Ling 566
Nov 1, 2022

Lexical Rules

© 2003 CSLI Publications

Overview

- How lexical rules fit in
- Three types of lexical rules, constraints
- Example: Plural noun lexical rule
- Advice on writing lexical rules
- Constant lexemes
- ARG-ST & ARP
- The feature FORM

© 2003 CSLI Publications

Lexical Types & Lexical Rules

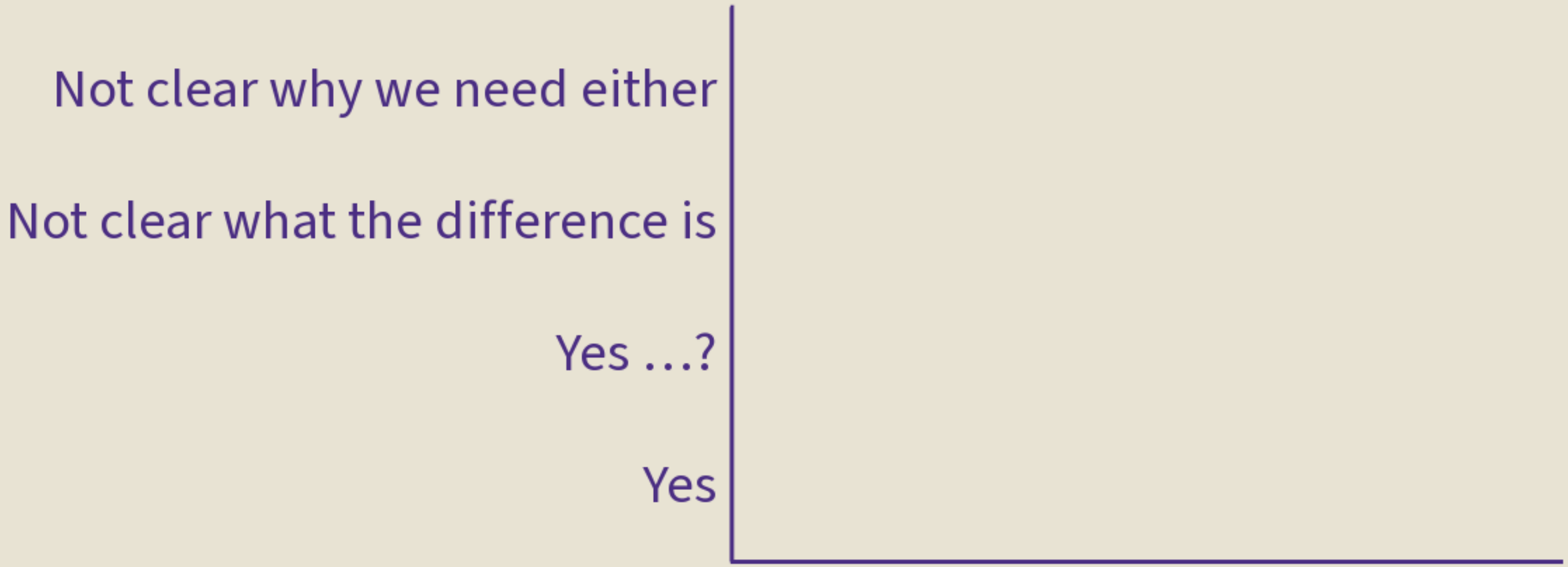
- Lexemes capture the similarities among *run*, *runs*, *running*, and *ran*
- The lexical type hierarchy captures the similarities among *run*, *sleep*, and *laugh*, among those and other verbs like *devour* and *hand*, and among those and other words like *book*.
- Lexical rules capture the similarities among *runs*, *sleeps*, *devours*, *hands*, ...

© 2003 CSLI Publications

When poll is active, respond at **pollev.com/emb**

Text **EMB** to **22333** once to join

Is it clear what type of regularities are captured by lexical types and lexical rules? (take 3)



Start the presentation to see live content. For screen share software, share the entire screen. Get help at **pollev.com/app**

Parsimony & Plausibility

- Lexical rules capture **productive** generalizations.
- There may be some ‘precompiling’ going on as well.

© 2003 CSLI Publications

Three Kinds of Lexical Rules

- Inflectional: *lexeme* to *word*

Examples?

