Psych 156A/ Ling 150: Acquisition of Language II

Lecture 4

Sounds of Words

Announcements

Be working on HW1 (due 4/13/10)

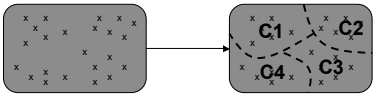
Be working on the sounds & sounds of words review questions

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

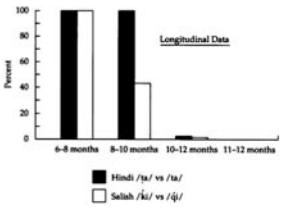
What Happens

Divide sounds into contrastive categories (phonemes)



When It Happens

Between 8-10 months



Werker & 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

Acoustics

Patricia Kuhl

"Perceptual Magnet"

How Change Happens

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Natural boundaries
(acoustically salient)

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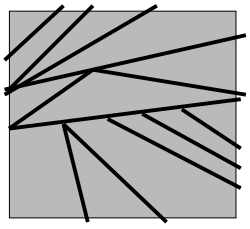

"Perceptual Magnet"

How Change Happens

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Sounds from Language 1

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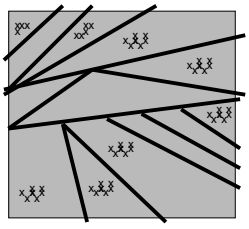


"Perceptual Magnet"

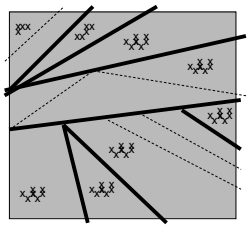
How Change Happens

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

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

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

Sounds from Language 2

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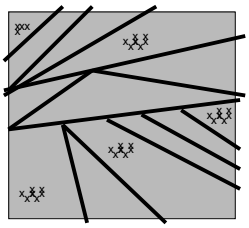

"Perceptual Magnet"

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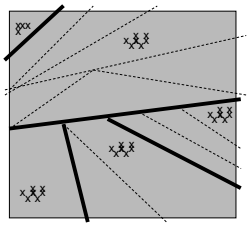

"Perceptual Magnet"

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

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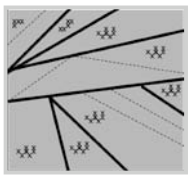
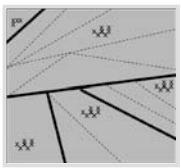




"Perceptual Magnet"

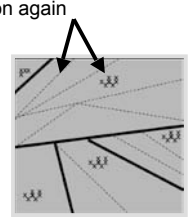
How Change Happens

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

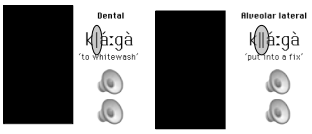
Pisoni et al. (1982), Werker & Logan (1985): adults can be trained if given enough trials or tested in sensitive procedures with low memory demands.

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

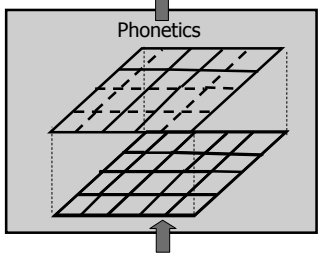
How change happens

Another theory: Functional reorganization

Janet Werker

Phonology

Phonetics



Structure-building

Native language phonemes built from universal phones

Acoustics

How change happens

Another theory: Functional reorganization

Janet Werker

Linguistic level

conscious perception of language sound

Unconscious filter imposed

Perception of sound

Non-linguistic level

Changes attested experimentally reflect operation of postperceptual processes that kick in 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.

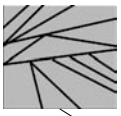
How change happens

Another theory: Functional reorganization

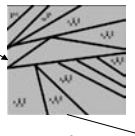
Explanatory power: the whole story

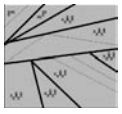
Very young infants respond to any detectable variation - so they can pick up any salient contrasts in surrounding language. Adults have a bias for phonemic contrasts since those are the ones relevant to language. If they're in a non-language setting, adults can distinguish non-native contrastive sounds.

How it happens



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

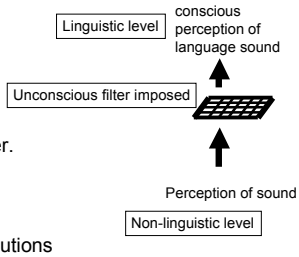




Problem: Doesn't seem to be permanent loss, and doesn't seem to affect sounds if processed as non-language

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

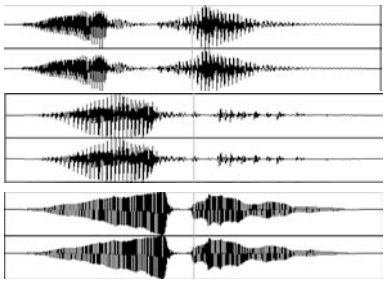
Computational Problem:
Map variable word signals to more abstract word forms

"friends"

What's Involved in Word Learning

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

"goblin"



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!*

Word Learning Experiment (Stager & Werker 1997)

14-month-olds

…this is a *dih*…look at the *dih*

…this is a *bih*…look at the *bih*

Habituation

Test

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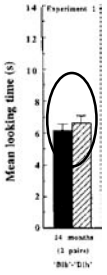


No looking time difference = 14-month-olds didn't notice the difference!

