Language development in childhood

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

- Good narrative skills
- Gestures
- New words for new concepts
  - Light-up sword, Obi-Wan is a teacher
- Phoneme errors
  - Erratic production of final L sound
    - “well” followed by “new”
    - sh --> s (tiny guy, spaceship)
  - th --> f (He tried to do it without seeing, Darth Vader)
- Verb forms overregularized (“blowed up”)
- Social phrases (Darth 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?

What ARE they thinking?

(A Q&D tutorial on infant methods)
Headturn Preference Procedure: What seems interesting?
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
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?

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?)

Early speech development

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.
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.

Uniquely human genetic innate language capacity!…or not

Basic auditory ability

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.

Some contrasts: some contrasts infants discriminated in studies

- big/pig
- shed/said
- dumb/nurb
- ñora/nora
- b/p
- b/d
- r/l
- b/w
- b/m

- s/z
- s/θ
- f/θ
- d/g
- E/e
- i/t
- w/j

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.
**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;
- Bilingual 8.0 month olds don’t;
- At 12 months, bilinguals regain.

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**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)**

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)**

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.
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>
</tbody>
</table>

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

Results (HPP): 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)

-- 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?

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.

**Transitional probability:**

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

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

```
baypado baidakupadotigolabubidakugolabu...
```

Likely listened longer to "novel" (low transitional probability) sequences `ku.pad` than to `bida`. Also works with tones, sequences of visual objects—*not a language-specific learning mechanism*.

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Learning word forms

**Statistics**

**Biases (from what?)**

12-month-olds know a stock of word-forms, possibly quite large (150-350 words), some of which are connected to some meaning.

These words, first learned only as sounds,* form the basis of the early vocabulary.

*For frequent words, children show some recognition as early as 6 months.

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Acquisition of the vocabulary:

**Words produced, shown by age, 8-16 months**

Oller & Eilers, 1988

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*Speech and babbling—developments in the first year*

- **Around 6-8 weeks:** cooing (contented vowel sounds)
- **Around 2-3 months:** some consonantlike sounds, often velars like [g] and [k]
- **Around 6 months:** other consonantlike sounds with labial or alveolar constriction ([m], [n], [b], [p], [d])
- **Around 6-9 months:** canonical babbling (dadada or nanana)
- **Around 11 months:** variegated babbling (dababi with prosody)

Also, throughout (and beyond) the first year, words gradually approach adult pronunciation.

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Onset of canonical babbling: age distribution

*Figure 5.7. Age of onset of babbling in nine hearing-impaired (filled symbols) and twenty-one normally hearing (open symbols) infants.*

Oller & Eilers, 1988
Words produced, shown by age, 16-30 months

Word learning

Are children’s word meanings fundamentally like ours?
Maybe not: some words may be context bound
   Bloom: car only for particular viewpoint
   Barrett: duck only for duck bath game
   Bates: words used only in the presence of their referent
But this phase is limited (only children’s very first words), and may refer only to production tendencies, not weird denotations.
Mostly, children’s words refer to categories, where the sorts of categories are comprehensible (even if they’re not quite the right meanings).

What do children talk about?
Why are children talking? -- Not only requests; many comments too.
Which words? -- a variety:
   proper nouns (Mommy);
   common nouns and pronouns (dog, this)
   action words (go, up, look)
   modifiers (all-gone, mine, big)
   social words (no, want)
   function words (what, for, is)
--K. Nelson 1973
As vocabulary expands, the proportion of nouns balloons.

Why so many nouns?
Some crosslinguistic variation; noun bias not universal
   Mandarin: children produce more verbs than nouns.
   (a) verbs more likely to be sentence-final
   (b) verbs vary less in their realization in M. than in Eng.
   (c) parents simply say more verbs in M.
But the general pattern favors nouns, and in particular object labels.
   Why?
   - maybe the concepts are simpler
   - maybe the concepts are easier to identify

Problems in word learning
Problems in word learning

**phonological encoding**: what sounds did you say?

**present-referent identification**: what are you talking about now?

**category identification**: how can a word be extended?

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**Phonological encoding**: production

Children’s speech: often hard to understand

“squirrel” (skwrl) → /ga/

- **simplify** consonant cluster skw → k (“cluster reduction”)
- **omitted** liquids /l/ and /r/
- **voiced** voiceless stop consonants
- **undifferentiated** vowels

Does children’s speech reflect their knowledge of words, or just what they can do with their vocal apparatus?

