



Chapter 5, Sections 5.6-5.9:

Semantics

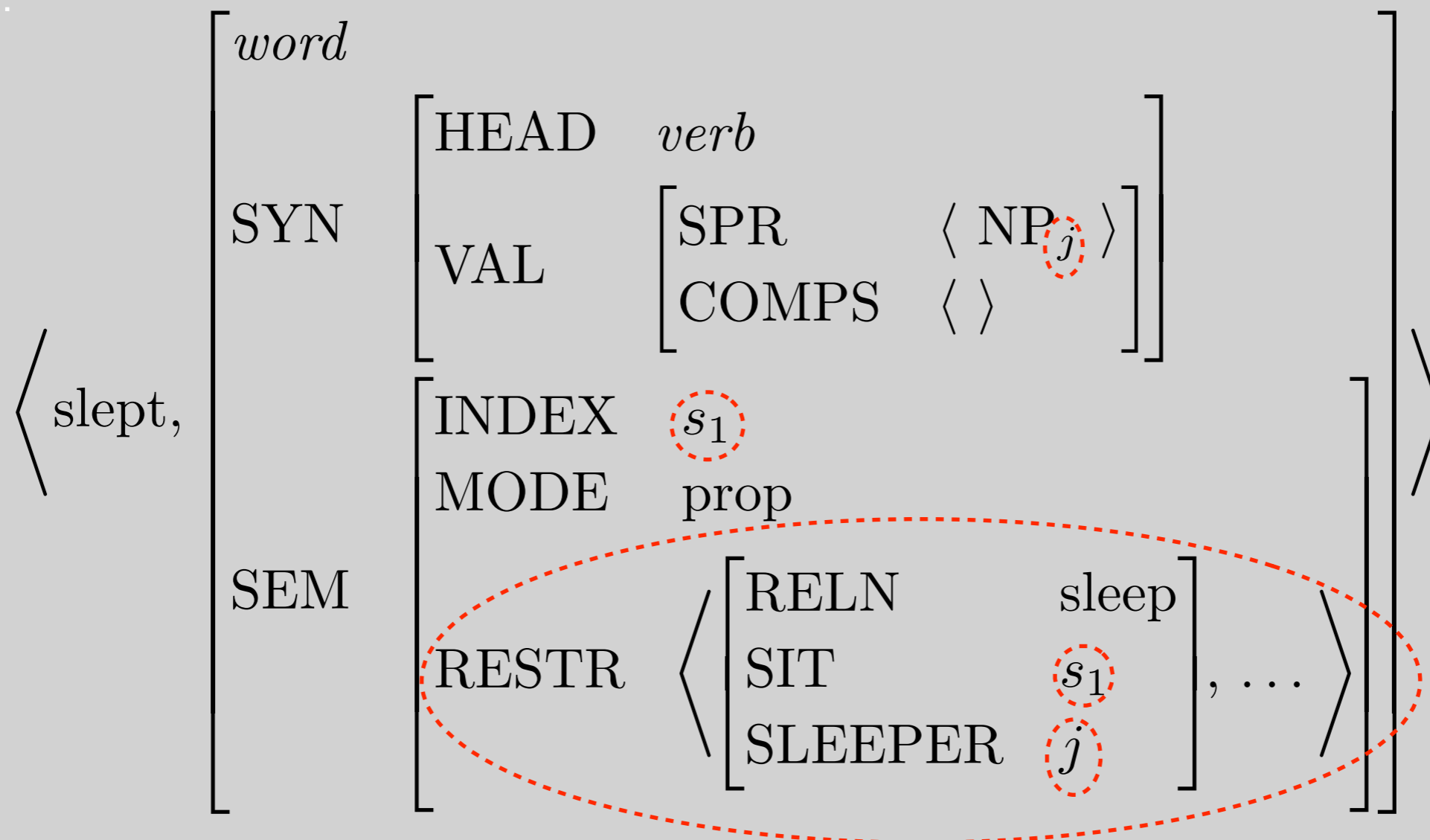
Review: Semantic Compositionality

The meaning of a phrase is determined by:

- the meaning of its parts, and
- how those parts are put together

Review: Words ...

- contribute predications
- ‘expose’ one index in those predications, for use by words or phrases
- relate syntactic arguments to semantic arguments



Review: Grammar Rules ...

- identify feature structures (including the INDEX value) across daughters

Head Specifier Rule

$$\left[\begin{array}{l} \textit{phrase} \\ \text{SYN} \left[\text{VAL} \left[\text{SPR} \langle \rangle \right] \right] \end{array} \right] \rightarrow \boxed{1} \mathbf{H} \left[\text{SYN} \left[\text{VAL} \left[\begin{array}{l} \text{SPR} \langle \boxed{1} \rangle \\ \text{COMPS} \langle \rangle \end{array} \right] \right] \right]$$

