Language development in childhood

attention to sound structure in infancy
word recognition and phonological encoding

Language
(as performed by a 3-year-old)

- Good narrative skills
- New words for new concepts
  - Light-up sword, pokey-ball*
- Phoneme errors
  - Erratic production of final L sound
    - "weel" followed by "wew"
  - sh --> s (tiny guy, spacesip)
  - th --> f (He tried to do it without seeing, Darf Vader)
- Verb forms overregularized ("blowed up")
- Social phrases (Darf Vader, he'll get ya!)

What’s going on in the first year

innate auditory abilities govern categorization of speech
then, infants start sorting out which sounds of a particular language are meaningfully different
at the same time, infants begin building a vocabulary of words (mainly sound-forms only, no meanings)
by 10-12 months, infants say their first words

What ARE they thinking?
(A Q&D tutorial on child language methods)

What do kids say (sounds, words)?
But what if they can’t talk?
Have to ask what they pay attention to.
  What seems interesting?
  What seems new?
  What means something’s going to happen?
What did a spoken word refer to?
What ARE they thinking?
(A Q&D tutorial on infant methods)

**Headturn Preference Procedure: What seems **interesting**?**

Play sounds out of a speaker

Some sounds of Type 1, some of Type 2

Does infant look at speaker longer (indicating more interest) for Type 1, or is there no difference?

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What ARE they thinking?
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**Habituation: What seems **new**?**

Version 1: high-amplitude sucking (HAS)–good if v. young kid gets to hear sound with each HA suck
after hearing the same sound, suck rate declines
present slightly-changed sound:
does sucking rate perk up again?
(= renewed interest)

Version 2: visual habituation
hear sound whenever kid looks at visual stimulus
gradually, look length declines
change sound: do looks get longer again?

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What ARE they thinking?
(A Q&D tutorial on infant methods)

**Conditioned Head-Turn Procedure**

teach kid that whenever sound Y happens, reward usually a toy drumming bear
then present X, X, X, Y, X…
do they look for reward at Y?
I.e., can they detect Y (is it different from X?)

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What ARE they thinking?
(A Q&D tutorial on infant methods)

1. trial starts with green light
2. once baby’s ready, flash one side light
3. when baby turns to light, start playing sounds from speaker
4. when baby turns away, stop sounds and start new trial

dependent measure: listening time to a given kind of auditory material
What ARE they thinking?

(A Q&D tutorial on infant methods)

Picture fixation: What did a spoken word refer to?

Show pictures of a ball and an apple.

Sound: “Look at the ball! Isn’t it nice?”

Videotape eyes as word is heard.

Code eye movements to given picture.

Do they look more at the ball than the apple? (=know the word?)

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**Early speech development**

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**innate auditory abilities**

Case study: Eimas et al., 1971, on [p] vs [b]--HAS

The sound [p] in, say, “a pack”:

1. stop vocal fold vibration
2. put lips together
3. release lips and let air through
4. start vocal fold vibration

Time between #3 and #4: **Voice Onset Time (VOT)**

VOT is a primary cue listeners use to distinguish [p] from [b] at syllable onset.

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VOT variation in English

\[
\begin{array}{c|c|c|c|c|c}
\text{VOT (ms)} & 20 & 0 & 20 & 40 & 60 & 80 \\
\hline
/p/ (voiceless) & & & & & & \\
/b/ (voiced) & & & & & & \\
\end{array}
\]

Voicing lead

- Short lag
  - like Spanish /b/
  - like Eng. /b/  
- Long lag
  - like Eng. /p/ 

Thai uses all three: ba: ‘crazy’; pa: ‘aunt’; paa: ‘cloth’
English speakers can distinguish synthesized b/p sounds differing only in VOT, if tested using 20 and 40 msec. But they can’t (or perform poorly) if tested using 0 and 20 or 40 and 60.

Categorical perception (strict definition): listeners can only discriminate sound pairs they can give different labels.

Categorical perception (loose definition): listeners are much better at discriminating between categories than within categories.

How do infants perceive speech sounds?
Eimas et al.: 1- and 4-month-olds; habituation procedure.

Uniquely human genetic innate language capacity!…or not

Further study: replications testing discrimination of many speech sounds.

