Babies Are Natural Scientists

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A recent review of research with infants by psychologist Dr. Alison Gopnik (University of California, Berkeley) suggests that babies as young as 8 months old not only pay attention to how often something occurs but that they may actually assign probabilities and make predictions about events based on their observations. Since babies that age can't talk, the researchers measure how long the infant stares at something, based on the finding that babies look longer at unexpected events than they do at expected events. One experiment presented infants a box filled with either white ping pong balls with a few red ones mixed in, or a box of all red ping pong balls. The infants stared longer when the experimenter removed mostly red balls from the mostly white ball box than when mostly red balls were drawn from the all red ball box. In a similar experiment with plastic frogs and ducks, 20 month old infants also noticed when the experimenter drew frogs from a bowl of mostly ducks, but this experiment went one step further. The experimenter next presented the infants a bowl of all ducks and all frogs and extended her hand over both bowls. The infants randomly gave her either a frog or a duck if the experimenter had previously pulled a frog from a bowl of all frogs and a duck from a bowl of all ducks, but if she had previously drawn frogs from a bowl of mostly ducks, the children gave her a frog, as if they inferred that she had a preference for frogs. Thus it appears infants not only take notice and remember frequencies of events, but they also make predictions based on their observations!

Gopnik's lab has also studied infants' ability to infer physical causation. She created a box that plays music when certain objects or combinations of objects are placed in it and then gave infants opportunities to try it out with various objects which they could manipulate themselves. These little experimenters (some as young as 20 months old) had little difficulty learning which combinations of objects made the box respond and which did not. They even learned how to operate more sophisticated boxes requiring sequences of object placements before it would play music.

By the ages of 3 or 4 children are no longer merely observing what goes on around them but are actively experimenting with things themselves. They are tinkerers, sticking things into other things, pulling things apart and putting them together. Gopnik and colleagues gave 4 year olds a "music box" that didn't work with the usual combination of objects. The children showed remarkable persistence trying various objects in interesting combinations to get it to work again. They also paid attention when watching others play with the box. In one such experiment 4 year olds watched the experimenter trying to make the toy work by trying out several sequences of different moves. Many of the children figured out the quickest moves to make it work without ever seeing the experimenter perform that exact sequence.

Conclusions: Young children are not passive receivers of information. Even before they learn to walk or speak babies are actively engaged with their environment, taking note of probabilities, inferring causation, and formulating hypotheses. As they become

able to manipulate their environment they also begin to test these hypotheses, from which they draw more inferences about reality in much the same way scientists test hypotheses in the laboratory.

These results should not be too surprising to parents of young children, especially when you watch them moving around, reaching for things, grasping things, and putting them in their mouths. The fact that they are already watching for consistencies and inconsistencies in their environment while still in the crib is more remarkable. Although Gopnik doesn't discuss it in her article, infants are also likely to make inferences about the actions of people from an early age, perhaps forming notions about the intentions and reliability of others. In other words, they are studying us even as we watch and study them.

This research has implications for education. As Gopnik puts it, "Children's spontaneous exploratory and pretend play is designed to help them learn." Providing them more opportunities to explore and manipulate what they see may facilitate learning in ways that rote learning and repetitive instruction do not. It also suggests that they are already educating themselves about the world long before they ever enter a classroom.

A. Gopnik. 2012. Scientific thinking in young children: Theoretical advances, empirical research, and policy implications. *Science*, Vol. *337*, Pages 1623 – 1627.