Head Complement Rule

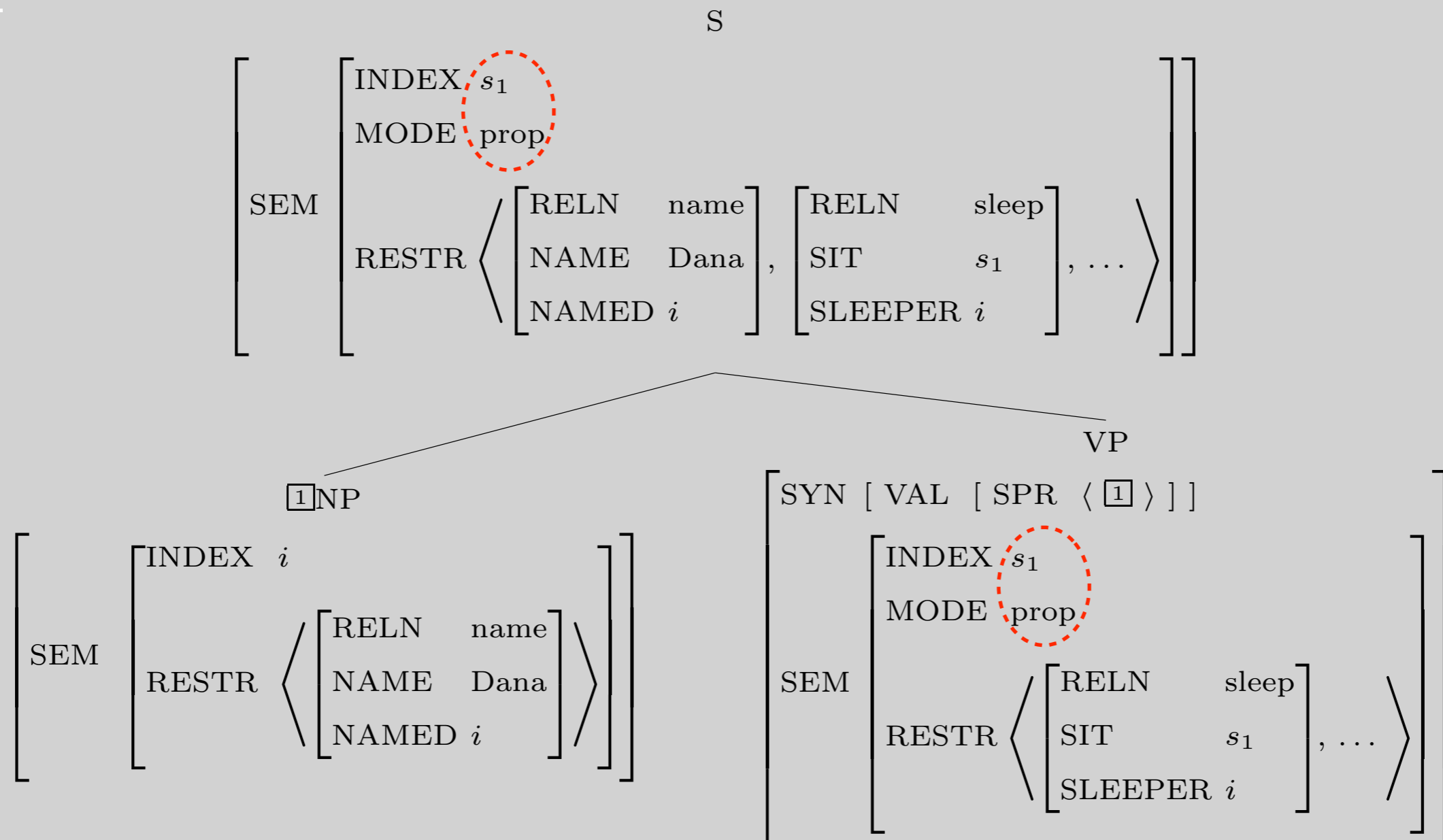
$$\left[\begin{array}{l} \textit{phrase} \\ \text{SYN} \left[\text{VAL} \left[\text{COMPS} \langle \rangle \right] \right] \end{array} \right] \rightarrow \mathbf{H} \left[\begin{array}{l} \textit{word} \\ \text{SYN} \left[\text{VAL} \left[\text{COMPS} \langle \boxed{1}, \dots, \boxed{n} \rangle \right] \right] \end{array} \right] \boxed{1} \dots \boxed{n}$$

Head Modifier Rule

$$[\textit{phrase}] \rightarrow \mathbf{H} \boxed{1} \left[\text{SYN} \left[\text{COMPS} \langle \rangle \right] \left[\text{SYN} \left[\text{VAL} \left[\begin{array}{l} \text{COMPS} \langle \rangle \\ \text{MOD} \langle \boxed{1} \rangle \end{array} \right] \right] \right] \right]$$

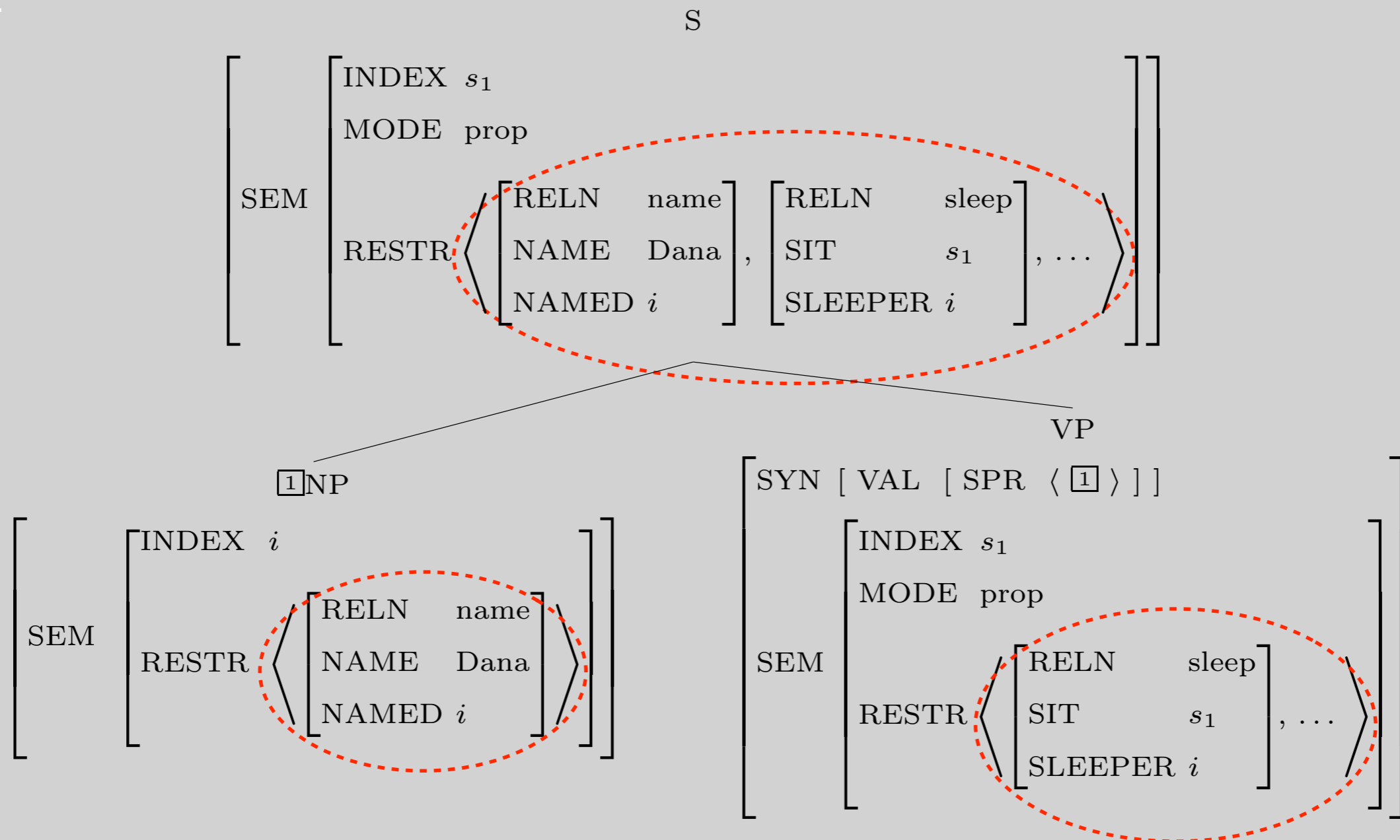
Review: Grammar Rules ...

