The dynamics of early empathy in children: changes according to age and mothers emotional state

A dinâmica da empatia precoce nas crianças: mudanças de acordo com a idade e o estado emocional das mães

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ABSTRACT
Empathy in children is an important process that allows social interaction, but little is known about its onset, dynamics, development as well as the influence of the mother’s affective state. In this study, we aimed 1) to compare the dynamics of empathic responses of two groups of healthy children (11-12 and 14-15 months) in a well-established model of simulated distress by the mother and 2) to assess the association between children's empathic responses and mother's anxiety, depressive symptomatology and empathy trait. We show that children exhibited the full repertoire of empathic components from 11-12 months. The dynamic profile of the affective and cognitive empathic responses in the pain and recovery phases changed according to the age of the children. In addition, we found that maternal anxiety was correlated with children’s affective responses in an opposite manner according to children’s age while maternal empathy was only correlated with affective behaviors in younger children. In conclusion, this study underscores the early onset of empathic responses as well as their dynamic character. A distinct profile of responses emerged according to children's age, emphasizing the necessity to analyze the
timing of the empathic responses during development. This study also stresses mother´s affective state and empathy as important modulators of children´s empathy.

**Keywords:** empathy, child development, maternal anxiety, maternal depression, maternal empathy

**RESUMO**

A empatia em crianças é um processo importante que permite a interação social. Porem, pouco se sabe sobre seu início, dinâmica, desenvolvimento, assim como a sua influência sobre o estado afetivo da mãe. Este estudo teve como um primeiro objetivo comparar a dinâmica das respostas empáticas de dois grupos de crianças saudáveis (11-12 e 14-15 meses) em um modelo bem estabelecido de angústia simulada pela mãe. No segundo objetivo foi avaliado a associação entre as respostas empáticas das crianças com os comportamentos de ansiedade, a sintomatologia depressiva e a empatia da mãe. Os resultados observados foram que as crianças demonstraram um repertório completo de componentes empáticos a partir de 11-12 meses. Os perfis das respostas empáticas afetivas e cognitivas nas fases de dor e recuperação mudaram de acordo com a idade dessas crianças. Além disto, a ansiedade materna foi relacionada com as respostas afetivas das crianças de maneira oposta, de acordo com a idade, enquanto a empatia materna estava relacionada apenas com os comportamentos afetivos das crianças mais novas. Em conclusão, este estudo ressalta o início precoce das respostas empáticas, assim como seu caráter dinâmico. Ademais, sugere que o estado afetivo e a empatia da mãe podem ser importantes moduladores da empatia nas crianças. Um perfil distinto foi observado de acordo com a idade dessas crianças, enfatizando a necessidade de analisar as respostas empáticas durante o desenvolvimento.

**Palavras-chave:** Empatia, desenvolvimento infantil, ansiedade materna, depressão, empatia materna

**1 INTRODUCTION**

Navigating the social world requires skills that allow the interaction with others and the establishing of long-lasting bonds. One of these skills is empathy. Despite the existence of multiple definitions (Batson, 2009; Bloom, 2017, Schurz et al., 2020), empathy can be considered as the ability to experience an emotional response to another individual's affective state (affective component), to recognize and understand its emotions, distinguishing them from one's own (cognitive component) and to express prosocial behavior to care for the other’s well-being (motivational component) (Eisenberg et al., 2015; Preston & de Waal, 2002; Decety & Jackson, 2004; Davidov et al., 2020).

The onset and development of empathy have been subject of controversy. Some studies propose that young children are emotionally and cognitively immature to experience concern for others (Butterworth, 1992; Bischof-Köhler, 1991; Hoffman, 1975; Eisenberg et al., 2006). In this sense, Hoffmann et al (1975, 2001) posit that children do
not start to show concern for others before the second year of life. In contrast, other studies suggest that the building blocks of empathy appear as early as the first week after birth. For example, newborns cry in response to another infant crying (Dondi et al., 1999; Geangu et al., 2010, Liddle et al., 2015), and exhibit facial expressions in response to the emotions of others (Izard, 1982; Havard et al., 2010, Uzefovsky et al., 2019). According to this, a recent paper (Davidov et al., 2020) shows that children exhibit empathic concern to the mother's pain simulation from as early as three months of age. Later during development arise more complex components related to the cognitive and prosocial aspects of empathy (Feldman 2007a; Warneken and Tomasello, 2006; Nichols et al., 2009; Geangu et al., 2011; Zahn-Waxler et al., 2018).

