Psych 215: Language Sciences (Language Acquisition)

Lecture 6

Word Storage in the Lexicon

Recap: Sounds of Language (Speech Perception)

Learner's job: figure out phonemes (contrastive sounds of the language)

big vs. dig

Phonemes are language-specific
- r/l is a phonemic contrast (changes word's meaning) in English but not in Japanese

Lisa = Risa for some of my Japanese friends

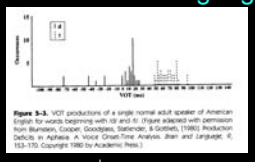
- Dental D vs. retroflex d is a distinction in Hindi, but not in English

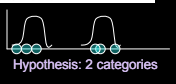
Sounds of Language (Speech Perception)

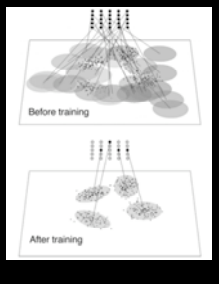
Time course: weird?

Children of the world acquire knowledge of phonemes before they can figure out what different words are - and when different meanings are signaled by different words

Sounds of Language (Speech Perception)







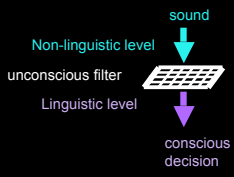
Time course: not so weird…

Children may be able to key into distributional information available about sounds in the language and figure out the relevant categories

How change happens

One idea: Functional reorganization
Changes attested experimentally reflect operation of postperceptual processes that kick in for language

Janet Werker



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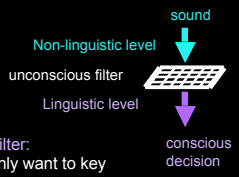


Usefulness of the native language sound filter:
When infants are learning words, they only want to key into meaningful sound differences. So, imposing the native language sound filter means they can figure out what sounds are important for making words and distinctions between words.

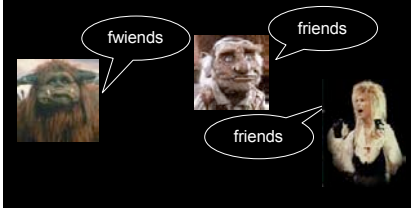
goblin vs. goooblin (not meaningful)

goblin vs. koblin (meaningful)

Learning Words

Word Forms

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

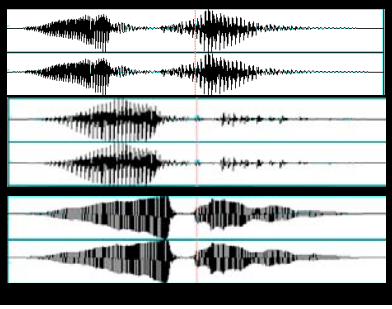


"friends"

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

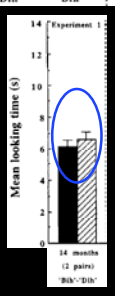
Test

Same: look at the ***bih!***

Switch: look at the ***dih!***

Word Learning Experiment (Stager & Werker 1997)

14-month-olds



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

Word Learning Experiment (Stager & Werker 1997)

8-month-olds & 14-month-olds

Habituation

…this is a *bih*…look at the *bih*

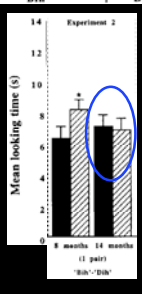
Test

Same: look at the *bih!*

Switch: look at the *dih!*

Word Learning Experiment (Stager & Werker 1997)

8-month-olds & 14-month-olds

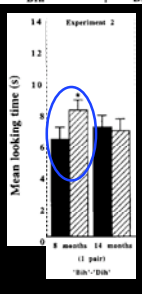


No difference in looking time = 14-month-olds didn't notice the difference again!

