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To cite this article: Maria Paulina Hauser & Marijn van Dijk (2016): A pilot study on early mother–infant communication during and after NICU admission, *Early Child Development and Care*, DOI: [10.1080/03004430.2016.1156674](https://doi.org/10.1080/03004430.2016.1156674)

To link to this article: <http://dx.doi.org/10.1080/03004430.2016.1156674>



Published online: 04 Apr 2016.



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A pilot study on early mother–infant communication during and after NICU admission

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ABSTRACT

Premature children or infants with neonatal pathologies have a higher risk of developing communicative problems. This pilot study aimed to explore communicative behaviour between the mothers and the infants during the hospitalization in the Neonatal Intensive Care Unit (NICU) and follow-up paediatric visit. The verbal interactions in the NICU were observed using an Observational Scale (N-EOV-INC). Observations at follow-up were carried out in 9 mothers and their high-risk children at infant's age around 9 and 11 months. The results show that the number of words produced by the mother during follow-up was associated both with the number of verbal interactions initiated by the mother and infant replies during NICU stay. The infant's verbal responses during neonatal admission were also related with the number of words uttered by the mother at follow-up. Our study is a first exploratory investigation on the communicative interaction between mothers and their high-risk children.

ARTICLE HISTORY

Received 19 November 2015
Accepted 17 February 2016

KEYWORDS

Communicative interactions;
mother–child; observation;
NICU admission

Introduction

Early mother–child communication is currently considered a highly interesting area of research. Research shows that differences in the environments of children create differences in their rates of language development and consequently in the language skills they display at any age (Hoff, 2014). Through daily interactions, adults draw infants into communicative exchanges that become the basis for the later emergence of true intentional communication (Snow, 1999). Studies show that language development is promoted when the mothers respond to the vocalizations of their pre-verbal infants (e.g. Tamis-LeMonda, Bornstein, Kahana-Kalman, Baumwell, & Cyphers, 1998). Socio-economic status (SES) also influences language development (Hoff & Tian, 2005).

Maternal responsiveness is an important factor that supports early language development. Responsiveness is understood as the quality of the parental replies to a child's actions that are timely, adequate and adapted to the developmental age of the child (Tamis-LeMonda, Kuchirko, & Song, 2014). A recent study has shown that parental responsiveness benefits language skills during early periods of development even before children produce conventional words. For instance, it is related with the complexity of infant's babbling. Usually, parents use didactic language characterized by providing more information in the responses, and ask about object and events more than less informative language such as prohibitions (Tamis-LeMonda et al., 2014). Mothers who not only respond, but also do this in a manner that is related to the child's previous verbal or non-verbal move

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appear to benefit their children's language development (Hoff, 2014). The amount of speech the infants hear is related to the rate at which their language skills grow (Hart & Risley, 1995; Hurtado, Marchman, & Fernald, 2008; Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991). Responsive replies are more likely to consist of multimodal inputs and coordinated verbal, physical and visual cues. Research shows that children with highly responsive mothers displayed language milestones – such as first words – considerably earlier than children with low-responsive mothers (Tamis-LeMonda et al., 2014).

Some children have an increased risk to present delays in language development (Schapira, 2008). Infants who are born prematurely or with neonatal pathologies, and who have been hospitalized during their neonatal period in an NICU can experience delay in language development (Nikodem, 2009). Prematurity is defined as birth before 37-week gestation period (Kelly, 2006). In the noisy and highly lit environment of NICU, filled with technical devices and unusual sounds, early mother–child communicative interactions take place. Despite these particular conditions, many dyads are able to maintain a wide behavioural exchange, which has certain specific characteristics (Santos, 2010).

Furthermore, high-risk children face the possibility of experiencing problems concerning communication and early language development. The particular child's capacity to participate in communication may also alter the maternal interactive behaviour. Problems in communication and development may hinder the mother to build reciprocal exchanges with the infant (Stolt et al., 2014). There is limited information about the effects of NICU environment on future language outcomes (Caskey & Vohr, 2013). However, the exposure to parental language during hospitalization has been identified as an important predictor of infant's vocalizations and conversational turns at 32 weeks of age (Caskey & Vohr, 2013).