A widely used and validated model to assess children's empathy to others' distress at early ages has been developed by Zahn-Waxler et al. (1992a). It consists of a pain phase, during which the mother (or the experimenter) simulates pain, followed by a recovery phase in which she expresses a gradual recovery from pain. Using this model, it has been recently shown that the expression of the different empathic components differ according to the age of the children (Knafo et al., 2008; Roth-Hanania et al., 2011; Davidov et al., 2013; Zahn-Waxler et al., 2018). However, as far as we know, there is no study that has assessed the dynamics of the empathic components along the two phases of the model, which is relevant because it could present variations according to age. For instance, it has been shown that 24 months old children reach an intensity peak in their empathic responses faster than 14 months old children (Knafo, 2008; McDonald & Messinger, 2011). In addition, based on the finding that the capacity to regulate emotions is not totally developed during the first year of life (Kestenbaum & Nelson, 1992, Tronick 1989, Calkins, S. D. (2008), it could be hypothesized that children of that age maintain some of their empathic responses during the recovery phase, while older children may be able to down-regulate their responses in that phase.

Recent studies have emphasized the role of the early environment in the development of empathic skills (Demetriou & Hay, 2004; Zahn-Waxler, & Goldsmith, 2007; Knafo et al., 2008). Thus, children start to sculpt their social and emotional abilities early in life, in a complex process influenced by the quality of the environment. Specifically, the emotional state of the parents and their strategies to express and regulate emotions within social interactions are key for children's emotional development (Fonagy et al., 2007; Denham, 2007, Meins, 2013; Zeytinoglu et al., 2017). In this sense, maternal depression has been extensively studied regarding child emotional development. For
instance, depressive mothers are less responsive to their child's demands and have a more negative perspective of their child, which can lead to a disrupted interaction in the mother-child interaction (Gelfand & Teti, 1990; Hughes et al., 2020). Maternal anxiety also has a deep impact on mother-child interactions (Bergman et al., 2007; Feldman et al. 2009). Hence, the majority of the studies show that anxious parents have difficulties to adjust their behavior to the children’s needs, and are more likely to intervene in emotionally-charged situations in an intrusive manner affecting their outcomes (Hudson & Rapee, 2002; Ballash, et al., 2006), although some findings suggest that the effect of maternal anxiety on children's affective behavior is small (Rees et al., 2019; Walker et al., 2020).

Despite the relevance of these factors, there are few studies associating mothers’ depression with the development of children’s empathic responses (Apter-Levy et al., 2013) and as far as we know, none regarding maternal anxiety.

There is plenty of evidence showing that the ability of parents to explain emotions, vocalizing positively, sharing positive emotions, and comforting, correlates with greater social competence and understanding of emotions in children (Denham et al., 1997; Zhou et al. 2002; Taylor et al. 2013; Ornaghi et al., 2020). For instance, Eisenberg et al., (2011) found that children whose mothers accept and positively react to their emotions are more empathic. Maternal empathy has also been related to an increased adaptability of the mother during the interaction with her child (Settipani & Kendall, 2017). Most of these studies had focused on empathy within the context of the parent-child relationship (Fonagy et al., 2007; Spinrad & Gal, 2018; Levy et al., 2019), but little is known about the relationship between maternal empathy as a trait and the early empathic responses of children. Thus, examination may allow a further understanding of the influence of mother’s trait empathy on the development of empathic responses in children.

Based on previous results (Roth-Hanania et al., 2011), we hypothesize that all components of empathy are present at 11-12 months of age. In addition, we posit that the dynamics of the empathic responses change depending on the phase of the model: pain or recovery, and that a different time profile emerges according to children’s age. Besides, we hypothesize that maternal anxiety, depressive symptomatology and empathy are associated with children’s empathic responses. Therefore, we first aimed to characterize and compare the empathic responses of two age groups of healthy children (11-12 and 14-15 months old) over the two phases (pain and recovery) of a well-established model of simulated distress (Zahn-Waxler et al., 1992a). Secondly, we aimed to assess the
association between mother’s trait anxiety, depressive symptomatology and trait empathy, and children’s empathy at these two different ages.

