



Contents lists available at ScienceDirect

Infant Behavior and Development

journal homepage: www.elsevier.com/locate/inbede



Changes in patterns of Early Mother-Child Interaction: A longitudinal study of the first 18 months of life

Laura Patricia Perea-Velasco^a, María Teresa Martínez-Fuentes^b, Julio Pérez-López^{b,*}

^a University of Murcia, Therapist of Early Intervention/Care, Torrevieja's Early Care Center APANEE, Spain

^b Department of Developmental and Educational Psychology, Faculty of Psychology, University of Murcia, Campus de Espinardo, Murcia, Spain

ARTICLE INFO

Keywords:

Mother-child interactions
Maternal sensitivity
Response latency
Childhood
Infant's development
Attachment
Sensitive parenting

ABSTRACT

Objective: The main objective of the present longitudinal study is to describe the progression of early adult-child interactions between the first and second years of life. Changes identified in interactions are described, focusing on both the qualitative aspects of maternal responses, as well as maternal response latency to the child's behavior using a microanalytical methodology that collected data on maternal and child behavior in real-time without losing sight of the temporal dimension.

Participants: This study examined 52 mother-child dyads from intact families that presented no psychological, social, or biological risk factors at 6, 12 and 18 months of age.

Instrument: CITMI-R (early mother-child interaction coding system, revised edition) was used to assess early mother-infant interactions during free play sessions between mother and child the.

Results: The results indicate that some components of maternal sensitivity improve as children progress towards the second year of life, detecting an increase in sensitive maternal behavior and a decrease in intrusive behavior in the evolutive observed period; moreover, regarding latency of maternal response, we observed that mothers of older children give more time for their children to explore, which stimulates autonomy. Finally, the implication of these results for intervention directed to optimizing early adult-child interactions are addressed.

1. Introduction

The experiences that allow children to learn about the world and its objects, which are necessary to promote child development, happen between individuals, and often, in response to the persons whom they interact with (Smith, 2010). The importance of the quality of these interactions as catalysts for development throughout the life cycle, though especially in the first few years of life, depends largely on the extent of adjustment and synchrony between children and the adults in their surroundings, that is, the quality of the interactions between children and their primary caregivers; this is because children begin to confidently explore and internalize the world around them through these individuals (Binnie, 2020; Cerezo et al., 2017), and the younger and more vulnerable the child is, more important the primary caregiver's intervention in providing support (Dietrichson et al., 2020).

Much of what is known about these interactions and their impact on child development is described in the scientific literature on the topic. A group of these studies has created a body of evidence that relates the quality of early interactions to secure attachment

* Corresponding author.

E-mail address: juliopl@um.es (J. Pérez-López).

(Ainsworth et al., 1978; De Wolff & van IJzendoorn (1997)). The results from these studies seem to confirm that secure attachment is a good indicator of the quality of early primary caregiver-child interactions, as well as to defend secure attachment as a protective factor for development (Letourneau et al., 2015).

Likewise, the quality of early interactions, understood as a function of the extent of primary caregiver sensitivity, has been related to different aspects of child development. Thus, some studies link interactions in which the caregiver shows sensitivity to the child's needs to greater emotional regulation (Olhaverby et al., 2022; Rodrigues et al., 2021; Samdan et al., 2020), while others indicate a lower incidence of childhood behavioral problems (Gerstein et al., (2015); Kok et al., 2013a; Van Aken et al., 2007), improved social skills (Groh et al., 2014; Mills-Koonce et al., 2015), optimal moral development (Kok et al., 2013a), and, generally, improved socio-affective development in children. In the same line, many studies relate maternal sensitivity to linguistic competence (Alvarenga et al., 2021; Camarata & Yoder, 2002; Gilkerson et al., 2017; NICHD Early Child Care Research Network (2006); Vallotton et al., 2017), as well as the development of basic cognitive processes such as attention, memory, and problem solving (Gerstein et al., (2015); Schore, 2005; Mills-Koonce et al., 2015). In addition, sensitive parenting is shown to have positive effects on child development in at-risk populations and represents an ideal scenario to favor child brain development in all populations (Gerstein et al., (2015); Mills-Koonce et al., 2015; Schore, 2005; Zengin Akkus et al., (2020)).

This is only a portion of the evidence that leads us to highlight the relevant role in determining child development played by how primary caregivers handle early interactions with their children. The majority of this research recognizes the importance of the quality of interactions as a catalyst and protective factor for all areas of development in the short, medium, and long term (Dietrichson et al., 2020; NICHD Early Child Care Research Network (2006)). Another finding from these studies is the transactional approach used to interpret dyadic relationships, which recognizes their bidirectional nature and the mutual feedback between primary caregivers and children in the consolidation of healthy rhythms of interaction (Kok et al., 2013a, 2013b; Sameroff, 2009; Feldman et al., 2004).

All of the previously mentioned studies reference maternal sensitivity to describe the quality of interactions. This construct, as stated above, originates in the work of Ainsworth and her colleagues in the 1970 s (Ainsworth et al., 1978). Their findings indicate that maternal sensitivity refers to a mother's ability to perceive behavioral signals from her child in real time, interpreting and responding to them in an appropriate, prompt, and contingent manner (Ainsworth et al., 1978). This definition entails a dynamic and reciprocal process that considers changes to each actor and involves the need to establish mutual and synchronous adaptation to those changes (Ainsworth et al., 1974; 1978; Shin et al., 2008). As a result, maternal sensitivity is a key construct to understanding the interaction processes children are immersed in, the experience of which creates models for the mental representation of others, of oneself, and of the world; these 'internal working models' are not limited to childhood but expand into adult life (Alink et al., 2009; Altschul, 1984; Caughy et al., 2009; Santelices et al., 2010). Addressing the temporal dimension of these models is crucial because the manner in which the adult responds to the child occurs in a specific amount of time, and children are especially sensitive to the contingencies between their behavior and what happens in their surroundings from a very early age (Bigelow & DeCoste (2003); Moore et al., 2009). These contingencies are the basis of interactional synchrony in the dyad (Yousafzai et al., 2015), and when sustained over time they help children to create expectations about themselves and the predictability and accessibility of others (Álvarez et al., 2017), as well as to facilitate exploration and skills acquisition (Schore, 2005). These issues are extremely relevant to cognitive development in early childhood (Samdan et al., 2020; Forcada-Guex et al., 2006) and are based on the appropriateness and promptness of the responses children receive from the individuals around them in the context of development.

From a methodological perspective, different approaches have been developed to record maternal sensitivity in early interactions between children and their primary caregivers. Traditionally, this phenomenon was analyzed in macro-analytical studies that typically used comprehensive rating scales to evaluate the process and focused primarily on maternal responses to child behavior, examples of this type of scales are the Ainsworth Maternal Sensitivity Scales, the Crittenden's Care Index and the Peterson MBQS, among others (Mesman & Emmen (2016)). This type of instrument makes possible to record the promptness and appropriateness of the maternal response to child's signals, but they do not explicitly measure the temporal dimension of the interactive processes that allows measuring the contingency of this responses (Trenado et al., 2021). Conversely, this issue is, in fact, addressed in studies with a micro-analytical approach, this type of works, generally record mother-child interactions in very short intervals of time (for instance, one minute), the CITMI-R is a good modern example of useful micro-analytical instruments (Cerezo et al., 2012; Cerezo et al., 2021). Using this paradigm, sequential coding of the flow of mother-child interactions is possible in real time during situations of free play, and the resulting interactions can be observed and followed without the need to establish specific time windows (Cerezo et al., 2019), which gives greater ecological validity to these observations.

Despite limited use of the micro-analytical approach in the field of interaction, this represents a major breakthrough in this area because it enables recording of the dynamic nature of these exchanges in real time as well as the changes in empirical patterns of response (Cerezo et al., 2012). Studies on the precursors of attachment security show the validity of this approach to understanding the construct of maternal sensitivity (Beebe & Steele, 2013). Given the analysis includes the temporal dimension, this approach enables determining the quality of the dyadic interaction and addresses not only the type of behavior exhibited between adults and children but also the contingencies and response times among members of the dyad. This highlights the importance of 'when' and 'how' adults respond in the flow of social exchange (Cerezo et al., 2012) and the impact it may have on the child's cognitive development.

