

24. SLIM machine in the speaker mode

24.1 Subcontext as concatenated propositions

24.1.1 Immediate vs. mediated subcontexts

In immediate subcontexts, the coherence of the content follows directly from the coherence of the external world which they reflect, i.e., the temporal and spatial sequence of events, the part-whole relations of objects, etc. In contrast, mediated subcontexts have the special property that the elements familiar from direct recognition may be reordered and reconnected by the author at will.

24.1.2 Comparing coherence and incoherence, Example I

The representation of a swimmer standing at the pool side, diving into the water, and disappearing with a splash is coherent. In contrast, a representation in which a pair of feet appears in the foaming water and a swimmer flies feet first into the air landing on the pool side, would be incoherent – unless it is specified in addition that the representation happens to be, e.g., a backward running movie.

24.1.3 Comparing coherence and incoherence, Example II

A representation of people talking with each other would be coherent. In contrast, a similar representation of a deer conversing with a skunk in English would be incoherent – unless it is specified in addition that the representation happens to be fictional.

24.1.4 Mediated subcontexts reflecting the coherence of the external world

world \rightarrow speaker context \rightarrow language \rightarrow hearer context \rightarrow world

24.1.5 A sequence of propositions forming a subcontext

1. Peter leaves the house. 2. Peter crosses the street. 3. Peter enters a restaurant. 4. Peter orders a salad.
5. Peter eats the salad. 6. Peter pays the salad. 7. Peter leaves the restaurant. 8. Peter crosses the street.
9. Peter enters the house.

24.1.6 Equivalent representation of 24.1.1 as a word bank

CONCEPT TYPES:

COPLETS:

<div style="border-left: 1px solid black; border-right: 1px solid black; padding: 5px; display: inline-block;"> [M-concept: cross role: T-verb] </div>	<div style="border-left: 1px solid black; border-right: 1px solid black; padding: 5px; display: inline-block;"> I-concept_{loc}: cross P: indicative C: [MOD: NP: Peter, street] I: [prn: 2 epr: [2 then 3 1 then 2]] </div>	<div style="border-left: 1px solid black; border-right: 1px solid black; padding: 5px; display: inline-block;"> I-concept_{loc}: cross P: indicative C: [MOD: NP: Peter, street] I: [prn: 8 epr: [8 then 9 7 then 8]] </div>
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[M-concept: eat]
 role: T-verb

[I-concept_{loc}: eat
 P: indicative
 C: [MOD:
 NP: Peter, salad]
 I: [prn: 5
 epr: [5 then 6]
 4 then 5]]]

[M-concept: enter]
 role: T-verb

[I-concept_{loc}: enter
 P: indicative
 C: [MOD:
 NP: Peter, restaurant]
 I: [prn: 3
 epr: [3 then 4]
 2 then 3]]]

[I-concept_{loc}: enter
 P: indicative
 C: [MOD:
 NP: Peter, house]
 I: [prn: 9
 epr: [8 then 9]]]

[M-concept: house]
 role: noun

[I-concept_{loc}: house
 P: A sg def
 C: [MOD:
 VERB: leave]
 I: [prn: 1
 id: 2]]]

[I-concept_{loc}: house
 P: A sg def
 C: [MOD:
 VERB: enter]
 I: [prn: 9
 id: 2]]]