2 METHODS

2.1 PARTICIPANTS

Twenty one infants (13 girls) were divided into two groups A: 11–12 (M=11.4, SD= 0.5) B: 14-15 months old (M = 14.8, SD = 1.3), as well as their mothers (A: M= 34.9, SD=2.4; B: M= 33.8, SD= 3.0). All subjects that participated in the study were from Uruguay and lived in metropolitan areas. Data from six additional infants were excluded from the study due to unreliable mother’s pain simulation (n=3), or experiment interruptions (n= 3). All participants were of middle to upper-middle socioeconomic status and had a university degree. Table 1 presents the demographic characteristics of the sample. All mothers responded to an online survey, posted through the Universidad de la República’s communication channels.

Mothers who were under pharmacological mental treatment or diagnosed with psychological disorders were excluded from participation as well as children with mental or physical challenges (e.g., hearing impairment, autism, cardiopathies) or with medical negative observations on their three last pediatric controls. Adoptive mothers and twins were also excluded.

3 PROCEDURE

Mothers were contacted to evacuate doubts and to explain the procedure. Afterwards, they were divided into two groups according to their children’s age. Then, they received a link to access to two self-report questionnaires: State-Trait Anxiety Inventory Subscale (STAI, Spielberger, 1983) to assess anxiety and Edinburgh Postnatal Depression Scale (EPDS, Cox et al., 1987), to assess depressive symptomatology. Both questionnaires were sent in that order approximately two months prior to the empathy assessment. The mother’s empathy score was assessed after the home visit with the Empathy Quotient questionnaire (EQ, Baron-Cohen & Wheelwright, 2004), to avoid interference with data collection. Mothers completed all questionnaires on a secure platform that tracked the time of completion (Psy Toolkit, Stoet; 2010,2017).

Children empathic responses were assessed at home in a simulated distress model (Zahn-Waxler et al., 1992a). To standardize the acting of the mothers during the empathy test we previously sent to them a video of an actress simulating pain and recovery. Data
were collected by two trained researchers, who were blind regarding the conformation of the groups, and were videotaped for subsequent coding.

3.1 BEHAVIORAL MEASURES AND DATA CODING (MODIFIED FROM ROTH-HANANIA ET AL., 2011)

Mothers were instructed to interact with their children as following: 1: mother engages in play with the child using a new toy (a spinning top) during 30 seconds (neutral situation); 2: mother simulates pricking herself and pretends to feel pain by means of verbalizations and pain gestures for 30 seconds (pain simulation), avoiding to establish eye contact or promote child’s response; 3: mother simulates gradual diminishing in pain for additional 30 seconds until reaching neutral affect, relieving the stress that the child may have experienced (recovery phase). Three reasons support the selection of this pain simulation. Firstly, it generates clear distress in children without being too intense or overwhelming, as the distress is only moderate at its peak and the episodes are relatively short. Secondly, it takes place in a familiar environment, allowing a more naturalist and ecological observation; and thirdly, similar procedures have been used in prior work on empathy development with older infants, toddlers and young children (e.g. Sigman, et al., 1992; Young, et al., 1999; Kiang et al., 2004). The behavioral responses were classified into three components, and were coded and scored as described below.

3.1.1 Affective concern

Affective expressions of apparent concern for the victim, including facial, vocal, or gestural-postural manifestations were rated on a 4-point scale on which 1 = absent, 2 = slight (some concern expressed in face or voice, e.g., brow furrow, but relatively fleeting or slight), 3 = moderate (prolonged brow of eyes or vocal contours expressing concern or sadness, freezing body and limbs), and 4 = substantial (sustained sadness expressed in sympathetic vocal tones, cooing, prolonged freezing, or facial expressions, e.g., a sympathetic face in which eyebrows are drawn down and brow drawn up over the nose, or a sad expression with the corners of the mouth drawn downward).

