Ling 566
Oct 14, 2008
How the Grammar Works
Overview

• What we’re trying to do
• The pieces of our grammar
• Two extended examples
• Reflection on what we’ve done, what we still have to do
What We’re Trying To Do

- Objectives
  - Develop a theory of knowledge of language
  - Represent linguistic information explicitly enough to distinguish well-formed from ill-formed expressions
  - Be parsimonious, capturing linguistically significant generalizations.

- Why Formalize?
  - To formulate testable predictions
  - To check for consistency
  - To make it possible to get a computer to do it for us
How We Construct Sentences

• The Components of Our Grammar
  • Grammar rules
  • Lexical entries
  • Principles
  • Type hierarchy (very preliminary, so far)
  • Initial symbol (S, for now)

• We combine constraints from these components.

Q: *What says we have to combine them?*

A: The definition of well-formed structure
An Example

A cat slept.

• Can we build this with our tools?

• Given the constraints our grammar puts on well-formed sentences, is this one?
**Lexical Entry for** $a$

$$
\begin{array}{c}
\text{word} \\
\text{SYN} \\
\text{VAL} \\
\text{SEM} \\
\langle a, \rangle
\end{array}
\begin{array}{c}
\begin{array}{c}
\text{HEAD} \\
\text{COMPS} \\
\text{MODE} \\
\text{INDEX} \\
\text{RESTR}
\end{array} \\
\begin{array}{c}
det \\
\text{AGR} \\
\text{AGR} \\
\text{none} \\
\text{RELN}
\end{array} \\
\begin{array}{c}
\text{AGR} \\
\text{COMPS} \\
\text{COMPS} \\
\text{RELN} \\
\text{RELN}
\end{array} \\
\begin{array}{c}
3\text{sing} \\
{+} \\
\langle \rangle \\
j \\
\langle j \rangle \\
\langle j \rangle
\end{array}
\end{array}

- Is this a fully specified description?
- What features are unspecified?
- How many word structures can this entry license?
Lexical Entry for *cat*

- Which feature paths are abbreviated?
- Is this a fully specified description?
- What features are unspecified?
- How many word structures can this entry license?
Effect of Principles: the SHAC

\[
\begin{array}{c}
\text{word} \\
\text{HEAD} \\
\text{SYN} \\
\langle \text{cat} , \\n\text{VAL} \\
\text{SEM} \\
\text{MODE} \\
\text{INDEX} \\
\text{RESTR} \\
\end{array}
\]

\[
\begin{array}{c}
\langle \text{noun} \\
\text{AGR} \begin{array}{c} 2 \\
\text{3sing} \\
\text{GEND neut} \end{array} \\
\text{D} \\
\text{SPR} \langle \text{AGR} \begin{array}{c} 2 \\
\text{COUNT +} \\
\text{INDEX k} \end{array} \rangle \\
\text{COMPS} \langle \rangle \\
\text{MOD} \langle \rangle \\
\text{MODE ref} \\
\text{INDEX k} \\
\text{RESTR} \langle \text{RELN cat} \rangle \\
\end{array}
\]

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Description of Word Structures for *cat*

```
word
  | head
  | agram 3sing
  | gen GEND neut

syn
  | spr
  | count +
  | index k

val
  | comps ⟨ ⟩
  | mod ⟨ ⟩

sem
  | mode ref
  | index k
  | restr ⟨ [reln cat] ⟩
  | restr ⟨ [instance k] ⟩
```

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Description of Word Structures for $a$

```
word
SYN
  HEAD
  det
    AGR
    3sing
    COUNT
    +
  COMPS
    ⟨ ⟩
VAL
  SPR
    ⟨ ⟩
  SPR
    ⟨ ⟩
  SPR
   ⟨ ⟩
SEM
  MODE
    none
  INDEX
    j
  RESTR
    RELN
    a
    BV
    j
  a
```
Building a Phrase

[ ]

[ ]

[ ]
Constraints Contributed by the Grammar Rule
A Constraint Involving the SHAC

[phrase
  SYN [ VAL [ SPR ⟨⟩]]]

[7]

word
  [DET [AGR 3sing GEND neut]]
  HEAD
  SYN
  [COUNT +]
  VAL
  [COMPS ⟨⟩]
  SPR ⟨⟩
  MOD ⟨⟩
  MODE none
  INDEX k
  SEM
  RESTR [RELN a ⟨⟩]

word
  [noun 3sing GEND neut]
  HEAD
  SYN
  VAL
  [COMPS ⟨⟩]
  SPR ⟨⟩
  MOD ⟨⟩
  MODE ref
  INDEX k
  SEM
  RESTR [RELN cat INSTANCE k]

7D
Effects of the Head Feature Principle
Effects of the Semantic Inheritance Principle
Effects of the Semantic Compositionality Principle
Is the Mother Node Now Completely Specified?

