Ling 151/Psych 156A: Acquisition of Language II

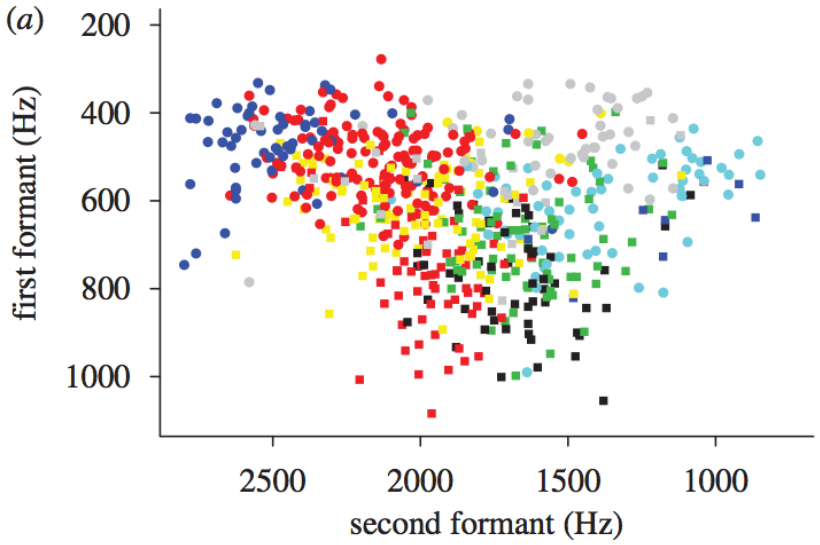
Lecture 5

Sounds II

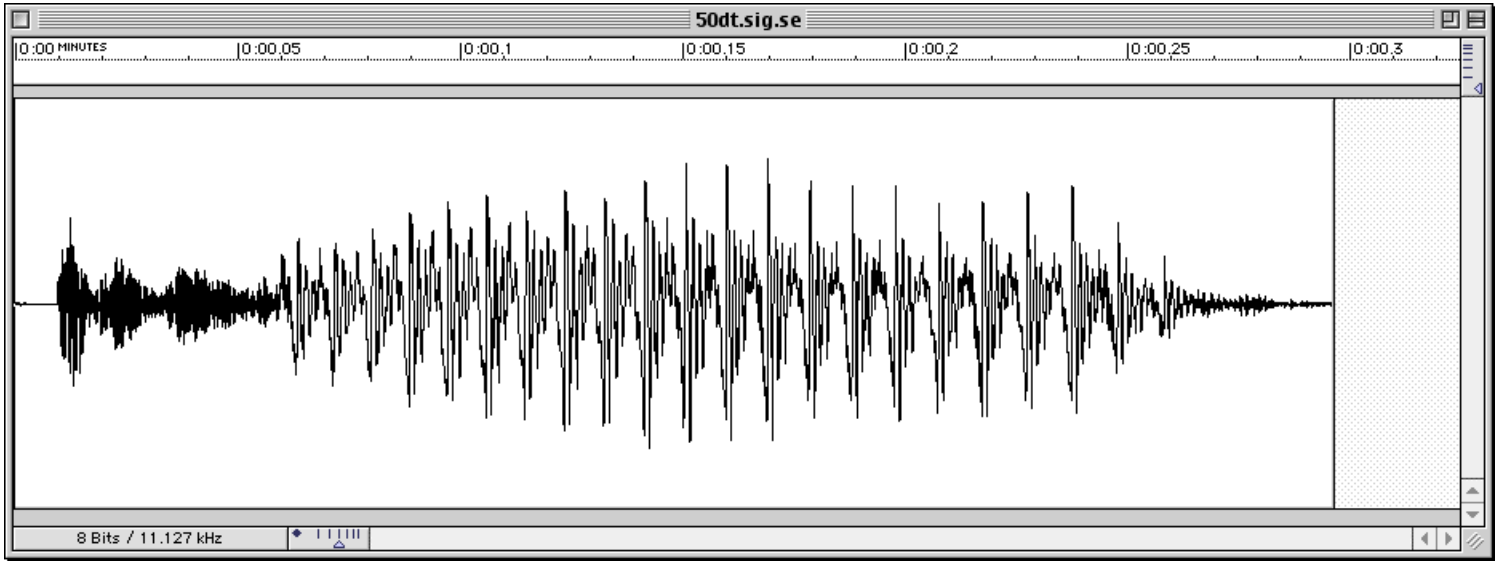
Announcements

Be working on HW2 (due 1/26/18)

Be working on review questions for sounds and sounds of words



Learning sounds



Perceiving sound contrasts

Kids…

This ability to distinguish sound contrasts extends to phonemic contrasts that are non-native. (Japanese infants can discriminate contrasts used in English but that are not used in Japanese, like r/l.) This goes for both vowels and consonants.

…vs. adults

Adults generally can't, especially without training - even if the difference is quite acoustically strong.

So when is this ability lost?

And what changes from childhood to adulthood?

Infants are really good at making sound categories

Perszyk & Waxman 2016

"…merely exposing 6-month-old infants to nonhuman primate vocalizations permits them to preserve, rather than sever, their early link between these signals and categorization."

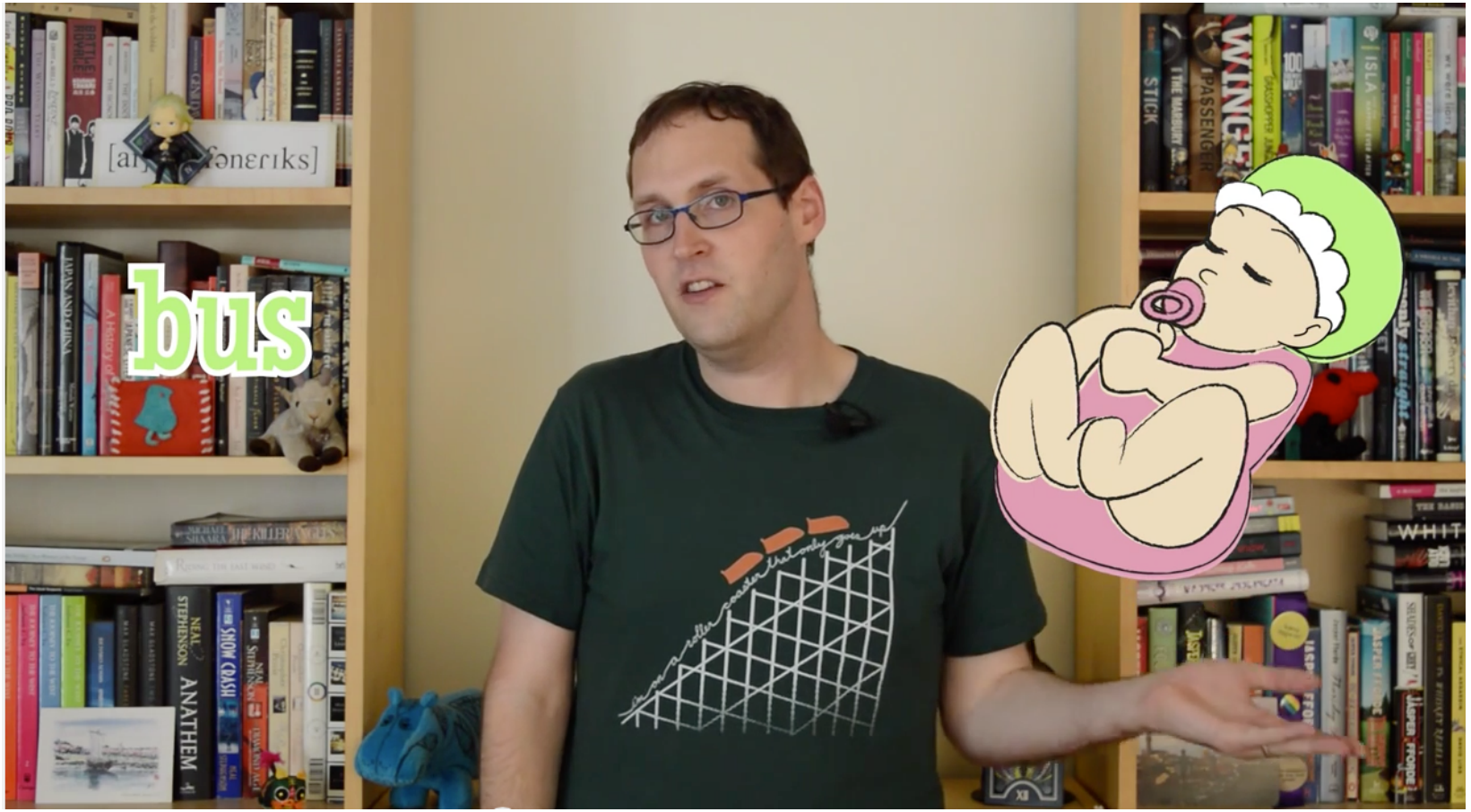
https://www.sciencedaily.com/releases/2016/05/160523141552.htm

Studying infant speech perception

http://www.thelingspace.com/episode-16

https://www.youtube.com/watch?v=3-A9TnuSVa8

beginning through 3:34: High Amplitude Sucking Procedure (HAS)



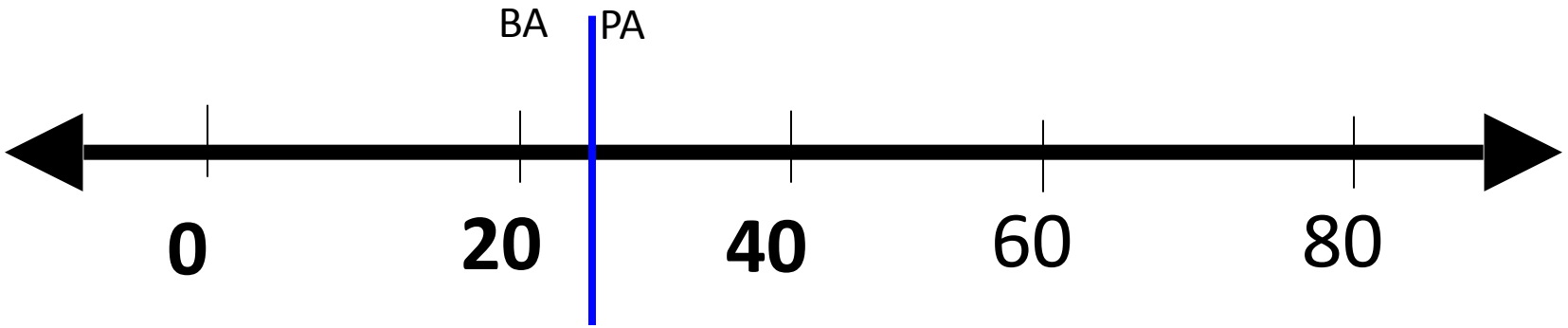
A useful indirect measurement

High Amplitude Sucking (HAS) Procedure

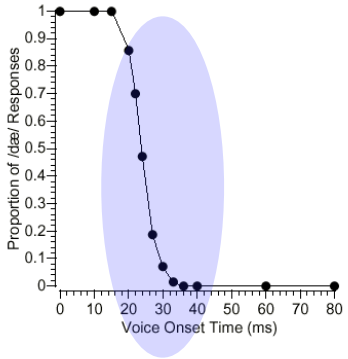
- Infant given a pacifier that measures sucking rate
- Habituation – Infant sucks to hear sound (e.g. ba) until bored.
- Test – Play sound (e.g., ba or pa). Is there *dishabituation*?
  - Infants will suck to hear sound if the sound is no longer boring.