- identify feature structures (including the INDEX value) across daughters
- license trees which are subject to the semantic principles
 - SIP 'passes up' MODE and INDEX from head daughter



Review: Grammar Rules ...

- identify feature structures (including the INDEX value) across daughters
- license trees which are subject to the semantic principles
 - SIP ‘passes up’ MODE and INDEX from head daughter
 - SCP: ‘gathers up’ predications (RESTR list) from all daughters



Other Aspects of Semantics

- Tense, Quantification (only touched on here)
- Modification
- Coordination
- Structural Ambiguity

Evolution of a Phrase Structure Rule

Ch. 2: NOM NOM PP
 VP VP PP

Ch. 3: $\left[\begin{array}{l} phrase \\ VAL \left[\begin{array}{l} COMPS \quad itr \\ SPR \quad - \end{array} \right] \end{array} \right] \rightarrow \mathbf{H} \left[\begin{array}{l} phrase \\ VAL \left[\begin{array}{l} SPR \quad - \end{array} \right] \end{array} \right] PP$

Ch. 4: $[phrase] \rightarrow \mathbf{H} \left[VAL \left[COMPS \langle \rangle \right] \right] PP$

Ch. 5: $[phrase] \rightarrow \mathbf{H}[\boxed{1}] \left[SYN \left[VAL \left[COMPS \langle \rangle \right] \right] \right] \left[SYN \left[VAL \left[\begin{array}{l} COMPS \langle \rangle \\ MOD \langle \boxed{1} \rangle \end{array} \right] \right] \right]$

Ch. 5 (abbreviated): $[phrase] \rightarrow \mathbf{H}[\boxed{1}] \left[COMPS \langle \rangle \right] \left[\begin{array}{l} COMPS \langle \rangle \\ MOD \langle \boxed{1} \rangle \end{array} \right]$

Evolution of Another Phrase Structure Rule

Ch. 2: $X \rightarrow X^+ \text{ CONJ } X$

Ch. 3: $\boxed{1} \rightarrow \boxed{1}^+ \begin{bmatrix} \textit{word} \\ \text{HEAD } \textit{conj} \end{bmatrix} \boxed{1}$

Ch. 4: $\left[\text{VAL } \boxed{1} \right] \rightarrow \left[\text{VAL } \boxed{1} \right]^+ \begin{bmatrix} \textit{word} \\ \text{HEAD } \textit{conj} \end{bmatrix} \left[\text{VAL } \boxed{1} \right]$

Ch. 5: $\begin{bmatrix} \text{SYN } \left[\text{VAL } \boxed{0} \right] \\ \text{SEM } \left[\text{IND } s_0 \right] \end{bmatrix} \rightarrow$
 $\begin{bmatrix} \text{SYN } \left[\text{VAL } \boxed{0} \right] \\ \text{SEM } \left[\text{IND } s_1 \right] \end{bmatrix} \cdots \begin{bmatrix} \text{SYN } \left[\text{VAL } \boxed{0} \right] \\ \text{SEM } \left[\text{IND } s_{n-1} \right] \end{bmatrix} \begin{bmatrix} \text{SYN } \left[\text{HEAD } \textit{conj} \right] \\ \text{SEM } \begin{bmatrix} \text{IND } s_0 \\ \text{RESTR } \langle \left[\text{ARGS } \langle s_1 \dots s_n \rangle \right] \rangle \end{bmatrix} \end{bmatrix} \begin{bmatrix} \text{SYN } \left[\text{VAL } \boxed{0} \right] \\ \text{SEM } \left[\text{IND } s_n \right] \end{bmatrix}$

Ch. 5 (abbreviated):

$$\begin{bmatrix} \text{VAL } \boxed{0} \\ \text{IND } s_0 \end{bmatrix} \rightarrow \begin{bmatrix} \text{VAL } \boxed{0} \\ \text{IND } s_1 \end{bmatrix} \cdots \begin{bmatrix} \text{VAL } \boxed{0} \\ \text{IND } s_{n-1} \end{bmatrix} \begin{bmatrix} \text{HEAD } \textit{conj} \\ \text{IND } s_0 \\ \text{RESTR } \langle \left[\text{ARGS } \langle s_1 \dots s_n \rangle \right] \rangle \end{bmatrix} \begin{bmatrix} \text{VAL } \boxed{0} \\ \text{IND } s_n \end{bmatrix}$$

