The Language Acquisition Debate

COMP-599

Nov 26, 2015

Announcements

Course evaluations now open.

Course projects: Due on myCourses. Submit by **Dec 17, 11:59pm** without penalty

I'd like to send everybody in the class a copy of your project report, so that you know what everybody else in the class did. If you'd like, please let me know and I'll include it.

Outline

Stages of language acquisition

Universal Grammar

Criticisms of Universal Grammar

Language Learning

How to get

from  to 

L1 Acquisition

Learning your first language is called **L1 acquisition**.

Actually, even the term acquisition is a little bit loaded:

- Acquisition, as opposed to learning, implies that there is no teaching or conscious learning involved.

Stages:

Pre-linguistic sounds

One-word stage

Two-word stage

Telegraphic stage

Multi-word stage

Pre-linguistic Stage

Cooing stage

- 0-1 month (sleep, eat, cry)
- 1-4 months (intonation)

Babbling stage

- 5-12 months

One-Word (Holophrastic) Stage

At around 9-18 months, start saying individual words.

Indicate acquisition of:

- sound-to-meaning mapping
- conveying action, desire, emotion
- naming function

In general, comprehension precedes production:

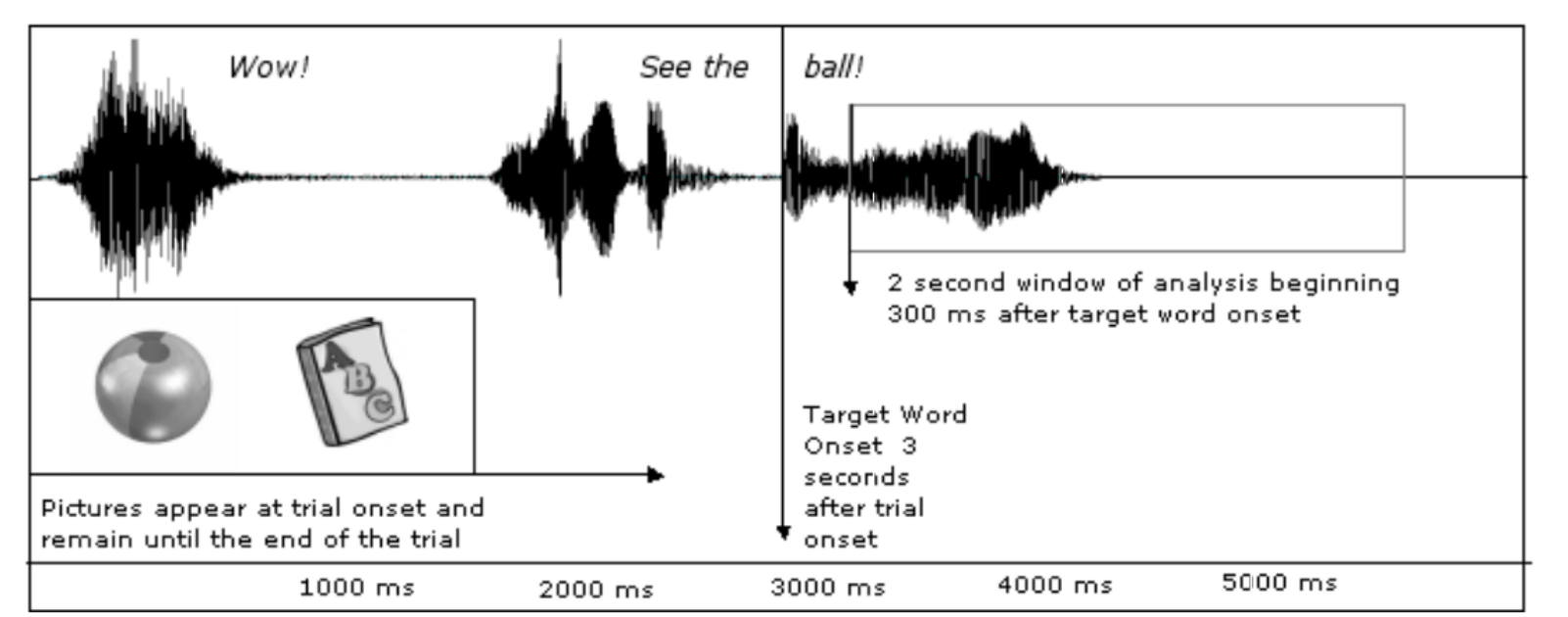
- Children producing 10 words can understand about 60 (Benedict, 1979)

