Patricia Kuhl:

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.

Patricia Kuhl:

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 on what the romantic writers and poets describe as the celestial openness of the child's mind.

Patricia Kuhl:

What we see here is a mother in India, and she's speaking Koro, which is a newly discovered language. And she's talking to her baby. What this mother and the 800 people who speak Koro in the world, understand that to preserve this language, they need to speak it to the babies. And therein lies a critical puzzle. Why is it that you can't preserve a language by speaking to you and I, to the adults? Well, it's got to do with your brain.

Patricia Kuhl:

What we see here is that language has a critical period for learning. The way to read this slide is to look at your age on the horizontal axis, you've done that, and you'll see on the vertical your skill at acquiring a second language. The babies and children are geniuses until they turn seven, and then there's a systematic decline.

Patricia Kuhl:

After puberty, we fall off the map. No scientists dispute this curve, but laboratories all over the world are trying to figure out why it works this way. 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.

Patricia Kuhl:

So we've been studying the babies, using a technique that we're using all over the world in 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 adores the task.

Patricia Kuhl:

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.

Patricia Kuhl:

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 in the United States, here in Seattle, as they listened to, "Ra," and, "La," sounds important to English, but not to Japanese.

Patricia Kuhl:

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, the babies in Japan are getting a lot worse, but both of those groups of babies are preparing for exactly the language that they're going to learn.

Patricia Kuhl:

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, the universal language we use when we talk to kids, first in English and then in Japanese.

Speaker 3:

Ah, I love your big blue eyes, so pretty and nice.

Speaker 4:

[Foreign language 00:04:17].

Patricia Kuhl:

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

Patricia Kuhl:

English has a lot of R's and L's 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.

Patricia Kuhl:

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.

Patricia Kuhl:

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. So we asked ourselves, "Can the babies take statistics on a brand new language?" And we tested this by exposing

American babies who had never heard a second language to Mandarin for the first time during the critical period.

Patricia Kuhl:

We knew that when monolinguals were tested in Taipei and Seattle, on the Mandarin sounds they showed the same pattern, six to eight months they're equivalent; two months later something incredible happens, but the Taiwanese babies are getting better, not the American babies.

Patricia Kuhl:

What we did was expose American babies during this period to Mandarin, it was like having Mandarin relatives come and visit for a month and move into your house and talk to the babies for 12 sessions. Here's what it looked like in the laboratory.

Speaker 5:

[Foreign language 00:06:19].

Patricia Kuhl:

So what have we done to their little brains? We had to run a control group, to make sure that just coming into the laboratory didn't improve your Mandarin skills. So a group of babies came in and listened to English, and we can see from the graph that exposure to English didn't improve their Mandarin.

Patricia Kuhl:

But look, what happened to the babies exposed to Mandarin for 12 sessions. They were as good as the babies in Taiwan who'd been listening for 10-and-a-half months. What it demonstrated is that babies take statistics on a new language, whatever you put in front of them, they'll take statistics on.

Patricia Kuhl:

But we wondered what role the human being played in this learning exercise. So we ran another group of babies, in which the kids would get the same dosage, the same 12 sessions, but over a television set, and another group of babies who had just audio exposure and looked at a teddy bear on the screen, what did we do to their brains?

Patricia Kuhl:

What you see here is the audio result, no learning whatsoever. And the video result, no learning whatsoever. It takes a human being for babies to take their statistics. The social brain is controlling when the babies are taking their statistics; 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.

Patricia Kuhl:

Thankfully we have a new machine, magnetoencephalography, that allows us to do this. It looks like a hairdryer from Mars, but it's completely safe, completely non-invasive, and silent.

Patricia Kuhl:

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.

Patricia Kuhl:

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.

Patricia Kuhl:

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.

Patricia Kuhl:

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 for children who have difficulty learning.

Patricia Kuhl:

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. Thank you.

Speaker 6:

The precision of a watch is a function of its movement. For Rolex, and for Hans Wilsdorf, to guarantee the precision of a timepiece the pressing question was how to protect the movement itself from the elements, not only water, but also tiny particles of dust.

Speaker 6:

In 1926, a major step was taken with the creation of the world's first waterproof and dustproof wristwatch, the Rolex Oyster was born. Over the years subtle changes in the design continue to improve the Oyster, adding more comfort, while keeping the style contemporary. And along with style, more functions have been added. A Rolex wristwatch was the first to show the date through a small aperture on the face. It was also the first wristwatch to spell out the day of the week in full.

Speaker 6:

In the early 1950s, Rolex developed professional watches whose functions went far beyond telling the time; launched in 1953, the Submariner was the first Rolex watch guaranteed waterproof to a depth of 330 feet. Already on an incredible journey of innovation and design, Rolex decided to push the boundaries even further. In 1960, the bathyscaphe Trieste and Rolex made history. The submersible successfully dived to 35,800 feet below the surface of the ocean. A Rolex Deep Sea Special was strapped to the outside.

Speaker 6:

The development of undersea exploration led to the launching in 1967 of the Sea-Dweller 2000, waterproofed to a depth of 2000 feet. In 2008 the Submariner in gold is redesigned, and the case features a new unidirectional rotatable bezel, with a Cerachrom disk. Fitted with the patented Rolex Ring Lock System, the Rolex Deepsea safely descends to 12,800 feet.

Speaker 6:

Rolex has incorporated countless hours and more than a century of experience, years of research, innovation, and development into every one of its models, and the benefits arising from this work, including waterproofness, precision, and durability are the result of Rolex's continuous pursuit of perfection.

Speaker 6:

From the most elegant and prestigious models, to the professional timepieces, all are exquisitely crafted. Piece-by-piece we design and manufacture every single watch; and the story continues.