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"



Word Learning Experiment (Stager & Werker 1997)

14-month-olds

Habituation

…this is a *lif*…look at the *lif*

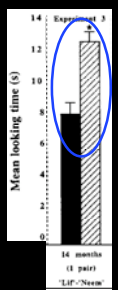
Test

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

…this is a ***bih***…look at the ***bih***

Habituation

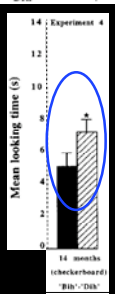
Same:
look at the ***bih!***

Switch:
look at the ***dih!***

Test

Word Learning Experiment (Stager & Werker 1997)

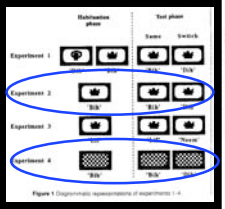
14-month-olds



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



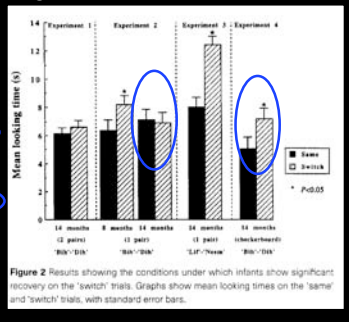


Figure 2 Results showing the conditions under which infants show significant recovery on the 'switch' trials. Graphs show mean looking times on the 'same' and 'switch' trials, with standard error bars.

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* (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 is going on?

- Is this true for all words?
- When do they learn to do this?
- What triggers the ability to do this?

Was the task too hard for 14-month-olds?

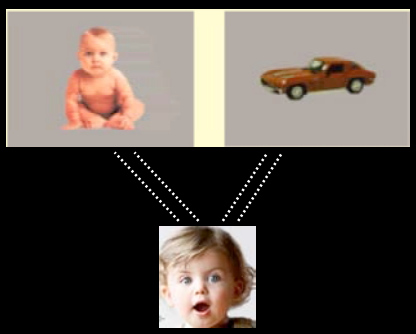
Swingley & Aslin (2002)

Maybe the problem with the younger infants was that these were *novel* words. The task was too demanding: learning a new name for an object and then being asked to give that object to the experimenter.

What would happen if we tested children on familiar words, like "baby"? Would they notice if they were mispronounced (like "vaby")?

Eyetracking Task: measures fixations on target picture

Where's the baby?



Eyetracking Task: measures fixations on target picture

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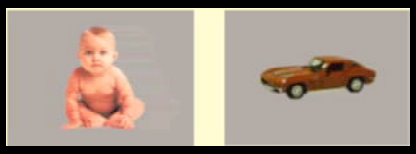
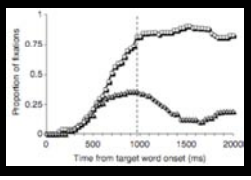
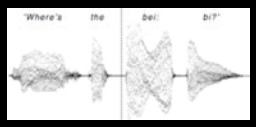
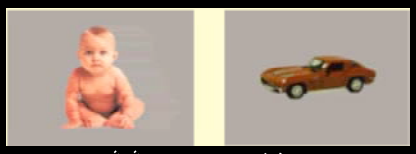






Eyetracking Task: measures fixations on target picture

Where's the vaby?



Was the task too hard for 14-month-olds?

Swingley & Aslin (2002)

Maybe the problem with the younger infants was that these were *novel* words

Also, 18- to 23-month-olds did better on this eyetracking task. Maybe younger kids will, too…

Swingley & Aslin 2002: Familiar Word Tests

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 (/æpl̩/)	opple (/apl̩/)	opal (/opl̩/)
baby (/beˈbi/)	vaby (/veˈbi/)	raby (/ɹeˈbi/)
ball (/bɔl/)	gall (/gɔl/)	shawl (/ʃɔl/)
car (/kaɹ/)	cur (/kɝ/)	kier (/kiɹ/)
dog (/dɔg/)	tog (/tɔg/)	mog (/mɔg/)
kitty (/kɪti/)	pity (/pɪti/)	yitty (/jɪti/)

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 phonetically similar, more attention to detail is required to distinguish them.

