Chapter 13, Sections 13.3-13.5

The NICE Properties of Auxiliaries
Our Analysis of Auxiliaries So Far

- Auxiliaries are subject-raising verbs (following Ross)
- Most basic distributional facts about them can be handled through ARG-ST constraints -- that is, selectional restrictions between auxiliaries and their complements (following McCawley)
- Auxiliaries are identified via a HEAD feature AUX, which we have not yet put to use
### Descriptive Summary of the NICE Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Negation</strong></td>
<td>Sentences are negated by putting <em>not</em> after the first auxiliary verb; they can be reaffirmed by putting <em>too</em> or <em>so</em> in the same position.</td>
</tr>
<tr>
<td><strong>Inversion</strong></td>
<td>Questions are formed by putting an auxiliary verb before the subject NP.</td>
</tr>
<tr>
<td><strong>Contraction</strong></td>
<td>Auxiliary verbs take negated forms, with <em>n’t</em> affixed.</td>
</tr>
<tr>
<td><strong>Ellipsis</strong></td>
<td>Verb phrases immediately following an auxiliary verb can be omitted.</td>
</tr>
</tbody>
</table>
Negation (and Reaffirmation)

• Polar adverbs (sentential *not, so, and too*) appear immediately following an auxiliary
  • *Pat will not leave*
  • *Pat will SO leave*
  • *Pat will TOO leave*

• What about examples like *Not many people left*?

• What happens when you want to deny or reaffirm a sentence with no auxiliary?
  • *Pat left*
  • *Pat did not leave*
  • *Pat did TOO leave*
The Auxiliary *do*

- Like modals, *do* only occurs in finite contexts:
  *Pat continued to do not leave*

- Unlike modals, *do* cannot be followed by other auxiliaries:
  *Pat did not have left*
The ADV_{pol}-Addition Lexical Rule

\[
\begin{align*}
\text{INPUT } & \langle X, \rangle \\
\text{ARG-ST } & \langle 1 \rangle \oplus A \\
\text{SEM } & \text{INDEX } s_1 \\
\text{SYN } & \text{HEAD } \begin{bmatrix} \text{FORM} & \text{fin} \\ \text{POL} & - \\ \text{AUX} & + \end{bmatrix} \\
\text{OUTPUT } & \langle Y, \rangle \\
\text{ARG-ST } & \langle 1 \rangle \oplus \left\langle \begin{bmatrix} \text{INDEX} & s_2 \\ \text{RESTR} & \langle [\text{ARG } s_1] \rangle \end{bmatrix} \right\rangle \oplus A \\
\text{SEM } & \text{INDEX } s_2
\end{align*}
\]
What does the type *pi-rule* mean?

- It maps words to words (hence, "post-inflectional")
- It preserves MOD values, HEAD values as a default, and (like other lexical rule types) SEM values as a default
What is the role of these indices?
Which *nots* does the rule license?

Andy must *not* have been sleeping?
Andy must have *not* been sleeping?
Andy must have been *not* sleeping?
*Kleptomaniacs cannot not steal.*
*Kleptomaniacs cannot not steal.*
Which *nots* does the rule license?

Andy must *not* have been sleeping? ✓

Andy must have *not* been sleeping? ▬

Andy must have been *not* sleeping? ▬

Kleptomaniacs cannot *not* steal. ✓

Kleptomaniacs cannot *not* steal. ▬
Negation and Reaffirmation: A Sample Tree

NP
  Leslie

VP
  V
  did

ADV_{pol}
  so

VP
  eat the whole pizza
Inversion

- Yes-no questions begin with an auxiliary:  
  \textit{Will Robin win?}

- The NP after the auxiliary has all the properties of a subject
  - Agreement: \textit{Have they left?} vs. \textit{Has they left?}
  - Case: \textit{*Have them left?}
  - Raising: \textit{Will there continue to be food at the meetings?}

- What happens if you make a question out of a sentence without an auxiliary?
Inversion

- Yes-no questions begin with an auxiliary: 
  \textit{Will Robin win?}

- The NP after the auxiliary has all the properties of a subject 
  - Agreement: \textit{Have they left?} vs. *\textit{Has they left?}
  - Case: *\textit{Have them left?}
  - Raising: \textit{Will there continue to be food at the meetings?}