1.1. The present study

In light of our currently acknowledge about the construct of maternal sensitivity, the quality of mother-child interactions, and the role these play in promoting optimal child development, the objective of this study is to analyze from a longitudinal perspective how mother-child interactions unfold and what characteristics emerge from the flow of dyadic interactions in a normal population with the

goal of identifying predominant patterns of interaction and their progression over the first two years of life.

Sameroff's transactional regulation model (2009) establishes that the child's developmental results depend, among other factors, on the mutual regulations that occur within the mother-child dyad, expecting a greater fit as the child grows. Likewise, Bronfenbrenner (1979) highlights that an indicator of the evolutionary change of the child is the gradual modification of the behavior of the main caregiver towards children; in this sense, adults tend to give way to children as they reach a greater capacity for play. The purpose of this work is to find out the changes that appear in the maternal response as the cognitive, motor and socio-affective abilities of her child change during the first 18 months of life. The ages of 6, 12, and 18 months have been chosen, in particular, because different evolutionary milestones emerge in this moments promoting new modes of interaction of the child with her/his physical and social environment. On the one hand, advances in motor and cognitive abilities give the child greater autonomy in exploring the environment, both physical and social, and on the other, it is the moment in which the attachment bond is configured, being the attachment figure responsible for regulating the exploratory activity and emotions of the child. In this process, it is expected that the adult-child dyad undergoes modifications in their shared interactive process, as a result of changes in infant's development, as Green et al. (1980) point out.

In this study, the approach to the analysis of the maternal response is made through the construct of maternal sensitivity proposed by Ainsworth et al. (1978), that considers the appropriateness of primary caregiver responses but also the temporal dimension (promptness) of maternal responses to children's demands based on their stage of development, in a no stressing free play situation (Leekers, 2011). Specifically, this research has a micro-analytical methodology, which allows a better capture of the behavioural contingencies within the dyad in both pointed aspects, appropriateness and prompt-ness of maternal responses to infant behavior, in a free-play situation.

Consequently, the temporal dimension included in this work is double, as it addresses, firstly, the changes between the ages of 6 and 18 months and, secondly, the interactive exchanges between the mother and the child that occur over real time (contingencies), given that the evaluation instrument used, CITMI-R, allows the measurement of contingent mother-infant sequences (Trenado et al., 2021).

This study analyzes the changes experienced by maternal sensitivity to the behavior of the child between 6 and 18 months in the following behaviors:

(1) *Appropriateness of maternal behavior to infant behavior*: examining the proportion of infant behavior to which the mother responded with sensitive vs. intrusive behaviour, considering two different infant antecedents: social approach and non-interactive behavior, i.e. play. In this way and as indicated by Cerezo et al. (2019) it is possible to capture the contingency between the behavior of the mother and the behavior of the child. We expect to find an increase in the ratio of sensitive response and a reduction in the ratio of intrusive behavior to interactive and non-interactive behavior in the child between 6 and 18 months of age.

(2) *Promptness of maternal response to infant behavior*: examining the latency of mother's response to the infant's social approach and infant play behavior. Taking into account the evolutionary milestones in the analyzed age period, we expect that the latency of mother's response to the infant's social approach do not have important changes between the measure moments. On the contrary, and taking into account that the child progresses towards a higher level of autonomy, we expect the latency of mother's response to infant play behavior to be higher.

2. Methods

2.1. Participants

The participants chosen for this study were part of a larger sample of families that participated in a child development monitoring program from 0 to 3 years old in the Prevention, promotion of child development and early care service of the University of Murcia (SEPRODIAT). The inclusion criteria were: children with normative development, without pathology, without biological or social risk, whose mothers had normal levels of parental stress, coming from intact heterosexual families, in possession of all the necessary evaluations for the purposes of this study. Participants were informed of the objectives and timing for each of the assessments, and they provided their informed consent to record the evaluation sessions and free play with their children, agreeing to transfer their rights to the information collected to be used exclusively for academic and research purposes.

Specifically, the participants in this study were 52 mother-child dyads from intact, middle-class families living in the Autonomous Community of the Region of Murcia. The average age of the mothers was 29.74 years ($SD=3.5$), and the age range was 22–39 years. Regarding their levels of education, 14.3% had completed a university degree, 54.3% had completed only secondary education, while only 31.4% had finished just primary education. The majority of the participants were first-time mothers (57.1%), while the remainder (42.9%) had two children. At the time of the evaluation, 57.9% of the mothers were employed full time, while they worked, children were in day care, during 4 or 6 h at day, and with their parents the rest of the time.

All the infants (29 boys and 23 girls) assessed were on term pregnancies (between 37 and 42 weeks of gestation [average = 39.75 / $SD=1.23$]) with no pre or postnatal complications, heights and weights in the normal range (range from 47 to 54 cm average = 50.55; range 2640 to 4580 g, average = 3352.65 g respectively), and an average APGAR score of 9 at one minute and 9.9 at five minutes.

The infants were assessed at three points in time: at six months (average=6.24 / $SD=0.26$), at 12 months (average=12.31 / $SD=0.18$) and at 18 months (media=18.18 / $SD=0.42$). Mental and psychomotor development indices for the infant participants were evaluated using the Bayley Scales of Infant and Child Development (Bayley, 1993) and were within normative ranges at each instance of measurement. The mental development indices average values obtained were 105.2, 103.0, and 95.5 at 6, 12, and 18 months, respectively; and the psychomotor development indices average values obtained were 92.3, 100.60 y 97.34 at 6, 12, and 18 months, respectively.

2.2. Instruments and measures

2.2.1. CITMI-R: Early Mother-Child Interaction Coding System, Revised Edition (Trenado & Cerezo, 2007)

Early mother-child interactions were evaluated using the 'CITMI-R: Early Mother-Child Interaction Coding System, revised edition' designed by Trenado and Cerezo (Trenado & Cerezo, 2007). As is explained by Cerezo et al., (2012, 2019, 2021), the CITMI allows for the sequential coding of mother-child interactions (although this study focused on this particular dyad, it can also be used with fathers or primary caregivers) and includes mutually exclusive categories for both participants. This instrument includes a micro-social analysis and records the frequency, length, sequence, and valence of mother-child interactions. Through the use of this instrument, the observer can codify interactions using distinct codes for different behaviors as they happen in real time (Trenado & Cerezo, 2007). Moreover, the CITMI-R has shown good standards in terms of psychometric properties in criterion of validity and content validity (Cerezo et al., 2019).

The CITMI-R includes a series of categories for each of the members of the interactive dyad (in our study, mother and child). Specifically, infant behavior can be recorded using six codes. There are three interactive codes for social approach (A), one each for neutral, positive, and negative valence and three non-interactive codes: playing (J), crying (L) and passiveness (Pa). For the mother or caregiver, there are three interactive categories: sensitive behavior (S) with neutral or positive valence; intrusive (T) and protective (P) behaviors, each with neutral, positive, and negative valence; and, a non-interactive category, indifference (F) (Trenado & Cerezo, 2007). Each of these categories is mutually exclusive and collectively exhaustive (see Table 1), and, together, they allow the flow of mother-child behavior to be recorded as observational time-event sequential data that can be used in a micro-social and sequential analysis of the interactions. The frequency, duration, sequence, and valence of exchanges is registered using this coding system; moreover, the system includes software that facilitates recording this data in real time. Thus, the data collected can be read as a coded text that includes all the interactions (Cerezo et al., 2012, 2021), and the sequence of behaviors can then be analyzed statistically.

The frequencies and response rates per minute of the interactive and non-interactive behaviors observed in the dyads, focusing on the most common behaviors and pairs of exchanges among the members of the dyad (see Table 1) specifically:

-Interactive Infant Behavior: Social Approach (A).

-Non-interactive infant behavior: Solitary play (J).

-Interactive maternal behavior: Sensitive (S), Intrusive (I), and Protective (P).

-The pairs of interactive behaviors are AS, AT, and AP.

-The pairs of non-interactive behaviors are JS, JT, and JP.

Frequency is the number of times that the observed behaviors are repeated throughout the observation. The response rate per minute was calculated by dividing the total frequency of each behavior or pairs of behaviors by the total observation time, and multiplying this result by 60.