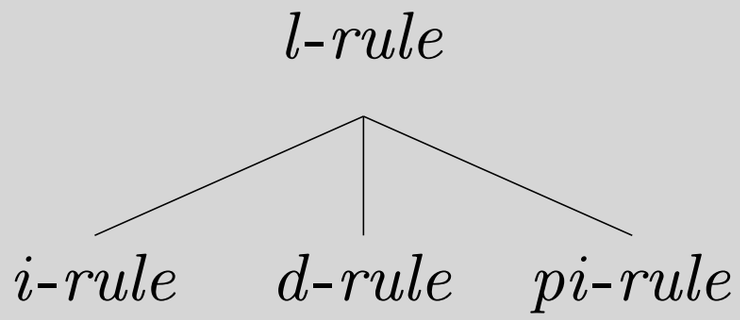
- Derivational: *lexeme* to *lexeme*

Examples?

- Post-Inflectional: *word* to *word*
  (Chapters 11, 13, 14)

© 2003 CSLI Publications

Three Subtypes of *l-rule*



$$\textit{l-rule}: \begin{bmatrix} \text{INPUT} & \textit{l-sequence}\left\langle \text{X} , [\ \text{SEM} \quad / \boxed{2}\ ] \right\rangle \\ \text{OUTPUT} & \textit{l-sequence}\left\langle \text{Y} , [\ \text{SEM} \quad / \boxed{2}\ ] \right\rangle \end{bmatrix}$$

$$\textit{i-rule}: \begin{bmatrix} \text{INPUT} & \left\langle \text{X} , \begin{bmatrix} \textit{lexeme} \\ \text{SYN} \quad \boxed{3} \\ \text{ARG-ST} \quad \boxed{\text{A}} \end{bmatrix} \right\rangle \\ \text{OUTPUT} & \left\langle \text{Y} , \begin{bmatrix} \textit{word} \\ \text{SYN} \quad \boxed{3} \\ \text{ARG-ST} \quad \boxed{\text{A}} \end{bmatrix} \right\rangle \end{bmatrix}$$

$$\textit{d-rule}: \begin{bmatrix} \text{INPUT} & \left\langle \text{X} , \begin{bmatrix} \textit{lexeme} \\ \text{SYN} \quad / \boxed{3} \end{bmatrix} \right\rangle \\ \text{OUTPUT} & \left\langle \text{Y} , \begin{bmatrix} \textit{lexeme} \\ \text{SYN} \quad / \boxed{3} \end{bmatrix} \right\rangle \end{bmatrix}$$

© 2003 CSLI Publications

Plural Noun LR

$$\left[\begin{array}{l} \textit{i-rule} \\ \text{INPUT} \quad \left\langle \boxed{1}\ ,\ \textit{cntn-lxm} \right\rangle \\ \text{OUTPUT} \quad \left\langle \text{F}_{NPL}(\boxed{1})\ ,\ \left[\begin{array}{l} \textit{word} \\ \text{SYN} \left[\text{HEAD} \quad \left[\text{AGR} \quad \left[\text{NUM} \quad \text{pl}\right]\right]\right] \end{array}\right] \right\rangle \end{array}\right]$$

© 2003 CSLI Publications

Plural Noun LR with Inherited Constraints

$$
\left[\begin{array}{l}
\textit{i-rule} \\
\\
\text{INPUT} \quad \left\langle \boxed{1}, \left[\begin{array}{l} \textit{cntn-lxm} \\ \\ \\ \end{array}\right] \right\rangle \\
\\
\text{OUTPUT} \quad \left\langle \mathrm{F}_{NPL}(\boxed{1}), \left[\begin{array}{ll} \textit{word} & \\ & \left[\text{HEAD} \quad [\text{AGR} \quad [\text{NUM} \quad \text{pl}]]\right] \\ & \end{array}\right] \right\rangle
\end{array}\right]
$$

© 2003 CSLI Publications

Plural Noun LR with Inherited Constraints

$$
\left[\begin{array}{l}
\textit{i-rule} \\
\\
\text{INPUT} \quad \left\langle \boxed{1}, \left[\begin{array}{l} \textit{cntn-lxm} \\ \\ \text{SEM} \quad \boxed{2} \end{array}\right] \right\rangle \\
\\
\text{OUTPUT} \quad \left\langle \mathrm{F}_{NPL}(\boxed{1}), \left[\begin{array}{l} \textit{word} \\ \\ \text{SEM} \quad \boxed{2} \end{array}\right. \right. \\
\left. \left. \left[\text{HEAD} \quad [\text{AGR} \quad [\text{NUM} \quad \text{pl}]]\right] \right] \right\rangle
\end{array}\right]
$$

