

Psych 56L/ Ling 51:  
Acquisition of Language

Lecture 12  
Development of Morphology & Syntax I

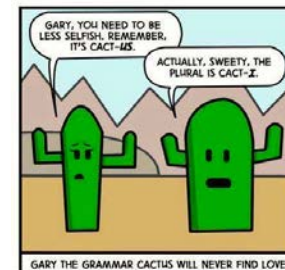
Announcements

- HW2 due today by 3:20pm
- Review questions for morphology and syntax available
- HW3 available (begin working on it): due 12/09/14

Adult knowledge:  
The target state for morphology



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The target state for morphology



<http://arnoldzwick.org/category/morphology/inflection/>

## Words and word parts

The smallest unit manipulated by the rules of syntax is *not* a single word. Instead there are units smaller than words that play a role, called **morphemes**.

One goblin.

Two goblins.

goblins = goblin + s =



+ plural

Morpheme = smallest unit of meaning

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**Bound morpheme** = morpheme that can't stand on its own - it must be attached to something

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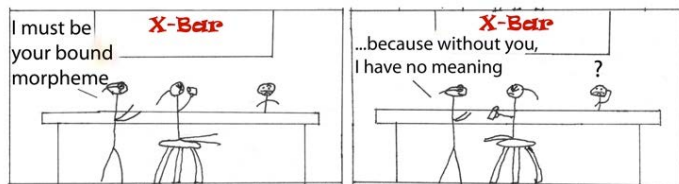
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+ plural

**Free morpheme** = morpheme that can stand on its own - it does not need to be attached to another morpheme

## Types of morphology

**Inflectional morphology:** adds grammatical information, but does not change the word's category (nouns stay nouns, verbs stay verbs, etc.)

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+ present tense

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+ plural

He scowls.

scowls = scowl + s =



+ present tense

He's scowling. scowling = scowl + ing =

+ continuing action

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goblin

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+ similar to

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goblin

goblinish

goblinish = goblin + ish =



+ similar to

scowl

scowler

scowler = scowl + er =



+ one who  
does that  
action

## Cross-linguistic comparison

English does not have a rich morphological system, compared to other languages. Instead, English mostly relies on word order to indicate who did what to whom.

Languages like Hungarian, however, rely more on morphology.

“The boy gave a book to the girl.”

A fiú könyvet adott a lánynak.

The boy a book+ACC gave the girl+DAT

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Inflectional morphology:

ACC = accusative case = direct object (thing given)

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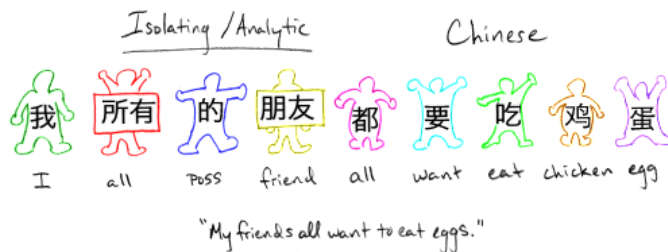
A fiú könyvet adott a lánynak.  
The boy a book+ACC gave the girl+DAT

Inflectional morphology:

DAT = dative case = indirect object (recipient of giving)