-Mother's response latency: the time (expressed in seconds) between child Play (J) or Approach (A) behaviors, and his/her mother's response, is the difference between the coding time for the maternal behavior and the coding time for infant behavior.

Four female Psychology graduates received training as CITMI-R coders. Dr. Cerezo and her team, authors of the observation instrument, provided the training on its use. The training consists of 25 h that includes the following: theory and practice with recorded mother-infant interaction in a free-play setting of increased difficulty.

Inter-observer reliability was obtained using a timed-event alignment kappa coefficient, as described in Bakeman & Quera (Bakeman & Quera, 1995; Cerezo et al., 2021; Trenado et al., 2021). This reliability coefficient was chosen based on the characteristics of the assessment instrument, which provided timed-event sequential data. CITMI-R allowed us to capture the sequential and temporal nature of interactions due to its micro-analytical approach.

Table 1

Summary of CITMI-R categories (Cerezo et al., 2012, 2019).

INFANT CATEGORIES	
INTERACTIVE	Social approach (A): All verbal and non-verbal social interaction as a response to the mother or as a result of the child's own initiative.
Possible levels of affective valence: positive, negative, or neutral.	Solitary Play (J): The child plays entirely by him or herself, with or without objects, focusing his or her attention on examining his or her surroundings.
NON-INTERACTIVE	Solitary Crying and/or complaining (L): The child manifests general distress through these behaviors, specifically, tiredness, fatigue, hunger, frustration, etc.
	Passive/apathetic behavior (Pa): The child displays a distracted or bored facial expression and does not show interest in the adult nor seems interested in the different toys or objects present, which he or she neither looks at nor examines.
MATERNAL CATEGORIES	
INTERACTIVE	Sensitive (S): Applies to all maternal verbal or gestural social approach behavior directed at the child that do not represent an intrusion into their space nor an apparent interruption of their actions. The valence for this category of behavior can be either positive or negative.
Possible levels of affective valence:	Intrusive (T): Intrusive maternal behavior is defined as verbal or gestural approaches by the mother that interrupt the child's ongoing actions or invade his or her space without supporting his or her needs. This includes offering toys or games that are beyond the child's ability, capability, or interest or not allowing the child to choose. The valence for this category of behavior can be positive, neutral, or negative.
- Positive: when the mother behaves with an affectionate tone and a positive, warm, or outwardly sweet facial and vocal expression.	
- Neutral: when the mother behaves with a neutral facial and vocal expression.	
- Negative: when the mother addresses the child with a negative tone and a rigid, angry, or clearly annoyed facial expression.	

Coefficients such as Fleiss' kappa or Cohen's kappa do not permit evaluating levels of agreement between observers while also considering the temporal or sequential dimension of the data (Cerezo et al., 2019, 2021); these statistics are more appropriate in comprehensive or macro-analytical approaches to evaluating interactions. Accordingly, inter-observer reliability using a timed-event alignment kappa had been calculated.

To calculate this kappa coefficient, two pairs of observers assessed a total of 48 randomized interaction sessions (of the pool of 156 free-play episodes of mother-child dyads), which correspond to the three moments of evaluation at 6, 12, and 18 months (19, 18, and 11 respectively). The instrument's authors recommended to use the 15% of the sample, at least, for the interobservers reliability calculations (Trenado et al., 2021), the current study use more than this percent for this purpose (specifically a 30% of the total sample). The Event Alignment Kappa obtained a mean value of .51 (SD = .06) with a Maximum value of Kappa of .67 (SD = .09) and agreement percentage of 60.8% (average = 60.79, SD = 6.43%). These results indicated that the observers presented a reliability above .50, and given the number of codes from the CITMI-R and the great variability in their prevalence, the accuracy was considered to be above 67%. In the CITMI-R's coders protocol, the outcome criterion used was obtaining an Alignment Kappa above .60, which is a reliability level considered good (Trenado et al., 2021).

2.3. Procedure

2.3.1. Free-play sessions

As part of the child development monitoring program carried out by SEPRODIA of the University of Murcia, and after the developmental assessment, mothers were instructed to play with their children as they normally would and were given three or four age-appropriate toys for each of the three recorded session; all the dyads were given the same sets of toys for each session. While the mother receives the proper instructions, the child remains with her.

The sessions were held in a 15 m² room, air-conditioned, with toys and furniture adapted to the needs and characteristics of the child and the dyad (high chair, carpet to play on the floor and a chair for the mother), with two cameras located in opposite corners of the room providing two different views, one of the mother and one of the child. In all the evaluation and play sessions, the children had their sleeping and feeding needs covered.

All play sessions, at all ages, began with the child sitting in the high chair and the mother sitting in a chair across from him. The mothers were told that if they considered it appropriate, they could take their child out of the high chair and place it on the floor (on a carpet) to continue playing. These play sessions could reach a maximum duration of 10 min.

However, and with coding purposes, the first four-five minutes of the mother-child interactions were coded using the CITMI-R, as the authors of the instrument recommended (Cerezo et al., 2019). No significant differences were found in the different moments of measurement evaluated, regarding the duration of the free play sessions (M 6 months = 304.65 s, SD = 29.97, M 12 months = 309.59 s, SD = 18.67, M 18 months = 305.80 s, SD = 14.20, $F(2,102) = 0.806$, $p = .450$).

2.4. Data analysis

A two-way Repeated Measures MANOVA (multivariate analysis of variance) was conducted to examine the effect of age (6, 12, 18 months) on the rates (frequency of the behavior per minute) of the child social approach and solitary play variables (A and J respectively). In addition, Bonferroni post-hoc tests were performed to determine at which points in child development (6, 12, and 18 months) significant differences may arise and why; this test was chosen specifically to avoid Type 1 errors. Two One-way Repeated Measures ANOVAs, one each for the social approach (A) and solitary play (J) variables, had been also performed.

Two One-way Repeated Measure ANOVAs were conducted to examine the latency of maternal response to the child social approach (A) and solitary play (J) variables. For each One-way Repeated Measure ANOVAs performed (the frequency of variables A and J, and the response latency to variables A and J) the ratio of F and p values were reported as well as the effect sizes of eta squared values, η^2 .

Lastly, Chi-squared tests of goodness-of-fit was performed to determine if the age variable (6, 12, and 18 months) was related to the distribution of different patterns of maternal responses to infant behavior. All of these analyses were performed using the statistical program SPSS v. 20.0 for Windows and Microsoft Excel.

3. Results

3.1. Preliminary analysis

3.1.1. Infant play behavior and Infant's Social Approach

Considering the conditions for coding with the instrument used, the trajectory of social approach (A) and play (J) behaviors of the infants at 6, 12, and 18 months was analyzed before considering the sequences of mother-infant interaction. This attempted to avoid possible interpretation bias in the progression of pairing mother and child behaviors caused by the effect age had on the infant behavior (A and J). The purpose of this analysis was to identify the quality of the predominant maternal response without letting the tendency to provide more play and approach behavior as the child nears 18 months of age affect this assessment.

A repeated measures MANOVA was performed to evaluate the impact of age on the social approach (A) and play (J) variables. The results from the MANOVA indicate statistically significant differences at the three times of measurement considering the A and J variables jointly ($\lambda = 0.888$; $F(4, 202) = 3.088$, $p = .017$; $\eta^2 = 0.058$). Nevertheless, to verify whether one of the variables or both of them were statistically significant, each variable was analyzed separately; to do so, two repeated measures ANOVAs were performed,

one each for the dependent variables Social Approach (A) and Play (J). The Social Approach (A) variable did not show statistically significant differences [$F(2, 102) = 0.255$; $p = .775$; $\eta^2 = .005$], which indicates that the frequency of infant social approach behavior does not vary based on age; by contrast, the results from the repeated measures ANOVA for the Play variable (J) did show statistically significant differences [$F(2, 102) = 5.006$; $p = .008$; $\eta^2 = .089$]. In the latter case, a Bonferroni test was used to perform post hoc contrasts on the play variable to determine changes in behavior at the three times of measurement (see Table 2).

