PSYCH 142 APPLIED DEV PSYCH

WEEK 1: Welcome!

READ BY 25 MAY 2021

PAGES 1-4 OF THIS DOCUMENT

Author: Last Name, First Initial

(PUBLICATION YEAR)

Book title, italicized & first letter capitalized

Kaye, K. (1982). The mental and social life of babies: How parents create persons. Harvester Press.

↑ BECAUSE IT'S A BOOK: PUBLISHER, unitalicized

PAGES 5-16

Talbot, M. (2006). The Baby Lab. The New Yorker, September 4, 2006, 90-101.

PERIODICAL ISSUE

PERIODICAL TITLE / italicized

page range, UN italicized.

Kenneth Kaye

(1982)

The Mental and Social Life of Babies

GREAT book!

How Parents Create Persons

FULL PDF ON BCOURSES, IF YOU'RE INTERESTED

READ IN WEEK 1 TO INTRODUCE WEEKS 2-6, RE: HUMANS FROM BIRTH TO AGE 3

The University of Chicago Press

A NOTE THAT BOTH ARTICLES USE NOTABLY GENDERED LANG.

course of research 13 years ago. Since so many of their ideas are presented in these pages as my own, I want to acknowledge their responsibility against the day when those ideas will be shown to have been unsound.

The book itself owes much to others. Large sections of the manuscript were read carefully by three anonymous reviewers (one of whom later identified himself as Kurt Fischer) as well as by Alan Fogel, Dan Freedman, and Michelle Perry-Barras, good friends and good critics. I disclaim responsibility for any flaws in the book that all these readers failed to bring to my attention, as well as for any that I may have introduced into it at their suggestion.

Some of the people mentioned so far might try to escape criticism by pleading that their tact or respect for my academic freedom led them to hold back some criticisms that occurred to them. There is one person, the center of my own mental and social life, who cannot use that excuse: My wife, Rosalind Charney, neither held back her criticisms nor gave me the freedom to ignore them. She is therefore most to blame for whatever measure of cogency and clarity the book still lacks. She is also responsible for many of the ideas and arguments found in these pages (perhaps the very ones the reader will disagree with). In her defense I can only plead that her motives were pure: scientific integrity, the deepest intellectual curiosity about human psychology, a phenomenal capacity for work, humor, and love.

1

Overture

THIS IS ONLY 3 PAGES – PLEASE READ IT CAREFULLY!

YOU CAN SKIM A LOT OF THE FLUFF IN THE NEXT [10-16H PAGE] ARTICLE

. . . At first the infant,
Mewling and puking in the nurse's arms.

William Shakespeare, *As You Like It*, 1599

The babe whose birth embraves this morn,
Made his own bed ere he was born.

Richard Crashaw, *Hymn of the Nativity*, 1652

STARTING WITH OBSERVATION

At 2 weeks, Jessica lay on her back between her mother's knees, half-swaddled in an oversized flannel nightdress. The mother talked to Jessica and to the visitor at the same time. "You're quiet now, aren't ya? You should have seen her at 4:00 this morning. Yeah! Yeah! You weren't quiet then, were ya? No. No. No you weren't!" Jessica did not reply. Her eyes, not quite meeting the mother's gaze, flickered across her face as though inspecting one eye, then the other, then the mother's bangs, then the eyes again. Her mother had been playing with Jessica's hands. Now each small hand was wrapped around one of the mother's index fingers. "Could she know who I am already? The way she holds on to me." The baby's lips parted and seemed to make a round O. Her mother imitated this, then laughed. "Is that 'Yes'? Say, 'I know who Mommy is!' "

Amy, almost 4 months old, sat in her father's lap in a booth at the coffee shop. He was talking to a friend. Amy was teething on a hard rubber ring he had brought along for her. Her father supported Amy's back with his left arm, keeping his hand free. Twice he used that hand to catch the ring when it fell to her lap or his own lap. When Amy dropped the ring for the third time, he interrupted his conversation, said, "Klutz," picked it up and put it on the table. She leaned toward

it, awkwardly reached out and touched it, but was not able to grasp it well enough to pick it up. Her father had returned to his conversation, and this time without interrupting it (though he was glancing back and forth between Amy's hand and his friend) he tilted the ring upward toward Amy so that she could get her thumb under it. She grasped the ring and pulled it away from him. Absorbed in chewing on the toy, Amy did not look at him. He went on talking and drinking his coffee, paying no further attention to her until he felt the toy drop into his lap once again.

Dylan, at 9 months, played pat-a-cake with his grandmother. She held her hands up, ready to clap them together, and made a face as if to say, "Are you ready?" He reached toward one of her hands with both of his, but she clapped her hands together slowly, three times. Dylan stopped, in mid-reach. When his grandmother finished clapping, he started: slowly touching his hands together, separating them, touching them together again. Grandma tried to get him to clap his hands against hers, but he was distracted by the dog's barking. The doorbell rang and Grandma had to leave the house. When she came in the door 6 hours later, Dylan was sitting on the living room floor. He looked up at her, smiled when she greeted him, then grandly reached out his hands and clapped them together three or four times, without taking his eyes from Grandma.

At 17 months, Nathan was standing between mother and father, who were sitting in the kitchen. His father handed him a wooden block from a pile on the table. Nathan took it in his right hand, passed it to his left hand, and pointed with his right hand at the pile of blocks. His father handed him another. "Now you've got one in each hand, don't ya?" But Nathan added the second block to the one in his left hand, managing not to drop either of them. He pointed to the pile again. Father offered him another block. This time, holding two blocks in his left hand and one in his right, Nathan seemed to hesitate for a moment. Then he put the block that was in his right hand into his mother's lap, taking another block from his father. He held out the blocks in his left hand toward mother, who took them. Now he dropped the block from his right hand into his mother's lap, and she did the same with the two blocks she was holding. Nathan picked up one of those, looked at it, then pointed at the pile on the table, looked at his father, and grunted, "More." Father obliged. Soon Nathan had transferred all the remaining blocks to mother's lap, where he could reach them without help.

At 30 months Nikki, whom we were observing in her home, said to her mother, "I have to pee," whereupon she left the room. She turned on the light in the bathroom, pulled down her pants, sat down, urinated, stood up, pulled up her pants, turned off the light, and rejoined us in

the living room. At that moment she truly seemed to have joined the community: independent agent, tool-user, aficionado of electric lights and toilets, respecter of domestic tranquillity and hygiene; socialized, intelligent; a person in her own right.

All these incidents have something in common: They are cognitive achievements in a social context. They illustrate the impossibility of drawing a line between mental life and social life at any age. And they raise some specific controversial issues about the psychology of infancy: Would substantially the same behavior have occurred without the parents' participation, perhaps in somewhat different form, but involving the same basic skills? Or do we have to use some notion of *communication* in any explanation of this behavior? Do we see an exchange of meaningful gestures between Jessica and her mother, or between Amy and her father, long before language development begins? If so, shall we say that later language development is merely a more complex level of gesturing, with conventional words and sentences taking the place of innate gestures?

This book replies "No" to all those questions. It argues instead that the behavior of these children depends as much upon preadapted adult behavior and universal human interaction patterns as it does upon the infant's intrinsic cognitive abilities. The kind of exchanges with adults that facilitate sensorimotor and later linguistic development require little from the infant at first except regularities in behavior and expressive reactions that parents tend to interpret *as if* they were meaningful gestures.

It surely is a miracle that the kind of creature a man and a woman can bring into the world by purely biological processes becomes (eventually) the kind of creature that possesses a mind and a sense of self, an unsurpassed intelligence and a personal identity in relation to society. The explanation has most often been given by pointing to man's superior brain. This book offers an additional perspective. It supports an argument that has been, until recently, a minority view. The evolution of the human brain alone, as the instrument of learning and thought, could not have brought about mind. Symbolic representation, language, and thought could not emerge in any species, and would not develop in any individual, without a special kind of fit between adult behavior and infant behavior. That fit is preadapted: It comes to each child as a birthright, both as a result of biological propensities and as a result of social processes learned and transmitted by each new generation.