Combining Constraints and Coordination

Coordination Rule

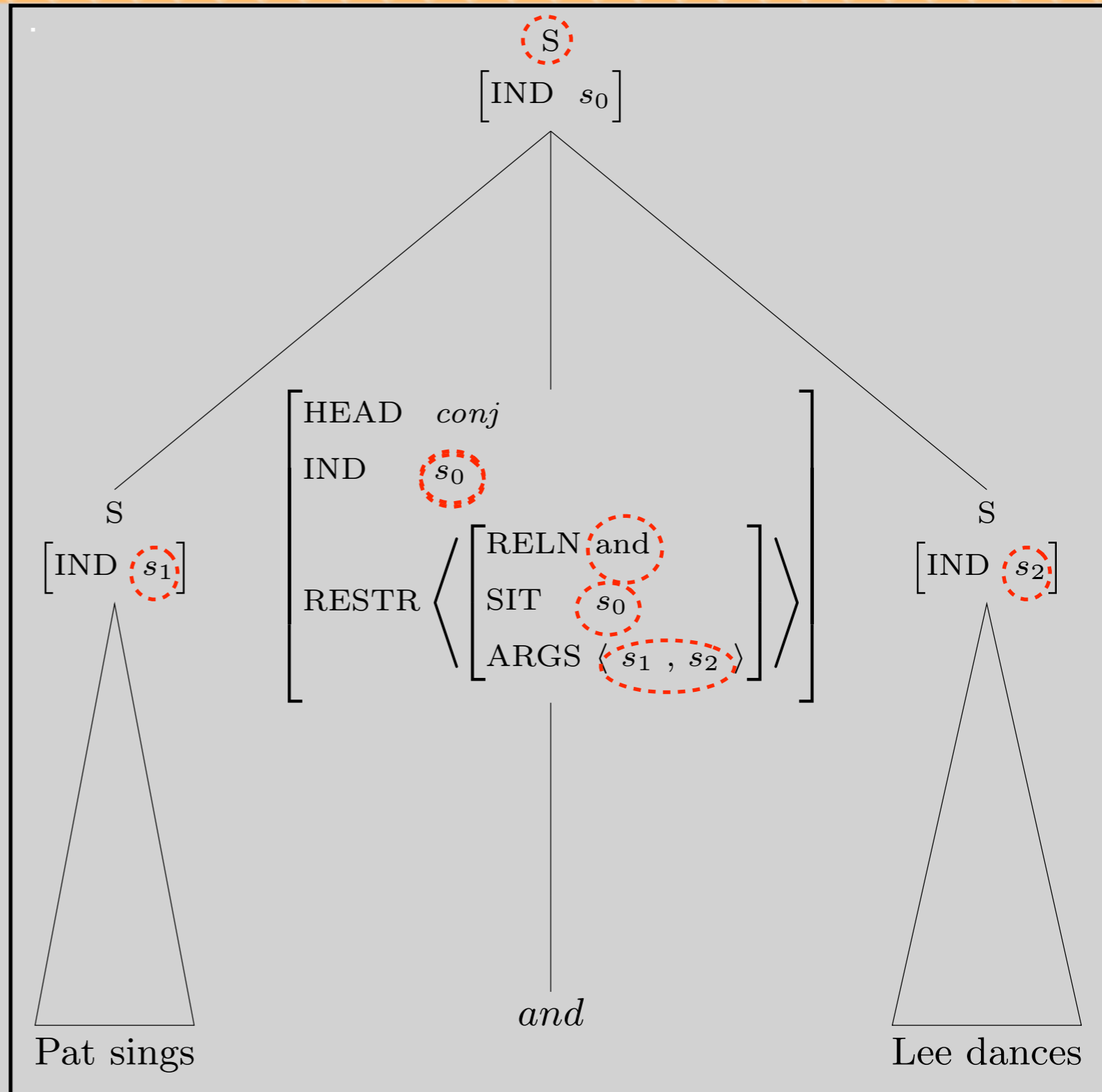
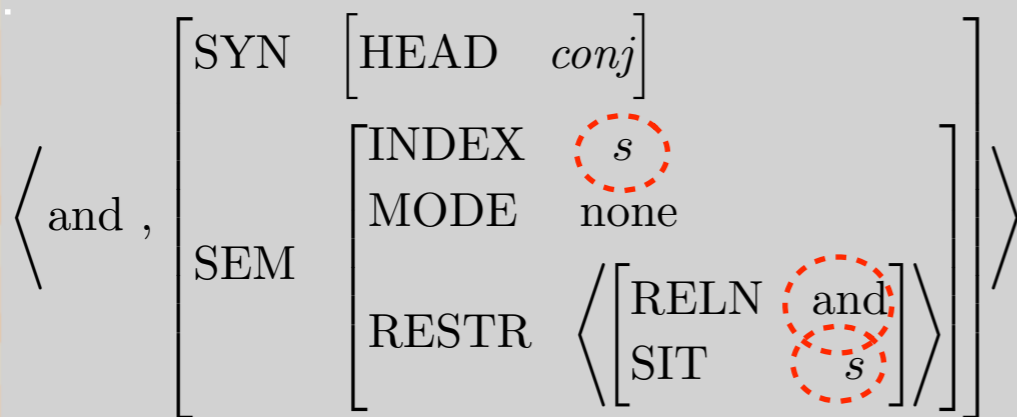
$$\begin{bmatrix} \text{VAL} & \boxed{0} \\ \text{IND} & s_0 \end{bmatrix} \rightarrow \begin{bmatrix} \text{VAL} & \boxed{0} \\ \text{IND} & s_1 \end{bmatrix} \cdots \begin{bmatrix} \text{VAL} & \boxed{0} \\ \text{IND} & s_{n-1} \end{bmatrix} \begin{bmatrix} \text{HEAD} & conj \\ \text{IND} & s_0 \\ \text{RESTR} & \langle \text{ARGS} \langle s_1 \dots s_n \rangle \rangle \end{bmatrix} \begin{bmatrix} \text{VAL} & \boxed{0} \\ \text{IND} & s_n \end{bmatrix}$$

Lexical Entry for a Conjunction

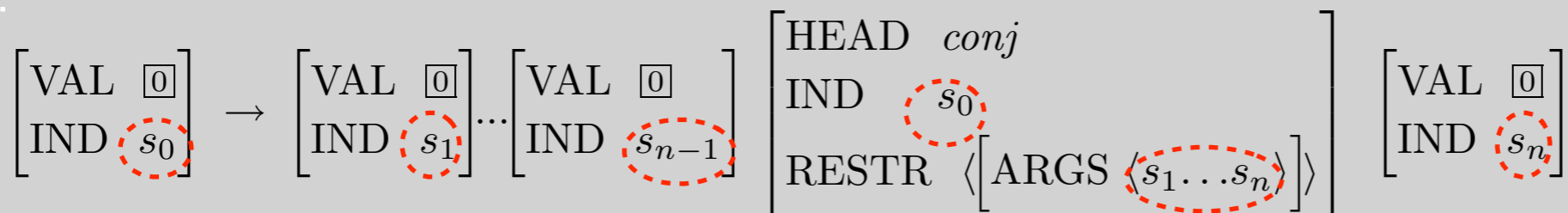
$$\left\langle \text{and} , \begin{bmatrix} \text{SEM} \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & conj \end{bmatrix} \\ \text{INDEX} & s \\ \text{MODE} & none \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{RELN} & and \\ \text{SIT} & s \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

