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Joint adaptation in Child-Caregiver interaction, and its impact on Word Learning

Context and Objectives

Language is a key predictor of cognitive development and academic success, and vocabulary acquisition plays a central role in this process. While infants initially know only a few words, their lexical knowledge improves dramatically during the second year of life, a phenomenon known as the *vocabulary burst* (Bergelson, 2020; Bergelson et al., 2023).

The mechanisms underlying this phenomenon remain poorly understood and are marked by considerable variability. Several studies suggest that this variability may stem from the quality, rather than the mere quantity, of interactions between young children and their caregivers. Research conducted in both Western and non-Western communities indicates that adaptive communicative strategies within caregiver–child dyads are key predictors of successful lexical—and more broadly, language—development (Bergelson et al., 2023; Masek et al., 2021). In most Western cultures, the use of child-directed speech (CDS) constitutes a central component of such adaptive communication strategies.

From a phonetic perspective, child-directed speech is typically characterized by elevated pitch, increased pitch variability, hyperarticulation, and enhanced prosody (Kitamura et al., 2001). It also involves modifications at other linguistic levels: lexical (e.g., simpler, more frequent words), syntactic (e.g., reduced complexity), and pragmatic (e.g., repetition, exaggerated gestures and facial expressions, and pointing behaviors) (Genovese et al., 2020). These adaptations likely serve multiple functions, including attracting the child's attention, conveying positive affect, enhancing the clarity of audiovisual speech cues, facilitating speech segmentation, highlighting relevant information, and supporting word meaning interpretation (see Nencheva & Lew-Williams, 2022 for a recent review).

However, little is known about how this caregiver adaptation operates under real-world acoustic constraints, such as background noise, or how these conditions modulate its impact on word learning. This gap is critical, as infants and toddlers are rarely exposed to noise-free environments (e.g., daycare settings, presence of siblings). Understanding how communicative strategies adapt—or fail to adapt—in such contexts therefore constitutes an important public health issue, given the potential long-term consequences of early language delays on educational achievement and social development.

This project will therefore examine :

- From the caregiver's perspective : how child directed speech – and its associated modifications – is modulated by the child's age, environmental constraints (e.g., background noise), and available interaction modalities (audio-only vs. audiovisual).
- From the child's perspective : how children allocate attention to these different cues, depending on their age and communication environment, and how this influences their behavior (e.g., attention, scene exploration, vocalizations) and ultimately their word learning.

Method

Several experiments will be conducted with toddlers (aged from 18 to 36 months) and their caregivers, as well as with a control group of adults.

First, a face-to-face interaction experiment will be carried out, in which caregivers and potentially other adults interact with toddlers in a playful situation. Interaction conditions will also be experimentally manipulated: either in quiet or noisy environments. The audio and video signals of adults' communicative behavior will be recorded, while toddlers' visual attention will be measured using eye-tracking (either head-mounted or screen-based). Collecting these data will constitute a major component and contribution of

the PhD project, with the aim of building a large-scale, ecologically valid database of child–adult interactions. This database will be made available to other researchers, in particular to other PhD projects associated with the MIAI chair "DevAI & Speech".
In a second perceptual experiment, conducted in babylab conditions, children will watch or interact with a humanoïd robot (Furhat) which will present objects corresponding to novel words to be learned, while reproducing selected infant-directed behaviors identified in the first experiment. These behaviors will be systematically manipulated (e.g., speech and gestural characteristics) in order to measure children's attention to these different cues and to evaluate their impact on word learning.

Environment and Supervision

The proposed work will be conducted in a multidisciplinary environment, as part of a broader collaborative project. It will correspond to an experimental PhD thesis in cognitive sciences and developmental psychology, affiliated with the EDISCE doctoral school, while also being part of and funded by the MIAI chair "DevAI&Speech" which involves several interconnected PhD projects in artificial intelligence.
The PhD student will be jointly affiliated with both the LPNC and the GIPSA-lab, with access to toddler populations through the Babylab platform. The PhD will be supervised by Mathilde Fort (LPNC, expert in developmental psychology) and Maëva Garnier (GIPSA-lab, expert in communicative interactions), with the support of Thomas Hueber (GIPSA-lab, expert in developmental AI). The project will benefit from regular supervision through weekly progress meetings, complemented by more frequent interactions whenever needed.

Required skills

The candidate should have a strong background in cognitive science, psycholinguistics, developmental psychology, speech sciences, or a related field. A strong interest in human communication and language development is essential.
Experience in designing and conducting behavioral experiments (ideally with young children) will be highly valued. Skills in programming (e.g., Python, MATLAB, or R), data analysis, and statistical modeling are not required but will be considered an asset. Similarly, familiarity with signal processing (audio and/or video), eye-tracking data, or multimodal data analysis would be advantageous.
The candidate should demonstrate strong organizational skills, autonomy, and the ability to work in an interdisciplinary research environment at the interface of cognitive science and artificial intelligence. Good communication skills in both French and English (written and spoken) are expected.

Application instructions

The application consists of a motivation letter, CV (with detailed list of courses related to psychology, speech or cognitive science), names and contact details of two references, and transcripts of grades from undergraduate and graduate programs.

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