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► To cite this version:

Giulia Danielou, Estelle Hervé, Anne-Sophie Dubarry, Thierry Legou, Béatrice Desnous, et al.. Impact of moderate prematurity on early speech perception and language acquisition in infants, a longitudinal planned study. Auditory Development Workshop, Nov 2023, Paris, France. . hal-04434413

HAL Id: hal-04434413

<https://hal.science/hal-04434413>

Submitted on 2 Feb 2024

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Impact of moderate prematurity on early speech perception and language acquisition in infants, a longitudinal planned study

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Introduction

The development of phonological perception in early childhood is crucial to language acquisition. During the first year of life, infants undergo a phenomenon of perceptual narrowing, during which their sensitivity to non-native contrasts diminishes as they gradually adapt to the phonological properties of their mother tongue (Kuhl et al., 2006; Maurer & Werker, 2014).

Moderate to late preterm infants (32-36 weeks' gestational age) have protracted neurodevelopmental outcomes at age 2 (De Jong et al., 2015; Shah et al., 2016) and an increased risk of low academic outcomes at age 5 (Quigley et al., 2012).

The aim of this study is (i) to explore the role of cortical and subcortical brain structures in encoding native contrasts during early development, (ii) to determine the impact of moderate prematurity.

This longitudinal study will enable us to follow the development of children, whether born at term or with moderate prematurity, from birth to two years of age.

Aims

- To understand how the encoding of speech features evolves over the first year of life, in both typically and atypically developing children, by examining the impact of auditory pathway immaturity and early environment on native phonetic contrasts.
- Assess whether neuroplasticity mechanisms that enhance native language encoding in young children can predict the later development of lexical skills.
- To highlight the importance of phonetic boundary refinement in the early years of life in predicting later ability to learn new words.