Since the argument places social relations at the very root of mental development, it amounts to an extension of Vygotsky's theory and of his objections to Piaget, down to the first year of life. (Their debate actually dealt with the preschool years.) However, in the course of this

discussion and in the light of modern evidence we can also refine the Vygotskyan perspective. This perspective reverses the tacit assumption of many authors, that communication is the felicitous by-product of a symbol-using mind. Like Vygotsky, I assume the contrary: that communication is the origin of mind. Yet this only raises the question: How does communication itself develop in an organism that still lacks a mind?

A great deal happens between birth and sometime around the middle of the third year (when, filled with pleasure and pride at that glorious accomplishment, we tell Nikki she is no longer a baby). The processes producing those changes are a great mystery in between two lesser mysteries. Before infancy, our mechanisms of reproduction and gestation, miraculous and mysterious as they are, are similar to other mammals. After infancy, human development is an elaboration of the intelligence, learning processes, and communication that all originate in the first 2 or 3 years. But human babyhood itself is practically without precedent: The uniqueness of our species is never more evident than in the extraordinary transformation from newborn to 2-year-old.

From the Mouths of Babes

Surprisingly, the psychology of human infancy has been a battleground for many of the great issues of the modern social sciences: issues about education (what must be taught? what is learned spontaneously? what is innate?), evolution (what distinguishes the infant homo sapiens from other primates that could explain its subsequent achievements?), language (how does it originate?), culture (how early do cultural differences affect the child, and by what means?), social class (are differences in ability hereditary or acquired?), sex roles (are sex differences biological or conditioned?), humanism (is man ever an animal? and if so, when does that animal change into a person?), theology (are we born innocent or cloaked in sin?), social reform (can we reduce poverty, retardation, drug addiction, etc., by early intervention?), and the relation between science and political ideology (does the asocial, socialized, or innately social character of infants tell us anything about how a society ought to be organized or governed?). In the past decade, each of these issues has been the subject of at least a dozen articles, sometimes of entire edited volumes. We seem to be turning to the young infant with questions our wisest old heads have not been able to answer.

Perhaps the practical importance of those questions is only a way of rationalizing an enduring fascination. Paul Tillich (1951) wrote that "man's ultimate concern" is the question of what lies ahead, beyond the death of the body. Personally, with no anticipation of a hereafter and with little confidence even in a tomorrow, I would be satisfied with a better understanding of what lies behind. The mystery of where we

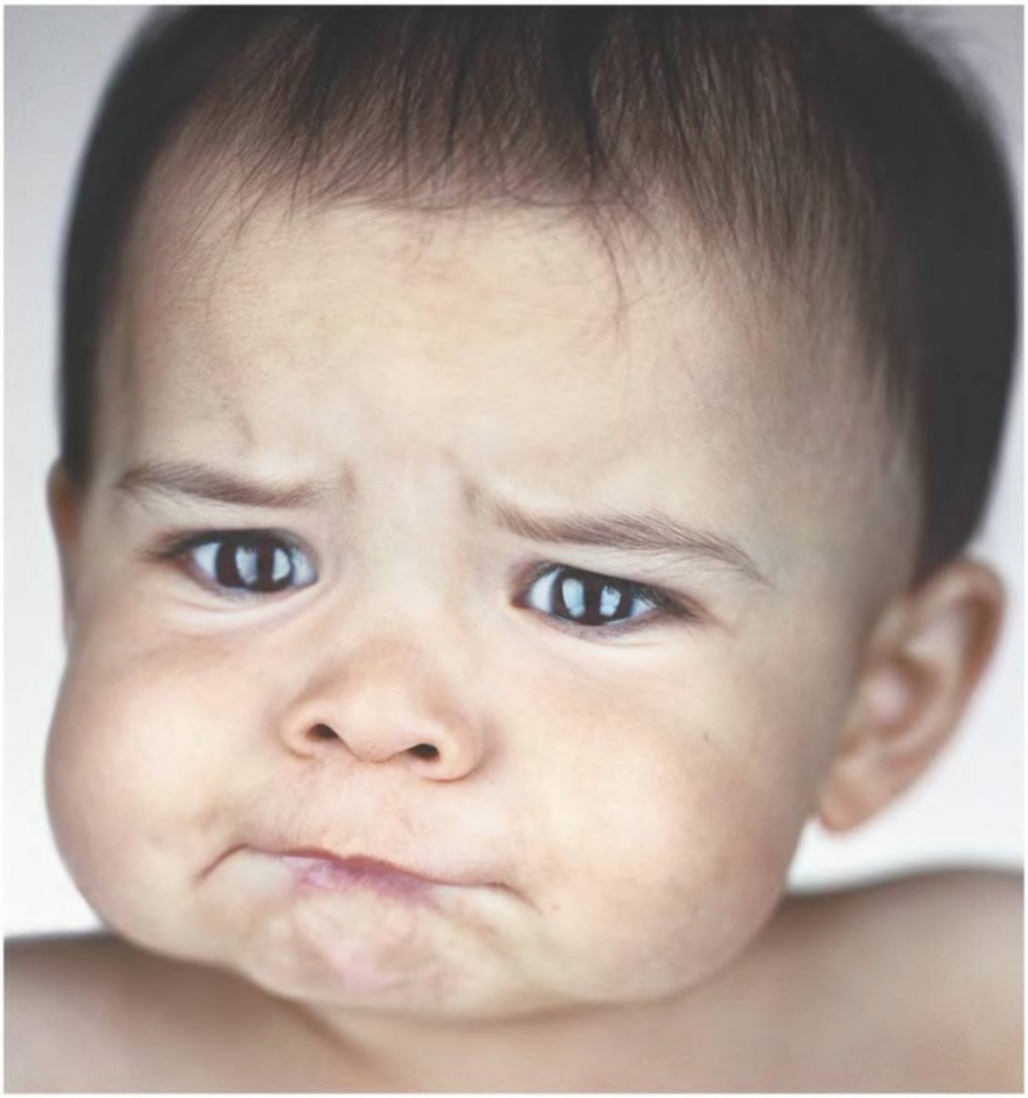
came from and the contrast between what we are and what we were at birth are at the core of man's ceaseless quest to understand nature. There are special obstacles in the way of understanding the part of nature that is man himself, but there is also a special aesthetic, a special energy that comes from confronting directly the most profound mystery of human life.

To participate in that quest and to develop a coherent theory, we psychologists have to avail ourselves (as well as we can) of biology, anthropology, philosophy, and sociology. We need to think about how evolution has provided man with the means to be opportunistic and adaptable while also passing along technology and culture. We need to think about the behavior of adults and children as they interact with an infant. We need to think about symbolic representation and the origins of mental life together with the acquisition of language and the way it transforms social relations.

This book has five main goals. First is to explore the nature of the human mind, self, and social relations, as all three of those gradually and simultaneously emerge in infancy. We shall be concerned with the intersection (not the union) of those three areas of work in developmental psychology. Second is to examine a set of critical concepts for the field, especially *system*, *communication*, *gesture*, *symbol*, *representation*, *intersubjectivity*, *imitation*, *socialization*, and *self-consciousness*. Third is to describe a new conception of the parental role in early development. Fourth is to outline a theory that saves the best features and abandons the worst features of what I call the "inside-out" and the "outside-in" views of how the human infant becomes an intelligent person. The theory is concerned with causal factors in development from a universal, species point of view. This turns out to be a different task from theorizing about the causes of individual differences in development. A final goal, between the lines, is to pose some major metatheoretical and methodological problems of developmental psychology in a way that is, while not definitive, at least challenging.

The substance of the book is in two parts. Chapters 2 through 6 deal with the problem of our unit or units of analysis. I shall first explore what we know about human action at the level of organism-as-system, then expand the perspective to that of two or more organisms functioning together as a system. At both levels, the fundamental constructs with which we must be concerned are the same: intention, attention, representation, coordination, and so forth. But we cannot simply equate the "parent-infant system" with the kind of system a single organism is. The mutual coordination of infants with adults changes in the course of their development together, and that change is nothing less than the development of human communication. Our task is to identify and de-

THE NEW YORKER (4 September 2006)



A REPORTER AT LARGE

THE BABY LAB

How Elizabeth Spelke peers into the infant mind.