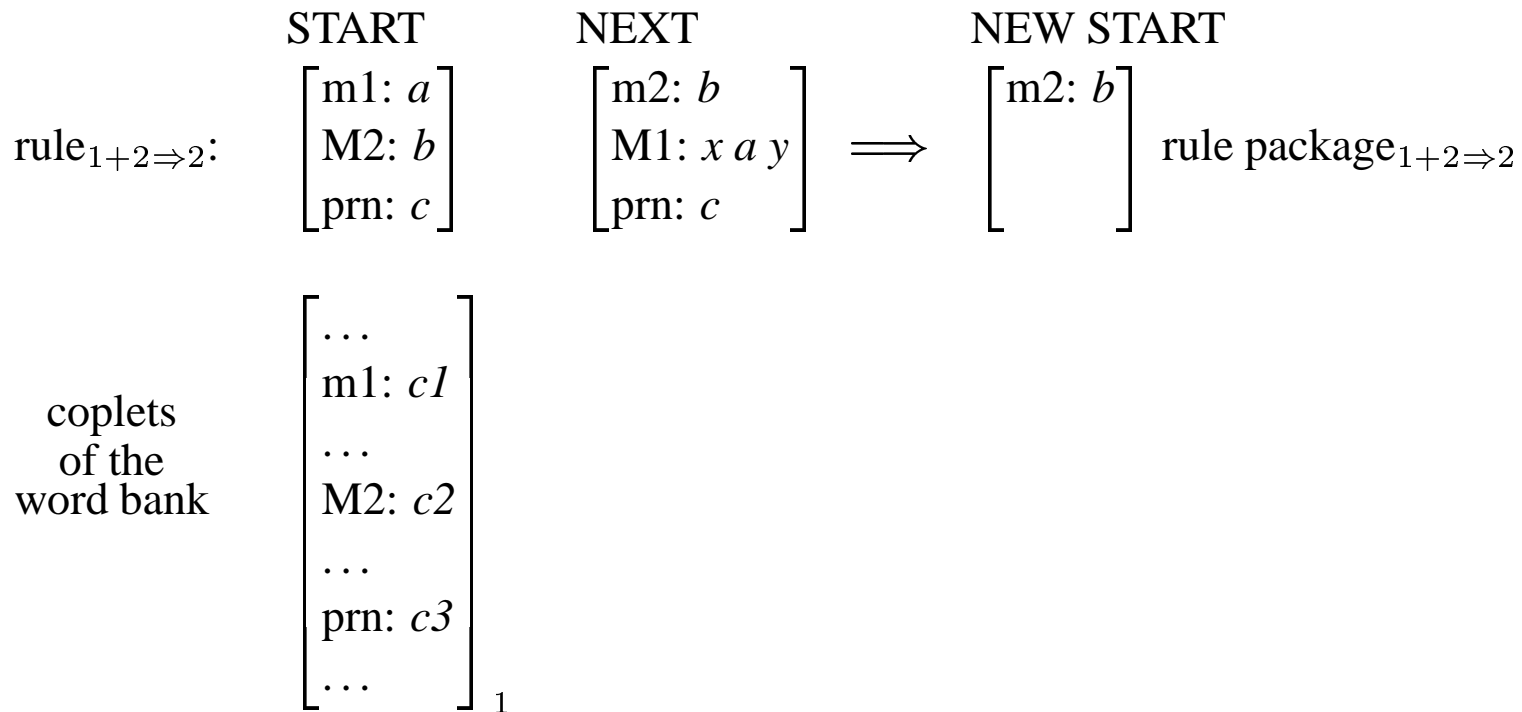
[M-concept: leave role: T-verb]	[I-concept _{loc} : <i>leave</i> P: indicative C: [MOD: NP: Peter, house] I: [prn: 1 epr: [1 then 2]]]	[I-concept _{loc} : <i>leave</i> P: indicative C: [MOD: NP: Peter, restaurant] I: [prn: 7 epr: [7 then 8] [6 then 7]]]
[M-concept: order role: T-verb]	[I-concept _{loc} : <i>order</i> P: indicative C: [MOD: NP: Peter, salad] I: [prn: 4 epr: [4 then 5] [3 then 4]]]	
[M-concept: pay role: T-verb]	[I-concept _{loc} : <i>pay</i> P: indicative C: [MOD: NP: Peter, salad] I: [prn: 6 epr: [6 then 7] [5 then 6]]]	

[M-concept: Peter role: name]	[I-concept _{loc} : Peter P: Nom C: [MOD: VERB: leave] I: [prn: 1 id: 1]	[I-concept _{loc} : Peter P: Nom C: [MD: VB: cross] I: [prn: 2 id: 1]	[I-concept _{loc} : Peter P: Nom C: [MD: VB: enter] I: [prn: 3 id: 1]
	[I-concept _{loc} : Peter P: Nom C: [MOD: VERB: order] I: [prn: 4 id: 1]	[I-concept _{loc} : Peter P: Nom C: [MOD: VERB: eat] I: [prn: 5 id: 1]	[I-concept _{loc} : Peter P: Nom C: [MOD: VERB: pay] I: [prn: 6 id: 1]
	[I-concept _{loc} : Peter P: Nom C: [MOD: VERB: leave] I: [prn: 7 id: 1]	[I-concept _{loc} : Peter P: Nom C: [MD: VB: cross] I: [prn: 8 id: 1]	[I-concept _{loc} : Peter P: Nom C: [MD: VB: enter] I: [prn: 9 id: 1]

[M-concept: restaurant] role: noun	[I-concept _{loc} : restaurant] P: A sg indef C: [MOD: VERB: enter] I: [prn: 3 id: 4]	[I-concept _{loc} : restaurant] P: A sg def C: [MOD: VERB: leave] I: [prn: 7 id: 4]	
[M-concept: salad] role: noun	[I-concept _{loc} : salad] P: A sg indef C: [MOD: VERB: order] I: [prn: 4 id: 5]	[I-concept _{loc} : salad] P: A sg def C: [MOD: VERB: eat] I: [prn: 5 id: 5]	[I-concept _{loc} : salad] P: A sg def C: [MOD: VERB: pay] I: [prn: 6 id: 5]
[M-concept: street] role: noun	[I-concept _{loc} : street] P: A sg def C: [MOD: VERB: cross] I: [prn: 2 id: 3]	[I-concept _{loc} : street] P: A sg def C: [MOD: VERB: cross] I: [prn: 8 id: 3]	