- What happens if you make a question out of a sentence without an auxiliary? 
  \textit{Robin won}
  \textit{Did Robin win?}
The Inversion Lexical Rule

\[
\begin{align*}
\text{pi-rule} & \\
\text{INPUT} & \left\langle W, \right\rangle \\
\text{ARG-ST} & \text{Syn} \\
\text{VAL} & \text{Val} \\
\text{SEM} & \text{Sem} \\
\text{OUTPUT} & \left\langle Z, \right\rangle \\
\text{ARG-ST} & \text{Syn} \\
\text{VAL} & \text{Val} \\
\text{SEM} & \text{Sem} \\
\end{align*}
\]
How the Rule Yields Inverted Order

\[ \text{INPUT} \left\langle \text{W}, \text{SYN} \right\rangle \]

\[ \text{ARG-ST} \quad \text{SEM} \]

\[ \text{OUTPUT} \left\langle \text{Z}, \text{SYN} \right\rangle \]

\[ \text{ARG-ST} \quad \text{SEM} \]

...plus the ARP
The Feature INV

• What is the INV value of inputs to the Inversion LR?
  • Perhaps surprisingly, the input is [INV +]
  • Word-to-word rules (pi-rules) have default identity of HEAD features, and no INV value is given on the input
  • Then what work is the feature doing?
The Feature INV

• What is the INV value of inputs to the Inversion LR?
  • Perhaps surprisingly, the input is [INV +]
  • Word-to-word rules (*pi-rules*) have default identity of HEAD features, and no INV value is given on the input

• Then what work is the feature doing?
  • It’s used to mark auxiliaries that can’t or must be inverted

  You better watch out vs. *Better you watch out
  I shall go (shall ~ ‘will’) vs. Shall I go? (shall ~ ‘should’)
Other Cases of Inversion

• Inversion is not limited to questions
  • Preposed negatives: *Never have I been so upset!*
  • Conditionals: *Had we known, we would have left.*
  • Exclamations: *May your teeth fall out!*

• Does the Inversion Lexical Rule account for these?
Other Cases of Inversion

• Inversion is not limited to questions
  • Preposed negatives: *Never have I been so upset!*
  • Conditionals: *Had we known, we would have left.*
  • Exclamations: *May your teeth fall out!*

• Does the Inversion Lexical Rule account for these?
  • No. The rule’s output says [MODE ques]. And each construction has slightly different idiosyncracies.
Other Cases of Inversion

• Inversion is not limited to questions
  • Preposed negatives: *Never have I been so upset!*
  • Conditionals: *Had we known, we would have left.*
  • Exclamations: *May your teeth fall out!*

• Does the Inversion Lexical Rule account for these?
  • No. The rule’s output says [MODE ques]. And each construction has slightly different idiosyncracies.

• How might we extend the analysis to cover them?
Other Cases of Inversion

• Inversion is not limited to questions
  • Preposed negatives: *Never have I been so upset!*
  • Conditionals: *Had we known, we would have left.*
  • Exclamations: *May your teeth fall out!*

• Does the Inversion Lexical Rule account for these?
  • No. The rule’s output says [MODE ques]. And each construction has slightly different idiosyncracies.

• How might we extend the analysis to cover them?
  • Define a type of inversion lexical rules, sharing certain properties, but with some differences.
Inversion: A Sample Tree

S
  V
  Did
  NP
  Leslie
  VP
  eat the entire pizza?
Contraction

- There are several types of contraction in English, but we’re only talking about words ending in n’t
- It may seem like just not said fast, but there’s more to it
  - Only finite verbs can take n’t:
    - *Terry must haven’t seen us
- There are morphological irregularities:
  - won’t, not *willn’t  %shan’t, not *shalln’t
  - mustn’t pronounced mussn’t
  - don’t pronounced doen’t, not dewn’t
  - *amn’t
The Contraction Lexical Rule

\[
\begin{align*}
\text{INPUT} & \quad \left\langle 2, \begin{bmatrix}
\text{SYN} & \text{HEAD} & \begin{bmatrix}
\text{verb} \\
\text{FORM} & \text{FIN} \\
\text{AUX} & + \\
\text{POL} & - 
\end{bmatrix}
\end{bmatrix}, \right. \\
\text{ARG-ST} & \quad \Box \\
\text{SEM} & \quad \begin{bmatrix}
\text{INDEX} & s_1 \\
\text{RESTR} & \Box
\end{bmatrix}
\end{align*}
\]