BY MARGARET TALBOT

On weekday mornings at nine o'clock, at Harvard University's Laboratory for Developmental Studies, the babies start arriving in a long procession, looking like young pashas in their luxurious, oversized strollers. Researchers rush out to greet them, brandishing toys and consent forms. One day this summer, eight-month-old William was carried into a small, darkened room, where he sat on his father's lap and viewed, on a screen in front of him, rectangles and dots shrinking in size or number. He was alerted to a new picture by a silly *boing* noise (and a brief appearance by Clifford the Big Red Dog). William, who is blond and wide-eyed, contemplated this spectacle with the grave dignity of the preverbal. By noon, most of the lab's half-dozen study rooms were occupied. Babies listened to French and English speakers coo over toys and watched piles of sand grow and diminish; toddlers hunted after hidden Cheerios and gauged the nature of gravity and solidity.

The lab, which sprawls over three buildings on the Harvard campus, is a pleasant place, with wide windows offering an expansive view of Cambridge. The waiting area has a wooden train set, and a Gary Larsonesque cartoon that some-

Spelke is firmly convinced that boys and girls are born with essentially the same cognitive tools. Photographs by Martin Schoeller.

"This wouldn't be so bad if they'd pipe in some jazz."

• •

one taped up is captioned "At the National Sippy Cup Research Center." A bulletin board in the office lists ongoing studies in a surrealistic shorthand: "Talking Blobs," "Blocks and Holes," "Wet Animals." The lab is a domain of peculiar little scenarios, all energetically and painstakingly staged for the very young in an effort to probe the black box—the mysterious machine—that is their minds. It is also the domain of Elizabeth Spelke, a fifty-seven-year-old cognitive psychologist, who supervises the work of ten graduate students, twenty undergraduate research assistants, and assorted visiting scholars and postdocs, most of whom are testing various aspects of her signature idea—namely, that babies come into the world mentally equipped with certain basic systems for ordering it. Her grad students call the lab Spelkeland.

A few weeks earlier, Spelke had watched a videotape of a researcher who was running a pilot study with a talkative, curly-haired two-year-old girl. The study, which used finger puppets, was aimed at determining what kinds of mathematical concepts a toddler might understand intuitively. Could she track the number of bunny puppets that were missing when the researcher removed them from her fingers, stowed them in a box, then lifted them out, leaving one or two inside? This little girl seemed to be doing just that—she wasn't satisfied with the number of bunnies that the researcher, Véronique Izard, had removed from the box, and she was craning her neck in search of more puppets. Like all studies in Spelke's lab, this one would be evaluated at both a high level and a humble one. "Yes!" Spelke said, punching the air. "Wow! She definitely expected another one." Izard struggled to push a recalcitrant bunny puppet onto her finger, and Spelke frowned. "We definitely need to get puppets that go on faster," she said.

Later, I talked with Spelke in her sunny corner office, which featured stray touches of whimsy—an inflatable palm tree, a windup toy brain on a crowded bookshelf. When she leans forward to make a point, her shoulders hunch; she is tall and gangly, with straight, shoulder-length hair parted in the middle, large oval glasses, and a way of speaking about her work that is at once eager and precise. "I'm fascinated by babies and little kids," she said. "But the questions that really keep me up at night are: What distinguishes us from other animals? How do we make sense of what goes on around us? What are the core notions that all of our systematic knowledge is based on?"

Over the past three decades, Spelke has created a series of ingenious studies that have given us a picture of the baby mind which is far different from the long-standing view of it as, in William James's famous formulation, a "blooming, buzzing confusion." As Spelke likes to say, there are some forms of knowledge that humans get "for free." Even at two and a half months, she argues, infants apprehend certain laws of the physical world—for example, that objects are cohesive and distinct and cannot pass through solid surfaces, and that they move along expected trajectories unless something obstructs them. Contrary to the Swiss developmental psychologist Jean Piaget—who believed that babies were born with sensory capacities but with no real knowledge, and who theorized, in 1954, that infants lacked a sense of "object permanence"—Spelke says that even newborns understand that things still exist when they can no longer see them. Babies, in her view, have a sense of other people as "goal-directed agents" who are capable of forming intentions and acting on them. And humans are endowed with a natural sense of geometry, an ability to orient themselves in space.

In 1981, Spelke, along with her colleagues Barbara Landau and Henry Gleitman, published the results of a study in which they introduced blind, or blindfolded, toddlers into a room with objects in four locations. They had the children walk between them on a specific path, then asked them to use another path to move one object to another—putting a toy onto a chair, for example. The kids proved strikingly adept at the task. Spelke's experiment linked her to Socrates, who quizzed an uneducated Athenian slave on principles of shape, angle, and line, found him remarkably apt, and concluded that geometry was a gift of the human soul. (Descartes, too, believed that humans had an innate sense of geometry; he described an exercise in which a blind man holding two sticks in front of him could infer the point at which the sticks crossed.)

Spelke's work even suggests that babies have an ability to compare large approximate sets. In 2000, a study that she did with the psychologist Fei Xu showed that

six-month-old infants can reliably distinguish between displays of eight and sixteen dots; a 2005 study revealed that they could tell the difference between sixteen and thirty-two. (The subjects ran into trouble with smaller ratios.) Babies can also do a kind of addition and subtraction, tracking small numbers of objects and reasoning about what happens when one is added or taken away.

In Spelke's view, these innate capacities are the foundations for all kinds of other learning. She told me, "When you are a baby, even before you acquire language, you need a stock of concepts, so that, for instance, when someone says, 'Look at the dog,' you can divide up the world in such a way that you know what to look at." Human babies share most of these core capacities with other animals, suggesting that they are part of our evolutionary heritage. Even desert ants, which leave home to look for carcasses to feed on and make their way back by a different but direct path, possess what Spelke would call "natural geometry." And many animals, from pigeons to monkeys, can distinguish between quantities. What is uniquely human is the capacity to combine such core abilities—through the medium of language, Spelke surmises—into more sophisticated capabilities; a baby's intuitive sense of quantities eventually flowers into an ability to perform mental arithmetic.

Spelke's ideas have been enormously influential among academics. "Nowadays every psychology student is taught that James and Piaget were wrong," the cognitive scientist and evolutionary psychologist Steven Pinker wrote in *Time* five years ago. "From their earliest months, in fact, children interpret the world as a real and predictable place. . . . This new understanding is largely the legacy of Harvard psychologist Elizabeth Spelke." Karen Wynn, an infant-cognition researcher at Yale, told me, "Spelke has done more to shape our understanding of how the human mind initially grasps the world than anyone else." In 2000, when the Association for Psychological Science gave her its William James Fellow Award, the citation noted that Spelke had "developed techniques of studying infants' beliefs that are far more probative than might have been imagined only a short time ago," and that her work had begun "to answer perennial philosophical questions about the origins of human knowledge about space, objects, motion, unity, persistence, identity, and number."

That infants could be said to have "beliefs" at all is a surprising notion, and one that would give many parents pause. It gives some cognitive psychologists pause, too. Spelke's findings about how infants perceive objects—as solid, continuous, and perduring even when you don't see them—have been widely replicated, and are now firmly established in the infant-studies curricula. But her more ambitious theories of "core knowledge" have their critics. Empiricists argue that scientists such as Spelke underestimate how much babies learn through experience; evolutionary psychologists such as Pinker think that we are genetically encoded with many more core competencies than the four or five that Spelke allows for, including things like an ability to tell edible from poisonous food and to sense danger. Other scholars think that Spelke has contributed to a distorted view of babies as preternaturally smart. Marshall Haith, a developmental psychologist at the University of Denver, believes that she and her colleagues "seriously overplay what is going on in infants' heads." As he sees it, Spelke's "rich interpretation of infants' capabilities encourages parents and caretakers to feel as though they have to pour as much into the 'sophisticated' infant mind as possible." In this view, Spelke's research has helped fuel the modern parent's obsession with Baby Einstein videos and bilingual nannies.

Yet Spelke's arguments could be seen as doing the opposite. After all, in her opinion, infants come equipped with crucial knowledge that they will never need to be taught. As she wrote to me in an e-mail, "Infants are world-class learners and can be trusted to select, more or less on their own, experiences that will enhance their learning. From the earliest age, they attend to novel objects and events. They are also highly predisposed to learn by observing and interacting with other people." She went on, "There seems to be a common assumption, in thinking about children's development, that earlier is better. So, the reasoning goes, if it's good for a four-year-old to understand counting, it would be even better if a two-year-old could be induced to understand counting. There's no evidence to support this assumption and some reason to be skeptical of it. Two-year-olds are already engaged in the task of mastering much of the encyclopedic knowledge about objects, events, places, and people that we adults take for granted. Diverting them from this task by introducing other tasks, like learning to read or work with numbers, seems useless at best and possibly harmful."