24.2 Tracking principles of LA-navigation

24.2.1 Step 1 of a LA-NA rule application



24.2.2 Step 2 of an LA-NA rule application

$$\begin{array}{ccc}
 \text{rule}_{1+2 \Rightarrow 2}: & \begin{array}{c} \text{START} \\ \left[\begin{array}{l} \text{m1: } a \\ \text{M2: } b \\ \text{prn: } c \end{array} \right] \end{array} & \begin{array}{c} \text{NEXT} \\ \left[\begin{array}{l} \text{m2: } b \\ \text{M1: } x a y \\ \text{prn: } c \end{array} \right] \end{array} \Rightarrow \begin{array}{c} \text{NEW START} \\ \left[\begin{array}{l} \text{m2: } b \end{array} \right] \end{array} \text{rule package}_{1+2 \Rightarrow 2} \\
 \\
 \text{coplets} \\ \text{of the} \\ \text{word bank} & \left[\begin{array}{l} \dots \\ \text{m1: } c1 \\ \dots \\ \text{M2: } c2 \\ \dots \\ \text{prn: } c3 \\ \dots \end{array} \right]_1 + \left[\begin{array}{l} \dots \\ \text{m2: } c2 \\ \dots \\ \text{M1: } ..c1.. \\ \dots \\ \text{prn: } c3 \\ \dots \end{array} \right]_2
 \end{array}$$

24.2.3 Step 3 of a LA-NA rule application

$$\begin{array}{ccc}
 \text{START} & \text{NEXT} & \text{NEW START} \\
 \text{rule}_{1+2 \Rightarrow 2}: \begin{bmatrix} \text{m1: } a \\ \text{M2: } b \\ \text{prn: } c \end{bmatrix} & \begin{bmatrix} \text{m2: } b \\ \text{M1: } x a y \\ \text{prn: } c \end{bmatrix} \Rightarrow & \begin{bmatrix} \text{m2: } b \end{bmatrix} \text{ rule package}_{1+2 \Rightarrow 2} \\
 \\
 \text{coplets} & & \\
 \text{of the} & & \\
 \text{word bank} & + & \\
 \begin{bmatrix} \dots \\ \text{m1: } c1 \\ \dots \\ \text{M2: } c2 \\ \dots \\ \text{prn: } c3 \\ \dots \end{bmatrix}_1 & & \begin{bmatrix} \dots \\ \text{m2: } c2 \\ \dots \\ \text{M1: } ..c1.. \\ \dots \\ \text{prn: } c3 \\ \dots \end{bmatrix}_2 \Rightarrow \begin{bmatrix} \dots \\ \text{m2: } c2 \\ \dots \\ \text{M1: } ..c1.. \\ \dots \\ \text{prn: } c3 \\ \dots \end{bmatrix}_2
 \end{array}$$

24.2.4 Tracking principles of LA-navigation

1. *Completeness*

Within an elementary proposition those coplets are preferred which have not yet been traversed during the current navigation.

2. *Uniqueness*

If several START or NEXT coplets are available, no more than one of each are selected whereby the choice may be at random or – if activated – based on a specific navigation pattern.

3. *Recency*

In extrapositional navigations, propositions which have been least recently traversed are preferred.

4. *Frequency*

When entering a new subcontext, the navigation prefers paths most frequently traversed in previous navigations.

24.2.5 Definition of universal LA-NA syntax

$ST_S: \{([M-np: a] \{1 V+NP1, 2 V+NP2\})\}$

$V+NP1: \begin{bmatrix} M\text{-verb: } a \\ NP: x b y \\ prn: m \end{bmatrix} \begin{bmatrix} M\text{-np: } b \\ VERB: a \\ prn: m \end{bmatrix} \Rightarrow \begin{bmatrix} M\text{-verb: } a \end{bmatrix} \{3 V+NP1, 4 V+NP2, 5 V+epr\}$

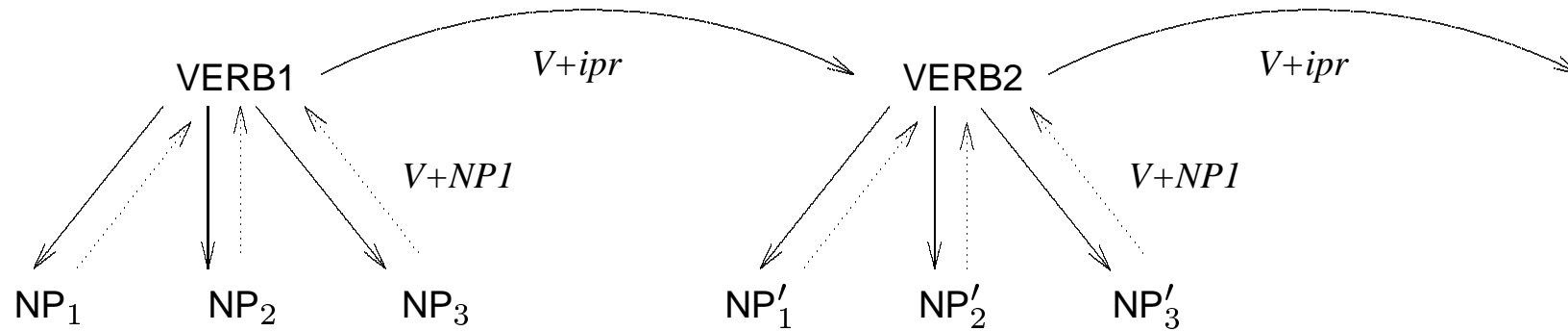
$V+NP2: \begin{bmatrix} M\text{-verb: } a \\ NP: x b y \\ prn: m \end{bmatrix} \begin{bmatrix} M\text{-np: } b \\ VERB: a \\ prn: m \end{bmatrix} \Rightarrow \begin{bmatrix} M\text{-np: } b \end{bmatrix} \{6 NP+id\}$

