

## A pilot study on early interactions and its relationship with high-risk infant's development

### Estudio piloto de interacciones tempranas y su relación con el desarrollo en infantes de alto-riesgo

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#### Abstract

The characteristics of early interactions are fundamental during the first three years of the child, as these early experiences may affect child's growth, development and behavior. High-risk infants have a high-risk of sequelae, especially those with a history of premature birth, low birth weight, neonatal pathologies and important psychosocial problems. This pilot study aimed to determine whether the mother-child interactions during the first 12 months of corrected age affect the development achieved by high-risk infants. Interactions in the Neonatal Intensive Care Unit were observed using an Observational Scale (N-EOV-INC) and the Scale of observation of mother-child bond was used for observations at the follow-up Office. We observed 36 dyads during the children first 12 months of corrected age. The results show that the highest percentage of infants with difficulties in development belonged to the "Mismatch" Type of mother-infant bond. Our tentative findings suggest a relation between mother-infant type of bond and child development. Our study represents a first attempt to explore the different ways of bonding between mothers and their high-risk infant, and the incidence these may have on the psychomotor and cognitive development of infants.

Key words: mother-child interactions; high-risk infants; development; observation.

#### Resumen

Las características de las interacciones tempranas son fundamentales durante los primeros tres años de vida y pueden afectar el crecimiento, el desarrollo y el comportamiento del niño. Los bebés de alto riesgo tienen un riesgo elevado de sufrir secuelas, especialmente aquellos con antecedentes de prematuridad, bajo peso al nacer, patologías neonatales y problemas psicosociales importantes. El objetivo fue determinar si las interacciones madre-hijo durante los primeros 12 meses de edad corregida afectan el desarrollo logrado por los bebés de alto riesgo. Las interacciones en la Unidad de Cuidados Intensivos Neonatales se observaron utilizando una Escala de Observación (N-EOV-INC) y se utilizó la Escala de observación del vínculo madre-hijo en el Consultorio de Seguimiento. Se observaron 36 díadas durante los primeros 12 meses de edad corregida. Los resultados muestran que el mayor porcentaje de bebés con dificultades en el desarrollo pertenecía al tipo de vínculo madre-hijo "Desencontrado". Nuestros resultados sugieren una relación entre el tipo de vínculo y el desarrollo infantil. Nuestro estudio representa un primer intento de explorar las diferentes formas de vinculación entre las madres y sus bebés de alto riesgo, y la incidencia que pueden tener en el desarrollo psicomotor y cognitivo de los bebés.

Palabras claves: interacciones madre-hijo; bebés de alto riesgo; desarrollo; observación.

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## Introduction

The first years of life are critical in child development. Achieving an adequate development does not depend solely on having an intact nervous system but also on enriching and varied early experiences (Nikodem, 2009). In this sense, the characteristics of early interactions are fundamental during the first three years of life, as these early experiences may modify functional and anatomical aspects and behavior (Nikodem, 2009). Several authors have noted that a strong mother-child emotional connection is the basis for proper development in infants (Winnicott, 1958/1999, 1962/2002, 1971/1987; Spitz, 1965/2003, Bowlby 1969/1993; Klaus & Kennell, 1973/2001; Brazelton & Cramer, 1993; Stern, 1997). A secure base is achieved when the primary attachment figure provides the infant with stability and security in times of stress, which will allow him to explore the environment. Secure attachment provides the fundamental neurological and psychosocial framework for the healthy development of personality (Fonagy, Lorenzini, Campbell & Luyten, 2014).

The relationship that is established with the relevant care figures in the first years of life acquires a crucial role in the psychic constitution and in the development of the child. This relationship takes shape mainly through daily care and play as a privileged mode of exchange between the child and adults (Leonardelli, Vernengo, Wainer & Duhalde, 2009). The bond that mother and child can establish after birth will be influenced by numerous factors of both mother and baby and the environment, such as prematurity, postpartum depression and maternal problems in childhood itself (Mass, Vreeswijk, Cock, Rijk & van Bakel, 2012).

The quality of the mother-child's relationship affects the child's neurodevelopment, emotion regulation, and stress response. Children exposed to sustained stress usually evidence dysregulation of physiologic systems involved in energy balance, which could lead to feeding disorders as obesity (Anderson, Gooze, Lemeshow & Whitaker, 2012). In a recent study, Marshall (2014) discusses the impact of early bond on child development. The basic thesis is that the baby's brain expects to receive stimulation from the environment, especially from an attentive caregiver, but if this does not happen, it leads to abnormalities in neuronal activity and in the structure of the brain. The lack of stimulation causes delays at the cognitive and emotional level, children simply stop crying, gesturing or making eye contact since there is no one there to respond. The critical period for cognitive development seems to be up to 24 months, however, this may improve when the child is inserted into a supportive environment.