One of the most contentious elements of Spelke's thinking is her firm conviction that boys and girls are born with essentially the same cognitive tools. (Although she has not done experiments expressly designed to assess gender differences, she has never found sex to be a relevant factor in any of her cognition studies.) In 2005, the former Harvard president Lawrence Summers said, during a speech, that women's underrepresentation in fields such as engineering was "not easy to attribute to socialization," and speculated that it was the result of innate gender differences. At Harvard, Summers's remarks set off all manner of soul-searching and recrimination: meeting after meeting at which Summers apologized, sort of apologized, or failed to apologize to female professors and other offended parties; a lack-of-confidence vote by the faculty of arts and sciences; dozens of op-eds condemning him for bumptiousness and sexism. When he ultimately announced his resignation, last February, it was in large part because important people at the university had never forgiven him.

Spelke had been one of Summers's fiercest critics, calling his remarks "wrong, point for point." And she lambasted him for ignoring a more obvious explanation for the disparity in achievement: "the impediments to women's progress posed by long-standing patterns of prejudice, unwelcoming environments and unequal resources." Spelke soon found herself at odds with old allies like Steven Pinker, whom she debated at Harvard at the height of the tumult, in April, 2005, on "the science of gender and science." Recent studies, Pinker said, suggested that men and women had intrinsic differences in aptitude; Spelke acknowledged the ex-

istence of small variances but said that there was no aggregate gap in ability.

The field of evolutionary psychology is prone to a cheerful—sometimes gleeful—fatalism about sex differences. (Older men ditching their aging wives for nubile mistresses? Men are genetically programmed to spread their DNA! Women more inclined toward gardening than particle physics? Blame it on our hunter-gatherer ancestors!) Although Spelke is a staunch Darwinian who believes, like Pinker, that natural selection shaped the modern human brain, her research on infants and toddlers has led her to conclude that gender is simply not a significant dividing line when it comes to doing math or science. Other scientists, including Pinker, believe that some sex differences in cognition emerge later, perhaps with the hormonal changes of puberty. But Spelke tends to believe that these effects are minimal, and, in any case, are trumped by the fundamental commonalities manifest in infants and young children.

"We have a tendency, when we think intuitively about ourselves and other people, to greatly overemphasize differences," Spelke said as we sat on her back-yard deck in Cambridge, a vantage point from which you notice that she lives an enviable five-minute walk from her laboratory. "We think that differences we can see on the surface signal some deeper, underlying difference, and I think this is almost always an illusion. To me, the important and interesting implication of the sex-difference stuff is not that there should be more or fewer women in science; it's how much we are alike. And, sure, biologically we play different roles, and we can imagine that Darwinian evolution might create cognitive differences, and even two different psychologies for men and women. But, as a matter of fact, it hasn't turned out that way. We are *deeply* alike. And we see this when we study infants."

Babies and toddlers, for all their charm, are messy research subjects, in more ways than one. At the Harvard lab one morning this summer, six-month-old Alice sat on a bench in the waiting area, crumpling up—and drooling over—the consent forms that her father was trying to sign. Blue-eyed, six-month-old Jaleanna, who sat on her mother's lap, appeared mildly interested in the piles of colored sand that a lab intern kept pouring onto a small black stage, but she was riveted by her mother's hands. "Do you think you could possibly hold her a little differently, so she can't play with your thumb?" the lab intern asked delicately.

Designing an experiment for studying babies is complicated by the fact that they cannot speak, let alone fill out questionnaires, or do much of anything that requires motor skills. The developmental psychologist Paul Bloom, of Yale, in his book "Descartes' Baby," writes, "It is difficult to learn about the mental life of any creatures that cannot use language, but a baby poses special challenges. Mature nonhumans, although nonverbal, are physically adroit. Chimpanzees can easily express their preferences through coordinated action; pigeons peck; rats run through mazes, and so on. But young babies just lie there, crying and gurgling." They also easily get restless and out of sorts, which means that anyone who wants to study them has to work quickly.

The researchers at Spelke's lab must constantly adjust their protocols to account for unforeseen behavior. At a lab meeting that I attended, Véronique Izard's bunny-puppets study was under discussion; one researcher pointed out that you couldn't necessarily conclude much from a toddler's continuing to search inside a box, as children tend to be fascinated by the boxes themselves (just as babies often like the wrapping paper better than the gift). "Oh, yeah," a grad student added. "They *always* reach in. You're sticking a box in their face; there's nothing else to do except stick their hands in." Somebody wondered whether filling the box with Styrofoam peanuts, in order to make the puppet search more challenging, might be a good idea; somebody else countered that it would involve too much cleanup afterward. Two visiting scholars from Sweden lamented that toddlers had too much fun with the task that a new study was designed around: dropping blocks into shape-sorting boxes. It slowed things down, because the children, all about twenty-four months old, weren't very good at it. "They can sit and do this for an hour," Claes von Hofsten, one of the Swedish scholars, said. "They make enormous mistakes, but they do it again and again and again."

At the lab, children must be accompanied by their parents, and babies are held by them. Parents—especially the sort of parents who respond to letters from a Harvard lab (which gets their names from the Cambridge City Hall and other local governments)—aren't always able to resist coaching. Nathan Winkler-Rhoades, a graduate student in Spelke's lab, ran into that problem when he was testing two-year-olds to see whether they can ascertain the relationship between a room and a simple map of it (a difficult developmental leap). One mother, frustrated by her little girl's incomprehension of the task, jumped up in exasperation and said, "Look, honey: *This* is the room. *This* is the picture of the room."

Experiments can be derailed when babies get hungry, wet, or cranky. Particularly avid wailers have to be dropped from studies altogether. Spelke and her researchers call this population the "fuss-outs." One afternoon, I watched videotapes of a study that Winkler-Rhoades was doing, which was staged in a circular white room where Spelke and her students conduct experiments involving orientation in space. (I found the room creepy, not least because once you're inside you can't tell where the exit is. But a graduate student told me that when Spelke walked in for the first time she spun in circles, delighted with its possibilities.) On one tape, a small boy had stopped in the middle of the experiment in order to pick up a chair and pound it on the floor. "When they quit, they *really* quit," Winkler-Rhoades said. "I've lost about a third of my subjects to fuss-outs. You get kind of romantic about the work, how we're building theories, but, day to day, it feels nothing like the grandiosity it's going to be woven into." We watched for a few minutes as a little girl in braids who turned out to have an unusually good sense of direction scampered around the room. "Her nose was running the whole time," Winkler-Rhoades said, sounding very much like a nonparent.

For much of the history of experimental psychology, which has its origins in the nineteenth century, babies weren't considered worthy or practical subjects for research. In 1897, Wilhelm Wundt, a prominent German psychologist, wrote, "The results of experiments which have been tried on very young children must be regarded as purely chance results, wholly untrustworthy on account of the great number of sources of error. For this rea-

son, it is an error to hold, as is sometimes held, that the mental life of adults can never be fully understood except through the analysis of the child's mind."