Research also suggests that sensory or maternal deprivation affects language development during the first year of life (Rodríguez, Vivas, Cangelosi, & Schapira, 2008). Language assessment by the age of 12 months shows that preterm infants tend to score significantly lower than their full-term-born counterparts. For instance, these infants have more difficulties to perform simple requests, to understand simple questions, to indicate objects or to imitate words. These infants utter their first words late in time and vocabulary development is slow. Changes in the forms of communication also tend to occur with the members of the family (Casiro, Moddermann, Stanwick, & Cheang, 1991). Caregivers who are overly attentive to the needs of the infant may also hamper the emergence of language as the child hardly needs to communicate what he needs or wants because he is satisfied before even asking (Jansson-Verkasalo et al., 2003). Some early indicators of language delay are the use of a poor jargon around 12 months corrected age, the absence of first words before 15 months and showing difficulties in understanding orders (Jansson-Verkasalo et al., 2004).

Mother's sensitivity and responsiveness seemingly support later cognitive and language performance in preterm infants (Stolt et al., 2014). A recent study has demonstrated an association between the quality of early mother–infant interaction and the early language development in very low-birth-weight children. In this longitudinal analysis, a significant correlation was found between early mother–infant interaction at six months of life and later language skills at two years of age. However, none of the measured interactions predicted later language development (Stolt et al., 2014). The assessment of communicative and language delay during the first years of life is difficult because the line between variability and delay in language development is not always clear (Verma, Sridhar, & Spitzer, 2003). These children should be assessed as early as possible in order to reveal possible deficits, potentially leading to language disorders (Jansson-Verkasalo et al., 2003). However, because development is nonlinear and self-organizing, early prediction is by definition hard (van Dijk & van Geert, 2015). In the domain of human development, the components of a system influence each other constantly and mutually whereby the strength of the relations varies and is nonlinear (van Dijk et al., 2013).

In the current study, we aim to describe communication between mothers and high-risk infants during the paediatric follow-up around the age of 9 and 11 months. We consider that early

hospitalization may influence later mother–child verbal interactions, for that reason we aim to investigate communicative interaction during neonatal hospitalization using the N-EOV-INC scale. This is a pilot study on the communicative variation between dyads. The main research question that guides our study is: What is the relation between mother–child communicative interaction during early hospitalization and mother–child communication at 9 and 11 months of age?

Methods

Participants

The sample for this research is part of a larger longitudinal study ($n = 36$) on the interactions between mother and their high-risk infants. The children included had been hospitalized in the NICU during the first month of life. They were born at the Maternity Hospital in the province of San Luis, Argentina between October 2011 and November 2014. A subsample of nine dyads was included in the present pilot study. The inclusion criteria were that the infants had to be in the age range of 6–15 months and remained in the follow-up programme after the neonatal hospitalization. All the participants in the sample were Spanish speakers. We excluded children that were older at the moment of participation and the dyad in which the mother had a diagnosis of mental illness. All the children were preterm, four were male and five female. Five children of the sample remained hospitalized during their neonatal period in NICU due to respiratory difficulties, three infants had intrauterine growth retardation and one had cardiovascular problems. The psychomotor and cognitive development was normal in seven children, two infants showed delays in both areas, specifically in motor development. All children had normal hearing assessments registered during the neonatal period and the follow-up. A summary of average frequencies and variance is described in [Table 1](#).

Materials

The quality of mother–child verbal interactions was measured during the child hospitalization using 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 behaviour and finally postural modifications during the observation. For this study we focused on verbal interactions, which include communicative sounds and words uttered by the mother and the infant responses to these. The mean verbal behaviour during hospitalization was counted as the frequency of verbal behaviours initiated by the mother and on the response of the infant.

Table 1. Child and mother characteristics.