In this sense, the environment children live in may affect their growth, development and behavior, in a comparable way to the influence that biological constitution can have. The odds of difficulties increase when a biologically vulnerable child and an inadequate environment concur, as in the case of high-risk infants (Follow up Guide High-risk Newborn, 2003). High-risk infants are those who require special care at birth that is indispensable for their survival and for reducing the possibility of occurrence of serious functional disorders in childhood (Nikodem, 2009). These babies mostly remain hospitalized during the neonatal period in a Neonatal Intensive Care Unit (NICU) and have a high risk of sequelae (Follow up Guide High-risk Newborn, 2003).

The possibility of occurrence of developmental abnormalities increases in high-risk infants, especially if associated with environmental risk (Schapira et al., 2005). Failures in early relationships with the confluence of other factors may lead to various problems in development (Brazelton & Cramer, 1993). Multiple variables are involved in the development achieved by high-risk infants: some of them are related with high biological risk, including perinatal history and premature birth (White-Traut & Norr, 2009). Prolonged stay in the NICU may have an impact in infant's development (Rodriguez, Vivas, Cangelosi & Schapira, 2008). The environmental risk is also important, especially if newborns come from an environment with no family support, lack of care or appropriate interactions (White-Traut & Norr, 2009).

Mother-child interactions may predict the development of premature infants of low birth weight (Muñoz-Ledo-Rabago, Sanchez-Perez, Mendez-Ramirez & Mandujano-Valdes, 2003). In a study conducted in preterm infants with perinatal neurological damage, Muñoz-Ledo-Rabago, Mendez-Ramirez, Sanchez-Perez, Mandujano-Valdes and Murata (2013), found that better results in children motor development were obtained in dyads with the highest number of reciprocal interactions. Schapira et al (2005) state that some of the protective factors of child development include continuous and prolonged parent-baby contact, quality of "mothering", support from family, friends, neighbors and health team. Flacking et al. (2012) emphasize the importance of physical and emotional closeness between the premature newborn and their parents in the NICU, as well as the effects that early separation may have on the development of the newborn. The physical and emotional closeness has positive effects on the child's brain development, the psychological well-being of the parents and on the parent-child interactions. It has been shown that environmental conditions can affect the promotion of the expression of certain genes as well as providing the necessary plasticity to cope with environmental variations.

In the same line, Milgrom et al. (2010) argue that when the immature brain is exposed to stress, alterations in its development occur. This occurs in premature babies, who face the stressful environment of the NICU, which includes exposure to noise, lights, numerous people, painful medical procedures and lack of contact with parents. However, when the mother intervenes by reducing stressful situations and recognizing signs of stress in her baby, an improvement in the microstructure of white matter in premature infants is observed, which allowed them to conclude that the quality of early experiences it influences brain development.

The present pilot study aimed to determine whether the mother-child interactions during the first 12 months of corrected age influence the development achieved by high-risk infants. It is here hypothesized that mother-child interactions may mitigate or accentuate the biological risk of these infants. The main research question that guided this study is whether dyadic interactions influence the development reached by high-risk infants at 12 months of corrected age.

## Method

### Participants

The current study was based on a sample of 36 high-risk infants and their mothers. The dyads participated in the study from infant birth to 12 months of corrected age. The inclusion criteria were that the infants were hospitalized in the NICU during the first month of life and they remained in the follow-up program after the neonatal hospitalization. We excluded children that were older at the moment of participation and the dyads in which the mother had a diagnosis of mental illness.

According to gestational age, thirty-two children were preterm and four infants were full-term. Twenty-one children of the sample remained hospitalized during their neonatal period in NICU due to respiratory difficulties, ten children due to Intrauterine Growth Retardation. The remaining five children had neonatal sepsis, jaundice, gastrointestinal disease, neurological disease and cardiovascular disease. See Table 1 for some descriptive statistics of the participants.

**Table 1**  
Child and Mother characteristics

	N	
Mother educational level	Uneducated (2) Primary studies (17) High school studies (15) University studies (2)	
Mother working status	Housewife (21) Unemployed (5) Informal job (7) Formal job (3)	
	Mean	Std. Deviation
Infant Gestational age (weeks)	32,22	3,547
Infant Birth weight (grams)	1,652	,619521
Hospitalization time in NICU (days)	39,64	19,724
Mother age (years)	22,78	5,111

### Material

During the infant hospitalization in NICU we used the Observation Scale of Mother–infant bond in NICU (N-EOV-INC) (Santos, 2010). This instrument assesses six different aspects in the interaction: approach to the infant, contact with the incubator where the infant is, corporal, visual and verbal behavior and finally postural modifications during the observation. After neonatal hospitalization, interaction data was collected during follow-up at the High-Risk Child Office in the Maternity Hospital. We used the Scale of observation of mother-child bond (Oberman, 2008). This instrument evaluates visual, corporal, verbal behavior and holding.