Word Learning Experiment (Stager & Werker 1997)

8-month-olds & 14-month-olds

…this is a *bih*…look at the *bih*

Habituation

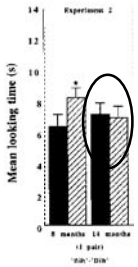
Test

Same: look at the *bih!*

Switch: look at the *dih!*

Word Learning Experiment (Stager & Werker 1997)

8-month-olds & 14-month-olds

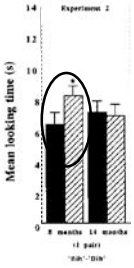


No difference in looking time = 14-month-olds didn't notice the difference again!

Word Learning Experiment (Stager & Werker 1997)

8-month-olds & 14-month-olds

But 8-month-olds did! They have a difference in looking time. They look longer at the "bih" object when it is labeled "dih" - so they must know "b" and "d" are different.

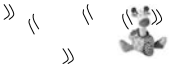


Word Learning Experiment (Stager & Werker 1997)

14-month-olds

…this is a *lif*…look at the *lif*

Habituation



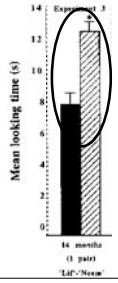
Test

Same: look at the *lif!*

Switch: look at the *neem!*

Word Learning Experiment (Stager & Werker 1997)

14-month-olds



Here, the 14-month-olds look longer at the "lif" object when it's labeled "neem". They notice the difference.

Word Learning Experiment (Stager & Werker 1997)

14-month-olds

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

…this is a *bih*…look at the *bih*

Habituation

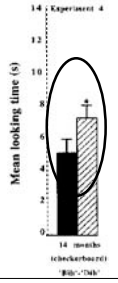
Same:
look at the *bih!*

Switch:
look at the *dih!*

Test

Word Learning Experiment (Stager & Werker 1997)

14-month-olds



Here, the 14-month-olds look longer at the "bih" "object" when it's labeled "dih". They notice the difference.

Word Learning Experiment (Stager & Werker 1997)

Key: Experiment 2 vs 4

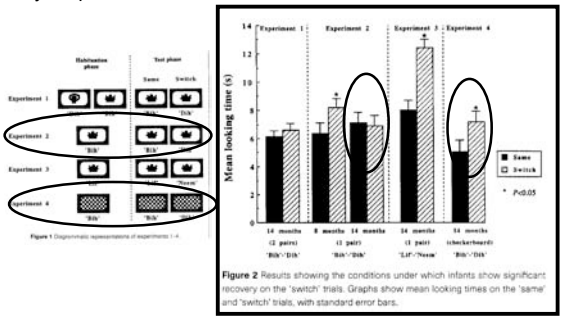


Figure 2 Results showing the conditions under which infants show significant recovery on the 'switch' trials. Graphs show mean looking times on the 'same' and 'switch' trials, with standard error bars.

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

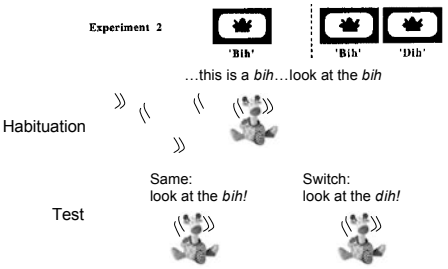
If children have small vocabularies, it may not take so much detail to distinguish one word from another. (*baby, cookie, mommy, daddy*…)

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

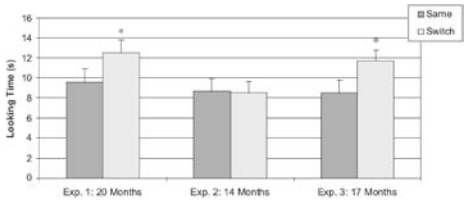


Werker et al. 2002: Vocabulary Size Matters

Stager-Werker task
Test

Same:
look at the *bih!*

Switch:
look at the *dih!*



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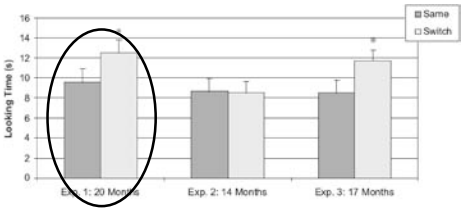