© 2003 CSLI Publications

Plural Noun LR with Inherited Constraints

$$
\left[\begin{array}{l}
\textit{i-rule} \\
\\
\text{INPUT} \quad \left\langle \boxed{1}, \left[\begin{array}{ll}
\textit{cntn-lxm} & \\
 & \\
 & \\
\text{SEM} & \boxed{2} \\
\text{ARG-ST} & \boxed{B} \oplus \boxed{C}
\end{array}\right] \right\rangle \\
\\
\text{OUTPUT} \quad \left\langle \text{F}_{NPL}(\boxed{1}), \left[\begin{array}{ll}
\textit{word} & \\
 & \left[\text{HEAD} \quad [\text{AGR} \quad [\text{NUM} \quad \text{pl}]]\right] \\
 & \\
\text{SEM} & \boxed{2} \\
\text{ARG-ST} & \boxed{B} \oplus \boxed{C}
\end{array}\right] \right\rangle
\end{array}\right]
$$

© 2003 CSLI Publications

Plural Noun LR with Inherited Constraints

$$
\left[\begin{array}{l}
\textit{i-rule} \\
\\
\text{INPUT} \quad \left\langle \boxed{1}, \left[\begin{array}{ll}
\textit{cntn-lxm} & \\
 & \\
\text{SYN} & \boxed{3} \\
 & \\
\text{SEM} & \boxed{2} \\
\text{ARG-ST} & \boxed{B} \oplus \boxed{C}
\end{array}\right] \right\rangle \\
\\
\text{OUTPUT} \quad \left\langle \text{F}_{NPL}(\boxed{1}), \left[\begin{array}{ll}
\textit{word} & \\
 & \\
\text{SYN} & \boxed{3}\left[\text{HEAD} \quad [\text{AGR} \quad [\text{NUM} \quad \text{pl}]]\right] \\
 & \\
\text{SEM} & \boxed{2} \\
\text{ARG-ST} & \boxed{B} \oplus \boxed{C}
\end{array}\right] \right\rangle
\end{array}\right]
$$

© 2003 CSLI Publications

Plural Noun LR with Inherited Constraints

$$\left[\begin{array}{l} \textit{i-rule} \\ \\ \text{INPUT} \quad \left\langle \boxed{1}, \left[\begin{array}{ll} \textit{cntn-lxm} & \\ \\ \text{SYN} & \boxed{3}\left[\begin{array}{ll} \text{HEAD} & \left[\begin{array}{ll} \textit{noun} & \\ \text{AGR} & \boxed{4}[\text{PER} \quad \text{3rd}] \end{array}\right] \\ \\ \text{VAL} & \left[\text{SPR} \quad \left\langle \left[\begin{array}{ll} & \text{DP} \\ \text{COUNT} & + \\ \text{AGR} & \boxed{4} \end{array}\right] \right\rangle\right] \end{array}\right] \\ \text{SEM} & \boxed{2}[\text{MODE} \ / \ \text{ref}] \\ \text{ARG-ST} & \boxed{B} \oplus \boxed{C} \end{array}\right] \right\rangle \\ \\ \text{OUTPUT} \quad \left\langle \text{F}_{NPL}(\boxed{1}), \left[\begin{array}{ll} \textit{word} & \\ \\ \text{SYN} & \boxed{3}\left[\text{HEAD} \quad [\text{AGR} \quad [\text{NUM} \quad \text{pl}]]\right] \\ \\ \text{SEM} & \boxed{2} \\ \text{ARG-ST} & \boxed{B} \oplus \boxed{C} \end{array}\right] \right\rangle \end{array}\right]$$