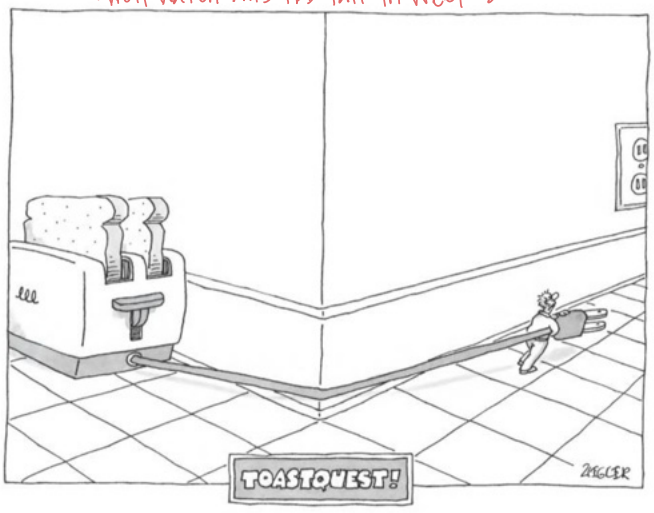
One Victorian scientist who was eager to study infants was Charles Darwin, who wrote one of the first "baby biographies"—diaristic examinations of a baby's every burp and grasp. In 1877, Darwin published his "Biographical Sketch of an Infant," basing it on notes that he had made during the babyhood of his oldest child, nicknamed Doddy. In Darwin's account, the doting father is as easy to detect as the dispassionate scientist. He wrote, "On the seventh day, I touched the naked sole of his foot with a bit of paper, and he jerked it away, curling at the same time his toes, like a much older child when tickled. . . . Once when he was 66 days old, I happened to sneeze, and he started violently, frowned, looked frightened, and cried rather badly. . . . For a long time afterwards sounds made him start and wink his eyes much more frequently than did sight." Darwin took note of early language, such as Doddy's appropriation of the word "mum," at fourteen months, to signify all foods. He observed that his son, when asking for food, gave the word "a most strongly marked interrogatory sound at the end." He added that the boy "also gave to 'Ah,' which he chiefly used at first when recognizing any person or his own image in a mirror, an exclamatory sound, such as we employ when surprised."

In the nineteen-twenties, Jean Piaget and his wife, Valentine, embarked on a project of fine-grained—at times minute-by-minute—observation of their three children; they also performed gentle experiments on them. The Harvard psychologist Howard Gardner, in his book "The Quest for Mind," writes, "Piaget's method and materials were deceptively simple. He sat near his child, who was lying in the crib, or playing on the floor, watched the infant's spontaneous behavior, and from time to time introduced various kinds of interruptions or 'problems,' carefully noting the child's reactions to these impositions. The experimental materials were restricted to the most banal objects: pens, berets, pocket watches, boxes." Piaget did not conduct controlled experiments or statistical analyses, but his delineation of the stages of a child's mental development—from egocentrism to the interiorization of thought to a symbolic understanding of the world—has exerted a resilient influence on education, as well as on cognitive psychology. As Steven Pinker told me, although much of Piaget's theoretical superstructure has "imploded" under experimental scrutiny, "for a guy who just played with his three kids, his observations have stood the test of time astonishingly well." Piaget's version of the baby biography was not only the crucible of cognitive psychology but also the most convincing argument to date that babies were interesting.

In recent years, technology has offered new ways of creating such records. Deb Roy, a cognitive scientist at M.I.T., and his wife, Rupal Patel, a professor of speech and hearing sciences at Northeastern, are one year into a project of videotaping the first two to three years of their son's life—an enterprise that involved the installation of microphones and fish-eye video cameras in every room of their house. Roy told me that he hopes the project will yield new insights into language acquisition. One of the first things they'll be analyzing is how their son learns early words like "car," "bath," or "bye." Roy explained, "Often a child will 'under-extend' these words—using them only in specific contexts, like saying 'car' only when he sees a car through the window. We'll track the history of a word, every time it's used, and see what cues it." He went on, "When you're a diarist, you have only so much time, and, typically, you're also the caregiver. You can take notes of only a very small subset of experience." Roy seemed undisturbed by the idea of domestic life in the company of an all-seeing camera, though he noted that his home was equipped with "Oops!" buttons that allowed him to erase moments better left to the imagination than to scientific posterity.

Observing a baby's external behavior is, to say the least, an oblique way of assessing its mind. In the mid-twentieth century, scientists began looking for a more direct window into the infant soul. Though babies can't control their hands or limbs very well, they do have control over their eyes. Show them two images, and they often exercise that control by looking longer at one than at the other. It's probably too much to say that they "like" looking at one more than the other—who knows what a baby's affective connection is to a picture of a checkerboard or a purple cow?—so psychologists adopted the more neutral word "prefer." By looking longer, the theory goes, babies show a preference for one image over another, and, by the same token, an ability to distinguish between them.

In the late nineteen-fifties, Robert Fantz, a psychologist at Western Reserve University, noticed that newly hatched birds preferentially peck on a spot where food is sprinkled. He kept reducing the size of the food pellets until birds couldn't



perceive them well enough to peck at the spot. He then tried something similar with human babies: he put two images side by side—one a black-and-white set of stripes, the other a gray block—and found that infants looked longer at the stripes. Fantz made the stripes narrower and narrower until they blended into a gray haze and babies could no longer register a difference.

Fantz's method, known as a "preferential looking" study, was embraced by baby researchers, who soon discovered things about infants that no one had been able to document before: they could distinguish colors (and preferred red); they recognized their mother's face and voice, even as newborns; they preferred looking at human faces to looking at anything else; they could reliably distinguish among facial expressions. As Spelke told me, preferential looking "gave us a set of tools that let us play Twenty Questions with a baby. 'Yes or no—does this look like this or like that?' Progress was slow, but over the course of a decade or two you could learn a lot." Of course, it wasn't absolutely clear what some of this gazing meant. If a baby didn't evince a looking-time preference between, say, sky blue and teal blue, did that mean he couldn't tell the difference between them—or that he could, but judged them equally appealing?

In the seventies, other baby researchers—chiefly, the psychologist Frances Horowitz—observed that if you keep showing babies the same visual stimulus they eventually look at it less and less. When something that they perceive as new comes into their line of vision, they perk up and look at it longer. Spelke and Xu exploited this tendency in their dots experiment, which is easily replicated. Show an infant a picture of sixteen dots over and over again, and measure how long he looks at it each time. After a while, he gets used to it—or "habituated," as psychologists say—and the time he spends looking at it decreases. Then show him eight dots; he will likely look at it longer, presumably recognizing it as something novel—which suggests that he can distinguish between a quantity of eight and a quantity of sixteen. If you were to try preferential looking without habituating the baby first, he probably would not look longer at one set of dots than at the other, since neither is more intrinsically entertaining. Bore him with one set of dots, though, and you should be able to tell something. (At the Harvard lab, looking times are measured by two people who each use a button to indicate when they see the baby look away; their results are then compared and consolidated by a computer. One day, in Spelke's lab, I watched a researcher named Ariel Grace flash the same face on the screen again and again for a baby. "Congratulations, Alice," she murmured as she saw the baby's looking time fall below the target number of seconds. "You're officially bored.")

"Don't forget to call the Fire Department."

Spelke's renown in psychology is based, in part, on her use of looking-time measures to answer questions not only about perception but also about cognition. Did infants have expectations of how the world worked—and could you tell what those expectations were by determining what surprised them? Starting in the eighties, Spelke and several other researchers—including Renee Baillargeon, of the University of Illinois, and Karen Wynn, of Yale—developed a provocative variation on the preferential-looking scheme, usually called the "violation of expectations" study. These experiments were staged a little like magic shows. Babies sat in a darkened room, watching scenarios of varying degrees of plausibility unfold on a small stage. Spelke, for example, showed the babies a ball rolling along a path with an obstruction in the middle of it. A screen was lowered and then raised to reveal the ball either resting against the obstruction—where it logically should be—or on the other side of it, as though the ball had magically rolled through a solid surface. Spelke found that babies looked longer at the unexpected event. In a 1983 experiment, Spelke and her colleague Philip Kellman placed a gray wooden barrier on the stage, parallel to the proscenium and raised a few inches. The baby watched as what appeared to be a long stick, its tips extended above and below the barrier, crossed the stage. Spelke and Kellman wanted to know if a three-month-old baby would assume—as an adult would—that he was watching just one stick, even though the middle portion was concealed. Then they lifted the barrier, revealing sometimes one stick, sometimes two. Their hypothesis was that if babies found the appearance of two sticks strange they would look longer at the two sticks. The babies did, staring at the two sticks thirty seconds longer.

Spelke and Kellman's finding contradicted Piaget's theory of object permanence, and it galvanized other psychol-

ogists. Piaget's notion was based on experiments with his children which involved motor skill—watching, for example, to see whether his daughter Jacqueline continued to search for a toy duck after Piaget hid it under a sheet. Spelke thought that limitations in babies' ability to lift and grab, more than limitations in what they could represent in their minds, were the real obstacle. In a series of papers, Spelke boldly argued that babies did not have to depend on a fumbling, trial-and-error exploration of their world for all their knowledge of it. They were born with some knowledge—though it would need testing and revising along the way.