Under ideal conditions, young infants can tell apart any two speech sounds that are used in any language for conveying different meanings.

Basic auditory ability
**language-specific refinement**

Werker & Tees 1984: test discrimination of Hindi dental and retroflex /t/, and discrimination of Nthlakampx velar and uvular consonants [k’] and [q’], using CHT.

Canadian babies: discriminated at 6-8 months only some did at 8-10 months almost none at 10-12 months

Infants get worse at discriminating sounds that aren’t contrastive in their language.

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**language-specific refinement: vowels**

Similar results, perhaps even earlier development

Polka & Werker 1994, using visual habituation procedure

German /u/ vs /y/  
4 months discriminate  
6 months don’t  
10-12 months don’t

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**language-specific refinement: vowels**

Catalan and Spanish

Catalan: has /e/ and /E/ (like “bait” and “bet”)  
Spanish: just something in between, near /e/  

Bosch & Sebastian-Gallés, using habituation procedure:

all 4.5 month olds discriminate /e/ and /E/;  
Catalan 8.0 month olds discriminate them too;  
Spanish 8.0 month olds don’t.

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*Once infants recognize phonetic categories, they’re all set, right?*

No! They still have to find words: the *segmentation problem*

Sometimes word boundaries are clear.
Sometimes word boundaries are not clear.

This is essentially what infants are faced with!

**What about actual speech to infants?**

In general, parents don’t do much to mark where linguistic units (words, phrases) begin and end. The baby has to figure that out.

Start by learning words in isolation?

Word-teaching experiment (see Aslin, 1993)
- Get parents to teach word (e.g., “rist”) to infants
- Parents rarely produced in isolation...

Even though trying to teach kids the word!

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**Infants’ learning of word-forms from speech**

Infants remember words from stories after two weeks. Shown by preference for hearing those words rather than other words.

*(Jusczyk & Hohne 1997)*

**Jusczyk & Hohne (1997)**

1. Visit home of 8-month-olds 10 times over 2 weeks.

On each visit, sit infant in a seat, and play a tape-recording of someone reading a story. Meanwhile flip through a book with pictures relating to story.

3 stories total, 30 min. per visit, 5 talkers each story.

*(Jusczyk & Hohne 1997)*
2. Wait 2 more weeks.

3. Use headturn-preference procedure to test word lists.

<table>
<thead>
<tr>
<th>In stories</th>
<th>Foils</th>
</tr>
</thead>
<tbody>
<tr>
<td>sneeze</td>
<td>aches</td>
</tr>
<tr>
<td>elephant</td>
<td>apricot</td>
</tr>
<tr>
<td>ants</td>
<td>sloth</td>
</tr>
<tr>
<td>gray</td>
<td>jaunt</td>
</tr>
<tr>
<td>python</td>
<td>lanterns</td>
</tr>
<tr>
<td>[...]</td>
<td>[...]</td>
</tr>
</tbody>
</table>

*in-stories* words occurred ~13 times per story visit.

Results (HPP): Infants preferred the familiar-word lists.

Results: Infants preferred the familiar-word lists.

But not in a control study of infants with the same test, but no familiarity with the stories.

8-month-olds remember at least some words they’ve heard (even if they don’t know what the words mean yet)
So how do they find the words?

Biases

Statistics

How do infants know which things might be words?

Distributional analysis: which things tend to go together. Sound sequences that appear together in various environments are more likely to be words.

- thatsaprettybabyisntit
- doyoulikeyourbabybrother
- thebabyspitupagain

Transitional probability:

- ba-->by: 100%
- ty-->ba: 33%
- by-->is: 33%

Saffran, Newport & Aslin 1996, 8-mo-olds (HPP):

Also works with tones, sequences of visual objects—*not a language-specific learning mechanism*

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* infants’ learning of word-forms from speech

Similar results to Jusczyk & Hohne are found with shorter training and testing just after the training.

These studies show that children are *biased* in what words they extract and remember.

-- extract strong-weak (BERry), not weak-strong (beRET)

[French infants do the reverse.]

Most English words are strong-weak.

French words (arguably) are weak-strong.

*Puzzle: how do you know what language you’re in to know what bias to have?*