$V+epr: \begin{bmatrix} M\text{-verb: } a \\ NP: x \\ prn: m \\ epr: m C n \end{bmatrix} \begin{bmatrix} M\text{-verb: } b \\ NP: y \\ prn: n \\ epr: m C n \end{bmatrix} \Rightarrow \begin{bmatrix} M\text{-verb: } b \end{bmatrix} \{7 V+NP1, 8 V+NP2\}$

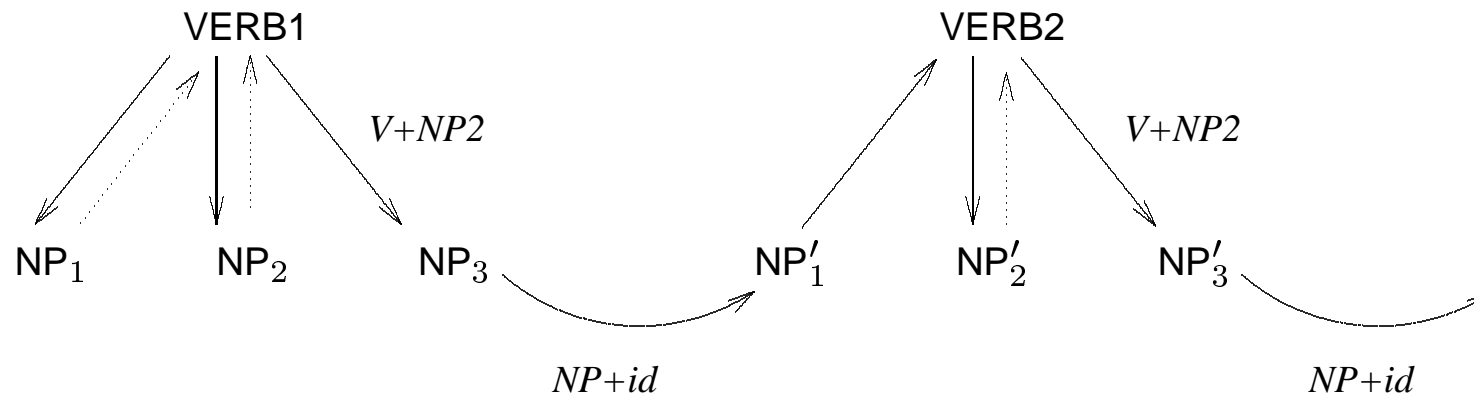
$NP+id: \begin{bmatrix} M\text{-np: } a \\ VERB: b \\ prn: k \\ id: m \end{bmatrix} \begin{bmatrix} M\text{-np: } a \\ VERB: c \\ prn: l \\ id: m \end{bmatrix} \Rightarrow \begin{bmatrix} M\text{-verb: } c \\ NP: x a y \\ prn: l \end{bmatrix} \{9 V+NP1, 10 V+NP2\}$

$ST_F: \{([M\text{-verb: } x] rp V+NP1)\}$

24.2.6 Extrapositional epr-navigation



24.2.7 Extrapositional id-navigation



24.2.8 First Application of V+NP1 in the word bank 24.1.2

$$\text{V+NP1: } \begin{bmatrix} \text{M-verb: } a \\ \text{NP: } x \ b \ y \\ \text{prn: } c \end{bmatrix} \quad \begin{bmatrix} \text{M-np: } b \\ \text{VERB: } a \\ \text{prn: } c \end{bmatrix} \implies \begin{bmatrix} \text{M-verb: } a \end{bmatrix} \quad \{ 3 \text{ V+NP1, } 4 \text{ V+NP2, } 5 \text{ V+epr} \}$$

$$\begin{bmatrix} \text{I-concept}_{loc}: \textit{eat} \\ \text{P: indicative} \\ \text{C: } \begin{bmatrix} \text{MOD:} \\ \text{NP: Peter, salad} \end{bmatrix} \\ \text{I: } \begin{bmatrix} \text{prn: } 5 \\ \text{epr: } \begin{bmatrix} 5 \text{ then } 6 \\ 4 \text{ then } 5 \end{bmatrix} \end{bmatrix} \end{bmatrix} \quad \begin{bmatrix} \text{I-concept}_{loc}: \textit{salad} \\ \text{P: A sg def} \\ \text{C: } \begin{bmatrix} \text{MOD:} \\ \text{VERB: eat} \end{bmatrix} \\ \text{I: } \begin{bmatrix} \text{prn: } 5 \\ \text{id: } 2 \end{bmatrix} \end{bmatrix} \quad \begin{bmatrix} \text{I-concept}_{loc}: \textit{eat} \\ \text{P: indicative} \\ \text{C: } \begin{bmatrix} \text{MOD:} \\ \text{NP: Peter, salad} \end{bmatrix} \\ \text{I: } \begin{bmatrix} \text{prn: } 5 \\ \text{epr: } \begin{bmatrix} 5 \text{ then } 6 \\ 4 \text{ then } 5 \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

