

Psych 215L: Language Acquisition

Lecture 1 Introduction to Language Acquisition

Administrivia

Class web page:

http://www.socsci.uci.edu/~lpearl/courses/psych215L_2012fall/

Accessible from EEE and my home page, as well. Contains overview, schedule, readings, course assignments, and grading policies.

Important to access readings

user name = langacq

user password = models

Authentication Required	
Enter username and password for "Linguistics Readings" at http://www.socsci.uci.edu	
User Name:	<input type="text" value="langacq"/>
Password:	<input type="password" value="models"/>

Knowledge of Language

It's so natural for us to produce and comprehend language that we often don't think about what an accomplishment this is.

Or how we learned language in the first place.



Jackendoff (1994)

"For the moment, the main thing is to appreciate **how hard a problem this is**. The fact that we can talk (and cats can't) seems so obvious that it hardly bears mention. But just because it's obvious doesn't mean it's easy to explain. Think of another perfectly obvious, well-known phenomenon: the fact that metals turn red when you heat them. Why does this happen? It could be otherwise - they might just as well turn green or not change color at all. It's a simple phenomenon, easily observable, but the explanation isn't simple at all. It turns out to involve at the very least the theories of electromagnetic radiation and quantum mechanics, two of the more amazing intellectual advances in the past century. So it is, I want to suggest, with the human ability to use language."

About Language

Language is a complex system of knowledge that all children learn by listening to native speakers in their surrounding environment.



It includes sound structure, word structure, word meaning, sentence structure, mapping from sentence structure to meaning, unspoken rules of conversation...

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Stress pattern → go blins

Individual sounds (in IPA) → g a b l i n z

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goblin (plural) = goblin + s

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Language is a complex system of knowledge that all children learn by listening to native speakers in their surrounding environment.

Goblins like children.



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About Language

Language is a complex system of knowledge that all children learn by listening to native speakers in their surrounding environment.

Don't goblins like children?

Goblins like children.



goblins

goblin (plural) = goblin + s

go blins

g a b l i n z


It includes sound structure, word structure, word meaning, sentence structure, mapping from sentence structure to meaning, unspoken rules of conversation...

Some Terminology

Phonology: sounds and sound system of the language

g a b l i n z go blins

Lexicon: Words and associated knowledge (word forms, word meanings, etc.)

goblins =  (not koblins)

Morphology: system for combining units of meaning together

(goblin + [plural] = goblins)

Some Terminology


Syntax: system for combining words into sentences

Goblins like children.

Pragmatics: knowledge of language use

Don't goblins like children? = surprise if the answer is 'no' (expectation is that the answer is 'yes')

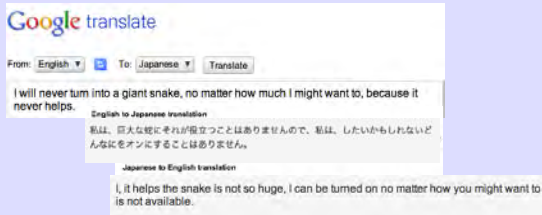
Use this question format to show expectation of a 'yes' answer.



So About That Universal Translator...

Languages can differ significantly on how they instantiate this knowledge, particularly the structural knowledge.

Automatic translation attempts (when structural differences strike!) demonstrate this (using <http://translate.google.com>)



Kids Do Amazing Things

Much of the linguistic system is already known by age 3.



...when kids can't tie their own shoes or reliably recognize "4".

What kids are doing: extracting patterns and making generalizations from the surrounding data **mostly without explicit instruction.**

Terminology: Patterns or "rules" of language = **grammar**

How do we know they're not only imitating or being taught?

Imitation certainly *is* useful for learning some aspects of language, such as learning that the sequence of sounds "cat" refers to a furry, purring pet.



However, children can't learn how to understand and produce full sentences by imitating what they hear and repeating it word for word.

Why not?

One reason: Most sentences are novel – you understand and produce them on the fly, and may never have heard them before.

How do we know they're not only imitating or being taught?