3.1.2 Inquiry behaviors or hypothesis testing

Behaviors indicating that the child attempts to cognitively comprehend the other’s state, as seen in exploration and efforts to understand the distress situation of the victim. These behaviors were rated on a 4-point scale in which 1 = absent, 2 = simple non-vocal
or simple vocal inquiries or exploration about the distress (e.g., non-vocal: touches own body part corresponding to the “injured” part of the victim, looks back and forth from victim’s face to “hurt part” or to other adult; vocal: vocalization with a questioning intonation), 3 = combination of both non-vocal and vocal inquiry of the distress (a single query combining both non-vocal and vocal hypothesis testing), and 4 = repeated or relatively sophisticated attempts to understand the distress, combining both vocal non-vocal behaviors.

3.1.3 Prosocial behavior

Attempts to help or comfort the distressed victim were rated on a 4-point scale, where 1 = none, 2 = slight assistance (one pat or verbalization), 3 = moderate assistance (offer a toy or physical contact for 3–5 s, or repeatedly verbalize prosocially), and 4 = prolonged assistance (offer a toy or physical contact for more than 5 s).

All previous studies, using the codifications system developed by Zahn-Waxler et al. (1992), have traditionally analysed the distress simulation as a whole (including 30s for pain simulations and 30s for recovery). Here we introduced a separated analysis for each phase in both ages based on the clear differences between both phases.

We also included a complementary approach to coding children’s empathic responses. In addition to using the traditional 4 point score scale for the three components (affective concern, inquiry and prosocial behavior), we also quantified the time spent in the behaviors included within each component. To achieve this aim we microcoded behaviors with an open source software (JWatcher; Blumstein & Sunderland, 2007) frame by frame during the pain and the recovery phases. Within the affective component we measured the time spent in: sad and serious expressions, distress vocalization and freezing. For the inquiry component we included: looking at the mother's face, looking at the object, looking at the damaged area, touching the corresponding part to the damaged area on one’s own body, and looking for information; and for the prosocial behavior component we assessed: physical contact and attempts to help or comfort.

3.1.4 Intercoder agreement

To establish coding reliability, half of the recorded empathy sequences, equally distributed between age groups, were scored by a second coder, who was naive about the purposes of the study and the age of the children. Intercoder agreement, measured using
Cohen’s kappa, averaged 0.82 and never scored below 0.5, which can be considered a substantial agreement (Zegers et al., 2010).

3.2 MOTHER’S EMOTIONAL STATE AND EMPATHY MEASUREMENT

3.2.1 Edinburgh Postnatal Depression Scale

(EPDS, Cox et al., 1987) The EPDS is a 10-item instrument widely used to assess maternal postnatal depression. It has also been found to have satisfactory validity among non-postnatal women (Cox et al., 1996; Eberhard-Gran et al., 2002). Its sensitivity and validity have been tested in Latin American and Spanish-speaking countries (e.g. Garcia-Esteve et al., 2003; Terrén et al., 2003; Alvarado et al., 2015). We used a Spanish translated version used in previous studies (translated by University of Iowa; Ferreira et al., 2018). Mothers were asked to choose from the given options those that best describe their feelings during the previous week. Each question is scored 0–3, resulting in a range from 0 to 30. Here we use EDPS scores of 10 and 13 as a cut-off indicative of possible minor or major depression, respectively (Cox et al., 1987).

3.2.2 State-Trait Anxiety Inventory

(STAI; Spielberger, 1983) The STAI is a self-report measure comprising 40 items to assess state and trait anxiety, with 20 items in each subscale. In this study we used only the 20 items scale for trait anxiety, where mothers rate how they generally feel in regard to each item (e.g., worry, calm). Participants respond using a Likert’s scale ranging from 1 (almost never) to 4 (almost always). Here we used a Spanish version validated for Latin-American countries (Uruguay, Argentina, Colombia, Ecuador, Mexico and Peru) (Arias-Galicia, 1990; Rojas-Carrasco, 2010; Ferreira et al., 2018). As recommended by the developer of the test, anxiety scores between 40 and 59 were taken as indicative of moderate anxiety (Spielberger, 1983).

