Syntax: The Sentence Patterns of Language
Learning Goals

• Hierarchical sentence structure
• Word categories
• X-bar
• Ambiguity
• Recursion
• Transformations
Syntax

• Any speaker of any human language can produce and understand an infinite number of possible sentences

• Thus, we can’t possibly have a mental dictionary of all the possible sentences

• Rather, we have the rules for forming sentences stored in our brains

  – Syntax is the part of grammar that pertains to a speaker’s knowledge of sentences and their structures
What the Syntax Rules Do

• The rules of syntax combine words into phrases and phrases into sentences

• They specify the correct word order for a language
  – For example, English is a Subject–Verb–Object (SVO) language
    • The President nominated a new Supreme Court justice
    • *President the new Supreme justice Court a nominated

• They also describe the relationship between the meaning of a group of words and the arrangement of the words
  – I mean what I say vs. I say what I mean
What the Syntax Rules Do

- The rules of syntax also specify the grammatical relations of a sentence, such as the subject and the direct object
  - Your dog chased my cat vs. My cat chased your dog

- Syntax rules specify constraints on sentences based on the verb of the sentence

*The boy found
*The boy found in the house
The boy found the ball soundly

*Disa slept the baby
Disa slept
Disa slept soundly

Zack believes Robert to be a gentleman
*Zack believes to be a gentleman
Zack tries to be a gentleman
*Zack tries Robert to be a gentleman
What the Syntax Rules Do

• Syntax rules also tell us how words form groups and are hierarchically ordered in a sentence

  “The captain ordered the old men and women off the ship”

• This sentence has two possible meanings:
  – 1. The captain ordered the old men and the old women off the ship
  – 2. The captain ordered the old men and the women of any age off the ship

• The meanings depend on how the words in the sentence are grouped (specifically, to which words is the adjective ‘old’ applied?)
  – 1. The captain ordered the [old [men and women]] off the ship
  – 2. The captain ordered the [old men] and [women] off the ship
What the Syntax Rules Do

• These groupings can be shown hierarchically in a tree

• These trees reveal the structural ambiguity in the phrase “old men and women”
  – Each structure corresponds to a different meaning

• Structurally ambiguous sentences can often be humorous:
  – Catcher: “Watch out for this guy, he’s a great fastball hitter.”
  – Pitcher: “No problem. There’s no way I’ve got a great fastball.”
What Grammaticality Is Not Based On

• Grammaticality is not based on prior exposure to a sentence

• Grammaticality is not based on meaningfulness

• Grammaticality is not based on truthfulness
Sentence Structure

• We could say that the sentence “The child found the puppy” is based on the template:
  Det—N—V—Det—N

  – But this would imply that sentences are just strings of words without internal structure

  – This sentence can actually be separated into several groups:

  • [the child] [found a puppy]
  • [the child] [found [a puppy]]
  • [[the] [child]] [[found] [[a] [puppy]]
Sentence Structure

• A tree diagram can be used to show the hierarchy of the sentence:

  The child found a puppy
Constituents and Constituency Tests

• **Constituents** are the natural groupings in a sentence

• Tests for constituency include:
  
  – 1. “stand alone test” : if a group of words can stand alone, they form a constituent
    
    • A: “What did you find?”
    • B: “A puppy.”

  – 2. “replacement by a pronoun” : pronouns can replace constituents
    
    • A: “Where did you find a puppy?”
    • B: “I found him in the park.”
Constituents and Constituency Tests

– 3. “move as a unit” test: If a group of words can be moved together, they are a constituent

- A: “The child found a puppy.” → “A puppy was found by the child.”
Constituents and Constituency Tests

• Experimental evidence shows that people perceive sentences in groupings corresponding to constituents

• Every sentence has at least one constituent structure
  – If a sentence has more than one constituent structure, then it is ambiguous and each constituent structure corresponds to a different meaning
Syntactic Categories

- A **syntactic category** is a family of expressions that can substitute for one another without loss of grammaticality

  The child found a puppy.  
  A police officer found a puppy.  
  Your neighbor found a puppy.

