

Neural reorganization of dialect perception within a critical two-month window in infancy: A longitudinal fNIRS study

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Introduction

- **At 4 to 5 months:** infants discriminate a broader range of language contrasts, including within-language variants, than at birth [1], [2].
- **Language preferences:** Familiarity preference at 4 months shifts to novelty preference by 6 months [3], [4]. Familiarity confirmed at neural level (EEG) at 4 months [5]. No longitudinal brain imaging study had examined this shift.

1. How do neural responses to a familiar and unfamiliar dialect change between 4 and 6 months of age?
2. Which brain regions support dialect discrimination, and do hemispheric patterns reveal the acoustic cues infants rely on?

Czech-learning infants were tested longitudinally on their **neural responses to Standard Czech (familiar)** and the **Silesian dialect (unfamiliar)** at **4 and 6 months**. The two varieties differ in **intonation and vowel length** (see Fig. 1).

Methods

Participants: 37 monolingual Czech-learning infants (19 girls; from 87 recruited) tested longitudinally at 4 and 6 months in Prague.

- **Method:** Bilateral cortical oxygenation was recorded with an NIRSport2 fNIRS system during blocked dialect presentation. 8 optical channels per hemisphere covering frontal, temporal, and parietal regions.
- **Design:** Two **homogeneous conditions (Standard Czech vs. Silesian dialect)** + two alternating conditions.
- **Stimuli:** 64 IDS sentence pairs from fairy tales, recorded by a 23-year-old bidialectal female speaker in both Standard Czech and Silesian. Authenticity verified by 40 adult raters. Infants watched a neutral visual display during auditory stimulation.