© 2003 CSLI Publications

Plural Noun LR with Inherited Constraints

$$\left[\begin{array}{l}
\textit{i-rule} \\
\\
\text{INPUT} \quad \left\langle \boxed{1}, \left[\begin{array}{ll}
\textit{cntn-lxm} & \\
\\
\text{SYN} & \boxed{3}\left[\begin{array}{ll}
\text{HEAD} & \left[\begin{array}{ll} \textit{noun} & \\ \text{AGR} & \boxed{4}[\text{PER} \quad \text{3rd}] \end{array}\right] \\
\\
\text{VAL} & \left[\text{SPR} \left\langle \left[\begin{array}{ll} \text{COUNT} & + \\ \text{AGR} & \boxed{4} \end{array}\right] \right\rangle_{\text{DP}}\right]
\end{array}\right] \\
\\
\text{SEM} & \boxed{2}[\text{MODE} \ / \ \text{ref}] \\
\text{ARG-ST} & \boxed{B} \oplus \boxed{C}
\end{array}\right] \right\rangle \\
\\
\text{OUTPUT} \quad \left\langle \text{F}_{NPL}(\boxed{1}), \left[\begin{array}{ll}
\textit{word} & \\
\\
\text{SYN} & \boxed{3}\left[\begin{array}{ll}
\text{HEAD} & [\text{AGR} \quad [\text{NUM} \quad \text{pl}]] \\
\\
\text{VAL} & \left[\begin{array}{ll} \text{SPR} & \boxed{B} \\ \text{COMPS} & \boxed{C} \end{array}\right]
\end{array}\right] \\
\\
\text{SEM} & \boxed{2} \\
\text{ARG-ST} & \boxed{B} \oplus \boxed{C}
\end{array}\right] \right\rangle
\end{array}\right]$$

© 2003 CSLI Publications

Practicalities - Applying Lexical Rules

- INPUT is a family of lexical sequences.
- OUTPUT is another family of lexical sequences.
  - ...usually a smaller family
  - ...usually a disjoint one
- The only differences between the families are those stipulated in the rule (or the rule's type).
- Similarities are handled by the constraints on *l-rule* and its subtypes.
- If we've written the LRs correctly, nothing is left underconstrained.

© 2003 CSLI Publications

Example: Lexical Entry for *cat*

$$\left\langle \text{cat} \;,\; \left[\begin{array}{l} \textit{cntn-lxm} \\ \\ \text{SEM} \end{array} \right. \left[\begin{array}{ll} \text{INDEX} & k \\ \\ \text{RESTR} & \left\langle \left[\begin{array}{ll} \text{RELN} & \text{cat} \\ \text{INST} & k \end{array} \right] \right\rangle \end{array} \right] \right\rangle$$

© 2003 CSLI Publications

Example: *cat*, with inheritance

$$\left\langle \text{cat}\ ,\ \begin{bmatrix} \textit{cntn-lxm} & \\ \text{SYN} & \begin{bmatrix} \text{VAL} & \begin{bmatrix} \quad \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & k \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{RELN} & \text{cat} \\ \text{INST} & k \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

© 2003 CSLI Publications

Example: *cat*, with inheritance

$$\left\langle \text{cat} , \left[\textit{cntn-lxm} \right. \right.$$

$$\text{SYN} \left[\text{VAL} \left[\text{SPR} \left\langle \left[\text{COUNT} \quad + \right] \right\rangle \right] \right]$$

$$\left. \text{SEM} \left[\begin{array}{ll} \text{INDEX} & k \\ \text{RESTR} & \left\langle \left[\begin{array}{ll} \text{RELN} & \text{cat} \\ \text{INST} & k \end{array} \right] \right\rangle \end{array} \right] \right] \right\rangle$$

© 2003 CSLI Publications

Example: *cat*, with inheritance

$$\left\langle \text{cat} , \left[\begin{array}{l} \textit{cntn-lxm} \\ \text{SYN} \left[\begin{array}{ll} \text{HEAD} & \left[\begin{array}{ll} \textit{noun} & \\ \text{AGR} & [\ \text{PER} \quad \text{3rd}\ ] \end{array}\right] \\ \text{VAL} & \left[\begin{array}{ll} \text{SPR} & \left\langle \left[\begin{array}{ll} \text{DP} & \\ \text{COUNT} & + \end{array}\right] \right\rangle \\ & \end{array}\right] \end{array}\right] \\ \text{SEM} \left[\begin{array}{ll} \text{MODE} & \text{ref} \\ \text{INDEX} & k \\ \text{RESTR} & \left\langle \left[\begin{array}{ll} \text{RELN} & \text{cat} \\ \text{INST} & k \end{array}\right] \right\rangle \end{array}\right] \\ \text{ARG-ST} \quad \left\langle \text{X} \right\rangle \end{array}\right] \right\rangle$$