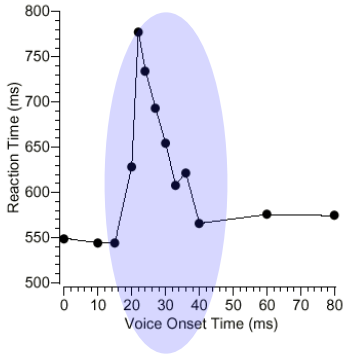
Testing categorical perception in infants: Eimas et al. (1971)

- BA vs. PA
- Vary Voice Onset Time (VOT): time between consonant release and vocal cord vibration



VOT in milliseconds





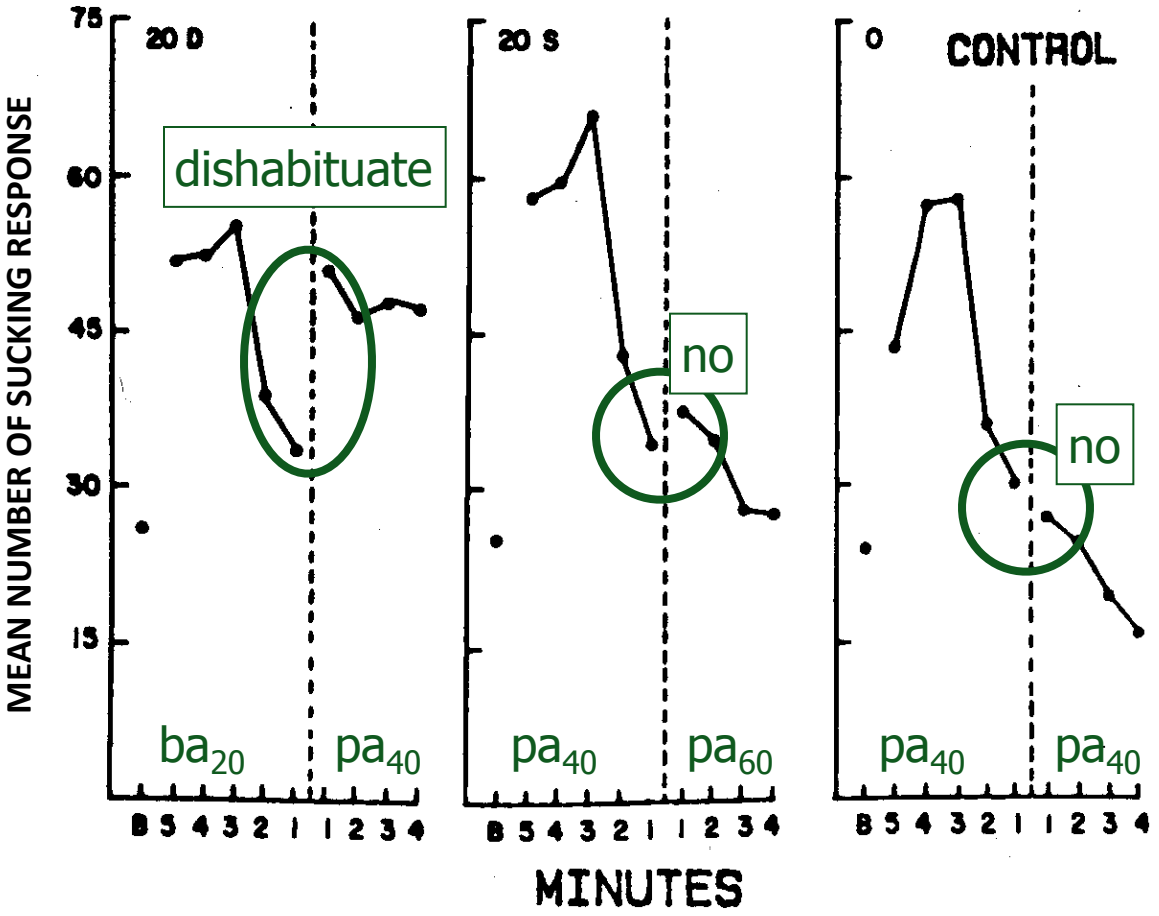


Figure 4.7
Mean number of sucking responses for 4-month-old infants as a function of time and experimental condition. The dashed line indicates the occurrence of the stimulus shift, or, in the case of the control group, the time at which the shift would have occurred. Adapted from P. D. Eimas, E. R. Siqueland, P. W. Jusczyk, and J. Vigorito (1971). Speech perception in infants. *Science* 171, 303–306. © 1971 by the AAAS.

Studying infant speech perception

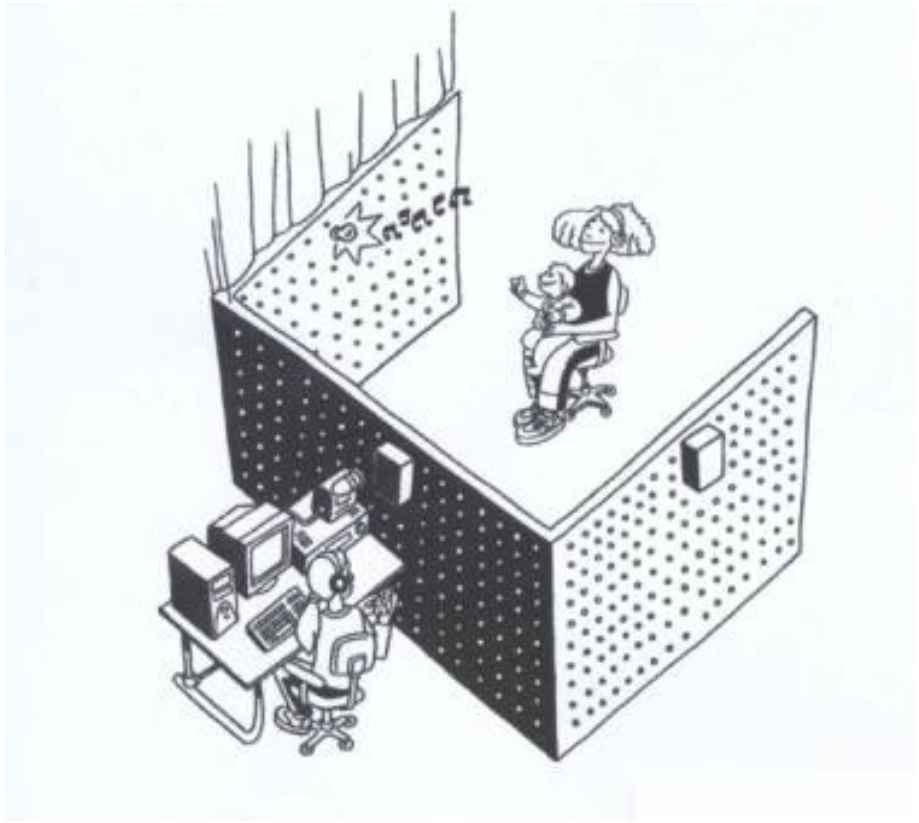
http://www.thelingspace.com/episode-16

https://www.youtube.com/watch?v=3-A9TnuSVa8

3:34 - 5:48: Head-Turn Preference Procedure

A useful indirect measurement

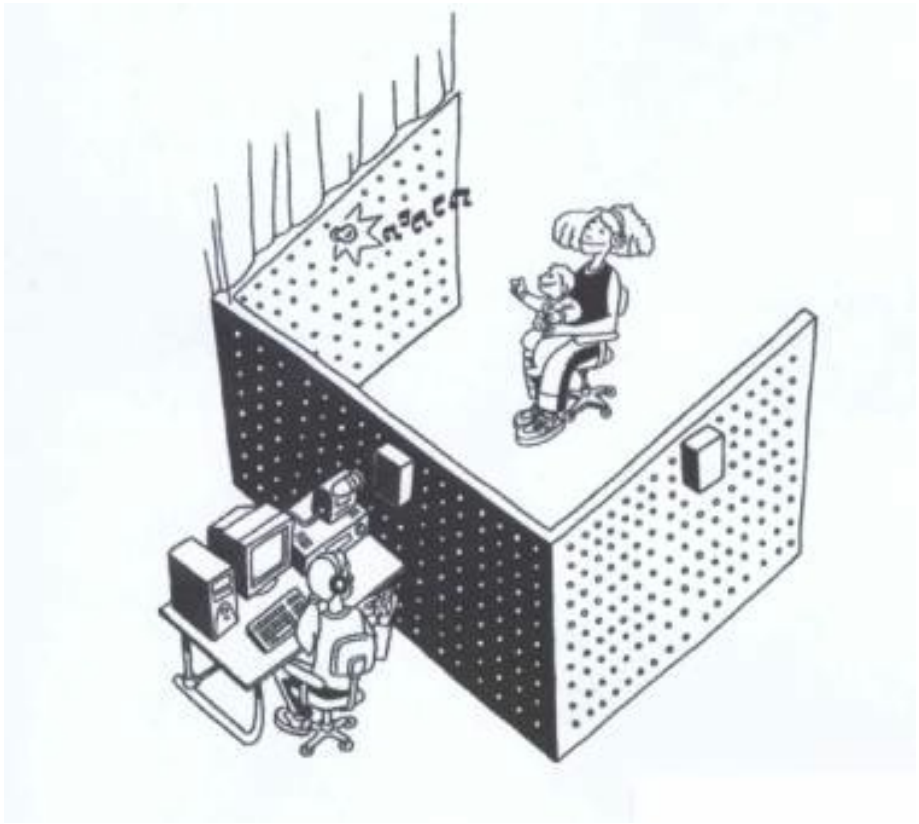
Head-Turn Preference Procedure



Infant sits on caretaker's lap. The wall in front of the infant has a green light mounted in the center of it. The walls on the sides of the infant have red lights mounted in the center of them, and there are speakers hidden behind the red lights.

A useful indirect measurement

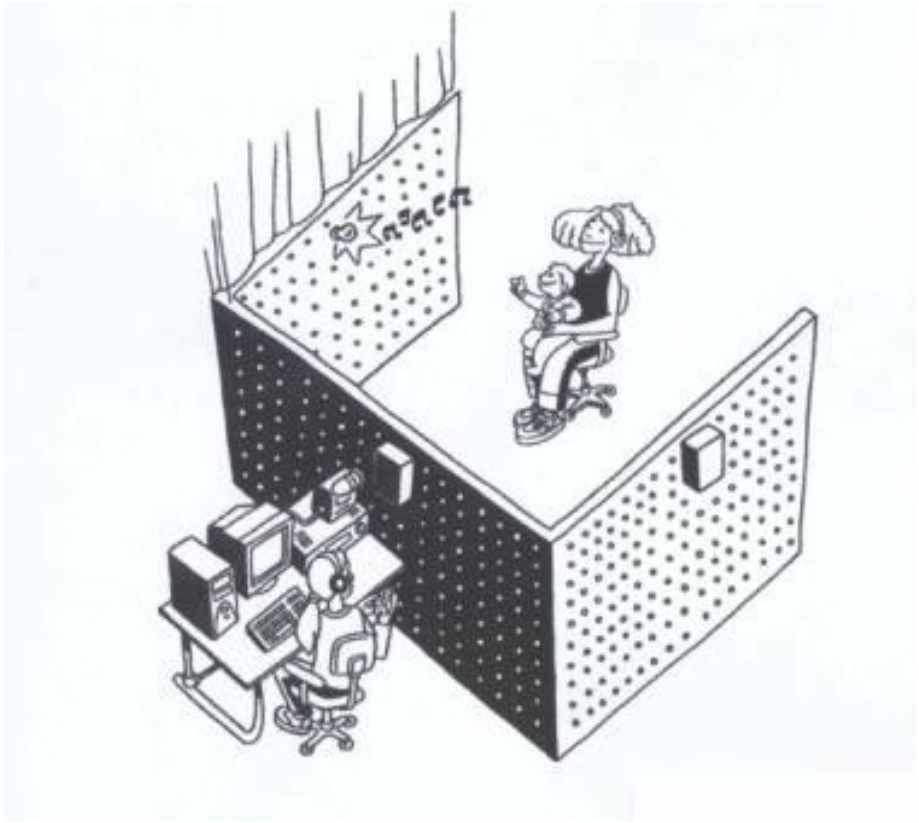
Head-Turn Preference Procedure



Sounds are played from the two speakers mounted at eye-level to the left and right of the infant. The sounds start when the infant looks towards the blinking side light, and end when the infant looks away for more than two seconds.

A useful indirect measurement

Head-Turn Preference Procedure



Thus, the infant essentially controls how long he or she hears the sounds. Differential preference for one type of sound over the other is used as evidence that infants can detect a difference between the types of sounds.

Head-Turn Preference Procedure

"How Babies Learn Language"
(first part, up to 2:04)

http://www.youtube.com/watch?v=mZAuZ--Yeqo

A useful indirect measurement

Head-Turn Technique

Babies tend to be interested in moving toys. Using the presentation of a moving toy as a reward, babies are trained to turn their heads when they hear a change in the sound being presented.

A useful indirect measurement

Head-Turn Technique

A sound is played over and over, and then the sound is changed followed immediately by the presentation of the moving toy. After several trials, babies turn their heads when the sounds change even before the moving toy is activated.

A useful indirect measurement

Head-Turn Technique

https://www.youtube.com/watch?v=EFlxiflDk_o

5:30-8:20

Note on infant attention:

Familiarity vs. novelty effects

For procedures that involve measuring where children prefer to look (such as head turn preference), sometimes children seem to have a "familiarity preference" where they prefer to look at something similar to what they habituated to. Other times, children seem to have a "novelty preference" where they prefer to look at something different to what they habituated to.

