Ling 566
Oct 17, 2011
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
• Reading questions
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?
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 \( a \)

- 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
Description of Word Structures for *cat*

```
word[
    [noun[AGR 2][GEND neut] 3sing]
    [head]
    [syn]
    [val]
    [sem]
    [mode ref]
    [index k]
    [restr]
    [comps ⟨ ⟩]
    [mod ⟨ ⟩]
]
```

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Description of Word Structures for \( a \)
Building a Phrase

[ ]

[ ]
[ ]
Constraints Contributed by Daughter Subtrees

```

Constraints Contributed by Daughter Subtrees

```

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Constraints Contributed by the Grammar Rule
A Constraint Involving the SHAC

[phrase
  SYN [ VAL [ SPR ]]]

word
  [det
    HEAD
    AGR [ 3sing
      COUNT +
      GEND neut
    ]
    COMPS ⟨ ⟩
    SPR ⟨ ⟩
    MOD ⟨ ⟩
  ]
  SYN
  VAL
  SEM
  INDEX k

word
  [noun
    HEAD
    AGR [ 3sing
      GEND neut
    ]
  ]
  SYN
  VAL
  SPR [ COUNT +
    INDEX k
  ]
  COMPS ⟨ ⟩
  MOD ⟨ ⟩
  SEM
  INDEX k

word
  [noun
    HEAD
    AGR [ 3sing
      GEND neut
    ]
  ]
  SYN
  VAL
  SPR [ COUNT +
    INDEX k
  ]
  COMPS ⟨ ⟩
  MOD ⟨ ⟩
  SEM
  INDEX k

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Effects of the Valence Principle

[phrase
SYN
VAL
COMPS 3
MOD 4]

[word
SYN
VAL
COMPS 3
MOD 4]

[word
SYN
VAL
COMPS 7
MOD 4]

[word
SYN
VAL
COMPS 7
MOD 4]

[word
SYN
VAL
COMPS 7
MOD 4]
Effects of the Head Feature Principle
Effects of the Semantic Inheritance Principle
Effects of the Semantic Compositionality Principle

phrase

SYN

VAL

COMPS ( )

MOD ( )

SEM

INDEX k

RESTR A ⊕ B

word

SYN

det

AGR 2

COUNT +

VAL

COMPS ( )

SPR ( )

MOD ( )

SEM

MODE none

INDEX k

RESTR A ( RELN a BV k )

word

SYN

noun

AGR 2

3sing GEND neut

VAL

SPR ( )

COMPS ( )

MOD ( )

SEM

MODE 8 ref

INDEX k

RESTR B ( RELN cat INSTANCE k )
Is the Mother Node Now Completely Specified?

Phrase SYN
- HEAD 6
- SPR ⟨⟩
- COMPS 3
- MOD 4

SEM
- MODE 8
- INDEX k
- RESTR A ⊕ B

Word SYN
- HEAD det
- AGR 2
- COUNT +
- COMPS ⟨⟩
- SPR ⟨⟩
- MOD ⟨⟩

SEM
- MODE none
- INDEX k
- RESTR A

Word SYN
- HEAD noun
- AGR 2
- 3sing
- GEND neut
- COMPS 3 ⟨⟩
- MOD 4 ⟨⟩

SEM
- MODE 8 ref
- INDEX k
- RESTR B ⟨RELN cat INSTANCE k⟩
Lexical Entry for *slept*

```
<slept,

\begin{array}{c}
\text{word} \\
\text{SYN} \\
\text{SEM}
\end{array}

\begin{array}{c}
\text{HEAD} \quad \text{verb} \\
\text{SPR} \quad \langle \quad \text{AGR} \quad \langle \ 9 \ \rangle \quad \text{CASE} \quad \langle \ \text{nom} \ \rangle \\
\text{COMPS} \quad \langle \ \rangle \\
\text{MOD} \quad \langle \ \rangle \\
\text{INDEX} \quad s_1 \\
\text{MODE} \quad \text{prop}
\end{array}

\begin{array}{c}
\text{RESTR} \quad \langle \text{RELN} \quad \langle \ 9 \text{sleep} \rangle, \ldots \rangle \\
\text{SLEEPER} \quad m
\end{array}
```
Another Head-Specifier Phrase

Key

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

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Is this description fully specified?
Does the top node satisfy the initial symbol?
RESTR of the S node

\[ \langle [\text{RELN} \ a \ k], [\text{RELN} \ \text{cat} \ k], [\text{RELN} \ \text{sleep} \ s_1 \ k], \ldots \rangle \]
Another Example

\[
S \\
NP \quad VP \\
\quad D \quad NOM \quad V \quad ADV \\
\quad \quad the \quad N \quad P \quad disappeared \quad yesterday \\
\quad \quad photos \quad PP \quad NP \\
\quad \quad \quad P \quad NP \\
\quad \quad \quad \quad of \quad D \quad N \\
\quad \quad \quad \quad \quad the \quad suspect
\]
Head Features from Lexical Entries

\[ S \]

\[ NP \]

\[ [\text{HEAD} \text{det}] \]

\[ \text{the} \]

\[ [\text{HEAD} \text{noun}] \]

\[ \text{photos} \]

\[ [\text{HEAD} \text{prep}] \]

\[ \text{of} \]

\[ [\text{HEAD} \text{det}] \]

\[ \text{the} \]

\[ [\text{HEAD} \text{noun}] \]

\[ \text{suspect} \]

\[ [\text{HEAD} \text{verb}] \]

\[ \text{disappeared} \]

\[ [\text{HEAD} \text{adverb}] \]

\[ \text{yesterday} \]
the photos of the suspect disappeared yesterday
Valence Features: Lexicon, Rules, and the Valence Principle