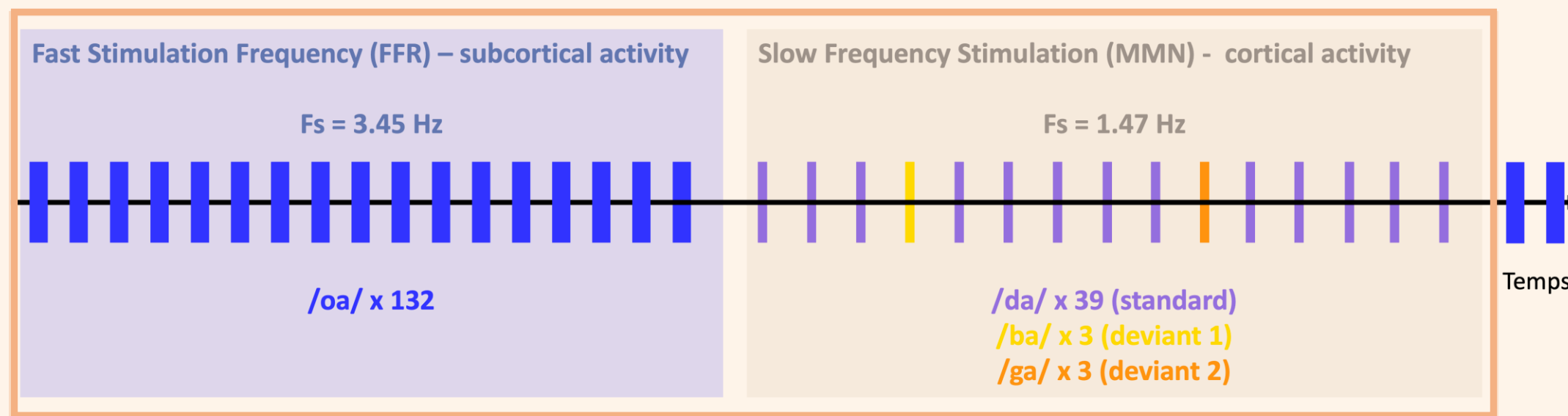
Experimental design and procedure

Longitudinal design with infants



Passive listening paradigm

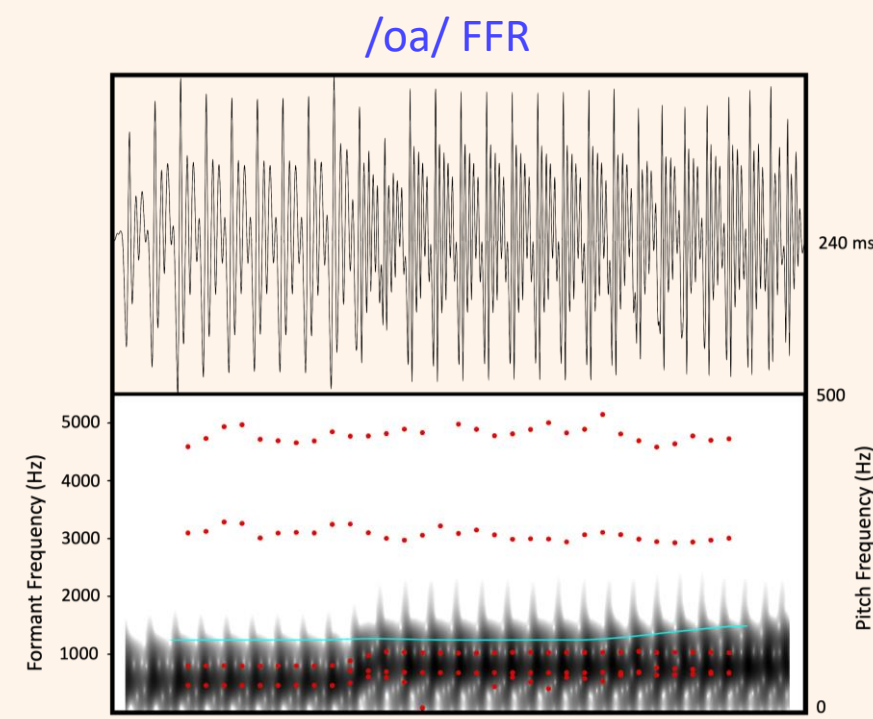
EEG recordings with simultaneous cortical and subcortical responses during a passive listening task (Bidelman, 2015).



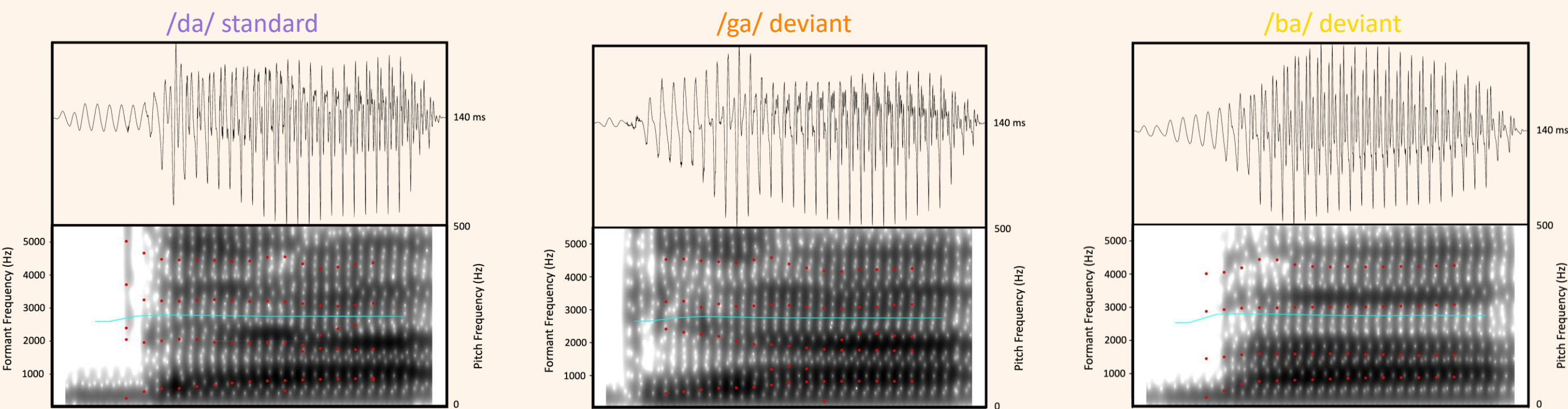
Neural processing of the acoustic features of speech, such as fundamental frequency and formants, is crucial to the acquisition of the phonological repertoire in infants from birth (Arenillas-Alcón et al. 2021).

