Scientists tap the genius of babies and youngsters to make computers smarter

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Scientists are tapping the brains of children, who think like young scientists, to improve artificial intelligence

People often wonder if computers make children smarter. Scientists at the University of California, Berkeley, are asking the reverse question: Can children make computers smarter? And the answer appears to be 'yes.'

UC Berkeley researchers are tapping the cognitive smarts of babies, toddlers and preschoolers to program computers to think more like humans.

If replicated in machines, the computational models based on baby brainpower could give a major boost to artificial intelligence, which historically has had difficulty handling nuances and uncertainty, researchers said.

“Children are the greatest learning machines in the universe. Imagine if computers could learn as much and as quickly as they do,” said Alison Gopnik a developmental psychologist at UC Berkeley and author of “The Scientist in the Crib” and “The Philosophical Baby.”

In a wide range of experiments involving lollipops, flashing and spinning toys, and music makers, among other props, UC Berkeley researchers are finding that children – at younger and younger ages – are testing hypotheses, detecting statistical patterns and drawing conclusions while constantly adapting to changes.

“Young children are capable of solving problems that still pose a challenge for computers, such as learning languages and figuring out causal relationships,” said Tom Griffiths, director of UC Berkeley’s Computational Cognitive Science Lab. “We are hoping to make computers smarter by making them a little more like children.”

For example, researchers said, computers programmed with kids’ cognitive smarts could interact more intelligently and responsively with humans in applications such as computer tutoring programs and phone-answering robots.

And that’s not all.

“Your computer could be able to discover causal relationships, ranging from simple cases such as recognizing that you work more slowly when you haven’t had coffee, to complex ones such as identifying which genes cause greater susceptibility to diseases,” said Griffiths. He is applying a statistical method known as Bayesian probability theory to translate the calculations that children make during learning tasks into computational models.

This spring, to consolidate their growing body of work on infant, toddler and preschooler cognition, Gopnik, Griffiths and other UC Berkeley psychologists, computer scientists and philosophers will launch a multidisciplinary center at the campus's Institute of Human Development to pursue this line of research.

Exploration key to developing young brains

A growing body of child cognition research at UC Berkeley suggests that parents and educators put aside the flash cards, electronic learning games and rote-memory tasks and set kids free to discover and investigate.

"Spontaneous and 'pretend play' is just as important as reading and writing drills," Gopnik said.

Of all the primates, Gopnik said, humans have the longest childhoods, and this extended period of nurturing, learning and exploration is key to human survival. The healthy newborn brain contains a lifetime's supply of some 100 billion neurons which, as the baby matures, grow a vast network of synapses or neural connections – about 15,000 by the age of 2 or 3 – that enable children to learn languages, become socialized and figure out how to survive and thrive in their environment.

Adults, meanwhile, stop using their powers of imagination and hypothetical reasoning as they focus on what is most relevant to their goals, Gopnik said. The combination of goal-minded adults and open-minded children is ideal for teaching computers new tricks.

"We need both blue-sky speculation and hard-nosed planning," Gopnik said. Researchers aim to achieve this symbiosis by tracking and making computational models of the cognitive steps that children take to solve problems in the following and other experiments.

Calculating the lollipop odds

In UC Berkeley psychologist Fei Xu's Infant Cognition and Language Lab, pre-verbal babies are tested to see if they can figure out the odds of getting the color of lollipop they want based on the proportions of black and pink lollipops they can see in two separate jars. One jar holds more pink lollipops than black ones, and the other holds more black than pink.

Research indicates that babies do most of their learning as they "play"

After the baby sees the ratio of pink to black lollipops in each jar, a lollipop from each jar is covered, so the color is hidden, then removed and placed in a covered canister next to the jar. The baby is invited to take a lollipop and, in most cases, crawls towards the canister closest to the jar that held more pink lollipops.

“We think babies are making calculations in their heads about which side to crawl to, to get the lollipop that they want,” Xu said.

The importance of pretend play

Gopnik is studying the “golden age of pretending,” which typically happens between ages 2 and 5, when children create and inhabit alternate universes. In one of her experiments, preschoolers sing “Happy Birthday” whenever a toy monkey appears and a music player is switched on. When the music player is suddenly removed, preschoolers swiftly adapt to the change by using a wooden block to replace the music player so the fun game can continue.

Earlier experiments by Gopnik — including one in which she makes facial expressions while tasting different kinds of foods to see if toddlers can pick up on her preferences — challenge common assumptions that young children are self-centered and lack empathy, said Gopnik, and indicate that, at an early age, they can place themselves in other people’s shoes.

Preschoolers take new evidence into account

UC Berkeley psychologists Tania Lombrozo and Elizabeth Bonawitz are finding that preschoolers don’t necessarily go with the simplest explanation, especially when presented with new evidence. In an experiment conducted at Berkeley and the Massachusetts Institute of Technology, preschoolers were shown a toy that lit up and spun around. They were told that a red block made the toy light up, a green one made it spin and a blue one could do both.

It would have been easiest to assume the blue block was activating the toy when it simultaneously spun and lit up. But when the preschoolers saw there were very few blue blocks compared to red and green ones, many of them calculated the odds and decided that a combination of red and green blocks was causing the toy to spin and light up at the same time, which is an appropriate answer.

“In other words, children went with simplicity when there wasn’t strong evidence for an alternative, but as evidence accumulated, they followed its lead,” Lombrozo said. Like the children in the study, computers would also benefit from looking at new possibilities for cause and effect based on changing odds.

Overall, the UC Berkeley researchers say they will apply what they have learned from the exploratory and “probabilistic” reasoning demonstrated by the youngsters in these and other experiments to make computers smarter, more adaptable — and more human.

Provided by University of California - Berkeley