

Infant Speech Perception

Week 2: Perceiving Phonemes

Substitute Lecturer

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<http://www.ualberta.ca/~jparadis/> ("Teaching")
- Duration: Sept 13-24; *possibly* Sep 27-Oct 1
- Topics:
 - Perceiving phonemes
 - Perceiving phonotactics
 - Word segmentation

Homework and Presentations

- 1st homework will be posted Sep 27 (due 1 week later and marked by Dr. Tessier)
- Presentations will be organized by Dr. Tessier when she returns

Where to start?

What do you need to learn to learn a phonology?

One starting point:

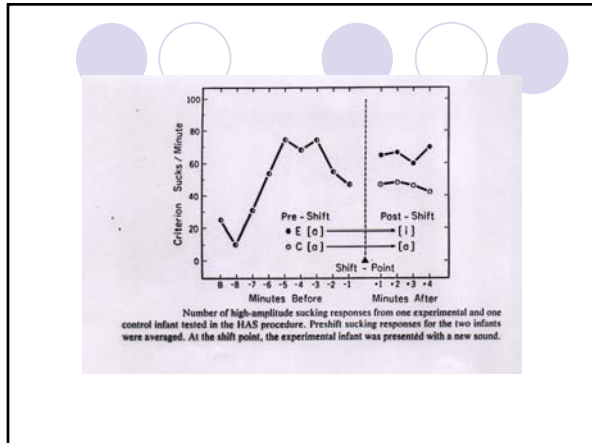
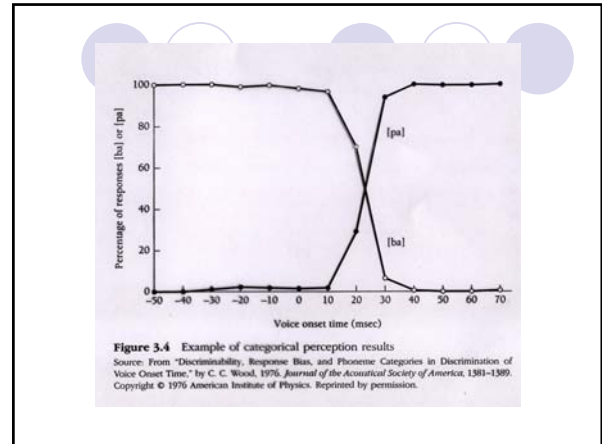
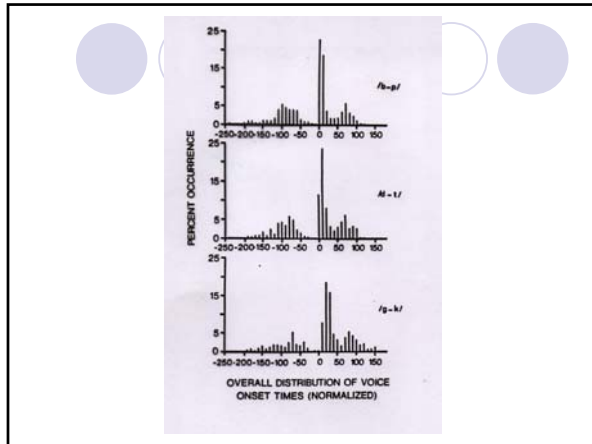
Learning to discriminate phonemes

Two logical possibilities:

1. Infants learn to hear and therefore discriminate the phonemes in their L1
2. Infants initially discriminate most (all?) speech sounds, and learn to suppress those that are not phonemic in L1

The classic VOT study: Eimas, Siqueland, Jusczyk & Vigorito 1971

- First some background:
 - What is VOT?
 - What is categorical perception?
 - What is High Amplitude Sucking?

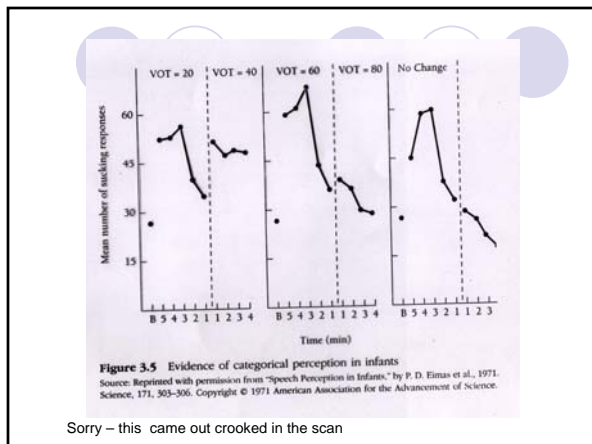


The classic VOT study:
 Eimas, Siqueland, Jusczyk & Vigorito 1971

L1 English infants discriminate two VOT steps
 ... **better** across the English [+/- voice] boundary
 ... **worse** within it

Already at 1-4 months!