Also, it turns out that children are bad at imitating sentences where they don't know some of the words (so how could they learn those words by imitating them?):

"The cat is hungry" becomes "Cat hungry."

In addition, children don't often repeat word-for-word what adults around them say.

How do we know they're not only imitating or being taught?

(From Martin Braine)

Child: Want other one spoon, Daddy.
 Father: You mean, you want the other spoon.
 Child: Yes, I want other one spoon, please Daddy.
 Father: Can you say "the other spoon"?
 Child: Other...one...spoon.
 Father: Say "other".
 Child: Other.
 Father: "Spoon."
 Child: Spoon.
 Father: "Other spoon."
 Child: Other...spoon. Now give me other one spoon?



How do we know they're not only imitating or being taught?

What about children of immigrants?

"The adults often never feel comfortable with the language of the adopted country...speak with an accent...their children become fully fluent native speakers of the new language. Evidently the children have learned something their parents don't know. So the parents couldn't have taught them." - Jackendoff (1994)

How do we know they're not only imitating or being taught?

It's also unlikely children learn by being explicitly taught. This is because once we go beyond the most superficial things (like "cat" is a furry, purring pet), most of our knowledge is subconscious (more on this later). *We know it – but we don't know how we know it or why it's so.*

A learning analogy: Set



Here are some cards - they have some salient properties associated with them.



A learning analogy: Set



Task: Find Sets.

Here's one:



What generalizations might you make about Sets?

A learning analogy: Set



Task: Find Sets.

Here's another one:



Does this fit your generalization?

A learning analogy: Set



Task: Find Sets.

Here's another one:



What about this one?


A learning analogy: Set



Task: Find Sets.

Are these Sets?




A learning analogy: Set 

Task: Find Sets.

Are these Sets?


			Yes
			Yes
			No

A learning analogy: Set 

Task: Find Sets.

Here are some more examples:


What generalization can you make now?

A learning analogy: Set 

Task: Find Sets.

Are these Sets?

Can you guess the rule of Set?

A learning analogy: Set 

Task: Find Sets.

Are these Sets?

			No
			No
			Yes

Can you guess the rule of Set?

The Grammar of Set

"To create a SET, a player must locate three cards in which each of the four features is either all the same on each card or all different on each card, when looked at individually. The four features are, symbol (oval, squiggle or diamond), color (red, purple or green), number (one, two or three) or shading (solid, striped or open)." - www.setgame.com

Back to Kids & Language

Children infer rules with this amount of complexity (and more!) from examples of language. And sometimes, even when there's noise (misleading examples in the input).

Noise Analogy: "All these are Sets."

noise

not really a set

Knowledge of Language & Hidden Rules

Some examples from language:

You know that...

... *strop* is a possible word of English, while *stvop* isn't.

Knowledge of Language & Hidden Rules

Some examples from language:

You know that...


...In "She ate the peach while Sarah was reading", *she* ≠ *Sarah*

but *she* can be *Sarah* in all of these:

Sarah ate the peach while *she* was reading.

While *she* was reading, *Sarah* ate the peach.

While *Sarah* was reading, *she* ate the peach.



Knowledge of Language & Hidden Rules


Some examples from language:

You know that...

...the 's' in 'cats' sounds different from the 's' in goblins

cats: 's' = /s/

goblins: 's' = /z/





Knowledge of Language & Hidden Rules

Some examples from language:

You know that...

...one structure doesn't necessarily have the same interpretation.

This is the rabbit I want to banish.
 == I want (me) to banish the rabbit.
 [NOT: I want the rabbit to banish (something).]

This is the rabbit I want to disappear.
 == I want the rabbit to disappear.
 [NOT: I want (me) to disappear the rabbit.]


Knowledge of Language & Hidden Rules

Some examples from language:

You know that...

... contracted forms like "wanna" and "gonna" can't always replace their respective full forms "want to" and "going to".

You get to choose who you will rescue.
 "Who do you want to rescue?"
 "Who do you wanna rescue?"



Knowledge of Language & Hidden Rules



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You get to choose who will do the rescuing.
 "Who do you want to do the rescuing?"
 * "Who do you wanna do the rescuing?"


