Constituent Structure

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The problem

Form-meaning mapping

The same meaning may be expressed by quite different forms in different languages. Are these differences only superficial? Are there categories and concepts that are relevant across all languages realized with relatively superficial formal differences? Alternatively, are there a few basic architectural types that can help explain all the diversity?
Form-meaning anomaly

Within a single language, the same form may have more than one meaning. We call such forms **ambiguous**:

1. *Keep the promises you make to yourself.*
Form-meaning anomaly

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   *When you make a promise to yourself, keep it.*
Within a single language, the same form may have more than one meaning. We call such forms **ambiguous**:

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   *When you make a promise, keep it to yourself.*
Grammar

1. We call the formal patterns that help us recognize formal classes like Subject, Noun, Verb, Adjective grammar:
   1. Adjectives come before Nouns
   2. Verbs come after Subjects
   3. Plural Nouns end in /s/

2. Meaning can be conveyed without obeying the rules of grammar.

3. But the rules of grammar and semantic patterns involving prepositions and sound sequences help us construct meaning representations even when our grasp of word meaning is tenuous or non existent.
# Grammar: Formal patterns of the language at multiple levels

## Components

| SYNTACTIC | The ____, imperatives (verse 2), relative clauses (verse 2), poetic inversion (verse 1) |
| MORPHOLOGICAL | -ous, -ish, -s |
| PHONOLOGICAL | brillig, gimble vs. bgillir, gmible |
| PHONESTHEMIC | sl- → slithey, br- → brillig |
| POETIC | A-B, A-B rhyming pattern |
| DISCOURSE | story telling sequence: description of place, warning of peril, hunt, successful return |

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Constituent patterns

i. The promises you make are very important.
ii. The promises you make to your self are very important.
iii. You always forget the promises you make.
iv. You always forget the promises you make to yourself.

Two constituents

The strings the promises you make and the promises you make to yourself are constituents (recurring partials with constant meaning consisting of one or more words). [To be revised.]
Constructions

I.  i.  He kept his business activities to himself.
    “He was secretive about his business activities”
    keep X to oneself ⇒ “be secretive about X”
   ii. He kept everything to himself.
   iii. He kept that information to himself.

   Keep \([x \text{ the promises you make to yourself}]\) to yourself.
   Keep \([x \text{ the promises you make}]\) to yourself.

II. He kept his promise/word/appointment.
    keep X ⇒ fulfill the obligation entailed by X.

   Keep \([x \text{ the promises you make to yourself}]\).
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Constructions

I. i. He kept his business activities to himself.
   “He was secretive about his business activities”
   keep $X$ to oneself $\Rightarrow$ “be secretive about $X$”
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\[
\text{Keep} \ [x \text{ the promises you make to yourself}] \text{ to yourself.}
\]
Keep $[x$ the promises you make$]$ to yourself.

II. He kept his promise/word/appointment.
keep $X \Rightarrow$ fulfill the obligation entailed by $X$.

\[
\text{Keep} \ [x \text{ the promises you make to yourself}].
\]
Keep $[x \text{ the promises you make}]$. 
Analysis of ambiguity

The sentence:

\[
\text{Keep the promises you make to yourself.}
\]

is ambiguous because it can be derived two different ways:

(a) Substitute the constituent \textit{the promises you make} into the \textit{Keep X to yourself} construction.

(b) Substitute the constituent \textit{the promises you make to yourself} into the \textit{Keep X} construction.

Thus we have an ambiguity of both constituent structure and construction.
Current definition of constituent too loose

Two constituents
Constituents are recurring partials with constant meaning consisting of one or more words. [To be revised.]

i. He kept that promise.
ii. She kept that appointment.
Better definition of constituent

Constituents

Constituents of type X are recurring partials with constant meaning consisting of one or more words that can be substituted into constructions allowing constituents of type X.

i. He kept that appointment.
   * He kept \([_x\text{kept that}]\).
   * He kept \([_x\text{kept that}]\) to himself.
Intuition

Meaningful expressions

The constructions of the language define slots into which meaningful expressions of the right type can be substituted. *kept that* is not a constituent because there is no construction of English that treats it as a meaningful unit.
Defining meaningful expression

Meaningful expressions of type X

Words of type X are meaningful expressions of type X. Phrases that can be substituted for meaningful expressions of type X into constructions calling for meaningful expressions of type X are meaningful expressions of type X-Phrase.

<table>
<thead>
<tr>
<th>Type</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noun</td>
<td>a. He kept ([x \text{promises}]).</td>
</tr>
<tr>
<td>Noun Phrase</td>
<td>b. He kept ([x \text{his promises}]).</td>
</tr>
<tr>
<td></td>
<td>c. He kept ([x \text{the promises}]).</td>
</tr>
<tr>
<td></td>
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Keep \([_{NP}X]\): fulfill the obligation entailed by X.
Defining meaningful expression

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Keep \([\text{NP}X]\): fulfill the obligation entailed by X.
Substitutability

Intuition: Complex linguistic expressions are always related (built up out of) simpler ones:
Malay example

Lone verbs define constructions: \( X \text{ makan } Y = X \text{ eats } Y \) (Malay)

(i) Ahmad makan nasi 
Ahmad eats rice

(ii) Orang ini makan nasi 
Person this eats rice

(iii) Anjing itu makan nasi 
dog that eats rice.

