Word Learning

Informatics 1 CG: Lecture 9

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January 29, 2016

Reading:

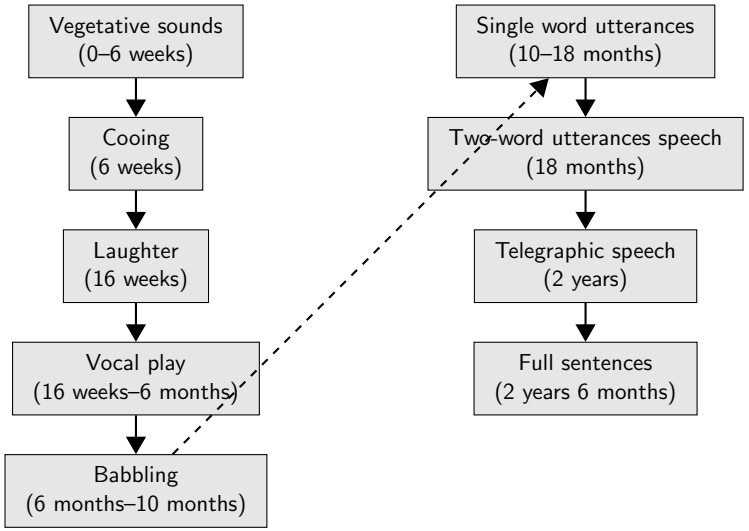
T. Harley (2001). The Psychology of Language, Chapter 4

Recap

In order to acquire a lexicon young children segment speech into words using multiple sources of support; we focused on distributional regularities.

- transitional probability provides cues
- verified by Saffran et al. (1996) experiments
- Brent and Cartwright's (1996) computational model of word segmentation
- Based on Minimum Description Length Principle
- In today's lecture we focus on word learning

The Development of Language



The Linguistic Genius of Babies

Learning to speak is much harder than it first appears, and the mechanics necessary to achieve it are complex.

The Word Spurt

- First words are typically produced between 10–15 months
- Next few months: add 8–11 words per month
- At about 50 words (approx 18 months), acquisition of words takes off: add roughly 10 words per day.

Task for Language Learner

- Mapping a stream of sound to meaning
- Task 1: learning which sound sequences are words using clues such as stress, transitional probabilities, caregiver speech, some degree of subtraction.
- Task 2: Pairing sounds with meanings (e.g., objects, events).

Semantic Development is Hard!

Mom says: Isn't the moon pretty?

- How does the child pick the correct referent for *moon*?
- Is *moon* even an object available in its visual field?
- How does it know *moon* refers to an object rather than a property (silver colored, round)?
- The moon has different shapes (crescent, full moon), but is still the same object.
- The task of associating names with objects and actions is enormous!

Meaning Errors (Overextensions)

moon: any round thing
(cakes, round marks, postmarks, letter o)

dog: anything furry
(dog, cat, sheep, slippers, fur coats, rugs)

potato: any food wrapped in foil
(baked potato, sweet potato, pizza)

fly: any small, possibly mobile object
(specks of dirt, dust, small insects, bread crumbs)

Meaning Errors (Underextensions)

kitty: only the family kitty

Meaning Errors

Overextensions

- Possibility 1: Child has incomplete definition (once *four-legged* is added to the meaning of *doggie*, *slippers* and *rugs* are no longer *doggies*).
- Possibility 2: Child is compensating for vocabulary limitations (once the child learns *cat* and *sheep*, those animals are no longer *dogs*).

Underextensions

- Possibility 1: Child has trouble separating the essential features from the accidental.
- Possibility 2: Child attempts to be conservative.

The Mapping Problem

W. V. O. Quine (1960) *Word and Object*

A rabbit!
Our dinner!
Shh, be quiet!
What a cute furry thing!
Rabbit parts!
Get it out!
Don't move!
What long ears!

The child does not know which attribute is being labeled!

Word Meaning Clues

So how do children learn what words mean? Given the array of things a word could mean, how do they decide what it means?

- **Socio-Pragmatic clues:** eye gaze, facial expression, inference of speakers semantic intentions.
- **Child-directed speech:** focus on the here-and-now, labeling objects that the child is looking at.

```
M:  That's a chair.
M:  It's called an eel. It's like a snake,
    only it lives in the water.

Ch: Mommy, where my plate?
M:  You mean your saucer?
Ch: Yeah.
```

The Mapping Problem

But speech-context correspondence isn't always sufficient and could be misleading!

Mom says: *What are you doing?*
(not *This is a door.*)

Mom says: *Eat your peas*
(child is thinking about the family dog).

Word Meaning Clues

So how do children learn what words mean? Given the array of things a word could mean, how do they decide what it means?