Testing Newborn Awareness

Can test newborns even before they produce much language

Preferential Looking Paradigm

- Show baby two pictures side by side (or other stimuli), track their eye movements to test word learning



from Johnson and Zamuner, 2010

Two-Word Stage

18-24 months

"Proto-sentences" with simple syntactic relations:

Subject-verb	*Kitten go.*
Verb-modifier	*Eat fish.*
Possessor-possessed	*Baby toy.*

Go through stage of **overgeneralization**:

Me go

rather than

I go

Telegraphic Stage

24-30 months

Leave out most functional morphemes, say only content morphemes

See cow.

Doggy bite.

Kathryn no like celery.

Baby doll ride truck.

Pig say oink.

Car going?

Examples from http://www.ling.upenn.edu/courses/Fall_2011/ling001/acquisition.html

Towards Adult-like Grammar

Syntactic complexity increases

Vocabulary increases (20-30 words per day from 2-5 years old)

Speech sounds: gradually become more and more adult-like

- Acquisition of “difficult” sounds such as [r], [ch], [th], [zh], by age 8

Question

How do children come to learn their mother tongue?

Need to account for the following:

- Universality (barring atypical development)
- Does not require explicit instruction
- Goes through similar stages across all languages and cultures, despite their differences
- “Fast” (though not clear compared to what)

Universal Grammar (UG)

A proposal that much of linguistic knowledge is *innate*, and *hard-wired*; i.e., part of humanity's genetic endowment

UG:

- constrains what possible human languages are
- is said to be *unique to language* (as opposed other aspects of cognition)
- *is not learned*

Related to the last point, UG is associated with positing a structure "in the brain" that contains an innate capacity for language, called the **faculty of language**.

Polysemy of the Term UG

There are at least two senses of the word UG.

Many disagreements are due to people, sometimes deliberately, referring to the wrong sense of the term.

Sense 1: The true underlying genetic basis for human language – unfalsifiable, and not a scientific theory (in the Popperian sense)

Sense 2: A proposal about the nature of human language and how it is related to language acquisition – falsifiable

Argument from the Poverty of Stimulus

Argument that there is insufficient linguistic data for children to learn their mother tongue

Though compatible with both UG and no UG, often presented as something that UG can explain

Example: Syntactic structure in yes-no questions in English (Chomsky, 1975)

That man is happy.

Is that man happy?

That man can sing.

Can that man sing?

Yes-No Questions

Competing hypotheses:

1. Child has innate knowledge syntactic structure, and 'moves' the auxiliary verb from one syntactic position to another.
2. To form the question from the declarative , go to the sentence until you get to the first *is*, *can*, or other similar word (i.e., the class of auxiliary verbs and modals), and move it to the front of the sentence.

Under an empiricist view, it is claimed that H2 should be preferred, because it is simpler and does not require positing language-specific structures.

Generalization

The first hypothesis generalizes correctly, but not the second one.

The boy who is reading is happy.

H1: Is the boy who is reading happy?

*H2: *Is the boy who reading happy?*

Problems with this argument?

Statistical Learning

Perfors et al., (2006) showed that a statistical learner exposed to child language data can learn to prefer the hierarchical hypothesis over a flat hypothesis:

- PCFG
- Regular grammar (essentially a bigram language model)
- Flat (memorize all of the data in the training corpus, only)

Test corpus likelihood is higher with the PCFG.

There are more sophisticated arguments for APS.

Computational Learning Theory

Recall that a (formal) language is a set of strings

Classes of languages we have looked at include:

- Regular languages
- Context-free languages

Some others (not exhaustive):

- Mildly-context sensitive languages
- Context-sensitive languages
- Turing-complete

Language learning = selecting a particular language from a class of languages

Gold, 1967

Treats language learning as **identification in the limit**

Learner is presented with an infinite series of strings, $s_1, s_2, \ldots$, generated from language L, and must select L from among a class of languages. Every string in L must appear at least once in the presentation.

Learner updates their decision on what language to select after seeing each string.