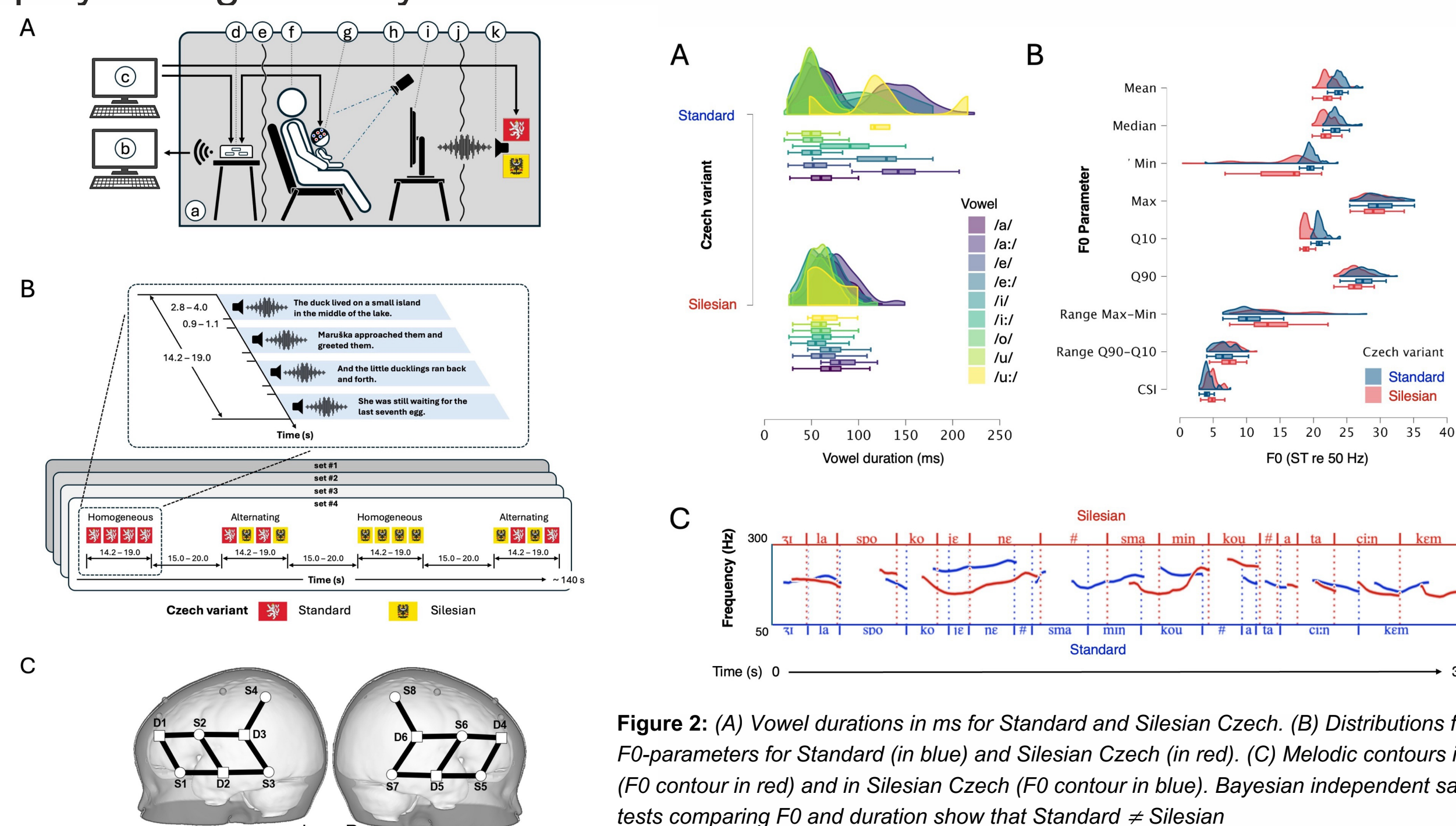


Figure 1: A. Schema of Laboratory Set-Up. B. Stimuli presentation. C. fNIRS montage