Going with the neighborhood idea, look at Stager & Werker (1997)

"bih" and "dih" are too close, and kids don't know any words close enough to motivate attention to the "b"/"d" difference when word-learning

…this is a ***bih***…look at the ***bih***

Habituation

Test

Same:
look at the ***bih!***

Switch:
look at the ***dih!***

Swingley & Aslin 2002: Familiar Word Tests

Correctly pronounced words easier to recognize than all mispronounced words (so task is reasonable & infants notice the difference in pronunciation) [p <.001]

…but both were significantly different from chance (50%)

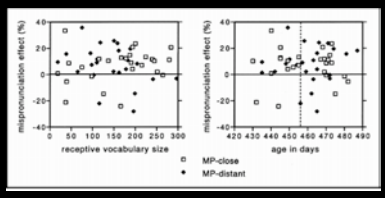
Correct word fixation on target: ~60%

Mispronounced word fixation on target: ~54%

So infants can recognize mispronounced words, but they have a harder time

Note: there was no effect for whether it was a close mispronunciation (opple) or a distant mispronunciation (opal) (contrary to prediction of neighborhood, which says that words that are more phonetically similar should be harder)

Swingley & Aslin 2002: Neighbors?



No relationship between mispronunciation effect and age or receptive vocabulary size (possible neighbors) - so it doesn't matter how many neighbors there are

Swingley & Aslin 2002: Really Neighbors?

Idea: Any mispronunciation may be noticeable (so not necessarily a difference between close mispronunciations & distant mispronunciations)

Good thing: If infants initially store words with phonetic detail, they don't need minimal pairs to force them into noticing more phonetic detail (minimal pair = *ball* vs. *doll*, which require some semantic knowledge to know they're different)

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
beɦ	baɬ	deɦ
beʃ	bøɬ	deʃ
bœyk	bœyn	kœyk
eɦt	eɸ	eɦt
h nt	hak	x nt
haʃ	heɦ	saʃ
hont	ho	font
ku	kus	xu
mont	maɦt	nont
nøɬ	nut	møɬ
paɦt	pøɦt	daɦt
pus	purt	tus
sxaɸ	sxeʃ	ɦaɸ
teɦ	to	peɦ
v s	vaɦt	v s
vut	veɦt	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 that drives the detailed representations of the sounds in the words.

Why does having a familiar word help? Another Idea

Idea: Maybe phonetic detail involves hearing the word a number of times - get a little more detail each time

{p/b/d/g}{a/o/u}{l/r} *"ball"*

…

(p/b}{a}{l/r}

…

{b}{a}{l}

If it's a novel word, kids haven't heard it enough yet.

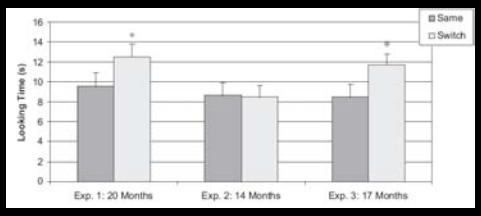
(Stager & Werker, 1997 = novel words with only 7 repetitions}

Werker et al. 2002: Vocabulary Size

Test

Same:
look at the *bih!*

Switch:
look at the *dih!*



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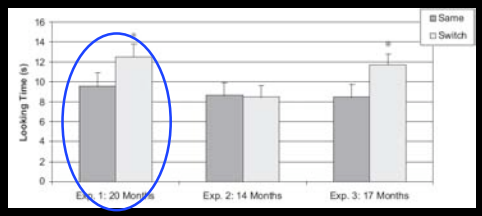