This may have to do with the Goldilocks effect (Kidd et al. 2010, 2012), effect where children prefer to look at stimuli that are neither too boring nor too surprising, but are instead "just right" for learning, given the child's current knowledge state.

Speech perception of non-native sounds

Werker et al. 1981: English-learning 6-8 month olds compared against English & Hindi adults on Hindi contrasts

Figure 4.2
Proportion of subjects reaching criterion as a function of age and language contrast. Adapted from Werker et al. 1981.

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Werker et al. 1981: English-learning 6-8 month olds compared against English & Hindi adults on Hindi contrasts

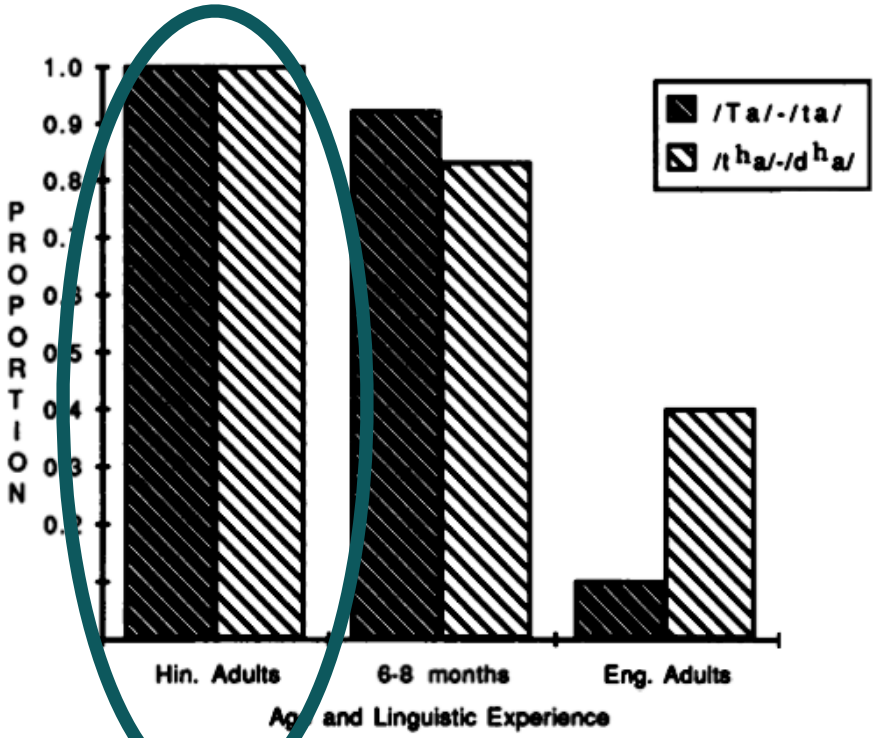


Figure 4.2
Proportion of subjects reaching criterion as a function of age and language contrast. Adapted from Werker et al. 1981.

Hindi adults can easily distinguish sounds that are used contrastively in their language

Speech perception of non-native sounds

Werker et al. 1981: English-learning 6-8 month olds compared against English & Hindi adults on Hindi contrasts

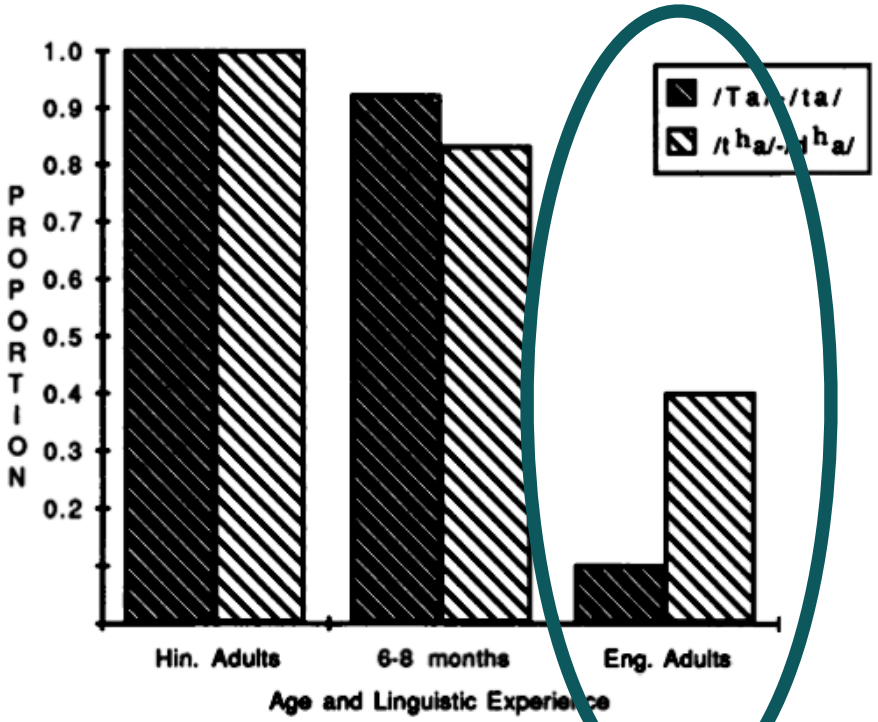


Figure 4.2
Proportion of subjects reaching criterion as a function of age and language contrast. Adapted from Werker et al. 1981.

English adults are terrible (below chance), though there is some variation depending on which sounds are being compared

Speech perception of non-native sounds

Werker et al. 1981: English-learning 6-8 month olds compared against English & Hindi adults on Hindi contrasts

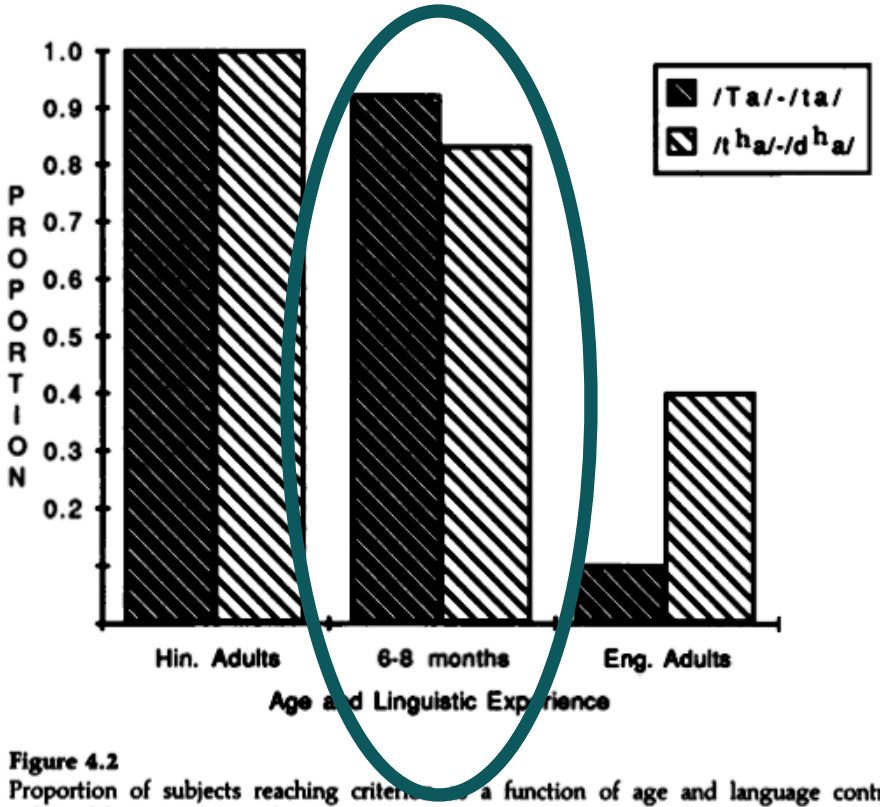


Figure 4.2
Proportion of subjects reaching criterion as a function of age and language contrast. Adapted from Werker et al. 1981.

English infants between the ages of 6-8 months aren't quite as good as Hindi adults - but they're certainly much better than English adults! They haven't yet learned to ignore these non-native contrasts.

Sound-learning movie

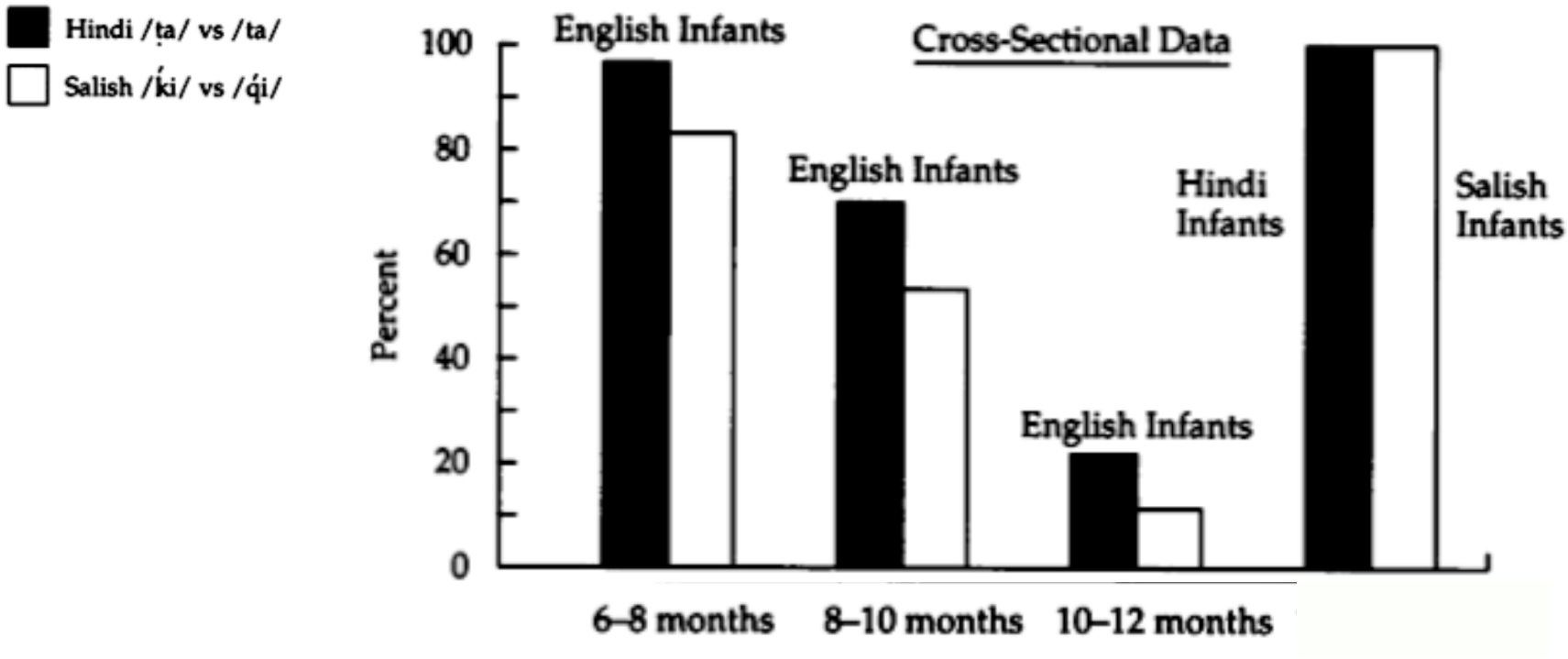
Infant speech discrimination (~6.5min)

http://www.youtube.com/watch?v=GSIwu_Mhl4A

When change happens

But when after 6-8 months is the ability to lost? Werker & Tees (1984)