© 2003 CSLI Publications

Example: *cat*, with inheritance

$$\left\langle \text{cat} , \left[\begin{array}{l} \textit{cntn-lxm} \\ \text{SYN} \left[\begin{array}{ll} \text{HEAD} & \left[\begin{array}{ll} \textit{noun} & \\ \text{AGR} & \boxed{7}\left[\text{PER} \quad \text{3rd} \right] \end{array} \right] \\ \text{VAL} & \left[\begin{array}{ll} \text{SPR} & \left\langle \left[\begin{array}{ll} \text{DP} & \\ \text{COUNT} & + \\ \text{AGR} & \boxed{7} \end{array} \right] \right\rangle \\ & \end{array} \right] \end{array} \right] \\ \text{SEM} \left[\begin{array}{ll} \text{MODE} & \text{ref} \\ \text{INDEX} & k \\ \text{RESTR} & \left\langle \left[\begin{array}{ll} \text{RELN} & \text{cat} \\ \text{INST} & k \end{array} \right] \right\rangle \end{array} \right] \\ \text{ARG-ST} \quad \left\langle \text{X} \right\rangle \end{array} \right] \right\rangle$$

Default constraint now inviolable

© 2003 CSLI Publications

Plural Noun LR

$$\left[\begin{array}{l} \textit{i-rule} \\ \text{INPUT} \quad \left\langle \boxed{1}\ ,\ \textit{cntn-lxm} \right\rangle \\ \text{OUTPUT} \quad \left\langle \text{F}_{NPL}(\boxed{1})\ ,\ \left[\begin{array}{l} \textit{word} \\ \text{SYN} \left[\text{HEAD} \quad \left[\text{AGR} \quad \left[\text{NUM} \quad \text{pl}\right]\right]\right] \end{array}\right] \right\rangle \end{array}\right]$$

© 2003 CSLI Publications

Licensing *cats*

$$\left[\begin{array}{l}\textit{i-rule}\\ \\ \text{INPUT}\quad \left\langle \boxed{1}\text{cat}\ ,\ \left[\begin{array}{ll}\textit{cntn-lxm}\\ \\ \text{SYN} & \boxed{3}\left[\begin{array}{ll}\text{HEAD} & \left[\begin{array}{ll}\textit{noun}\\ \text{AGR} & \boxed{7}[\ \text{PER}\quad \text{3rd}\ ]\end{array}\right]\\ \text{VAL} & \left[\text{SPR}\ \left\langle \left[\begin{array}{ll}\text{COUNT} & +\\ \text{AGR} & \boxed{7}\end{array}\right]\right\rangle\right]\end{array}\right]\\ \text{SEM} & \boxed{2}\left[\begin{array}{ll}\text{MODE} & \text{ref}\\ \text{INDEX} & k\\ \text{RESTR} & \left\langle \left[\begin{array}{ll}\text{RELN} & \text{cat}\\ \text{INST} & k\end{array}\right]\right\rangle\end{array}\right]\\ \text{ARG-ST} & \boxed{B}\langle\ \text{X}\ \rangle \oplus \boxed{C}\langle\ \rangle\end{array}\right]\right\rangle\\ \\ \text{OUTPUT}\quad \left\langle \text{F}_{NPL}(\boxed{1})\ ,\ \left[\begin{array}{ll}\textit{word}\\ \\ \text{SYN} & \boxed{3}\left[\begin{array}{ll}\text{HEAD} & [\text{AGR}\quad [\text{NUM}\quad \text{pl}]]\\ \text{VAL} & \left[\begin{array}{ll}\text{SPR} & \boxed{B}\\ \text{COMPS} & \boxed{C}\end{array}\right]\end{array}\right]\\ \text{SEM} & \boxed{2}\\ \text{ARG-ST} & \boxed{B} \oplus \boxed{C}\end{array}\right]\right\rangle\end{array}\right]$$

© 2003 CSLI Publications

cats: The (family of) Lexical Sequence(s)

$$\left\langle \text{cats} , \left[\begin{array}{ll} \textit{word} & \\ \text{SYN} & \left[\begin{array}{ll} \text{HEAD} & \left[\begin{array}{ll} \textit{noun} & \\ \text{AGR} & \textit{3pl} \end{array}\right] \\ \text{VAL} & \left[\begin{array}{ll} \text{SPR} & \boxed{\text{B}}\left\langle \left[\begin{array}{ll} & \text{DP} \\ \text{COUNT} & + \\ \text{AGR} & \boxed{7} \end{array}\right] \right\rangle \\ \text{COMPS} & \langle\,\rangle \end{array}\right] \end{array}\right] \\ \text{SEM} & \left[\begin{array}{ll} \text{MODE} & \text{ref} \\ \text{INDEX} & k \\ \text{RESTR} & \left\langle \left[\begin{array}{ll} \text{RELN} & \text{cat} \\ \text{INST} & k \end{array}\right] \right\rangle \end{array}\right] \\ \text{ARG-ST} & \boxed{\text{B}} \end{array}\right] \right\rangle$$

