Psych 156A/ Ling 150: Acquisition of Language II

Lecture 4
Sounds of Words

Announcements

Be working on HW1 (due 4/13/10)
Be working on the sounds & sounds of words review questions
Note: some material has been skipped (Dietrich, Swingley, & Werker 2007) so these questions have been removed from the review questions. You are not responsible for this extra material.
Read Saffran, Aslin, & Newport (1996) for next time

What Happens

Divide sounds into contrastive categories (phonemes)

When It Happens

Between 8-10 months

Werker & Taeo (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.

Patricia Kuhl

"Perceptual Magnet"

Phonology

Structure-changing

Phonetics

Acoustics

Sounds from Language 1

Natural boundaries (acoustically salient)
How Change Happens

Maintenance & Loss Theory

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

Category boundaries that are maintained to keep these sound clusters distinct

Perceptual Magnet

Use it or lose it

Patricia Kuhl

Sounds from Language 2

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

Maintenance & Loss Theory

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

"Use it or lose it"

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.

Non-linguistic perception

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.

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/Vowel sandConsonants/course/chapter6/zulu/zulu.html
How change happens
Another theory: Functional reorganization

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: Recap

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.

Learning Words

Word Forms

Computational Problem:
Map variable word signals to more abstract word forms

friends
friends
friends
"friends"
What's Involved in Word Learning

Word learning: mapping among concept, word, and word's variable acoustic signal

“goblin”

<table>
<thead>
<tr>
<th>Phoneme</th>
<th>BIH</th>
<th>DIH</th>
</tr>
</thead>
</table>

Word Learning Experiment
(Stager & Werker 1997)

Learning nonsense words that are minimal pairs (differ by one phoneme): ‘bih’ vs. ‘dih’. Comparing against words that are not: ‘lif’ vs. ‘neem’

“Switch” Procedure: measures looking time
...this is a bih...look at the bih

Habituation

Test

Same: look at the bih!
Switch: look at the dih!

Habituation Test

14-month-olds

...this is a dih...look at the dih
...this is a bih...look at the bih

14-month-olds

No looking time difference = 14-month-olds didn't notice the difference!
Word Learning Experiment (Stager & Werker 1997)

Habituation

Test

...this is a b/h...look at the b/h

Same: look at the b/h!

Switch: look at the d/h!

8-month-olds & 14-month-olds

No difference in looking time = 14-month-olds didn’t notice the difference again!

But 8-month-olds did! They have a difference in looking time. They look longer at the “b/h” object when it is labeled “d/h” - so they must know “b” and “d” are different.
Here, the 14-month-olds look longer at the “lil” object when it’s labeled “neem”. They notice the difference.

Habituation

Test

Same:
look at the bil!

Switch:
look at the dil!

14-month-olds

Infants unlikely to associate label with checkerboard pattern (that is, to treat it like a word that has a referent/meaning)

Key: Experiment 2 vs 4

Figure 2: Model showing the conditions under which infants show significant recovery in the “wash” task. Graphs above show looking time on the “wash” and bottom shows: “wash” with closed eyes
Key Findings

14-month-olds can discriminate the minimally contrasting words (Expt. 4)

…but they fail to notice the minimal change in the sounds when they are paired with objects, i.e., when they are words with associated meaning (Expt. 2)

They can perform the task, when the words are more distinct (Expt. 3)

Therefore, 14-month-olds use more detail to represent sounds than they do to represent words!

What’s going on?

They fail specifically when the task requires word-learning

They do know the sounds…but they fail to use the detail needed for minimal pairs to store words in memory

What’s going on?
– Is this true for all words?
– When do they learn to do this?
– What triggers the ability to do this?

What children may be doing

One idea: Encode detail only if necessary

If children have small vocabularies, it may not take so much detail to distinguish one word from another. (baby, cookie, mommy, daddy…)

Neighborhood structure idea: When a child knows two words that are differ only by a single phoneme (like “cat” and “bat”), more attention to detail is required to distinguish them.

Prediction: Children’s vocabulary drives their ability to notice the difference between words that differ minimally (ex: by a single phoneme)

Going with the neighborhood idea, look at Stager & Werker (1997) “bih” and “dih” are too close (they differ only by one phoneme), and kids don’t know any words close enough to motivate attention to the “b”/”d” difference when word-learning

Experiment 2

…this is a bih…look at the bih

Habitation

Same: look at the bih

Switch:

Test:

look at the dih!
Werker et al. 2002: Vocabulary Size Matters

Stager-Werker task

Test

Same: look at the bih!

Switch: look at the dih!