Spelke and like-minded researchers emphasize that they are talking about a baby's "implicit knowledge"—no infant, even if he could talk, could say why he can't walk through a wall. They are not claiming that babies spin theories about motion and gravity while wearing out their pacifiers. As Karen Wynn explained, the kind of understanding that babies reveal by looking longer at an unprecedented event is "available only to their attentional systems. It's a kind of general alert—'Pay attention, something interesting and unexpected has just happened.' That need not be explicitly available at a conscious, salient level; it could be at an automatic, unconscious one."

Some more recent studies of toddlers and preschoolers have raised a seeming paradox: the older children's sense of solid objects appears to be less secure than that of infants. (A 2003 article on this topic is subtitled "Why Do Infants Look So Smart and Toddlers Look So Dumb?") Rebecca Rosenberg, a psychology graduate student at Harvard, has lately been running a study in which she shows two-year-olds a cabinet with a shelf in the middle and a sliding door that conceals the front. With the sliding door open, she drops a Koosh ball on the shelf and asks her subject if the ball is on top or under it. The toddler usually confidently responds, "On top!" But when Rosenberg conceals the shelf with the sliding door, and drops the ball again, most children have no idea where the ball is—they will say that it has vanished or fallen to the bottom of the cabinet (sailing right through a solid wood shelf). It isn't until at least the age of three that kids can perform this task successfully, Rosenberg told me. "It's just astounding to see the toddlers fail at it," she said. "We know that couple-month-old infants already know about solidity. Do they somehow unlearn what they knew as infants? That seems unlikely."

One possibility, of course, is that Spelke's infant studies, or their conclusions, are somehow flawed. Spelke said that she is interested in the toddler studies, but she is not worried by them. She believes that the knowledge we have in one system (say, the attentional system) isn't always available to us in others (say, the verbal or motor systems). Even adults show this split. Wynn told me about some recent studies in which adults are asked to predict where a ball that rolls around and around a circular ramp will finally come out. Adults, she said, are "terrible at it if they're asked to draw the pathway the ball took, or make a verbal prediction of the path it will take. But if they are asked to reach in and find the ball, their hand automatically goes to the right place. With their motor system, they can anticipate correctly, but that knowledge isn't accessible to them verbally."

To the layperson, there's something faintly comic about looking-time studies. So much strenuous effort is made to engage the attention and record the fleeting stares of bobble-headed babies who are distracted by their own feet and fingers; and so many lofty claims about human nature are being based on these odd little encounters. Nevertheless, the looking-time paradigm has proved remarkably durable, and is widely trusted by researchers in the field. Brain imaging may be the next wave in infant studies, but it's not yet very useful. Babies don't lie flat and hold perfectly still, as an M.R.I. requires, unless they're asleep—and if they're asleep you can't show them anything.

When Spelke was an undergraduate at Harvard, in the late sixties, she studied with the eminent child psychologist Jerome Kagan. "I was doing an undergrad thesis, looking at attachment and emotional reactions in babies," she recalled. "But I realized that we didn't have a clue about what babies actually understood. I really wanted to study these emotional and social issues. But it seemed as if we first needed to know some basic things about what infants perceived and understood. So I made what's become a thirty-year detour into human nature and the human mind."

The first major stop on the detour was Cornell, where Spelke earned her Ph.D. in an expeditious four years. One of her mentors was Eleanor Gibson, the grande dame of developmental psychology, who was gifted at designing elegant experiments. The most famous of these is known as the "visual cliff." (In the waiting area at Spelke's laboratory, a small diorama depicts the experiment, with a doll standing in for the baby.) In the 1957 study, a sturdy sheet of glass was laid on a three-foot-high platform, with some of the glass extending beyond the platform. Gibson pasted checkerboarded paper between the glass and the platform; she also placed the paper on the floor, beneath the overhanging glass, creating the appearance of a checkerboarded "cliff." Would a baby who began crawling along the patterned path sensibly stop at the edge of the platform, even if his mother were coaxing him to continue onto the glass overhang? The answer was yes. The babies clearly had depth perception, Gibson concluded, and they did not require direct sensory experience of a cliff edge to know the most important thing about it.

Spelke said of Gibson, "She was the best experimental psychologist I ever met. I've spent my whole life aspiring to be like her. She combined hard-nosed experimental rigor with an insistence that the work you do be directly connected to real-world phenomena. Never do a study the motivation of which is to understand the result of a previous study. Do a study the motivation of which is to understand how people are functioning in the real world."

Spelke found Gibson inspiring for another reason, too. Gibson managed to have both a prominent scientific career and a family, without much help at home; her husband, a theorist of perception, had adopted a quixotic schedule that involved working all night and sleeping most of the day. Spelke recalled, "What most impressed me was that she could carry on with her whole life of teaching, running her lab, and doing these absolutely superb experiments, all while raising two children and taking out the garbage and cutting down the Christmas tree. I looked at her life, and I thought, Boy, this is an exis-

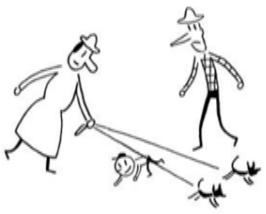
tence proof. This life is possible. Totally insane, maybe, but possible."

The first breakthrough in Spelke's quest to understand how much infants knew occurred at Cornell. Piaget had contended that in babies the five senses operated separately, and that "inter-modal perception"—the capacity to recognize, for instance, that the clattering sound you just heard and the pot lid you just saw your mother drop are part of the same event—developed later, in toddlerhood. Spelke was skeptical of the Piaget line; in the mid-seventies, she devised an experiment to test it. She showed babies two films, on side-by-side screens, while playing the soundtrack for just one of them. Babies focussed on the screen for which the soundtrack was appropriate, correctly matching the picture and the sound.

Spelke's first academic post was at the University of Pennsylvania. After nine years, she moved to Cornell, then to the Department of Brain and Cognitive Sciences at M.I.T.; in 2001, she accepted an offer from Harvard, in part so that she could work alongside the cognitive psychologist Susan Carey, with whom she enjoys "productive disagreements." Along the way, Spelke was married briefly and later had a daughter, Bridget, who is now a premed student at McGill University, in Montreal. When Spelke was thirty-seven, she met her second husband, Elliott Blass, a psychology professor who was then at Johns Hopkins and is now at the University of Massachusetts at Amherst. Spelke recalled, "I was raising Bridget as a single mother, and felt quite complete and satisfied and happy in my life, which I think is always the moment at which you fall in love with someone." She and Blass had a son, Joe, who will enter the University of Chicago this fall. Blass studies motivation and emotions. "We sort of divide up the field between us," Spelke said. "But we'd rather talk about movies." She went on, "I adore movies. And, from the time my kids were old enough to keep their eyes open for two hours, they've been going to movies. We bought our present house because it's walking distance from the Harvard Film Archive. And, when we first moved in, it was a hot August and then a hot September, and I remember watching Leni Riefenstahl on the Berlin Olympics with them for *days*." When I expressed surprise over this choice, she said earnestly, "They're gripping. Oh, they're wonderful movies for kids."

Spelke and her husband have a second home, a ramshackle farmhouse in the Loire Valley; they've spent all their sabbatical years in France, as well as nearly every summer while Bridget and Joe were growing up. To Spelke's delight, both children are bilingual and "bicultural," with close friends in both countries. She wasn't always so sanguine, though, about how this particular experiment would turn out. When she enrolled her then three-year-old son at the local *école maternelle*, he announced that he wasn't going to say a word all year long. "For Joe's first four months, the entire class would be focussed on some activity, and Joe would be off in a corner looking at Tintin books," she recalled. "And I thought, He's never going to learn a word of this language; he's never going to be integrated; I'm a terrible mother. And then, four months in, we were walking into class, and he said, 'I've changed my mind now, Mom, I'm going to talk.' And the next time I went in he was speaking complete sentences in French and singing all the songs, which he had learned all the words to while pretending not to pay attention. Both kids said it was the best year of their lives, and made them feel they can go anywhere or do anything."

Spelke mistrusts products that are marketed as brain boosters for babies, but, in an e-mail, she said that she thinks it's "a good idea, whenever possible, for parents to expose their babies to people, places, and events that they themselves love and want their children to enjoy with them later on. There's little explicit memory for events or places that are experienced in infancy, but I do think (and some research supports this) that there is implicit emotional memory for them." Spelke may never test this notion in her laboratory, but she is satisfied with the data generated by her family. She went on, "My hunch is that my own children love the things I love—travel, movies, blundering along in new languages—in part because they have been exposed to these things with me, literally since birth."



