Psych 156A/ Ling 150: Acquisition of Language II

Lecture 4
Sounds

Announcements

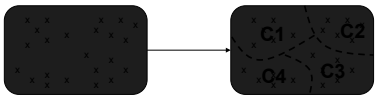
Be working on HW1 (due 4/19/12)

Be working on the sounds & sounds of words review questions

Read Stager & Werker (1997) for next time

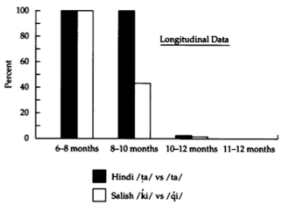
What Happens

Divide sounds into contrastive categories (phonemes)



When It Happens

Around 10 months



Werker & Tees (1984), testing English infants

How Change Happens

Maintenance & Loss Theory **"Use it or lose it"**

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

Structure-changing

Phonology

Phonetics

Patricia Kuhl

"Perceptual Magnet"

Acoustics

How Change Happens

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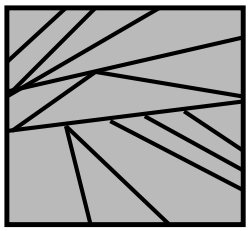
Natural boundaries
(acoustically salient)

Patricia Kuhl

"Perceptual Magnet"



How Change Happens

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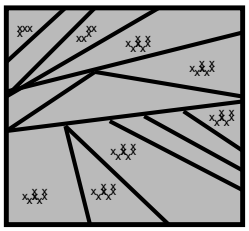
Sounds from Language 1

Patricia Kuhl

"Perceptual Magnet"

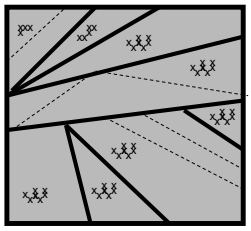


How Change Happens

Maintenance & Loss Theory **"Use it or lose it"**

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"

How Change Happens

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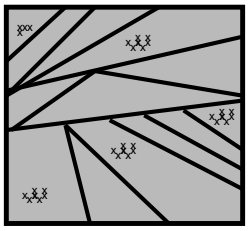
Sounds from Language 2



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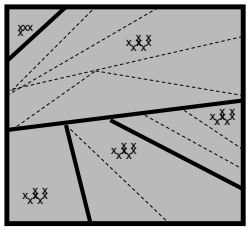


Patricia Kuhl

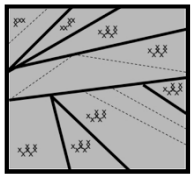
"Perceptual Magnet"

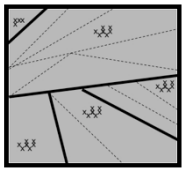
How Change Happens

Maintenance & Loss Theory **"Use it or lose it"**

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"

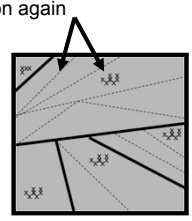
How Change Happens

Maintenance & Loss Theory **"Use it or lose it"**

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



How change happens

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

How change happens

Problems with the Maintenance & Loss Theory

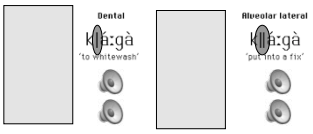
Pisoni et al. (1982), Werker & Logan (1985): adults can be trained if given enough trials or tested in sensitive procedures with low memory demands.

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.

How change happens

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

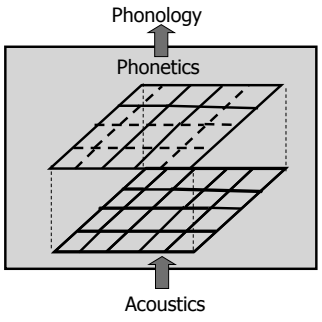
How change happens

Another theory: Functional reorganization

Janet Werker

Structure-building

Native language phonemes built from universal phones



How change happens

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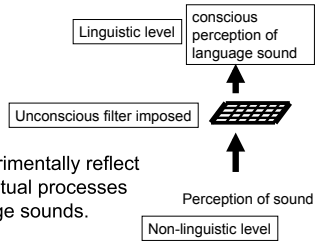


Changes attested experimentally reflect operation of postperceptual processes that activate for language sounds.