- **Socio-Pragmatic clues:** eye gaze, facial expression, inference of speakers semantic intentions.
- **Child-directed speech:** focus on the here-and-now, labeling objects that the child is looking at; but speech-context correspondence isnt sufficient and could be misleading.
- **Internal Assumptions:** Whole Object Assumption, Taxonomic Assumption, Mutual Exclusivity Constraint
- **Syntactic Bootstrapping:** exploiting syntactic structure to uncover word meaning.

Whole Object Assumption

Words refer to a whole object, rather than individual attributes or parts. Adults are sensitive to this constraint too!

Word learning experiments

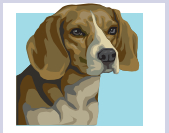
- 3-year olds see unfamiliar objects (*pagoda, lung, microscope*)
- Use an unfamiliar word (e.g. *finial, trachea, platform*)
- Test whether word referred to whole or part.
- Observe a tendency to associate words with wholes.

(Markman & Wachtel, 1988; Mervis & Long, 1987; Taylor & Gelman, 1988; Waxman & Markow 1995).

Taxonomic Assumption

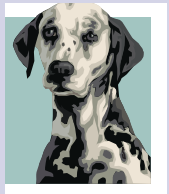
Words refer to things of the same kind rather than things that are thematically related.

Markman and Hutchinson (1984): No Word Condition



Look carefully now. See this?

59%



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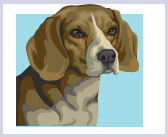
Find another one that is the same as this.

Taxonomic Assumption

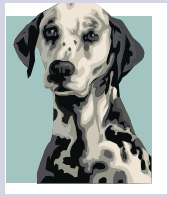
Words refer to things of the same kind rather than things that are thematically related.

Markman and Hutchinson (1984): Word Condition

83% 17%



See this? It is a sud.



Find another sud that is the same as this sud.

Mutual Exclusivity Assumption

Each object has only one label.

- Children do not usually like more than one name for things.
- Few meanings have more than one word.
- Pinker: Homonyms are plentiful, synonyms rare.
- Given a new word, children will chose to apply it to an object without a name rather than an object with a name. (Clark 1990, de Villiers & de Villiers 1992, Markman 1991).
- Constraint is also used to override the whole word assumption (Markman & Wachtel, 1988). e.g., When the child already knows *cup* and mother says, *this is a handle*.

Mutual Exclusivity Assumption

Mervis and Bertand (1994)





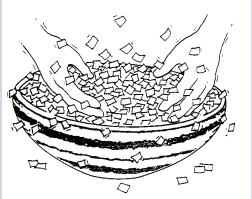
"Can I have the shoe?"
"Can I have the *zib*"

- Showed familiar objects + 1 unfamiliar object
- Children who had "word-spurted" concluded that the *zib* referred to the unfamiliar object.

Syntactic Bootstrapping

- There are syntactic cues to learning word meaning.
- Brown (1958) first proposed that children may use parts of speech as a cue to meaning.

Children are shown a picture and told either:



- Do you know what it means to sib? In this picture you can see sibbing. (verb)
- Do you know what a sib is? In this picture you can see a sib. (count noun)
- Have you seen any sib? In this picture you can see sib. (mass noun)

Syntactic Bootstrapping

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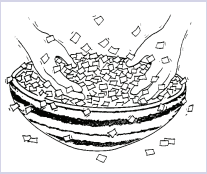
During test trials:

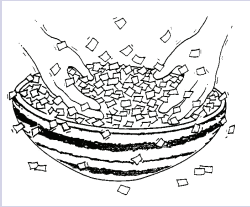


- Verb learners: Can you show me sibbing?
- Count noun learners: Can you show me a sib?
- Mass noun learners: Can you show me sib?

Syntactic Bootstrapping

- There are syntactic cues to learning word meaning.
- Brown (1958) first proposed that children may use part-of-speech as a cue to meaning.

And the result was:



- Verb learners tend to construe "sibbing" as referring to the action.
- Count noun learners tend to construe "sib" as referring to the object.
- Mass noun learners tend to construe "sib" as referring to the substance acted on.

- Children use structure of sentences in combination with what they perceive in the world to interpret meaning of new words.
- Children learn a great deal of syntax before word meanings!

Summary

Word learning is hard, children use multiple sources of support:

- use of socio-pragmatic skills
- some aspects of child directed speech
- biases towards certain interpretations over others
- linguistic constraints through use of syntax

Remaining questions:

- Relative contribution of each information source.
- Whether the constraints are language specific or general strategies.
- Whether the constraints are innate or acquired.

Next lecture: learning syntactic categories.