	<i>n</i>	
Mother educational level	Primary studies (5) High school studies (4)	
Mother working status	Unemployed (5) Informal job (3) Formal job (1)	
	Mean	Std. deviation
Child age at first observation (months)	9 (min 6, max 11)	1.810
Child age at second observation (months)	11 (min 8, max 15)	2.472
Gestational age (weeks)	31	1.936
Birth weight (grams)	1363	0.289137
Hospitalization time in NICU (days)	46	18.160
Mother age (years)	22.78	5.783

Note: Informal job is defined as temporary activities (such as construction, cleaning and street vending) carried out in precarious conditions, low-paid and without social protection, which are very common in underdeveloped countries.

Data were collected from spontaneous mother–child verbal interaction that took place in the natural observational context of follow-up at the High-Risk Child Office in the Maternity Hospital. Each dyad was recorded twice at infant average age of 9 and 11 months. The programme CHILDES (MacWhinney, 2000) was used to process and analyse the recordings. This system addressed three tools for processing language data: the CHAT (Codes for the Human Analyses of Transcripts), the CLAN analyses programme (Computerized Language ANalysis) and the database that provide data from different research, ages and speaking languages. The CHILDES tools have been extensively tested for ease of application, accuracy, and reliability. The collected data were transcribed according to CHAT conventions using the software InqScribe®.

We designed a coding system in order to distinguish babblings from words uttered by the infants. We considered babblings as the infant's vocalization formed by true syllables, typically organized in reduplicated series of the same consonant and vowel combination (for instance *bebebe, tatata*). We considered infant's verbalization that had a consistent meaning as a word. In some cases, verbalizations clearly resemble the sound of a word in the target language, even when the word was not clear. We codified 44 different communicative sounds as babblings, as well as 17 different words verbalized during the observations (for example: *mamá* (mother), *papá* (father), *tomá* (take)). Furthermore, we included a specific code for crying. The transcribed data were then exported to CLAN where we calculated frequency and length turn.

The frequency analysis (FREQ) calculates the number of words or babbles. By the time this study was done, most of the children were still at the non-reduplicated babbling stage. They produced few words; this is the reason why different sounds that carried a communicative intention were considered as vocalizations. In the analysis, we included babblings and real words produced by the infants. The MLT calculates the mean number of utterances in a turn, the average number of words in an utterance and the mean number of words in a turn. Utterances that consist only of unintelligible vocal material are still considered as a turn (MacWhinney, 2000). In our study, MLT also includes babblings. A turn is defined as a sequence of utterances spoken by a single speaker. It is considered as a turn every time one of the participants initiates the communication that ends when the other interlocutor starts to talk or to babble. An utterance is defined as any speech sequence consisting of one or more words preceded and followed by silence.

Procedure

The present paper is part of a larger research approved by the ethical committee of the Facultad de Psicología, Universidad Nacional de San Luis (Argentina). The mothers in the study were contacted privately and the objective and procedure of the study was explained. 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, communicative verbal interactions were measured using the N-EOV-INC (Santos, 2010). These measurements were done 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. The observation time was five minutes, starting when the mother stood near the incubator and finished five minutes later or the moment when the mother left the room. The observational protocol was completed immediately after the observation that was carried out by a trained observer (the first author of this paper).

Verbal interactions were measured between May 2014 and October 2014 in nine high-risk children in a range of age from 6 to 15 months of corrected age. During follow-up, we assessed communication twice (once around the age of 9 months and once around 11 months). We documented mother–child communication during the 15–25 minutes of the paediatric visit. In order to improve the sound quality the device used to record was placed over the gurney where the child laid. The physician's and the mother's verbal interactions were recorded as well as the physician speaking to the child. For this study, we consider only the mother's speech directed to the child and vice

versa. The records were transcribed by the same person who observed the interactions during hospitalization.

Statistical analyses

The statistical analyses were conducted using IBM SPSS Statistics 22. The Pearson correlation coefficient was calculated in order to get information on the possible association between child's communicative behaviour and mother's communicative behaviour between 6 and 15 month of age as well as responsiveness during follow-up. The communication data were also correlated with verbal interactions scores measured during infant's hospitalization in the NICU, Pearson coefficient was used so as to establish if those behaviours are associated with language development. An alpha of 0.05 was used to determine significance.