Testing ability to distinguish Salish & Hindi contrasts



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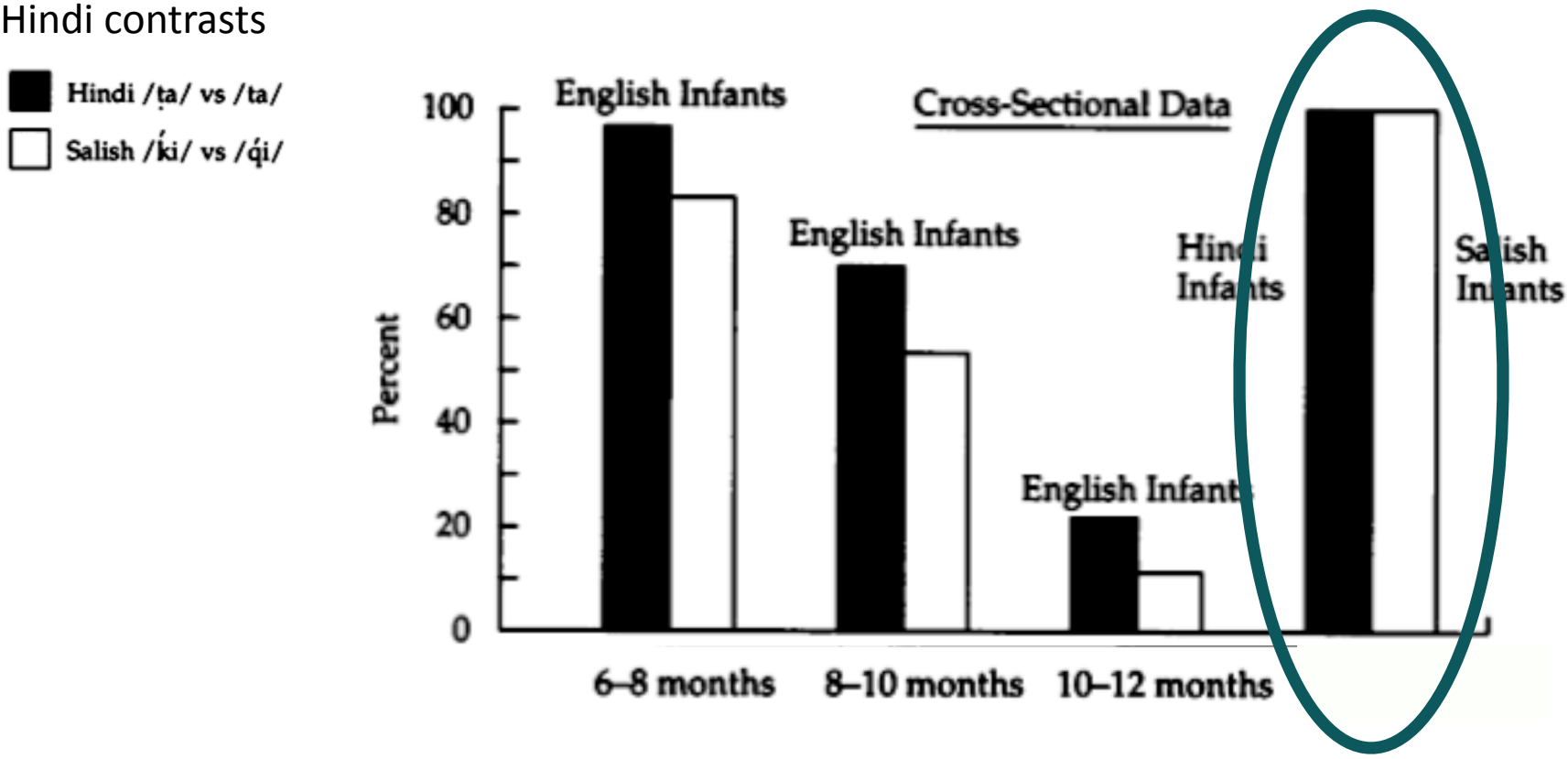

Control (make sure experiment is doable by infants): Hindi and Salish infants do perfectly

When change happens

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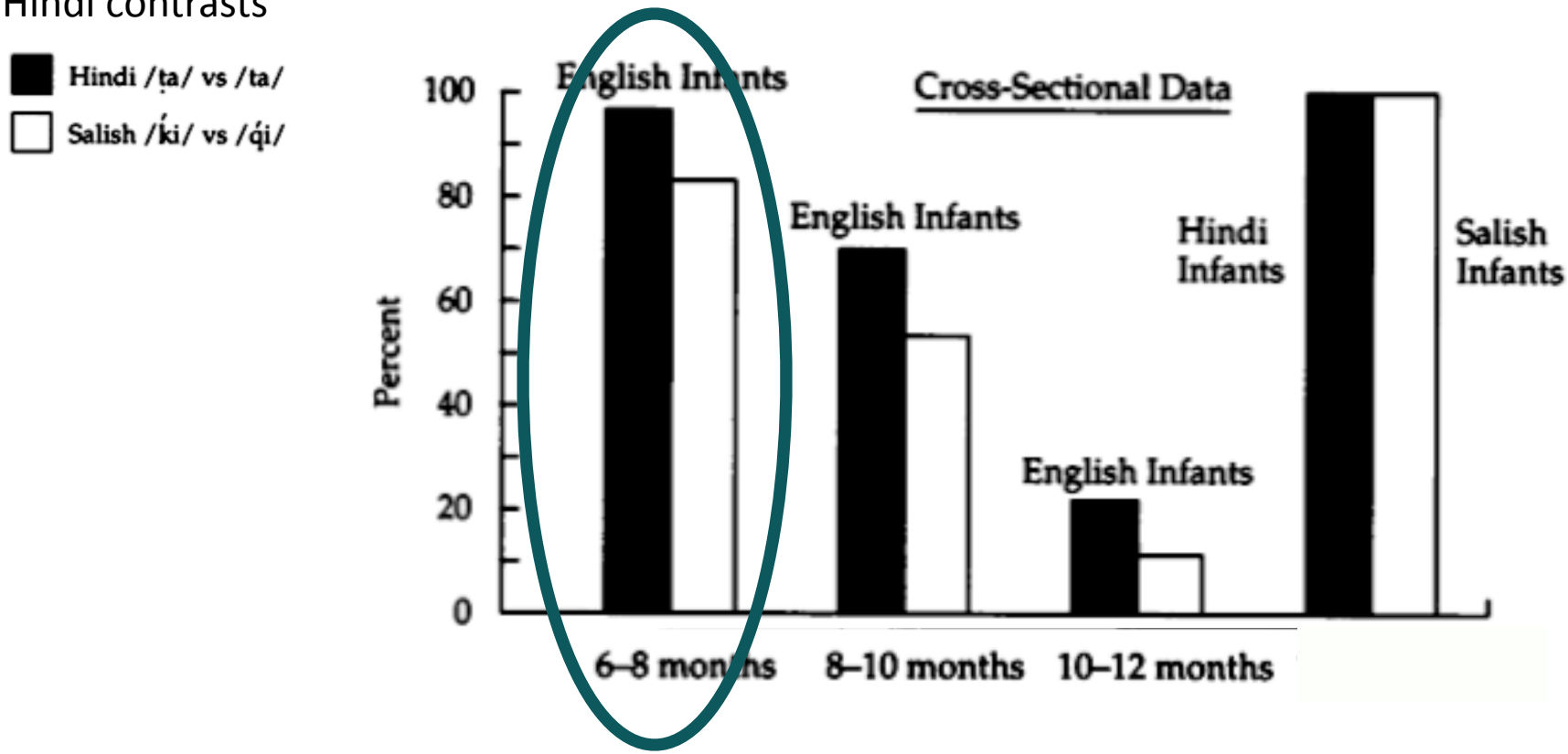

English 6 to 8-month-olds do well

When change happens

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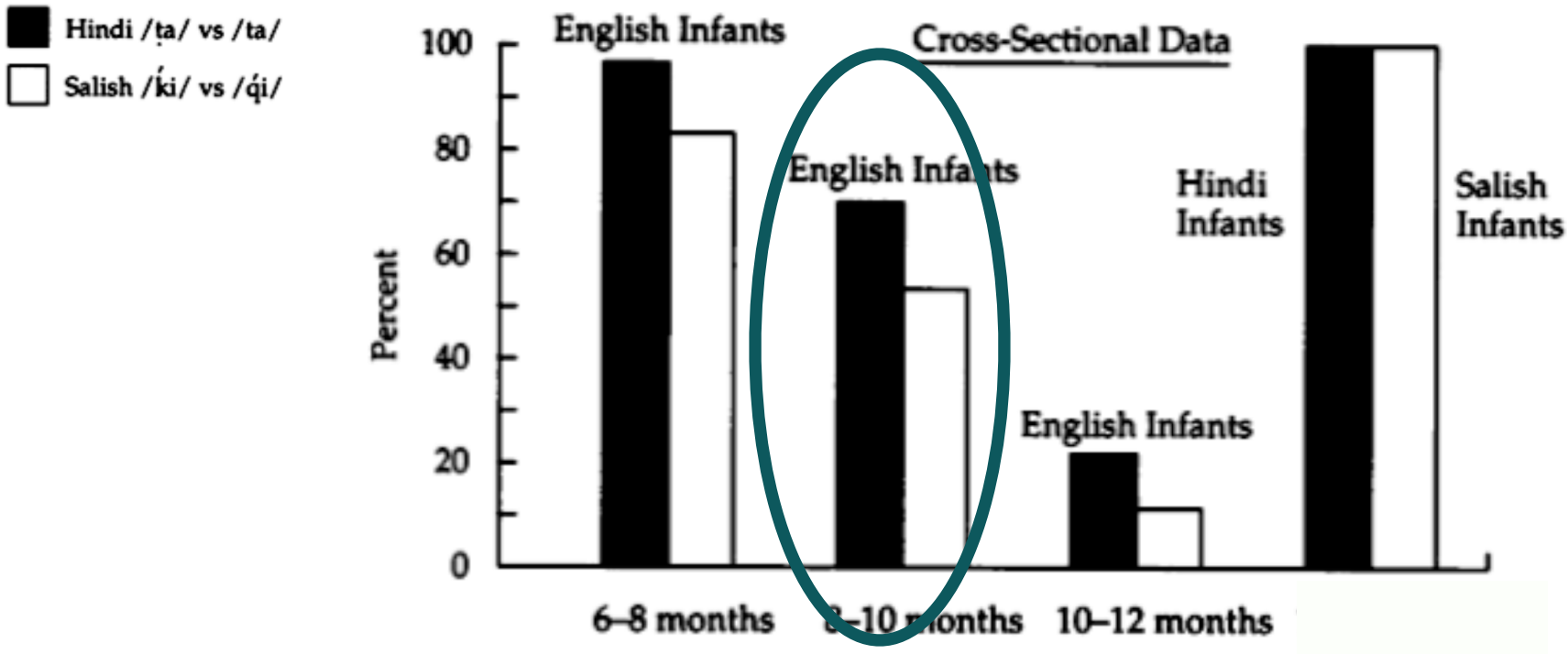
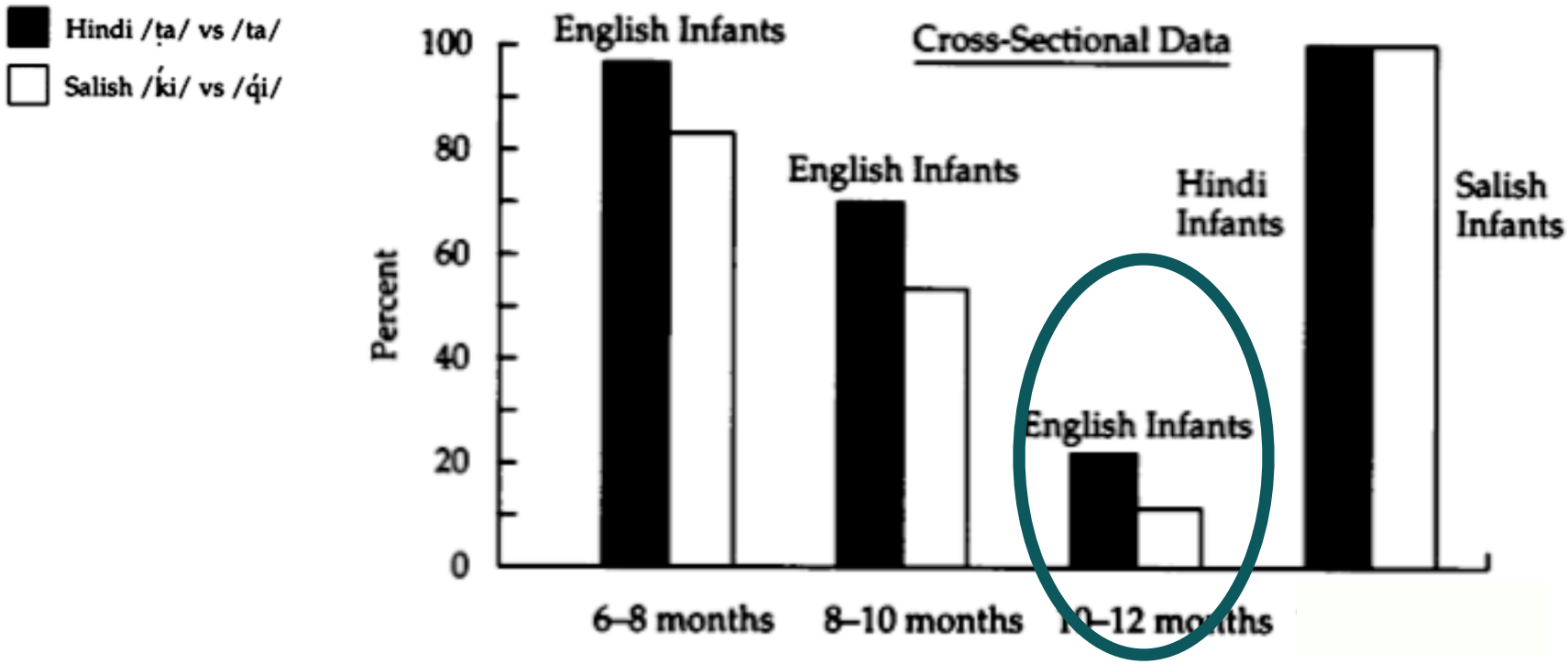