24.2.9 Second application of V+NP1 in the word bank 24.1.2

$$\text{V+NP1: } \begin{bmatrix} \text{M-verb: } a \\ \text{NP: } x \ b \ y \\ \text{prn: } c \end{bmatrix} \quad \begin{bmatrix} \text{np: } b \\ \text{VERB: } a \\ \text{prn: } c \end{bmatrix} \Rightarrow \begin{bmatrix} \text{M-verb: } a \end{bmatrix} \{ 3 \text{ V+NP1, } 4 \text{ V+NP2, } 5 \text{ V+epr} \}$$

$$\begin{bmatrix} \text{I-concept}_{loc}: \textit{eat} \\ \text{P: indicative} \\ \text{C: } \begin{bmatrix} \text{MOD:} \\ \text{NP: Peter, salad} \end{bmatrix} \\ \text{I: } \begin{bmatrix} \text{prn: } 5 \\ \text{epr: } \begin{bmatrix} 5 \text{ then } 6 \\ 4 \text{ then } 5 \end{bmatrix} \end{bmatrix} \end{bmatrix} \quad \begin{bmatrix} \text{I-concept}_{loc}: \textit{Peter} \\ \text{P: Nom} \\ \text{C: } \begin{bmatrix} \text{MOD:} \\ \text{VERB: eat} \end{bmatrix} \\ \text{I: } \begin{bmatrix} \text{prn: } 5 \\ \text{id: } 1 \end{bmatrix} \end{bmatrix} \quad \begin{bmatrix} \text{I-concept}_{loc}: \textit{eat} \\ \text{P: indicative} \\ \text{C: } \begin{bmatrix} \text{MOD:} \\ \text{NP: Peter, salad} \end{bmatrix} \\ \text{I: } \begin{bmatrix} \text{prn: } 5 \\ \text{epr: } \begin{bmatrix} 5 \text{ then } 6 \\ 4 \text{ then } 5 \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

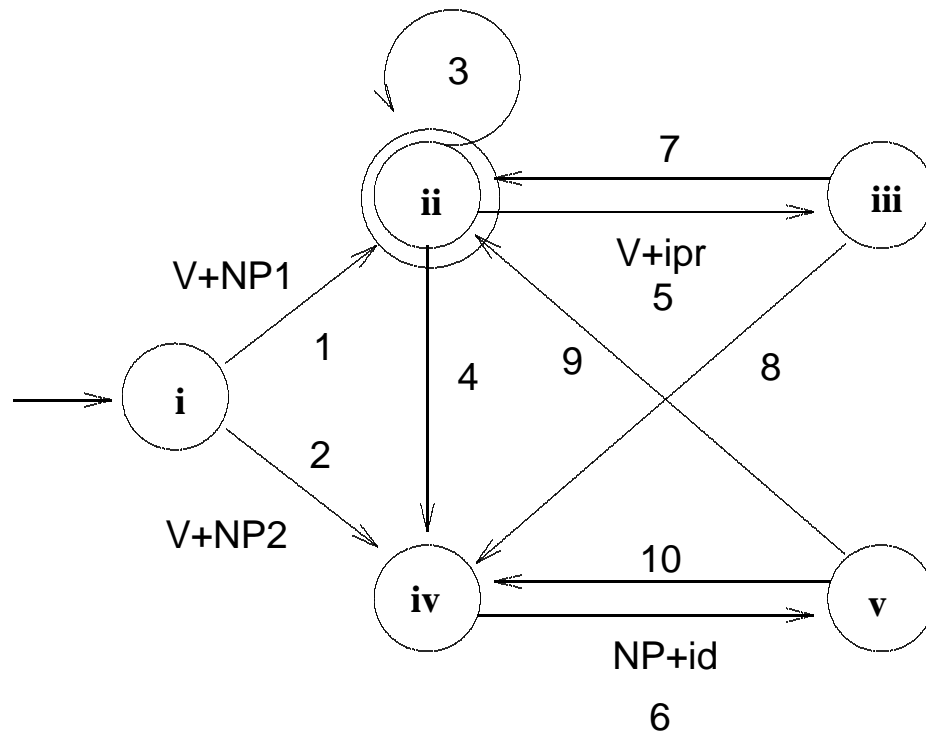
24.2.10 Application of V+epr in the word bank 24.1.2

$$\text{V+epr: } \begin{bmatrix} \text{M-verb: } a \\ \text{NP: } x \\ \text{prn: } m \\ \text{epr: } m \ C \ n \end{bmatrix} \quad \begin{bmatrix} \text{M-verb: } b \\ \text{NP: } y \\ \text{prn: } n \\ \text{epr: } m \ C \ n \end{bmatrix} \implies \begin{bmatrix} \text{M-verb: } b \\ \\ \\ \end{bmatrix} \{7 \text{ V+NP1, } 8 \text{ V+NP2}\}$$