Results

Description of the interactions

During the follow-up, most infants produced a variety of sounds trying to get their mother attention. In addition, the infants frequently looked at their mothers but they did not touch them with the same frequency. Mothers responded positively to communicative verbal interactions in only half of these situations. They frequently talked to the children without getting a verbal response. The infants tended to answer more to visual and physical interactions.

Correlations between mother-child communication and responsiveness

Children mostly communicated with their mothers using sounds, crying and in very few cases words. Only four children in this study used words. In total, the mothers pronounced 277 different types of words during the study.

We found a positive correlation between the number of utterances the child produced in the first observation (9 months) with the number of vocalizations spoken in the second observation (11 months) ($r = .682$; $p = .043$). Children who uttered a greater number of sounds at 9 months also produced more vocalizations at 11 months. The number of child utterances at 9 months age also correlates positively with the number of mother turns at the same age ($r = .681$; $p = .043$). Child turns at 9 months of age correlates positively with the number of mother utterances at the same age ($r = .901$; $p = .001$). The mother's utterances at the age of 11 months positively correlates with her child turns in the same observation ($r = .943$; $p < .001$). In addition, the number of utterances produced by the child at 9 months old is negatively correlated with crying at age of 11 months ($r = -.802^{**}$; $p = .009$). Medical background of the children, such as gestational age, birth weight and hospitalization time, did not correlate with verbal responses during the NICU and the number of utterances and vocalizations produced during the follow-up.

We found that the number of vocalizations by the child around 9 months was positively correlated with the number of maternal utterances at the 11 months visit ($r = .691^*$; $p = .039$). The number of vocalizations uttered by the child at 9 months correlates positively with the number of turns the mother took when the child was 11 months old ($r = .687^*$; $p = .041$). This suggests that children who are participating more in the communication encouraged their mothers to respond with a more communicative behaviour.

Finally, a strong positive correlation was found between the number of words used by the mother at 9 months and the number of verbal interactions initiated by the mother during her child period at the NICU ($r = .803^{**}$; $p = .009$). The frequency of infant's verbal responses in the neonatal ward also correlates positively with the mother's number of words at 9 months of age ($r = .698$; $p = .037$) and 11 months old ($r = .717$; $p = .030$). These results indicate that maternal communicative

Table 2. Pearson correlations between mother–child utterances, words and turns.

	Mother utterances (9 m)	Mother utterances (11 m)	Mother turns (9 m)	Mother turns (11 m)	Mother words (9 m)	Mother words (11 m)	Child vocalizations (9 m)	Child crying (11 m)
Correlation coefficient								
Child utterances (9 m)			$r = .681^*$ $p = .043$				$r = .682^*$ $p = .043$	$r = -.802^{**}$ $p = .009$
Child vocalizations (9 m)		$r = .691^*$ $p = .039$		$r = .687^*$ $p = .041$				
Child turns (9 m)	$r = .901^{**}$ $p = .001$							
Child turns (11 m)		$r = .943^{**}$ $p = .000$						
Mother verbal interactions NICU					$r = .803^{**}$ $p = .009$			
Child verbal responses NICU					$r = .698^*$ $p = .037$	$r = .717^*$ $p = .030$		

*Correlation is significant at the .05 level (two-tailed).

**Correlation is significant at the .01 level (two-tailed).

behaviour at the moment of follow-up seems to be related to the way in which child answered to verbal intents of communication at the time of hospitalization. See Table 2 for an overview of all results.

Discussion

The present paper is a pilot study of the communicative interactions between mothers and their high-risk infants during hospitalization and of the follow-ups carried out at the ages of 9 and 11 months. In this paper, we aimed to understand whether early mother–child interaction during hospitalization at the NICU is associated with later dyadic communicative relationships as well as child language development.

