Psych 156A/ Ling 150: Psychology of Language Learning

Lecture 5
Sounds III

Announcements

Tayopa's office hours: T/Th 10:30-11:30am in SST 687

Homework 1 returned
- Average: 12.8 out of 16
- Note on extra points: very good/funny answers will occasionally gain you an extra 1/2 point or so.

Homework 2 assigned (due next Tuesday: 4/22/08)

Speech Perception of Non-Native Sounds

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

Salish & Hindi contrasts

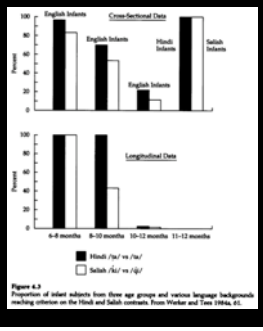


Figure 4.3
Proportion of infant subjects from three age groups and various language backgrounds reaching criterion on the Hindi and Salish contrasts. From Werker and Tees 1984a, 61.

Change happens somewhere around 8-10 months, depending on the sound contrast.

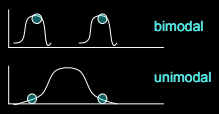
How change happens

Possible Mechanism: Statistical Learning

9 month infants are sensitive to the frequency and distribution of perceptual input in speech.

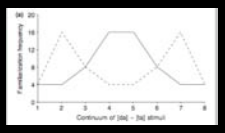
Highly frequent distinctions are learned earlier.

Life's easier when the distribution is bimodal, though



Distributional learning

Possible Mechanism: Statistical Learning

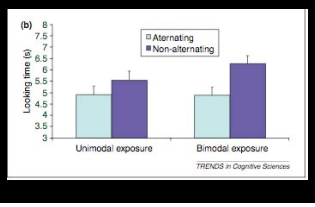


Infants exposed to either unimodal or bimodal distribution

Alternating test: stimuli 1 and 8

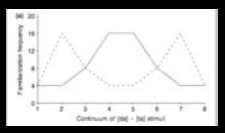
Non-alternating baseline: stimuli 3 or stimuli 6

Maye et al. 2002



Distributional learning

Possible Mechanism: Statistical Learning



Infants exposed to either unimodal or bimodal distribution

Alternating test: stimuli 1 and 8

Non-alternating baseline: stimuli 3 or stimuli 6

Maye et al. 2002

Bimodal children are sensitive to the presence of two categories

Distributional learning from real language data

Dietrich, Swingley, & Werker (2007)

Dutch and English vowel categories differ

In English, the length of the vowel is not contrastive

"cat" = "caat"

In Dutch, the length of the vowel is contrastive

"tam" is a different word from "taam"

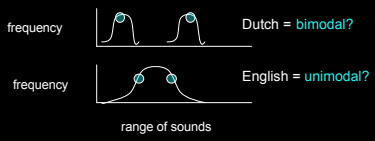
(Japanese also has this distinction)

Distributional learning from real language data

Dietrich, Swingley, & Werker (2007)

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."



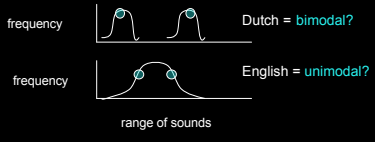
Distributional learning from real language data

Dietrich, Swingley, & Werker (2007)

Prediction if children are learning distributionally from the data:

Dutch children interpret vowel duration as a meaningful contrast
Implication: Change to vowel duration = new word

English children should not
Implication: Change to vowel duration = same word as before



Distributional learning from real language data

Dietrich, Swingley, & Werker (2007)

Tests with 18-month old children

"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!*

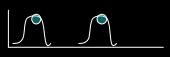
Distributional learning from real language data

Dietrich, Swingley, & Werker (2007)

Tests with 18-month old children

Expt 1

Dutch vowel sounds



Dutch kids

5.04 sec 9.23 sec

difference

English kids

6.66 sec 7.15 sec

no difference

Same:
look at the *tam!*

Switch:
look at the *taam!*

Distributional learning from real language data

Dietrich, Swingley, & Werker (2007)

Tests with 18-month old children

Expt 2

English vowel sounds

Dutch kids

5.92 sec 8.16 sec

difference

English kids

7.34 sec 8.04 sec

no difference

Same:
look at the *tam!*

Switch:
look at the *taam!*

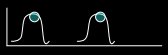
Distributional learning from real language data

Dietrich, Swingley, & Werker (2007)

