (towards the experimenter).

crying experimenter ($\Delta_{Change} = -.22$, *s.e.* =.07, $z = -3.36$, $p < .01$) There was also a statistically significant between-condition difference in the change from 10 to 14 months (Δ_{Change} =.18, *s.e.* =.07, $z = 2.41$, $p = .02$) and from 14 and 18 months (Δ_{Change} =.45, *s.e.* =.10, $z = 4.55$, $p < .01$), where children showed more increase in the crying condition (see Fig. 1).

6.2.3. Distress

At 6 months, children showed more distress in the crying condition than in the laughing condition (Δ_{Mean} =.14, *s.e.* =.06, $z = 2.32$, $p = .02$). In the crying condition, distress significantly increased from 10 to 14 months and then significantly decreased from 14 to 18 months. Infants' distress level did not change in the laughing condition (see Table 4).

There was no statistically significant difference between the change in the crying condition and the change in the laughing condition between 6 and 10 months ($\Delta_{Change} = -.05$, *s.e.* =.09, $z = -0.53$, $p = .60$), but between 10 and 14 months (Δ_{Change} =.39, *s.e.* =.09, $z = 4.41$, $p < .01$). Between 14 and 18 months, the distress ratings in the crying condition but not in the laughing dropped; the difference in the changes between both simulations was statistically significant ($\Delta_{Change} = -.43$, *s.e.* =.07, $z = -6.36$, $p < .01$) (see Fig. 1).

6.3. Prediction of developmental changes

As a second step, we tested which predictors at which developmental timepoint related to children's responses. For this analysis, the changes in empathic concern served as dependent variables, maternal sensitivity served as one predictor, child's negativity served as second predictor, and the interaction of those two variables as a third predictor. The intercorrelations between the predictions were estimated. For each time point apart from T1, we used the negativity measure from the respective previous time point as a predictor. For T1, we had to use the negativity measure from the same timepoint, therefore resulting in a correlative predictor only.

Participants who dropped out of the study before T4 ($n = 30$) reported (at T1) lower maternal education than participants completing T4 ($n = 97$), $U = 1020.5$, $p = .024$, but the two groups did not differ regarding child gender, temperament (T1), and maternal sensitivity (T1), $ps > .121$. We therefore included mother's educational degree next to child's gender as control variables in this set of longitudinal analyses. In another analysis, we analysed self-recognition as a correlate of empathic concern at 18 months.

Table 5 presents the results of both models. The fit of the model for predicting changes in empathic concern towards the mother was acceptable, $\chi^2 = 22.145$, $df = 12$, $p = .036$; CFI = .91, RMSEA = .08, SRMR = .03, and for predicting changes in empathic concern towards the experimenter it was excellent, $\chi^2 = 6.43$, $df = 12$, $p = .893$; CFI = 1.0, RMSEA = .00, SRMR = .02.

6.3.1. Maternal sensitivity

Maternal sensitivity positively predicted only the change of empathic concern towards the experimenter from 10 to 14 months (ß =.25, *s.e.* =.06, $z = 4.00$, $p < .01$). Higher levels of maternal sensitivity went along with the stronger increase in empathic concern towards the experimenter.

6.3.2. Negative emotionality

Children's negative emotionality positively predicted the change of empathic concern towards the experimenter from 14 to 18 months (ß =.27, *s.e.* =.13, $z = 1.99$, $p = .046$): Children with more negativity would show a stronger increase in empathic concern towards the experimenter from 14 to 18 months. There was no such effect on the change in empathic concern towards the mother from 14 to 18 months (ß = −.08, *s.e.* =.14, $z = -.59$, $p = .56$) or on earlier indicators of developmental change ($p > .05$, see Table 5).

Interestingly, the interaction between maternal sensitivity and child's negativity negatively predicted the change in empathic concern towards the experimenter (ß = −.33, *s.e.* = 0.10, $z = -3.23$, $p < .01$) and towards the mother (ß = −.28, *s.e.* = 0.11, $z = -2.67$, $p < .01$) from 14 to 18 months. Children with higher negativity and more sensitive mothers showed less increase in empathic concern.