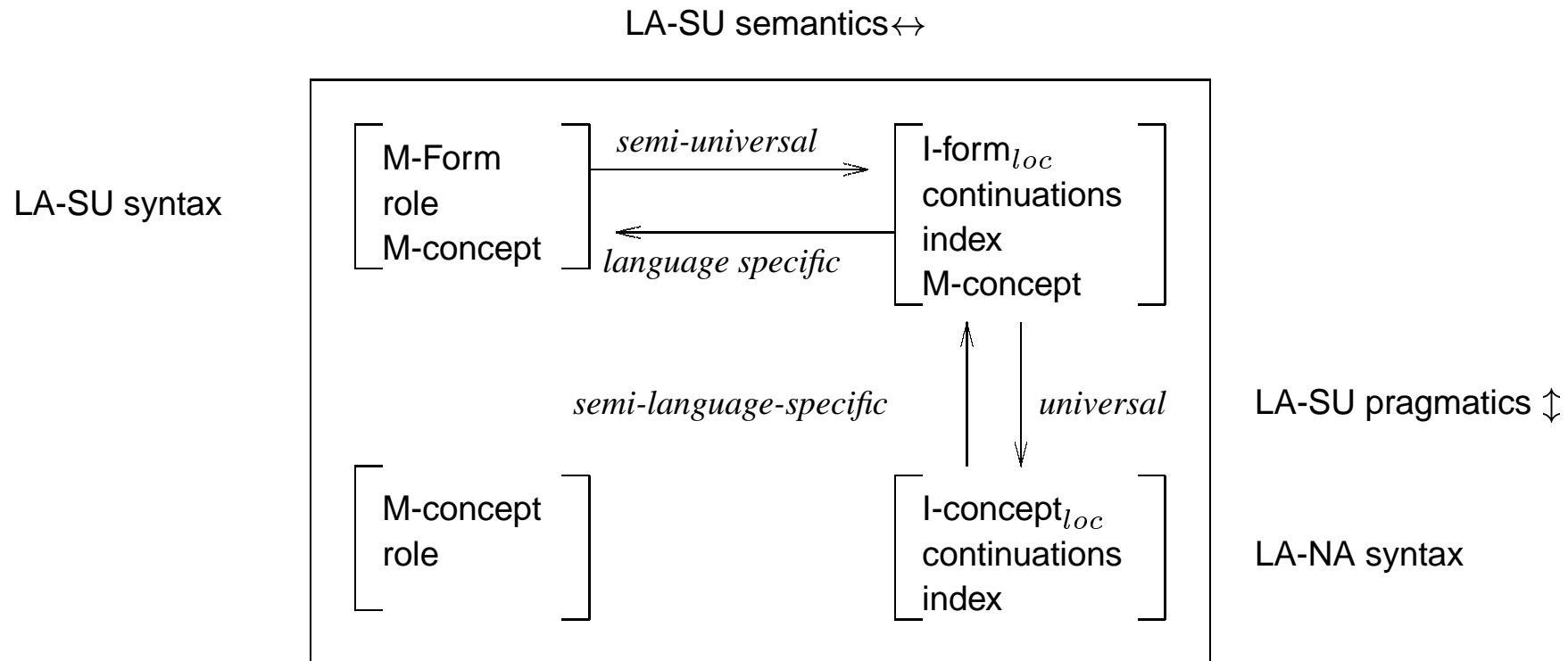
$$\begin{bmatrix} \text{I-concept}_{loc}: \textit{eat} \\ \text{P: indicative} \\ \text{C: } \begin{bmatrix} \text{MOD:} \\ \text{NP: Peter, salad} \end{bmatrix} \\ \text{I: } \begin{bmatrix} \text{prn: } 5 \\ \text{epr: } \begin{bmatrix} 5 \text{ then } 6 \\ 4 \text{ then } 5 \end{bmatrix} \end{bmatrix} \end{bmatrix} \quad \begin{bmatrix} \text{I-concept}_{loc}: \textit{pay} \\ \text{P: indicative} \\ \text{C: } \begin{bmatrix} \text{MOD:} \\ \text{NP: Peter, salad} \end{bmatrix} \\ \text{I: } \begin{bmatrix} \text{prn: } 6 \\ \text{epr: } \begin{bmatrix} 6 \text{ then } 7 \\ 5 \text{ then } 6 \end{bmatrix} \end{bmatrix} \end{bmatrix} \quad \begin{bmatrix} \text{I-concept}_{loc}: \textit{pay} \\ \text{P: indicative} \\ \text{C: } \begin{bmatrix} \text{MOD:} \\ \text{NP: Peter, salad} \end{bmatrix} \\ \text{I: } \begin{bmatrix} \text{prn: } 6 \\ \text{epr: } \begin{bmatrix} 6 \text{ then } 7 \\ 5 \text{ then } 6 \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