English 8 to 10-month-olds do less well

When change happens

But when after 6-8 months is the ability to lost? Werker & Tees (1984)

Testing ability to distinguish Salish & Hindi contrasts

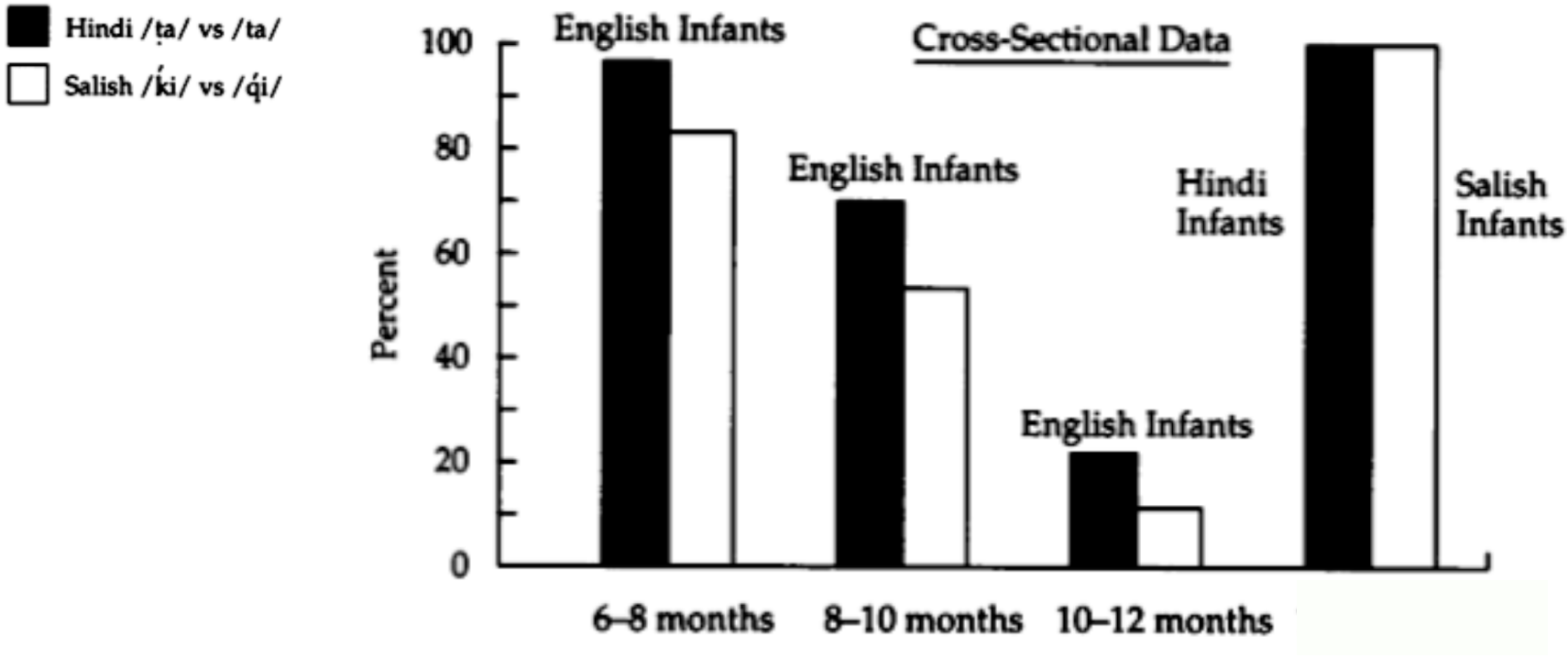


English 10 to 12-month-olds do very poorly

When change happens

But when after 6-8 months is the ability to lost? Werker & Tees (1984)

Testing ability to distinguish Salish & Hindi contrasts



Implication: The ability to distinguish non-native contrasts is lost by 10-12 months. Change seems to be happening between 8-10 months.

When change happens

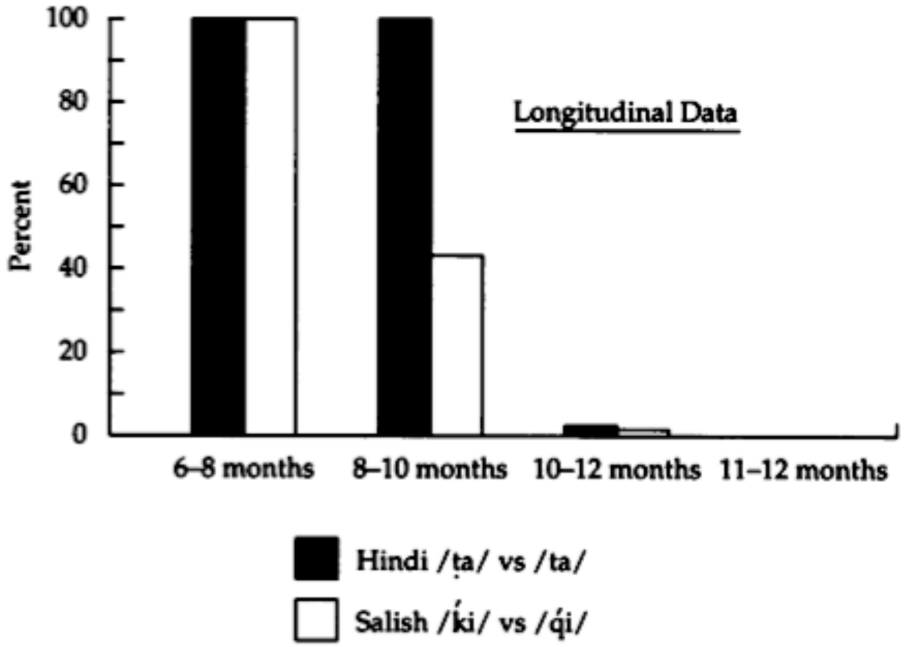
But when after 6-8 months is the ability to lost?

Werker & Tees (1984)

Testing ability to distinguish Salish & Hindi contrasts

Doing a longitudinal study with English infants (where the same infants are tested over time), change seems to happen somewhere around 10-12 months, depending on the sound contrast.

Yoshida et al. (2010) suggest that infants have some malleability still at 10 months, but it's much less than at 6 or 8 months.



Distinctive sounds for all six-month-olds

http://sites.sinauer.com/languageinmind/wa04.08.html

Hindi, Nama

Young babies from English-speaking households
contrastive pairs in the next audio clip (4). If yo
different from the others. The sounds represent

Voiceless unaspirated dental stop

Voiceless unaspirated retroflex stop

Voiceless aspirated dental stop

Voiceless aspirated retroflex stop

Audio 4

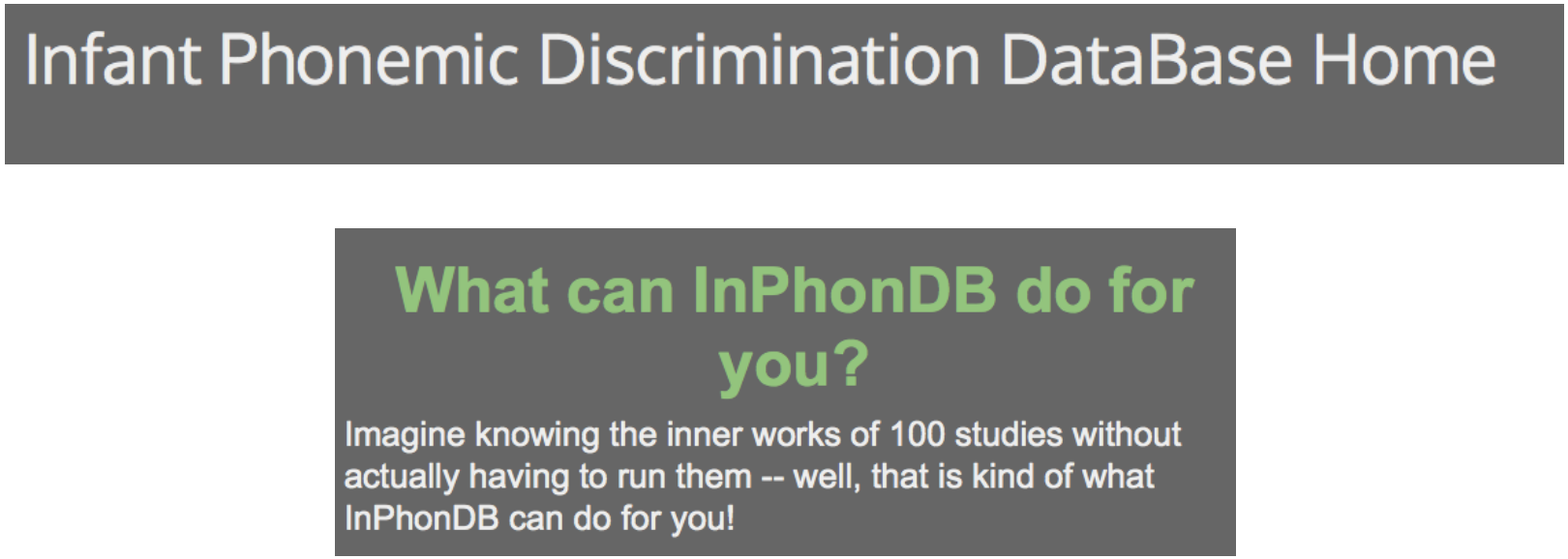
English does not use "click" consonants; nevertheless, 6-month-old infants
two variants illustrated in the next audio clip (5) by a speaker of Nama. Th
contains an alveolar lateral click.

Audio 5

When change happens

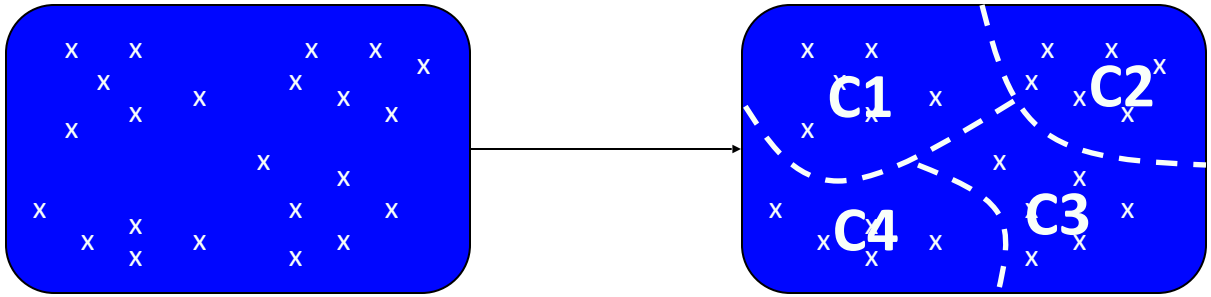
For more examples of which sounds infants learn when and how to run studies that test this, check out the Infant Phonemic Discrimination DataBase.