Combining Constraints and Coordination

Lexical Entry for *and*



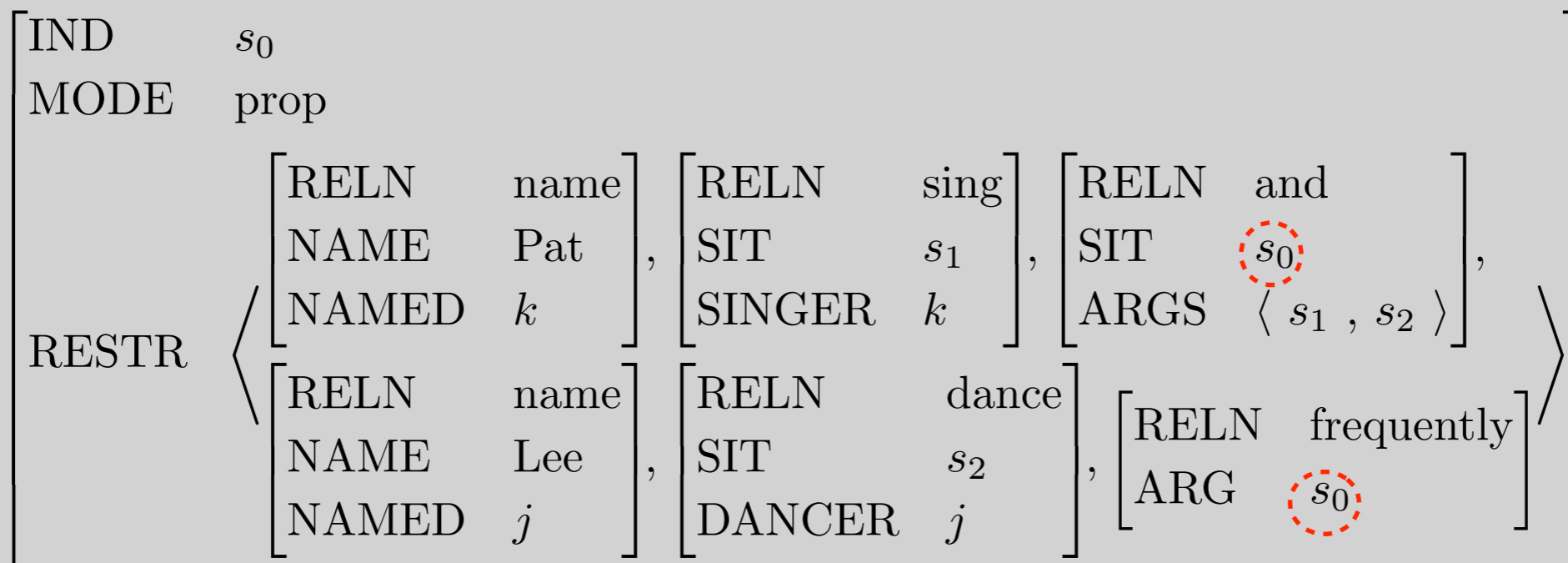
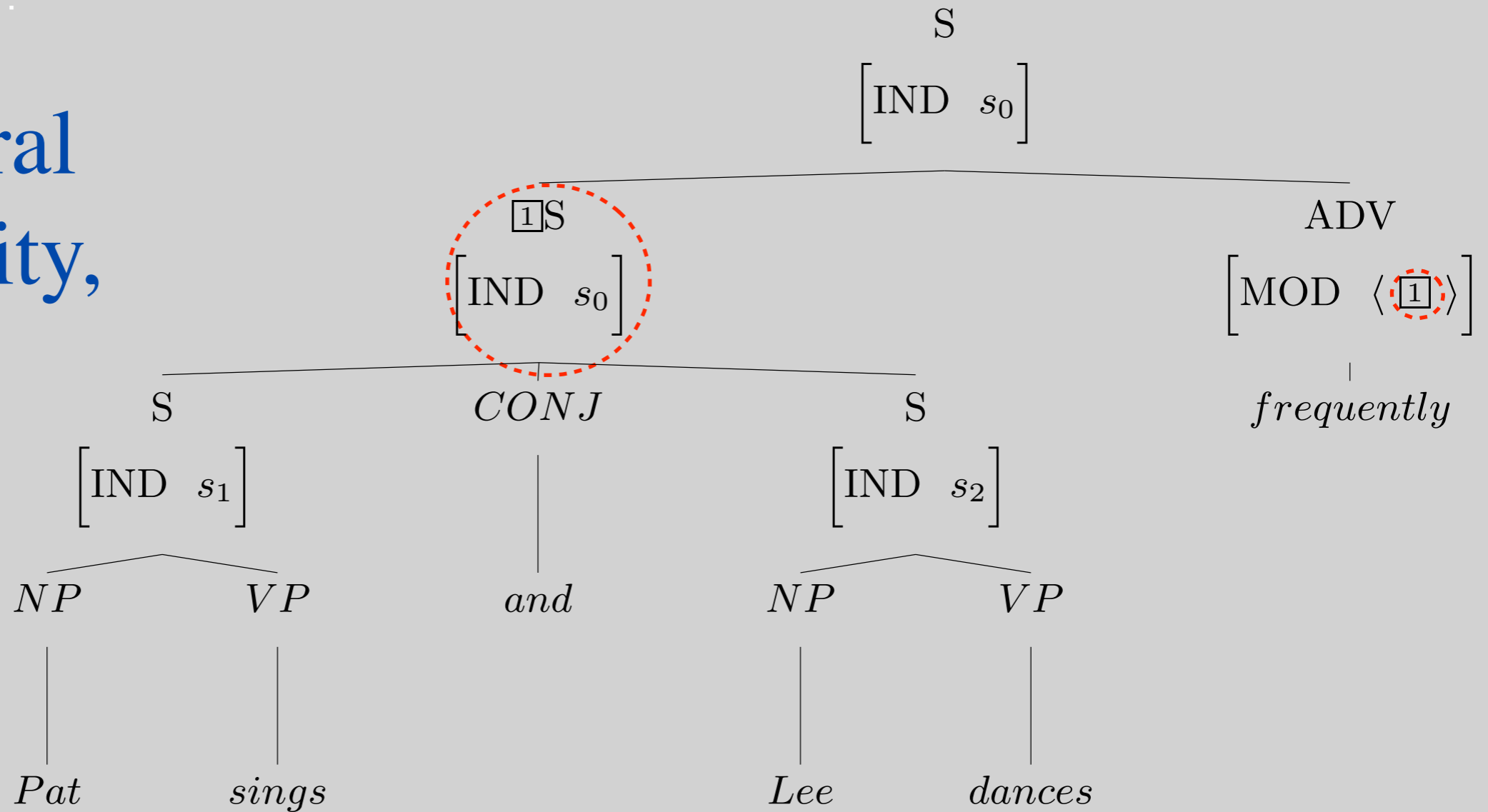
Coordination Rule