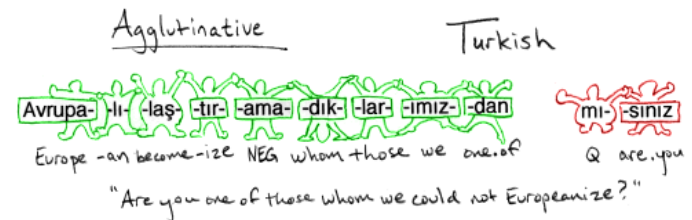
## Cross-linguistic comparison

<http://specgram.com/CLII.3/09.phlogiston.cartoon.3.html>



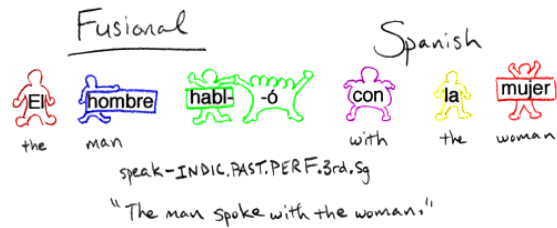
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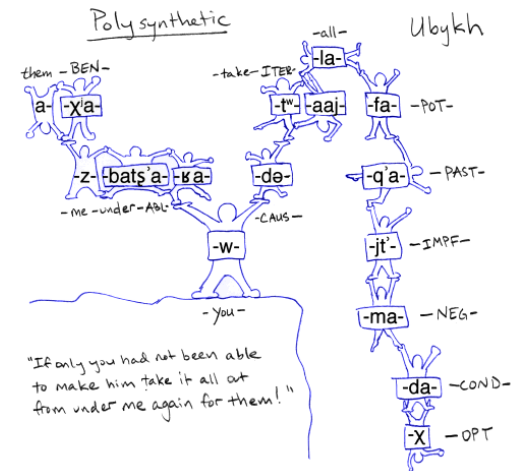
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## Morphology recap

Morphology refers to how words are put together to convey meaning.

The smallest units of meaning are morphemes, which can be smaller than a whole word.

Some morphology can change the category of a word (**derivational**), while other morphology does not (**inflectional**).

Languages vary on how rich their system of morphology is. Children must learn how their language puts words together, and what types of meaning can be conveyed via morphology.

## Adult knowledge: The target state for syntax



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<http://arnoldzwicky.org/category/syntax/word-order/>



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## Creativity of human language

Ability to combine signs with simple meanings to create

- (1) Utterances with complex meanings
- (2) Novel expressions
- (3) *Infinitely* many



Sentences never heard before...

"Some tulips are starting to samba on the chessboard."



Sentences of prodigious length...

"Hogge said that he thought that the odiferous leader of the goblins had it in mind to tell the unfortunate princess that the cries that she made during her kidnapping from the nearby kingdom that the goblins themselves thought was a general waste of countryside ..."

## An account that won't work

"You just string words together in an order that makes sense"

In other words...

*"Syntax is determined by Meaning"*

(The way words are put together is determined solely by what they mean)



## Syntax is more than meaning

Nonsense sentences with clear syntax

Colorless green ideas sleep furiously. (Chomsky)

A verb crumpled the ocean.

I gave the question a goblin-shimmying egg.

...which are incomprehensible when the syntax is nonsense

\*Furiously sleep ideas green colorless.

\*Ocean the crumpled verb a.

\*The question I an egg goblin-shimmying gave.

## Syntax is more than meaning

### Famous nonsense sentences with clear syntax

'Twas brillig and the slithy toves  
Did gyre and gimble in the wabe;  
All mimsy were the borogroves,  
And the mome raths outgrabe

Beware the Jabberwock, my son!  
The jaws that bite, the claws that catch!  
Beware the Jubjub bird, and shun  
The frumious Bandersnatch!"

- Lewis Carroll, *Jabberwocky*



## Syntax is more than meaning

'It seems very pretty,' she said when she had finished it,  
'but it's RATHER hard to understand!' (You see she  
didn't like to confess, even to herself, that she couldn't  
make it out at all.) 'Somehow it seems to fill my head  
with ideas -- only I don't exactly know what they are!  
However, **SOMEBODY** killed **SOMETHING**: that's clear,  
at any rate -- '



## Syntax is more than meaning

### And these same nonsense sentences with nonsense syntax are incomprehensible...

'Toves slithy the and brillig 'twas  
wabe the in gimble and gyre did...



## Syntax is more than meaning

### Ungrammatical sentences that make perfect sense

Jareth put the cape on.  
Jareth put on the cape.