Can learner eventually find and maintain the correct language L, after N steps? Strings may be presented in any order.

Results by Gold

1. The class of finite languages is IIL.
2. A finite class of recursive languages is IIL.
3. A supra-finite class of languages is not IIL..
    - All finite languages plus at least one infinite language

Result 3 is said to support the APS, and indirectly, UG.

Rebuttals to Universal Grammar

Theoretical

- Re-examine assumptions about learnability from a formal or statistical perspective

Empirical

- Criticize specific proposals for UG and its contents

Proposing alternative accounts of language learning

- Unsupervised models of grammar induction
- Cognitively plausible language learning

Realistic Assumptions About Learning

IIL is overly severe and unrealistic:

- Strings may be presented in any order!
- Not able to make use of **indirect negative evidence** – if something hasn't appeared after a while, it's probably not in the language!

Statistical learning can help us make use of indirect negative evidence

- e.g., maximum likelihood estimation from a training corpus, which we have seen throughout this course

Unsupervised Statistical Learning

In NLP, we have many unsupervised algorithms and models of grammar induction.

- What are some examples we have seen?

These are more for language technologies, though. At best a “proof of concept”.

Cognitively Plausible Models

In cognitive science, develop cognitively plausible models of language learning:

- Use child-language data (e.g. CHILDES http://childes.psy.cmu.edu/)
- Models are incremental, and updated as more data is given to the learner
- Incorporate semantic information into learning

Usually validated by whether models replicate human language learning behaviour in some way

- e.g., whether models go through a phase of overgeneralization, as toddlers do

Specific Proposals for UG and FL

Somewhat tangentially, there have been other claims of **language universals**

In some, older formulations of UG, there have been specific claims about characteristics of languages that are universal, and others that can vary in restricted ways.

Principles and parameters

- Principles are universal across all languages
- Parameters are settings vary across languages

Evans and Levinson, 2009

E&L compile a list of such claims of language universals, and find counterexamples for them:

http://pubman.mpdl.mpg.de/pubman/item/escidoc:468682/component/escidoc:468681/FinalMyth.pdf

Criticisms of Evans and Levison

One common criticism of this work: they do not analyze language data deeply.

e.g., E&L claim that Kayardild lacks recursion on embedded clauses, because in this language, embedding requires a certain affix, and there can only be one of them.

Safir (2010), argue that there is actually recursion in this case, but it is "blocked" by this morphological restriction.

Disagreement about level of analysis:

- If we are allowed to posit abstract entities without limits, can account for any data!
- On the other hand, the specifics of how something works in each language will be different. What is equivalent?

Space of Possible Languages

If there is no agreement on what kinds of analyses are admissible, it seems like there is no way to settle the debate.

Also, *we don't have a good sample of all conceivable languages*.

- Many languages have gone extinct
- Many languages belong to language families, which have a common ancestry with other languages
- Languages may borrow features from each other

Discovering linguistic universals seems like a daunting task, given these issues.

Another Proposal: Recursion

Hauser, Chomsky, and Fitch (2002) propose that **recursion** is the only component of UG.

- A major retreat from previous claims
- Later, they clarified that recursion could also be part of other cognitive mechanisms, such as visual processes.

Pirahã (Everett, 2005)

Spoken by <400 people in the Amazon

Claimed to have no morphological or syntactic recursion *of any kind*:

- No clausal embedding beyond one level (e.g., relative clauses, subordinate clauses, etc.)
- No coordination or disjunction
- Multiple adjectives, adverbs, etc. not allowed
- No numbers (just words for smaller amount, larger amount)

Response by Chomsky: even if recursion does not exist in Pirahã, it is not a necessary property of all languages

Readings

- Chomsky, Noam. "Reflections on language." *New York: Pantheon* 212 (1975).
- Everett, Daniel 2005. Cultural Constraints on Grammar and Cognition in Pirahã: Another Look at the Design Features of Human Language. Current Anthropology 46:621–646.
- Evans, Nicholas, and Stephen C. Levinson. "The myth of language universals: Language diversity and its importance for cognitive science." *Behavioral and brain sciences* 32.05 (2009): 429-448.
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- Perfors, Amy, Josh Tenenbaum, and Terry Regier. "Poverty of the stimulus? A rational approach." Proceedings of *Cognitive Science*. 2006.