© 2003 CSLI Publications

Practicalities -- Writing Lexical Rules

- Determine the type of the LR.
- Determine the class of possible inputs.
- Determine what should change.
  - If INPUT and OUTPUT values are identified (by default or otherwise) and only OUTPUT value is mentioned, then...
    information is added.

    (Lexical sequences incompatible with that value are not possible inputs)
  - If INPUT and OUTPUT values are identified by default, but different values are given on the INPUT and OUTPUT of the rule, then...
    information is changed.
  - If INPUT and OUTPUT values are identified by an inviolable constraint, but different values are given on the INPUT and OUTPUT of the rule, then...
    there is no well-formed output

© 2003 CSLI Publications

Constant lexemes

- What kinds of words are constant lexemes in our grammar?
- Why do we need a rule for these words?
- What would be an alternative analysis?

© 2003 CSLI Publications

Constant Lexeme LR

$$\left[\begin{array}{ll} \textit{i-rule} & \\ \text{INPUT} & \langle\ \boxed{1}\ ,\ \textit{const-lxm}\ \rangle \\ \text{OUTPUT} & \left[\text{FIRST}\quad \boxed{1}\right] \end{array}\right]$$

- What keeps this from applying to, say, verb lexemes?
- Why is this an *i-rule*?

© 2003 CSLI Publications

Constant Lexeme LR

$$\begin{bmatrix} \textit{i-rule} & \\ \text{INPUT} & \langle\ \boxed{1}\ ,\ \textit{const-lxm}\ \rangle \\ \text{OUTPUT} & \langle\ \boxed{1}\ ,\ [\ ]\ \rangle \end{bmatrix}$$

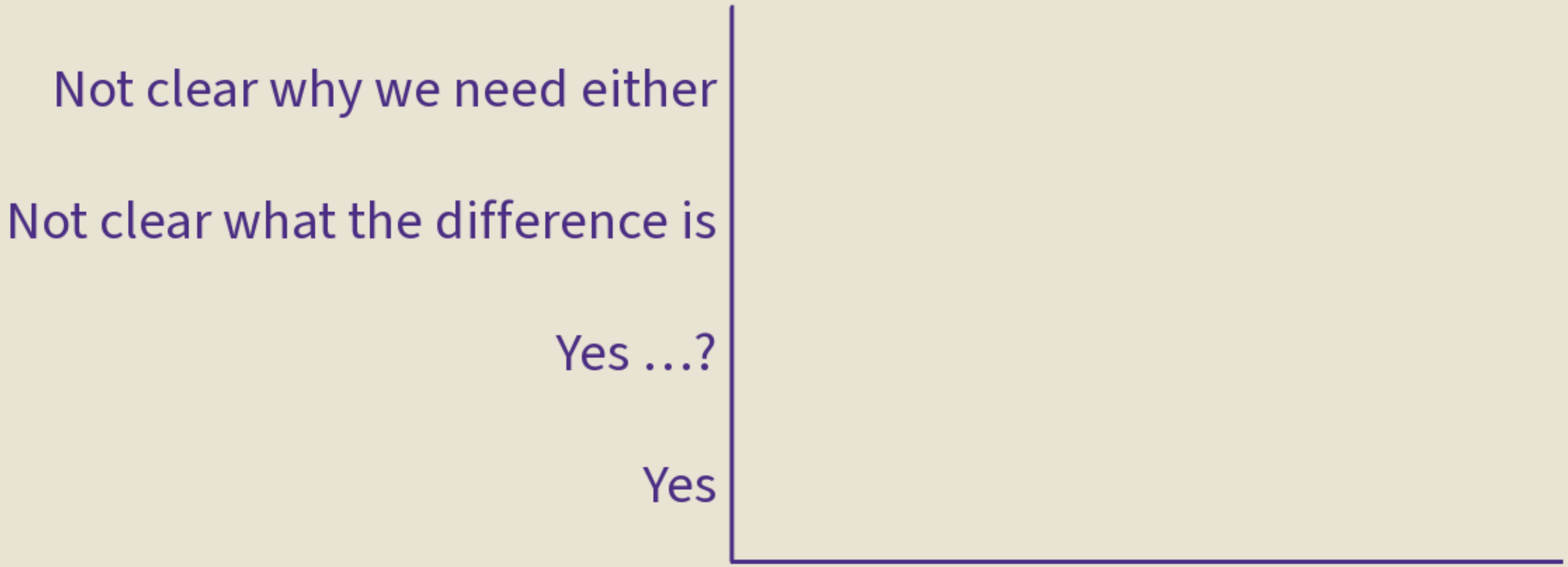
- What keeps this from applying to, say, verb lexemes?
- Why is this an *i-rule*?