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

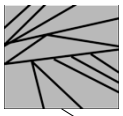
How change happens

Another theory: Functional reorganization

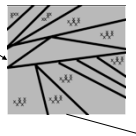
Explanatory power: the whole story

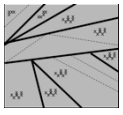
Very young infants respond to any detectable variation - so they can pick up any salient contrasts in surrounding language. Adults have a bias for phonemic contrasts since those are the ones relevant to language. If they're in a non-language setting, adults can distinguish non-native contrastive sounds because their postperceptual language filter isn't activated.

How it happens



Idea 1: Maintenance & Loss
Data distributions determine which boundaries are maintained and which ones are lost/ignored

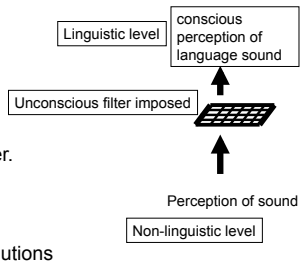




Problem: Doesn't seem to be permanent loss, and doesn't seem to affect sounds if processed as non-language

How it happens

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

Learning Sounds: Taking stock

One of the things children must do is figure out what the meaningful contrastive sounds (phonemes) in their native language are.

Phonemes vary from one language to another.

Children initially can hear many contrastive sounds, even non-native ones. However, they seem to have lost this ability by 10-12 months and instead only consciously hear the contrastive sounds of their native language.

Evidence suggests that this perceptual change is a specialized unconscious filter that is only active when the brain believes it is processing language sounds.

More about contrastive sounds

There are a number of acoustically salient features for sounds. All it takes for sounds to be contrastive is for them to have "opposite" values for one feature.

Example:
English sounds "k" and "g" differ only with respect to voicing. They are pretty much identical on all other features. Many contrastive sounds in English use the voicing feature as the relevant feature of contrast (p/b, t/d, s/z, etc.). However, there are other features that are used as well (air flow, manner of articulation, etc.).

Task for the child: Figure out which features are used contrastively by the language. Contrastive sounds for the language will usually vary with respect to one of those features.

Experimental Study: Dietrich, Swingley & Werker (2007)

Testing children's perception of contrastive sounds

Dutch and English contrastive features differ.

In English, the length of the vowel is not contrastive

"cat" = "caat"

In Dutch, the length of the vowel is contrastive

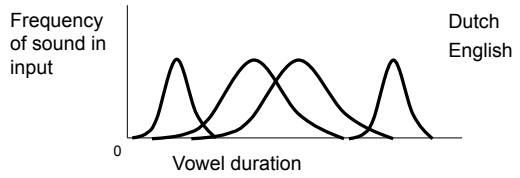
"cat" ≠ "caat"

(Japanese also uses this feature)

Does the data distribution show this?

Dutch and English vowel sounds in the native language environment also seem to differ

"…studies suggest that differences between the long and short vowels of Dutch are larger than any analogous differences for English."



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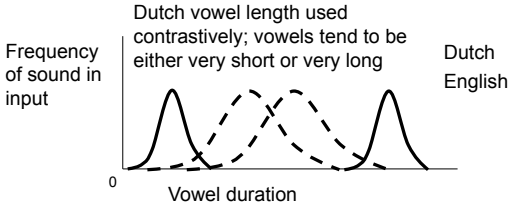

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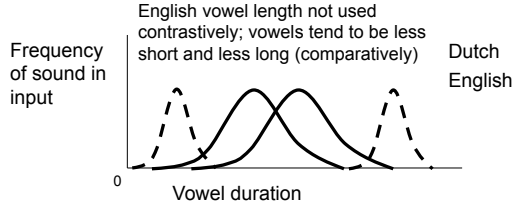

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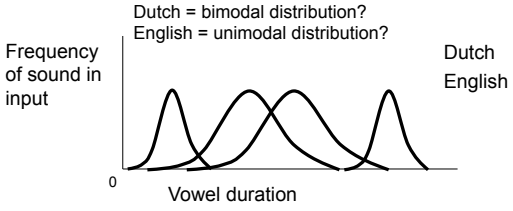

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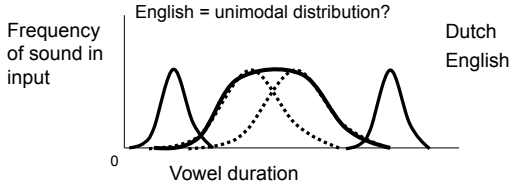
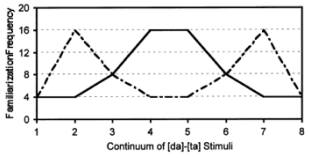
Dutch = bimodal distribution?
English = unimodal distribution?



