Learning About How Young Children Learn

Research by Tamar Kushnir in the Department of Human Development at Cornell University sheds light on how young children learn about cause and effect through everyday experiences.

Young children are naturally curious about cause and effect, and are naturally motivated to learn all about the "hows" and "whys" of the world. "Babies and children are like little scientists. They gather evidence by observing and experiencing the world," Kushnir says. While playing with dolls, searching through a toy box, or banging blocks together in a seemingly haphazard manner, they're actually engaging in a quite rational process of making hypotheses, evaluating statistical data, and dismissing prior beliefs when presented with stronger evidence. They also display remarkable psychological intuition and, by observing the actions of other people, can determine underlying motivations, desires and preferences.

While early childhood cognition has traditionally been studied separately from social context, Kushnir's research brings these strands together. Children learn about people from statistical information and they in turn evaluate evidence in light of their developing social knowledge, in an ongoing, reinforcing cycle.

By the time children are in preschool, they already understand a lot about other people's desires, preferences, beliefs and emotions. But how do they learn about these internal motivations? It is generally thought that children pick up this knowledge from emotional cues such as facial expressions. But Kushnir's recent work demonstrates that children can use statistics to figure out another person's preference.

"Babies and children are like little scientists. They gather evidence by observing and experiencing the world"

Young Children Use Statistical Evidence to Infer Preferences

In two experiments, Kushnir, Xu and Wellman (2010), examined the questions of whether young children use statistical evidence to understand the reasons for people's actions.

In one study, three- and four-year-olds were introduced to the puppet "Squirrel" and told that Squirrel likes some toys but not others. The children watched Squirrel select five toys of one

type—for example, red foam circles—from a container of toys and play happily with them for a few minutes. One third of the children watched Squirrel select the toys from a container with 100% red circles. One third of the children watched Squirrel select the toys from a container filled with 50% red circles and 50% blue flowers. A final group watched Squirrel select the toys from a container with only 18% red circles and 82% blue flowers.

Afterwards the experimenter took away the box and put out three bowls of toys—red circles, blue flowers, and another toy that the children hadn't seen before—and asked the children to give Squirrel the toy he likes best.

Children in the 18% group chose the correct toy (red circles) most often. When children saw Squirrel pick red circles from a box that was dominated by blue flowers, they took that statistical cue to infer a preference: Gee, Squirrel must really like red circles to bypass so many blue flowers. Children in the 50% group chose the correct toy slightly less often. Children in the 100% group gave Squirrel toys at random. Watching Squirrel pick red circles from a box of nothing but red circles gave the children little statistical evidence on which to infer a preference: Squirrel probably liked red circles well enough, because he did seem happy to play with them, but because that's all there was in the box there wasn't enough information to, in Kushnir's phrasing, develop a theory that Squirrel might have liked something better.

Kushnir and her research partners then repeated the experiment with 19- to 24-month-olds, with minor modifications aimed at the younger participants, and found consistent results. Even very young children, then, expect a sample to be representative of its population—a blue flower should be picked from a box of, or mostly of, blue flowers. When it isn't, the children seize on that violation of random sampling to deduce a preference. The findings are notable because it's generally thought that children deduce desires and preferences only from emotional cues, such as smiles and grimaces. Kushnir and her co-authors show that from a very young age, statistical information plays a major role in social learning.

Children form theories, Kushnir says, based on very little information. It takes a puppet less than a minute to select toys from a box, but that's enough for children to infer a preference. "They're not going to wait until they have ten pieces of evidence; they'll make an inference after one piece of evidence," Kushnir says. "If you think about this as a computation, they're not a kind of computer that waits for a whole big batch of data; they are processing moment by moment."

Preschoolers use new evidence to overcome prior assumptions

In a series of experiments exploring children's causal reasoning, Kushnir and Gopnik (2007), demonstrated that children can revise existing beliefs if they get good evidence that contradicts their earlier assumptions.

These studies involved a box that lights up and plays music that is activated by a hidden switch that an experimenter flips on and off. When given a block and asked if they could make the box work, children will usually put the block into contact with the box, says Kushnir. They'll hit it, place the block on top, lay the block alongside the box, etc. This tendency exhibits a belief in "contact causality"– that touching something makes something else happen. Humans experience this type of causal perception within the first year of life.