© 2003 CSLI Publications

When poll is active, respond at **pollev.com/emb**

Text **EMB** to **22333** once to join

Is it clear what type of regularities are captured by lexical types and lexical rules? (take 4)



Start the presentation to see live content. For screen share software, share the entire screen. Get help at **pollev.com/app**

ARG-ST & ARP

- Given the ARP, what do we need to specify about the valence properties of words?
- Why isn't the ARP a constraint on the type *lexeme*?

© 2003 CSLI Publications

The Feature FORM

- Different inflected forms of verbs show up in different syntactic environments. Examples?
- These different forms are syntactically distinguished by the feature FORM, as assigned by lexical rules.
- FORM is also useful in our analyses of coordination and PP selection.

© 2003 CSLI Publications

How do we rule these out?

- *Kim eat pizza.
- *Kim seems to eats pizza.
- *Dana helped Leslie [pack and moved].
- *Kim relies for Sandy.
- *Dana walked and Kim.

© 2003 CSLI Publications

Overview

- How lexical rules fit in
- Three types of lexical rules, constraints
- Example: Plural noun lexical rule
- Advice on writing lexical rules
- Constant lexemes
- ARG-ST & ARP
- The feature FORM
- Reading Questions

© 2003 CSLI Publications

Reading Questions

- lexeme
- lexical entry
- lexical rule
- lexical rule instantiation
- lexical sequence
- word structure

© 2003 CSLI Publications

Reading Questions

- Why are we using functions for morphophonology?
- How would the lexical rules look like for languages like German with circumfixes? eg, the past participle *ge-*⟩...⟨*-t*

© 2003 CSLI Publications

Reading Questions

- I'm not sure I completely understand the point of introducing lexical rules. The rule itself doesn't tell me anything about how to actually form the inflected form, we still require a function that does the actual transformation. Why not make the function a transform on the lexeme and also on the lexical entry instead of introducing both the function and the lexical rule?

- What's the relationship between inflectional/derivational rules and inflectional/derivational affixes? It looks to me that they share a lot of similarities.

© 2003 CSLI Publications

Reading Questions

- From page 256, tense information of verb lexemes is stored in a predication within SEM; furthermore, the FORM value for present and past is the same (both fin). Why is tense not stored in SYN the way that aspect is (in FORM, like for prp and psp, which are also distinguished by tense)?

© 2003 CSLI Publications

Reading Questions

- How are derivational rules related to valence?
- For words with valence alternations, like give, is there an argument that one of them, like "Jan gave Dan the book", is the "true" structure? Or is one picked arbitrarily so the other can be derived?

© 2003 CSLI Publications

Reading Questions

- Why does ARP apply only to words and not lexemes?

© 2003 CSLI Publications

Reading Questions

- Lexical rules are basically lexeme/word formation rules, which are morphological than syntactic to me. The connection to syntax is not entirely clear to me.

© 2003 CSLI Publications

Reading Questions

- How much of the values and categories used in feature structures (especially names of atomic values) are influenced by primary school grammar vs the other way around?

© 2003 CSLI Publications

Reading Questions

- What indicates verb tense in the feature structure?
- How do you actually handle tense in HPSG?

© 2003 CSLI Publications

Reading Questions

- Can we get some clarification on what "the INPUT specifications of a lexical rule cannot override any constraint associated with a lexical entry." (Footnote 29 on page 253) means? What would a violation of this look like?

© 2003 CSLI Publications

Reading Questions

- How do we deal with morphologically poor languages like Mandarin Chinese? Do languages which don't appear to have any morphology have no derivational rules?

© 2003 CSLI Publications