  The child **found a puppy**.  
  The child **ate the cake**.  
  The child **slept**.

- All the underlined groups constitute a syntactic category known as a **noun phrase (NP)**

  - NPs may be a subject or an object of a sentence, may contain a determiner, proper name, pronoun, or may be a noun alone

- All the bolded groups constitute a syntactic category known as a **verb phrase (VP)**

  - VPs must always contain a verb but may also contain other constituents such as a noun phrase or a **prepositional phrase (PP)**
Syntactic Categories

• Phrasal categories: NP, VP, PP, AdjP, AdvP

• Lexical categories:
  – Noun: puppy, girl, soup, happiness, pillow
  – Verb: find, run, sleep, realize, see, want
  – Preposition: up, down, across, into, from, with
  – Adjective: red, big, candid, lucky, large
  – Adverb: again, carefully, luckily, very, fairly

• Functional categories:
  – Auxiliary: verbs such as have, and be, and modals such as may, can, will, shall, must
  – Determiners: the, a, this, that, those, each, every
Phrase Structure Trees

• The core of every phrase is its head
  – In the VP walk the pugs, the verb walk is the head

• The phrasal category that may occur next to a head and elaborates on the meaning of the head is a complement
  – In the PP over the river, the NP the river is the complement

• Elements preceding the head are specifiers
  – In the NP the fish, the determiner the is the specifier
Phrase Structure Trees

• The internal structure of phrasal categories can be captured using the X–bar schema:

```
XP
 /  \  
specifier of X  X
   /   \  /   \  
 X (head)  Complement of X
```
examples

The subject will later in Spec-T

This should be A
Phrase Structure Trees

Phrase structure (PS) trees show the internal structure of a sentence along with syntactic category information:

```
  S
 /   |
NP   VP
  /   |
Det N   V
  /   |
the N   |
  /   |
child
```
```
  V
 /   |
NP   N
  /   |
Det N
  /   |
a
  N
  |
puppy
```
Phrase Structure Trees

• In a PS tree, every higher node dominates all the categories beneath it
  – S dominates everything

• A node immediately dominates the categories directly below it

• Sisters are categories that are immediately dominated by the same node
  – The V and the NP are sisters
Phrase Structure Trees: Selection

- Some heads require a certain type of complement and some don’t
  - The verb find requires an NP: Alex found the ball.
  - The verb put requires both an NP and a PP: Alex put the ball in the toy box.
  - The verb sleep cannot take a complement: Alex slept.
  - The noun belief optionally selects a PP: the belief in freedom of speech.
  - The adjective proud optionally selects a PP: proud of herself

- **C-selection** or **subcategorization** refers to the information about what types of complements a head can or must take
Phrase Structure Trees: Selection

• Verbs also select subjects and complements based on semantic properties (S-selection)
  – The verb murder requires a human subject and object
    !The beer murdered the lamp.
  – The verb drink requires its subject to be animate and its optional complement object to be liquid
    !The beer drank the lamp.

• For a sentence to be well-formed, it must conform to the structural constraints of PS rules and must also obey the syntactic (C-selection) and semantic (S-selection) requirements of the head of each phrase
Building Phrase Structure Trees

• Phrase structure rules specify the well-formed structures of a sentence
  – A tree must match the phrase structure rules to be grammatical

1. $S \rightarrow NP \ VP_1$
2. $NP \rightarrow \text{Det} \ N$
3. $N \rightarrow \underline{N}$
4. $VP \rightarrow \underline{V}$
5. $\underline{V} \rightarrow V \ NP$
6. $\underline{V} \rightarrow V \ PP$
7. $\underline{V} \rightarrow V \ AP$
8. $\underline{N} \rightarrow N \ PP$
9. $PP \rightarrow \underline{P}$
10. $\underline{P} \rightarrow P \ NP$
11. $\underline{AP} \rightarrow \underline{A}$
12. $\underline{A} \rightarrow A$
13. $\underline{A} \rightarrow A \ PP$
The majority of the senate became afraid of the vice president.