Jareth put it on.  
\*Jareth put on it.





## Syntax is more than meaning

### Ungrammatical sentences that make perfect sense

Sarah gave a ring to the Wiseman.  
Sarah gave him a ring.

Sarah donated a ring to the Wiseman.  
\*Sarah donated him a ring.



## Syntax is more than meaning

### Ungrammatical sentences that make perfect sense

Jareth made Hoggle leave.  
Jareth let Hoggle leave.  
Jareth saw Hoggle leave.  
\*Jareth wanted Hoggle leave.

\*Jareth made Hoggle to leave.  
\*Jareth let Hoggle to leave.  
\*Jareth saw Hoggle to leave.  
Jareth wanted Hoggle to leave.



## Syntax is more than meaning

### Cross-linguistic variation

If syntax was entirely determined by meaning, then we should not expect to find syntactic differences between languages of the world....but we do see variation.

English: Sarah sees that book.

Korean: Sarah ku chayk poata.  
Sarah that book see

## Syntax is more than meaning

### Cross-linguistic variation

If syntax was entirely determined by meaning, then we should not expect to find syntactic differences between languages of the world....but we do see variation.

English:  
Baso put the money in the cupboard.

Selayarese (spoken in Indonesia):  
Lataroi doe injo ri lamari injo i Baso.  
put money the in cupboard the Baso

## So...what does determine how you string words together?

Answer: Syntax!

(That is, our knowledge of the possible *forms* of sentences in our language.)

~~"Syntax is determined by Meaning"~~  
 (The way words are put together is determined solely by what they mean)

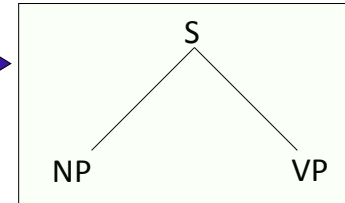


## A template

A sentence often consists of a **Noun Phrase** followed by a **Verb Phrase**

S --> NP VP ← **Phrase Structure Rule**

**Phrase Structure Tree** →



## A template

### Noun Phrase

Hoggle  
 The chicken  
 Seven goblins  
 Sarah  
 A feeling  
 The strangest story that  
 you ever did hear

### Verb Phrase

slept  
 tricked the guards  
 left  
 said that Ludo thought that  
 pixies were nasty  
 kicked the bucket  
 got drunk on dwarf wine

## A template

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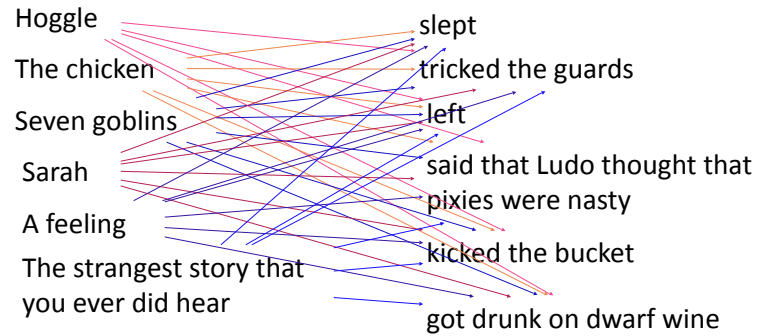
slept  
 tricked the guards  
 left  
 said that Ludo thought that  
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**6 Sentences**

## A template

### Noun Phrase

### Verb Phrase

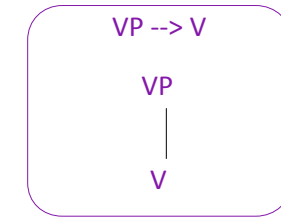
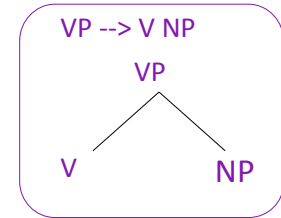
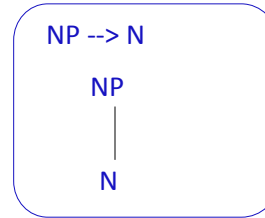
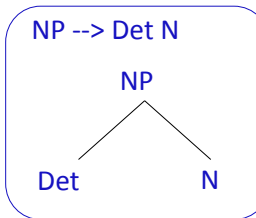