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"I'm **going to** the witch's lair to rescue her."
 * "I'm **gonna** the witch's lair to rescue her."



Knowledge of Language & Hidden Rules

Some examples from language:

You know that...

...these two statements mean fairly different things:

"Not even ten years ago **you could** see *Labyrinth* in theaters."
Could you see Labyrinth in theaters within the last ten years?

"Not even ten years ago **could you** see *Labyrinth* in theaters."
Could you see Labyrinth in theaters ten years ago?

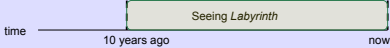
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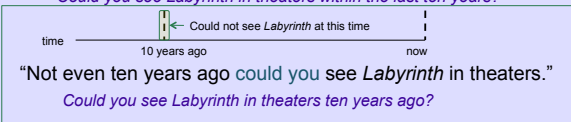
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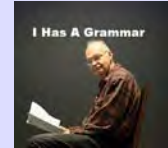
Could you see Labyrinth in theaters within the last ten years?



"Not even ten years ago *could you* see *Labyrinth* in theaters."

Could you see Labyrinth in theaters ten years ago?

What's being learned:
Patterns or "rules" of language = **grammar**



A distinction: Prescriptive vs. Descriptive Grammar Rules

Prescriptive: what you have to be taught in school, what is prescribed by some higher "authority". You don't learn this just by listening to native speakers talk.

"Don't end a sentence with a preposition."
" 'Ain't' is not a word."



A distinction: Prescriptive vs. Descriptive Grammar Rules

Descriptive: what you pick up from being a native speaker of the language, how people actually speak in their day-to-day interactions. You don't have to be explicitly taught to follow these rules.

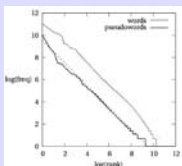
The dwarf is who Sarah first talked **with**.

"You're horrible!" - Sarah
"No, I **ain't** - I'm Hoggle!" - Hoggle



A property of language use (and other things): Zipfian distribution

"Under the so-called *Zipf's law* (Zipf 1949), the empirical distributions of [linguistic items] follow a curious pattern: relatively few [items] are used frequently—very frequently—while most [items] occur rarely, with many occurring only once in even large samples of texts. More precisely, the frequency of [an item] tends to be approximately inversely proportional to its rank in frequency." – Yang 2010



Zipfian distribution of words (top) and pseudowords (bottom) in the Brown corpus. The lower line is plotted by taking "words" to be any sequence of letters between e's (Chomsky 1958). The two straight dotted lines are linear functions with the slope -1, which illustrate the goodness of the Zipfian fit.

A property of language use (and other things): Zipfian distribution

"...the Zipfian nature of language raises important questions for the development of linguistic theories. First, Zipf's law hints at the inherent limitations in approaches that stress the storage of construction-specific rules or processes (e.g., Goldberg 2003, Culicover & Jackendoff 2005). For instance, the central tenets of Construction Grammar views constructions as "stored pairings of form and function, including morphemes, words, idioms, partially lexically filled and fully general linguistic patterns" and "the totality of our knowledge of language is captured by a network of constructions" (Goldberg 2003, p219). Yet the Zipfian distribution of linguistic combinations...ensure that most "pairings of form and function" simply will never be heard, never mind stored, and those that do appear may do so with sufficiently low frequency such that no reliable storage and use is possible." – Yang 2010

A property of language use (and other things): Zipfian distribution

However, a Zipfian distribution is apparently helpful for some language acquisition tasks, such as word segmentation (Kurumada et al. 2012):

"...“chunking” models...hypothesize that learners store word representations in memory and match these memory representations up with the input to segment new utterances... A Zipfian distribution makes it highly likely that a few of the most frequent words appear consistently across sentences, guaranteeing that at least a few words will be learned and retained with high reliability.

"A Zipfian distribution would facilitate a bootstrapping effect because a small number of high-frequency words provide known context for many low-frequency words..."