Kushnir and Gopnik hypothesized that, despite the bias toward contact causality, children would revise their beliefs in the face of compelling evidence. In one set of experiments, children saw an unambiguous activation rule. In the over condition, the box always lit up when the object was over, but never when it was on the box. In the on condition, the box always lit up when the object contacted the box, but never when it hovered over.

To mirror real-world scenarios in which we often have only imperfect evidence of cause-effect relationships, children in another set of experiments were shown evidence for how the box activates in the form of patterns of probability. The box was more likely to activate either when objects made contact with its surface (on condition) or when objects were several inches above its surface (over condition). Both the on and the over approaches worked, but one condition worked far more often.

Their results demonstrate that when children received unambiguous evidence that their beliefs were incorrect—touching the box with the block did not make the box go—they changed their behavior and operated the box with remote control (over condition). When the evidence was less certain—sometimes touching worked, sometimes not; the remote control usually worked, but not always—a significant number of children still changed their behavior, but many held on to their prior beliefs. Overall these studies show that children can revise previous beliefs—that contact makes something

work—and infer a non-contact causal relationship based on statistical evidence. However, the degree of uncertainty matters. New evidence does not completely overturn their previous theories about how things work, but it does make children more likely to consider alternatives.

Findings from these studies and her other research will add to a growing body of knowledge on the mechanisms of learning in young children with important implications for the study of cognitive development as well as for early childhood education.

Tips for Parents and Caregivers

• Provide a stimulating environment with plenty of opportunities for supportive social interaction and let children play. By playing, children explore, evaluate, and learn.

• Choose toys that encourage children to explore their physical world and to play with others. Possibilities abound with simple toys such as nesting measuring cups, blocks, toy cars and balls.

• Recognize that children will be watching you and the others around them very closely and learning from the actions and choices they observe.

• Engage in play with young children that involves different outcomes (e.g., dropping a soft ball on a hard surface will result in the ball bouncing; dropping a hard ball, such as a baseball or golf ball on a hard surface, will not result in a bounce).

• Use language to explain different ways of achieving the same outcome to children (e.g., you can get the blocks to touch each other either by stacking them or by laying them side-by-side).

• Ask questions of your child about cause-and-effect situations and possible outcomes. For example, you could ask, "What happens if…" Ask questions about events your child is familiar with, such as "What happens if you miss the school bus?" Help your child identify 2-3 outcomes for each "What happens if…scenario. Discuss which outcomes are the most likely. Ask your child how she arrived at her answers and why she chose the most likely answer.

• Discuss alternative solutions with your child. For example, "If your child is disappointed that a play date with a favorite friend has been postponed, help him to see alternative solutions: "I know that you are disappointed that you and Jimmy could not play together today but instead you could play together next Friday afternoon or on Saturday morning.

• Take advantage of everyday opportunities to explain inferences or explore inferences that your child makes. When your child makes predictions or pronouncements ask them: "How did you decide that?" "What makes you think that?"

Further Resources

The Early Childhood Cognition Laboratory:
http://courses.cit.cornell.edu/tk397/ECCL/Home.html

The Surprising Rationality of Young Children's Learning - Kushnir (video lecture):
http://www.ctl1.com/publicaccess/humanecology/hdru-20090506-eng-tk

CDC Parent Portal:
http://www.cdc.gov/parents

Tufts University Child&Family WebGuide:
http://www.cfw.tufts.edu

Extension Just In Time Parenting:
http://www.parentinginfo.org

References

Kushnir, T., Xu, F. & Wellman, H. M. (2010). Young children use statistical sampling to infer the preferences of other people. Psychological Science, 21, 1134-1140.

Kushnir, T. & Gopnik, A. (2007). Conditional probability versus spatial contiguity in causal learning: Preschoolers use new contingency evidence to overcome prior spatial assumptions. Developmental Psychology, 44, 186-196.

Kushnir, T. The surprising rationality of young children's learning (video lecture), May 2009. Human Development Research Update, Cornell University.

Special thanks goes to Kim Kopko, who assisted with the tips for parents and caregivers section.

Development of this publication was supported by Smith Lever funds from the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture. Any opinions, findings, conclusions, or recommendations expressed here are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.