Corrections to the textbook typos are in red.
Building Phrase Structure Trees

The majority of the senate became afraid of the vice president.

The diagram illustrates the phrase structure tree for the sentence "The majority of the senate became afraid of the vice president."
Recursive rules are rules in which a phrasal category can contain itself:

14. \( \bar{N} \rightarrow A \bar{N} \)

Recursive rules allow a grammar to generate an infinite number of sentences:

-the kindhearted, intelligent, handsome, ... boy
What Heads the Sentence

• All sentences contain information about tense—when a certain event or state of affairs occurred, so we can say that Tense is the head of a sentence
  – So sentences are TPs, with T representing tense markers and modals
What Heads the Sentence

The girl may cry.  The child ate.
Structural Ambiguities

• The following sentence has two meanings:

  The boy saw the man with the telescope.

• The meanings are:

  – 1. The boy used the telescope to see the man
  – 2. The boy saw the man who had a telescope

• Each of these meanings can be represented by a different phrase structure tree

  – The two interpretations are possible because the PS rules allow more than one structure for the same string of words
The boy used a telescope to see the man

The boy saw the man who had a telescope
More Structures

- Adverbs are modifiers that can specify how (quickly, slowly) and when (yesterday, often) an event happens.

17. $\overline{V} \rightarrow \text{AdvP} \overline{V}$

16. $\overline{V} \rightarrow \overline{V} \text{AdvP}$

Diagram:

- TP
  - NP: the dog
    - TP
      - T
        - VP
          - V: completely
            - AdvP
              - V: destroy
                - NP: the house
Transformational Analysis

• Recognizing that some sentences are related to each other is another part of our syntactic competence

  The boy is sleeping. Is the boy sleeping?

• The first sentence is a **declarative sentence**, meaning that it asserts that a particular situation exists

• The second sentence is a **yes–no question**, meaning that asks for confirmation of a situation

• The difference in meaning is indicated by different word orders, which means that certain structural differences correspond to certain meaning differences
  – For these sentences, the difference lies in where the auxiliary occurs in the sentence
Transformational Rules

- Yes-no questions are generated in two steps:
  - 1. The PS rules generate a declarative sentence which represents the basic structure, or **deep structure (d-structure)** of the sentence
  - 2. A **transformational rule** then moves the auxiliary before the subject to create the **surface structure (s-structure)**
Transformational Rules

• Other sentence pairs that involve transformational rules are:

  – Active to passive
    • The cat chased the mouse.  →  The mouse was chased by the cat.

  – there sentences
    • There was a man on the roof.  →  A man was on the roof.

  – PP preposing
    • The astronomer saw the quasar with the telescope.  →  With the telescope, the astronomer saw the quasar.
The Structural Dependency of Rules

- Transformations are structure-dependent, which means they act on phrase structures without caring what words are in the structures
  - The Move rule can be applied to any PP as long as it is an adjunct to V.
  - Subject–verb agreement stretches across all structures between the subject and the verb:

```
TP
  NP
  T
     pst
     3rd
  VP
  seems kind of cute
```

The guy =============== seems kind of cute
Yes/No

• The formation of yes-no questions comes from the transformation Move relocating the T from the corresponding declarative sentence:

• The boy will sleep \textit{will} the boy \underline{____} sleep
C takes TP

• C takes TP as its complement, C can have Q feature, but not always
Embedded CP’s

• CP’s are needed not just for questions:
  
  – belief that iron floats (NP complement)
  – wonders if iron floats (VP complement)
  – happy that iron floats (AP complement)
  – about whether iron will sink (PP complement)
Examples of embedded CP

NP
├── N
│   ├── N
│       └── belief
├── CP
│   ├── C
│       └── TP
│           ├── NP
│               ├── T
│                   └── VP
│                       └── V
│                           └── float
PP
├── P
│   ├── C
│       └── TP
│           ├── NP
│               └── T
│                   ├── VP
│                                   └── V
│                                           └── sink
├── CP
│   ├── C
│       └── TP
│           ├── NP
│               ├── T
│                   └── VP
│                                   └── V
│                                           └── will
Yes/No questions T->C

```
CP   CP
   / \   /
  /   \ /   \    
C    C C    C
  /  / +Q +Q \  
 /  /    /    
|  |  |   |   |
NP  TP  T  TP
  |   |    |    |
the boy T  will T
  |   |    |    |
  |   |    |    |
  will sleep

```

Wh Questions

Example: What will Max chase?