20-month-olds notice

Werker et al. 2002: Vocabulary Size Matters

Stager-Werker task
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Same:
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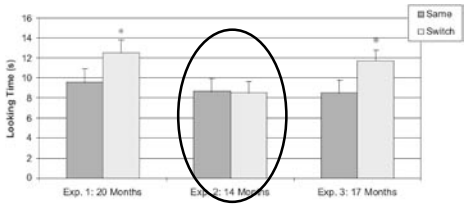
Switch:
look at the *dih!*



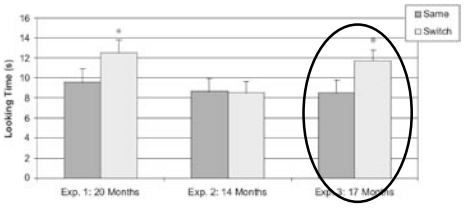
14 month-olds don't

Werker et al. 2002: Vocabulary Size Matters

Stager-Werker task
Test

Same:
look at the *bih!*

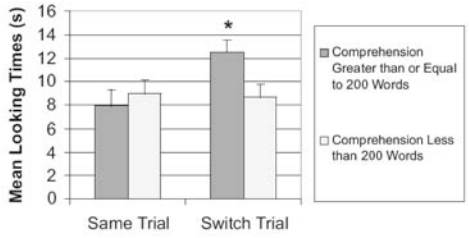
Switch:
look at the *dih!*



17-month-olds do

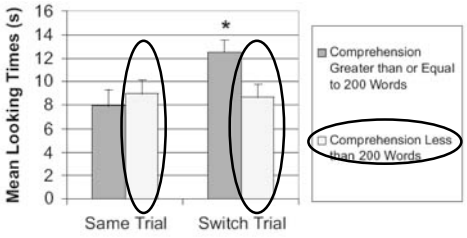
Werker et al. 2002: Vocabulary Size Matters

Zoom in on the 17-month-olds



Werker et al. 2002: Vocabulary Size Matters

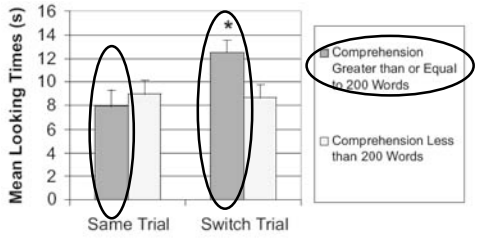
Zoom in on the 17-month-olds



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.

Werker et al. 2002: Vocabulary Size Matters

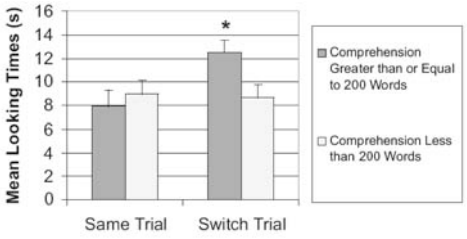
Zoom in on the 17-month-olds



Those with a large vocabulary look like 20-month-olds - they *can* tell the difference for a novel word, even though they haven't heard it much.

Werker et al. 2002: Vocabulary Size Matters

Zoom in on the 17-month-olds



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 (/æpl/)	opple (/apl/)	opal (/opl/)
baby (/be^{i}bi/)	vaby (/ve^{i}bi/)	raby (/ɹe^{i}bi/)
ball (/bɔl/)	gall (/gɔl/)	shawl (/ʃɔl/)
car (/kaɹ/)	cur (/kɜ˞/)	kier (/kiɹ/)
dog (/dɔg/)	tog (/tɔg/)	mog (/mɔg/)
kitty (/kɪti/)	pity (/pɪti/)	yitty (/jɪti/)

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)

Familiar	Nonword	Onset-MP
beɦn	baɦ	deɦn
beɾ	bøɦ	deɾ
bœyk	bœyn	kœyk
eɦnt	eɦp	eɦnt
h nt	haɦk	x nt
haɾ	heɦn	saɾ
hont	ho	font
ku	kus	xu
mont	maɦnt	nont
nøɦ	nut	møɦ
paɦrt	pøɦnt	daɦrt
pus	purt	tus
sxaɦp	sxeɾ	ɬaɦp
teɦn	to	peɦn
v s	vaɦnt	v s
vut	veɦnt	but

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)

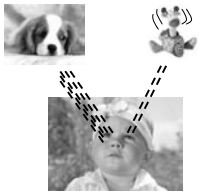
Maybe the problem with the 14-month-old infants was that the switch task was too hard - they have to be very confident the close mispronunciation of the new word (*dih* for novel word *bih*) is not actually close enough

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



"Where's the dog?"

Familiar object better match for familiar word

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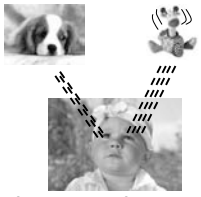
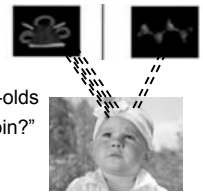


"Where's the tog?"

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)

Novel labels **"bin"** **"din"**



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/r} = "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.