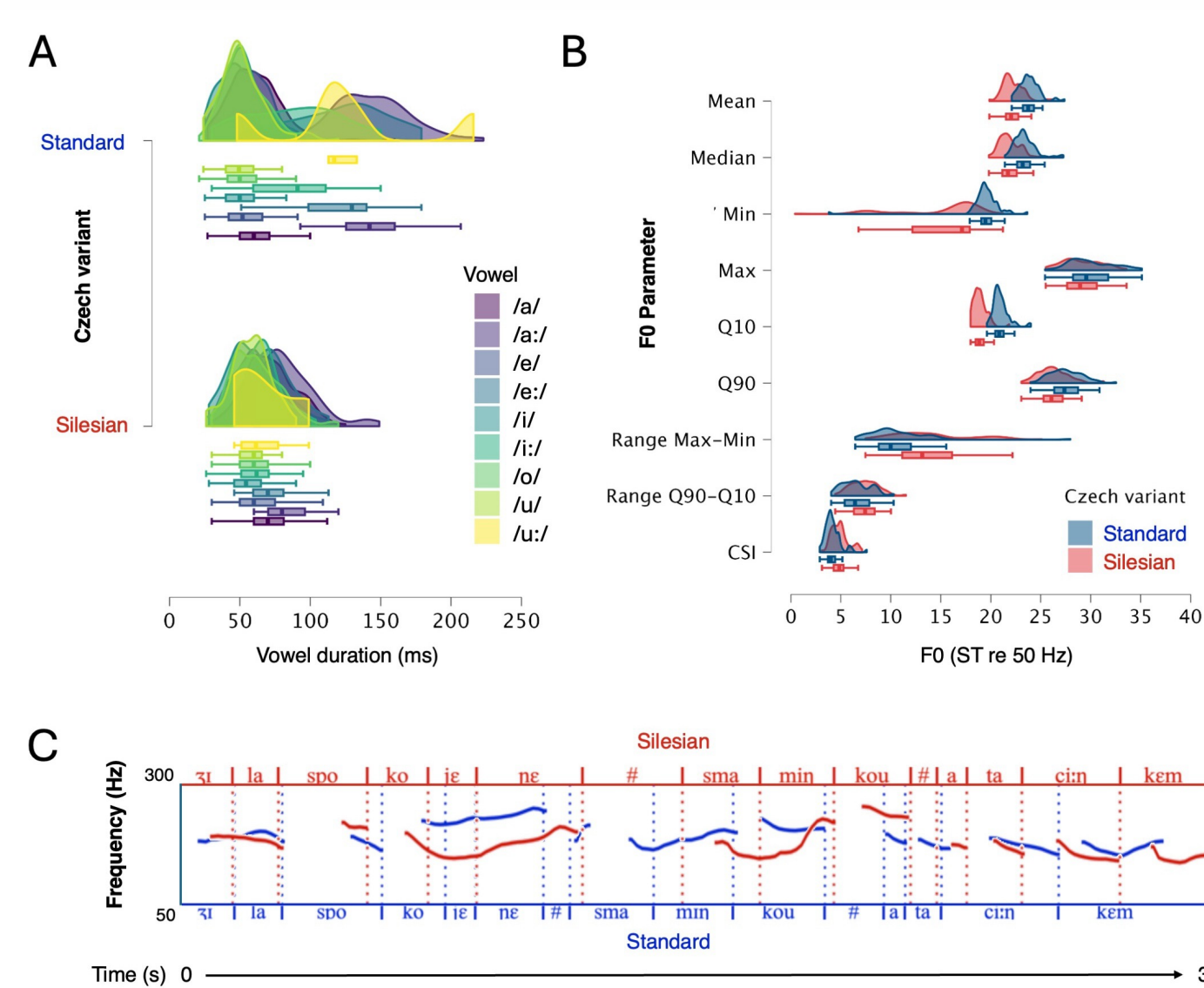


Figure 2: (A) Vowel durations in ms for Standard and Silesian Czech. (B) Distributions for different F0-parameters for Standard (in blue) and Silesian Czech (in red). (C) Melodic contours in Standard (F0 contour in red) and in Silesian Czech (F0 contour in blue). Bayesian independent sample t-tests comparing F0 and duration show that Standard ≠ Silesian

Detailed stimuli showcase can be viewed using the presented QR code.



Results

fNIRS study

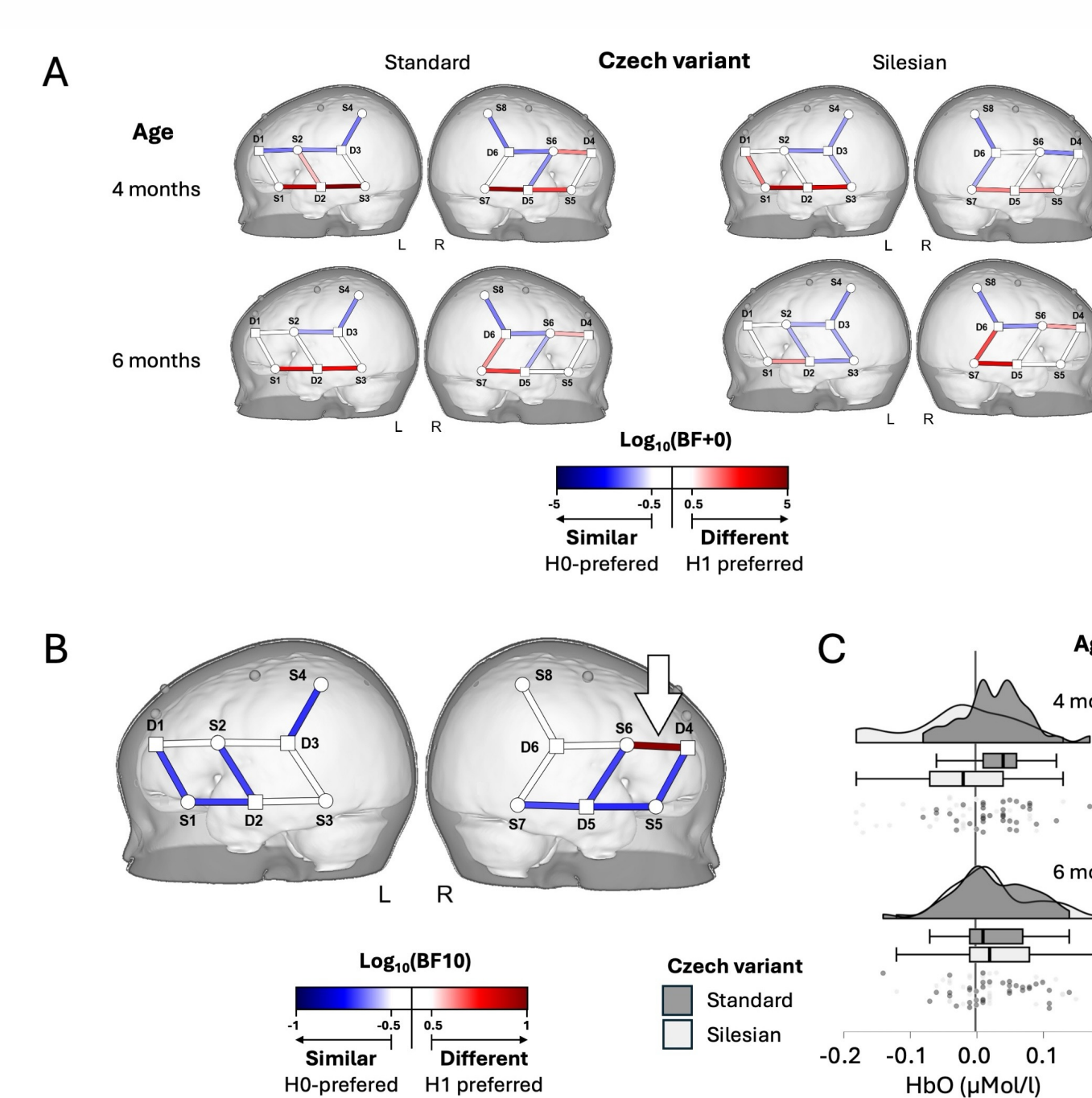
- Data processing: MNE-Python NIRS-toolbox [6], according to a previously established pipeline described in [7].