24.3 Interpreting autonomous LA-navigation with language

24.3.1 The finite state back bone of LA-NA



24.3.2 Universality and language specificity in a SLIM machine



24.3.3 Realization principles of the basic word orders

VSO languages

$$\begin{array}{ccc} & \text{realization} & \\ & \uparrow & \\ \text{V+NP} & & \\ \text{buffer: [Verb] + [NP}_1\text{]} & \Longrightarrow & \text{[Verb] [NP}_1\text{]} \end{array}$$

$$\begin{array}{ccc} & \text{realization} & \\ & \uparrow & \\ \text{V+NP} & & \\ \text{buffer: *[Verb] [NP}_1\text{] + [NP}_2\text{]} & \Longrightarrow & \text{*[Verb] [NP}_1\text{] [NP}_2\text{]} \end{array}$$

$$\begin{array}{ccc} & \text{realization} & \\ & 1\uparrow \quad 2\uparrow & \\ \text{V+NP} & & \\ \text{buffer: *[Verb] *[NP}_1\text{] [NP}_2\text{] + [NP}_3\text{]} & \Longrightarrow & \text{*[Verb] *[NP}_1\text{] [NP}_2\text{] [NP}_3\text{]} \end{array}$$

SVO languages

realization

↑

V+NP
buffer: [Verb] + [NP₁] \implies [Verb] [NP₁]

realization

↑

V+NP
buffer: *[NP₁] [Verb] + [NP₂] \implies *[NP₁] [Verb] [NP₂]

realization

1↑ 2↑

V+NP
buffer: *[NP₁] *[Verb] [NP₂] + [NP₃] \implies *[NP₁] *[Verb] [NP₂] [NP₃]

SOV languages

realization
↑

V+NP
buffer: [Verb] + [NP₁] \implies [Verb] [NP₁]

realization
↑

V+NP
buffer: *[NP₁] [Verb] + [NP₂] \implies *[NP₁] [Verb] [NP₂]

realization
2↑ 1↑

V+NP
buffer: *[NP₁] *[NP₂] [Verb] + [NP₃] \implies *[NP₁] *[NP₂] [Verb][NP₃]

24.4 Subordinating navigation

24.4.1 epr-concatenation

Peter leaves the house. Then he crosses the street.

Peter crosses the street. Before that he leaves the house.

24.4.2 id-concatenation

Peter orders a salad. The salad is eaten by Peter.

24.4.3 epr-subordination (adverbial clauses)

Before Peter crosses the street, he leaves the house.

Peter, before he crosses the street, leaves the house.

Peter leaves, before he crosses the street, the house.

Peter leaves the house, before he crosses the street.

After Peter leaves the house, he crosses the street.

Peter, after he leaves the house, crosses the street.

Peter crosses, after he leaves the house, the street.

Peter crosses the street, after he leaves the house.

24.4.4 id-subordination (relative clause)

Peter, who leaves the house, crosses the street.

24.4.5 Applying NP+id in the word bank 24.1.2

$$\text{NP+id: } \begin{bmatrix} \text{M-np: } a \\ \text{VERB: } b \\ \text{prn: } k \\ \text{id: } m \end{bmatrix} \quad \begin{bmatrix} \text{M-np: } a \\ \text{VERB: } c \\ \text{prn: } l \\ \text{id: } m \end{bmatrix} \implies \begin{bmatrix} \text{M-verb: } c \\ \text{NP: } x a y \\ \text{prn: } l \\ \text{epr:} \end{bmatrix} \{9 \text{ V+NP1, } 10 \text{ V+NP2}\}$$

$$\begin{bmatrix} \text{I-concept}_{loc}: Peter \\ \text{P: Nom} \\ \text{C: } \begin{bmatrix} \text{MOD:} \\ \text{VERB: cross} \end{bmatrix} \\ \text{I: } \begin{bmatrix} \text{prn: } 2 \\ \text{id: } 1 \end{bmatrix} \end{bmatrix}$$

$$\begin{bmatrix} \text{I-concept}_{loc}: Peter \\ \text{P: Nom} \\ \text{C: } \begin{bmatrix} \text{MOD:} \\ \text{VERB: leave} \end{bmatrix} \\ \text{I: } \begin{bmatrix} \text{prn: } 1 \\ \text{id: } 1 \end{bmatrix} \end{bmatrix}$$

$$\begin{bmatrix} \text{I-concept}_{loc}: leave \\ \text{P: indicative} \\ \text{C: } \begin{bmatrix} \text{MOD:} \\ \text{NP: Peter, house} \end{bmatrix} \\ \text{I: } \begin{bmatrix} \text{prn: } 1 \\ \text{epr: } \begin{bmatrix} \\ \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

24.4.6 Adnominal embedding navigation (preverbal)

Peter, who leaves the house, crosses the street.