3.2.3 Empathy Quotient

(EQ, Baron-Cohen & Wheelwright, 2004). The EQ is a 40-item self-report measure that assesses empathic traits, including cognitive empathy, emotional reactivity, and social skills (Lawrence, et al., 2004). The EQ provides a total empathy score that has adequate test-retest reliability and concurrent validity with additional measures of empathy (Lawrence et al., 2004). We used a Spanish version developed by Redondo and
Herrero-Fernandez (2018). The instrument scores from 0 to 80, the lowest and the highest empathy level respectively (Baron-Cohen & Wheelwright, 2004).

3.2.4 Statistical analysis

As the data did not follow a normal distribution (Kolmogorov-Smirnov test, p < 0.05), all data is presented as medians and semi-interquartile ranges (SIQR). To compare between independent groups we use the Mann-Whitney U test and to compare dependent groups we utilize the Wilcoxon sign rank test. In order to explore the correlation between children’s empathic responses and mother’s anxiety, depressive symptomatology and empathy we use the Spearman correlation test and we correct the correlations with the Bonferroni test (Siegel, 1956).

3.2.5 Ethical considerations

Ethics approval was provided by the Comité de Ética de Facultad de Psicología de la Universidad de la República (191175-000728-18.) Each mother gave an informed consent previous to each questionnaire and signed a physical consent at the beginning of the researcher’s visit.

4 RESULTS

<table>
<thead>
<tr>
<th>Table 1. Demographic variables of the studied population</th>
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<tbody>
<tr>
<td>Characteristics</td>
</tr>
<tr>
<td><strong>Age</strong></td>
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<tr>
<td>Children (months)</td>
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<tr>
<td>Mothers (years)</td>
</tr>
<tr>
<td>Maternal education</td>
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<tr>
<td>High school</td>
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<tr>
<td>Bachelor’s degree</td>
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<tr>
<td><strong>Family status</strong></td>
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<tr>
<td>Married (or common-law partnership)</td>
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<tr>
<td>Divorced or separated</td>
</tr>
<tr>
<td>Single</td>
</tr>
<tr>
<td><strong>Number of children</strong></td>
</tr>
<tr>
<td>1</td>
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<tr>
<td>2</td>
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<tr>
<td>3</td>
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<tr>
<td><strong>Level of perceived support</strong></td>
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<tr>
<td>Low</td>
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<tr>
<td>Sufficient</td>
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<tr>
<td>High</td>
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<tr>
<td>Very High</td>
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</table>
### 4.1 AFFECTIVE CONCERN, INQUIRY AND PROSOCIAL BEHAVIOR

#### 4.1.1 Empathic responses in the pain and recovery phases (using 4 point score scale).

As shown in figure 1, the comparisons between age groups show that the younger children exhibited lower, although not significant, scores of prosocial behavior than the older ones during the recovery phase (Mann-Whitney U test; younger: 2.5(0.5); older: 3.5(0.5) U= 27; p=0.076)

In addition, in the comparison between phases affective concern shows a strong tendency to be higher in the pain than in the recovery phase for older children (Wilcoxon sign rank test; pain: 3(.87); recovery: 2.0 (1.0); W=32; p=0.066). Also, the older children exhibited a significant increase in prosocial behavior during the recovery phase than during the pain phase (pain: 1.5(.87); recovery: 3.5 (0.5);W=34; p=0.027).

#### 4.1.2 Time spent in different empathic behaviors

Table 2 shows the duration of each behavior included in the empathy’s components (affective concern, inquiry and prosocial behaviors) using a frame by frame microcoding analyzing (see Methods).