Within-subject level analysis: A two-condition GLM applied to each session, participant, and channel. HbO responses to homogeneous Standard Czech and Silesian blocks modelled separately per session [6], [7].

Group analysis: JASP [8]; Bayesian channel-wise one-sample t-tests, paired t-tests, and 2x2 rmANCOVA (within-subject factors age (4m | 6m) and Czech variant (Standard | Silesian) and covariates (sex and head size increase). Bayesian model comparison of interaction vs. null model.

- Weakly informed Cauchy priors ($r=0, \sqrt{2}/2$). Evidence reported as $\text{Log}_{10}(\text{BF}_{10} \text{ or } \text{BF}+0)$: >0.5 = moderate, >1.0 = strong.

Figure 3



(A) Effect of auditory stimulation. Results of channel-wise Bayesian one-sample t-test for an increase in HbO ($\Delta\text{HbO} > 0$).

(B) Variant specific changes in cortical oxygenation with age: rm Bayesian ANCOVA. The right PFC channel S6-D4 showing evidence of the superiority of our interaction model ($\text{Log}_{10}(\text{BF}_{10}) = 1.01$) over the null model is marked with an arrow. (C) Oxygenation values for this channel were compared via post-hoc Bayesian paired t-tests: standard Czech ($\text{Log}_{10}(\text{BF}+0) = - 0.87$) stable, Silesian ($\text{Log}_{10}(\text{BF}+0) = 1.39$) increase over time.

Optical channels with an **increase in HbO** concentration in **red**. No increase in HbO concentration during auditory stimulation and **stable cortical oxygenation with age** (similar) in **blue**. Channels with no sufficient evidence in **white**.

At 4mo, infants show stronger left temporal and right lateral PFC activation for Standard Czech reflecting familiarity preference.

By 6mo, right PFC activation to Silesian increases and reaches the same level as Standard Czech reflecting a transitional state.

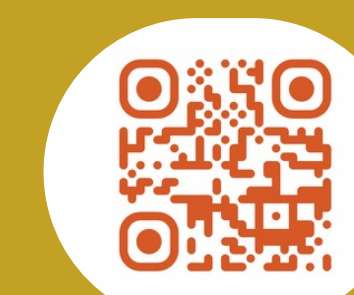
Temporal regions show stable bilateral speech responses at both ages.

Between 4 and 6 months, infants become increasingly sensitive to the unfamiliar Silesian dialect, with right frontal activation reflecting growing attention to intonational cues in the unfamiliar dialect.

References

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PR



- WEB
- Newsletter
- FB and Instagram
- Facebook group
- Mambiente club



Figure 5: Mambiente Club - Reoccurring Meetings with Parents

Paillereau et al. (2026). Neural reorganization of dialect perception within a critical two-month window in infancy: A longitudinal fNIRS study. *NeuroImage*, 336, 122006.