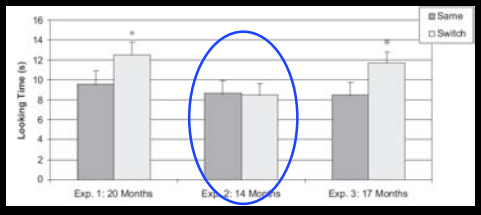
20-month-olds notice

Werker et al. 2002: Vocabulary Size

Test

Same:
look at the *bih!*

Switch:
look at the *dih!*



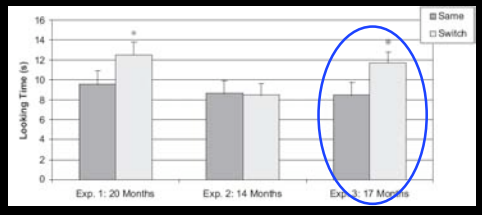
14-month-olds don't

Werker et al. 2002: Vocabulary Size

Test

Same:
look at the *bih!*

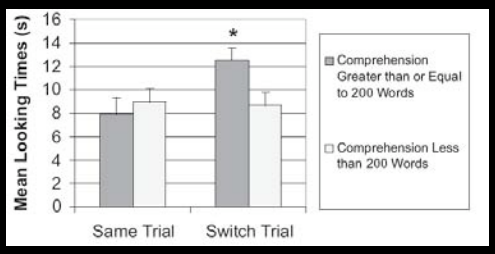
Switch:
look at the *dih!*



17-month-olds do

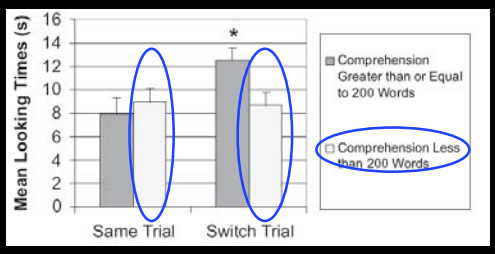
Werker et al. 2002: Vocabulary Size

Zoom in on the 17-month-olds



Werker et al. 2002: Vocabulary Size

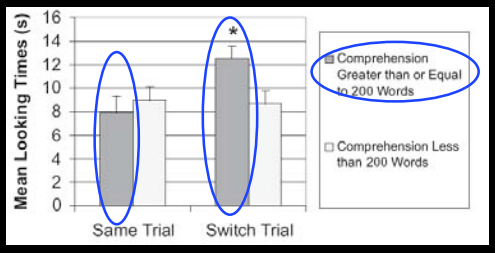
Zoom in on the 17-month-olds



Those with a small vocabulary look like 14-month-olds - they can't tell the difference.

Werker et al. 2002: Vocabulary Size

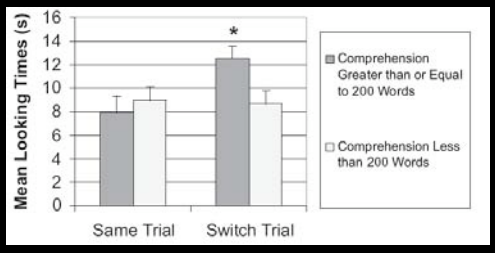
Zoom in on the 17-month-olds



Those with a large vocabulary look like 20-month-olds - they *can* tell the difference.

Werker et al. 2002: Vocabulary Size

Zoom in on the 17-month-olds



Implication: Performance on novel words *does* depend on how many words the child knows.

Why does having a familiar word help? Revising another Idea

Idea: Maybe phonetic detail involves hearing the word a number of times - get a little more detail each time and realize which sounds are phonemic in the language

{p/b/d/g}{a/o/u}{l/r}

…

(p/b}{a}{l/r}

…

{b}{a}{l}

If it's a novel word with a sound contrast children haven't encountered often enough, they will not distinguish it. (Stager & Werker (1997) results, Werker et al. (2002) results)

Word-learning & phonetic detail

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

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

Success on the Werker/Stager task seems to be related to the ***vocabulary spurt***, rapid growth in vocabulary after ~50 words