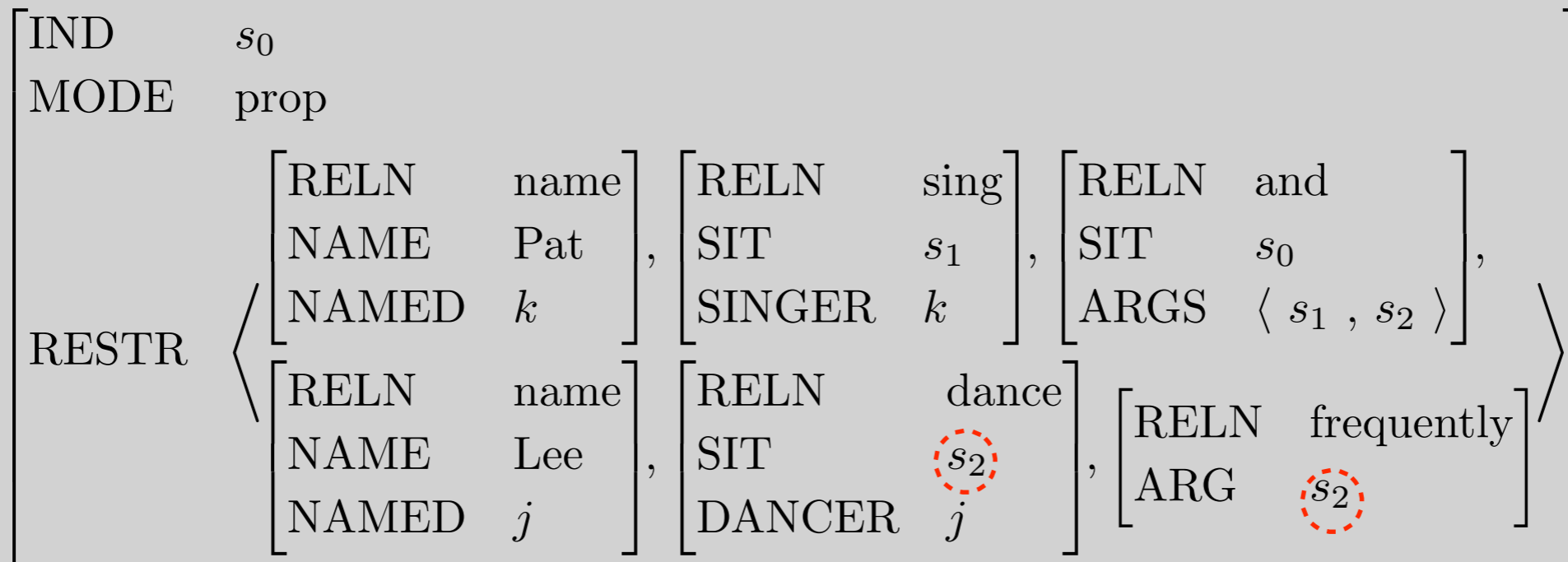
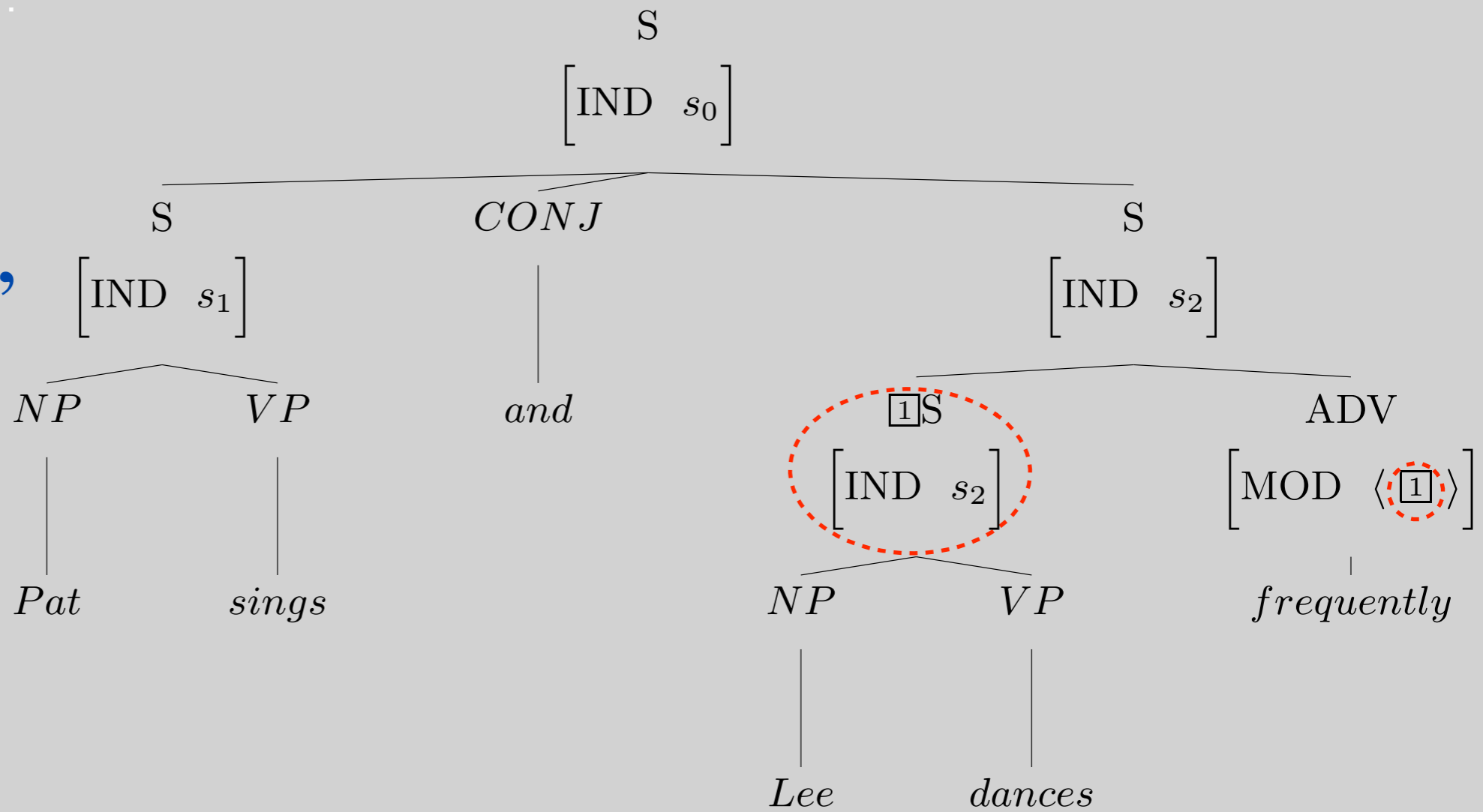
Lexical Entry for *frequently*