Spelke's work has always been oriented toward finding the universal human attributes that lie beneath what she calls—optimistically, perhaps—the "superficial" cognitive differences of language, culture, and gender. At M.I.T., Spelke was inspired by Noam Chomsky's ideas about the properties shared by all languages. "Beneath the surface variability of human languages are deep commonalities," she said in a public lecture with Chomsky last year. "Common underlying principles have to be there, because children have to be able to learn any of the world's languages depending on where they happen to be born. And, as a matter of fact, they learn these languages very rapidly with no instruction, and from rather minimal and fragmentary evidence."

Lately, Spelke's cross-cultural preoccupations have been sparking ideas for her kind of fastidious, imaginative, and weirdly specific experiments. (Working out the kinks of studies is clearly something she relishes. More than once, I heard her exclaim, "Damn, this is hard!" while talking to students about refining an experimental design—but she always said it with a grin.) A few years ago, Spelke, working with Susan Hespos, of Northwestern University, fashioned a study around a curious linguistic distinction that is made by Korean but not by English. Korean speakers indicate whether an object fits loosely or tightly with something else—a ring on a finger, a shoe in a box, a cup inside another cup—whereas English speakers simply use "in" or "on." (In English, a wedding ring is "on" your finger, but it could also be "on" the kitchen counter.) Spelke and Hespos relied on looking-time measures to see if five-month-old infants living in English-speaking households would also note the loose-versus-tight distinction—by looking longer at a cylinder that fitted loosely into a container after they'd been habituated to looking at a cylinder that fitted tightly, and vice versa. The babies detected the difference. Apparently, before their own language had convinced them that the distinction wasn't a vital one, they carried a concept of it in their minds. In 2004, Spelke and Hespos wrote up their findings in modest, technical language for the journal *Nature*. ("Our research focuses on the

crosscutting conceptual distinctions between actions producing loose- and tight-fitting contact relationships . . .") As a result, the layman might not have noticed that they were making an aggressive philosophical claim: that thought preëxists language. "These findings suggest that humans possess a rich set of concepts before we learn language," Spelke told the *Financial Times* when the study came out. In the science press, her colleagues concurred. "How do we think about the world before we are corrupted by culture and the world?" the psychologist Paul Bloom asked. "One way to learn is to look at babies."

Spelke has recently explored another way of addressing Bloom's question. She has been working with a team of French researchers, including the linguist Pierre Pica and the neuroscientist Stanislas Dehaene, who are studying the Mundurukú, an isolated Amazonian tribe. (Since the Mundurukú are suspicious of outsiders, Pica is the only team member who goes to the Amazon. He travels to the jungle with a solar-powered laptop, and videotapes all the testing sessions.) The Mundurukú don't have maps or compasses, words for any geometric shape except the circle, a counting routine, or words for numbers above five. Nonetheless, according to the team's experiments, they do have a sense of geometry that allows them to navigate efficiently. And they also have the two core math abilities that Spelke has identified: the ability to differentiate between quantities and the primordial sense of addition and subtraction. When tribe members were given maps for the first time, they were able to orient themselves correctly and find hidden objects. Mundurukú children, when shown five right triangles and one isosceles triangle, and asked, in their language, to point to the "ugly" or "weird" one, performed as well as American children on a similar task. The Mundurukú could add and subtract with numbers under five, and they could do approximate number comparisons as successfully as the educated French speakers who constituted the control group. ("Pierre Pica came back from the Amazon with these necklaces," Spelke announced, laughing, at a recent lab meeting. "One of them has got a carving of hands on it, and several of the hands have only four fingers on them. It was, like, 'Look! Hands have approximately five fingers!' ") For Spelke, all this has been further confirmation of the notion that certain core abilities emerge spontaneously, and universally.

"Poor thing. The first night out, her husband fell overboard."

Spelke's universalism, combined with her view that some mental capacities are inborn, has led her to an unusual place in academe. She believes in a fundamental human nature but parts company with other Darwinians when she casts doubt on the idea that cognitive gender differences are innate. A committed liberal who talks indignantly about race and gender discrimination, she diverges from most left-wing academics—who like to conceive of human beings as "socially constructed"—when she posits a biological basis to discrimination. Some of the newest studies in her lab examine whether babies make distinctions between people on the basis of race, or the language they speak. A recent study, led by Spelke's graduate student Katherine Kinzler, showed that twelve-month-old babies are more likely to choose food offered by a stranger who speaks their parents' language, even though they don't yet speak themselves, and are only beginning to understand much of what is being said to them, and even though, at the moment when they are offered the gift, the stranger isn't speaking. It could be, Spelke said, that there is "a core system whose job is to take all the people out there and divide them up into groups, so that when you encounter new people, or even familiar people about whom you have limited information, you can make inferences about their behavior and decide what you're going to do."

Recently, when another graduate student, Kristin Shutts, presented the lab's initial findings at a conference in South Africa, the response from some scientists was vitriolic—the researchers were accused of "reifying" the concept of race. Spelke knows that if further studies eventually confirm the existence of an "us versus them" instinct in babies, it won't be a welcome finding. But she believes that we shouldn't be wary of asking the question—"Just because babies see it doesn't mean it's right," she said. In her view, nurture, or human will, is ultimately more powerful than nature, because humans are capable of rejecting certain aspects of their evolutionary inheritance—recognizing them as wrong, either factually or morally or both.

She said, "Suppose it turned out that babies were predisposed to racism—that, once they figure out what race their parents are, they negatively evaluate people of other races. The worry would be that such a finding somehow justifies racism in adults, or makes us more defeatist about combatting racism. I would put it exactly backward. I would say, insofar as racism

exists in human societies, we have a phenomenon and we need to know what produced it. Cognitive scientists have learned over the last couple of decades that people are really bad at probabilistic reasoning. We don't conclude from this that we should fold all our statistics departments! We say, 'Let's try and understand what it is about the way that we think about numbers that makes us bad at understanding probability, and figure out what we can do to *overcome* those weaknesses.'"

Spelke is equally determined to overcome what she considers to be sexist attitudes about women and science. Her debate with Steven Pinker was ostensibly on the limited subject of whether intrinsic gender differences accounted for the paucity of women among the ranks of tenured engineering, physical science, and math professors at élite institutions like Harvard. Nevertheless, the debate ranged farther, into basic questions about men's and women's ambitions and aptitudes. It was a civil occasion, certainly, but lively enough that the Harvard *Crimson* couldn't quite resist calling the exchange a "showdown of the sexes."

When Pinker stepped up to the lectern, he chided Spelke, his fellow-innatist, for embracing "the extreme nurture position." He took issue with public remarks that Spelke had recently made at a campus panel, in which she declared that the evidence against an intrinsic male aptitude in science was overwhelming—"as conclusive as any finding I know of in science." She had added that she found it hard to see how anyone could make a case for the other side. Pinker paused, then said, to an eruption of laughter, "Well, we certainly aren't seeing the stereotypical gender difference in confidence here!"