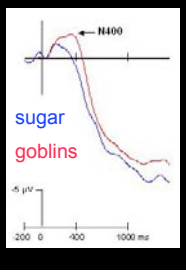
Children's Brains

Another look at children's knowledge

Neurological Data: Brain Activity at 14 months

N400 effect in adults: An event-related potential (ERP) component typically elicited by unexpected linguistic stimuli

I like my coffee with cream and…



Another look at children's knowledge

Neurological Data: Brain Activity at 14 months

N400-like effect in 14-month-olds when hearing an incongruous (mispronounced) familiar word paired with a familiar picture (Friedrich & Friederici 2005)

Familiar word: "cup"

Incongruous word: "tup"

Another look at children's knowledge

Neurological Data: Brain Activity at 14 months

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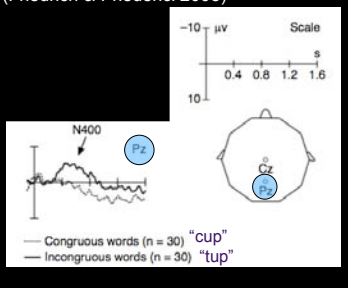
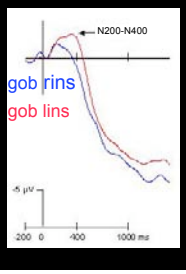


The child's brain responds as if the child has detailed phonetic information stored about familiar words.

Another look at children's knowledge

Neurological Data: Brain Activity at 14 months

N200-N400 effect in adults: An event-related potential (ERP) component typically elicited by word recognition



Another look at children's knowledge

Neurological Data: Brain Activity at 14 months

Mills et al. 2004: auditory presentation of word (no picture)

"cup"

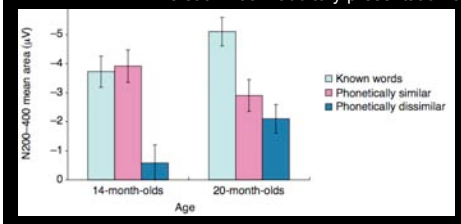
"tup"

Known words	Phonetically similar	Phonetically dissimilar
cup	tup	mon
bear	gare	kobe
nose	mose	jud
dog	bog	riss

Another look at children's knowledge

Neurological Data: Brain Activity at 14 months

Mills et al. 2004: auditory presentation of word

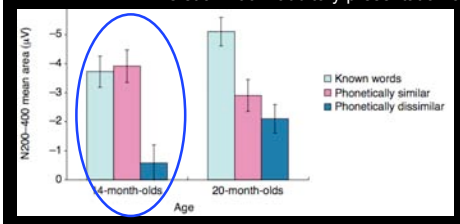


cup
tup
mon

Another look at children's knowledge

Neurological Data: Brain Activity at 14 months

Mills et al. 2004: auditory presentation of word



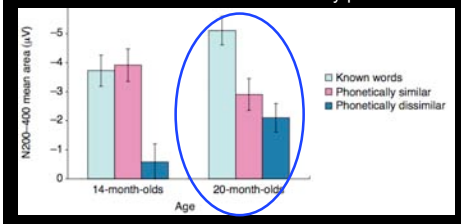
cup
tup
mon

14 months: brains respond as if they don't notice the difference in phonetic detail (cup = tup response)

Another look at children's knowledge

Neurological Data: Brain Activity at 14 months

Mills et al. 2004: auditory presentation of word



cup
tup
mon

20 months: brains respond as if they do notice the difference in phonetic detail (cup ≠ tup response)

Another look at children's knowledge

Neurological Data: Brain Activity at 14 months - why the difference?

N400-like effect when hearing an incongruous (mispronounced) familiar word paired with a familiar picture

(Friedrich & Friederici 2005)

No noticeable distinction between correct and mispronounced familiar words with auditory presentation of word alone

(Mills et al. 2004)

Speculation: Difference because recognizing the word form alone without link to real world object (meaning) is harder?