Moreover, the interaction between maternal sensitivity and child's negative emotionality positively predicted the change in

Table 5
Results of the regression model analysis of the changes in empathic concern in both situations as dependent variables.

Outcome	Predictor	Change 6 to 10 months				Change 10 to 14 months				Change 14 to 18 months			
		β	*s.e.*	*z*	*p*	*β*	*s.e.*	*z*	*p*	*β*	*s.e.*	*z*	*p*
Concern Mother	Sensitivity	.03	0.06	0.46	.64	-.11	0.08	-1.39	.17	.11	0.10	1.17	.24
	Negative Emot.	.06	0.05	1.04	.30	.07	0.10	0.66	.51	-.08	0.14	-0.59	.56
	Interaction	.19	0.05	3.65	.00	-.02	0.08	-0.20	.84	-.28	0.11	-2.67	.01
	Degree	-.07	0.06	-1.12	.26	-.14	0.09	-1.66	.10	.10	0.11	0.92	.36
	Gender	.16	0.13	1.20	.23	.00	0.18	0.01	.99	.73	0.23	3.21	.00
Concern Experimenter	Sensitivity	.00	0.05	0.02	.98	.25	0.06	4.00	.00	-.13	0.09	-1.40	.16
	Negative Emot.	.07	0.06	1.22	.22	-.14	0.09	-1.58	.11	.27	0.13	1.99	.05
	Interaction	-.04	0.05	-0.86	.39	-.03	0.07	-0.45	.65	-.33	0.10	-3.23	.00
	Degree	-.06	0.06	-1.03	.30	.07	0.07	1.01	.31	-.12	0.11	-1.09	.27
	Gender	-.10	0.12	-0.84	.40	.42	0.14	2.89	.00	-.28	0.23	-1.21	.23

Notes. ß= standardized regression coefficient, s.e. = Standard Error, z = z-Value
Interaction = Interaction between Maternal Sensitivity and Child's negative emotionality
Gender: 1 = male, 2 = female

empathic concern towards the mother from 6 to 10 months (ß =.19, s.e. = 0.05, z = 3.65, p < .01). That means, children with higher negativity and more sensitive mothers showed more increase on the scale measuring empathic concern towards the mother.

6.3.3. Self-recognition

This analysis tested the hypothesis that self-recognition supports the emergence to empathic concern. Therefore, we used simple regressions to analyse if self-recognition at 18 months is linked to empathic concern. Self-recognition did not significantly predict empathic concern towards the experimenter (ß = −.04, *s.e.* =.05, $z = -0.85$ $p = .197$) but positively predicted empathic concern towards the mother (ß =.09, *s.e.* =.05, $z = 1.86$, $p = .032$). Note that this effect turns non-significant when using two-sided tests.

7. Discussion

Developmental science has a longstanding interest in exploring how empathic concern for others emerges in human ontogeny. Yet, its early origins are debated. This study investigated the ontogenetic emergence of empathic concern and the psychological processes that contribute to its developmental growth over the first two years.

Influential theories hypothesized that empathy emerges within the second year of life (e.g., Bischof-Köhler, 2012; Hoffman, 2000). Likewise, recent theories on the ontogeny of altruism propose that young infants first develop an interest in others and social preferences to interact with others, before genuine altruistic motivations emerge in the second year of life (Dahl & Paulus, 2019). On the other hand, recent theorizing assumes the existence of an early onset of concern for others, and therefore hypothesized the existence of empathic concern early within the first year of life (Davidov et al., 2013). The first line of theorizing also proposed an impact of explicit self-other differentiation on the development of empathy for others (Hoffman, 2000). Yet, there is little systematic longitudinal work examining these hypotheses in the same design. Furthermore, empirical evidence on this important question lacked systematic controls and remained inconclusive. The current study aimed at closing this gap by assessing empathic responses to different emotional stimuli, including a pain simulation and a laughing simulation, in 6- to 18-month-old infants. Moreover, in order to explain development in children's empathic concern, we assessed maternal sensitivity and children's negative emotionality as central predictors. Taken together, the study aimed at providing a comprehensive assessment of the early emergence of empathy in human ontogeny. Overall, several findings are noteworthy and will be discussed in the following sections.