During children follow-up we evaluated psychomotor development with the Assessment Scale of Psychomotor Development (EEDP) (Rodríguez, Arancibia & Undurraga, 1978). Moreover, cognitive development was evaluated using the Argentinian Scale of Sensorimotor Intelligence (EAIS) (Oberman, Mansilla & Orellana, 2002). The total score obtained in both instruments was converted into a percentile that indicates the level of development (normal, risk, delay) reached by the child according to his or her age.

### Procedure

The present paper is part of a research approved by the ethical committee of the Faculty of Psychology, National University of San Luis (Argentina). The mothers accepted to be part of the project after signing a written informed consent.

During the period when the infant was in the NICU, interactions were measured every three days. The observation took place in the NICU when the mother had access to the neonatal ward to visit her infant, mostly to feed him. At follow-up, we assessed spontaneous mother–child interactions that took place in the natural observational context of the High-Risk Child Office. During each visit, we also evaluated infant psychomotor development using EEDP and from 6 months an evaluation of cognitive development was performed by EAIS.

At the time of child stay at the NICU mothers were interviewed once in order to investigate the characteristics of the family group, the history of the parental couple, pregnancy planning, parents reaction to pregnancy. Besides, we inquired if the mother did obstetrics controls and ultrasound, physical and emotional state of the mother during pregnancy, emotional support received by the mother during pregnancy and hospitalization of the child, fantasies about the baby during pregnancy, expectations about childbirth. There were also inquired about the first encounter with the baby in the NICU, fears and fantasies regarding the health of the baby, feeding, sleep of the baby, and changes in relation to the mother herself.

The relationship of the mother with her child does not begin at the moment of birth, but goes back to pregnancy and beyond. The representations that the mother has made about this unborn baby are related to the representations that are constructed after birth and the interactions between them, all experiences will leave traces in the newborn, even those that occurred during pregnancy. Parents at the time of the birth of a child meet three babies: the imaginary son of dreams and fantasies; the invisible but real fetus whose particular rhythms and personality has become evident during the months of pregnancy; and the real newborn who can see, hear and embrace. The bond with a newborn then is built on previous relationships with an imaginary child and the developing fetus that has been part of the world of parents during the months of pregnancy (Brazelton & Cramer, 1993). In this sense, inquire about pregnancy planning, the acceptance or rejection of it, if the mother imagined the baby (appearance, sex, name) and dreamed of it, if she perceived the movements of the baby in her womb, the emotional responses to the first images in the ultrasound, allow knowing the characteristics of the baby imagined by that mother. The investigation about the infantile conflicts, the relation with its own mother, allow to know the characteristics of the fantasmatic baby. Finally, questions about the experience of being with a premature newborn and the hospitalization allows knowing the characteristics of the real baby.

### **Analyses**

The statistical analysis was performed on Software R from the database built with the frequencies of each variable, both initiation and response, in corporal, visual, verbal and holding. A cluster analysis using the k-means technique was performed in order to group the dyads according to interactions characteristics. From the analysis of the interactions, we constructed types of mother-infant interactions. These typologies were developed from the distinguish elements, considering both the characteristics of the interactions in the NICU and during follow-up. The scores obtained by infants in the evaluation of psychomotor and cognitive development underwent a descriptive statistical analysis using IBM SPSS Statistics 21. We related types of mother-infant interactions with the development achieved by the high-risk infant.

## **Results**

### ***Description of the mother-infant type of interactions***

Type 1 “Mismatch”: this group was characterized predominantly by mismatch, failed encounters and difficult to repair. The interactions during hospitalization in NICU were characterized as minimal. Mothers searched to interact with their children through body contact and gazes in few opportunities, but they never addressed their children verbally during the observations. Infants repeatedly sought both corporal and visual contacts, but received the lowest number of maternal responses in the total sample. In turn, a mismatch was observed in the communication, since mothers preferably chose visual interactions but these received the least responses by their children. These dyads showed few proposals of behavioral interactions, both by mothers and infants during follow-up at the High-Risk Child Office. Both members of the dyad used different communication channels when interacting. It is important to note that these infants searched to establish interactions more intensively than their mothers and other children during their stay in the NICU. However, at the time of the observations at the follow-up office, these children significantly reduced interaction attempts, being part of the group that proposed fewer initiatives. The situation described, caused interaction attempts to be interrupted quickly, because the answer was not timely, appropriate or adapted to the intentions of the other member of the dyad.