A property of language use (and other things): Zipfian distribution

Still, word segmentation is only one task among many, and may not have the same complexity of knowledge as other linguistic systems like phonology, syntax, and semantics do, for example.

"To attain full linguistic competence, the child learner must overcome the Zipfian distribution and draw generalizations about language on the basis of few and narrow types of linguistic expressions. In the face of such statistical reality of language, a grammatical system with full generative potentials (Chomsky 1965, Brown 1973) from the get go still seems the best preparation a child can hope for." – Yang 2010

Chomsky's Arguments



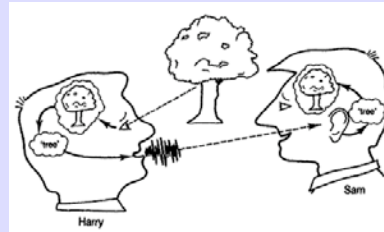
First laid out in late 1950s and early 1960s

The argument for **Mental Grammar**: The expressive variety of language use implies that a language user's brain contains a set of unconscious grammatical principles.

The argument for **Innate/Prior Knowledge**: The way children learn to talk implies that the human brain contains a genetically predetermined specialization for language.

These two arguments lead to conclusion that learning language (English, French, Japanese, Zulu, Mohawk, ...) is a complex interaction of nature and nurture

The argument for mental grammar



Harry tells Sam about a tree - this is a fairly involved process.

The argument for mental grammar

Some other things Harry might say:

"There's a bird in the tree."

"A bird was in the tree yesterday."

"Are there birds in that tree?"

"A bird might be in the tree."

"Birds like that tree."

"That tree looks like a bird."



These show off the expressive variety of language.
(This differs from animal communication.)


Why rules?

"The expressive variety of language use implies that a language user's brain contains unconscious grammatical principles" - Jackendoff (1994)



Example: Most sentences we have never seen or used before, but we can still understand them.

Question: Can speakers simply memorize all the possible sentences of a language the way they learn vocabulary of their language? **Not if there are an infinite number of them...**



Linguistic Infinity

Hoggle has two jewels.
 Hoggle has three jewels.
 Hoggle has four jewels.
 ...
 Hoggle has forty-three million and five jewels.
 ...

One (dumb) way to get infinity




Linguistic Creativity

Can speakers just memorize lists of sentences?



What lists include this sentence?
 "Through dangers untold and hardships unnumbered, I have fought my way here to the castle beyond the goblin city to take back the child you have stolen, for my will is as strong as yours and my kingdom is as great." - Sarah, *Labyrinth*




Linguistic Infinity

A more complex pattern: X Verbs that [sentence].

This shows recursion because "X Verbs that [sentence]" is itself a [sentence].

Sentence --> X Verbs that Sentence



Linguistic Infinity

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Sentence --> Hoggle thinks that [Sarah has Jareth's attention].
 --> Hoggle thinks that [Ludo knows that [Sarah has Jareth's attention]].
 --> Hoggle thinks that [Ludo knows that [Didymus suspects that [Sarah has Jareth's attention]]].

Two more examples of recursion

Sarah's friend is a dwarf.
 Sarah's friend's older brother is a dwarf.
 Sarah's friend's older brother's best friend is a dwarf.
 ...

Noun-Phrase
 --> *Noun-Phrase*'s Noun ...is a dwarf

Two more examples of recursion

This is the castle where Jareth lives.
 This is the throne that's in the castle where Jareth lives.
 This is the goblin that sits next to the throne that's in the castle where Jareth lives.
 This is the fairy that bites the goblin that sits next to the throne that's in the castle where Jareth lives...

Sentence
 --> This is *Noun-Phrase*

Noun-Phrase
 --> *Noun-Phrase* that *Sentence*

The argument for mental grammar

"In short, in order for us to be able to speak and understand novel sentences, we have to store in our heads not just the words of our language but also the patterns of sentences possible in our language. These patterns, in turn, describe not just patterns of *words* but also patterns of *patterns*. Linguists refer to these patterns as the *rules* of language stored in memory; they refer to the rules as the *mental grammar* of the language, or *grammar* for short." - Jackendoff (1994)

Possible objections to a mental rule set

"Why should I believe I store a set of rules unconsciously in my mind? I just understand sentences because they make sense."

