

Toddlers learn to reason logically before they learn to speak, according to study

September 5 2023



A toddler during one of the experiments of the research. Credit: Provided by the RICO research group at the Center for Brain and Cognition (CBC) at UPF

How do we learn to speak during childhood or how do we acquire knowledge about the world around us? Toddlers' social interactions in their social and family environment and in schools help to explain this, but they are not the only factors involved.

Natural logical thinking, which manifests itself from a very early age and does not depend on knowledge of language, also facilitates the [learning process](#), according to a study led by UPF's Center for Brain and Cognition, the results of which have been published in the journal *Current Biology*.

The study focuses on a question that still generates debate among neuroscientists: whether infants who have not yet learned to speak (or are developing speech) are capable of logical reasoning. This pioneering research shows that this natural logical reasoning exists from at least 19 months of age, does not depend on knowledge of language and is developed mainly through the strategy of exclusion by elimination.

In other words, if toddlers are faced with an unknown reality, they would try to analyze it and reach some conclusion about it by ruling out the options that are not possible, according to their level of knowledge at the time.

The results of the paper are presented in the article entitled "The scope and role of deduction in [infant cognition](#)," written by Kinga Anna Bohus, Nicolo Cesana-Arlotti, Ana Martín-Salguero and Luca Lorenzo Bonatti.

The principal researcher, L. Bonatti (ICREA), is the director of the

Reasoning and Infant Cognition (RICO) research group at the Center for Brain and Cognition (CBC) at UPF. Kinga Anna Bohus (main author) also belongs to the group. N. Cesana-Arlotti and Ana Martín-Salguero, previously linked to the CBC at UPF, are currently researchers at Yale University (U.S.) and at the École Normale Supérieure in Paris.

Toddlers tend to solve uncertainties by ruling out impossible options

The study analyzes the importance of two strategies for infants to deal with uncertainties: association and exclusion (or disjunction elimination). The first strategy would mean that toddlers hearing a new word that may refer to two unfamiliar objects that they can see, mentally associate the term with each of them. Subsequently, they would associate the term with the object with which this name fits better.

The second strategy (exclusion) explains how a [toddler](#) can learn a new word through logical reasoning by eliminating alternatives. For example, if they see two objects (A and B) and hear an unknown term that they know is not A (because they know the name of A), they will determine that it is the name of B. This is the predominant strategy, according to the results of the study.

Two experiments to analyze toddlers' natural logic posed with known and unknown objects and terms

The research team conducted two different experiments, the first with 61 monolingual (26) and bilingual (35) 19-month-old toddlers and the second with 33 (19 mono and 14 bilingual). The analysis of each group was crucial to determine whether deductive processes depend on linguistic experience.

In the first experiment, the participants were shown two objects, which they had to associate with one of the words they heard, through different tests. In the first test, they had to look at two objects they knew (e.g., a spoon and a biscuit) and, upon hearing a term (e.g., spoon), associate it with one of the two.

In the second test, the infants were shown an object they knew (e.g., an apple) and an object they did not know (e.g., a carburetor), and they heard the word corresponding to the known object (apple), which they had to identify. The third test was the same as the second, except that the word heard corresponded to the unknown word (e.g., carburetor).

In the second experiment, two objects or animate beings were used (for example, an umbrella and a figure of a boy), each associated with a sound. Subsequently, the two objects were covered so that the infant could not see them and one of them was placed in a glass. When they were uncovered, the toddler could only see one of the two objects and had to guess, by elimination, which one was inside the glass.

In a subsequent test (with the two objects covered and without changing their position), the infant listened to the sound associated with one of them and it was analyzed whether he/she looked in the direction of the correct object.

In all these tests, their gaze movement patterns were assessed. For example, when reasoning by exclusion, toddlers look at object A and, if they rule out that the term they have heard refers to it, then they turn their gaze towards B. This is known as the double check strategy.

There are no relevant differences in the logic of monolingual and bilingual toddlers

The main author of the research, Kinga Anna Bohus, summarizes the main findings of the study as follows, "We studied the presence of the concept of logical disjunction in 19-month-old infants. In a word-referent mapping task, both bilingual and monolingual infants display a pattern of oculomotor inspection previously found to be a hallmark of disjunctive reasoning in adults and children."

In short, the results of the study show no relevant differences between the logical reasoning of monolingual and bilingual toddlers, which confirms that it does not depend on linguistic knowledge. This natural logical thinking could be present before the age of 19 months, although there is still not enough scientific evidence to demonstrate its presence at earlier ages.

More information: Kinga Anna Bohus et al, The scope and role of deduction in infant cognition, *Current Biology* (2023). [DOI: 10.1016/j.cub.2023.08.028](https://doi.org/10.1016/j.cub.2023.08.028)

Provided by Universitat Pompeu Fabra - Barcelona

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