\[
\text{OUTPUT} \quad \left\langle \text{F}_{\text{NEG}}(2), \begin{bmatrix}
\text{SYN} & \begin{bmatrix}
\text{HEAD} & \begin{bmatrix}
\text{POL} & + 
\end{bmatrix}
\end{bmatrix}
\end{bmatrix}, \right. \\
\text{ARG-ST} & \quad \Box \\
\text{SEM} & \quad \begin{bmatrix}
\text{INDEX} & s_2 \\
\text{RESTR} & \begin{bmatrix}
\text{RELN} & \textbf{not} \\
\text{SIT} & s_2 \\
\text{ARG} & s_1
\end{bmatrix}
\end{bmatrix} \oplus \Box
\]
Most of the work is in the semantics

Why?
What does POL do?

INPUT \( \langle 2, \begin{array}{c}
\text{SYN} \\ \text{ARG-ST} \\ \text{SEM}
\end{array}
\begin{array}{c}
\text{HEAD} \\ \text{INDEX} \\ \text{RESTR}
\end{array}
\begin{array}{c}
\text{\[verb\]} \\ \text{\[FORM\text{ \text{fin}}\]} \\ \text{\[AUX\text{ \text{+}}\]} \\ \text{\[POL\text{ \text{-}}\]}
\end{array}
\rangle \)

OUTPUT \( \langle F_{\text{NEG}}(2), \begin{array}{c}
\text{SYN} \\ \text{ARG-ST} \\ \text{SEM}
\end{array}
\begin{array}{c}
\text{\[\text{POL}\text{ \text{+}}\]} \\ \text{\[\text{SPR}\langle X\rangle\]}
\end{array}
\begin{array}{c}
\text{\[\text{INDEX}\]} \\ \text{\[\text{RESTR}\]}
\end{array}
\begin{array}{c}
\text{\[\text{\[RELN\text{ \text{not}}\]}\]}
\end{array}
\rangle \)
What does POL do?

\[
\begin{align*}
\text{INPUT} & : \left\langle \begin{array}{c}
2, \\
\text{ARG-ST} \left[ \mathbb{B} \right], \\
\text{SEM} \left[ \begin{array}{c}
\text{INDEX } s_1 \\
\text{RESTR } \left[ \mathbb{A} \right]
\end{array} \right]
\end{array} \right\rangle\\
\text{OUTPUT} & : \left\langle \begin{array}{c}
\text{F}_{\text{NEG}(2)}, \\
\text{ARG-ST} \left[ \mathbb{B} \right], \\
\text{SEM} \left[ \begin{array}{c}
\text{INDEX } s_2 \\
\text{RESTR} \left[ \begin{array}{c}
\text{RELN } \text{not} \\
\text{SIT } s_2 \\
\text{ARG } s_1
\end{array} \right] \oplus \left[ \mathbb{A} \right]
\end{array} \right]
\end{array} \right\rangle
\end{align*}
\]

*We can’tn’t stop*
*They won’t TOO mind*
Contraction: Sample Tree

NP

VP

V wouldn’t

eat the entire pizza

Leslie

S
Ellipsis

• Ellipsis allows VPs to be omitted, so long as they would have been preceded by an auxiliary

  *Pat couldn’t have been watching us, but Chris could have been watching us.*
Ellipsis

• Ellipsis allows VPs to be omitted, so long as they would have been preceded by an auxiliary

  Pat couldn’t have been watching us, but Chris could have been.
Ellipsis

• Ellipsis allows VPs to be omitted, so long as they would have been preceded by an auxiliary

  *Pat couldn’t have been watching us, but Chris could have.*
Ellipsis

• Ellipsis allows VPs to be omitted, so long as they would have been preceded by an auxiliary

  *Pat couldn’t have been watching us, but Chris could.*
Ellipsis

• Ellipsis allows VPs to be omitted, so long as they would have been preceded by an auxiliary

  *Pat couldn’t have been watching us, but Chris.
Ellipsis

• Ellipsis allows VPs to be omitted, so long as they would have been preceded by an auxiliary

  \textit{Pat couldn’t have been watching us, but Chris could}

• Unlike the other NICE properties, this holds of all auxiliaries, not just finite ones
Ellipsis

- Ellipsis allows VPs to be omitted, so long as they would have been preceded by an auxiliary
  
  *Pat couldn’t have been watching us, but Chris*

- Unlike the other NICE properties, this holds of all auxiliaries, not just finite ones

- What is the elliptical counterpart to a sentence with no auxiliary?