7.1. Ontogenetic emergence of empathy

We investigated when children begin to show empathy by comparing their reactions towards a crying and a laughing person. Based on developmental theorizing (e.g., Bischof-Köhler, 2012; Hoffman, 2000) we expected to observe clear differences between those two situations within the second year of life. Indeed, the results showed clear and marked differences between the two emotional contexts for empathic concern and inquiry behavior at 18 months. At the same time, a closer inspection on younger children's responses revealed small differences at the empathic concern scales in the first year of life (at one, but not the other measurement point significant), albeit in each case below half a point of the scale. In the following, the central findings on the three empathy related behaviors (empathic concern, inquiry behavior, and no self-distress) will be discussed.

As the most central aspect of empathy development, we assessed infants' empathic concern. A first analysis showed a difference in empathic concern between crying and laughing at 6 months. At first sight, this seems to be in line with proposals of an early emerging empathic ability (Davidov et al., 2013). Indeed, it should be noted that we replicated empirical patterns reported, for example, by Davidov and colleagues (2021) of infants displaying subtle facial reactions to others' emotional states. At the same time, a closer inspection indicates that differences between conditions were subtle and at the lowest level of the scale, on average even below half a point. This comprises rather weak and ambiguous movements in the brows and in the mouth area. Given our search for unequivocal indicators of empathic concern, we argue that these behavioral reactions are too subtle to allow for the attribution of empathic concern. Nonetheless, we decided to rely on this scale in order to keep our results comparable to previous infant studies and to explore empirically, whether and how these early behavioral reactions relate to other meaningful constructs (see discussion section on the correlates and predictors). However, without further indicators of true empathic concern, there exist many possible interpretations of these subtle cues. For example, these behavioral reactions could indicate a surprise reaction (see Reisenzein et al., 2013), stress signals in an unfamiliar situation, or emotional contagion (Hoffman, 2000). Importantly, analyses also indicated a significant correlation between the empathic concern scale and self-distress at 6 months for both contexts, the mother's and the experimenter's simulation of pain. This relation was absent at older ages. This overlap demonstrates that some variance detected by the empathic concern scale is equivalent to self-distress. This suggests that the subtle cues might not indicate true empathic concern at this young age but rather an unspecific arousal or distress reaction.

Interestingly, empathic concern showed a pronounced developmental growth between 10 and 18 months. Moreover, the difference in infants' reactions towards the different emotional scenarios become more pronounced and reliable. Thus, empathic concern towards suffering people emerges as a specific and sophisticated response over the first two years of life. This general pattern seems to be in line with theories proposing empathic concern to emerge in the course of early development (e.g., Bischof-Köhler, 2012; Hoffman, 2000), while it also seems to indicate rather a linear growth than a sudden onset.

As a second aspect of empathy development, we analysed inquiry behavior. Interestingly, children showed most inquiry behavior in the laughing condition at 10 months. The expected difference in terms of more inquiry behavior in response to crying others than in response to laughing others was found at 18 months. The early effect of increased inquiry behavior in the laughing condition at 10 months might reflect a general attentional focus on emotional and interesting situations. At 18 months, inquiry behavior – often

interpreted as cognitive empathy – was specific for the crying condition, supporting theoretical approaches that true empathy emerges in the course of the second year of life.

As a third variable of interest, we analysed self-distress. Both emotional conditions elicited a certain amount of stress in the children. However, only in the crying condition children showed a change pattern that relates well to theories on emotional contagion in the first year. While the distress in the laughing condition did not increase, the distress in the crying condition increased at 14 months and decreased at 18 months. This is in line with theories proposing emotional contagion as a basis for the development of empathic concern (Eisenberg, 2000; Hoffman, 2000; Panfile & Laible, 2012).