**36 Sentences**

## A template

### Noun Phrase

### Verb Phrase



## A tiny little grammar

### 5 Rules

S --> NP VP

NP --> Det N

NP --> N

VP --> V NP

VP --> V

### 9 Words

Det: *the, four, some*

N: *goblins, crystals, peaches*

V: *understood, ate, approached*

**468 Sentences**

## A tiny little grammar

### 5 Rules

S --> NP VP

NP --> Det N

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VP --> V NP

VP --> V

### 30 Words

Det: *the, four, some*  
+ 7 more

N: *goblins, crystals, peaches*  
+ 7 more

V: *understood, ate, approached*  
+ 7 more

**122,100 Sentences**

## Embedded sentences

Additional VP Rule

Hoggle thought Sarah ate the peach.

VP → V S



Can be used to create a sentence-inside-a-sentence = example of *recursion*

Recursion = a phrase of one kind inside a phrase of the same kind (a sentence is a kind of phrase, so a sentence-inside-a-sentence fits this definition)

Combine with S → NP VP, to get recursion:

S → NP VP → NP V S



## Embedded sentences

Additional VP Rule

Hoggle thought Sarah ate the peach.

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Can be used to create a sentence-inside-a-sentence = example of *recursion*

We can also see this property in English noun phrases

NP → NP's Noun

Sarah's friend is a dwarf.

Sarah's friend's uncle is a dwarf.

Sarah's friend's uncle's neighbor is a dwarf.

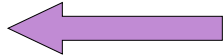


## Embedded sentences

Additional VP Rule

Hoggle thought Sarah ate the peach.

VP → V S



Can be used to create a sentence-inside-a-sentence = example of *recursion*

Ludo said Hoggle thought Sarah ate the peach.

The fairy claimed Ludo said Hoggle thought Sarah ate the peach.

The Wiseman's bird that hoped the fairy claimed Ludo said Hoggle thought Sarah ate the peach.

**Infinitely many sentences can be generated!**

## Complementizer

Complementizer (Comp): words like THAT, IF, and WHETHER that allow one sentence to be the subject or object of another sentence

Hoggle realized that Sarah ate the peach.

Whether Sarah ate the peach didn't matter.

S' → Comp S

VP → V S'

S → S' VP

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Hoggle realized that Sarah ate the peach.  
Whether Sarah ate the peach didn't matter.

$S' \rightarrow \text{Comp } S$

$VP \rightarrow V S'$

$S \rightarrow S' VP$

Example of Recursion 1:

S expands to include S'

S' expands to include S

$S \rightarrow S' VP \rightarrow \text{Comp } S VP$

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$VP \rightarrow V S'$

$S \rightarrow S' VP$

Example of Recursion 2:

S expands to include VP

VP expands to include S'

S' expands to include S

$S \rightarrow S' VP \rightarrow S' V S' \rightarrow S' V \text{Comp } S$

## A slightly bigger grammar

9 Rules

$S \rightarrow NP VP$

$S \rightarrow S' VP$

$NP \rightarrow \text{Det } N$

$NP \rightarrow N$

$VP \rightarrow V NP$

$VP \rightarrow V$

$VP \rightarrow V S$

$VP \rightarrow V S'$

$S' \rightarrow \text{Comp } S$

Sentences it can generate:

Hoggle likes jewels.

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$S \rightarrow NP VP$

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$VP \rightarrow V NP$

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9 Rules

S --> NP VP  
S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP

VP --> V

VP --> V S

VP --> V S'

S' --> Comp S

Sentences it can generate:

Hoggle likes jewels.