The results indicate significant differences between 18 months and 6 and 12 months with a statistically significant reduction in the rate of play at 18 months (M 6 months = 7.36, $SD = 3.13$; M 12 months = 7.06, $SD = 2.05$; M 18 months = 5.89, $SD = 2.05$). The trend for infant Social approach and Play behaviors from 6 to 18 months can be seen in Fig. 1.

The results from the analysis of the sequences of mother-infant interactions are presented below, first considering the maternal responses to child social approach behavior (AS, AT, and AP), and later considering maternal responses to non-interactive play behavior (JS, JT, and JP), and finally, the results related to latency times for maternal responses to both interactive behavior (A) and non-interactive behavior (J).

3.2. Appropriateness of maternal behavior to infant's social approach

The rates of each type of maternal response to infant's social approach behavior varied based on the age group ($\chi^2_{22} = 214.98$, $N = 52$, $p < 0.00001$). There was a higher rate of sensitive maternal responses to infant's social approaches for all ages observed; however, this tendency increased over time: 72.82% at six months, 85.03% at twelve months, and 89.63% at eighteen months (see Fig. 2). Both intrusive and protective maternal responses to infant behavior represent an interruption of the actions and space of the child, so they were grouped together in the Intrusive category (see Fig. 2). The proportion of intrusive maternal responses to infant social approach behavior (AT and AP) also demonstrates a change over time, with a tendency to decrease. Intrusive maternal behaviors changed over time as follows: 22.25% at six months, 12.21% at twelve months, and 9.04% at eighteen months (see Fig. 2). Protective maternal behaviors changed over time as follows: 4.88% at six months, 2.76% at twelve months, and 1.27% at eighteen months (see Fig. 2).

3.3. Appropriateness of maternal behavior to Infant Play Behavior

The rates of each type of maternal response to infant play behavior varied based on the age group ($\chi^2 = 155.48$, $N = 52$, $p < 0.00001$). There was a higher rate of sensitive maternal responses to infant play for all age groups observed; however, this

Table 2

Bonferroni test for the variable frequency of play at 6, 12, and 18 months.

(I)AGE	(J) AGE	Difference between averages (A-J)	Standard Error	Significance
6 months	12 months	.301	.495	1000
	18 months	1.475 *	.567	.036
12 months	6 months	-.301	.495	1000
	18 months	1.174 *	.401	.015

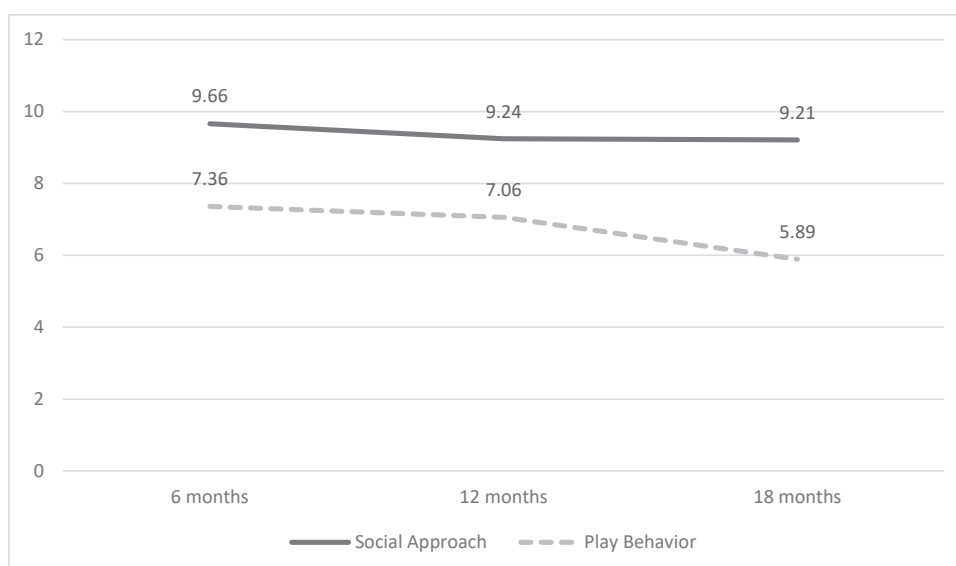


Fig. 1. Changes in the rates of infant social approach (A) and play (J) behavior at 6, 12, and 18 months.

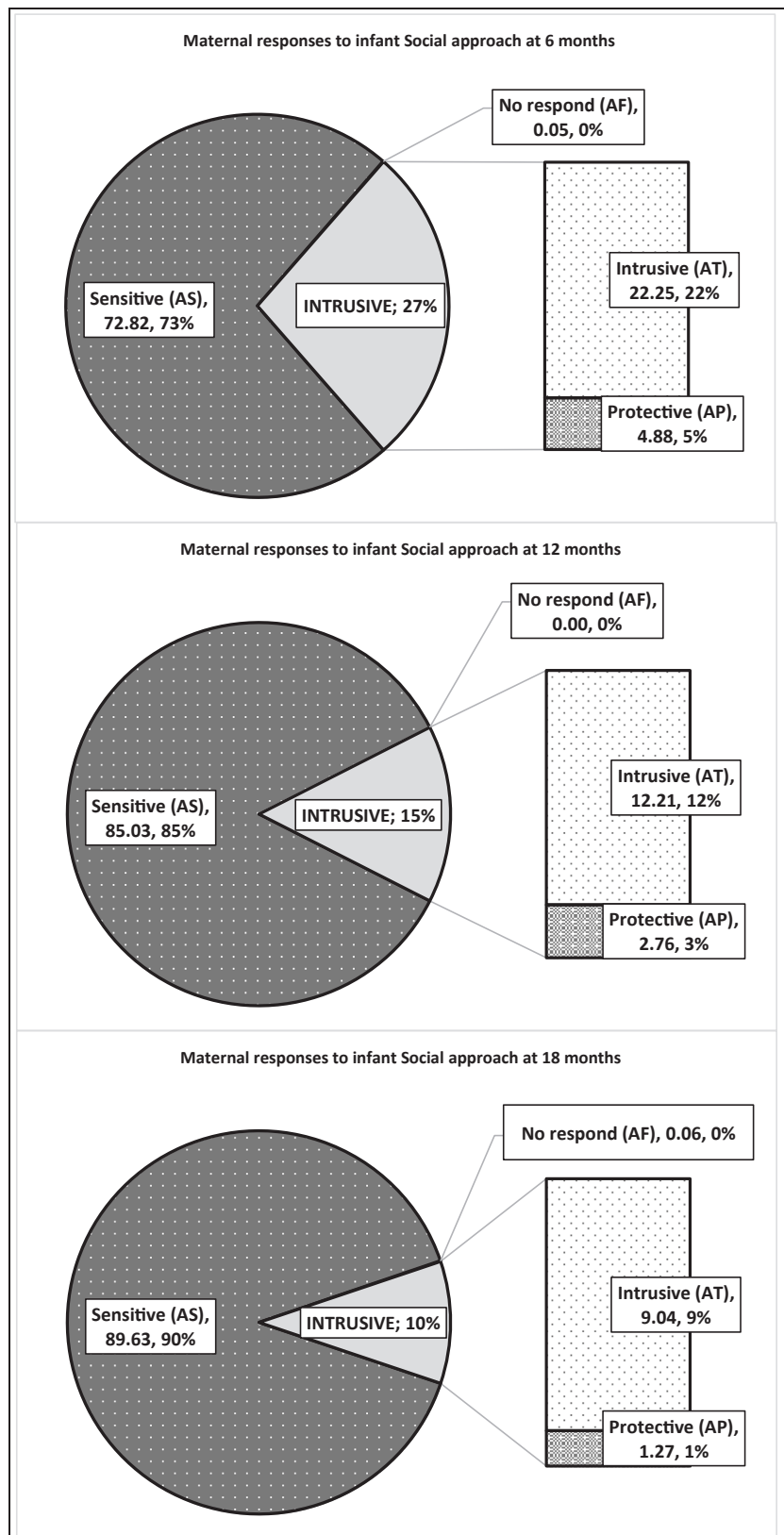


Fig. 2. Appropriateness of maternal responses to infant's social approach behavior in free play at 6, 12, and 18 months.

