

## Naïve Theories

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While the idea of the mind as a blank slate has long been abandoned, the question of what exactly a “non-blank slate” might look like is still debated. In this entry we discuss the claim that children are equipped with *naïve theories*—primitive, incomplete, or otherwise ill-formed, but nevertheless systematic, mental representations of cause-effect relations. Other terms that reflect this idea include ‘misconceptions’, ‘naïve beliefs’, ‘prior theories’, ‘alternative conceptions’, or ‘intuitive theories’. Their main characteristic is that they interfere with an open-minded exploration of the surrounding. The unfortunate result of such biased exploration is that children ignore evidence that conflicts with their naïve theory, posing an important challenge for science learning and pedagogy.

Evidence of the presence of naïve theories is straightforward, documented in children as young as preschool age. A classic example is the belief that objects either balance at their geometric midpoint or not at all—independent of the objects’ center of mass. There is also the belief that heavy objects sink faster than light objects—irrespective of how the mass is distributed in an object. There are also naïve theories about motion: For example, children often believe that a ball traveling through a curved tube will continue to follow a curved path upon exiting. And when describing the earth, children might claim that the planet is a disk that one

could walk off. Naive theories have been documented in all aspects of science, including physics, chemistry, biology, and astronomy.

While the presence of naïve theories is taken for granted, questions remain about of how naïve theories form, get remembered, and can be changed. On the question of how naïve theories form, the prevalent view is that naïve theories emerge spontaneously as an individual interacts with the surrounding. For example, the belief that objects balance at their midpoint might stem from the child's experience with symmetrical blocks made of only one type of material. Similarly, the belief that the earth is flat might stem from the experience of walking on flat ground. It is not always clear, however, what kind of experience—or lack thereof—is necessary for the formation of a belief. For example, spontaneous explorations of objects' sinking rates are difficult to be carried out by a child. Yet children nevertheless persist in believing that heavy objects sink fastest—even after being shown controlled evidence that contradicts such belief.

On the question of how naïve theories get remembered, a prevalent view is that theories are mental entities with clear boundaries. This view is tacitly assumed by those who seek to assess a child's theories (e.g., to determine whether the child “has” or “lacks” a specific belief). An alternative view is that theories are a collection of diffuse representations that surround a core idea. More fragmented than whole, these “conceptual ecologies” lack unifying coherence. Also known as “fragmented knowledge” or “knowledge-in-pieces”, this view is best illustrated by the often conflicting and contradictory accounts children give when probed about abstract concepts. For example, rather than committing to a fixed belief about the shape of the earth, they might

have multiple conceptions, depending on the idiosyncratic details of how they were asked about it.

Perhaps the most important question has to do with how naïve theories can be changed. Given that naïve theories shape a child's learning experience, pedagogical efforts that merely convey established facts are likely to be insufficient. Instead, learning requires a re-learning of sorts, widely known as "conceptual change". Without conceptual change, naïve theories are likely to show up unexpectedly and replace what was learned during formal instructions. Thus, there is far more research on how to bring about conceptual change, compared to the amount of research on the nature of theories.

Regarding conceptual change, one view is that naïve theories revise themselves incrementally as the child is exposed to empirical evidence: The idea is that evidence is incorporated into existing representations of theories bit by bit, until the modified theory represents correct information. Alternatively, there is the view that naïve theories have an inner life of sorts, actively fending off conflicting evidence. According to this view, conceptual change does not happen incrementally, as fragments of the naïve theory are being revised. Instead it takes place as an instantaneous re-organization, also known as a "paradigm shift": Here, the naïve theory is abandoned as a whole, once enough disconfirming evidence has accumulated to force a shift.

The two alternative views on how naïve theories change have not been reconciled yet. Thus, despite extensive research in the area of conceptual change, it is not clear what kind of

pedagogy can reliably overcome a child's naïve theories. To get past the challenge of conceptual change, it might be necessary to first settle questions about the nature of theories. Advances in complexity science offer a useful framework towards this goal. They cast doubt on the claim that theories are static entities (whether with clear boundaries or distributed). Instead, they suggest that theories are the result of a functional organization that can retain internal order, yet is capable of modification in the face of new experiences. This means that naïve theories are stable and flexible at the same time, allowing for both internal cohesion and sensitivity to outside changes—a conceptualization of naïve theories that opens new venues for understanding conceptual change.

### **Further Readings**

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