Learning by watching, toddlers show intuitive understanding of probability

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This is a screenshot from a video of the experiment in which a 2-year old watched a researcher play a game in which there were two winning strategies, but one worked more consistently than the other. When given her own turn to play (as seen in screenshot), the toddler picked the better strategy. Credit: Institute for Learning and Brain Sciences, University of Washington

Most people know children learn many skills simply by watching people around them. Without explicit instructions youngsters know to do things

like press a button to operate the television and twist a knob to open a door. Now researchers have taken this further, finding that children as young as age 2 intuitively use mathematical concepts such as probability to help make sense of the world around them.

In a study led by researchers at the University of Washington, toddlers could tell the difference between two different ways an experimenter played a game, with one strategy being more successful than the other. When it was their turn to play, the children could use the more successful strategy that they observed to increase their odds of winning. The study will be published in an upcoming issue of *Developmental Science*.

"In the real world, there are multitudes of possible ways to solve a problem, but how do we learn how to find the best solution?" said lead author Anna Waismeyer, a post-doctoral researcher at UW's Institute for Learning and Brain Sciences. "In our study, we wanted to see if young children could detect the difference between two imperfect ways of winning a game, and then use the better strategy to their own advantage."

Waismeyer and co-authors Andrew Meltzoff, co-director of the Institute for Learning and Brain Sciences, and Alison Gopnik, a psychology professor at the University of California, Berkeley, designed a cause-and-effect game.

First, the child watched as the researcher played. Placing a wooden block onto a lunchbox-sized box activated – much to the child's delight – a nearby marble-dispensing machine. One block activated the machine two thirds of the time, and a differently colored and shaped block triggered the machine only one third of the time.

In about 20 minutes, the children watched 12 run-throughs using the different blocks. Then, given the chance to play the game themselves, 23

out of the 32, or 72 percent, of the children eagerly picked the block with the greater success rate as shown in the video:

It wasn't clear, though, whether the toddlers were making their choice based on probability – the better two out of three rate – or frequency. That is, the more successful block led to a marble four out of six times compared with the less successful two-out-of-six frequency.

So the researchers ran the experiment again on a separate group of toddlers, keeping the frequency the same for both blocks – all the children saw the marble machine activate four times for each block. But the probability varied, with one block activating the marble four out of six times (two-thirds probability) and the block with the less probable chance activating the marble machine four out of 12 times (one-third probability).

When it was their turn to play the game most of the children (22 out of the 32) picked the more successful block, demonstrating that they were able to use the difference in probability to their advantage.

"Our findings help explain how young children learn so quickly, even in an uncertain and imperfect world," said Meltzoff, a UW professor who holds the Job and Gertrud Tamaki Endowed Chair. "Remarkably, they learn about causality even if the people they are watching make mistakes and are right some but not all of the time."

This intuitive grasp of statistics and weighing likelihoods of a cause-and-effect scenario show that toddlers don't need to have to go through trial and error to learn – they can just watch what other people do.

The researchers hope that educators can use the findings to develop science, technology, engineering and mathematics curriculum that take advantage of young children's ability to learn through observation using

less-than-perfect causal relationships.

"The current way of teaching probabilities relies on fractions and decimals, and many children struggle to understand these concepts when they are introduced in grade school," Waismeyer said. "Maybe it would be easier if we introduced these mathematical principles earlier and had our teaching mesh with or build on the intuitive ways that children think."

More information: *Developmental Science*, onlinelibrary.wiley.com/doi/10 … /desc.12208/abstract

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