---

**Table 1:**

<table>
<thead>
<tr>
<th>Family income (per month)</th>
<th>≤ 20.000 UYU</th>
<th>20.000 - 30.000</th>
<th>30.000 - 50.000</th>
<th>≥70.000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>6</td>
<td>6</td>
<td>9</td>
</tr>
</tbody>
</table>

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**Figure 1.** Comparisons of children’s empathic responses according to Zhan-Waxler et al., 1992 (4 points scale) A. Children’s affective concern B. Inquiry. C. Prosocial behaviors. Pain phase in white, recovery phase in dark. * p<0.05, Wilcoxon sign rank test; † p<0.08, Mann-Whitney U test.
4.1.2.1 Age groups comparisons

During the pain phase, the older children spent more time in three affective concern’s behaviors - sad and serious expressions and freezing - than the younger ones. Also, the older children spent more time looking at the mother’s face and the spinning top - two behaviors included in the inquiry component - than the younger ones. Interestingly, during the recovery phase, the younger children spent more time than the older ones in the same three affective concern behaviors. In addition, at this phase, older children kept expressing the same two inquisitive behaviors for a longer period of time compared to the younger children. Finally, only at this phase, time in attempts to help - a prosocial behavior - was higher in the older children than in the younger ones (see Table 2).

4.1.2.2 Pain and recovery phases comparisons

As shown in Table 2, the comparisons between phases show that younger children spent an increased time in affective behaviors (sad and serious expressions) at the recovery phase than at the pain phase. Younger children also exhibited a decreased time in some inquiry behaviors (looking at the damaged area and seeking information from the mother) at the recovery phase compared to the pain phase. In contrast, the older children spent more time in affective behaviors (sad and serious expressions and freezing) at the pain than at the recovery phase. Older children also spent less time in some inquiry behaviors (looking at the mother’s face and information seeking), and more time attempting to help or comfort the mother at the recovery phase than at the pain phase.

<table>
<thead>
<tr>
<th>Table 2. Time spent in components of affective concern, inquiry and prosocial behaviors according to children age and phase (pain and recovery)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>11-12 m</strong></td>
</tr>
<tr>
<td>Pain</td>
</tr>
<tr>
<td><strong>Affective concern</strong></td>
</tr>
<tr>
<td>Sad expression</td>
</tr>
<tr>
<td>Serious expression</td>
</tr>
<tr>
<td>Freezing</td>
</tr>
<tr>
<td><strong>Inquiry</strong></td>
</tr>
<tr>
<td>Look at the mother’s face</td>
</tr>
<tr>
<td>Look at the spinning top</td>
</tr>
<tr>
<td>Look at the damage area</td>
</tr>
<tr>
<td>Information seeking</td>
</tr>
<tr>
<td><strong>Prosocial behavior</strong></td>
</tr>
<tr>
<td>Attempts to help</td>
</tr>
<tr>
<td>Attempts to comfort</td>
</tr>
</tbody>
</table>

Data are expressed as medians (SIQRs). *p < 0.05 vs. pain phase, Wilcoxon test. #p < 0.05 vs. 11-12 months, Mann Whitney U test.
4.2 CORRELATION BETWEEN MOTHERS’ ANXIETY, DEPRESSIVE SYMPTOMATOLOGY AND EMPATHY TRAIT AND CHILDREN EMPATHY RESPONSES

4.2.1 Anxiety, depressive symptomatology and empathy trait

Table 3 shows the scores of maternal depression, trait anxiety and trait empathy. Only three mothers scored between 40 and 50 indicating moderate anxiety levels (one in group A: younger children’s mothers, and two in B: older children’s mothers). All mothers were below the cutoff score for severe depressive symptomatology and presented a high level of empathy. There was no significant difference between mothers from both groups.

<table>
<thead>
<tr>
<th>Variable</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal depression (EPDS)</td>
<td>7.2 (.84)</td>
<td>5.5 (.46)</td>
</tr>
<tr>
<td>Maternal trait anxiety (STAI-T)</td>
<td>35 (2.9)</td>
<td>31 (1.4)</td>
</tr>
<tr>
<td>Maternal empathy (EQ)</td>
<td>56 (1.4)</td>
<td>53 (1.0)</td>
</tr>
</tbody>
</table>

Data are expressed as medians (standard error), p > 0.05 A vs. B. Mann Whitney U test.