• This Wh question is formed in three steps:

  – 1. The PS rules generate a basic declarative word order: Max will chase what?

  – 2. Move shifts the word what to the beginning of the sentence: What Max will chase?

  – 3. Move shifts the modal will to occur before the subject NP: What will Max chase?
Wh-derivation

The d-structure for *What will Max chase?* is:

```
CP
  Specifier of CP
    C
      +Q
      TP
        NP
          N
              N
                  Max
        T
          will
        VP
          V
            NP
              N
                  what
```
Wh-movement
Do-insertion

- Which toys does Pete like
Modals/ Auxiliaries

1. Spot has chased a squirrel.
2. Nellie is snoring.
   • Like the modals, the auxiliaries have and be move to the position preceding the subject in both yes-no questions and wh questions.
3. Has Spot _____ chased a squirrel?
4. Is Nellie _____ snoring?
5. What has Spot _____ chased _____?
   • The question is: where do have and be originate in the d-structure?
   • Note that have and be can occur in the same sentence with a modal:
     – Nellie may be snoring.
     – Spot must have found a squirrel.
recursive v

• Our analysis leads us to conclude that have/be originate under V in a recursive $\overline{V}$ structure, as follows.
Tense/Modal

• When there is no modal, T is occupied by a tense feature, which is realized on have/be, as would be the case for other verbs like snore:
Movement from V->T->C

• What has Spot chased?
• Here is the d-structure (from the X-bar derived phrase structure rules):
V->T

Specifier of CP

C
+Q

NP

Spot

T
[-pst]

has

V

chased

V

VP

NP

what
T->C
Wh-move

- We see that V->T feeds T->C, which allows wh move.
PS rules – **Warning**, these are textbook PS rules. For ones recommended by me see my additional text

- 1. $S \rightarrow NP\ VP$
- 2. $NP \rightarrow Det\ N$
- 3. $N\rightarrow N$
- 4. $VP \rightarrow \overline{V}$
- 5. $\overline{V}\rightarrow V\ NP$
- 6. $\overline{V}\rightarrow V\ PP$
- 7. $\overline{V}\rightarrow V\ AP$
- 8. $N\rightarrow N\ PP$
- 9. $PP \rightarrow \overline{P}$
- 10. $\overline{P}\rightarrow P\ NP$
- 11. $AP \rightarrow \overline{A}$
- 12. $\overline{A}\rightarrow A$
- 13. $\overline{A}\rightarrow A\ PP$
- 14. $N\rightarrow A\ N$
- 15. $\overline{A}\rightarrow Int\ A$
- 16. $\overline{V}\rightarrow \overline{V}\ PP$
- 17. $N\rightarrow N\ PP$
- 18. $\overline{V}\rightarrow AdvP\ \overline{V}$
- 19. $\overline{V}\rightarrow \overline{V}\ Adv$
- 20. $\overline{V}\rightarrow V\ VP$
UG Principles and Parameters

• Universal Grammar (UG) provides the basic design for all languages, and each language has its own **parameters**, or variations on the basic plan
  
  – All languages have structures that conform to X-bar schema
  – All phrases consist of specifiers, heads, and complements
  – All sentences are headed by T
  – All languages seem to have movement rules

  – However, languages have different word orders within phrases and sentences, so heads and complements may be present in different orders across languages
Sign Language Syntax

• The syntax of sign languages also follow the principles of UG and has:
  – Auxiliaries
  – Transformations such as topicalization, which moves the direct object to the beginning of a sentence for emphasis, and wh movement
  – Constraints on transformations

• That UG is present in signed languages and spoken languages shows that the human brain is designed to learn language, not just speech.