

A New Round of Research Rattles Old Ideas of How Infants Interpret the World

BY RICHARD MONASTERSKY

Renee Baillargeon spends much of her time conjuring up mice and passing boxes through solid walls. But the magic tricks never get any applause. Her audience hasn't yet mastered the complicated process of slapping one hand against the other.

A professor of psychology at the University of Illinois at Urbana-Champaign, Ms. Baillargeon works with infants as young as 2¹/₂ months old to test what they know about the world they so recently joined. Her experiments and those of others are transforming researchers' understanding of how human brains develop the skills necessary to grasp a bottle and eventually, the fundamentals of Euclidean geometry.

"We're trying to figure out what babies can do and can't do," she says. "We've showed that babies can do so much early on. Now we're trying to explain this. Why do they learn so fast? How are their brains designed so this can happen so quickly?"

The quest has given birth to a vigorous debate and a range of competing theories, including the idea that babies themselves act like scientific researchers, performing experiments and testing hypotheses. That view is the subject of *The Scientist in the Crib*, written by three researchers and published last September by William Morrow and Co.

The recent flurry of work about infants builds on, and in some cases breaks away from, the concepts developed more than a half-century ago by the Swiss psychologist Jean Piaget, the founder of modern research on human development. In particular, scientists have tested Piaget's theory that very young children have no sense of "object permanence": They do not know that things continue to exist even when out of view. To an infant, Piaget believed, out of sight equals out of mind.



Using experiments like this one, in which objects are revealed and then hidden, scientists seek to discover at what age babies realize that things continue to exist even when they're out of sight.

'SMARTER THAN YOU THINK'

According to some scientists, however, the sage of developmental psychology didn't give infants enough credit. Fifteen years ago, Ms. Baillargeon demonstrated that infants can remember a toy after it has been hidden. Other scientists reported that 5-month-olds can keep track of absent objects well enough even to add and subtract. Part of a wave of findings in the late 1980's and early 90's, those studies gave rise to the idea that infants are more sophisticated thinkers than previously believed, and are perhaps endowed from birth with some of the same knowledge about the world that adults have. In 1993, *Life* magazine did a cover story about that research, proclaiming: "Babies Are Smarter Than You Think."

Now the pendulum is swinging back, as ideas in the field go through a growth spurt of their own. New research suggests that while Piaget underestimated babies' abilities, he was not as wrong as some scientists believed a decade ago. "Poor old Piaget," says Janellen Huttenlocher, a professor of psychology at the University of Chicago. "It's a good thing he's dead, because he was being castigated when he was perfectly right."

A LEGACY UNDONE

Piaget did his best work at home, where he and his wife meticulously documented the growth of their own children. In an example that found its way into textbooks, Piaget noted how their 7-month-old daughter, Jacqueline, couldn't keep track of a toy when it dropped from view. Reaching for a duck on a bed, she stopped when it toppled behind a fold in the sheet.

A slightly more mature baby, however, would not have given up. In his experiments, Piaget found that 9-month-old infants pulled away a cloth after watching him hide an object beneath it. By that stage, he hypothesized, infants had developed an elemental sense of object permanence, which would continue to grow in sophistication over the next 9 months.

In 1985, however, just five years after Piaget's death, Ms. Baillargeon started chipping away at his scientific legacy by revealing that 5-month-old infants do exhibit a concept of objects even when they vanish from sight. She used a more subtle test than Piaget's. Instead of checking whether babies would reach for a hidden object, she used their eyes as portals to their thoughts.

In her experiments, an infant sat in front of a table with a movable screen. It was hinged at the bottom, so it could swing to a vertical position or lie flat. At the start, with the screen flat, the baby could see a box at the far end of the table. Then the screen swung up, blocking the baby's view. In one scenario, the screen continued to rotate away from the baby until it hit the box and stopped. In another, a researcher surreptitiously removed the box, and the screen continued rotating until it hit the table, revealing nothing there. From the baby's point of view, the box had vanished completely.

To gauge what the 5-month-olds thought about the trick, Ms. Baillargeon measured how long her subjects gazed at each situation. They spent more time looking at the second, clearly impossible case, she found. Ms. Baillargeon's explanation is that they expected to see the box and were surprised when the screen seemed to pass right through it, revealing an empty table.

"Very young infants possess information about events and are able to have sophisticated explanations," she says. In subsequent experiments, she showed that even 10-week-old babies looked longer at situations in which a Minnie Mouse toy mysteriously disappears.



Renee Baillargeon: "Very young infants possess information about events and are able to have sophisticated explanations."

NO BLANK SLATE

Ms. Baillargeon's experiments and others contributed to the idea that babies enter the world with innate knowledge—one facet of which is a sense of object permanence.

That hypothesis takes its most extreme form in the writings of Ms. Baillargeon's graduate advisor, Elizabeth Spelke, now a professor of cognitive science at the Massachusetts Institute of Technology. Ms. Spelke proposed that people are born with a knowledge of fundamental physical principles for making sense of everyday events. For instance, a law of continuity would hold that objects continue to exist and move along a path even when they are not seen. A law of solidity would dictate that objects can't pass through each other.

For Ms. Spelke, those principles remain unchanged throughout life; an infant's knowledge of continuity is just as solid as an adult's. Babies fail to search for hidden objects in the first few months of life not because of a faulty sense of object permanence, this argument goes, but because they are thwarted by other factors, such as imperfect memories or physical clumsiness.