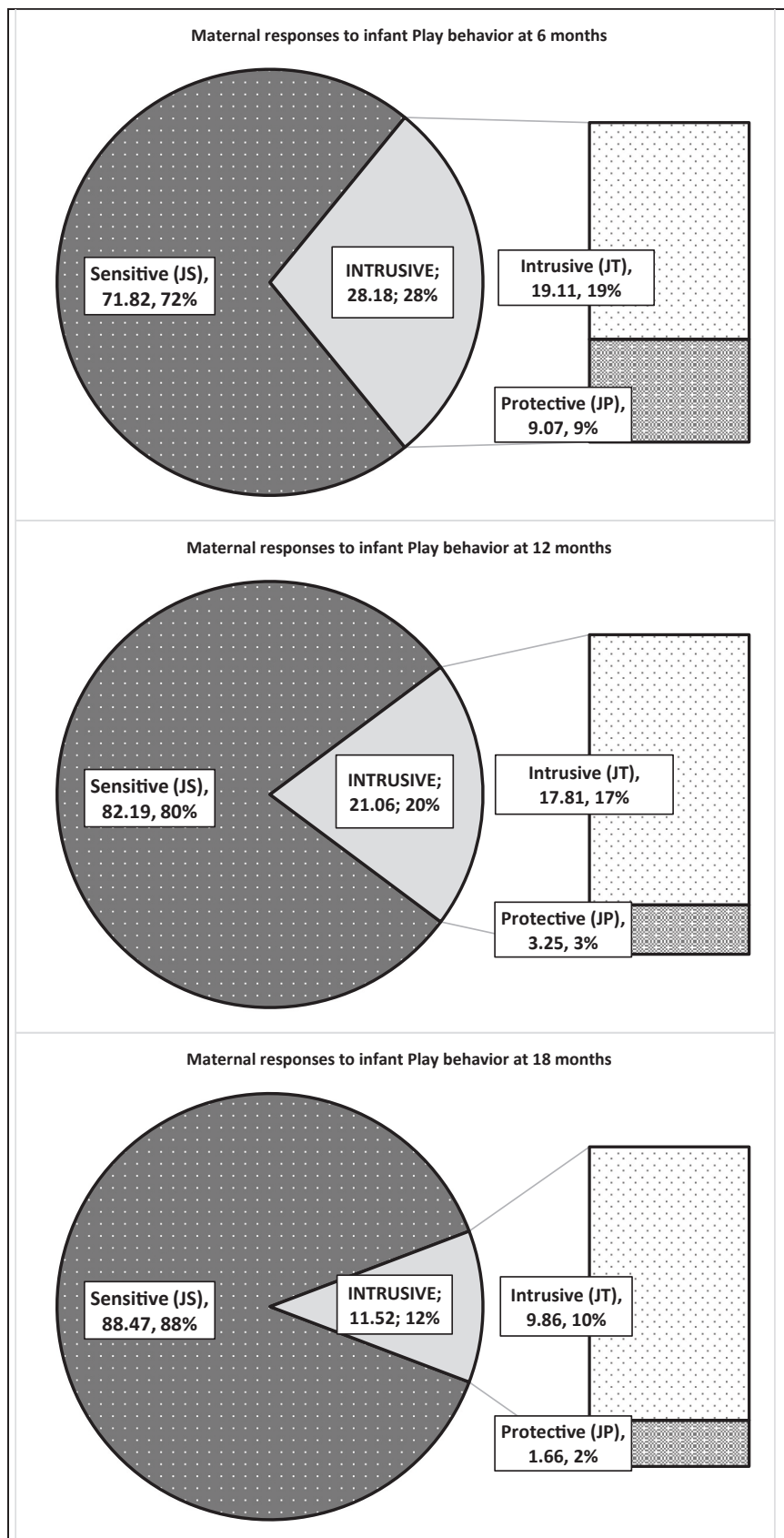


Fig. 3. Appropriateness of maternal responses to infant play behavior during free play at 6, 12, and 18 months.

tendency increased over time: 71.82% at six months, 82.19% at twelve months, and 88.47% at eighteen months (see Fig. 3). The rates of Intrusive maternal response (JT and JP) to infant play behavior were 19.11% at six months, 14.56% at twelve months, and 11.52% at eighteen months. The rates of protective maternal response to infant play behavior were 9.07% at six months, 3.25% at twelve months, and 1.66% at eighteen months (see Fig. 3).

3.4. Promptness of maternal behavior to infant behavior

The latency of maternal response (LMR) was calculated according to Cerezo et al. (2019): the difference between the coding time for the maternal behavior and the coding time for infant behavior. This calculation indicates the amount of time the mother took to respond to infant behavior. The trends for response times to infant Social Approach and Play behaviors are compiled in Fig. 4.

A repeated measures ANOVA was performed to verify whether the LMR to infant social approach and play behaviors changed over time. The differences in LMR to infant social approach behavior were not statistically significant ($F(2, 102) = 0.320$, $p = .727$, $\eta^2 = 0.006$), but they were in relation to the rates of infant play behavior (J) ($F(2102) = 4.919$, $p = .009$, $\eta^2 = 0.088$).

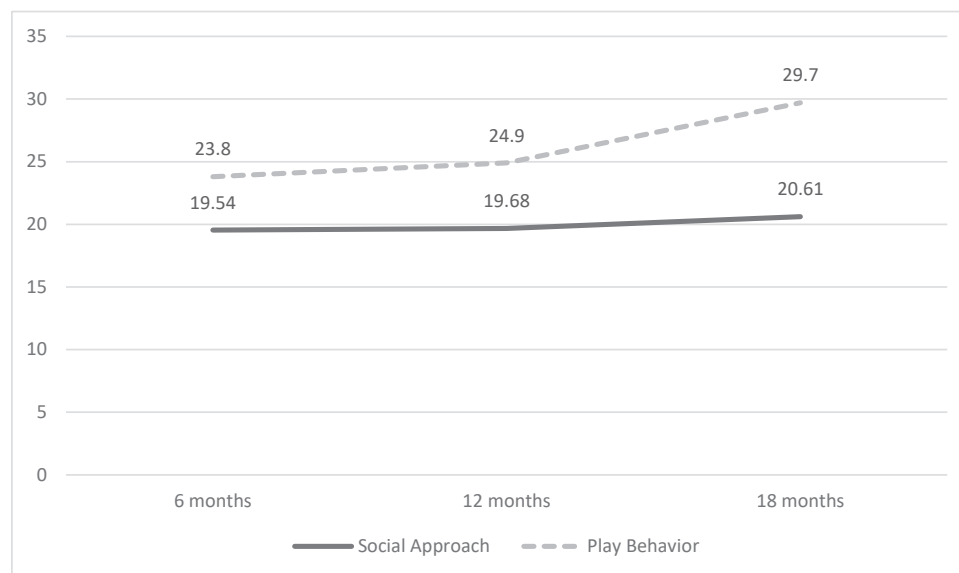
Subsequently, post-hoc contrasts were performed on maternal response latency to infant play behavior using the Bonferroni test to determine changes in behavior at the three times of measurement (see Table 3).

These results reveal significant differences between 6 and 18 months that result in a positive trend for maternal response latency to infant play behavior (average 6 months = 2.38, SD = 0.69; average 12 months = 2.49, SD = 0.83; average 18 months = 2.97, SD = 1.31).

4. Discussion

The results of this study enabled us to identify the progression of early adult-child interactions over the first two years of life. The research instrument used in this study permits to identify the two key components of the maternal sensitivity construct, as described by Ainsworth (Ainsworth et al., 1978; Cerezo et al., 2021), at every stage of development.

With regard to the appropriateness of maternal responses to child signals, results show a significant increase in the frequency of sensitive maternal responses to child behavior in place of intrusive responses (intrusive/protective maternal behaviors) from 6 months

**Fig. 4.** Changes in Latency of Maternal Response to infant social approach and play behavior at 6, 12, and 18 months in seconds.**Table 3**

Bonferroni test for Latency of Maternal Response to infant play at 6, 12, and 18 months.

