

Speech rhythm and pitch are fundamental in babies' language acquisition, shows study

April 26 2023



The study carried out by the University of Barcelona, the Institute of Neurosciences (UBneuro) and the IDIBELL reveals that prosody—speech rhythm and pitch—is fundamental in babies' language acquisition. Credit: University of Barcelona

Language acquisition is a complex process that requires different neural and cognitive skills since early childhood. One of children's big challenges in language learning is to distinguish the words that are

grammatically linked to each other, even though they hear one word after the other.

We can easily understand that in the sentence "She, who never drinks coffee, sleeps more," "she" is the subject to the verb "sleep," just like in the—easier—sentence "She sleeps well," although the first sentence has many words in between the subject and the verb. However, how does a child's brain cope with having to find regularities between the words that are separated from one another in a sentence? Since there are many words that could go together, it seems impossible to keep track of them all.

To date, it was thought that [babies](#) could not recognize these distant regularities in speech signal until their first year of life. Now, a study published in the journal *Science Advances* reveals that 9-month-old babies are sensitive to non-adjacent grammatical regularities contained in language components. The conclusions of the study highlight the importance of prosody—rhythm, melodic stress, pitch, pauses, etc.—that eases the babies' [language learning](#) process.

The study is led by Ruth de Diego Balaguer and Ferran Pons, lecturers at the Faculty of Psychology and the Institute of Neurosciences of the UB (UBneuro). Researchers Anna Martínez Álvarez and Judit Gervain, from the University of Padova (Italy), participated in the study as well.

Language learning and prosody in babies

Prosody, also known as "the music of speech," plays a fundamental role in people's communicative function and language comprehension. According to the new study, when prosody is present in speech, it improves the babies' ability to identify distant grammatical regularities, and this is seen in the babies' brain activity and in their behavior.

As part of the study, the researchers assessed the 9-month-old babies' sensitivity to non-adjacent grammatical regularities—with and without prosody—adding a high pitch in the syllables that had those [language](#) components. "Dependencies in speech structure were created through trisyllabic sequences that were incorporated into a regulated structure, in contrast to another sequence in which syllables were randomly organized," notes Ruth de Diego, ICREA researcher and member of the UB Department of Cognition, Development and Educational Psychology and the Bellvitge Biomedical Research Institute (IDIBELL).

The team applied the near-infrared spectroscopy technique (NIRS) to study the babies' neural response in a non-invasive manner. With this methodology, which can detect the differences in the changes in the [oxygen consumption](#) in the blood flow through [infrared light](#), it is possible to identify which brain regions respond to different conditions.

Babies' ability to discriminate language

When babies were exposed to a flat speech (without tone), no signs of learning-related behavior were detected, although their brains were able to detect them. "However, when the speech had pitch signals that stressed those regularities, we saw both neural responses and behavior measures, which indicates that babies could improve their learning in this new context," notes lecturer Ferran Pons.

Babies have powerful learning mechanisms that allow them to learn languages efficiently even before their first year of life, authors note. Therefore, 9-month-old babies can be sensitive to non-adjacent grammatical regularities, but reaching a strong and reliable learning in this age range is only possible when there is a statistical and prosodic regularity in the [speech](#), elements that help the child's brain detect the grammatical blocks that form a non-adjacent dependency.

"These findings shed light on the understanding of the role of prosody in [language acquisition](#) and provide evidence on the crucial impact of subtle pitch changes in processing [statistical information](#) in [early childhood](#)," conclude researchers Ruth de Diego and Ferran Pons.

More information: Anna Martinez-Alvarez et al, Prosodic cues enhance infants' sensitivity to nonadjacent regularities, *Science Advances* (2023). [DOI: 10.1126/sciadv.ade4083](https://doi.org/10.1126/sciadv.ade4083)

Provided by University of Barcelona

Citation: Speech rhythm and pitch are fundamental in babies' language acquisition, shows study (2023, April 26) retrieved 25 April 2024 from <https://medicalxpress.com/news/2023-04-speech-rhythm-pitch-fundamental-babies.html>

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