Descriptively, it is interesting to note that with the decrease in self-distress at 18 months, empathic concern increased. This observation relates well to the idea that empathic concern emerges when self-distress becomes transformed into other-oriented behavior (Eisenberg, 2000).

Taken together, while there were subtle indicators of empathic concern related behavior in both conditions before the second year of life, the reactions were subtle and unspecific. One could argue that these findings open a third perspective located between recent (Davidov et al., 2013) and classical (Hoffman, 2000) theories on the emergence of empathy. It is important to note that some kind of interpersonal reactivity to others' distress exists early in the first year of life. The recent line of work by Davidov and colleagues (2021) is valuable as it highlights and draws our attention to these phenomena. These responses fit also well to recent findings of pupillary contagion in infants (Fawcett et al., 2016, 2017) indicating how the perception of others' arousal leads infants to be aroused. Yet, the subtle indicators as well as findings on transfer of arousal should not be interpreted as representing true empathic concern. Instead, it is more reasonable to see them as precursors (e.g., interpersonal reactivity) that might support the emergence of emotional contagion (as found in our study by around 10–14 months) and true empathic concern (as evident by 14–18 months). This interpretation relates to proposals that infants in their first year of life develop interest in others (Dahl & Paulus, 2019). In this light, the interesting findings of relations between early reactivity to others and later social behavior (e.g., Davidov et al., 2021; Paz et al., 2022) can be interpreted in terms of developmental cascades. Infants who show higher reactivity to others and more emotional contagion (that is, are "more touched by others") are more likely to develop higher levels of empathic concern once they are able to transform the arousal into sympathic concern (Hoffman, 2000). Concern for the others then paves the way for the development of positive social behaviors such as comforting.

Overall, we interpret the results of the present study as demonstrating how a specific response to others' suffering rather than an unspecific response to others' emotions gradually emerges in the course of infancy. These findings extend previous work that has focused on older children (Dunfield & Kuhlmeier, 2013; Moreno et al., 2008; Wagers & Kiel, 2019; Zhai et al., 2020) and/or mainly compared children's reactions to a suffering other with a neutral condition (Davidov et al., 2021). Our study supports a developmental approach according to which empathic concern is not a given prerequisite of human prosocial development but itself the result of developmental processes (e.g., Brownell, 2013; Hoffman, 2000; Paulus, 2014).

Notably, we found correlations between empathic responses towards the mother and those towards the experimenter only at 18 months. The theories assessed in this study regard empathic concern to be a general ability and not a sensitive reaction towards one familiar person. Consequently, empathic concern should occur with different people. Despite mean level differences between infants' responses to their mother and to a stranger, one would expect relations between both contexts. The present finding of a general response tendency across different persons at 18 months, but not at younger ages is in line with Hoffman's (2000) theory that empathic concern emerges in the second year of life. It does not support the view that empathic concern is present early in the first year of life. However, Nichols and colleagues (2009) found a relation of empathic responses towards peer distress and those towards mother's distress already at 12 months. Yet, in their study, children were not directly presented with a distressed peer but only with recordings of crying sounds. It thus remains unclear whether to interpret this as a person-specific response. The current study, in contrast, directly compared children's reactions towards two different people.

Finally, our analysis revealed that self-recognition was related to the level of empathic concern towards the mother at 18 months. Interestingly, self-recognition affected only empathic concern towards the mother but not towards the experimenter. One could speculate that it might be more difficult for infants to differentiate themselves from the mother as a very close and familiar person. Indeed, research on self-development showed that infants are more sensitive to bodily overlap with their mother than with strangers (Maister et al., 2020). We leave it to future research to explore this possibility in detail.

In a nutshell, while the study constitutes a complex and heterogenous set of findings, the overall picture rather supports the assumption of developmental theories (e.g., Bischof-Köhler, 2012; Hoffman, 2000) proposing that empathy arises within the second year of life. Subtle responses to emotionally aroused others before the second year of life are not sophisticated and distinct enough to label them as empathy. In Hoffman's theory, empathy-related reactions of children in the first year are described as 'egocentric empathic distress'. This distress behavior does not fulfill the criterion of 'other oriented focus' that is key for true empathic concern. Indeed, this description fits well to the finding that empathic concern correlated with infants' own distress.