Learning from real data distributions

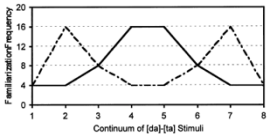
How do we know that children are sensitive to distributional information?

Maye, Werker, & Gerken (2002)



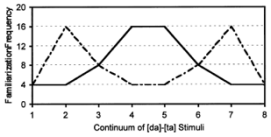
Created synthetic sounds ranging from [da] to [ta] that were non-native for the infants (because they were unaspirated).

Maye, Werker, & Gerken (2002)



- Familiarized 6 to 8-month-old infants to one of two sets
  - Bimodal Set: Sounds on the ends near [da] and [ta].
  - Unimodal Set: Sounds in the middle.
- Test preference for:
  - 3 6 3 6… (Alternating) vs. 3 3 3 3… (Non-alternating) stimuli

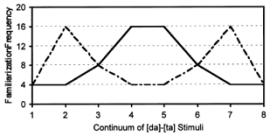
Maye, Werker, & Gerken (2002)



	3 6 3 6 ... Alternating trials (s)		3 3 3 3 Non-Alternating trials (s)
6 months Unimodal	4.85 (0.47)	=	4.53 (0.51)
8 months Unimodal	4.98 (0.63)	=	5.20 (0.56)
6 months Bimodal	5.66 (0.44)	<	6.41 (0.32)
8 months Bimodal	5.45 (0.52)	<	6.15 (0.56)

Maye, Werker, & Gerken (2002)

Infants trained on the Bimodal data had a novelty preference for non-alternating trials. They learned to expect alteration, and were surprised by non-alteration.



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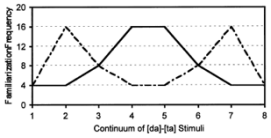
Maye, Werker, & Gerken (2002)

Infants trained on the Unimodal data did not prefer/ disprefer one over the other. The did not seem to learn any expectation.



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Back to Dietrich, Swingley, & Werker (2007)

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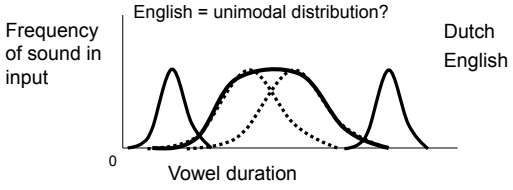
Dutch = bimodal distribution?
English = unimodal distribution?



Back to Dietrich, Swingley, & Werker (2007)

Prediction if children are sensitive to this distribution

Dutch children interpret vowel duration as a meaningful contrast because the distribution is more bimodal

Implication: Change to vowel duration = new word

English children should not interpret vowel duration as a meaningful contrast because the distribution is more unimodal

Implication: Change to vowel duration = same word as before

Dietrich, Swingley, & Werker (2007)

Tests with 18-month-old children who know some words (and so have figured out the meaningful sounds in their language)

"Switch" Procedure: measures looking time

…this is a *tam*…look at the *tam*

Habituation

Test

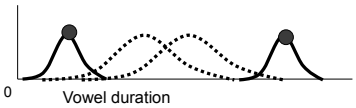
Same: look at the *tam!*

Switch: look at the *taam!*

Dietrich, Swingley, & Werker (2007)

Experiment 1: Testing English and Dutch kids on Dutch vowel durations

Frequency of sound in input



Dutch kids

5.04 sec 9.23 sec difference

English kids

6.66 sec 7.15 sec no difference

Test

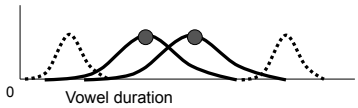
Same: look at the *tam!*

Switch: look at the *taam!*

Dietrich, Swingley, & Werker (2007)

Experiment 2: Testing English and Dutch kids on English vowel durations

Frequency of sound in input



Dutch kids

5.92 sec 8.16 sec difference

English kids

7.34 sec 8.04 sec no difference

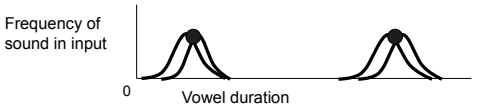
Test

Same: look at the *tam!*

Switch: look at the *taam!*

Dietrich, Swingley, & Werker (2007)