The use of the 'oddball' paradigm enables us to study the brain's ability to discriminate phonemes.

Synthetic CV syllable for FFR: /oa/ duration 240 ms (Gorina-Careta et al., 2022)



Semi-synthetic CV syllables for MMN: /da/, /ba/ and /ga/ duration 140 ms.

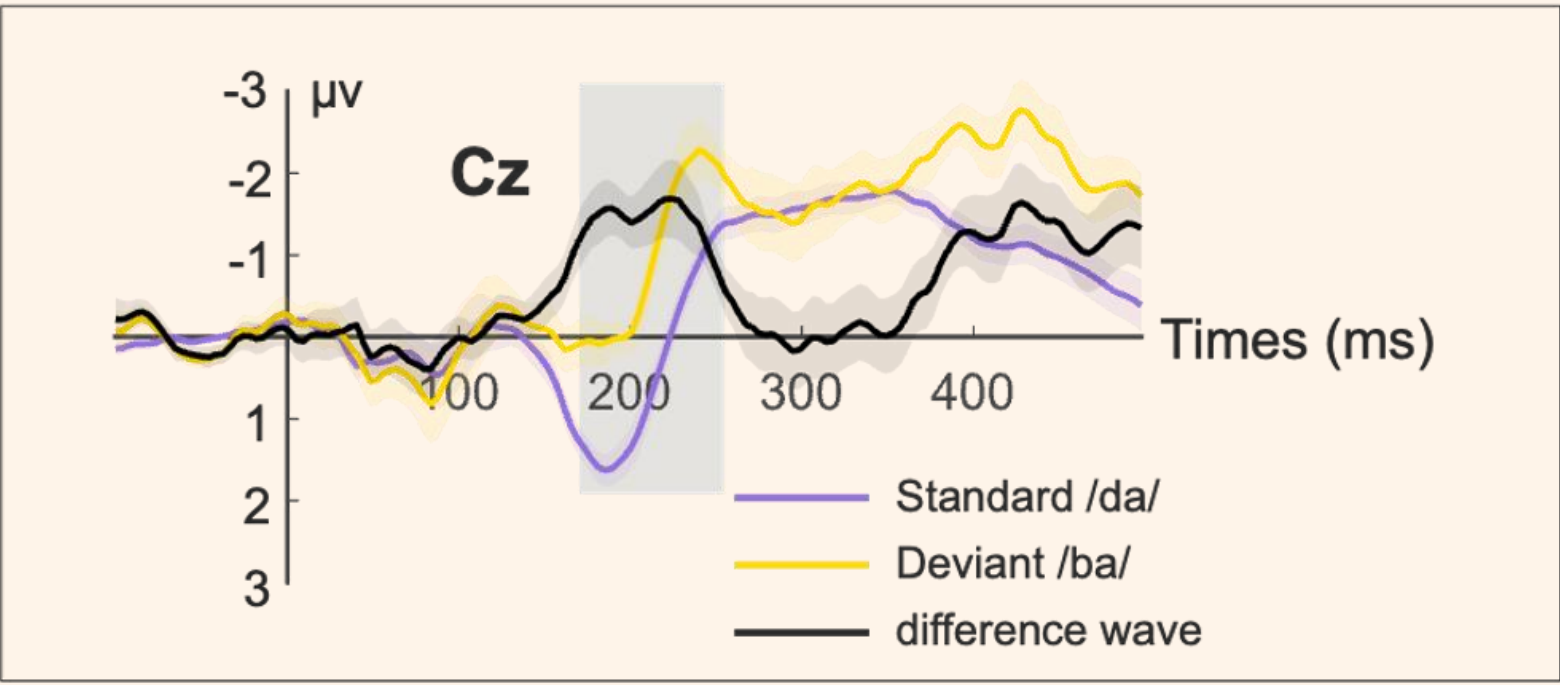


Preliminary results in adults

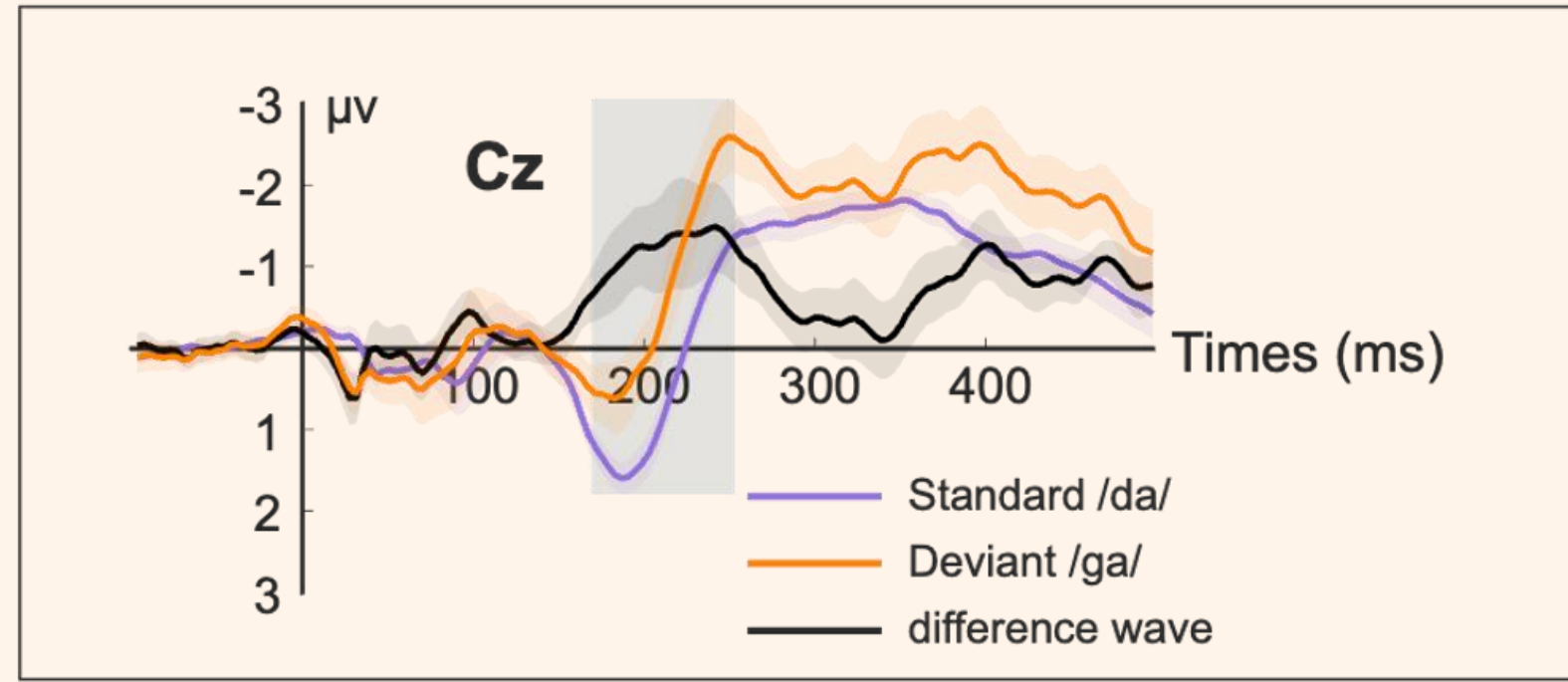
Grand average across participants (N=13, F = 6.), age range = 18 – 35 years (mean = 23,8)

Event-related brain Potentials:

