Unit 9 **PATRICIA KUHL**

The Linguistic Genius of Babies

Part 1

I want you to take a look at this baby. What you're drawn to are her eyes and the skin you love to touch. But today I'm going to talk to you about something you can't see—what's going on up in that little brain of hers. The modern tools of neuroscience are demonstrating to us that what's going on up there is nothing short of rocket science. And what we're learning is going to **shed some light**[1] on what the romantic writers and poets described as the "celestial openness" of the child's mind.

[. . .] Work in my lab is focused on the first critical period in development—and that is the period in which babies try to master which sounds are used in their language. We think, by studying how the sounds are learned, we'll have a model for the rest of language, and perhaps for critical periods that may exist in childhood for social, emotional, and cognitive development. So we've been studying the babies using a technique that we're using all over the world and the sounds of all languages. The baby sits on a parent's lap, and we train them to turn their heads when a sound changes—like from "ah" to "ee." If they do so at the appropriate time, the black box lights up and a panda bear pounds a drum. A **six-monther**[2] adores the task.

What have we learned? Well, babies all over the world are what I like to describe as "citizens of the world." They can discriminate all the sounds of all languages, no matter what country we're testing and what language we're using, and that's remarkable because you and I can't do that. We're culture-bound listeners. We can discriminate the sounds of our own language, but not those of foreign languages. So the question arises: When do those citizens of the world turn into the language-bound listeners that we are? And the answer: before their first birthdays. What you see here is performance on that head-turn task for babies tested in Tokyo and the United States, here in Seattle, as they listened to "ra" and "la"—sounds important to English, but not to Japanese. So at six to eight months, the babies are totally equivalent. Two months later, something incredible occurs. The babies in the United States are getting a lot better, babies in Japan are getting a lot worse, but both of those groups of babies are preparing for exactly the language that they are going to learn.

So the question is: What's happening during this critical two-month period? This is the critical period for sound development, but what's going on up there? So there are two things going on. The first is that the babies are listening intently to us, and they're taking statistics as they listen to us talk—they're taking statistics. So listen to two mothers speaking **motherese**[3]—the universal language we use when we talk to kids—first in English and then in Japanese.

[Video] *English Mother: Ah, I love your big blue eyes—so pretty and nice.*

Japanese Mother: [Japanese]

Part 2

During the production of speech, when babies listen, what they're doing is taking statistics on the language that they

[1] To "shed some light" on something means to explain it.

[2] Kuhl refers to a six-month old baby as a "six-monther."

[3] Kuhl uses the expression "motherese" to describe the animated way of speaking to babies that many mothers use.

hear. And those distributions grow. And what we've learned is that babies are sensitive to the statistics, and the statistics of Japanese and English are very, very different. English has a lot of Rs and Ls. The distribution shows. And the distribution of Japanese is totally different, where we see a group of intermediate sounds, which is known as the Japanese "R." So babies absorb the statistics of the language and it changes their brains; it changes them from the citizens of the world to the culture-bound listeners that we are. But we as adults are no longer absorbing those statistics. We're governed by the representations in memory that were formed early in development.

So what we're seeing here is changing our models of what the critical period is about. We're arguing from a mathematical standpoint that the learning of language material may slow down when our distributions stabilize. It's raising lots of questions about bilingual people. Bilinguals must keep two sets of statistics in mind at once and flip between them, one after the other, depending on who they're speaking to.

[. . .] We want to get inside the brain and see this thing happening as babies are in front of televisions, as opposed to in front of human beings. Thankfully, we have a new machine, **magnetoencephalography**[4], that allows us to do this. It looks like a hair dryer from Mars. But it's completely safe, completely **non invasive**[5], and silent. We're looking at millimeter accuracy with regard to spatial and millisecond accuracy using 306 SQUIDs—these are Superconducting QUantum Interference Devices—to pick up the magnetic fields that change as we do our thinking. We're the first in the world to record babies in an MEG machine while they are learning.

So this is little Emma. She's a six-monther. And she's listening to various languages in the earphones that are in her ears. You can see, she can move around. We're tracking her head with little pellets in a cap, so she's free to move completely unconstrained. It's a **technical tour de force**[6]. What are we seeing? We're seeing the baby brain. As the baby hears a word in her language, the auditory areas light up, and then subsequently areas surrounding it that we think are related to coherence, getting the brain coordinated with its different areas, and causality, one brain area causing another to activate.

We are embarking on a grand and golden age of knowledge about child's brain development. We're going to be able to see a child's brain as they experience an emotion, as they learn to speak and read, as they solve a math problem, as they have an idea. And we're going to be able to invent **brain-based interventions**[7] for children who have difficulty learning. Just as the poets and writers described, we're going to be able to see, I think, that wondrous openness, utter and complete openness, of the mind of a child. In investigating the child's brain, we're going to uncover deep truths about what it means to be human, and in the process, we may be able to help keep our own minds open to learning for our entire lives.

This is an edited version of Kuhl's 2011 TED Talk. To watch the full talk, visit TED.com.

[4] The magnetoencephalography, or MEG machine, is an apparatus that measures human brain activity by mapping electric currents in the brain. Students can see a picture of it on page 145 of the Student Book.

[5] A device that is "non-invasive" is one that does not go inside the body at all. The MEG machine sits on the child's head, like a helmet.

[6] A synonym for "tour de force" is "masterpiece."

[7] By "brain-based interventions" Kuhl means that new ways to help children with learning disabilities will focus on that child's brain activity while learning.