14 month-olds don’t

17-month-olds do
Zoom in on the 17-month-olds

Those with a small vocabulary look like 14-month-olds - they can’t tell the difference for a novel word they haven’t heard much.

Implication: Performance on Stager-Werker task with novel words does depend on how many words the child knows.
More vocabulary = more necessary distinctions

Werker et al. 2002: Performance on Stager-Werker task with novel words depends on how many words the child knows.

Implication: Children’s vocabulary drives their ability to notice the difference between words that differ minimally (ex: by a single phoneme)

Prediction: This should apply to familiar words too. Specifically, children with small vocabularies should have trouble noticing phonemic differences in familiar words.

Swingley & Aslin 2002: Familiar Word Tests

English 14-month-olds noticed the difference between correct pronunciations and mispronunciations when the words were familiar.

| Table 1. Correctly pronounced (CP) target words and their mispronounced (MP) versions |
|-------------------------------|-------------------------------|
| CP          | MP-close            | MP-distant        |
| apple (i/zip/) | apple (i/zip/) | opal (i/op/) |
| baby (b/bye)  | baby (b/bye)  | baby (b/bye)  |
| ball (b/ble)   | bawl (b/ble)   | shawl (b/awl) |
| car (k/are)   | car (k/are)   | karr (k/arr)   |
| dog (d/og)    | dog (d/og)    | dog (d/og)    |
| kitty (k/it)   | kitty (k/it)   | kitty (k/it)   |

But maybe these 14-month-olds just happen to have large vocabularies?

Swingley 2005: Familiar Words for Younger Children

(Dutch) 11-month-olds noticed the difference between correct pronunciations and mispronunciations when the words were familiar (Headturn Procedure: tests ability to hear sound differences)

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<tr>
<th>Familiar</th>
<th>Nounword</th>
<th>Correct-MP</th>
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<tbody>
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<td>bel</td>
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Swingley 2005: Familiar Words for Younger Children

(Dutch) 11-month-olds noticed the difference between correct pronunciations and mispronunciations when the words were familiar (Headturn Procedure: tests ability to hear sound differences)

But this is before they've likely learned many words...so it probably isn't just the number of words they know (and which words they know) that drives the detailed representations of the sounds in the words.

Point: Vocabulary can’t be the only thing determining children’s ability to distinguish the sounds of words. So what’s the problem with the 14-month-olds in the Stager-Werker task?
Was the task too hard for 14-month-olds?

Yoshida, Fennell, Swingley, & Werker (2009)

Maybe the problem with the 14-month-old infants was that the switch task was too hard - they have to be very confident the close mispronunciation of the new word (dih for novel word bih) is not actually close enough.

What would happen if we habituated 14-month-old children the usual way for the Switch procedure, but then tested them a different way that didn’t require them to be as confident about the correct pronunciation of a word’s form?

The Visual Choice Task
“Preferential Looking”

Golinkoff, Hirsh-Pasek, Cauley & Gordon 1987

A two-alternative forced choice looking task that compares visual fixations to target and distractor objects.

Novel object is a better match for novel word form and importantly familiar object is a poor match - infant knows familiar word.

Yoshida, Fennell, Swingley, & Werker (2009)

Test: 14-month-olds
“Where’s the bin?”

14-month-old infants look significantly more at the correct novel object - they do have detail for words!
The problem with the Stager-Werker Task

Maybe the problem with the 14-month-olds in the Stager-Werker task was that they encoded the phonetic forms with low confidence. So, when tested on the original switch task, they didn’t have enough confidence in their representation of the novel form to realize it was the wrong label for the novel object.

Yoshida et al. 2009: "Calling a din object by the word bin is not good pronunciation to the 14-month-old, but neither is it categorically incorrect."

Why does having a familiar word help?

Idea: Children build up more confidence in the word form the more times they hear it.

{p/b/d/g}{a/o/u}{l/r} = "pall", "dor"
... "gull", "ball"

{p/b}{a}{l} = "pall", "ball"
... "bar", "par"

{b}{a}{l} = "ball"

Recap: Sounds, Words, and Detail

Children figure out the contrastive, meaningful sounds (phonemes) in their language before they know words. They use the language data to help decide what features are likely to be contrastive in their language.

Word-learning is very hard for younger children, so detail seems to be initially missed when they first learn words.

Many exposures are needed to learn detailed word forms at the earliest stages of word-learning.

When children are tested with a visual choice task, they show more knowledge of detailed word forms than when they are tested with a Switch procedure task.

Questions?

Be working on HW1 and the review questions for the remainder of class.