https://sites.google.com/site/inphondb/



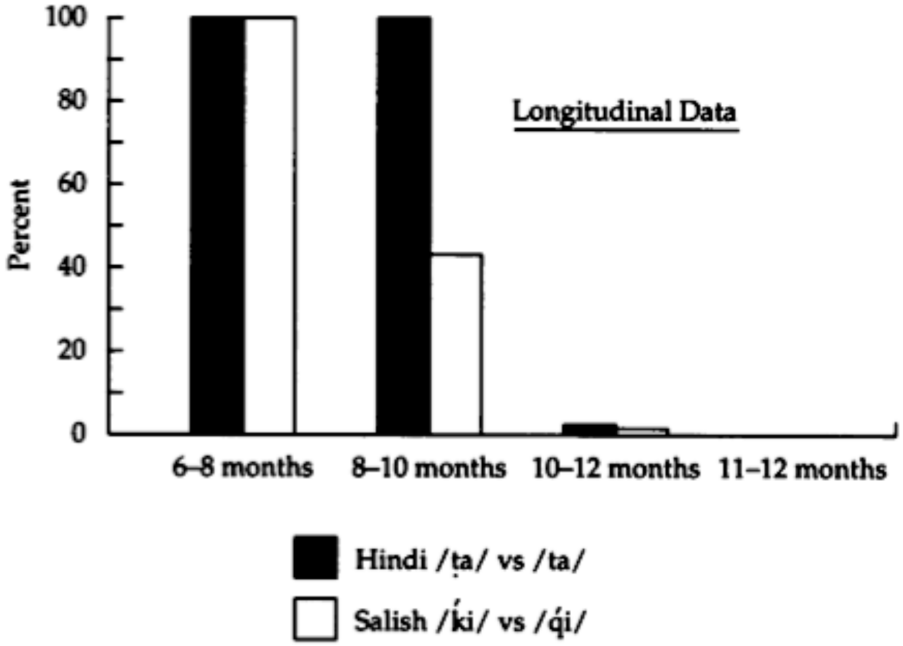
What happens

Divide sounds into contrastive categories (phonemes)



When it happens

Around 10 months



Werker & Tees (1984), testing English infants

Maintenance & Loss theory

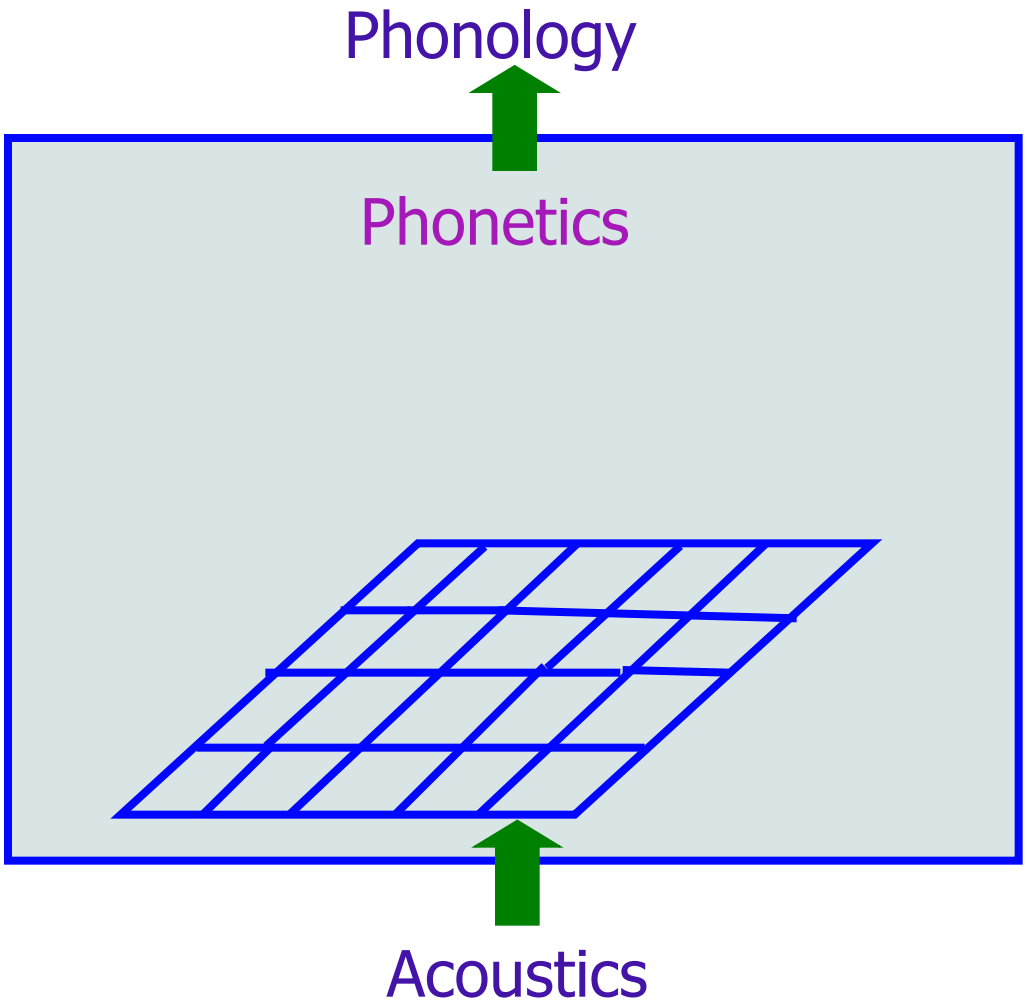
"Use it or lose it"

Infants maintain contrasts being used in their language and lose all the others.

Structure-changing

Patricia Kuhl

"Perceptual Magnet"



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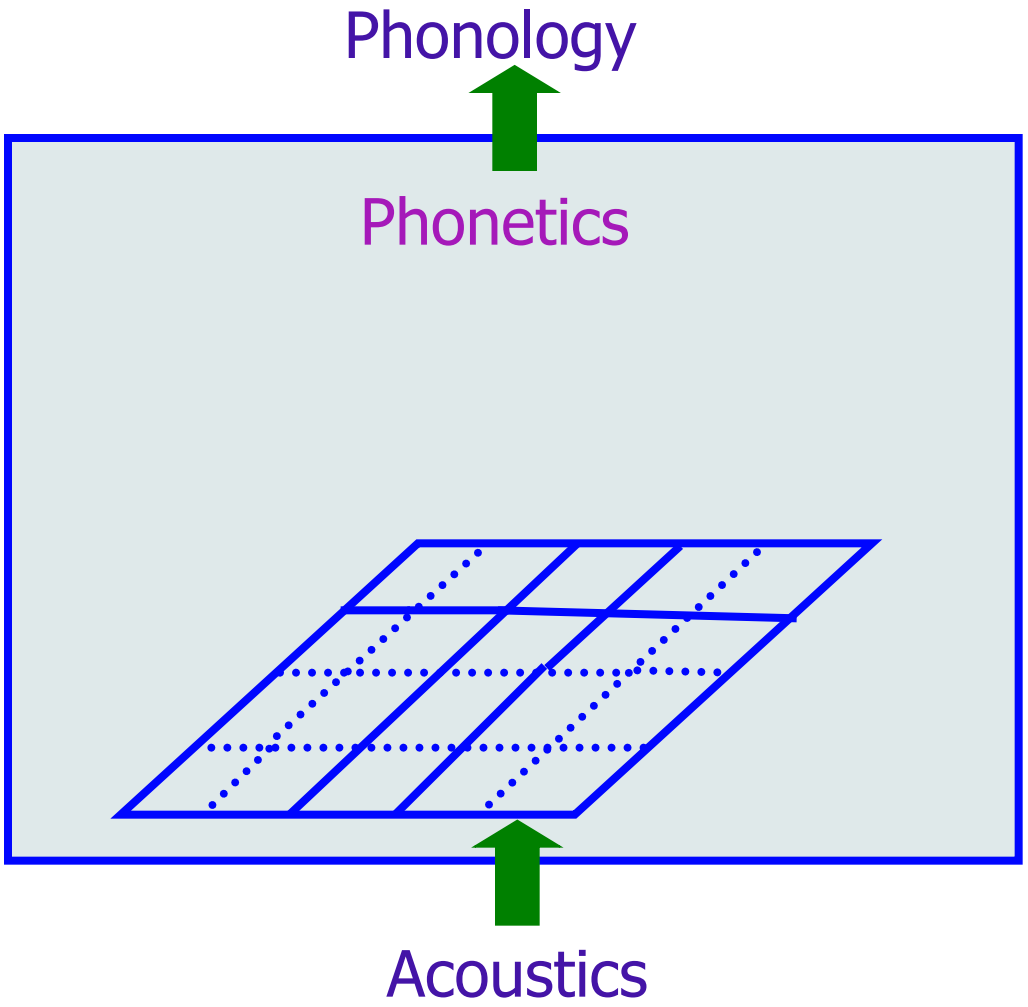
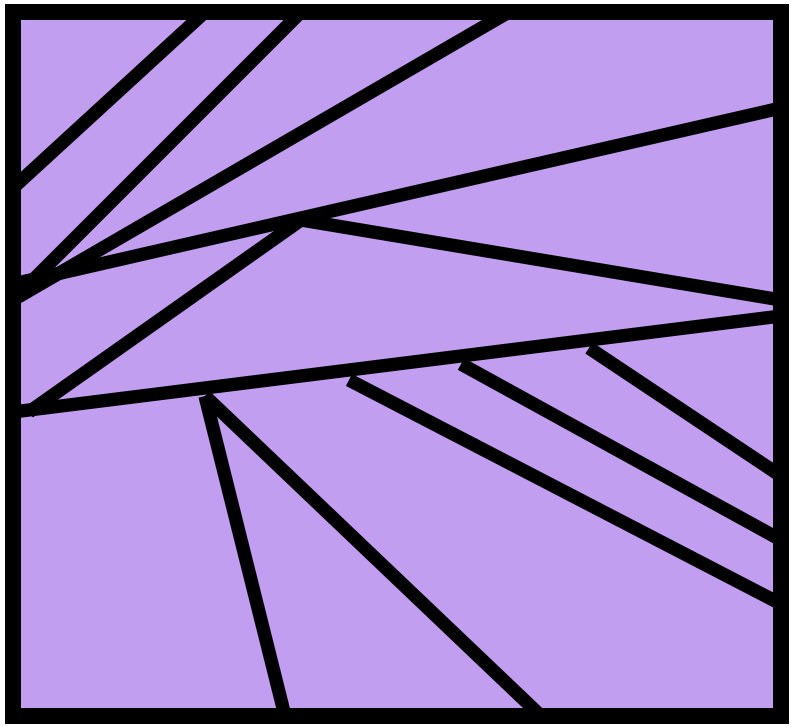


Maintenance & Loss theory

"Use it or lose it"

Infants maintain contrasts being used in their language and lose all the others.

Natural boundaries
(acoustically salient)



Patricia Kuhl

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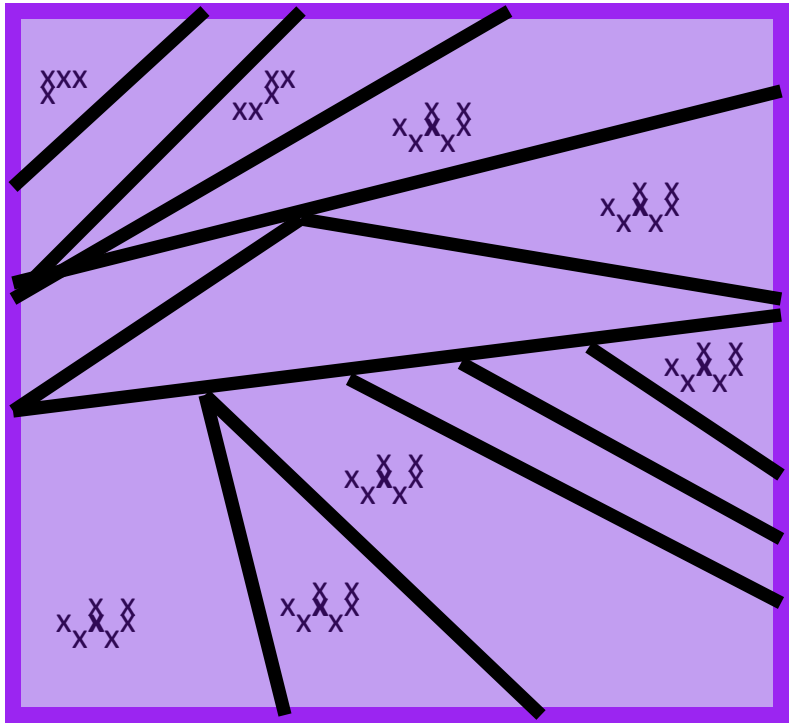
Sounds from Language 1



Patricia Kuhl

"Perceptual Magnet"

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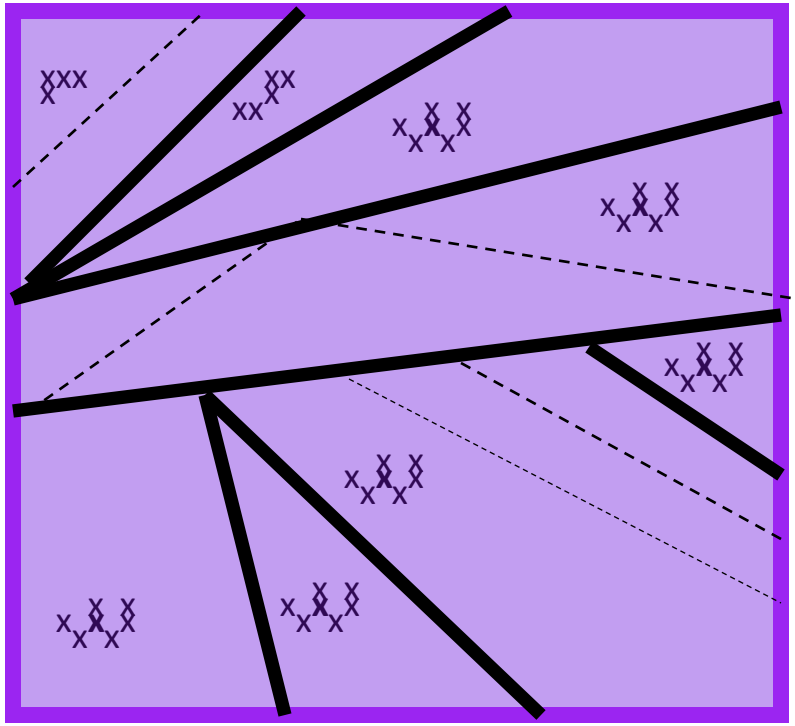
Infants maintain contrasts being used in their language and lose all the others.

