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Five-month-old Jared Mann, held here by his mother, Dawn Mann is being tested in the Department of Psychology's Infant Cognition Lab.

Babies' Rules About the World

Renee Baillargeon

In their daily lives, infants routinely observe many different physical events. For example, they might see a parent pour cereal into a bowl, stack dishes on a table, or store groceries out of sight in a cupboard. During the 1970's, I was taught in my undergraduate Child Psychology classes that infants understand very little of the physical events that they observe. I had no inkling at the time that this view would soon change dramatically, and that I would be one of the researchers responsible for the change.

Over the past 20 years, the field of infant cognition has undergone a quiet revolution: Most researchers are now convinced that infants are far more competent than was traditionally believed. Champaign-Urbana babies have played a very significant role in this revolution. Many of the findings showing that infants possess a wealth of expectations about physical events have come from my laboratory (the Infant Cognition Laboratory) in the Psychology Department.

Currently, we are conducting experiments with infants aged 2.5 to 14 months to find out how their physical knowledge develops, and what processes are responsible for this development. Below I

summarize two main findings from some of our recent experiments.

Renee Baillargeon

Infants learn rules about events

As they observe the world around them, infants formulate rules about how it operates. Infants use these rules to predict the outcomes of events. When we show infants outcomes different from those predicted by their rules, they are surprised or puzzled and, as a result, respond with prolonged looking—just as older children and adults do when watching magic tricks!

Initially, infants' rules about events tend to be rather limited, so that they often make mistakes when reasoning about events. In some cases, infants fail to be surprised by events that are in fact physically impossible. For example, 2.5 month-old infants expect an object to be hidden when behind a nearer object, irrespective of their relative sizes. Thus, infants are not surprised by impossible events in which a tall object becomes fully hidden behind a short screen, or a wide object becomes fully hidden behind a narrow screen. It is not until infants are about 3.5 months of age that they are surprised by these impossible events.

In other cases, infants are surprised by events that are perfectly possible, but happen to violate their (limited) rules; the world does not operate as their rules suggest it should. Such violations no doubt help infants realize that their rules are in need of revision. For example, at 6.5 months of age, infants expect an object to be stable when released on a support as long as over half of the object's bottom surface rests on the support. At this stage, infants are surprised to see an object remain stable when released with its middle third resting on a narrow support; they do not understand how the object can remain stable with less than half of its bottom surface supported. Infants are also surprised to see an asymmetrical object (e.g., an L-shaped box) fall when released with half of its bottom surface supported; they do not understand why the object does not remain stable with half of its bottom surface properly supported. It is not until infants are 8 and 12.5 months of age, respectively, that they no longer show surprise at these possible events, suggesting that their rules have become sufficiently complex to predict these events.

Infants' rules are narrow in scope

When learning about the physical world, do infants learn general rules that are applied to all relevant physical events, or narrow rules that remain closely tied to the specific events where they were first acquired? Recent findings from our laboratory suggest that the second possibility is correct. It now appears that infants form narrow event categories, and learn separately how each category operates.

Part of the evidence for this conclusion comes from experiments comparing infants' reasoning about height in occlusion events (events in which an object is placed behind a nearer object) and containment events (events in which an object is placed inside a container). At 3.5 months of age, infants are surprised to see a tall object being fully hidden behind a short screen. However, it is not until four months later, at 7.5 months of age, that infants are surprised to see a tall object being fully hidden inside a short container. These events are perceptually highly similar, and they are governed by the same physical principles; yet infants succeed at reasoning about the occlusion situation long before they do the containment situation.

Our interpretation of these findings is that infants view occlusion and containment as separate event categories and learn separately about each category; rules learned about occlusion events are not generalized in containment events.

Additional support for this conclusion comes from ongoing experiments comparing infants' reasoning about transparency in occlusion and containment events. By about 8.5 months of age, infants expect an object that is lowered behind a transparent occluder to be visible behind the occluder and they are surprised if it is not. However, infants of the same age are not surprised if an object is not visible when lowered inside a transparent container (see Figure A); it is not until infants are about 10.5 months of age that they show surprise at such an event.

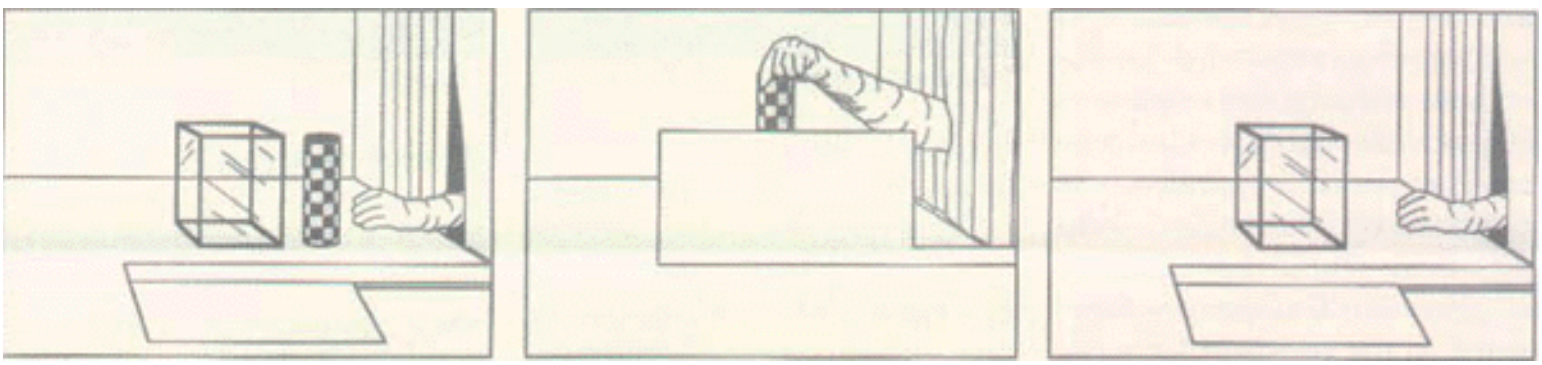

Figure A: An object is lowered into a transparent container behind a screen. Next, the screen is removed to reveal an empty container.

These and other results suggest that infants form narrow event categories and learn separately how each category operates. Why should infants use a "divide-to-conquer" learning strategy? Overall, it seems likely that this strategy greatly facilitates infants' acquisition of physical knowledge. After all, breaking down the task of learning into smaller, more manageable components is a time-honored solution to the difficulties of knowledge acquisition. For example, we typically teach our children about history, physics, and literature in separate classes—it is much easier to teach about these subjects separately than all at once.

In my comments, I have emphasized some of the limitations in young infants' reasoning about physical events. But it is also important to keep in mind their remarkable achievements. Young infants, like adults, try to make sense of the world around them. They break it into sensible pieces, and formulate rules about how each of these pieces might work. Infants' rules are at first simplistic and often lead them to incorrect predictions about events. With experience, however, infants readily revise their rules, and in this way slowly approximate the physical knowledge of their elders.