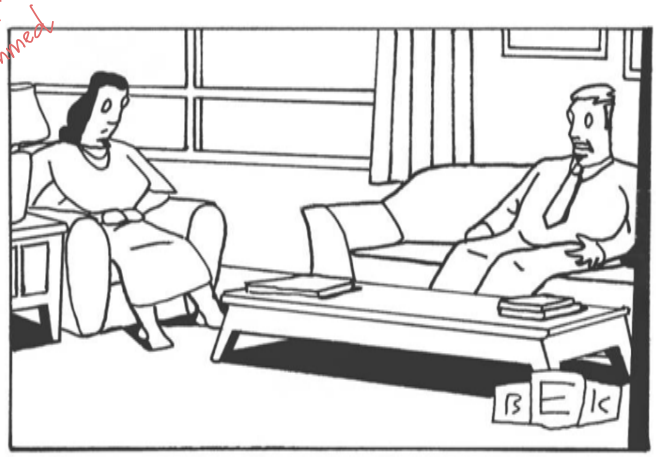
Spelke had argued that gender bias and social expectations, some of them quite subtle, were the significant factors behind women's limited presence in top scientific jobs. (For example, women tend to be evaluated for tenure in the same years that they are most likely to be having children.) But she had not claimed that men and women are indistinguishable in their cognitive profiles—just that the differences they do show don't add up to a clear advantage for one sex or the other. There were good data to suggest, she noted, that men and women tend to resort to different strategies when solving certain types of math problems, for instance. Spelke elaborated on this at the debate with her usual punctiliousness:

> If a task can only be solved by representing the geometry of the layout, we do not see a difference between men and women. But if the task can be accomplished either by representing geometry or by representing individual landmarks, girls tend to rely on the landmarks, and boys on geometry. To take another example, when you compare the shapes of two objects of different orientations, there are two different strategies you can use. You can attempt a holistic rotation of one of the objects into registration with the other, or you can do point-by-point featural comparisons of the two objects. Men are more likely to do the first; women are more likely to do the second. . . .
>
> Because of these differences, males and females sometimes show differing cognitive profiles on timed tests. When you have to solve problems fast, some strategies will be faster than others. Thus females perform better at some verbal, mathematical, and spatial tasks, and males perform better at other verbal, mathematical, and spatial tasks. This pattern of differing profiles is *not* well captured by the generalization, often bandied about in the popular press, that women are verbal and men are spatial. There doesn't seem to be any more evidence for that than there was for the idea that women are people-oriented and men are object-oriented. Rather the differences are more subtle.

Pinker countered that, at the level of achievement they were discussing, small differences might matter a lot. He wasn't talking about a gap in general intelligence—he agreed that neither gender had an advantage in this regard—or about the kinds of basic core abilities that Spelke had studied in infants. He wasn't even talking about over-all mathematical and spatial abilities, where, he conceded, men and women might well be equal. He was referring to rarefied competencies—like the ability to mentally rotate shapes—at which men tend to be faster and better.

"In many ways, this is an exotic phenomenon," Pinker said. "It involves biologically unprepared talents and temperaments: evolution certainly did not shape any part of the mind to do the work of a professor of mechanical engineering at M.I.T., for example." At issue here, Pinker argued, were "extremes of achievement. Most women are not qualified to be math professors at Harvard because most men aren't qualified to be math professors at Harvard." Pinker noted that the I.Q.s of females are less variable, predominating in the middle range, whereas males slightly predominate at both ends, accounting for both "more idiots and more prodigies." Beyond that, Pinker said, loomed bigger, psychological sex differences. Men across cultures, he noted, constituted the more risk-taking and competitive sex—though why risk-taking and competitiveness were more adaptive attributes for, say, aspiring mathematicians than for aspiring sociologists wasn't exactly clear.

After Pinker and Spelke had given their talks, they sat at a table onstage, and listened to each other without interrupting. But when Pinker spoke, Spelke wore one of those smiles which suggest a certain effort—and when she spoke she used her large hands to make sweeping gestures, as if she were dismissing one silly notion after another. When Pinker started talking about how "the most subjective fields in



"Let's go somewhere fun and not really experience it."

academia—the social sciences, the humanities, the helping professions" had the greatest representation of women because they jibed with "what gave women satisfaction in life," Spelke looked as though she'd had enough. "I think it's a really interesting possibility that the forces that were active in our evolutionary past have led men and women to evolve somewhat differing concerns," she began. "But to jump from that possibility to the present, and draw conclusions about what people's motives will be for pursuing one or another career, is *way* too big a stretch." The career choices people pursue now, she concluded acidly, were "radically different from anything that anybody faced back in the Pleistocene."

Pinker was suggesting that, because of both sexual selection and parental-investment issues, women are selected to be more nurturing and men more competitive. Suppose that this were true, Spelke said, in the final words of the debate. What sort of motivation made a better scientist? Was it "competitive motives like those J. D. Watson described in 'The Double Helix' to get the structure of DNA before Linus Pauling did? Or nurturant motives of the kind that Doug Melton"—the Harvard developmental biologist—"described recently to explain why he's going into stem-cell research: to find a cure for juvenile diabetes, which his children suffer from? I think it's anything but clear how motives from our past translate into modern contexts. We would need to do the experiment, getting rid of discrimination and social pressures, in order to find out."

The literature on sex difference is contradictory and confusing, and since the Summers upheaval there has been one volley after another. In a recent issue of *Nature*, the Stanford neurobiologist Ben Barres published a commentary on having done science as both a man and a woman. He had a sex change at forty-two, and found that he was treated with more respect upon becoming a male—evidence, he claimed, that "discrimination" is what holds female researchers back. On the other side, Louann Brizendine, a neuropsychiatrist at the University of California at San Francisco, has just published "The Female Brain," in which she claims, among other things, that women use twenty thousand words a day, whereas men use an economical seven thousand. (The implication, presumably, is that women are better suited for gossiping or novel-writing than for, say, composing scientific abstracts.) None of these arguments settle the matter, though a firm belief in gender difference does seem to produce more best-sellers—think of "Men Are from Mars, Women Are from Venus"—which could suggest either that the gender-difference view accords more with people's common sense and experience or that Spelke's hunch is right, and we are evolutionarily predisposed to dwell on difference. In the end, Spelke's belief in universal aptitude may be proved only if women eventually do join, in significant numbers, the ranks of the math and science faculties where they are currently sparse. A hundred years ago, plenty of people believed that the reason there weren't more female doctors was that women were intellectually and physically ill-suited for the job—and that these shortcomings were innate and immutable. Today, half of the medical students in the country are women.

Recently, I asked Pinker about the cause of his disagreement with Spelke, given their shared belief in innate forms of cognition. "It's hard to know," Pinker said. "Gender might be a factor. Also, my brand of nativism is tied more explicitly to evolutionary biology, which opens the door to differences between men and women in the same way there are differences between the sexes in almost all species." He added that, generally, what Spelke thinks is most interesting about human psychology is what we all have in common. He tended to agree, he said, but not to the extent that Spelke did.

Spelke's mode of inquiry, as fruitful as it has been, can sometimes seem rigid and doctrinaire. Are looking-time measures really equal to a task as complex as assessing, say, whether there is a universal human impulse toward prejudice? Can infants really be said to have such a tendency, or is Spelke overloading her interpretation of a baby's extended glance? Spelke's belief in hardwired capacities strikes some developmental psychologists as reductive. Alison Gopnik, a baby researcher at Berkeley, has described Spelke's idea of "core knowledge" as a "fundamentally oversimplified theoretical account."

Indeed, in some recent infant studies, babies' preferences seem to show surprising mutability. A 2006 study that Spelke's researchers are looking at with interest—one of the authors, Talee Ziv, is now working at Spelke's lab—involved Caucasian infants raised in Israel, African infants raised in Ethiopia, and Ethiopian infants raised in Israel. Presented with photos on a screen, the white Israeli infants preferred looking at new faces of their own race; African babies raised in Ethiopia preferred to look at African faces. But the Ethiopian-Israeli infants, who had been exposed since birth to people of both races, showed no preference. The import of this study is ambiguous, Spelke said. The finding could mean that babies aren't born prejudiced after all—that they learn to be wary of others only if they grow up in an isolated environment. Or it could mean that babies are programmed to trust people who look more like their own parents, and that this instinct can be counterbalanced through enlightened education.

If the latter interpretation proved to be the case, Spelke would be optimistic. As she recently posted on *Edge*, a Web publication that airs scientific controversies, "Humans are capable of discovering that our core conceptions are false and of replacing them with truer ones." Just as our core intuitions about geometry once led humans to believe that the world was flat—until the science that humans perfected proved otherwise—core intuitions might lead us to believe that linguistic and racial differences mean something more fundamental than they really do.

"Nobody should be troubled by our research, whatever we come to find," Spelke told me. "Everybody should be troubled by the phenomena that motivate it: the pervasive tendency of people all over the world to categorize others into different social groups, despite our common and universal humanity, and to endow these groups with social and emotional significance that fuels ethnic conflict and can even lead to war and genocide." This mirrors her belief that, in time, feminism will embolden more women to take up high-level careers in the physical sciences, and more of us will recognize how alike men's and women's minds really are. For Spelke, who has spent most of her life documenting the core knowledge that we're born with, the most important thing about it is our uniquely human ability to rise above it. ♦