As shown in Fig. 2A, the time spent in serious expression, a behavior included in the empathic concern component, was negatively correlated with the mother’s trait anxiety score during the pain phase. In addition, at this phase, the time that older children spent looking at the mother's face - an inquiry behavior - was positively correlated with the mother’s trait anxiety scores. No other children's behavior showed a significant association with the mother’s affective state. Figure 2C shows that during the pain phase, the time spent in sad expression was positively correlated with the mother’s empathy score, assessed with Empathy Quotient. We did not detect any significant correlation between mother’s depressive symptomatology and children's empathy behaviors (data not shown).
5 DISCUSSION

In this study we show that during the transition to the second year of life, children exhibited the full repertoire of empathic components towards the mother’s simulated distress. We also described, for the first time, the dynamics of the empathic responses during the two phases of the model and how they changed according to the age of the children. In addition, we found that maternal anxiety was correlated with children’s affective responses in an opposite manner according to children’s age, while maternal empathy was only correlated with affective behaviors in young children.

Here we show that affective concern, inquiry and prosocial behavior towards the distress of the mother were already present in children from as early as 11-12 months of age. While previous studies also found the presence of affective and cognitive components of empathy during the transition to the second year, the expression of prosocial behavior was very limited at this age (Hoffman, 1975, 2001; Knafo et al., 2008; Zahn-Waxler et al., 1992b). For instance, Roth-Hanania and colleagues (2011, 2020) found it only in 11-15% of the children. In this study we found that, at 11-12 months, most children expressed prosocial behaviors but very briefly. The nature of these differences is unknown but it could be proposed that they are related to variabilities in several factors concerning the mothers, the children and the culture. Interestingly, in this study mothers showed high levels of empathy scores together with low levels of depressive symptomatology which may be related to the higher expression of prosocial behaviors compared to previous studies.

It has been proposed that the capacity to show the full empathic response requires the cognitive ability to distinguish between the other’s distress and children’s own
(explicit self-other differentiation), a capacity that is achieved towards the middle of the second year of life (Butterworth, 1992). Our observation that all components of empathy were present at 11-12 months suggests that these components do not require the cognitive ability of self-other differentiation. In this sense, it has been proposed that a basic ability of implicit self-other differentiation is present in very young infants (Dondi, et al., 1999). Furthermore, it could be argued that the expression of empathic responses is not dependent on the explicit capacity of self-other differentiation, but on the ability to effectively regulate emotional arousal and remain focused on the other, which can be observed in young children (Davidov, 2013).

As empathic responses are flexible, changing according to the mother's distress signs, in this study we performed, for the first time, a separated analysis of the children’s behavior during the pain and the recovery phases of the model. Using this approach, we found that even if both age groups of children exhibited all the empathic behaviors, a different empathic profile emerged according to the age. Thus, while older children reduced the affective concern, the younger ones maintained this response at the recovery phase, according to the 4 point score scale (implemented by Zahn-Waxler et al., 1992a). Also, the microcoding of the responses, using a frame by frame analysis, a new approach of this study, shows that the duration of affective concern (sad and serious expressions, and freezing) was higher in older children than in younger ones during the pain phase, a pattern that was reversed during the recovery phase. It could be reasonable to propose that the reduction of affective behaviors in older children during the recovery phase relies on their ability to self regulate emotional arousal. Together, these results indicate an opposite temporal dynamics of affective concern expression according to age, probably related to differences in maturation.

Regarding the inquiry behavior, a cognitive component of empathy, no differences between ages were detected when using the 4-point scale. However, the microanalysis of these behaviors reveals that the time spent in looking at the mother’s face and at the spinning top was higher in older children than in younger ones during both the pain and the recovery phases. Interestingly, even though children from both ages decreased the time expressing inquiry at the recovery phase, the behaviors differed according to the age. Thus, younger children reduced the time spent looking at the damaged area while the older ones decreased the time looking at the mother. Taking into account the features of these behaviors, it could be proposed that looking at the damaged area could represent an active visual search pattern to infer the cause of the distress, while looking at the mother's
face could be considered a more passive response during which the child awaits the mother’s reaction with less cognitive effort. If this was the case, it could be speculated that younger children decreased their active inquiry response, whereas older children maintained this behavior and decreased the passive one.