\langle frequently ,	SYN	<table style="border-collapse: collapse;"> <tr> <td style="padding-right: 10px;">HEAD</td> <td><i>adv</i></td> </tr> <tr> <td style="padding-right: 10px;">VAL</td> <td> <table style="border-collapse: collapse;"> <tr> <td style="padding-right: 10px;">MOD</td> <td> \langle <table style="border-collapse: collapse;"> <tr> <td style="padding-right: 10px;">S</td> <td></td> </tr> <tr> <td style="padding-right: 10px;">INDEX</td> <td>s_1</td> </tr> </table> \rangle </td> </tr> <tr> <td style="padding-right: 10px;">SPR</td> <td>$\langle \rangle$</td> </tr> <tr> <td style="padding-right: 10px;">COMPS</td> <td>$\langle \rangle$</td> </tr> </table> </td> </tr> </table>	HEAD	<i>adv</i>	VAL	<table style="border-collapse: collapse;"> <tr> <td style="padding-right: 10px;">MOD</td> <td> \langle <table style="border-collapse: collapse;"> <tr> <td style="padding-right: 10px;">S</td> <td></td> </tr> <tr> <td style="padding-right: 10px;">INDEX</td> <td>s_1</td> </tr> </table> \rangle </td> </tr> <tr> <td style="padding-right: 10px;">SPR</td> <td>$\langle \rangle$</td> </tr> <tr> <td style="padding-right: 10px;">COMPS</td> <td>$\langle \rangle$</td> </tr> </table>	MOD	\langle <table style="border-collapse: collapse;"> <tr> <td style="padding-right: 10px;">S</td> <td></td> </tr> <tr> <td style="padding-right: 10px;">INDEX</td> <td>s_1</td> </tr> </table> \rangle	S		INDEX	s_1	SPR	$\langle \rangle$	COMPS	$\langle \rangle$
	HEAD	<i>adv</i>														
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Structural Ambiguity, Tree I