Category boundaries that are maintained to keep these sound clusters distinct



Patricia Kuhl

"Perceptual Magnet"

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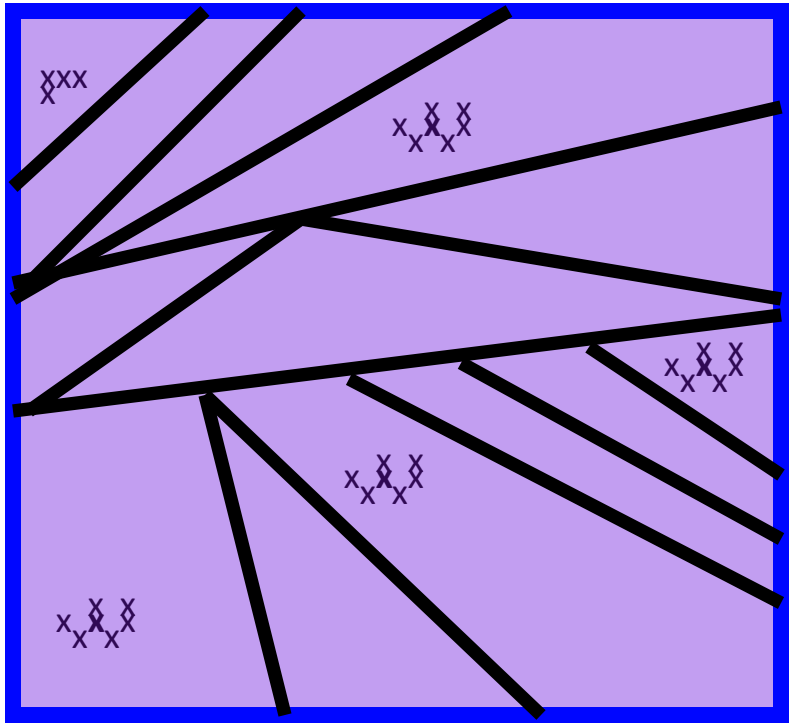
Sounds from Language 2



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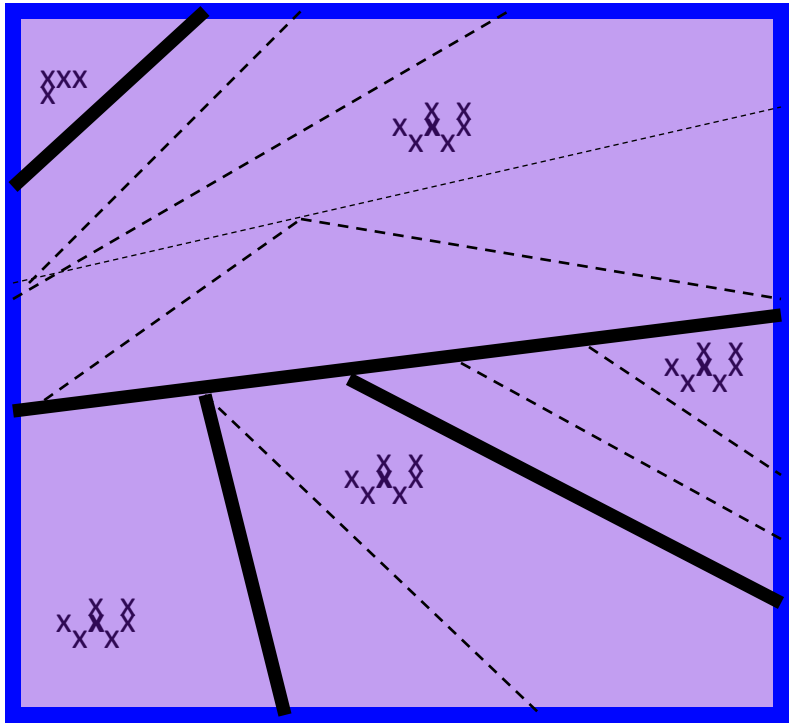

Patricia Kuhl

"Perceptual Magnet"

Maintenance & Loss theory

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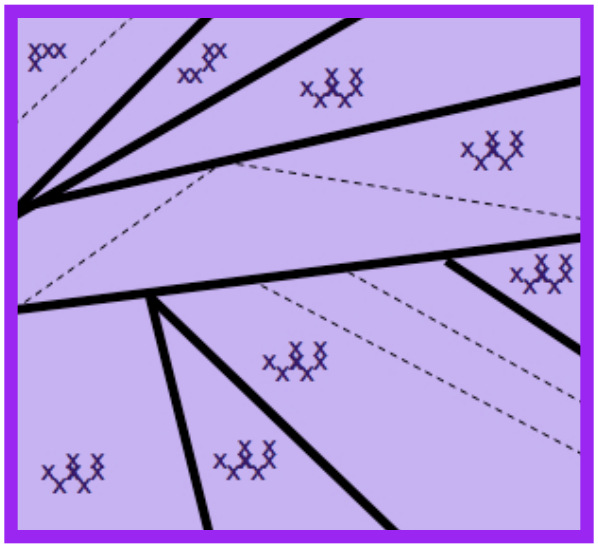
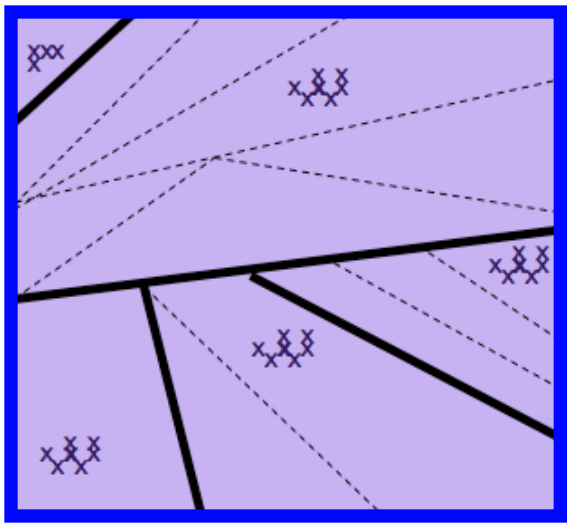
Infants maintain contrasts being used in their language and lose all the others.

Cross-linguistic variation in which contrasts are maintained, depending on language input

Patricia Kuhl





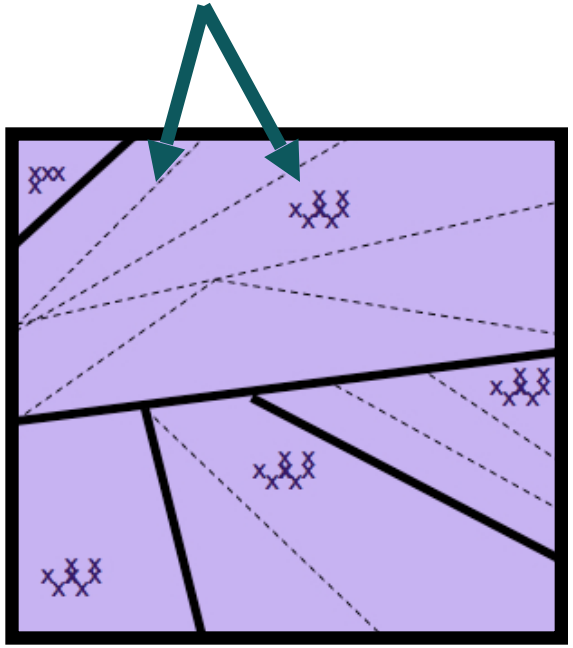
"Perceptual Magnet"

Maintenance & Loss theory: Predictions

Prediction for performance on non-native contrasts over time:

Loss of discrimination ability is permanent and absolute

Should never be able to hear
this distinction again



Problems with the Maintenance & Loss theory

If it doesn't sound like speech, adults can tell the difference. Werker & Tees (1984) showed this with truncated portions of syllables of non-native contrasts. They told subjects the sounds were water dropping into a bucket, and to tell them when the bucket changed. Adults who could not perceive the difference when they heard the entire syllable could perceive the difference when they processed the consonant sounds separately as a non-linguistic sound - like water dropping into a bucket.

Non-linguistic perception

Problems with the Maintenance & Loss theory

Pisoni et al. (1982), Werker & Logan (1985): adults can be trained if given enough trials or tested in sensitive procedures with low memory demands.

Maintenance & Loss would predict that this ability should be irrevocably lost - and it shouldn't matter how much training adults receive, or how the task is manipulated to help them.

Problems with the Maintenance & Loss theory

Massaro & Chen (1983): Adults were asked to decide where on a continuum a sound belongs (ex: VOT continuum, with sounds ranging from /bæ/ to /pæ/).

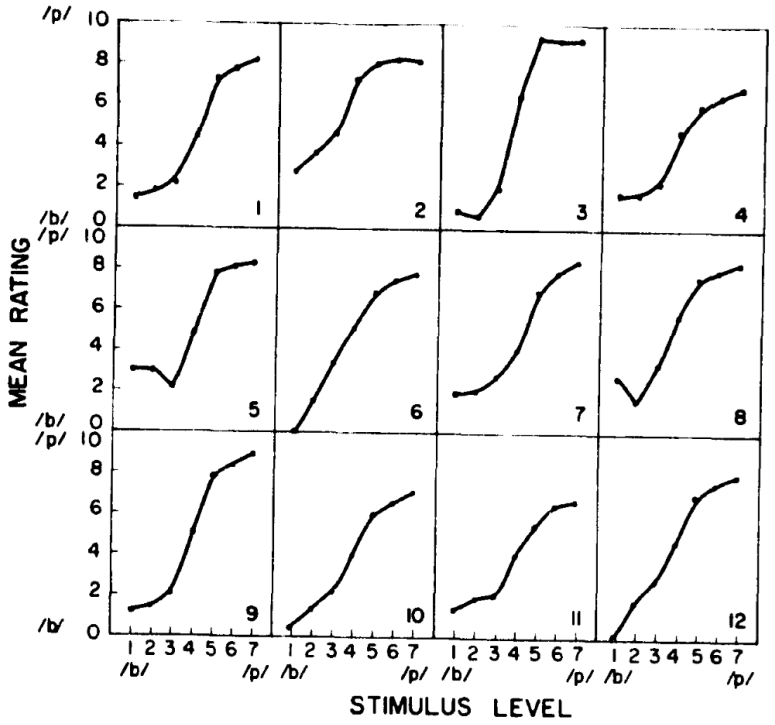


Fig. 5. Mean /bæ/–/pæ/ ratings for each of the 12 individual subjects from the voicing condition.

