

Typically human: Babies recognize nested structures similar to our grammar

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Babies as young as five months old were able to recognize embedding in innovative tone sequences created for the study. Credit: Nikolaus Brade / MPI CBS

At a mere five months of age, babies seemingly have the ability to

recognize very complex grammatical structures. That is what a research team headed by Professor Angela Friederici from the Max Planck Institute for Human Cognitive and Brain Sciences (MPI CBS) and Professor Jutta Mueller from the University of Osnabrück has now shown in a new study published in *Science Advances*.

Human language follows certain regularities. For instance, a plural noun must be accompanied by a plural verb, as in the following [sentence](#): "The kids from the neighborhood are playing." As a result, relationships arise where information at the beginning of a sentence is relevant at the end of the same sentence. In German, subordinate clauses can be inserted, before a sentence is complete—such structures are referred to by linguists as embeddings or nested structures. The following is a simple example, "The boy standing over there laughs."

It is believed that the ability to recognize such embedding is unique to humans. Although some animals are capable of learning individual words and their simple combination, they appear unable to grasp the complexity and possible combinations present in [human language](#). The team around study leader Dr. Claudia Männel from the Department of Neuropsychology now ask: If this ability is part of what makes us human, when does it begin? At the Children's Language Laboratory at MPI CBS, the scientists tested 38 babies to see if and how infants can handle nested structures. Remarkably, babies as young as five months old were able to recognize embedding in innovative tone sequences created for the study. These results mark the earliest evidence to date of this basic ability in humans.

Working with babies is not easy, particularly when studying language perception. One cannot simply play sentences and explain the task to the infants. Prof. Jutta Mueller, a collaborator from the University of Osnabruck, explains that this can actually be helpful. "In early childhood research we work with built-in errors or rule deviations and determine

whether children can detect them. If babies do so, we then know that they already have the underlying knowledge. Together with the group, we considered how to test this in babies, without overstraining them with too demanding spoken sentences." The team decided to simplify the experiment using simple tones instead—more specifically, five-tone and seven-tone sequences in separate experiments. Embeddings were created by specific arrangements of different tone frequencies.

Dr. Claudia Männel describes the [structure](#) of the experiments:

"Children learn by frequency information and acoustic deviations—we know that they perceive such deviations in the womb when you play them sounds. We used this knowledge for the experimental arrangements in the Children's Language Lab. However, in our experiments it wasn't the individual tones that deviated, but the sequences of tones, including the embedding as a whole. We varied these to see if [babies](#) recognize the construction of embedded structures. With the [brain activity](#) we measured, we could then see from the EEG curves that the infants did in fact register the deviating sequences and thus they must have processed the nested structures. "

The next step is to investigate whether non-human primates might also have the ability to recognize such embedded structures, which would address the question of how this ability may have phylogenetically evolved.

More information: "Infant cognition includes the potentially human-unique ability to encode embedding," *Science Advances*, [DOI: 10.1126/sciadv.aar8334](#) advances.sciencemag.org/content/4/11/eaar8334

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