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**Phonological encoding**: perception

To find out what children know about sound forms, try testing their word recognition with correct pronunciations and mispronunciations.

If children know how words should sound, mispronunciations should be **harder to understand** than correct pronunciations.

If children only have a vague idea how words should sound, they **shouldn’t care** how words are said.

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Where’s the **ball**? Correct

Where’s the **gall**? Mispron.

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Target fixation given correct pronunciation and mispron., plotted by child’s age

- **Correct pronunciations**
- **Mispronunciations**

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Swingley & Aslin, 2000, 2002
% better on correct pron. than on mispronunciation, shown by child’s production vocabulary (14-23 months)

A small caveat: doesn’t work so well for new words
Stager & Werker, 1997, habituation w/14-m-o

“bih”
No dishabituation!
Fine with lif/neem

“dih”

My work: long time to get to adult performance

“Click on the candle”

Problems in word learning

phonological encoding: what sounds did you say?

present-referent identification: what are you talking about now?
category identification: how can a word be extended?

present referent identification

Saint Augustine, bishop of Hippo, AD 397
They say, I look: “the natural language of all nations”

W.V.O. Quine
but you never know -- “gavagai” problem

How can you really know what someone else is talking about?
Even if they point and say a single word, they could mean many different things.

3 views on Quine’s problem
1. just store a correlation matrix
2. linguistic constraints on hypothesis space
3. St. Augustine was right: intention reading carries the day
1. just store a correlation matrix

<table>
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<tr>
<th></th>
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<th>huge</th>
<th>animal</th>
<th>right-here</th>
<th>big-ears</th>
<th>scary</th>
<th>wrinkles</th>
<th>edible</th>
<th>yummy</th>
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</thead>
<tbody>
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<tr>
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<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Just store a correlation matrix—but what about…

• What are the features in the matrix?
  okay for object labels, but what about “all-gone” or “think”
• Lots of things are present when a word is heard (for example, the child), yet children home in on the right meaning
• What about fast mapping?
  relatively error free learning, w/few trials

Fast mapping example:
“Give me the chromium one, not the green one, the chromium one.” (for colors, shapes, or textures)
2, 3, and 4 year olds better than chance in later choosing the right color/shape/texture from a set of 4.
Carey & Bartlett, 1978; Heibeck & Markman, 1987

Success in fast mapping suggests that “brute-force correlation”—gathering lots of information over lots of different exposures—is not the way children learn words.

2. linguistic constraints on hypothesis space

Success in fast mapping suggests that “brute-force correlation”—gathering lots of information over lots of different exposures—is not the way children learn words.

2. linguistic constraints on hypothesis space

Linguistic context as an aid in word learning

Roger Brown (1957), 3-4 year olds
“sibbing” vs. “some sib”
  sibbing --> verb interpretation
  some sib --> substance interpretation

Katz, Baker, & Macnamara (1974), 17 month olds
“a dax” vs. “Dax”
  object
  animate critter

Naigles (1990), 2-year-olds
1. rabbit pushing duck down; rabbit and duck twirl arms
  “The rabbit is gorping the duck.” or
  “The duck and the rabbit are gorping.”
2. rabbit pushing duck vs. rabbit and duck arm-twirling
  “Find gorping!”

2. linguistic constraints on hypothesis space

Maybe children are biased against certain word meanings, simplifying the learning problem.

Ellen Markman: constraints on object labels
  whole object assumption
  mutual exclusivity constraint

Experiments:
  “Where’s the mdo?”

More complex situation:
  “Hold the handle.”

Here, mutual exclusivity outranks whole-object assumption
3. St. Augustine was right

That is, maybe children are really good at figuring out what their parents are probably talking about, so word learning isn’t so hard after all.

Lots of social cues--joint attention

category identification: how should a word be extended?

Often, shape most important

“This is a dax.” (i.e. this has the non-obvious property of being called a dax.)

“Is this a dax?”

“Is this a dax?”

“Is this a dax?”

Landau, Smith, & Jones 1988
(2- and 3-year-olds)

Shape not always the most important factor
Soja, Carey, & Spelke 1991, 2-year-olds

Show children (a) novel object or (b) heap of substance

“This is a blicket.”

Test: “Find another blicket.”
(a) group: Picked same shape (b) group: Picked same substance

In general, children use whatever information they think is most relevant for identifying the category denoted by a word.

for object labels:
shape
material composition
function
intended category or intended function