

## Last of Infant Speech Perception Week3: Word Segmentation

Where we are  
By 9-10 months:  
infants know the fundamental  
of their L1 sound inventories,  
prosodics, phonotactics...

When and how do they start  
finding words (with them)?

### Jusczyk & Aslin 1995

"There are reports in the language acquisition literature that infants show some limited comprehension of words beginning at approximately 9 months ... Other studies suggest that comprehension skills are quite limited at 11 months, and that it is not until around 15 months that infants show signs of comprehending & recognizing novel words..."

### Jusczyk & Aslin 1995

Question:  
When do infants begin to reliably parse familiar words out of fluent speech?

*Critical words:*

feet    bike    cup    dog

*Population:* 6 and 7.5 month olds

*Method:* Preferential HT

### Jusczyk & Aslin 1995 Exp 1-2

Training: HT-triggered playing of 2 words (15 tokens), 30 s each  
Testing: 16 HT trials, list played till infant turned away

*Test sentences:*

"The **cup** was bright and shiny"

" A clown drank from the red **cup**"

" The **dog** was very friendly"

" The mailman called to the big **dog**"

### Jusczyk & Aslin 1995 Exp 1-2

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*Test sentences:*

"The **cup** was bright and shiny"

" A clown drank from the red **cup**"

" The **dog** was very friendly"

" The mailman called to the big **dog**"

## Jusczyk & Aslin 1995 Exp 1-2

### *Results:*

7.5 month olds listened longer to sentences with 'familiar' words,

6 month olds did NOT

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## What are infants doing? Exp 3

### *Interesting question:*

are infants paying attention to the WHOLE word they are 'segmenting' out of fluent speech?

### *New Critical words:*

'tup' 'zeet' 'gike' 'bawg'  
... Then tested on Exp 1 sentences!

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## Detail in segmentation: Exp 3

### *Results:*

7.5 month olds did NOT listen longer to passages with e.g. 'cup' repeated many times, after listening to lists of 'tup'!

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## Can infants segment first? Exp 4

### *Procedure:*

Training: lists of sentences with 2 key words

Testing: 12 trials of HT-triggered lists of 1 of 4 key words, played until infant looked away

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## Can infants segment first? Exp 4

### *Results:*

Yes! 7.5 month olds listened longer to the 2 lists of words that contained words from their training passages!

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## Myers et al 1996

### Question:

When do children become attuned to within-word phonotactics, in fluent speech?

(Remember F&W 93's 9 month olds...)

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## Myers et al 1996 Exp 1

*Population:* 11-month olds

*Method:*

- \* recording of IDS story telling
- \* 1 sec. pauses, inserted @ word boundaries OR within words:

'Some very big /animals live in the zoo'  
'Some very big ani /mals live in the zoo'

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## Myers et al 1996 Exp 1

Training: 8 trials, 4 of each list type, to get used to speaker/list affiliation

Testing: 12 trials BOTH side lights flash; list plays according to HT, until infant turns away.

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## Myers et al 1996 Exp 1-2

*Results*

11 month olds listened longer to word boundary pauses than w/n word ones ( $p < 0.05$ )

... But in later studies, 4.5 month and 9 month olds showed NO looking prefs.

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## Why do infants not like pauses w/n?

*Prosodic info?* Exp 3

low-pass filtered Exp1 passages  
... NO preferences in looking times

*Learned words?* Exp 4

"The emperor was slightly/disappointed"  
"The emperor was slightly disa/ppointed"  
... Sig. looking time pref. for 1<sup>st</sup> kind!

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## Does stress help? Exp 5

Recall facts that L1 English kids preferred Sw to wS?

"The emperor was slightly/disgrun~~t~~led"

"The emperor was slightly dis~~grun~~/tled"

"The emperor was slightly dis/gruntled"

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## Does stress help? Exp 5

Basic (if not terrifically robust) results:

Infants preferred lists with pauses btwn words than at *either* location w/n words

... This suggests they were NOT using stress cues to find words, at 11 months

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## Saffran et al 1996b

Question: What is the *mechanism* infants use to start word segmentation?

How can word-boundary phonotactics help if you don't know the word boundaries yet?

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## Saffran et al 1996b

"Within a language, the transitional probability (TP) from one sound to the next will generally be higher when the 2 sounds follow one another *within a word*, whereas TPs spanning a word boundary will be relatively low. For ex, given the sound sequence *pretty#baby* the TP from *pre* to *ty* is greater than the TP from *ty* to *ba*.