S --> NP VP

NP --> N      VP --> V NP

## A slightly bigger grammar

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S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP

VP --> V

VP --> V S

VP --> V S'

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Sentences it can generate:

Hoggle likes jewels.

S --> NP VP

NP --> N      VP --> V NP

N                  V NP

Hoggle            likes jewels.

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S --> NP VP  
S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP

VP --> V

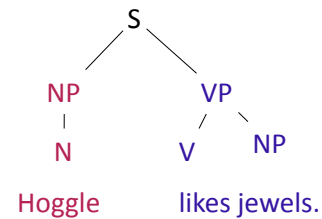
VP --> V S

VP --> V S'

S' --> Comp S

Sentences it can generate:

Hoggle likes jewels.



## A slightly bigger grammar

9 Rules

S --> NP VP  
S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP

VP --> V

VP --> V S

VP --> V S'

S' --> Comp S

Sentences it can generate:

Sarah thought that she solved the Labyrinth.

## A slightly bigger grammar

9 Rules

$S \rightarrow NP VP$

$S \rightarrow S' VP$

$NP \rightarrow Det N$

$NP \rightarrow N$

$VP \rightarrow V NP$

$VP \rightarrow V$

$VP \rightarrow V S$

$VP \rightarrow V S'$

$S' \rightarrow Comp S$

Sentences it can generate:

Sarah thought that she solved the  
Labyrinth.  $S \rightarrow NP VP$

## A slightly bigger grammar

9 Rules

$S \rightarrow NP VP$

$S \rightarrow S' VP$

$NP \rightarrow Det N$

$NP \rightarrow N$

$VP \rightarrow V NP$

$VP \rightarrow V$

$VP \rightarrow V S$

$VP \rightarrow V S'$

$S' \rightarrow Comp S$

Sentences it can generate:

Sarah thought that she solved the  
Labyrinth.  $S \rightarrow NP VP$

$NP \rightarrow N$        $VP \rightarrow V S'$

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$S \rightarrow NP VP$

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$VP \rightarrow V S$

$VP \rightarrow V S'$

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Sentences it can generate:

Sarah thought that she solved the  
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$NP \rightarrow N$        $VP \rightarrow V S'$

$N$        $V S'$

Sarah      thought  $S' \rightarrow Comp S$

## A slightly bigger grammar

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$S \rightarrow NP VP$

$S \rightarrow S' VP$

$NP \rightarrow Det N$

$NP \rightarrow N$

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$VP \rightarrow V S$

$VP \rightarrow V S'$

$S' \rightarrow Comp S$

Sentences it can generate:

Sarah thought that she solved the  
Labyrinth.  $S \rightarrow NP VP$

$NP \rightarrow N$        $VP \rightarrow V S'$

$N$        $V S'$

Sarah      thought  $Comp S$

## A slightly bigger grammar

9 Rules

S --> NP VP  
S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP  
VP --> V  
VP --> V S  
VP --> V S'

S' --> Comp S

Sentences it can generate:

Sarah thought that she solved the  
Labyrinth. S --> NP VP

NP --> N VP --> V S'  
N V S'

Sarah thought Comp S  
that

## A slightly bigger grammar

9 Rules

S --> NP VP  
S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP  
VP --> V  
VP --> V S  
VP --> V S'

S' --> Comp S

Sentences it can generate:

Sarah thought that she solved the  
Labyrinth. S --> NP VP

NP --> N VP --> V S'  
N V S'

Sarah thought that S

## A slightly bigger grammar

9 Rules

S --> NP VP  
S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP  
VP --> V  
VP --> V S  
VP --> V S'

S' --> Comp S

Sentences it can generate:

Sarah thought that she solved the  
Labyrinth. S --> NP VP

NP --> N VP --> V S'  
N V S'

Sarah thought that S --> NP VP

## A slightly bigger grammar

9 Rules

S --> NP VP  
S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP  
VP --> V  
VP --> V S  
VP --> V S'