(iv) Orang tua itu makan pisang 
Person old this eats banana

\( nasi \) (‘rice’), \( pisang \) (‘banana’), \( tulang \), and \( ikan \) are Nouns, and \( Ahmad \), \( orang \), and \( anjing \) are Nouns, so we define our \( makan \) construction as:

\[
[\text{NP } X] \text{ makan } [\text{NP } Y] = X \text{ eats } Y
\]
Generalizations: Phrase structure

We find, across an enormous variety of languages, an enormous amount of regularity in the word order in constructions. So in Malay whenever we have $[^{NP}X]$:

\[
\begin{align*}
Noun & \ Adj \ Det \\
Noun & \ Adj \\
Noun & \ Det \\
Noun
\end{align*}
\]

This is NOT the same word order we find in English $[^{NP}X]$, but it is consistent in Malay. So we write a **Phrase Structure Rule** for Malay:

\[
NP \rightarrow \text{Noun} \ (Adj) \ (Det)
\]
Hierarchy

So far we can handle a certain class of English sentences by assigning them to one of two constructions.

1. Keep $[\text{NP}X]$ to oneself = ‘be secretive about X’
2. Keep $[\text{NP}X]$ = ‘fulfill the obligation entailed by X’

But consider this sentence:

He kept $[\text{NP} \text{the appointments he kept}]$ to himself = ‘He was secretive about the appointments he kept.’

An instance of BOTH constructions simultaneously. One inside the other.
Hierarchy

So far we can **handle** a certain class of English sentences by assigning them to one of two constructions.

1. Keep \([_{NP}X]\) to oneself = ‘be secretive about X’
2. Keep \([_{NP}X]\) = ‘fulfill the obligation entailed by X’

But consider this sentence:

\[
\text{He kept } [_{NP}\text{the appointments } [_{S} \text{he kept } [_{NP}\text{those appointments } ] ] ] \text{ to himself = ‘He was secretive about the appointments he kept.’}
\]

An instance of BOTH constructions simultaneously. One **inside** the other.
Sentences inside sentences

1. Relative clauses
   
   \[\text{He kept } [_{\text{NP}} \text{the appointments } [_{\text{S}} \text{ he made } [_{\text{NP}} \text{ those appointments } ] ] ] \text{ to himself}\]

2. Clause complements
   
   \[\text{He believed } [_{\text{S}} \text{ that Mary was a fool.}]\]

3. Subordinate clauses
   
   \[\text{He liked Susan, because } [_{\text{S}} \text{ she was a Republican like him.}]\]
NPs inside NPs

1. [NP a book [PP about [NP the president ] ] ]
2. [NP a dessert [PP with [NP dark chocolate ] ] ]
Recursion

X inside X

Whenever we find a constituent of type X inside another constituent of type X, we call it recursion.

1. S: [s John believed [s Mary was a fool ] ]
2. NP: [NP the shop [PP at [NP the end [PP of the street ] ] ] ]
3. PP: [NP the shop [PP at [NP the end [PP of the street ] ] ] ]
4. VP: [s John [VP believed [s Mary [VP was a fool ] ] ] ]
Representing hierarchical structure

S

NP

NP

D

the

N

house

PP

P

on

NP

VP

V

is

ADJP

Adj

big

NP

D

the

N

corner

PP

P

of

NP

D

the

N

street
Colorlessness

The autonomy of syntax: This is grammatical; that is, it obeys the language’s formal requirements, while remaining hard to interpret;

```
S
  NP
    ADJP
      Adj
       colorless
    ADJP
      Adj
       green
  VP
    V
    sleep
    ADVP
      Adv
      furiously
```
Constituency

(a.) Substitutability: Constituents of types X can be substituted into construction slots of type X. As a result, we expect to find constituent of type X in more than one construction.

NPs
Can be subjects, direct objects, objects of preposition, possessors, ...

(b.) Type of construction slot: We determine the type of a construction slot by finding one word fillers. The part of speech of the word determines the type of the slot. (But what about S slots?)

(c.) Constructions: regular syntactic patterns in the language defining a fixed meaning when all of the slots are filled.
   1. Idioms (keep X to yourself)
   2. Verb constructions (Give \([NP X]\) to \([PP Y]\) Give \([NP Y]\) \([NP X]\), believe that \([S X]\), * walk that \([S X]\)
Phrase structure

a. Generalizations across constructions

b. Regularities in the order of the words in \([_{NP}X]\), \([_{PP}X]\), \([_{VP}X]\), and so on.

c. Phrase structure rules are quite variable from language to language:

**NP rules**

<table>
<thead>
<tr>
<th>Language</th>
<th>NP rule</th>
</tr>
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<tbody>
<tr>
<td>English</td>
<td>(NP \rightarrow (D) (Adj) N (PP) (S))</td>
</tr>
<tr>
<td>Malay</td>
<td>(NP \rightarrow N (Adj) (D))</td>
</tr>
<tr>
<td>Japanese</td>
<td>(NP \rightarrow (D) (Adj) (PP) (S) N)</td>
</tr>
</tbody>
</table>
English phrase structure: Version 1

S → NP (Aux) VP
PP → P NP
NP → (D) (AdjP)* N (PP)* (S)
VP → (AdvP) V (NP) (PP) (S) (AdvP)*
AdjP → (AdvP)* Adj
AdvP → (AdvP)* Adv