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Sorry – this came out crooked in the scan

Does this mean infants are born able to perceive all phonemes in all languages?

- Not exactly....
- In this work of the 1970s, infants mostly showed discrimination between two different *familiar* phonemes (or roughly so):
 - * different 'natural' VOTs
 - * liquids
 - * fricatives (sibilants)

For a summary of this original work, see Jusczyk 1980; Werker et al 1981

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Janet Werker and colleagues

Psychology, University of British
Columbia

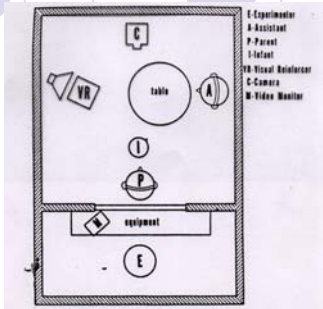
<http://infantstudies.psych.ubc.ca/>

Head Turn Procedure

The method: **Head Turn (HT)** 'Conditioning':
learning connection between sound
change (da~ba) and animated toybox

The goal: anticipatory head turns at
sound change (w/in 4.5 secs)

(This method gets rather more sophisticated later)



The Head Turn Procedure

Reaching criterion:

8/10 correct responses to change trials,
with no more than 2 errors

Failing to reach criterion means both:

- * discriminating ba~da before/after
- * getting to 25 change trials

Werker et al and Werker & Tees 1981, 1983

The phonemic pairs, from Hindi:

- dental/retroflex stops ɖa vs. ɗa
- voiced/voiceless aspirates d^ha vs. t^ha
(note use of multiple exemplars)

The populations:

- L1 English and L1 Hindi adults
- L1 English infants (6-8 months)
- L1 English children (4-12 years)

Werker et al and Werker & Tees 1981, 1983

The results:

	<i>Discriminate?</i>
L1 English adults	No
L1 Hindi adults	Yes (good)
L1 English infants	Yes
L1 English children	No (even at 4!)

The Next Questions

- How cross-linguistic are the results?
- When during development do we **lose** the ability to discriminate other language's phonemes?

In other words:

- *When do we start hearing like native speakers?*

Werker and Tees 1984, Exp 1

- The phonemic pairs, from Salish (Thompson):
glottalized velar vs. uvular stops
k'i vs. q'i

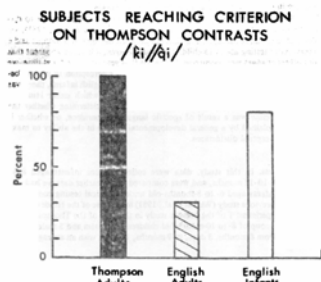
The populations:

- 10 L1 English adults
- 5 L1 Salish adults
- 12 L1 English infants (6-7 months)

Werker and Tees 1984, Exp 1

Results:

X-square
reveals
L1 Salish
=
English
infants



Werker and Tees 1984, Exp 2

Results across 3 age categories:

TABLE 1
Infant Discrimination Performance on Two Non-English Speech Contrasts

Reached Criterion	(1) 6-8 months	(2) 8-10 months	(3) 10-12 months
The Retroflex/Dental Contrast /tɑ/-/tɑ/			
Yes	11	8	2
No	1	4	8
The Velar/Uvular contrast /k'i/-/q'i/			
Yes	8	8	1
No	2	6	9

Werker and Tees 1984, Exp 2

- Why are the 10-12 month olds losing it?

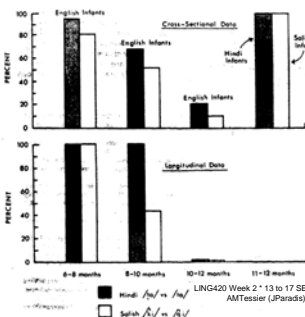
Werker and Tees 1984, Exp 3

A possible confound:
higher drop-out rates
at 10-12 months?

'Older infants prefer to try to 'visit' the toy rather than simply turn their head to see it' (oh dear.)

Werker and Tees 1984, Exp 3

INFANT SUBJECTS REACHING CRITERION ON HINDI AND SALISH CONTRASTS



Hindi/Salish don't lose them

Longitudinal data match cross-sectional

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Werker and Tees 1984 summary

'It is probably no accident that this decline, or tuning, occurs at about the age that the child is beginning to understand and possibly produce sounds appropriate to his/her native language.

It could be expected that this perceptual reorganization is closely related to the acquisition of phonological contrasts.'

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Taking a step back:

what are infants doing in speech perception tasks?

are they hearing speech sounds or raw auditory info?