Question: Do infants need the whole word to recognize it, or can they recognize it from partial information?

Whole word: “baby”
Partial information: “ba..”

Adults can do this (incremental processing of a word).

We can test when children can do this by seeing if infants can recognize a word (and its meaning/referent in the world) before they hear the whole word.

Incremental Processing of Word Forms

Swingley et al. 1999

Eyetracking with 2-year-olds

doll dog

“Where’s the do…”

Incremental Processing of Word Forms

Swingley et al. 1999

Eyetracking with 2-year-olds

doll dog

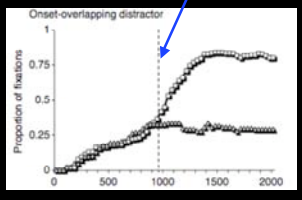
“Where’s the dog?

Incremental Processing of Word Forms

Swingley et al. 1999

Eyetracking with 2-year-olds: with onset-overlapping distractor (doll)

Looks to dog increase after crucial informative sound “g”



Incremental Processing of Word Forms

Swingley et al. 1999

Eyetracking with 2-year-olds

tree

dog

"Where's the do…"

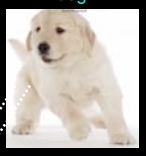
Incremental Processing of Word Forms

Swingley et al. 1999

Eyetracking with 2-year-olds

tree

dog



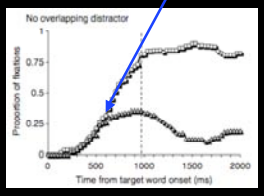
"Where's the dog?"

Incremental Processing of Word Forms

Swingley et al. 1999

Eyetracking with 2-year-olds: with non-overlapping distractor (tree)

Looks to dog increase as soon as initial part of word is recognized



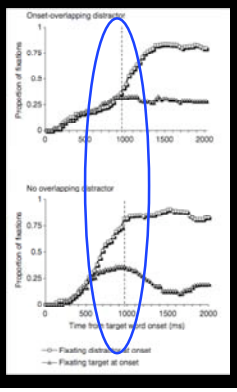
Incremental Processing of Word Forms

Swingley et al. 1999

Eyetracking with 2-year-olds

2-year-olds process words as the sound information is available - they don't have to wait till the end of the word to recognize it. This is how adults process language, too.

Time course: 2 yrs until incremental processing?



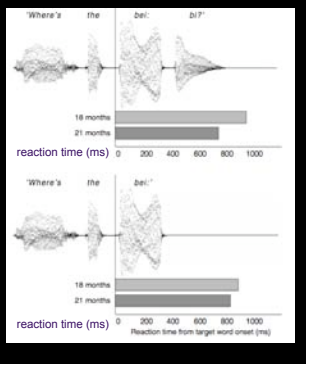
Incremental Processing of Word Forms

Swingley et al. 1999

Eyetracking

with 18- & 21-month-olds

Evidence for incremental processing even at this age.



Incremental Processing of Word Forms

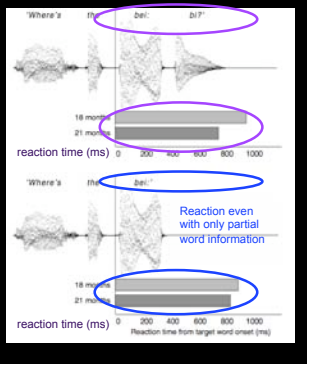
Swingley et al. 1999

Eyetracking

with 18- & 21-month-olds

Evidence for incremental processing even at this age: even if infants only get first part of the word, they shift their attention to the appropriate referent in the world (ex: the baby).

Equally fast reaction times for whole word vs. part-word reaction.



Incremental Processing of Word Forms

Swingley et al. 1999

Eyetracking

with 18- & 21-month-olds

Evidence for incremental processing even at this age.

Time course: By 18-months-old, children process words incrementally, just like adults.