Our tentative findings suggest a relation between mother–infant communicative behaviour at age of 9 and 11 months. We found that children communicative behaviour, in terms of number of vocalizations and turns, is significantly associated with mother communicative actions, specially related to number of turns, utterances and words. A positive association was also found between mother's turns, utterances and words done in observations at their infant's age of 11 months. Likewise, the number of utterances the child produced around 9 months is related with the number of words pronounced around 11 months. This indicates that children who tend to interact frequently with their mothers through sounds and babblings at early periods of development then produce more words. Also, when children participate actively in communicate exchanges taking more turns they used a greater number of utterances and vocalizations in the following interactions. Another interesting finding is the negative association between the number of utterances of the child around 9 months and crying around 11 months. This means that children who produce greater number of utterances at 9 months cried less often in the subsequent observation. Probably, these children are more able to express their needs, emotional states and frustration through more symbolic ways. Finally, the results suggest an interesting association between verbal interactions during hospitalization in the NICU and dyadic communication features during follow-up. The number of maternal verbal interactions initiated during child hospitalization in the NICU is related to the number of words she would produce around nine months, which means that mother who talks more during hospitalizations will produce more words at follow-up. Furthermore, the child's verbal responses during hospitalization are related to the mother's number of words during both follow-up moments. It seems that infants who are more responsive stimulate mothers to produce more words later in infancy. These results suggest that dyad communicative interactions seem to be

mutually regulated; the child has an active participation in these interactions contributing to synchronicity and feedback. The child's input in communicative behaviours may influence the mother's response. The results suggest that children who participate more, encourage their mothers to respond with a behaviour that is more communicative. Stolt et al. (2014) have emphasized that child's capacity to participate in communication may influence maternal interactive behaviour, when the child has complications in communication the mother faces more difficulties to engage in reciprocal exchanges. In this study, we also observed that mother communicative behaviour (utterances and turns) is related to the number of utterances the child produce during observations, which may indicate that more conversational and talkative mothers stimulate their children to participate more in the communication and to produce more sounds. Co-regulation seems to be a characteristic of mother-child dyads communication described as a continuous process by which individuals mutually adjust their actions to the actual and anticipated actions of the social partner (Fogel, 1993). Through the early interactions, infants are involved into communicative exchanges that become the basis for the future emergence of true intentional communication (Snow, 1999).

These findings also may suggest that maternal responsiveness and sensibility to child early communicative behaviours contribute to establishing conversational interactions. The findings are in line with previous research, in particular Stolt et al. (2014) and Tamis-LeMonda et al. (2014) which have shown that sensitive and consistent maternal responsive replies support later cognitive, language performance and skills in preterm children during early periods of development. The results suggest that some children produced fewer numbers of utterances, using mainly crying as a way to express themselves. We assumed that maternal responsiveness supports the transition from a more basic way of communication to a more symbolic way all this done through the production of intentional sounds and words. Crying is an indispensable capability for a newborn, but when crying continues after the first months of life, it often becomes an important concern for parents that leads to a decrease sensitivity and responsiveness to their infant's need. Persistent crying after five months corrected age has been related to problems in mother-child relationship (Korja et al., 2014).

The main limitation of this pilot study is the small sample size and the associated lack of statistical power. Because of this, we were only able to detect large effect sizes. Other limitations are that dyadic communication was assessed by only two follow-up visits in a reduced sample and that we lack a group to compare the results obtained. It is highly recommended to analyse the associations between early dyadic interactions and communication development in a larger group of children, since the small sample size may have restricted our capacity to be certain about these associations.

In conclusion, the present study is only a first attempt to explore whether early verbal interaction is related to future dyadic communication in a group of vulnerable children. We consider this an indispensable first step for future investigation that could contribute to understanding communicative interactions in high-risk mother-child dyads.

Acknowledgements

We thank to the Department of Developmental Psychology, Faculty of Behavioral and Social Sciences, University of Groningen, The Netherlands.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the National Scientific and Technical Research Council (CONICET), Argentina and by Erasmus Mundus – Peace Project.

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Marijn van Dijk (1972) is an associate professor in Developmental Psychology at the University of Groningen, The Netherlands. Her research theme is early social and cognitive development from a complexity approach. Specific topics are: parent–child interaction, language, cognition, feeding, and intra-individual variability. Most studies are focused on change processes and the observation of interaction behaviours in naturalistic circumstances.

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