Recap:

Sentences have structure

- In speaking and writing we string words together linearly (we have no choice)
- But in our minds, we represent sentences as hierarchical structures

Structurally ambiguous sentences

The spy saw the cop with the binoculars.

The spy saw the cop with the binoculars.
Recap:
So, what does determine what counts as a well-formed sentence?
- Templates for phrases and sentences

Recap
Our mini grammar

<table>
<thead>
<tr>
<th>Rule</th>
<th>Transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S \rightarrow NP \ VP$</td>
<td></td>
</tr>
<tr>
<td>$S \rightarrow S' \ VP$</td>
<td></td>
</tr>
<tr>
<td>$NP \rightarrow Det \ N$</td>
<td></td>
</tr>
<tr>
<td>$NP \rightarrow N$</td>
<td></td>
</tr>
<tr>
<td>$NP \rightarrow NP \ PP$</td>
<td>(NP modifier rule)</td>
</tr>
<tr>
<td>$VP \rightarrow V \ NP$</td>
<td></td>
</tr>
<tr>
<td>$VP \rightarrow V$</td>
<td></td>
</tr>
<tr>
<td>$VP \rightarrow V \ S$</td>
<td></td>
</tr>
<tr>
<td>$VP \rightarrow V \ S'$</td>
<td></td>
</tr>
<tr>
<td>$VP \rightarrow VP \ PP$</td>
<td>(VP modifier rule)</td>
</tr>
<tr>
<td>$S' \rightarrow Comp$</td>
<td></td>
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</tbody>
</table>

Ambiguous Sentences

The spy saw the cop with the binoculars.
Recap

Recursion

A recursive rule is one which can be applied over and over again to its own output, resulting in infinite generative capacity.

- NP → NP PP (NP modifier)
- VP → VP PP (VP modifier)
- NP → NP and NP (coordinate phrase)
- VP → V S (embedded clause)

Recap

Embedded Sentences

<table>
<thead>
<tr>
<th>VP → V S</th>
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</thead>
<tbody>
<tr>
<td>Gromit ate the cheese.</td>
</tr>
<tr>
<td>Wallace thinks Gromit ate the cheese.</td>
</tr>
<tr>
<td>Wendolene said Wallace thinks Gromit ate the cheese.</td>
</tr>
</tbody>
</table>

Question: What kind of verbs can take a whole sentence as an object?

- Simple clauses (S → NP VP) allow us to express propositions
- Clauses embedded in a VP (VP → V S) allow us to express propositional attitudes: attitudes that people hold with respect to particular propositions (which may be real or fictitious)

Theory of Mind: False Belief Understanding

So, what does determine what counts as a well-formed sentence?

- Templates for phrases and sentences
- The lexicon
Not every verb can appear in each of these VP templates

\[
\begin{align*}
\text{VP} & \rightarrow \text{V NP} \\
\text{VP} & \rightarrow \text{V} \\
\text{VP} & \rightarrow \text{V S} \\
\text{VP} & \rightarrow \text{V S'} \\
\text{VP} & \rightarrow \text{VP PP} \quad \text{(VP modifier rule)}
\end{align*}
\]

Optional & Obligatory Phrases

- Obligatory phrases
  b. *Sue hit.
  c. *Bob mentioned.
  d. *Eliza put the book.
  e. *Fred devoured.
  f. Wallace fed Gromit.
  g. Sue hit the wall.
  h. Bob mentioned his favorite TV show.
  i. Eliza put the book on the table.
  j. Fred devoured the pizza.

\[
\begin{align*}
\text{VP} & \rightarrow \text{V NP} \\
\text{VP} & \rightarrow \text{V}
\end{align*}
\]

Optional & Obligatory Phrases

- Optional Phrases
  a. Ella sang a song in the bathtub
  b. Boris slept all morning
  c. The train arrived at three o’clock

\[
\begin{align*}
\text{VP} & \rightarrow \text{V NP} \\
\text{VP} & \rightarrow \text{V}
\end{align*}
\]

New VP-Rules

- “ditransitive verbs”
  a. \(\text{VP} \rightarrow \text{V NP NP}\)
  b. \(\text{VP} \rightarrow \text{V NP PP}\)

7a. Wallace gave the cheese to Gromit.
7b. Wallace gave Gromit the cheese.

8a. *Wallace donated the museum a rocket.
8b. *Marilyn mentioned Jack a secret.
Arguments & Modifiers

9. Subjects
   a. *Fed Gromit
   b. *Slept

10. Objects
    a. *Wallace fed (Gromit)
    b. *Wallace gave Gromit (cheese)

Arguments & Modifiers

11. a. The cat sat
    b. The cat sat on the mat

12. a. VP → VP PP can apply to itself
    b. The cat sat on the mat in the morning
    c. The cat sat on the mat in the morning on Thursday

Arguments & Modifiers

13. a. NP → NP PP can apply to itself
    The dog in the kitchen.
    The man with a beard.

Ambiguity

- The dog barked at the cat in the park
- Wendolene realized that Wallace likes Cheddar in the bathtub
Different VP Rules

- Argument: VP --> V NP PP
  - VP
  - V
  - NP
  - PP
  - give

- Modifier: VP --> VP PP
  - VP
  - V
  - NP
  - PP

Distinguishing Arguments & Modifiers

I. Obligatory phrases (e.g., NP, PP, S) associated with a particular verb are called arguments of the verb.

Wallace fed Gromit in the morning.
Sue put the book on the table after lunch.

