Language Structure: Phrases
“Productivity” a property of Language

• Definition
  – Language is an open system. We can produce potentially an infinite number of different messages by combining elements differently.

• Example
  – Words into phrases.
An Example of Productivity

• Human language is a communication system that bears some similarities to other animal communication systems, but is also characterized by certain unique features. (24 words)

• I think that human language is a communication system that bears some similarities to other animal communication systems, but is also characterized by certain unique features, which are fascinating in and of themselves. (33 words)

• I have always thought, and I have spent many years verifying, that human language is a communication system that bears some similarities to other animal communication systems, but is also characterized by certain unique features, which are fascinating in and of themselves. (42 words)

• Although mainstream some people might not agree with me, I have always thought...
Creating Infinite Messages

• Discrete elements
  – Words, Phrases

• Selection
  – Ease, Meaning, Identity

• Combination
  – Rules of organization
Models of Word reCombination

1. Word chains (Markov model)
   Phrase-level meaning is derived from understanding each word as it is presented in the context of immediately adjacent words.

2. Hierarchical model
   There are long-distant dependencies between words in a phrase, and these inform the meaning of the entire phrase.
Markov Model

Rule: Select and concatenate (according to meaning and what types of words should occur next to each other).

Man → bites → over → jumps → house
     |       |       |       |
     |       |       |       |
     Man → bites → over → jumps → house
     |       |       |       |
Markov Model

• Assumption
  − Only adjacent words are meaningfully (and lawfully) related.

• Problem
  − Long-distance dependencies in most sentences.
  − Evidence in constituent structure of sentence (meaningful groups of words).
Testing for Constituents

“Many executives eat at really fancy restaurants.”

• Question-Answer
  – Who? many executives
  – Where? at really fancy restaurants

• Substitution

• Movement
  – At really fancy restaurants, many executives eat.
  – *fancy restaurants at really many executives eat.
Constituents Identified So Far

“Many executives eat at really fancy restaurants.”
Hierarchical Structure

“Many executives eat at really fancy restaurants.”
Interim Summary of Phrase Structure

All levels of language are hierarchically structured, but this structure may be the most complex and the most obviously productive at the phrase-level.

SYNTAX:

The study of the structure of phrases and sentences. The goal is to determine the abstract rules that govern the combination of words into phrases.
Syntax not Semantics

Lewis Carroll

‘Twas brillig, and the slithy toves
Did gyre and gimble in the wabe:
All mimsy were the borogoves,
And the mome raths outgrabe.

Chomsky

Colorless green ideas sleep furiously.
Structure is Learned Not Meaning

“When people learn a language, they are learning how to put words in order, but not by recording which word follows which other word. They do it by recording which word category—noun, verb, and so on—follows which other category.” (Pinker, p.85)

Modularity is assumed:

Phrase structure is encoded as one set of mental processes. The meaning of elements is encoded separately.
The man in the kitchen drives a truck.
Constituents and Categories

The man in the kitchen drives a truck.
Constituents and Categories

The man in the kitchen drives a truck.
The man in the kitchen drives a truck.
Constituents and Categories

The man in the kitchen drives a truck.
Some Phrase Structure Rules

English

\[
\begin{align*}
S &= NP + VP \\
NP &= NP + PP \\
PP &= P + NP \\
NP &= \text{Det} + N \\
VP &= V + NP
\end{align*}
\]
Phrase Structure Grammar Properties

• Generativity
  – Infinite number of novel sentences

• Hierarchical Structure
  – Smaller constituents embedded in larger ones.

• Resolves ambiguity
  – Same words, different underlying structure

• Infinite Recursion
Recursion in Phrase Structure Rules

\[
\begin{align*}
\text{NP} & = \text{Det} + \text{N} \\
& \quad \text{“the + dog” / “the + yard” / “the + house”} \\
\text{PP} & = \text{P} + \text{NP} \\
& \quad \text{“in + the yard” / “at + the house”} \\
\text{NP} & = \text{NP} + \text{PP} \\
& \quad 1. \text{“the dog + in the yard”} = \text{NP} \\
\text{NP} & = \text{NP} + \text{PP} \\
& \quad 2. \text{“the dog in the yard + at the house”} = \text{NP} \\
& \quad 3. \text{“the dog in the yard at the house + on the street”}
\end{align*}
\]
Recursiveness
Phrase Structure Rule Limits

• **PRO**: PS Rules do resolve ambiguity
  – Identifying different structures.

• **CON**: PS Rules do not capture similarity b/t sentences w/ different structure.
  1. Mary can accomplish a great deal.
  2. What can Mary accomplish?
  3. A great deal can be accomplished by Mary.

• **Solution**
  – Transformational Grammar Rules
Similarity Suggests Common Source

Simple Declarative
Mary can accomplish a great deal.

What can Mary accomplish?
Wh-Question

A great deal can be accomplished by Mary.
The Passive
Theory of Common Source (First Level)

DEEP STRUCTURE / UNDERLYING FORM

Mary can accomplish a great deal.

Mary can accomplish a great deal.  What can Mary accomplish?

A great deal can be accomplished by Mary.
Theory of Common Source
(Second Level)

Mary can accomplish a great deal.

Mary can accomplish a great deal.  What can Mary accomplish?

A great deal can be accomplished by Mary.

SURFACE STRUCTURE / SURFACE FORM
Transformational Rules

Mary can accomplish a great deal.

- No Transformation
- The Passive
- Wh-Question

Mary can accomplish a great deal.

What can Mary accomplish?

A great deal can be accomplished by Mary.
Phrase Structure Summary

• Words in a sentence are hierarchically organized.
• This organization, combined with the property of recursiveness enables generativity (productivity).
• Syntax
  – The rules that describe how syntactic categories are organized into constituents, and how constituents are organized relative to one another.
• Theories of syntax
  – Phrase Structure Grammar
  – Transformational Grammar