(I) AGE	(J) AGE	Difference between averages (A-J)	Standard Error	Significance
6 months	12 months	-.11	.14	1.00
	18 months	-.59 *	.22	.03
12 months	6 months	.11	.14	1.00
	18 months	.48	.22	.11

to 18 months of age. While sensitive responses to both child social approach and exploration behaviors were elevated for all age ranges, the same did not occur with intrusive and protective behaviors. In this case, as children approached two years of age, mothers tended to respond with fewer intrusive and protective behaviors. This type of response coincides with previous studies that associate this type of pattern of interaction with dyads displaying secure attachment, and inverted patterns, in populations that show insecure attachment, also relating this type of attachment, with a greater presence of intrusive and apathetic maternal behaviors in the mother-child interchanges (Cerezo et al., 2016; Cerezo et al., 2019, Martínez-Fuentes et al., 2013). These results are in line with the transactional model of development (Sameroff, 2009) and support the idea that caregivers adjust and adapt their responses to the child's needs at the time.

After the first year of life and in the framework of sensitive parenting (Mahoney & Nam, 2011; Whipple et al., 2011), in addition to being patient and receptive of their children's demands, adults are expected not to anticipate their children's needs and to allow them to experiment, make mistakes, recalculate, and perceive the consequences of their own actions. Adults should continue to interact physically and verbally and respond to their children's demands in a contingent manner. While adult supervision is still extremely important at this stage, it tends to be less invasive, interfering less in the child's play and begins to be more verbal, allowing children to move and act more freely (Alvarenga et al., 2021; Bornstein et al., 2008). The need for active attention from the caregiver and improvements in the same over time in normative populations is demonstrated in the present study through the gradual increase in sensitive maternal responses to infant behavior (interactive pairs AS and JS) in all age groups examined, as well as the decrease in maternal intrusive behaviors in response to play (interactive pairs JT and JP) and social approach behavior (interactive pairs AT and AP), as postural control and autonomy improves. This pattern reflects not only how mothers actively respond to child approach behavior (AS) and actively or passively guide their children in play (JS) but also reveals how mothers adjust their responses to children's needs providing greater freedom to explore, which results in quality interactions that catalyze optimal child development (Whipple et al., 2011).

The decrease in the rate of intrusive behaviors (T and P) observed starting at 12 months of age progresses rapidly, and at 18 months, mothers scarcely intervene physically in child play behavior—only when is necessary for the safety of their children. Furthermore, the results provide significant differences in the speed of maternal responses to infant play behavior over the first 18 months of life, manifested by the tendency to provide the child more time before responding to their behavior in free play, giving them, as well, greater autonomy. The variation in the contingencies of maternal responses to child behavior in the studied population is an interesting indicator that confirms the ability of mothers to tune in a flexible, contingent and patient manner to the needs of their children (Cerezo et al., 2016), fostering children's exploration, respecting their attention spans, without pressuring them, and allowing them to perform tasks by themselves regardless of the results; encouraging their children to try again if they were not initially successful. The contingency of these adult responses helps children to recognize they have the support of their parents or caregivers when is necessary, which not only promotes exploration, and learnings, but also has a positive effect on the quality of the adult-child attachment.

In summary, these results show that, in dyads with normative development, exist interactive patterns adjusted to the changing needs of the children. Despite the fact that changes occur quickly and harmoniously over the first few years of life, infants progress towards greater locomotor and cognitive autonomy and develop in their environment, freely exploring their surroundings. For optimal development, the child must not only be allowed to explore but also to solve problems independently; this seems to be reflected in this study through the decrease in Intrusive behaviors (JT and JP) and the increase in maternal response times to Play behavior as the child approached to 18 months of age, finding the mayor response latency at 18 months. This pattern of responses shows that adults give children more time to face the challenges involved in playing and to explore, on their own, which transforms these situations into opportunities to test out both their locomotor and cognitive skills. At all ages measured, the adult in the dyad supervised and responded actively to the child's demands, which is evident from the stability in the sequences of mother-child interactions (AS). However, mothers were less involved when the older children engaged in solitary play, encouraging children to explore freely. In this way, the adult promotes the necessary scenario for the child to explore his or her full range of potential skills and abilities.

Variations in times and types of maternal response based on the kind of child behavior is an indicator that the mother aptly distinguishes her child's needs (Gerstein et al., (2015)) and is capable of adjusting her behavior to fit these needs, which promotes child development over time. This study shows the relevance, not only of what but also when with regard to stimulation quality (Letourneau et al., 2015). The patterns of interaction observed in the dyads in this study are examples of quality mother-child interactions that are capable to functioning as a protective factor for development. It is important to consider that the cognitive and psychomotor development indices for all the children participants were within the normative range. The regularity of these patterns and their relevance based on the stage of development, as previously stated, allows children to perceive contingency, regularity, and predictability in sequences of behavior, which are extremely relevant to consolidating all forms of learning, especially social skills.

As Letourneau et al. (2015) point out, results like the ones from the present study highlight the need for more sequential and micro-analytical studies that are capable of analyze the temporal dimension of the flow of social interactions within the dyad, identifying relevant phenomena in the processes of interaction that can only be detected when observed in the resulting patterns, such as those identified in the present study.

4.1. Strengths, limitations, and future directions

This longitudinal and mycroanalytical study, highlights the dynamic nature of the construct of maternal sensitivity and how the expression of this concept changes in dyadic relationships before children reach two years of age. These results affirm that sensitivity is not static and unchangeable. On the contrary, it changes as the mother-child dyad engages in shared processes of interaction.

Despite the amount of research about the positive impact that the sensitive adult-child interactions to catalyze an optimal Infant

development, there are few papers in low biopsychosocial risk populations, the longitudinal studies are limited, works in population over than 12 moths and from a microanalytical perspective are scarce too. Thus, we consider that our study addresses and integrates several of the research gaps that we have found.

Another of the strengths of this work lies in the measurement instrument used to assess the interactions. The CITMI-R coding system allows us to capture the dynamics of the interaction from a relatively brief fragment of interaction (4–5 min); it also adequately captures the variations that occur in the two aspects of maternal sensitive behavior (appropriateness of maternal behavior and latency of maternal response) during the first 18 months of life.

The most important limitation of this work is that the participating families come from a child development monitoring program (SEPRODIAT, as we mentioned before). Despite the fact that no specific intervention was made on these dyads, given that the evaluations reported that child development occurred according to a normative pattern, we must take into account that the families that attend the program do so voluntarily and we can assume high level of motivation in raising their children.

Recognize the types of patterns of interaction based on age that we find in our research permits designing more precise and effective interventions for children and their families, starting from a model of positive, realistic, and healthy interaction of normative development. Lots of the intervention proposals found in the literature state their work objectives based on the needs that should be satisfied or repaired when there is a dysfunctional adult-child interaction; however, studies like ours allow us to identify work goals based on what we could define as a "healthy relationship" and adjusted to the evolutionary needs of the child. The ability to develop profiles of interaction for normative groups provides specialists a clear idea of interaction in these dyads at specific moments in development; this helps to better assess children's strengths and weaknesses as related to social exchanges between members of the dyad based on a non-dysfunctional model of interaction, which is thus far limited in the actual scientific literature. In this line, the CITMI-R (the instrument used in this study to assess interaction) appears promising, not only to identify the key components of the construct of maternal sensitivity, but also to help professionals to plan family interventions based on video-feedback (Trenado et al., 2021), providing a new and interesting line of research.

According to Dietrichson et al. (2020), extensive literature exists that shows how the context of early development has a strong, long-term impact on children's lives, with notable effects on development. The relevance of longitudinal studies that enable researchers to decipher key aspects to improve the quality of those contexts is undeniable. However, taking into account the relevance of the construct of sensitivity in childhood psychological development, more longitudinal studies and more research in general are needed to identify and understand the changes and expressions that this construct manifests throughout childhood: in populations with low and high levels of risk, including different types of families and main caregivers, and/or attending, among other factors, to differences in a transcultural or transgenerational level, in the type of interaction patterns that adults and children establish. The relevance and novelty of our findings encourage us to continue this line of research and promote sensitive parenting without overlooking the evolutionary perspective highlighting the relevance that this area of work could have in preventing physical problems or mental disorders, and in the promotion of well-being at all stages of individuals's life (Dietrichson et al., 2020).