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Wrt Werker and Tees 1984:

- '... In this earlier research ... the dimensions of phonetic relevance and physical similarity were confounded. That is, with the natural repetitions [of e.g. Hindi stops], the physical variability within category was much less than that between categories. As such, it is possible that the young infants were actually discriminating the stimuli on the basis of physical differences irrespective of phonetic status' (Werker and LaLonde 1988)

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A way to ask this question:

Are young infants equally good at discriminating *non-native* and *unnatural* contrasts?

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The initial evidence:

- young infants are better at non-native vs unnatural VOTs
- ... but that is just one phonetic dimension

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Werker and Lalonde 1988

Using synthetic stimuli, which adults categorize differently according to their L1 (why synthetic?)

Q: *Will infants discriminate non-native phonemes better along natural phonetic lines, or merely by raw acoustic difference?*

Werker and Lalonde 1988

Exp 1: The synthetic PoA scale

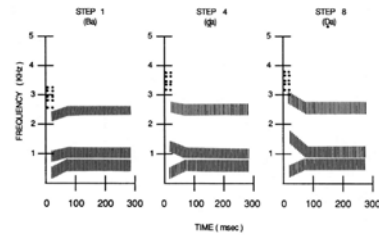
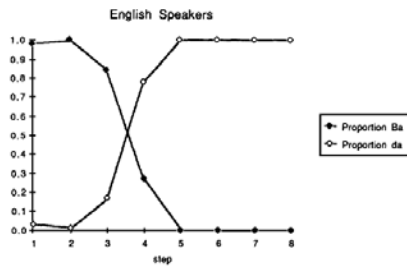


Figure 1. Sample pseudospectrograms of the synthesizer input parameters.

Werker and Lalonde 1988: Exp 1

Exp 1: ABX task results for L1 English



Werker and Lalonde 1988: Exp 1

Exp 1: ABX task results for L1 Hindi

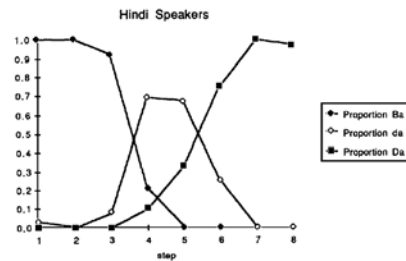


Figure 2. Average group identification functions.

Werker and Lalonde 1988, Exp 2

Discriminating synthetic triplets at three 'boundary' points on the continuum:

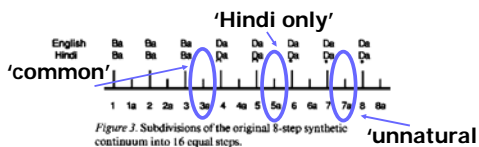


Figure 3. Subdivisions of the original 8-step synthetic continuum into 16 equal steps.

Werker and Lalonde 1988, Exp 2

The populations:

18 L1 English adults 5 adult Hindi speakers
8 L1 English 6-8 mos 8 L1 English 11-13 mos

The method:

Infants: HT, with 'conditioning' on experimental trials (3 consecutive days)

Adults: go/no-go button-pressing task (1 day)

Werker and Lalonde 1988, Exp 2

Results!

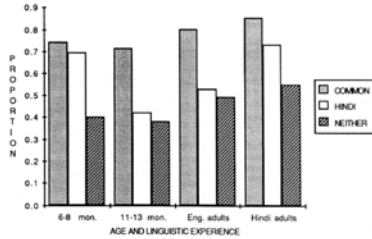


Figure 4. The proportion of correct responses by group for each of the one-step pairings.

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Werker and Lalonde 1988, Exp 3

A replication of Exp 2, but with:

- * less variability *within* 'categories'
- * more distance between exemplars *across* 'categories'

... yielded *identical* results to Exp 2

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Werker and Lalonde 1988 Sum

"This (failure to discriminate at the unnatural boundary) provide further X-lang. verification that infants are sensitive to the universal set of phonetic distinctions [...] This mapping between biologically given sensitivities and phonetic categories allows the young infant to segment the incoming speech stream into discrete perceptual entities and [into] the units that will be required in the important task of beginning to learn a language"

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References:

- Eimas et al 1971. 'Speech perception in infants'. *Science* 171: 303-306.
- Jusczyk 1980. 'Auditory vs. phonetic coding of speech signals during infancy'. CNRS paper.
- Werker et al 1981. 'Developmental aspects of cross-language speech perception'. *Child Development* 52: 349-355.
- Werker and Tees. 1983. 'Developmental changes across childhood in the perception of non-native speech sounds'. *Canadian Journal of Psychology* 57: 278-286.
- Werker and Tees. 1984. 'Cross-language speech perception: evidence for perceptual reorganization during the first year of life'. *Infant Behaviour and Development* 7, 49-63.
- Werker and Lalonde. 1988. 'Cross-language speech perception: initial capabilities and developmental change'. *Developmental Psychology* 24 (5): 672-683.

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