\[ \text{phrase} \]

\[ \begin{array}{c}
\text{SYN} \\
\text{VAL} \\
\text{SEM}
\end{array} \]

\[ \begin{array}{c}
\text{HEAD} \quad 6 \\
\text{SPR} \quad \langle \rangle \\
\text{COMPS} \quad 3 \\
\text{MOD} \quad 4
\end{array} \]

\[ \begin{array}{c}
\text{MODE} \quad 8 \\
\text{INDEX} \quad k \\
\text{RESTR} \quad A \oplus B
\end{array} \]

\[ \text{word} \]

\[ \begin{array}{c}
\text{SYN} \\
\text{VAL} \\
\text{SEM}
\end{array} \]

\[ \begin{array}{c}
\text{HEAD} \\
\text{AGR} \quad 2 \\
\text{COUNT} \quad +
\end{array} \]

\[ \begin{array}{c}
\text{COMPS} \quad \langle \rangle \\
\text{SPR} \quad \langle \rangle \\
\text{MOD} \quad \langle \rangle
\end{array} \]

\[ \begin{array}{c}
\text{MODE} \quad \text{none} \\
\text{INDEX} \quad k \\
\text{RESTR} \quad A \langle B
\end{array} \]

\[ \text{word} \]

\[ \begin{array}{c}
\text{SYN} \\
\text{VAL} \\
\text{SEM}
\end{array} \]

\[ \begin{array}{c}
\text{HEAD} \quad 6 \\
\text{AGR} \quad 2 \\
\text{3sing} \quad \text{GEND neut}
\end{array} \]

\[ \begin{array}{c}
\text{SPR} \quad \langle 7 \rangle \\
\text{COMPS} \quad 3\langle \rangle \\
\text{MOD} \quad 4\langle \rangle
\end{array} \]

\[ \begin{array}{c}
\text{MODE} \quad 8\text{ref} \\
\text{INDEX} \quad k \\
\text{RESTR} \quad A \langle B
\end{array} \]

\[ \begin{array}{c}
\text{RELN} \quad \text{cat} \\
\text{INSTANCE} \quad k
\end{array} \]
Lexical Entry for \textit{slept}
Another Head-Specifier Phrase

Key

- HSR
- SHAC
- Val Prin
- HFP
- SIP
- SCP

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Is this description fully specified?

phrase

SYN

HEAD 11

VAL

COMPS 12

MOD 13

SEM

MODE 10 prop

INDEX s1

RESTR A ⊕ B ⊕ C

word

SYN

HEAD 11 [verb]

VAL

COMPS 12

MOD 13

SEM

MODE 10 prop

INDEX s1

RESTR C

[ RELN sleep

SIT s1

SLEEPER k ]
Does the top node satisfy the initial symbol?
RESTR of the S node

\[ \langle \left[ \begin{array}{c} \text{RELN} \\ a \end{array} \right], \left[ \begin{array}{c} \text{RELN} \\ \text{cat} \end{array} \right], \left[ \begin{array}{c} \text{RELN} \\ \text{sleep} \end{array} \right] \rangle \text{ where } a, \text{cat}, s_1 \Rightarrow \text{SLEEPER} \]
Another Example

S

NP

D

the

N

NOM

photos

PP

of

VP

V

disappeared

ADV

yesterday

NP

D

the

N

suspect
Head Features from Lexical Entries

$S$

$NP$

$[\text{HEADdet}]$

$the$

$[\text{HEADnoun}]$

$photos$

$[\text{HEADprep}]$

$of$

$[\text{HEADdet}]$

$the$

$[\text{HEADnoun}]$

$suspect$

$PP$

$disappeared$

$VP$

$[\text{HEADverb}]$

$yesterday$
the photos of the suspect disappeared yesterday
Valence Features: Lexicon, Rules, and the Valence Principle

Key

- Lexicon
- Val.
- Rules

the photos disappeared yesterday

the suspect

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Required Identities: Grammar Rules

\[ S \]

\[ NP \]

\[ D \]

\[ the \]

\[ NOM \]

\[ photos \]

\[ PP \]

\[ of \]

\[ NP \]

\[ the \]

\[ suspect \]

\[ VP \]

\[ V \]

\[ disappeared \]

\[ ADV \]

\[ yesterday \]
Two Semantic Features: the Lexicon & SIP

the photos of the suspect disappeared yesterday.
RESTR Values and the SCP

A ⊕ B ⊕ C ⊕ D ⊕ E ⊕ F ⊕ G

A ⊕ B ⊕ C ⊕ D ⊕ E

RELN the
BV j

B ⊕ C ⊕ D ⊕ E

RELN photo
INST j
CONTENT k

C ⊕ D ⊕ E

disappeared

D ⊕ E

RELN the
BV k

E

RELN suspect
INST k

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An Ungrammatical Example

What’s wrong with this sentence?
An Ungrammatical Example

What's wrong with this sentence?

So what?
An Ungrammatical Example

The Valence Principle

* S

NP [CASE acc] np

V

[SPR 1] np

sent

NP

them

VP [SPR 1]

us np

D

a

N

letter
An Ungrammatical Example

Head Specifier Rule

\[
*S
\]

\[\text{NP}\]

\[\text{[CASE acc]}\]

\[\text{them}\]

\[\text{VP}\]

\[\text{[SPR } \langle 1 \rangle \text{ ]}\]

\[\text{V}\]

\[\text{[SPR } \langle 1 \rangle \text{ NP}[\text{nom}]]\]

\[\text{sent}\]

\[\text{NP}\]

\[\text{us}\]

\[\text{NP}\]

\[\text{D}\]

\[\text{N}\]

\[\text{a}\]

\[\text{letter}\]
Exercise in Critical Thinking

- Our grammar has come a long way since Ch 2, as we've added ways of representing different kinds of information:
  - generalizations across categories
  - semantics
  - particular linguistic phenomena: valence, agreement, modification

- What else might we add? What facts about language are as yet unrepresented in our model?
Overview

• What we’re trying to do
• The pieces of our grammar
• Two extended examples
• Reflection on what we’ve done, what we still have to do
• Next time: Review