S' --> Comp S

Sentences it can generate:

Sarah thought that she solved the  
Labyrinth. S --> NP VP

NP --> N VP --> V S'  
N V S'

Sarah thought that NP VP



## A slightly bigger grammar

9 Rules

S --> NP VP  
S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP

VP --> V

VP --> V S

VP --> V S'

S' --> Comp S

Sentences it can generate:

Sarah thought that she solved the  
Labyrinth. S --> NP VP

NP --> N VP --> V S'  
N V S'

Sarah thought that NP VP  
NP --> N VP --> V NP

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S --> S' VP

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VP --> V NP

VP --> V

VP --> V S

VP --> V S'

S' --> Comp S

Sentences it can generate:

Sarah thought that she solved the  
Labyrinth. S --> NP VP

NP --> N VP --> V S'  
N V S'

Sarah thought that NP VP  
NP --> N VP --> V NP  
N V NP  
she solved

## A slightly bigger grammar

9 Rules

S --> NP VP  
S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP

VP --> V

VP --> V S

VP --> V S'

S' --> Comp S

Sentences it can generate:

Sarah thought that she solved the  
Labyrinth. S --> NP VP

NP --> N VP --> V S'  
N V S'

Sarah thought that NP VP  
NP --> N VP --> V NP  
N V NP  
she solved  
NP --> Det N

## A slightly bigger grammar

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S --> NP VP  
S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP

VP --> V

VP --> V S

VP --> V S'

S' --> Comp S

Sentences it can generate:

Sarah thought that she solved the  
Labyrinth. S --> NP VP

NP --> N VP --> V S'  
N V S'

Sarah thought that NP VP  
NP --> N VP --> V NP  
N V NP  
she solved  
Det N  
the Labyrinth

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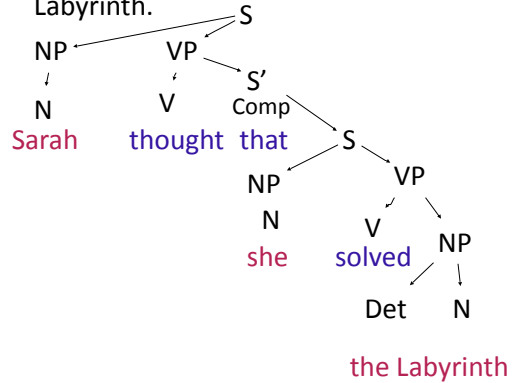
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VP --> V S  
VP --> V S'

S' --> Comp S

Sentences it can generate:

Sarah thought that she solved the Labyrinth.



## Figuring out structure: bottom-up

9 Rules

S --> NP VP  
S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP  
VP --> V  
VP --> V S  
VP --> V S'

S' --> Comp S

Sarah thought that Hoggle was a cheat.

## Figuring out structure: bottom-up

9 Rules

S --> NP VP  
S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP  
VP --> V  
VP --> V S  
VP --> V S'

S' --> Comp S

N V Comp N V Det N  
Sarah thought that Hoggle was a cheat.

## Figuring out structure: bottom-up

9 Rules

S --> NP VP  
S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP  
VP --> V  
VP --> V S  
VP --> V S'

S' --> Comp S

N V Comp N V Det N  
Sarah thought that Hoggle was a cheat.