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## Saffran et al 1996b Exp 1

### *Population*

L1 E 8 month olds

### *Method*

Preferential looking (2 mins passive familiarization, HT-triggered test lists)

### *Training Materials:*

'bidakupadotigolabubidaku...'

\* synthetic speech, no prosodic cues

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## Saffran et al 1996b Exp 1

### *Training Materials:*

'bidakupadotigolabubidaku...'

\* synthetic speech, no prosodic cues

### *Testing:*

Looking times for 2 kinds of lists:

\* 'words' from training

\* 3 training syllables, wrong order

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## Saffran et al 1996b Exp 1

### *Results*

Longer looking times for non-words (7.97 real words vs. 8.85 non-words)

!!

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## Saffran et al 1996b Exp 2

### Making the TPs less obvious

### *Same Training Materials:*

'bidakupadotigolabubidaku...'

### *Testing:*

words: bidaku **padoti**

non words: kupati **dotigo**

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## Saffran et al 1996b Exp 2

### Results:

Still!

Longer looking times for non-words  
(6.77 real words vs. 7.60 non-words)

!!!!

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## How good ARE 7.5 month olds?

Jusczyk & Aslin 1995's words:

*feet cup bike dog*

\* later work: not ALL words  
can be segmented at 7.5 mos

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One big problem area:

Jusczyk & Aslin 1995's words:

*feet cup bike dog*

\* all stop/fric initial

Vowel-initial words: harder

\*not only 13-16 months!

(Nazzi et al 2005; see refs in Johnson and Seidl 2008)

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About V-initial words

\* V-initial words/syllables are X-  
ling marked, dispreferred

\* initial Vs may well get  
resyllabified... 'a.nA.dult'

\* BUT: children *produce* V-initial  
words before 15 months

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Johnson and Seidl 2008

Question: Can 11 month olds  
segment V-initial wds

\* if *phonetic cues* are held  
constant across train/test?

\* biggest cue: initial glottals

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Johnson and Seidl 2008 Exp 1

*Procedure:* Preferential looking

*Training:* Phrases with 2 V-initial  
non-words

*eff igg ash eeb*

"**Eff** runs a circus in Toronto

**Ash** is chicken soaked in lime juice

I wonder if **Egg** wants to juggle too

It seems **Ash** can stand on his head"

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## Johnson and Seidl 2008 Exp 1

### Testing:

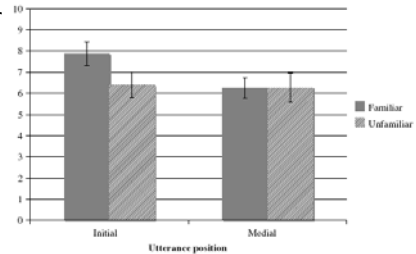
HD-triggered lists repeating 1 of the 2 familiar or 2 novel words...

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## Johnson and Seidl 2008 Exp 1

### Results:

Sig. longer looking to familiar words – only sentence-initially!



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## What kind of cues?

*Sentence-initial = pre-segmented?*

Exp 2: all pauses longer than 60 mscs between words/sentences removed ... Still found sig. looking time pref.

Lots of phonetic cues to word-initial V

- \* greater pitch reset
- \* relatively longer duration...

But also lots to word-*final* Vs!

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## Johnson and Seidl 2008 Exp3

*Can cues be used sentence-finally too?*

### Training:

"It is such bad luck to have a rough Eff  
We'll have to tell her we know Eff  
This baby giraffe seems creative like Ash  
He isn't nearly as shiny as that Ash"

Testing: Same word lists

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## Johnson and Seidl 2008 Exp3

### Results:

Infants still able to segment from final position!

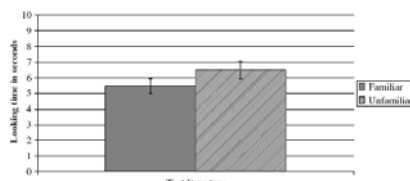


Fig. 4. Vowel-initial words sentence-final.

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## Johnson and Seidl 2008 Sum

By 11 months:

- \* some words are easier than others
- \* boundaries help a lot
- \* pitch changes, also duration, key
- \* note cnxn to IDS!

Infants' ability to segment a particular words lies on a continuum of factors.

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The biggest open question, I think

... Cross-linguistic comparisons?

How much do other L1-learning infants  
rely on:

- \* stress/word/sentence alignment
- \* vowel pitch/duration changes
- \* ... What else?!!

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- Saffran, Newport and Aslin 1996(a). 'Word Segmentation: The Role of Distributional Cues.' *Journal of Memory and Language* 35: 606-621.
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