7.2. Predictors of early ontogeny of empathic concern

In order to analyse the early influences on the development of children's empathic concern, we investigated whether and when maternal sensitivity and negative emotionality act as predictors of empathy development.

7.2.1. Maternal sensitivity

Following attachment theoretical considerations, we hypothesized maternal sensitivity to support the development of empathic concern. Regression analyses revealed that maternal sensitivity was positively related to the growth of empathic concern in the second

year of life. Our results contribute to a clearer picture of when caregiving behavior affects children's empathy development. Our results expand findings by Spinrad and Stifter (2006) who reported that maternal sensitivity measured at 10 months influenced children's concerned attention at 18 months. Furthermore, other studies found an influence of maternal sensitivity on children's empathic responses towards the end of the second year of life (Kiang et al., 2004) and at 3 years (Panfile & Laible, 2012). Our results support the assumption that children's experience of sensitivity towards their own needs influences their own empathic concern towards others.

Notably, we assessed maternal sensitivity towards the child and children's empathic reactions towards the mother and a stranger. The impact of maternal sensitivity on children's empathic reactions was not specific for their behavior towards the mother. Rather, it also predicted infants' reactions towards the stranger. This suggests a cognitive interpretation according to which early sensitive caregiving plays a role for the generalized skill of empathic concern. In addition, the mother serves as a role model that treats others with care and concern. Indeed, in the second year of life, children learn a variety of skills and abilities through imitation (Essler et al., 2023).

Interestingly, maternal sensitivity was not related to infants' reactions towards the distressed other in the first year of life. This pattern further supports the view that young infants' behavior in these tasks should be interpreted with caution.

7.2.2. Negative emotionality

Following Kochanska (1997), we hypothesized a negative relation of children's negative emotionality on their empathy development. Yet, our data revealed the opposite, that is, results showed a positive relation between negative emotionality and the development of empathic concern: The higher negative emotionality was, the higher was the increase in empathic concern from 14 to 18 months. Others have argued that children who often experience negative emotions might be able to better recognize them in others (Edwards, 2015; Spinrad & Stifter, 2006). Extending these thoughts, Abramson and colleagues (2019) hypothesized that sufficient self-regulation abilities are crucial for children who were high in negative emotionality to be able to engage in empathic behavior. Yet, our results do not coherently support this position. Results showed an interaction between infant negative emotionality with maternal sensitivity. Children high in negative emotionality developed less empathic concern from 14 to 18 months towards the experimenter as well as towards their mother when they had more sensitive mothers. This pattern was different earlier in development. Children with higher negativity and more sensitive mothers showed a higher increase in empathic concern from 6 to 10 months. Overall, our results indicate a complex picture in which the role of sensitive caregiving changes in the course of development. One possible interpretation of the results is based on the assumption that parts of the variance of the empathic concern scale rather reflect general affective arousal or emotional contagion. Initially, higher emotionality might support the emergence of affective resonance and emotional contagion with another person. This is supported by maternal sensitivity as sensitive caregiving is proposed to allow children to be more open in their emotional display (Sroufe, 1996). In the first year of life, sensitive caregiving might help children to develop and show their affective states in interpersonal situations. In the second year of life, the function of sensitive caregiving rather consists in helping children to regulate strong emotions and to adapt to social contexts so that children might be less affected the perception of others' negative states. Indeed, it has been argued that in order to allocate mental and emotional resources to someone else's affective state, children must first be able to manage their own emotions (Eisenberg, 2000). However, one difficulty of the interpretation of the interaction effect consists in the fact that child temperament was assessed by maternal report and the measure might be affected by maternal sensitivity (that includes, by definition, a clear perception of the infant's emotional states). It would be interesting to explore this issue in a more comprehensive longitudinal study that includes several independent measures of the key constructs.