## Figuring out structure: bottom-up

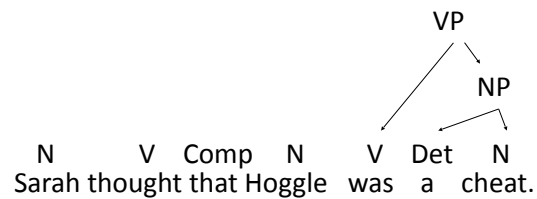
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NP --> Det N  
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VP --> V  
VP --> V S  
VP --> V S'

S' --> Comp S



## Figuring out structure: bottom-up

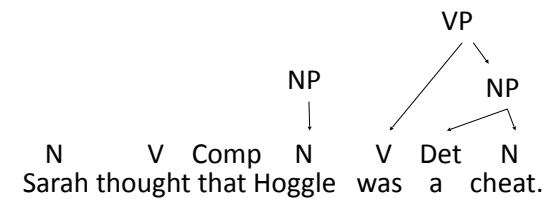
9 Rules

S --> NP VP  
S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP  
VP --> V  
VP --> V S  
VP --> V S'

S' --> Comp S



## Figuring out structure: bottom-up

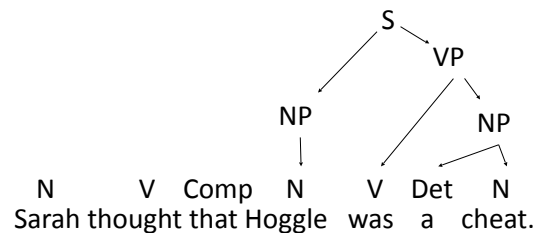
9 Rules

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VP --> V NP  
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VP --> V S  
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## Figuring out structure: bottom-up

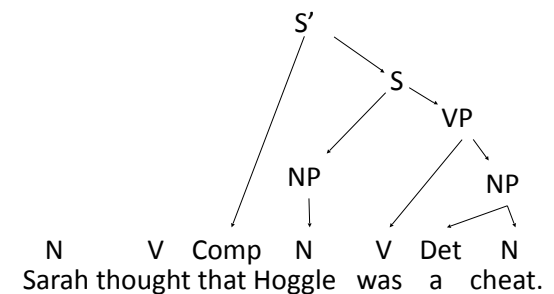
9 Rules

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## Figuring out structure: bottom-up

9 Rules

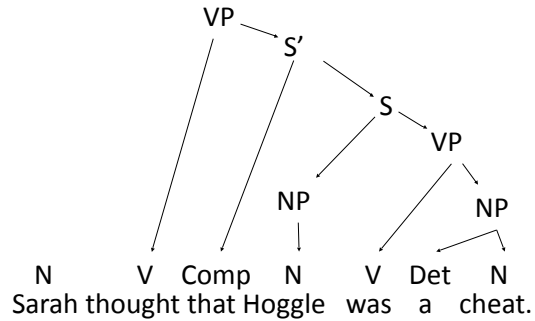
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## Figuring out structure: bottom-up

9 Rules

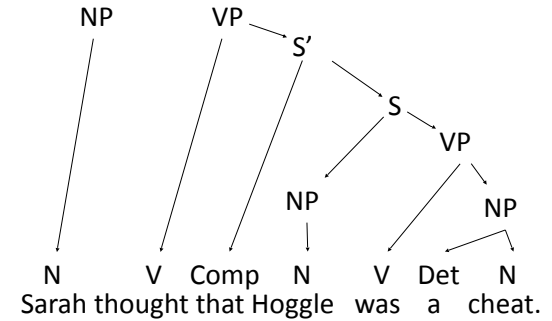
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VP --> V S'

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## Figuring out structure: bottom-up

9 Rules

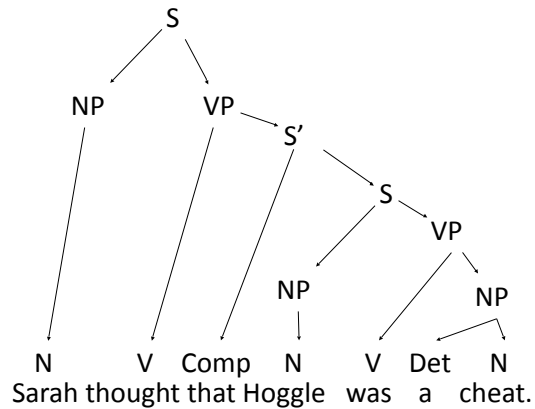
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VP --> V S

VP --> V S'

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## Figuring out structure: bottom-up

9 Rules

S --> NP VP  
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NP --> Det N  
NP --> N

VP --> V NP  
VP --> V  
VP --> V S

VP --> V S'

S' --> Comp S

That Hoggle lied surprised Sarah.