Experiment 3: Testing English and Dutch kids on vowel quality contrast (a/e)



(This is a control condition to make sure English kids can do the task when the sound is contrastive for them)

Dutch kids

4.08 sec 5.72 sec difference

English kids

6.31 sec 9.31 sec difference

Test

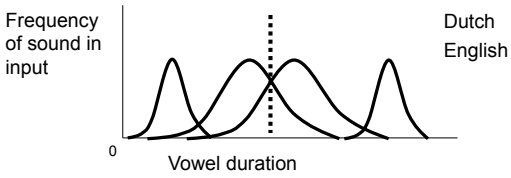
Same: look at the *tam!*

Switch: look at the *tem!*

Dietrich, Swingley, & Werker (2007)

Implications of experiments 1, 2, and 3: Dutch children recognize vowel duration as contrastive for their language while English children do not. This can only be due to the data encountered by each set of children in their language.

Dutch children have a category boundary approximately here. English children do not.



What drives children to learn the distinction?

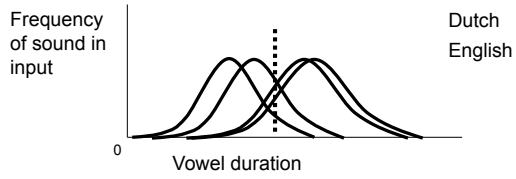
"One frequently raised hypothesis…is that it is driven by contrast in the vocabulary. Dutch children might learn that [a] and [a:] are different because the words [stat]…and [sta:t]…mean different things…however, children that young do not seem to know many word pairs that could clearly indicate a distinction between [a] and [a:]." - Dietrich, Swingley, & Werker (2007)

Dietrich, Swingley, & Werker (2007)

"The other current hypothesis is that children begin to induce phonological categories "bottom-up", based on their discovery of clusters of speech sounds in phonetic space…undoubtedly implicated in infants' early phonetic category learning, which begins before infants know enough words for vocabulary-based hypotheses to be feasible…"

Dietrich, Swingley, & Werker (2007)

"A necessary condition for such learning to be the driving force behind Dutch children's phonological interpretation in the present studies is that long and short vowels be more clearly separable in Dutch than in English…preliminary examination of this problem using corpora of Dutch child-directed speech indicated that the set of long and short instances formed largely overlapping distributions."



Implication: Dutch children need other cues to help them out

Swingley (2009)

One potential source of information: keep some contextual information for each vowel sound (what word it came from, if it comes from a frequent word).

Feldman et al. (2009) also suggest that associating sounds with particular words (specifically, learning about sounds and words at the same time) can be helpful.

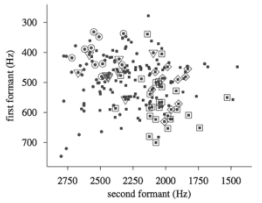
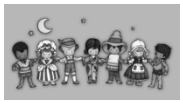


Figure 3. The vowels /i/ and /ɪ/ in first- and second formant space, as spoken by one mother to her infant. The /i/ instances are plotted as blue circles, /ɪ/ as red squares. Outlines around instances indicate tokens measured from the words *see* (open circles), *see* (open triangles), *dillon* (open squares), and *this* (open diamonds).

Discovering contrastive sounds: What's the point of it again?

The idea is that once children discover the meaningful sounds in their language, they can begin to figure out what the words are.



Ex: An English child will know that "cat" and "caat" are the same word (and should have the same meaning).

As adults, we can look at a language and figure out what the contrastive sounds are by looking at what changes a word's meaning. But children can't do this - they figure out the contrastive sounds *before* they figure out words and word meanings.

Recap: Sounds

It seems that we learn to have a language filter that abstracts away from the raw acoustic signal when we think we're listening to language (a language sound filter that creates phonemes).

Children need to learn what the phonemes of their language are by listening to their native language input, and phonemes will be constrastive with respect to at least one phonetic feature (like duration or voicing).

It may be helpful for children to keep track of where they hear particular sounds (that is, in which words) in order to figure out the phonemes of their language.

Questions?

You should be able to do up through question 5 on HW1 and up through question 17 on the sounds review questions.