II. Arguments are implied by 'core' meaning of verb.

feed
send
think
give

Distinguishing Arguments & Modifiers

III.

a. Sue made lunch, and Joe did so (too).

   did so = 'made lunch'

b. *Sue made lunch, and Joe put a book on the shelf.

   did so = 'made'

c. Sue put a book on the shelf, and Joe did so too.

   did so = 'put a book on the shelf'

d. *Sue put a book on the shelf, and Joe did so on the table.

   *did so = 'put a book'
Distinguishing Arguments & Modifiers

e. Sue read a book in the morning, and Joe did so in the evening.

did so = 'read a book'

f. *Sue read a book in the morning, and Joe did so a magazine in the evening.

*did so = 'read'

Distinguishing Arguments & Modifiers

• Generalization: do so is used to replace a Verb Phrase

Distinguishing Arguments & Modifiers

• Generalization: do so is used to replace a Verb Phrase

a. The cat chased the dog, and the ferret did so too.
   did so = chased the dog

b. The cat chased the dog in the morning, and the ferret did so too.
   did so = chased the dog in the morning

c. The cat chased the dog in the morning, and the ferret did so in the afternoon
   did so = chased the dog
Distinguishing Arguments & Modifiers

d. The cat chased the dog in the park in the morning, and the ferret did so in the living-room in the afternoon.

did so = chased the dog

e. The cat chased the dog in the park in the morning, and the ferret did so in the afternoon.

did so = chased the dog in the park

Distinguishing Arguments & Modifiers

What about the following…
a. Alice went to the store
b. Cedric sent the package to his mother
c. Andrea sang the song to her mother

etc.

Summary: The do so test

• Is a tool you can use to determine whether a sequence of words corresponds to a verb phrase.
• Is evidence for the psychological reality of phrase structure.
• Is a tool you can use to help you to distinguish the arguments of a verb from the modifier of a VP:
  – You can try applying it to smaller and smaller pieces of a sentence to determine what is the minimal VP in the sentence.
  – All of the phrases that are inside the minimal VP are arguments.
  – Any phrases outside this minimal VP are modifiers.

So, what does determine what counts as a well-formed sentence?

• Templates for phrases and sentences
• The lexicon
• Transformations
Our structure-dependent hypothesis

For yes-no questions
(rule stated in terms of structural positions in the sentence)

a) Find the verbal complex of the main clause, and...

b) ...if there are any auxiliary verbs, invert the first one with the subject

c) ...if there are no auxiliary verbs, add the appropriate (tensed) form of “do”, invert it with the subject, and remove the tense from the main verb.

(Main verb “be” is an exception to part c), as it is allowed to invert)

2 sentences with the same tense information (past tense)

John cried. John did cry.

TENSE can be expressed in 2 ways:

-ed
auxiliary

She smile-ed.
She didn’t smile.

Commonalities across phrases

NP → Det N
NP → N
NP → NP PP   (NP modifier rule)
PP → P NP
VP → V NP
VP → V
VP → V S
VP → V S’
S → NP VP
S → S’ VP
S’ → Comp

Every NP has a N
Every PP has a P
Every VP has a V
Every phrase has a ‘head’
Except S and S’?
Hypothesis: Both sentences are formed by the rule: \( \text{S} \rightarrow \text{NP} \text{ INFL } \text{VP} \)

John cried.  

John did cry.

Hypothesis: INFL is the head of a sentence

Therefore, we can think of a sentence (S) as an Inflection Phrase (an IP)

Old way  
\( \text{S} \rightarrow \text{NP} \text{ Aux } \text{VP} \)

New way  
\( \text{InflP} \rightarrow \text{NP} \text{ Infl } \text{VP} \)

Let’s look at this sentence as a phrase structure tree, and then see how the yes-no question transformation works:

The man who is watching the Simpsons is laughing.

But first…

We need a rule template that will generate “the man who is watching the Simpsons”

Hints:
1. Think about our NP-modifier rule: \( \text{NP} \rightarrow \text{NP PP} \)
2. Let’s call “who” a complementizer (like that/whether)
3. Remember that a sentence introduced by a complementizer in order to embed it inside a larger sentence is called an S’
The man who is watching the Simpsons is laughing.

The man who is watching the comedian who is impersonating Bush is laughing.

The man is laughing at the comedian who is impersonating Bush.
When the sentence doesn’t have an auxiliary…

**Do-support.** You put in a ‘dummy auxiliary’ entirely for the purpose of moving it to indicate a question.

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So, what *does* determine what counts as a well-formed sentence?

- Templates for phrases and sentences
- The lexicon
- Transformations
- System-wide Constraints and Requirements

System-Pervasive Constraints and Requirements

- All tensed sentences in English must have an overt subject
  
  - The soup was boiling.
  - Mary watered the flowers.
  - "Watered the flowers.
  - The flowers were watered.
  - There was an explosion.
  - "Was an explosion.
  - It is raining.
  - "Is raining.
  - Compare Italian "piove" and Spanish "llueve" (is-raining)

What determines what counts as a well-formed sentence?

- Templates for phrases and sentences
  
  - Phrase structure rules or trees
- The lexicon
  
  - Individual words dictate requirements for obligatory phrases (arguments)
- Transformations
  
  - Rules for transforming basic sentences in systematic ways (yes-no question transformation)
- System-wide Constraints and Requirements
  
  - All sentences must have a subject (or not)
  - More next week, and how they vary from language to language

Homework

- Read Baker chapters on Language Variation

- Hand in Homework #2 Monday