7.3. Limitations and future directions

While our study entered novel grounds by adding a laughing control condition to the assessment of infants' empathy development, the implementation of this condition came with some limitations. For one, at the first measurement the task was only be collected for a subgroup of infants due to experimenter error and fussiness. Yet, our data analytic approach allows to deal with missing data and the pattern of results was similar to that of the second measurement point. Moreover, future studies could rely on different control conditions. Notably, every control condition has strengths and weaknesses. The current control condition allowed us to go beyond studies that either lacked any control or merely constituted a neutral situation (e.g., book reading) by presenting children with an emotion of a different valence. It was interesting to explore whether and to which extent children's concern is specific to a suffering but not a happy other. Yet, it remains an open question to which extent laughter has an equivalent amount of emotionality as crying. This would necessitate to have an independent measure of emotionality that is neutral with respect to the type of emotion shown. We do not think that this is a meaningful construct. One could use physical measures (e.g., sound volume of the utterances), but what is regarded as the appropriate amount of volume for an emotion might differ between emotions (and contexts for emotions). Thus, a more promising line for future research would be to use different controls. For example, non-emotional but facial control stimuli might allow to better pinpoint the situational characteristics that lead infants to show the empathy-related behavior. Thereby, one could differentiate purely attentional reactions towards socially interesting stimuli from stress-related responses. Moreover, whereas experimenters were trained how to simulate and received feedback until their performance was very good, mothers did not receive formal training. Given young children's emerging ability to differentiate different levels of affect (e.g., Walle & Campos, 2014), future research could investigate whether or not different levels of uttering affective states have an impact on children's empathic concern. Overall, finding appropriate stimuli for comparison is a challenging task that needs be targeted in future research.

Given the longitudinal design, tasks were administered in a standardized order. While this optimizes analyses aimed at explaining individual differences, it is subject to order effects. It would thus be valuable to complement the current longitudinal approach by further experimental studies.

The current study focussed on the ontogenetic emergence and growth of empathic concern. It would be interesting to investigate in greater detail when individual differences in empathic concern stabilize, and which factors contribute to the development of a stable disposition to respond with empathic concern to others.

Analyses of infants' distress in the crying condition showed an increase between 10 and 14 months and a decrease between 14 and 18 months. It would be interesting to study this peak in greater detail. It could be related to an increase of stranger anxiety (due to the emergence of a clear-cut attachment) or a general increase in infants' capacity to be touched by others.

As with most research in this field, the exclusive focus on mothers' influence is a limitation of this study. Despite the predominant role of mothers as primary caregivers in our society, children grow up in a whole system of potential social influences. If empathy emerges out of infants' experienced social interactions with significant others (Hoffman, 2000), future research needs to investigate social influences other than only mothers. This consideration supports a need for more research on the influence of fathers, siblings, or childcare on empathy development of children. While there is some research with preschool children (e.g., Ferreira et al., 2016; Kienbaum, 2001), nothing is known on whether and/or how these persons support the early emergence of empathy in infancy. In addition, as our participants came from a racially and socioeconomically homogenous sample, it would be very interesting to explore the early ontogeny of empathy in more diverse samples.

8. Conclusion

Taken together, our results showed only minor differences in children's responses to laughing and crying persons before the second year of life. Due to the subtle and unspecific nature as well as their inconsistent appearance, we do not interpret these reactions as *indicators* of empathic concern but rather as *precursors* of a developing concern for others. Our findings provide novel evidence that empathy development is related to sensitive caregiving, explicit self-other differentiation, and temperamental characteristics in the second year of life.

CRediT authorship contribution statement

Markus Paulus: Writing – original draft, Supervision, Resources, Project administration, Methodology, Funding acquisition, Conceptualization. **Marina Kammermeier:** Writing – review & editing, Validation. **Burkhard Gniewosz:** Writing – review & editing, Supervision, Methodology, Formal analysis, Conceptualization. **Tamara Becher:** Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Natalie Christner:** Writing – review & editing, Visualization, Validation, Formal analysis, Data curation. **Carolina Pletti:** Writing – review & editing, Supervision, Methodology, Conceptualization.

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Declaration of Competing Interest

The authors declare no conflict of interest.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.cogdev.2024.101439.

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