Tests with 18-month old children

Expt 3

Dutch contrastive vowel sounds for the Dutch kids



English contrastive sounds for the English kids

Dutch kids

4.08 sec 5.72 sec difference

English kids

6.31 sec 9.31 sec difference

Same: look at the *tam!*

Switch: look at the *tem!*

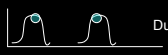
Distributional learning from real language data

Dietrich, Swingley, & Werker (2007)

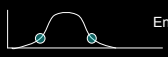
Tests with 18-month old children

Expts 1, 2, & 3

Dutch kids recognize vowel durations as contrastive



Dutch = bimodal



English = unimodal

English kids do not

Native language influence

Distributional learning from real language data

Dietrich, Swingley, & Werker (2007)

Tests with 18-month old children

A caveat about distributional learning

"…preliminary investigation of Dutch child-directed speech indicated that the set of long and short instances formed largely overlapping distributions."

Dutch = bimodal?

Implication: Dutch children need other cues to help them out

Distributional learning from real language data

Vallabha, McClelland, Pons, Werker, & Amano (2007)

Tests with computational models (digital children)

Distributional learning from real language data

Vallabha, McClelland, Pons, Werker, & Amano (2007)

Tests with computational models (digital children)

Sounds: Vowel contrasts in English and Japanese

English contrasts: contrast in quality (tense vs. lax) and a bit in duration

/ɪ/ vs. /i/ /ɛ/ vs. /e/

"ih" "ee" "eh" "ey"

Japanese contrasts: contrast almost solely in duration (short vs. long)

/i/ vs. /i:/ /e/ vs. /e:/

"ee" "eeee" "ey" "eeey"

Distributional learning from real language data

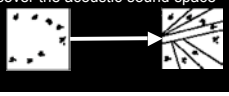
Vallabha, McClelland, Pons, Werker, & Amano (2007)

Tests with computational models (digital children)

Data (input to model): Infant-directed speech of English and Japanese mothers

Why? Idea = "motherese" makes differences more salient

Learning algorithm: learns from a single data point at a time, trying to identify how many categories should be formed from the data points and how the categories should cover the acoustic sound space



Distributional learning from real language data

Vallabha, McClelland, Pons, Werker, & Amano (2007)

Tests with computational models (digital children)

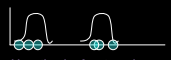
Estimating how many categories from observation of the data points: probabilistic learning

Hypotheses about how many categories exist are assigned probability based on how likely they are to have generated the observed data

Distributional learning from real language data

Vallabha, McClelland, Pons, Werker, & Amano (2007)

Tests with computational models (digital children)



Hypothesis probability raised

Hypothesis: 2 categories
high probability of generating data seen

frequency

Hypothesis probability lowered

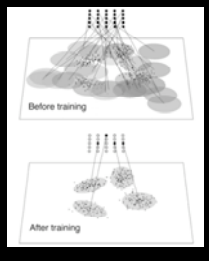
Hypothesis: 1 category
low probability of generating data seen

range of sounds

Distributional learning from real language data

Vallabha, McClelland, Pons, Werker, & Amano (2007)

Tests with computational models (digital children)

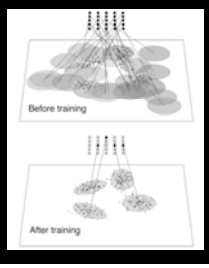


Trained on 50,000 data points
Tested on 2,000 data points

Distributional learning from real language data

Vallabha, McClelland, Pons, Werker, & Amano (2007)

Tests with computational models (digital children)



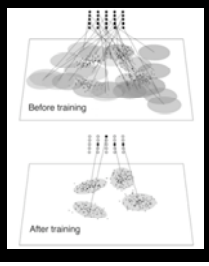
Results:

About 92% successful categorization on average when learning from only a single speaker.

Distributional learning from real language data

Vallabha, McClelland, Pons, Werker, & Amano (2007)

Tests with computational models (digital children)



Results:

One issue is that there is substantial variation even between speakers of the same language.

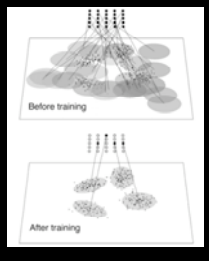
Testing on data from multiple English speakers and multiple Japanese speakers gave lower success rates

English = 69% Japanese = 77%

Distributional learning from real language data

Vallabha, McClelland, Pons, Werker, & Amano (2007)

Tests with computational models (digital children)



But speakers are able to categorize sounds from multiple speakers without trouble!

Implication: Children need to learn from more than one speaker (not just their mother) in order to be able to generalize across speakers.

Announcements

Quiz 2 on Thursday (4/17/08)