Prosocial behavior is considerably higher in the older children than in the younger ones during the recovery phase according to the 4-point scale analysis. In the same sense, the time engaged in attempts to help, an important prosocial behavior, was significantly higher in older children than in younger ones. This result is in accordance with previous studies showing that the expression of prosocial behavior is very reduced during the first year of life and increases during the second year as a reflection of children's capacity to act upon the motivation to help (Davidov et al., 2013, 2020).

Taken together these results evidence the existence of age-dependent profiles for the expression of the affective, inquiry and prosocial components of empathy. It could be proposed that the reduction of affective concern during the recovery phase and the increase of active inquiry behaviors may allow older children to emotionally regulate distress and infer information about the situation, leading to a more comprehensive understanding of the context and to an accurate performance of prosocial behaviors, such as offering a toy or touching the mother for comfort.

In this study, all mothers presented levels of depressive symptomatology below the cutoff and no associations were found between it and children’s empathic outcomes. Although it is well known that depressive symptoms in parents are related to adverse emotional, behavioral and cognitive outcomes in children (Jones et al., 2000; Beebe et al., 2010; Feldman, 2007b), the lack of association in this study could indicate that higher levels of maternal depressive symptomatology are required to detect changes in children’s empathy. In fact, as far as we know, all studies which claim an association between maternal depression and children’s empathy have focused on samples with high depressive scores or clinical population (Apter-Levy et al., 2013; Pratt et al., 2017; 2019).

Interestingly, we found associations between maternal anxiety scores and the time children spent in some empathic responses during the pain phase. Thus, the mother’s trait anxiety was negatively correlated with the serious expressions (affective component) of younger children. On the contrary, the mother's trait anxiety was positively correlated with looking at the mother's face (cognitive component) in older children. Taken together, these results indicate that children’s empathic responses are sensitive to maternal anxiety in an age-dependent manner. The negative correlation detected for the younger children
could be attributed to the mother’s lower sensitivity to detect children’s signals. In this sense, several studies show that maternal anxiety is characterized by maternal disengagement in facial, vocal and tactile communication during an interaction with their infants, and to a less supportive behavior during distress situations (Weinberg & Tronick, 1998; Nicol-Harper et al., 2007; Granat et al., 2016). This could lead to children developing self-soothing strategies such as emotional numbing or interpersonal avoidance behaviors due to insecurity (Rinck et al., 2010; Fearon et al., 2010). Conversely, the positive correlation between mother’s anxiety trait and an inquiry behavior detected for older children may reflect a better self-regulation and a less emotional dependence on the mother. In this regard, it has been observed that mild levels of maternal anxiety, like those observed in this study, are related to a greater development of some cognitive skills, particularly motor and visual skills (Keim et al., 2011, van den Heuvel et al., 2015).

Regarding maternal empathy, we found that children’s affective reaction (time in sad expression) was positively associated with the mother’s empathy scores. In fact, maternal empathy was proposed to have positive effects on the development of the child (Feshbach, 1987; Oppenheim et al., 2004). Probably, mothers with high or moderate empathy might be better at understanding and responding to the developmental and emotional needs of their children which can result in a greater quality of mother-child bond and in a decreased likelihood of developing emotional numbing as a self-shooting strategy or dyadic adjustments outcomes (Murphy et al., 2013; Levy et al., 2019).

Present results have to be taken with care due to the small sample used in this study. A larger population using the microcoding procedure in longitudinal designs may allow a deeper understanding of the development of each empathic behavior. Other factors, like the gender, the temperament, the presence of siblings, and the support that the mother receives may have influenced present results and should be taken into account in future studies. Despite these limitations, our findings may provide promising avenues for further research, related to the structure and the dynamics of children’s early empathic responses to mother’s distress.

In conclusion, this study underscores the early development of the full profile of empathic behavior as well as its dynamic character, changing according to the emotional signals of the mother during the pain and the recovery phases of the model; and according to age of the children, stressing the role of cognitive maturation. Furthermore, it sheds light on the idea that maternal anxiety and empathy may sculpt early empathic responses
in children. Taken together, our results underscore the dynamic character of children’s empathic behavior, that changes according to multiple factors such as the age, the emotional signals of the mother during the interaction and the mother’s emotional state.
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