Possible objections to a mental rule set

"Why should I believe I store a set of rules unconsciously in my mind? I just understand sentences because they make sense."

But why do some sentences make sense and others don't?

Hoggle has two jewels.
*Two Hoggle jewels has.



Possible objections to a mental rule set

Why can we recognize patterns even when some of the words are unknown?

'Twas brillig, and the slithy toves
did gyre and gimble in the wabe...



Possible objections to an unconscious rule set

"When I talk, the talk just comes out - I'm not consulting any rule set."

Possible objections to an unconscious rule set

"When I talk, the talk just comes out - I'm not consulting any rule set."



Analogy: wiggling your fingers

When you want to wiggle your fingers, you "just wiggle them".

But your finger-wiggling intention was turned into commands sent by your brain to your muscles, and you're never conscious of the process unless something interferes with it.

Nonetheless, there *is* a process, even if you're not aware of it.

The argument for prior knowledge

Suppose we have mental grammars in our heads - how did they get there?



"Many people immediately assume that the parents taught it. To be sure, parents often engage in teaching *words* to their kids: "What this, Amy? It's a *BIRDIE!* Say 'birdie,' Amy!" But language learning can't entirely be the result of teaching words. For one thing, there are lots of words that it is hard to imagine parents teaching, notably those one can't point to: "Say 'from', Amy!" "This is *ANY, Amy!*" - Jackendoff (1994)

The argument for prior knowledge

Some other things that are hard to teach: interpretations

Joan



Moira

- Joan appeared to Moira to like herself.
- Joan appeared to Moira to like her.
- Joan appealed to Moira to like herself.
- Joan appealed to Moira to like her.

The argument for prior knowledge

Some other things that are hard to teach: interpretations

Joan



Moira

- Joan appeared to Moira to like herself. M thinks J likes J
- Joan appeared to Moira to like her. M thinks J likes M
- Joan appealed to Moira to like herself. J wants M to like M
- Joan appealed to Moira to like her. J wants M to like J

The argument for prior knowledge

Some other things that are hard to teach: interpretations

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Moira

"How do we come to understand these sentences this way? It obviously depends somehow on the difference between ordinary pronouns such as "her" and reflexive pronouns such as "herself," and also on the differences between the verbs "appear" and "appeal." But how?...sure no one is ever taught contrasts like this by parents or teachers..." - Jackendoff (1994)

The argument for prior knowledge

"...we can draw another conclusion about human nature: *We can acquire unconscious patterns unconsciously, with little or no deliberate training.*" - Jackendoff (1994)



Paradox of Language Acquisition: "...an entire community of highly trained professionals, bringing to bear years of conscious attention and sharing of information, has been unable to duplicate the feat that every normal child accomplishes by the age of ten or so, unconsciously and unaided." - Jackendoff (1994)

Conclusion: "Children have a headstart on linguists"

What prior knowledge is

"...the claim is that all of us as children come to the task of language learning equipped with a body of innate knowledge pertaining to language. Using this knowledge, children can find patterns in the stream of language being beamed at them from the environment...Because this innate knowledge must be sufficient to construct a mental grammar for any of the languages of the world, linguists call it *Universal Grammar* or *UG*." - Jackendoff (1994)



The big fuss about Universal Grammar

"Suppose there is some aspect of language that children couldn't possibly figure out from the evidence in the speech they hear around them. Then this aspect can't be learned; it has to fall under the innate part of language [UG]." - Jackendoff (1994)

While the necessity of some kind of bias is generally granted by even the most ardent critics of the UG hypothesis, the nature of the necessary biases is the subject of considerable debate (see O'Grady 2012 for an overview).

Learning biases

The nature of learning biases

- what cognitive objects the bias operates over: hypothesis space, perception of data, learning algorithm

- whether the necessary bias is specific to language learning (i.e. *domain-specific*) or applies generally to any kind of cognitive learning (*domain-general*), and whether it is *innate* or can be *derived* from prior experience