Key
- Lexicon
- Val. Prin.
- Rules
Required Identities: Grammar Rules

\[ S \]

\[ \text{NP} \]

\[ \text{D} \]

\[ \text{the} \]

\[ \text{N} \]

\[ \text{photos} \]

\[ \text{PP} \]

\[ \text{of} \]

\[ \text{NP} \]

\[ \text{D} \]

\[ \text{the} \]

\[ \text{N} \]

\[ \text{SPR} \]

\[ \text{[COMPS]} \]

\[ \text{SPR} \]

\[ \text{[COMPS]} \]

\[ \text{SPR} \]

\[ \text{[COMPS]} \]
Two Semantic Features: the Lexicon & SIP

the

 MODE ref
INDEX j

photos

 MODE ref
INDEX j

of

 MODE ref
INDEX k

the

 MODE ref
INDEX k

 disappeared

 MODE ref
INDEX k

yesterday

 MODE prop
INDEX s3

 MODE prop
INDEX s3

 MODE prop
INDEX s4

 MODE none
INDEX j

 MODE none
INDEX k

 MODE ref
INDEX k

 MODE ref
INDEX k

 MODE ref
INDEX k

 MODE ref
INDEX k

 MODE prop
INDEX s3

 MODE none
INDEX s4
RESTR Values and the SCP

A ⊕ B ⊕ C ⊕ D ⊕ E ⊕ F ⊕ G

A ⊕ B ⊕ C ⊕ D ⊕ E

B ⊕ C ⊕ D ⊕ E

C ⊕ D ⊕ E

D ⊕ E

E ⊕ G

RELN the BV j

RELN photo INST j CONTENT k

RELN disap. SIT s3 D-ER j

RELN yest. ARG s3

RELN the BV k

RELN suspect INST k

the

photos

of

disappeared

yesterday

the

suspect
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]

them

VP

[SPR ⟨1⟩]

V

[SPR ⟨1⟩ NP[nom]]

sent

NP

us

NP

da

D

N

a

letter
An Ungrammatical Example

Head Specifier Rule

*\( S \)

\[ \begin{array}{c}
\text{NP} \\
[\text{CASE} \text{ acc}] \\
\text{them}
\end{array} \]

\[ \begin{array}{c}
\text{VP} \\
[\text{SPR} \langle 1 \rangle ] \\
\text{sent} \\
\text{us} \\
\text{NP} \\
\text{us}
\end{array} \]

\[ \begin{array}{c}
\text{D} \\
\text{a} \\
\text{N} \\
\text{letter}
\end{array} \]

← contradiction →
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
- Reading questions
- Next time: Catch up & review
Reading Questions

• Do we have to understand the squiggly bits?

• Does RESTR mean we can take any structure and make an infinite number of variations on it?

• Does dative shift mean that we need to lexical entries for every dative shift verb?

• Is \([\text{AGR non-3sing}]\) the same as not \([\text{AGR 3sing}]\)?
Reading Questions

• Are the grammar rules applied in some defined order of priority (e.g., HCR before HSR), or can they be applied in any order?

• Re (17) on p.179 the text says that the predications are listed “in the indicated order”. To what extent is that order meaningful?
• The lexical entry for *letter* has an *ADDRESSEE* role in its semantics, but in *They sent us a letter*, the text claims that nothing is coindexed with that role. Why isn’t *us* coindexed with it?
⟨letter ,

SYN

[word

HEAD

[noun

AGR [3sing

GEND neut]]

VAL

[⟨D

SPR ⟨[COUNT +]⟩

[INDEX k]⟩

COMPS ⟨(PPₘ)⟩

MOD ⟨⟩

[MODE ref

INDEX k]]

SEM

[RESTR ⟨[RELN letter]⟩

[INST k

ADDRESSEE m]⟩

⟩
Reading Questions

• Do the two structures for *We send two letters to Lee* have the same meaning?
We send two letters to Lee.
We send two letters to Lee.
\[ [\text{RELN \ group}]_{\text{INST } i}, [\text{RELN \ speaker}]_{\text{INST } l}, [\text{RELN \ member}]_{\text{SET } i, \text{ELEMENT } l}, \]
\[ [\text{RELN \ send}]_{\text{SIT } s_7, \text{SENDER } i, \text{SENDEE } j, \text{SENT } k}, \]
\[ [\text{RELN \ two}]_{\text{BV } k}, [\text{RELN \ letter}]_{\text{INST } k, \text{ADDRRESSEE } m}, \]
\[ [\text{RELN \ name}]_{\text{NAME Lee}}, [\text{NAMED } m}, \]
Reading Questions

• How much of the lexical entries will we be expected to include in our assignments? Will this be specified in the problems? To what extent can we use abbreviations?

• Should this be called “lexically driven phrase structure grammar” instead?

• Is it feasible to show complete trees of complex sentences in any reasonable amount of space?
Reading Questions

• Page 173: (10) obeys the Valence Principle. Doesn't that apply to all of VAL? Shouldn't the phrase have [2] in its SPR list? It says here that because of the Head Specifier rule, the mother's SPR list is empty. Do rules overtake principles? Furthermore, it appears to be completely contradicted on page 177, where it says (14) obeys the Head Complement Rule, so that the specifier bubbles up but the mother's COMPS list is empty. How can both happen at the same time, and what's the point of the Valence Principle if we're ignoring it because of these rules?
Reading Questions

- **Valence Principle:** Unless the rule says otherwise, the mother's values for the VAL features (SPR, COMPS, and MOD) are identical to those of the head daughter.