The New York Times

August 16, 2009

OP-ED CONTRIBUTOR

Your Baby Is Smarter Than You Think

By ALISON GOPNIK

Berkeley, Calif.

GENERATIONS of psychologists and philosophers have believed that babies and young children were basically defective adults — irrational, egocentric and unable to think logically. The philosopher John Locke saw a baby's mind as a blank slate, and the psychologist William James thought they lived in a "blooming, buzzing confusion." Even today, a cursory look at babies and young children leads many to conclude that there is not much going on.

New studies, however, demonstrate that babies and very young children know, observe, explore, imagine and learn more than we would ever have thought possible. In some ways, they are smarter than adults.

Three recent experiments show that even the youngest children have sophisticated and powerful learning abilities. Last year, Fei Xu and Vashti Garcia at the University of British Columbia proved that babies could understand probabilities. Eight-month-old babies were shown a box full of mixed-up Ping-Pong balls: mostly white but with some red ones mixed in. The babies were more surprised, and looked longer and more intently at the experimenter when four red balls and one white ball were taken out of the box — a possible, yet improbable outcome — than when four white balls and a red one were produced.

In 2007, Laura Schulz and Elizabeth Baraff Bonawitz at M.I.T. demonstrated that when young children play, they are also exploring cause and effect. Preschoolers were introduced to a toy that had two levers and a duck and a puppet that popped up. One group was shown that when you pressed one lever, the duck appeared and when you pressed the other, the puppet popped up. The second group observed that when you pressed both levers at once, both objects popped up, but they never got a chance to see what the levers did separately, which left mysterious the causal relation between the levers and the pop-up objects. Then the experimenter gave the children the toys to play with. The children in the first group played with the toy much less than the children in the second group did. When the children already knew how the toy worked, they were less interested in exploring it. But the children in the second group spontaneously played with the toy, and just by playing around, they figured out how it worked.

In 2007 in my lab at Berkeley, Tamar Kushnir and I discovered that preschoolers can use probabilities to learn how things work and that this lets them imagine new possibilities. We put a yellow block and a blue block on a machine repeatedly. The blocks were likely but not certain to make the machine light up. The yellow block made the machine light up two out of three times; the blue block made it light up only two out of six times.

Then we gave the children the blocks and asked them to light up the machine. These children, who couldn't yet add or subtract, were more likely to put the high-probability yellow block, rather than the blue one, on

the machine.

We also did the same experiment, but instead of putting the high-probability block on the machine, we held it up over the machine and the machine lit up. Children had never seen a block act this way, and at the start of the experiment, they didn't think it could. But after seeing good evidence, they were able to imagine the peculiar possibility that blocks have remote powers. These astonishing capacities for statistical reasoning, experimental discovery and probabilistic logic allow babies to rapidly learn all about the particular objects and people surrounding them.

Sadly, some parents are likely to take the wrong lessons from these experiments and conclude that they need programs and products that will make their babies even smarter. Many think that babies, like adults, should learn in a focused, planned way. So parents put their young children in academic-enrichment classes or use flashcards to get them to recognize the alphabet. Government programs like No Child Left Behind urge preschools to be more like schools, with instruction in specific skills.

But babies' intelligence, the research shows, is very different from that of adults and from the kind of intelligence we usually cultivate in school. Schoolwork revolves around focus and planning. We set objectives and goals for children, with an emphasis on skills they should acquire or information they should know. Children take tests to prove that they have absorbed a specific set of skills and facts and have not been distracted by other possibilities.

This approach may work for children over the age of 5 or so. But babies and very young children are terrible at planning and aiming for precise goals. When we say that preschoolers can't pay attention, we really mean that they can't not pay attention: they have trouble focusing on just one event and shutting out all the rest. This has led us to underestimate babies in the past. But the new research tells us that babies can be rational without being goal-oriented.

Babies are captivated by the most unexpected events. Adults, on the other hand, focus on the outcomes that are the most relevant to their goals. In a well-known experiment, adults saw a video of several people tossing a ball to one another. The experimenter told them to count how many passes particular people made. In the midst of this, a person in a gorilla suit walked slowly through the middle of the video. A surprising number of adults, intent on counting, didn't even seem to notice the unexpected gorilla.

Adults focus on objects that will be most useful to them. But as the lever study demonstrated, children play with the objects that will teach them the most. In our study, 4-year-olds imagined new possibilities based on just a little data. Adults rely more on what they already know. Babies aren't trying to learn one particular skill or set of facts; instead, they are drawn to anything new, unexpected or informative.

Part of the explanation for these differing approaches can be found in the brain. The young brain is remarkably plastic and flexible. Brains work because neurons are connected to one another, allowing them to communicate. Baby brains have many more neural connections than adult brains. But they are much less efficient. Over time, we prune away the connections we don't use, and the remaining ones become faster and more automatic. Moreover, the prefrontal cortex, the part of the brain that controls the directed, planned, focused kind of intelligence, is exceptionally late to mature, and may not take its final shape until our early 20s.

In fact, our mature brain seems to be programmed by our childhood experiences — we plan based on what we've learned as children. Very young children imagine and explore a vast array of possibilities. As they grow older and absorb more evidence, certain possibilities become much more likely and more useful. They then make decisions based on this selective information and become increasingly reluctant to give those ideas up and try something new. Computer scientists talk about the difference between exploring and exploiting — a system will learn more if it explores many possibilities, but it will be more effective if it simply acts on the most likely one. Babies explore; adults exploit.

Each kind of intelligence has benefits and drawbacks. Focus and planning get you to your goal more quickly but may also lock in what you already know, closing you off to alternative possibilities. We need both blue-sky speculation and hard-nosed planning. Babies and young children are designed to explore, and they should be encouraged to do so.

The learning that babies and young children do on their own, when they carefully watch an unexpected outcome and draw new conclusions from it, ceaselessly manipulate a new toy or imagine different ways that the world might be, is very different from schoolwork. Babies and young children can learn about the world around them through all sorts of real-world objects and safe replicas, from dolls to cardboard boxes to mixing bowls, and even toy cellphones and computers. Babies can learn a great deal just by exploring the ways bowls fit together or by imitating a parent talking on the phone. (Imagine how much money we can save on "enriching" toys and DVDs!)

But what children observe most closely, explore most obsessively and imagine most vividly are the people around them. There are no perfect toys; there is no magic formula. Parents and other caregivers teach young children by paying attention and interacting with them naturally and, most of all, by just allowing them to play.

Alison Gopnik is a professor of psychology at Berkeley and the author of "The Philosophical Baby."