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Review (Kuhl et al 1992) Kelli Wiseth

"Linguistic experience alters phonetic perception in infants by 6 months of age"

In this brief article, Kuhl and her colleagues provide details about their 1991 research study with American and Swedish infants in which they attempted to determine the role that language exposure has on perception, with respect to discriminating sounds that will ultimately be the infant's native language from those that are not. As the basis for the study, researchers suggest that there's a "perceptual magnet effect" at work that "causes other non-prototypic members of the category to be more similar to the category prototype than to each other." [Here, I need to make an editorial comment: I believe the word that should have been used in this passage is "*variant* of the prototype," since subsequent discussions regarding the prototype vs. non-prototype are referring to the difference between American English [i] (and variants) and Swedish [y] (and its variants). In other words, I thought this seemed a bit confusing as a description of the "perceptual magnet effect," so I referred to Kuhl's other paper and found what I think is a better description, specifically, "when the prototype of the category served as the referent, the other members of the category were perceived as more similar to it. The prototype perceptually assimilated near neighbors in the category, effectively reducing the perceptual distance between it and the other members of the category." (Kuhl 1991[1]: 104)]

The experiment involved a series of 64 trials of prototype and non-prototype sound variants with 64 test subjects (32 American 6-month old infants and 32 Swedish 6-month old infants). Subjects went through a training process that ensured they could successfully produce a "head-turn" (HT) accurately, in response to sound stimuli. (Many of the implementation details are covered in the footnotes to this article, and they seem to adhere to solid research principles. For example, only those infants that had gone through a series of 7/8 successful training-change-control sequences were used in the study (p.608; fn 9)). The stimuli were produced by altering the F1 and F2 (scaled in mels) such that a series of

[1] Kuhl, Patricia. 1991. Human adults and human infants show a "perceptual magnet effect" for prototypes of speech categories, monkeys do no. *Perception & Psychophysics*.50(2).93-107.

variants formed were made 30, 60, 90, and 120 mels from each prototype), resulting in 'four rings around the prototype.' (p. 608; Fn 8)

The results confirmed researchers hypothesis, that "linguistic experience in the first half-year of life alters infants' perception of speech sounds." They used a two-way ANOVA that showed no significant results for each main effect (individually), but showed that the "interaction of the two factors was highly significant," the two factors being language environment and vowel. (Kuhl et al: 607-608)

The main "take-away" from the article is that "by 6 months exhibit a strong magnet effect only for native-language phonetic prototypes," and that by this same time, "foreign-language prototypes begin to function like non-prototypes in the native language." (Kuhl et al: 608) They propose that "linguistic experience alters phonetic perception…by shrinking the perceptual distance around a native-language prototype and … causing the prototype to perceptually assimilate similar sounds." (Kuhl et al: 608). In other words, the variants of the prototype sound more like the prototype than each other—even when the variants are more alike than they are to the prototype.

I think on an intuitive level this makes sense if we think of the prototype as something of a benchmark against which other things are measured—then the things we are measuring we associate in our minds with the benchmark, rather than with each other. I think there is an analog in our everyday experience (outside of phonetics) that may capture this idea, but… the only thing that comes to mind is the old-fashioned trip to the eye doctor, when we look through the lenses and try to evaluate 'which is clearer, 1 or 2' (as he/she adjusts the lenses). I think that particular task becomes quite difficult because we don't have a prototype that we can gravitate to, unlike the phonetic material that infants begin to store in their long term memory and ultimately have an exemplar against which to measure other stimuli.

At any rate, Kuhl and her colleagues in this experiment demonstrate that by 6 months, "linguistic experience has resulted in language-specific phonetic prototypes that assist infants in organizing speech sounds into categories," which ultimately are the

"fundamental perceptual-cognitive building blocks… of language acquisition." (Kuhl et al: 608)

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This article (and Patricia Kuhl's work in general) really intrigues me. It seems that in the 20 years since the publication of this study, Kuhl has continued deep exploration of the brains of infants and the "critical period" of language acquisition, some of which is covered in a riveting 10-minute TED talk about "the linguistic genius of babies[2]" In the talk, she describes the 'head-turn (HT) task' discussed in the article in the context of an English and Japanese example (for [r] and [l] recognition), among many other interesting aspects of her research with infants, including the use of technology that enables a baby's brain to be imaged (non-invasively, without any deleterious consequences to the baby) in conjunction with stimuli. Her research has gone a long way in the 20 years since the publication of the article.

On a personal note, I enjoyed reading this article, and I'd like to study more of Kuhl's work which interests me perhaps because one of my favorite ways of interacting with the infants and young toddlers in my life (nieces, nephews, etc) over the years has been to play 'word and sound games' with them as they learn to speak. I think this is really one of the most basic pleasures we have as a species, interacting with infants (and children) learning a language, and Kuhl's research in this area offers enormous insight.

[2] http://www.ted.com/talks/patricia_kuhl_the_linguistic_genius_of_babies.html