CRediT authorship contribution statement

Laura Patricia Perea-Velasco: Conceptualization, Formal analysis, Investigation, Data curation, Writing- Original draft preparation, Writing - Review & Editing, Visualization, Project administration. **Maria Teresa Martinez-Fuentes:** Conceptualization, Methodology, Formal analysis, Investigation, Resources, Data curation, Writing- Original draft preparation, Writing - Review & Editing, Visualization, Supervision, Project administration. **Julio Perez-López:** Methodology, Formal analysis, Investigation, Resources, Data curation, Writing - Review & Editing, Visualization, Supervision, Project administration.

Data availability

Due to the sample characteristics and the kind of observational data that we manage in this research, raw data would remain confidential and would not be public shared.

Acknowledgments

We extend our thanks to the Professor M^a Angeles Cerezo, from the University of Valencia, for her active implication and constant advice about CITMI-R: Early mother-infant interactions coding system ; and to the Professor Julio Sanchez-Meca, from the University of Murcia, for his advice in data analysing issues.

Institutional review board statement

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of the University of Murcia (protocol code 3373/2021, date of approval 6th of May of 2021).

Informed consent statement

Informed consent was obtained from all subjects involved in the study.

References

- Ainsworth, M. D., Blehar, M. C., Waters, E., & Wall, S. N. (1978). *Patterns of Attachment: A Psychological study of the strange situation*. Hillsdale, NJ: Erlbaum Associates.
- Ainsworth, M. S., Bell, S. M., & Stayton, D. J. (1974). Infant-mother attachment and social development: "Socialisation" as a product of reciprocal responsiveness to signals. In M. P. M. Richards (Ed.), *The integration of the child into a social world*. London: Cambridge University Press.
- Alink, L. R. A., Mesman, J., Van Zeijl, J., Stolk, M. N., Juffer, F., Bakermans-Kranenburg, M. J., Van IJzendoorn, M. H., & Koot, H. M. (2009). Maternal sensitivity moderates the relation between negative discipline and aggression in early childhood. *Social Development*, 18(1), 99–120. <https://doi.org/10.1111/j.1467-9507.2008.00478.x>
- Altshul, S. (1984). Attachment and Loss, Vol. 3. Loss, Sadness and Depression. By John Bowlby. *Journal of the American Psychoanalytic Association*, 32(1), 216–218. <https://doi.org/10.1177/000306518403200125>
- Alvarenga, P., Kuchirko, Y., Cerezo, M. Á., De Mendonça-Filho, E. J., Bakeman, R., & Tamis-LeMonda, C. S. (2021). An intervention focused on maternal sensitivity enhanced mothers' verbal responsiveness to infants. *Journal of Applied Developmental Psychology*, 76, 1–10. <https://doi.org/10.1016/j.appdev.2021.101313>
- Álvarez Lorenzo, M., Rodrigo López, M. J., & Rodríguez Suárez, G. (2017). Predictores de una interacción eficaz entre madre e hijo / a en contextos de riesgo psicosocial. *Universitas Psychologica*, 16(1), 1–10. <https://doi.org/10.11144/Javeriana.upsy16-1.piem>
- Bakeman, R., & Quera, V. (1995). Log-linear approaches to lag-sequential analysis when consecutive codes may and cannot repeat. *Psychological Bulletin*, 118(2), 272–284. <https://doi.org/10.1037/0033-2909.118.2.272>
- Bayley, N. (1993). *Manual for the Bayley Scales of Infant and Child Development*. Second Edition. (BSID-II). Psychological Corporation.
- Beebe, B., & Steele, M. (2013). How does microanalysis of mother-infant communication inform maternal sensitivity and infant attachment? *Attachment & Human Development*, 15, 583–602. <https://doi.org/10.1080/14616734.2013.841050>
- Bigelow, A. E., & DeCoste, C. (2003). Sensitivity to social contingency from mothers and strangers in 2-, 4-, and 6-month-old infants. *Infancy*, 4(1), 111–140. https://doi.org/10.1207/S15327078IN0401_6
- Binnie, G. P. (2020). *Best practices to prevent intergenerational involvement in the child welfare sistem* [Alliant International University]. (<https://www.proquest.com/dissertations-theses/best-practices-prevent-intergenerational/docview/2418760660/se-2?accountid=17192>).
- Bornstein, M. H., Tamis-LeMonda, C. S., Hahn, C. S., & Haynes, O. M. (2008). Maternal responsiveness to young children at three ages: longitudinal analysis of a multidimensional, modular, and specific parenting construct. *Developmental Psychology*, 44(3), 867–874. <https://doi.org/10.1037/0012-1649.44.3.867>
- Bronfenbrenner, U. (1979). *The ecology of Human Development: experiments by nature and design*. USA: Harvard University Press.
- Camarata, S., & Yoder, P. (2002). Language transactions during development and intervention: Theoretical implications for developmental neuroscience. *International Journal of Developmental Neuroscience*, 20(3–5), 459–465. [https://doi.org/10.1016/S0736-5748\(02\)00044-8](https://doi.org/10.1016/S0736-5748(02)00044-8)
- Caughy, M. O. B., Huang, K. Y., & Lima, J. (2009). Patterns of conflict interaction in mother-toddler dyads: Differences between depressed and non-depressed mothers. *Journal of Child and Family Studies*, 18(1), 10–20. <https://doi.org/10.1007/s10826-008-9201-6>
- Cerezo, M. A., Trenado, R. M., & Pons-Salvador, G. (2012). Mother-infant interaction and quality of child's attachment: A nonlinear dynamical systems approach. *Nonlinear Dynamics, Psychology, and Life Sciences*, 16(3), 243–267.
- Cerezo, M. A., Pons-Salvador, G., Trenado, R. M. y, & Sierra, P. (2016). Mother-infant verbal and nonverbal interaction as predictor of attachment: nonlinear dynamic analyses. *Nonlinear Dynamics, Psychology, and Life Sciences*, 20(4), 485–508.
- Cerezo, M. A., Sierra-García, P., Pons-Salvador, G., & Trenado, R. M. (2017). Parental and infant gender factors in parent-infant interaction: State-Space dynamic analysis. *Frontiers in Psychology*, 8(OCT), 1724. <https://doi.org/10.3389/fpsyg.2017.01724>
- Cerezo, M. A., Pons-Salvador, G., Trenado, R. M. y, & Sierra, P. (2019). The temporal dimension in maternal sensitivity predicting organized attachment in children. *Nonlinear Dynamics, Psychology, and Life Sciences*, 23(1), 137–171.
- Cerezo, M. A., Abdelmaseh, M., Trenado, R. M., Pons-Salvador, G., & Bohr, Y. (2021). The temporal dimension in the understanding of maternal sensitivity in caregiver-infant interactions: The 'Early Mother-Child Interaction Coding System'. *Infant Behaviour and Development*, 63(1), 1–7. <https://doi.org/10.1016/j.infbeh.2021.101563>
- De Wolff, M., & van IJzendoorn, M. (1997). Sensitivity and attachment: A metaanalysis on parental antecedents of infant attachment. *Child Development*, 68, 571–591.
- Dietrichson, J., Lykke Kristiansen, I., & Viinholt, B. A. (2020). Universal preschool programs and long-term child outcomes: a systematic review. *Journal of Economic Surveys*. <https://doi.org/10.1111/joes.12382>
- Feldman, R., Eidelman, A. I., & Rotenberg, N. (2004). Parenting stress, infant emotion regulation, maternal sensitivity, and the cognitive development of triplets: A model for parent and child influences in a unique ecology. *Child Development*, 75(6), 1774–1791. <https://doi.org/10.1111/j.1467-8624.2004.00816.x>
- Forcada-Guex, M., Pierrehumbert, B., Borghini, A., Moessinger, A., & Muller-Nix, C. (2006). Early dyadic patterns of mother-infant interactions and outcomes of prematurity at 18 months. *Pediatrics*, 118(1). <https://doi.org/10.1542/peds.2005-1145>
- Gerstein, E. D., Poehlmann-Tynan, J., & Clark, R. (2015). Mother-child interactions in the NICU: Relevance and implications for later parenting. *Journal of Pediatric Psychology*, 40(1), 33–44. <https://doi.org/10.1093/jpepsy/jsu064>
- Gilkerson, J., Richards, J. A., Warren, S. F., Montgomery, J. K., Greenwood, C. R., Oller, D. K., Hansen, J. H. L. L., & Paul, T. D. (2017). Mapping the early language environment using all-day recordings and automated analysis. *American Journal of Speech-Language Pathology*, 26(2), 248–265. https://doi.org/10.1044/2016_AJSLP-15-0169
- Green, J. A., Gustafson, G. E., & West, M. J. (1980). Effects of infant development on mother-infant interactions. *Child Development*, 51(1), 199–207.
- Groh, A. M., Fearon, R. P., Bakermans-Kranenburg, M. J., Van IJzendoorn, M. H., Steele, R. D., & Roisman, G. I. (2014). The significance of attachment security for children's social competence with peers: a meta-analytic study. *Attachment & Human Development*, 16(2), 103–136. <https://doi.org/10.1080/14616734.2014.883636>
- Kok, R., Linting, M., Bakermans-Kranenburg, M. J., Van IJzendoorn, M. H., Jaddoe, V. W. V., Hofman, A., Verhulst, F. C., & Tiemeier, H. (2013a). Maternal sensitivity and internalizing problems: evidence from two longitudinal studies in early childhood. *Child Psychiatry and Human Development*, 44(6), 751–765. <https://doi.org/10.1007/s10578-013-0369-7>
- Kok, R., Van IJzendoorn, M. H., Linting, M., Bakermans-Kranenburg, M. J., Tharner, A., Luijk, M. P. C. M., Székely, E., Jaddoe, V. W. V., Hofman, A., Verhulst, F. C., & Tiemeier, H. (2013b). Attachment insecurity predicts child active resistance to parental requests in a compliance task. *Child: Care, Health and Development*, 39(2), 277–287. <https://doi.org/10.1111/j.1365-2214.2012.01374.x>
- Leekeers, E. M. (2011). Maternal sensitivity during distressing tasks: A unique predictor of attachment security. *Infant Behavior and Development*, 34, 443–446.
- Letourneau, N., Tryphonopoulos, P., Giesbrecht, G., Dennis, C. L., Bhogal, S., & Watson, B. (2015). Narrative and meta-analytic review of interventions aiming to improve maternal-child attachment security. *Infant Mental Health Journal*, 36(4), 366–387. <https://doi.org/10.1002/imhj.21525>
- Mahoney, G., & Nam, S. (2011). The parenting model of developmental intervention. *International Review of Research in Developmental Disabilities*, 41, 73–125.
- Martínez-Fuentes, M. T., Pérez-López, J., Perea-Velasco, L., Pérez-Lag, M., Saura-Cano, C., Montealegre, P., ... Miñarro, L. (2013). Analysis of infant-mother interactions and infants attachment security: some preliminary results. In Lavinia Barone (Ed.), *6th International Attachment Conference* (pp. 109–112). Italy: Medimond International Proceedings. August, 30-September, 1.
- Mesman, J., & Emmen, R. (2016). A Mary Ainsworth's legacy: A systematic review of observational instruments measuring parental sensitivity. *Maternal Sensitivity*, 43–64.
- Mills-Koonce, W. R., Willoughby, M. T., Zvara, B., Barnett, M., Gustafsson, H., & Cox, M. J. (2015). Mothers' and fathers' sensitivity and children's cognitive development in low-income, rural families. *Journal of Applied Developmental Psychology*, 38, 1–10. <https://doi.org/10.1016/j.appdev.2015.01.001>
- Moore, G. A., Hill-Soderlund, A. L., Propper, C. B., Calkins, S. D., Mills-Koonce, W. R., & Cox, M. J. (2009). Mother-infant vagal regulation in the face-to-face still-face paradigm is moderated by maternal sensitivity. *Child Development*, 80(1). <https://doi.org/10.1111/j.1467-8624.2008.01255.x>
- NICHD Early Child Care Research Network. (2006). The NICHD study of Early Child Care and Youth Development. Findings for Children up to Age 4½ Years. National Institute of Child Health and Human Development, Rockville, United States. (https://www.nichd.nih.gov/sites/default/files/publications/pubs/documents/secycd_06.pdf).