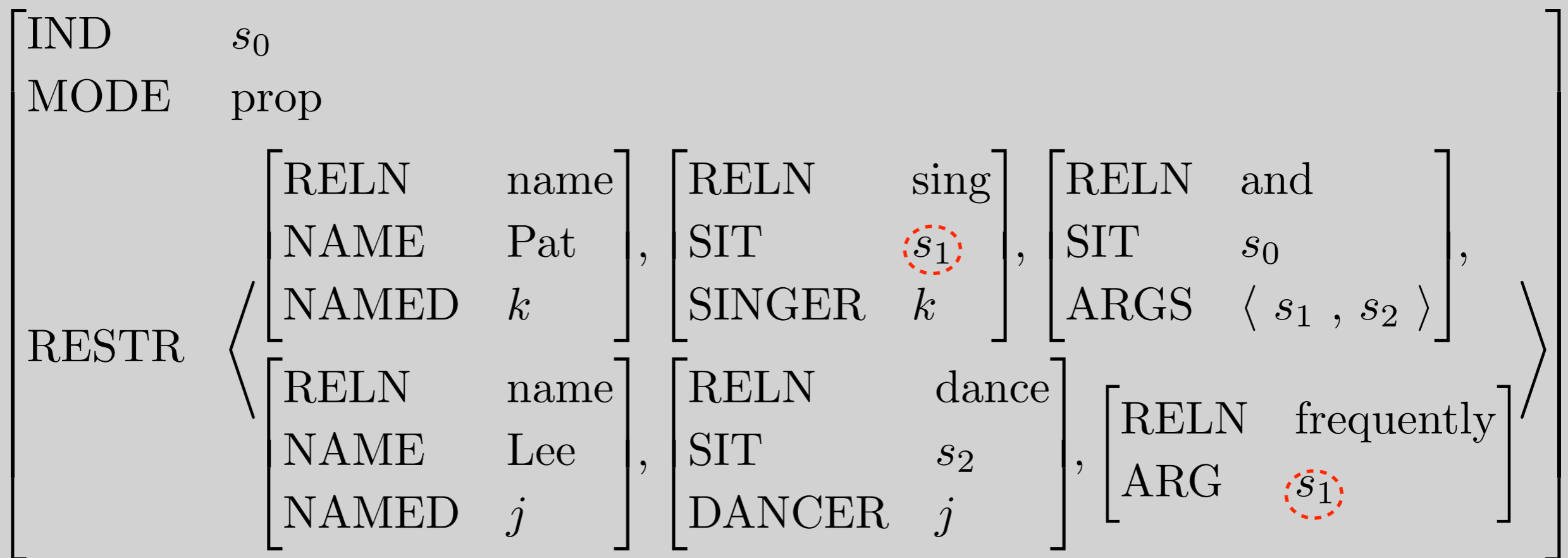


Structural Ambiguity, Tree II

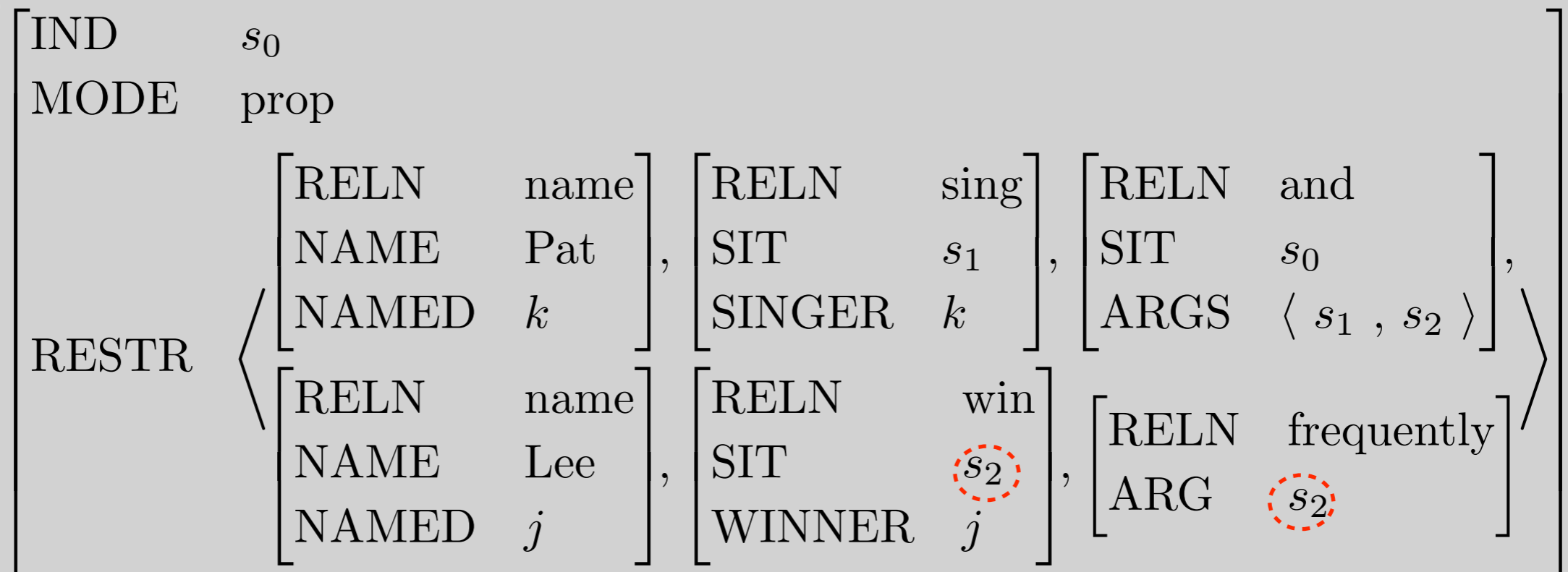
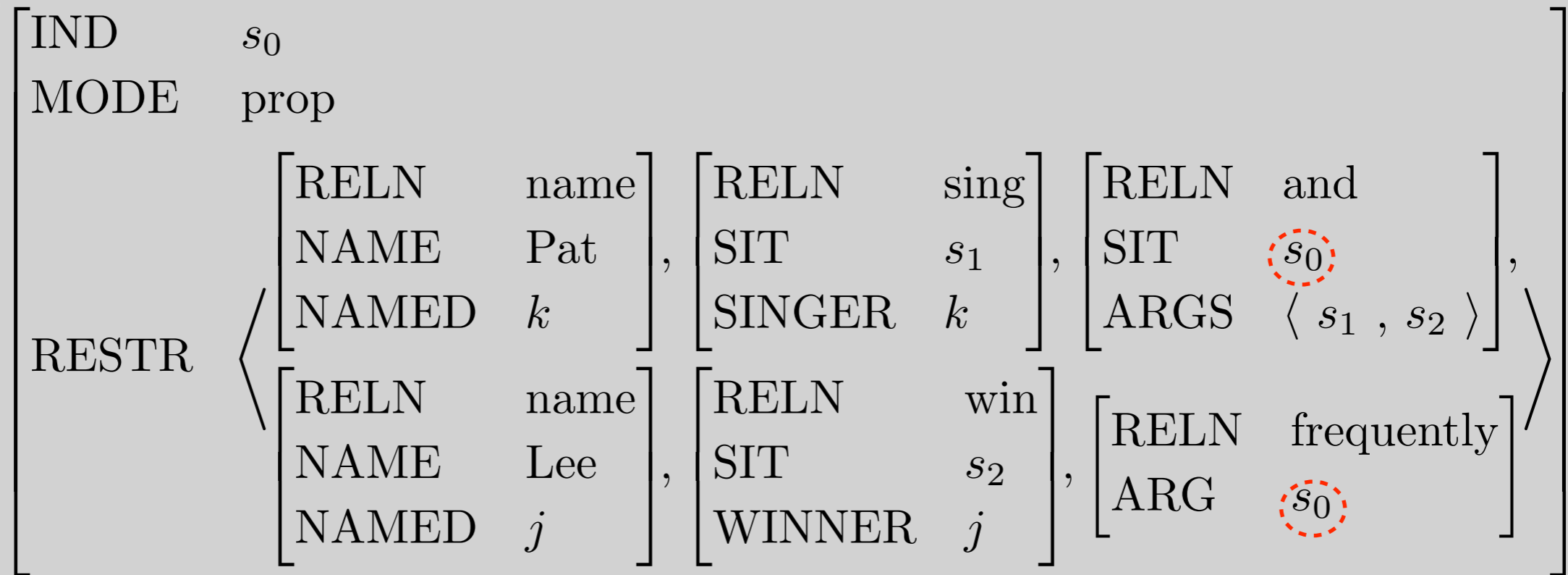


Question About Structural Ambiguity

Why isn't this a possible semantic representation for the string *Pat sings and Lee dances frequently*?



Semantic Compositionality



Semantic Compositionality

The meaning of a phrase is determined by

- the meaning of its parts
- and how they are put together.