Type 2 “Synchronized”: this group was characterized by seeking contact and willingness to communicate by both members of the dyads throughout the first year of life. During hospitalization in NICU, mothers touched the infant’s body, looked at him and, to a lesser extent, spoke to their child. Infants routinely reciprocated their mother’s body contacts and verbal sounds but replied more weakly to maternal gaze. These infants quite frequently touched the body of their mothers but looked at her at fewer opportunities. Mothers responded repeatedly to their children’s corporal contacts and looks. These dyads also interacted frequently during observations in the High-Risk Child Office; they used various communication channels, but appealed more to the verbal one. It was observed that they prioritized visual exchanges and to a lesser extent corporal interactions. Mothers and infants agreed on the language chosen at the moment of interaction, which resulted in sustained interactions over time.

Type 3 “Dual”: this group was distinguished by the fluctuation in the interactions during the first year of life. We recognized two different situations: in the first one, dyads had frequent interactions during hospitalization in NICU. Both mothers and babies sought behavioral exchange. The interactions of these dyads were modified considerably during follow-up, when there were few proposals of behavioral interactions both by mothers and infants. The members of the dyad used different communication channels when interacting. Interaction proposals were interrupted quickly.

In the second situation, dyads first faced difficulties when meeting at the NICU, but gradually got to know each other, leading to satisfactory emotional exchanges. At first, interactions during the stay in the NICU were limited. Mothers touched the infant’s body on few occasions and there was a total absence of language directed to him; although gazes were reduced, they were the prevalent behavior. By contrast, infants outstandingly sought to interact with their mothers, especially through body contact and, to a lesser extent, visually. The situation of these dyads reversed markedly after discharge from the neonatal ward. Interactions during follow-up were characterized by numerous behaviors initiated by both members of the dyad, as well as the coincidence in the choice of verbal language as a privileged means of communication.

### **Relation between type of interaction and infant development**

The level of development achieved by the infants and the dyadic type of interaction were related. See these results in Table 2.

**Table 2**  
Relation between type of bond and infant development

Type of mother - infant bond	EEDP				EAIS			
	Delay	Risk	Normal	Total	Delay	Risk	Normal	Total
Type 1	1 20%	2 40%	2 40%	5 100%	0 0%	1 20%	4 80%	5 100%
Type 2	0 0%	2 11,8%	15 88,2%	17 100%	1 5,9%	1 5,9%	15 88,2%	17 100%
Type 3	2 14,3%	0 0%	12 85,7%	14 100%	2 14,3%	1 7,1%	11 78,6%	14 100%
Total	3 8,3%	4 11,1%	29 80,6%	36 100%	3 8,3%	3 8,3%	30 83,3%	36 100%

The three infants who presented developmental delay or risk in Type 1 belonged to dyads that had certain aspects in common. In the first place, the children were very premature and presented very low or low birth weight. These characteristics refer to the biological risk with which the babies of these dyads were born. During the interviews, it was possible to know the context in which the interaction took place, in these dyads the parents’ relationships was conflictive. The mothers also experienced feelings of rejection before the pregnancy, accompanied by desires and attempts to interrupt. Emotional state during pregnancy was painful for mothers because it conflicted with their plans and / or expectations. In these mothers, there were difficulties to imagine the baby and to recognize or interpret fetal movements. It is possible to think then that these infants may have combined a moderate biological risk with maternal difficulties to establish a bond with the psychologically and emotionally growing child and to identify and connect emotionally with him or her. This may have resulted in difficulties in interactions, enhancing biological risk and contributing to subsequent development difficulties.

In the infants of Type 2 that obtained below-expected percentiles, the biological risk was more pronounced. From the interviews it can be inferred that the context in which the pregnancy and the birth occurred may have favored the interactions, since the mothers had support from the family, they did not go through conflicts of couple, and received the news of the pregnancy with happiness. The painful emotional state during the pregnancy was associated with fears of complications during pregnancy

and / or childbirth, which would explain the mothers' concern about the health status of their children. In addition, these mothers could imagine their babies during gestation and recognize and interpret fetal movements. In this sense, it could be speculated that although the interaction was satisfactory in this type, the impact of the biological risk in these infants may have been of such a magnitude that was not mitigated by the relationship.