- Olhaberry, M. P., León, M. J., Coó, S., Barrientos, M. y, & Pérez, J. C. (2022). An explanatory model of parental sensitivity in the mother–father–infant triad. *Infant Mental Health Journal*, 43(5), 714–729.
- Rodrigues, M., Sokolovic, N., Madigan, S., Luo, Y., Silva, V., Misra, S., & Jenkins, J. (2021). Paternal sensitivity and children's cognitive and socioemotional outcomes: a meta-analytic review. *Child Development*, 92(2), 554–577. <https://doi.org/10.1111/cdev.13545>
- Samdan, G., Kiel, N., Petermann, F., Rothenfußer, S., Zierul, C., & Reinelt, T. (2020). The relationship between parental behavior and infant regulation: A systematic review. *Developmental Review*, 57(September 2019), Article 100923. <https://doi.org/10.1016/j.dr.2020.100923>
- Sameroff, A. (2009). The transactional model. In A. Sameroff (Ed.), *The transactional model of development: How children and contexts shape each other* (pp. 3–21). American Psychological Association. <https://doi.org/10.1037/11877-001>.
- Santelices, P., Olhaberry, M., Pérez-Salas, C. P., & Carvacho, C. (2010). Comparative study of early interactions in mother-child dyads and care centre staff-child within the context of Chilean crèches. *Child: Care, Health and Development*, 36(2), 255–264. <https://doi.org/10.1111/j.1365-2214.2009.01032.x>
- Schore, A. N. (2005). Attachment affect regulation, and the developing right brain: Linking developmental neuroscience to pediatrics. *Pediatrics in Review*, 26(6), 204–211. <https://doi.org/10.1542/pir.26-6-204>
- Shin, H., Park, Y. J., Ryu, H. y, & Seomun, G. A. (2008). Maternal sensitivity: a concept analysis. *Journal of Advanced Nursing*, 64(3), 304–314.
- Smith, T. R. (2010). *The exploratory dyad that plays together stays together: parent play, attachment, and non-obvious object properties*. Texas A&M University.
- Trenado, R. M., & Cerezo, M. A. (2007). Codificación de la Interacción Temprana Materno Infantil [Early Mother-Child Interaction Coding System] –revised version. CITMI-R. Unpublished Document. Spain: University of Valencia, (Available at) (<http://www.uv.es/agrefa.es>).
- Trenado, R. M., Cerezo, M. A., Sierra-García, P., & Pons-Salvador, G. (2021). Sequential coding of maternal sensitivity: application of nonlinear dynamic analyses and reliability. *Quality & Quantity*, 55, 827–844.
- Vallotton, C. D., Mastergeorge, A., Foster, T., Decker, K. B., & Ayoub, C. (2017). Parenting supports for early vocabulary development: specific effects of sensitivity and stimulation through infancy. *Infancy*, 22(1), 78–107. <https://doi.org/10.1111/inf.12147>
- Van Aken, C., Junger, M., Verhoeven, M., Van Aken, M. A. G., & Dekovic, M. (2007). The interactive effects of temperament and maternal parenting on toddlers' externalizing behaviours. *Infant and Child Development*, 16, 553–572. <https://doi.org/10.1002/icd.529>
- Whipple, N., Bernier, A., & Mageau, G. A. (2011). Broadening the study of infant security of attachment: Maternal autonomy-support in the context of infant exploration. *Social Development*, 20(1), 17–32.
- Yousafzai, A. K., Rasheed, M. A., Rizvi, A., Armstrong, R., & Bhutta, Z. A. (2015). Parenting skills and emotional availability: An RCT. *Pediatrics*, 135(5), e1247–e1257. <https://doi.org/10.1542/peds.2014-2335>
- Zengin Akkus, P., Bahtiyar Saygan, B., Ilter Bahadur, E., Ozdemir, G., & Ozmert, E. N. (2020). Preterm birth and maternal sensitivity: Findings from a non-western country. *Infant Behavior and Development*, 61(April), Article 101476. <https://doi.org/10.1016/j.infbeh.2020.101476>