  *Whenever Pat watches TV, Chris watches TV*
Ellipsis

• Ellipsis allows VPs to be omitted, so long as they would have been preceded by an auxiliary

  *Pat couldn’t have been watching us, but Chris*

• Unlike the other NICE properties, this holds of all auxiliaries, not just finite ones

• What is the elliptical counterpart to a sentence with no auxiliary?

  *Whenever Pat watches TV, Chris watches TV*  
  *Whenever Pat watches TV, Chris does*
The Ellipsis Lexical Rule

\[
\begin{align*}
\text{INPUT} & : \langle 1, [\text{auxv-lxm} \ \text{ARG-ST} \langle 2 \rangle \oplus A] \rangle \\
\text{OUTPUT} & : \langle 1, [\text{dervv-lxm} \ \text{ARG-ST} \langle 2 \rangle] \rangle
\end{align*}
\]

- Note that this is a derivational LR (\textit{d-rule}) -- that is, lexeme-to-lexeme
- This means that SYN and SEM are unchanged, by default
Ellipsis: A Sample Output

\[
\begin{split}
&\langle \text{could} , \\
&\langle \text{NP} \rangle \\
&\langle \text{RELN} \rangle \\
&\langle \text{SIT} \rangle \\
&\langle \text{ARG} \rangle \\
&\langle \text{SEM} \rangle \\
&\langle \text{MODE} \rangle \\
&\langle \text{INDEX} \rangle \\
&\langle \text{ARG-ST} \rangle \\
&\langle \text{SYN} \rangle \\
&\langle \text{auxv-lxm} \rangle
\end{split}
\]
Ellipsis: A Sample Tree

S

NP

Kim

VP

V

could

VP

V

have

VP

V

been

VP

attending the conference
Kim could have been attending the conference.
Ellipsis: A Sample Tree

S

NP

Kim

VP

V

could

VP

V

have

have
Ellipsis: A Sample Tree

S
  NP
    Kim
  V
    could

NP: Kim
VP: could
V: have
VP: been
VP: attending the conference
Semantics of Ellipsis

What is the SEM value of the S node of this tree?
Semantics of Ellipsis

What is the SEM value of the S node of this tree?

INDEX $s_1$
MODE prop

RESTR<br>$\left\langle \left[ \text{RELN name} \right], \left[ \text{RELN could} \right] \right\rangle$

Note: $s_2$ has to be filled in by context.
Infinitival *to* Revisited

- VP Ellipsis can occur after *to*:
  
  *We didn’t find the solution, but we tried to.*

- This is covered by the Ellipsis LR if we say *to* is [AUX +].

- Since AUX is declared on type *verb*, it follows that *to* is a verb.
do Revisited

• Chomsky’s old analysis: in sentences w/o auxiliaries...
  • Tense can get separated from the verb in various ways
    • Negation/Reaffirmation inserts something between Tense and the following verb
    • Inversion moves Tense to the left of the subject NP
    • Ellipsis deletes what follows Tense
  • When this happens, *do* is inserted to support Tense

• The nontransformational lexicalist counterpart:
  • NICE properties hold only of auxiliaries
  • *do* is a semantically empty auxiliary, so negated, reaffirmed, inverted, and elliptical sentences that are the semantic counterparts to sentences w/o auxiliaries are ones with *do*.
Summary

• Our analysis employs straightforward mechanisms
  • Lexical entries for auxiliaries
  • 3 new features (AUX, POL, INV)
  • 4 lexical rules

• We handle a complex array of facts
  • co-occurrence restrictions (ordering & iteration)
  • the NICE properties
  • auxiliary *do*
  • combinations of NICE constructions