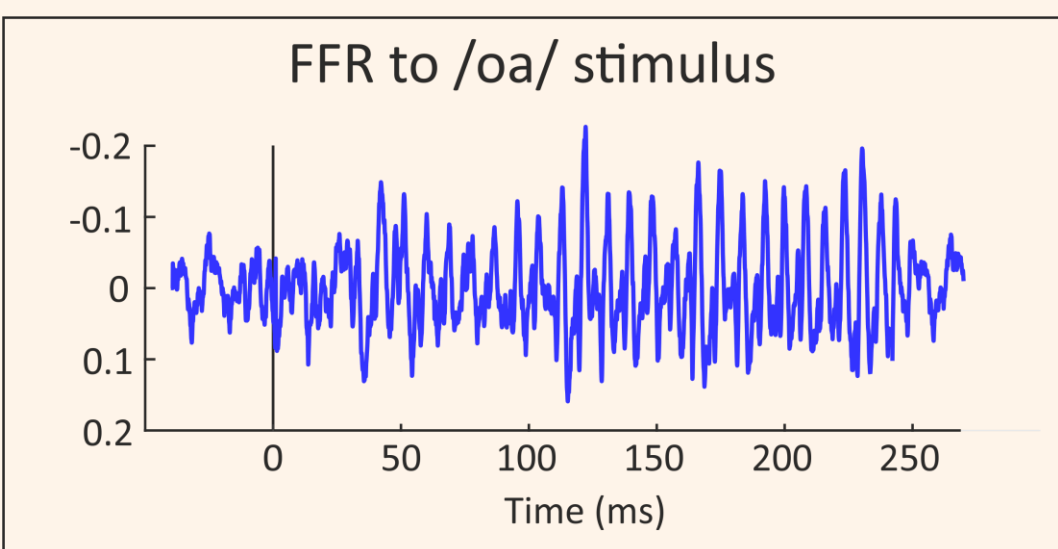
A) Response to deviant /ba/ (yellow) vs standard syllable /da/ (purple), MMN (black)



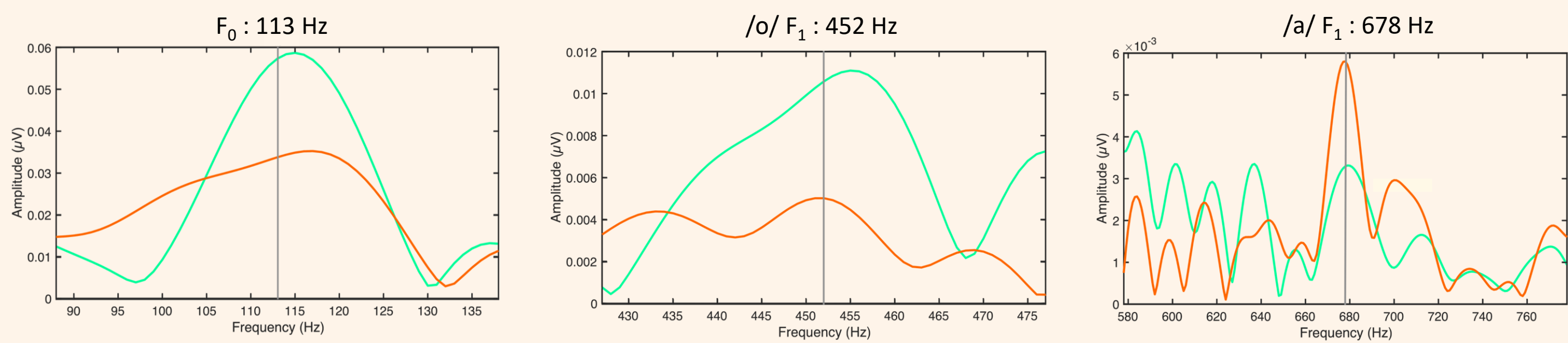
B) Response to deviant /ga/ (orange) vs standard syllable /da/ (purple), MMN (black)



Subcortical activity to /oa/ syllable: Time Domain



Frequency Domain



Perspectives

- To specify the neuroplastic mechanisms underlying the refinement of mother tongue sound encoding in early childhood.
- Explore the interaction between auditory pathway immaturity and precise environmental exposure on the perception of native phonetic contrasts during the critical period.
- Examine the impact of moderate prematurity on the complex relationship between early speech perception and vocabulary acquisition.
- Identify early biomarkers of language delay.



This work was funded by the French National Agency for Research (ANR), "BabyLang project" (ANR-20-CE28-0017) to CF. This work, carried out within the Institute of Convergence ILCB, was supported by grants from France 2030 (ANR-16-CONV-0002) and the Excellence Initiative of Aix-Marseille University (A*MIDEX).