SPEECH DEVELOPMENT

# New Insights Into How Babies Learn Language

When it comes to understanding language, it's a phonetic jungle out there. Adult speech is far from uniform, with countless subtle variations on each sound, such as the "a" in "cat" or the "o" in "cot." But somewhere a line must be drawn, separating the cats from the cots. So, as children learn language, they must master which phonetic differences to pay attention to and which to ignore. A paper in this issue of *Science* and one in last week's issue of *Nature* shed some new light on how babies gain this key skill.

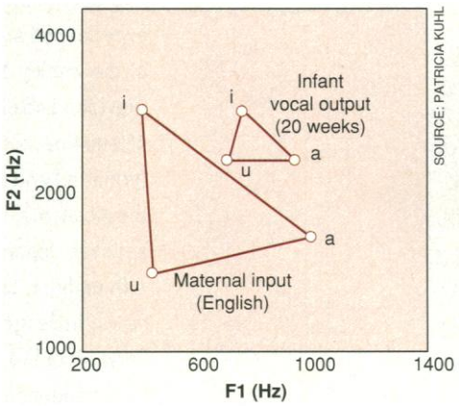
Adults in many cultures use a singsong type of exaggerated speech when they speak to babies. This speech, often called "parentese," seems to serve to get the baby's attention and to communicate and elicit emotions. But on page 684, Patricia Kuhl of the University of Washington, Seattle, and her coworkers provide evidence that it may be more than just a tool of endearment. Their analysis of the exaggerated and varied "caricatures" of vowel sounds that mothers use when talking to babies suggests, Kuhl says, that those distortions help infants learn the key features of the sounds.

But babies then set aside their capacity to make some of these distinctions. Christine Stager and Janet Werker at the University of British Columbia in Vancouver report in the 24 July *Nature* that when infants begin learning words, they neglect some differences between sounds. Presumably, that's because those distinctions won't matter until later, when their vocabulary becomes crowded with similar-sounding words.

Indeed, it appears that at each stage of early language learning, from categorizing sounds to applying those categories as they learn words, infants' brains are honing their efficiency, making rules for what to notice and what to dismiss. "To be experts in a language, we need to learn not only to make relevant distinctions, but to ignore irrelevant variability," says Stanford developmental psychologist Anne Fernald.

Kuhl and others have studied the sound-sorting process that precedes word learning. In 1992, Kuhl's team reported that by 6 months of age, Swedish and American babies learn to categorize vowel sounds, paying attention to distinctions that are meaningful in their native language, such as the difference between "ee" and "ah," while ignoring meaningless variations, such as all the ways a person might say "ee." Work done in the 1980s by Nan Bernstein Ratner at the University of Maryland suggested that English parentese might help babies learn these distinctions. Now Kuhl has probed further by studying the parentese of three different languages—English, Swedish, and Russian—to see if the distorted tones provide cues that may be useful for vowel pronunciation.

Her team's analysis focused on formants, the resonant frequencies that, like notes in a musical chord, make up each vowel sound. If vowel sounds are plotted on a graph, with the frequencies of the two dominant formants represented on the *x* and *y* axes, the result is a "vowel triangle," with the sounds "ah," "ee," and "oo" at the corners.




SOURCE: PATRICIA KUHL

JEFF CADGE/IMAGE BANK

**A melody with meaning.** Mothers' speech may help babies to form their own vowel triangles, although at higher pitch, by 20 weeks of age.

Kuhl's group found that, in all three languages, mothers talking to their babies produced exaggerated versions of vowels, emphasizing the features that distinguish them from each other. This nearly doubled the area of the vowel triangle. "It looks like the mothers are increasing the value of the signal," says Kuhl.

The mothers' speech also provided many examples of each vowel sound. This, Kuhl proposes, may help babies learn the features that make each sound special, and learn to ignore the phonetic variations that fall within a given vowel sound. Indeed, by 20 weeks of age, babies' babbling contains distinct vowel sounds that form their own—albeit higher pitched—vowel triangle.

The work "illustrates a close tie between the input and what the child is doing," says language researcher Peter Jusczyk of Johns Hopkins University. But that falls short of proving that parentese serves an instructive role. "The fact that parents do it doesn't necessarily mean that it is essential for language learning," says Stanford's Fernald. That hypothesis might be tested, she says, with studies across cultures that use different amounts or types of parentese.

Once infants learn the important distinctions between speech sounds in their native language, they appear to bank some of those abilities for later use. Stager and Werker showed this in a study of infants at 14 months, an age when babies are just beginning to learn words and match them to meanings. They tested to see whether infants who were engaged in word learning would catch small but significant changes in those words.

In earlier studies, Werker and Les Cohen at the University of Texas, Austin, showed that 14-month-olds could learn to associate a particular word with an image, and would notice if the word was changed. Werker and Cohen alternately showed the infants a picture of one nonsense object while playing a tape of the spoken nonsense word "lif" and a picture of another object while playing the word "neem." If, after many repetitions of the object-word pairs, the babies were shown the "lif" object but heard "neem," they studied the object longer, indicating they noticed the name switch.

The current study had the same design, but the names—"bih" and "dih"—differed phonetically by just one sound. Control studies showed that babies could make this distinction when they heard the words on their own. But when the words were linked with objects, the babies didn't seem to notice the switch. "To our surprise, they are actually listening less carefully" when they are listening for word meaning, says Werker. Werker suggests the babies miss the switch between "bih" and "dih" because—as studies by other teams have shown—their tiny vocabularies don't generally have words that differ by only one sound, so they don't yet need to concentrate on that level of detail. The distinctions they have learned are "almost like reserve capacity," she says.

That makes sense, says Jusczyk; for babies to spend effort on such distinctions would be a waste at that stage of development. "There is only so much you can do at once," he says, and it is important for infants engaged in the daunting task of learning words to disregard information that is not absolutely necessary. Later, when their vocabularies become crowded with words, that reserve capacity to distinguish sounds—a payoff perhaps of parentese—will be essential for navigating in the phonetic jungle.

–Marcia Barinaga