In the dyads of Type 3, whose infants had developmental difficulties, the biological risk was different, since some presented a more pronounced risk while in others the risk was slight. In all of these dyads, although there were interactions, these were intermittent and changeable throughout the first year of life. It may be argued that this could be related to the difficulties that these mothers had to put aside their own concerns and / or interests. In all cases, there was probably a difficulty in prioritizing the relationship with the infant, and in identifying and connecting emotionally with him or her. In these dyads, the biological risk of the infant might have been conjugated with an unstable attachment, which could have increased the risk and contributed to developmental difficulties. Furthermore, aggressive behavior, threats of abandonment, and neglect of the child's hygiene, feeding and safety were mother's behaviors observed in these dyads.

### Discussion

In this pilot study, the results show that in the first type of mother-infant interaction categorized as Type 1 exhibited the highest percentage of infants with difficulties in development. However, the remaining two types of interactions also showed below-expected percentiles.

The highest percentile of infants with difficulties in psychomotor development (60% - 3 infants) and cognitive development (20% - 1 infant) belonged to the first type of mother-infant interaction. In turn, compared with the other types, this type presented the highest number of infants with delayed and risk scores in psychomotor development within the total sample. The results allow us to point out that the characteristics of this type of interaction may have a more pronounced impact on the psychomotor aspect during the first year of life, since the difficulties were presented mainly in this area whereas it was not so in the cognitive one. This is consistent with what has been proposed by Schapira et al. (2008), since the most frequent alterations in high-risk infants are usually present in growth and motor development. Mothers characterized as non-interactive with children who have difficulties in establishing interactions predict the worst outcomes in the development of children (Muñoz-Ledo-Rábago et al., 2013). Type 1 of interaction was characterized by a lack of corporal contacts initiated by the mothers. Winnicott (1971/1987) proposes that poor manipulation acts against the development of muscle tone and coordination. Thus, the insufficient manipulation of the infant's body observed in this type of interaction could have had a negative impact on the psychomotor development. Therefore, from our results it could be inferred that the established type of interaction may have deepened the biological risk of these infants, thus contributing to the difficulties in development.

In the second type of interaction, percentiles of risk or retardation in psychomotor (11.8% - 2 infants) and cognitive development (11.8% - 2 infants) were also obtained, though to a lesser extent. Nikodem (2009), states that the characteristics of interactions and interpersonal relationships in the first years of the child's life can modify functional and anatomical aspects. Based on this, it could be argued that interacting types that were satisfactory and enriching for both members of the dyad may have contributed to lessening the impact that biological risk might have had on development of these children. In this sense, the greater the mother-child reciprocity, the greater the motor development in children with a history of perinatal neurological damage (Muñoz-Ledo-Rábago et al., 2013). According to the results of our study, it could be inferred that in those infants who presented developmental difficulties, the biological risk would have been of such magnitude that the established bond could not compensate for it, or that other social, economic, cultural and family factors could contribute to the difficulties in development. Besides, it may be inferred that low birth weight and prolonged hospitalization in the NICU were factors that could have influenced the development of the infants of this type of bond, even though the link was satisfactory (Rodríguez et al., 2008; Bear, 2004).

Likewise, in the third type of interaction, some infants presented delayed and risk assessments in psychomotor development (14.3% - 2 infants) as well as in cognitive development (21.4% - 3 infants). The 3 infants included in situation 1 described in this type of interaction, presented difficulties in the psychomotor or cognitive development independently; while the only infant who belonged to situation 2 presented psychomotricity along with cognition difficulties. It could be inferred that early attachment difficulties could have had a more global impact on development, even though attachment improved markedly after hospital discharge. This would allow inferring, that later interactions with more favorable characteristics could not have compensated for the impact of the early difficulties in this dyad. Soulé and

Lauzanne (1993), state that the less time the gap lasts and the older the child, the greater the chances of normal development. On the contrary, the interaction difficulties that emerged in the dyads of situation 1, and that were observed after the hospitalization during the controls at the Follow-up Office may have had a more partial influence, affecting one aspect of the development of these infants, either the psychomotor or the cognitive.

The main limitation of this research is the small size and heterogeneity of the sample, which restricts generalizations of the results to other high-risk mother-infant dyads. It would also be necessary to study the development of infants after the first year of life, since the interactions could affect other crucial developmental moments such as the acquisition of sphincter control, school beginning, among others.

In conclusion, the present study represents a first attempt to explore the different ways of interactions between mothers and their high-risk infant, and the incidence they may have on the psychomotor and cognitive development of infants. It can be argued that the established type of mother-infant interaction is one of the multiple variables that influence the development reached by these high-risk children during the first years of life. This study shows the importance of considering the multi-determination of development since in each particular case the biological risk and the established interacting type can be combined in different ways.

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