### Figuring out structure: bottom-up

9 Rules

S --> NP VP  
S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP  
VP --> V  
VP --> V S  
VP --> V S'

S' --> Comp S  
Comp N V V N  
That Hoggle lied surprised Sarah.

### Figuring out structure: bottom-up

9 Rules

S --> NP VP  
S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP  
VP --> V  
VP --> V S  
VP --> V S'

S' --> Comp S  
Comp N V V NP  
That Hoggle lied surprised Sarah.

### Figuring out structure: bottom-up

9 Rules

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S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP  
VP --> V  
VP --> V S  
VP --> V S'

S' --> Comp S  
Comp N V V NP  
That Hoggle lied surprised Sarah.

### Figuring out structure: bottom-up

9 Rules

S --> NP VP  
S --> S' VP

NP --> Det N  
NP --> N

VP --> V NP  
VP --> V  
VP --> V S  
VP --> V S'

S' --> Comp S  
Comp N V VP V NP  
That Hoggle lied surprised Sarah.

## Figuring out structure: bottom-up

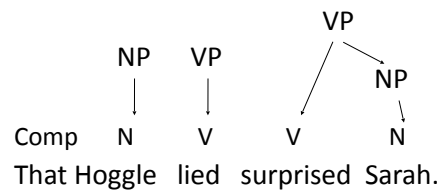
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## Figuring out structure: bottom-up

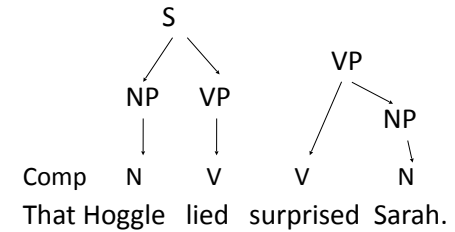
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## Figuring out structure: bottom-up

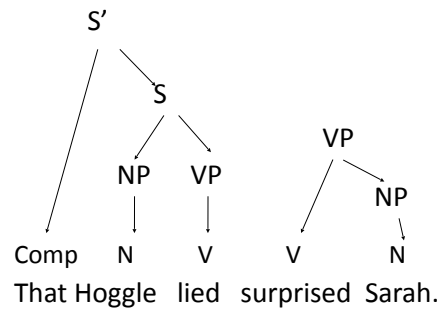
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## Figuring out structure: bottom-up

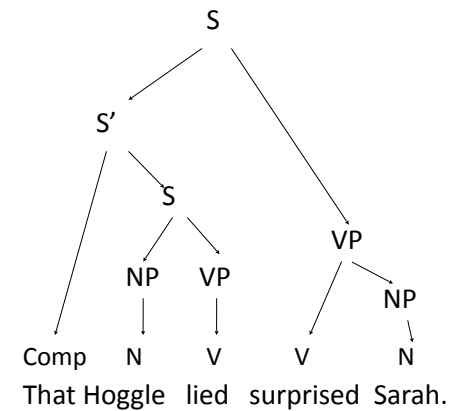
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S' --> Comp S



## Syntax recap

The structure of language (syntax) involves more than simply the meaning of the words. It involves rules about how the words themselves are allowed to go together.

It isn't enough to know the list of possible sentences in the language. Because adults can generate novel sentences and sentences of infinite length, adults need to know a rule system that can generate sentences.

Adults know (unconsciously) a system of rules for generating the word orders they use. A fairly small set of rules can generate a fairly large set of sentences.

## Questions?



You should be able to answer up through question 4 on the review questions, and up through question 3 on HW3.