Her hypothesis renewed a debate reaching back to Socrates—an argument between “nativists,” and those who see children as blank slates, such as the 17th-century philosopher John Locke.

In the last few years, researchers have backed away from a strong vision of innate knowledge. “I think that Baillargeon and Spelke's initial views went too far. It was too rich an interpretation,” says Rachel K. Clifton, a psychology professor at the University of Massachusetts at Amherst. “Infants have rudimentary concepts. Even in a 9-month-old, it's not as well developed as we might have thought.”

Ms. Baillargeon says her own experiments do, in fact, show that infants are not born with a fully formed knowledge of how objects behave. “All we're saying is that when babies begin to make sense of the world, there's a little something that helps them along. It doesn't have to be the Rock of Gibraltar,” she says.

For example, she has concluded that a 3-month-old expects any object to disappear when placed behind a screen, even if the object towers over the screen. Babies only 2 weeks older, though, apparently understand that size matters.

In recent experiments, she has even found that she can accelerate the learning process in 11 1/2-month-olds by repeatedly showing them examples of how two objects interact—something they would not typically learn until four to six weeks later, she reported last month at a meeting of the American Association for the Advancement of Science, in Washington.

Like Piaget, Ms. Baillargeon drew her conclusions in part from experiments with her own children, now 12 and 10, who served as preliminary subjects in her studies. “My son was a wonderful subject, very cooperative,” she says. “My daughter was a terrible subject. I think God arranged it that way so I wouldn't jump to any simplistic conclusions.” Given the current evidence, she proposes that babies are born with some sense of object permanence, which grows richer over the early months of life.

Several other researchers, however, attack even that view as too strong. “I do not believe that object permanence is innately available,” says Chicago's Ms. Huttenlocher. “I think Piaget wasn't really wrong. Renee showed something else, which is a precursor to the kind of real object permanence that

Piaget was talking about, and that was really interesting.”

BABY AS EXPERIMENTER

The most recent assault on the idea of innate object permanence comes from two researchers at the University of Washington, who tested babies from 10 to 14 months of age.

In their study, published last November in the *British Journal of Developmental Psychology*, M. Keith Moore and Andrew N. Meltzoff added a few twists to Piaget’s hiding an object beneath a cloth. In one test, an experimenter put a toy in his palm, covered his stationary hand with a washcloth, then left the toy under the cloth and showed his empty hand to the baby. To find the toy, the baby had to pull away the cloth. In a subsequent version, the experimenter slid his hand and a toy beneath the cloth, then withdrew his empty hand.

Slight as the difference seems, it flummoxed many babies. Of 93 subjects tested, 24 found the toy in the first test but failed to find it in the second. Only one baby exhibited the opposite pattern.

Because the two experiments required the babies to pull the cloth exactly the same way to find the toy, the researchers could rule out some issues that had clouded Piaget’s experiments. It couldn’t be immature motor skills that hindered the babies, say the pair. Instead, they blame incomplete object permanence.

LOCATION, LOCATION, LOCATION

At 10 months, a baby identifies an object by location rather than by other attributes, the researchers theorize. In the first experiment, the babies searched for the toy’s last location, just before the washcloth covered it. In the second experiment, the last place they saw the toy was in the palm of the experimenter’s hand. Confronted by the sight of an empty palm, the babies instinctively frowned, because they could not make sense of the situation, report Mr. Moore and Mr. Meltzoff.

“Our explanation is that object permanence is not innate, is not developed by 3 or 4 months,” says Mr. Meltzoff. “Very young kids do not have a full understanding of where objects are when they’re hidden.”

That test and others, he says, support a general concept of child development called “the theory theory,” which blends aspects of Piagetian thought with the idea of inherent knowledge. “Babies start out with theories about the world, but these theories are radically transformed in interaction with the world,” explains Mr. Meltzoff, who has explored this idea in scholarly papers written with Alison Gopnik, a professor of psychology at the University of California at Berkeley.



Alison Gopnik and her colleagues argue that children develop by experimenting with hypotheses, just as researchers do.

The two researchers equate infant development with the way scientists formulate and then test hypotheses. “They start out with a theory of the world, but it’s really an incorrect theory. As they operate with it, they come up with anomalies, puzzling findings. And when that happens, they furrow their brows, look at the problem, and then hide the rattle underneath the cloth, take it out again, hide it again. They’re actually performing experiments, trying to understand what’s going on,” says Mr. Meltzoff.

That explains why infants at a certain stage will repeatedly drop bottles off the side of their high chairs. “They’re just in the crux of developing a new theory,” he says. “It’s the most exciting thing to them. They’re like a scientist who can’t leave the laboratory at night.”

Ms. Gopnik, Mr. Meltzoff, and Patricia K. Kuhl, his wife, a professor of speech and hearing at the University of Washington, explore the implications of these ideas in *The Scientist in the Crib*. They argue that the scientific process itself may linger from researchers’ earliest days. “It’s not that children are little scientists but that scientists are big children,” they write.

If infants indeed see the world the way scientists do, then the cries that rouse parents in the night represent more than simply a sign of hunger. They are also the sound of a baby solving a problem—his empty tummy—by testing a hypothesis. In those midnight experiments, it is the parents who play the role of laboratory rat.