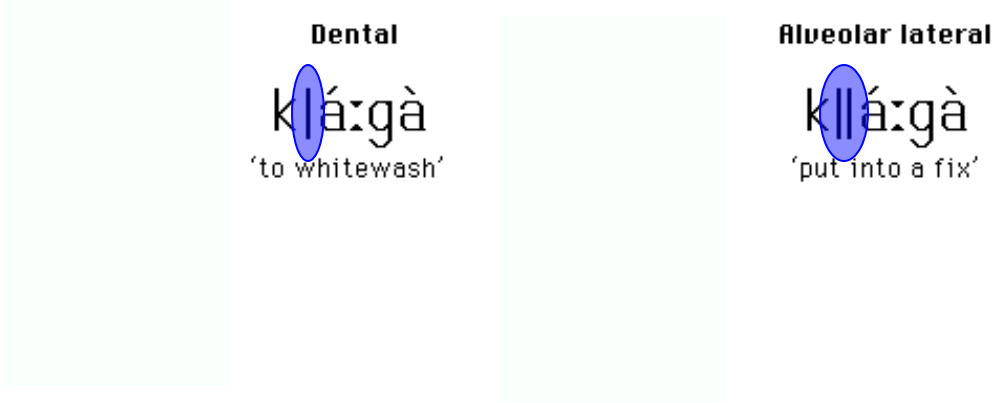
Most subjects were able to detect some of the variation, even within categories.

Key: Linear pattern, rather than S-curve.

Interpretation: Adults can recover some acoustic detail for language sounds — they haven't lost it forever, the way Maintenance & Loss would predict.

Problems with the Maintenance & Loss theory

Some non-native contrasts are easy for older infants and adults to discriminate, even though these sounds are never heard in their own languages. (Click languages (Zulu) - click sounds like “tsk tsk” nonspeech)



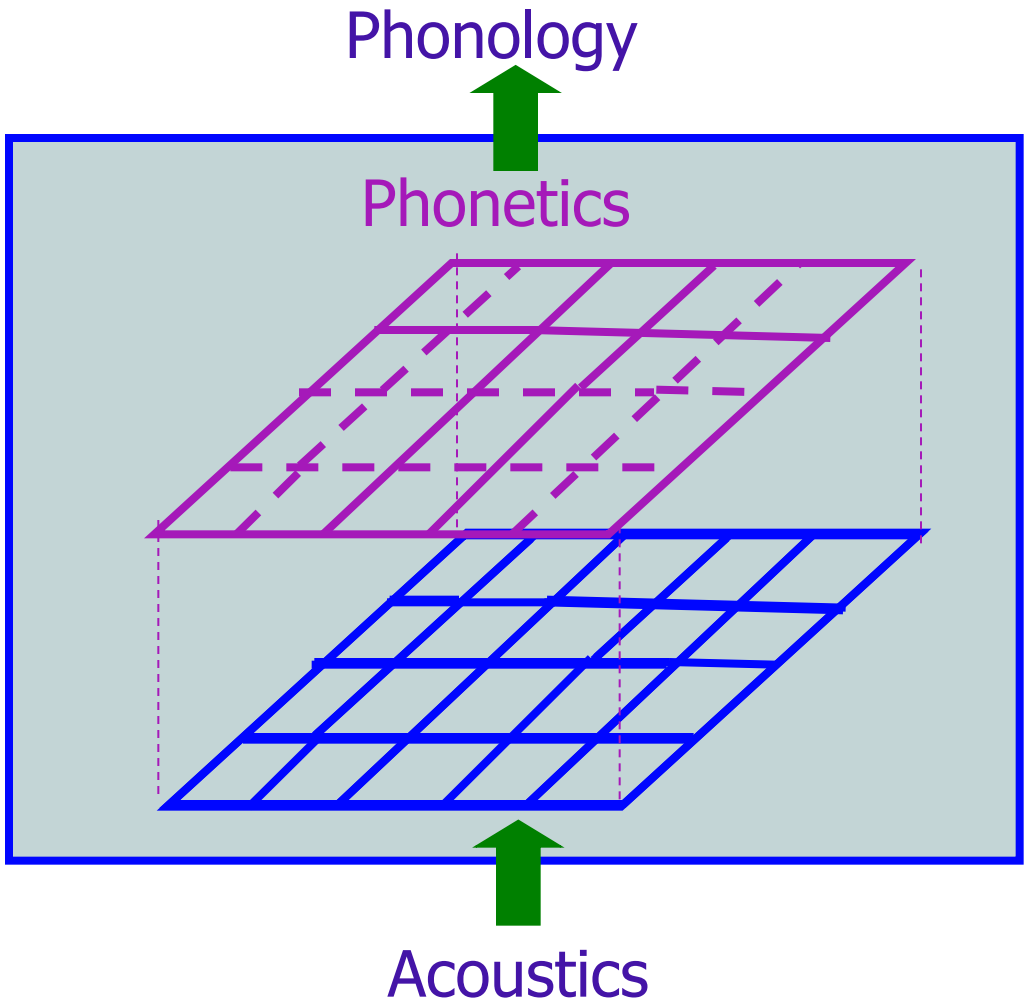
http://hctv.humnet.ucla.edu/departments/linguistics/VowelsandConsonants/course/chapter6/zulu/zulu.html

Functional reorganization

Janet Werker

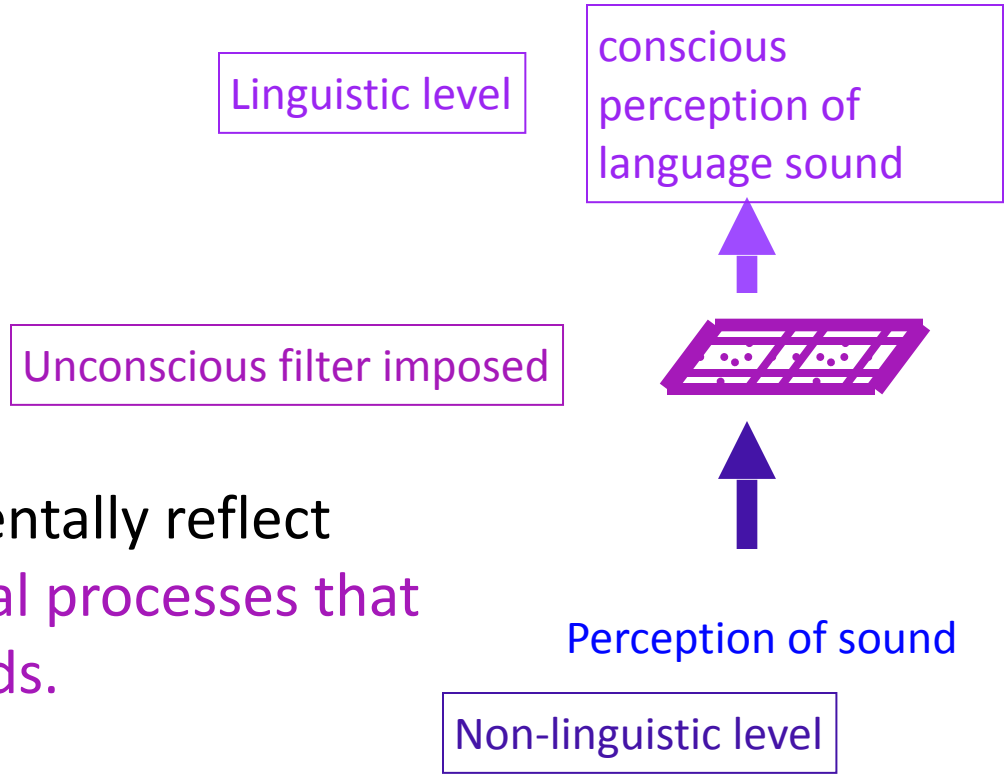
Structure-building

Native language phonemes
built from universal sound distinctions



Functional reorganization

Janet Werker



Changes attested experimentally reflect operation of postperceptual processes that activate for language sounds.

Data distributions determine what the category boundaries are in the filter. Importantly, constructing this filter does not affect base-level sound perception.

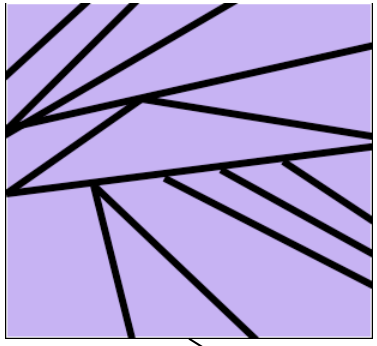
Functional reorganization: The developmental story

Very young infants respond to any detectable variation - so they can pick up any salient contrasts in surrounding language.

Adults have a bias for phonemic contrasts since those are the ones relevant to language.

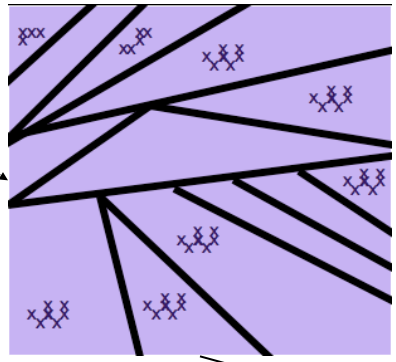
If sounds are in a non-language setting, adults can distinguish non-native contrastive sounds because their postperceptual language filter isn't activated.

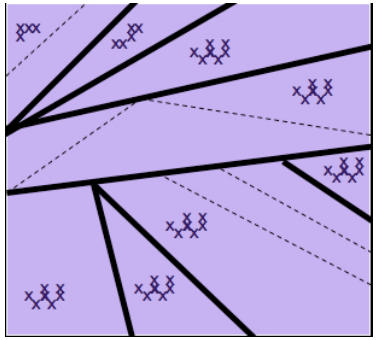
How change happens: Comparison



Idea 1: Maintenance & Loss

Data distributions determine which boundaries are maintained and which ones are lost/ignored





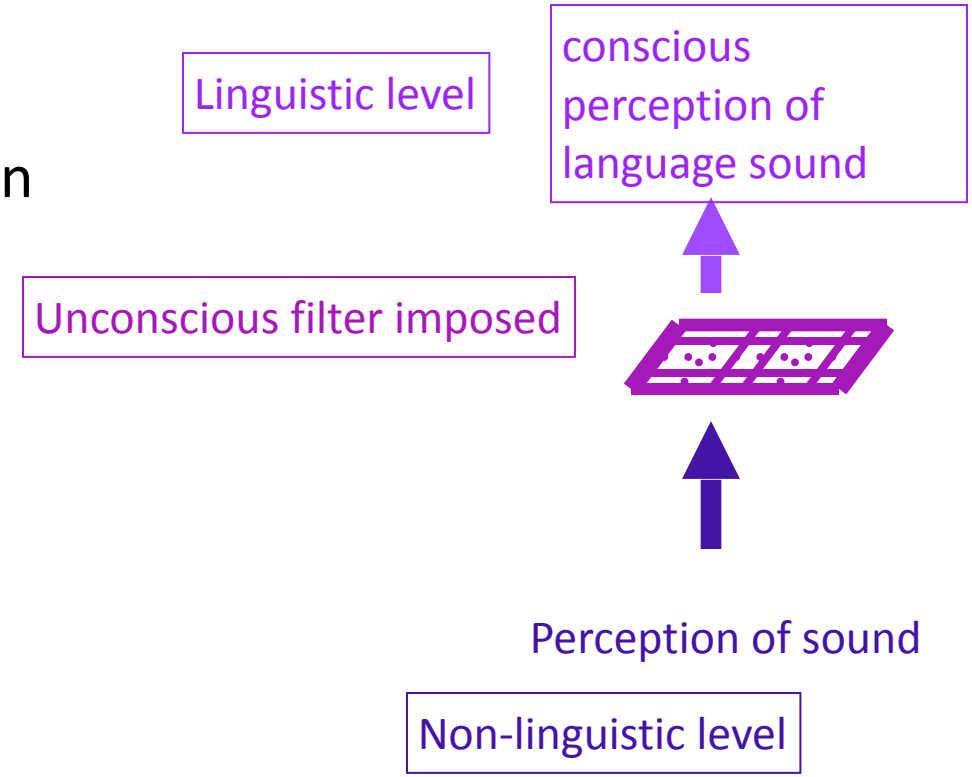
Problem: Doesn't seem to be permanent loss, and doesn't seem to affect sounds if processed as non-language

How change happens: Comparison

Idea 2:

Functional Reorganization

Unconscious filter imposed when sounds are processed as language. Data distributions determine what the boundaries are in the filter.



Common theme: Data distributions determine construction of relevant category boundaries for language

Recap: Infant speech perception

Using indirect techniques, we can tell what category boundaries infants have at different ages.

Infants seem to figure out their native language phonemes (and category boundaries) around 10-12 months.

Two theories of this process are the Maintenance & Loss theory and the Functional Reorganization theory. Both rely on the distribution of native language sounds to create category boundaries.

The Functional Reorganization theory is compatible with data about adult ability to perceive sounds in different contexts.

Questions?

You should be able to do up through question 16 on the sounds review questions, and up through question 2 on HW2.