

Early postural and motor markers of language delay in very preterm infants

Theoretical background

Language development is considered a reliable indicator of development and is related to school achievements (Nelson et al., 2006). Language delay (LD) can be identified between 18 and 36 months in children with limited expressive vocabulary, equivalent to the 10th percentile or below compared to normative values, who are free from cognitive, neurological, or sensory deficits (Rescorla, 2011). The prevalence of LD in population-based cohorts ranges from 13 to 20% for 2-year-old children (Zubrick et al., 2007). Early identification of children at risk for LD is thus important for planning interventions to improve language and reduce subsequent sequelae.

The risk of exhibiting LD is greater in populations with perinatal risk factors, such as infants born preterm (gestational age- GA <37 weeks), with increasing difficulties observed in very preterm infants (GA<32 weeks; Nelson et al., 2006). This at-risk population is characterized by multiple atypical biological and environmental constraints that lead to atypical developmental trajectories in several domains, among them motor and language ones (Oudgenoeg-Paz et al., 2017; Sansavini et al., 2011, 2014). A high interindividual variability, with more than 30% of very preterm infants showing a LD between 2 and 3 and a half years of age has been shown (Sansavini et al., 2010). Thus, it is important to examine whether early markers exist in this population that can identify infants with LD already in the first two years of life.

Despite knowledge of the conditions posing risks for language development has substantially increased, little is still known about the role of early developing motor skills in shaping typical and atypical language development (Iverson, 2010). The current project aims to fill this gap by exploring whether interindividual variability in postural, gross motor, and fine motor skills is associated to different outcomes in language development in a population at high risk for LD, i.e., very preterm infants, compared to typically developing full term infants at low risk for LD.

Aims and Hypotheses

By adopting a prospective longitudinal design, in which infants are followed from 6 to 18 months of age, the project will evaluate whether early interindividual variability in postural, gross motor and fine motor skills is associated to individual differences in language acquisition, and how this association occurs in populations of infants at high risk vs low risk for LD.

We hypothesize to observe a slower development of postural and motor skills in very preterm infants than in typically developing full term infants. Besides group differences, we expect to observe interindividual differences within the very preterm sample with about 30% of infants resulting LD at 18 months and showing a slower postural and motor development than both very preterm infants not resulting LD at 18 months and typically developing full term infants.

Methods

Participants and sample

Fifty very preterm infants and a comparison group of 25 typically developing full term infants, balanced by gender, parental education level, and exposure to the Italian language will be recruited. Neonatal data will be taken from hospital records. Sample size is estimated with a priori power analysis with a medium effect size ($f=.25$), based on studies on very preterm infants' development (Vohr, 2014).

Tools and Procedure

Postural and motor skills. Postural skills will be assessed through 10-min naturalistic infant play and 10-min semi-structured mother-infant play segments video-recorded at 6, 9, 12, 15 and 18 months of age. Micro-analytic coding will be carried out by a coder naive to infants' group using Interact, a video-linked computer program. Interrater reliability will be assessed via independent coding of about 20% of the videos. Infant posture will be coded using procedures adapted from

Leezenbaum & Iverson (2019). Postures will be classified according to posture type (i.e., lying, supported sitting, unsupported sitting, all-four, supported standing, unsupported standing). Source of support by the infant or the caregiver will also be classified. Proportional duration of each posture will be coded. Gross- and fine motor skills will be assessed with the Bayley-III scales (Bayley, 2006) at 6, 12 and 18 months of age. Ages of assessment will be corrected for prematurity. *Language Outcome.* The Primo Vocabolario del Bambino Parole e Frasi questionnaire (Caselli et al., 2015), that is the Italian adaptation of the MacArthur-Bates Communicative Development Inventory Words and Sentences (Fenson et al., 2007), a reliable widely used tool for identifying LD, will be filled out by parents at 18 months of infant age. A vocabulary size $\leq 10^{\text{th}}$ percentile will identify infants with LD. According to this criterion, about 30% of very preterm infants are expected to show LD. Absence of auditory and severe cognitive deficits will be ascertained with audiologic examination and Bayley-III scales.

Statistical analyses

Growth curve analysis will be used to examine individual and group differences in terms of initial status at 6 months and rate of growth up to 18 months with five points of observational postural assessment and three points of standardized motor assessment. Growth curve analysis will be conducted using HLM (Raudenbush & Bryk, 2002) to model growth of postures', gross-motor, and fine-motor development based on infant risk status and outcome classification (very preterm LD, very preterm no LD, typically developing full term).

Ethical approval

A formal approval by the Hospital Research Ethical Committee has been requested and parental informed written consent for participation will be requested.

Expected results and Implications

The aim of the current study will be to characterize trajectories of postural, gross motor, and fine motor development in populations of infants at high-risk (very preterm infants) vs low risk (typically developing full term infants) for LD. Slower postural, gross motor, and fine motor development is expected in very preterm infants with respect to typically developing full term infants. Besides group differences based on neonatal status, we expect also differences within the very preterm sample based on language outcome at 18 months. Specifically, very preterm LD infants are expected to show slower postural, gross motor, and fine motor development than very preterm no LD infants and typically developing full term infants.

Finding early postural and motor markers of LD can: a) increase our understanding of typical and atypical language development and of different phenotypes of LD; b) permit early identification of infants with LD and early planning of customized interventions; c) obtain ecological postural measures suitable for assessing early risk in motor and language development, which may reduce standardized assessments and make easier assessing infants raised in multilingual families.

Total characters (spaces included): 6965.

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Plan of activities

Project and training activities. The post-doc fellow will: a) analyze literature on early motor and language development in very preterm infants; b) assess postural and motor skills with standardized and observational tools; c) code postural skills; d) create the data base; e) carry out statistical analyses; f) disseminate results in national and international conferences; g) drafting one article for an international indexed journal.

Timing of activities. 1-12 months: Recruitment of children. 2-12 months: Assessment of children and data coding. 6-12 months: Data analysis. 9-12 months: Dissemination and article drafting.

Feasibility of the project. The project is feasible thanks to the collaboration among the proponent, Head of the DEvelopmental Psychology Lab (DEL), the Unit of Neonatology of the University of Bologna Hospital, and experts on this topic (Iverson, U. Pittsburgh, US; Bello, U. Roma Tre). The project is co-financed by PRIN 2017 funding awarded to the proponent.

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