▼ <i>cross</i>	<i>Peter</i>	NP+id:	<i>street</i>
prn:2	prn:2	<i>leave</i> <i>house</i> ▲	prn: 2
	id: 1	prn:1 prn:1	id: 2
		id:3	

24.4.7 Word order of adnominal embedding in German

Peter, der das Haus verlassen hat, überquert die Straße.

Peter, who the house left-has, crosses the street.

realization

V+NP2
 buffer: [Verb] + [NP₁] \implies [Verb]▼ [NP₁]

↑

realization

NP+id
 buffer: *[NP₁] [Verb] ▼ + [NP1'] \implies *[NP₁] PRO [Verb]▼ [Verb']

↑

realization

V+NP1
 buffer: *[NP₁] *[PRO] [Verb]▼ [Verb'] + [NP2'] \implies *[NP₁] *[PRO] [Verb]▲ [Verb'] [NP2']

2↑ 1↑

V+NP1

buffer: *[NP₁] *[PRO] *[NP2'] *[Verb'] [Verb]▲ + [NP₂]
 \implies *[NP₁] *[PRO] *[NP2'] *[Verb'] [Verb]▲ [NP₂]

realization

1↑ 2↑

24.4.8 Application of V+epr in the word bank 24.1.2

$$\text{V+epr: } \begin{bmatrix} \text{M-verb: } a \\ \text{NP: } x \\ \text{prn: } n \\ \text{epr: } m \ C \ n \end{bmatrix} \quad \begin{bmatrix} \text{M-verb: } b \\ \text{NP: } y \\ \text{prn: } m \\ \text{epr: } m \ C \ n \end{bmatrix} \implies \begin{bmatrix} \text{M-verb: } b \end{bmatrix} \{7 \text{ V+NP1, } 8 \text{ V+NP2}\}$$



$$\begin{bmatrix} \text{I-concept}_{loc}: \textit{cross} \\ \text{P: indicative} \\ \text{C: } \begin{bmatrix} \text{MOD:} \\ \text{NP: Peter, street} \end{bmatrix} \\ \text{I: } \begin{bmatrix} \text{prn: } 2 \\ \text{epr: } \begin{bmatrix} 1 \text{ then } 2 \\ 2 \text{ then } 3 \end{bmatrix} \end{bmatrix} \end{bmatrix} \quad \begin{bmatrix} \text{I-concept}_{loc}: \textit{leave} \\ \text{P: indicative} \\ \text{C: } \begin{bmatrix} \text{MOD:} \\ \text{NP: Peter, house} \end{bmatrix} \\ \text{I: } \begin{bmatrix} \text{prn: } 1 \\ \text{epr: } \begin{bmatrix} 1 \text{ then } 2 \end{bmatrix} \end{bmatrix} \end{bmatrix} \quad \begin{bmatrix} \text{I-concept}_{loc}: \textit{leave} \\ \text{P: indicative} \\ \text{C: } \begin{bmatrix} \text{MOD:} \\ \text{NP: Peter, house} \end{bmatrix} \\ \text{I: } \begin{bmatrix} \text{prn: } 1 \\ \text{epr: } \begin{bmatrix} 1 \text{ then } 2 \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

24.4.9 Different realizations of conjunctions

	temporal	causal	modal
coordinating forward:	P1. Then P2.	P1. Therefore P2.	P1. Thus P2.
coordinating backward:	P2. Earlier P1.		
subordinating forward:	p1, before P2, p1.	p1, for which reason P2, p1.	p1, as P2, p1
subordinating backward:	p2, after P1, p2.	p2, because P1, p2.	

24.4.10 Adverbial embedding navigation

Peter crossed, after he left the house, the street.

▼ <i>cross</i>	<i>Peter</i>	V+epr	<i>street</i>
prn:2	prn:2	<i>leave</i>	<i>Peter house</i> ▲
(2 then 3)	id: 1	prn: 1	prn:1 prn:1
(1 then 2)		(1 then 2)	id:1 id:2
			id: 3

24.4.11 Word order of adverbial embedding in German

Peter überquert, nachdem er das Haus verlassen hat, die Straße.

(Peter crosses, after he the house left-has, the street.)

realization

V+NP1

↑

buffer: [Verb] + [NP₁] \implies [Verb] [NP₁]

realization

V+epr

1↑ 2↑

buffer: *[NP₁] [Verb] + [Verb'] \implies *[NP₁] [Verb]▼ [CNJ] [Verb']

realization

V+NP1

1↑

buffer: *[NP₁] *[Verb]▼ *[CNJ] [Verb'] + [NP1'] \implies *[NP₁] *[Verb]▼ *[CNJ] [Verb'] [NP1']

V+NP1

realization

buffer: *[NP₁] *[Verb]▼ *[CNJ] *[NP1'] [Verb'] + [NP2']

2↑ 1↑

\implies *[NP₁] *[Verb]▲ *[CNJ] *[NP1'] [Verb'] [NP2']

V+NP1

realization

buffer: *[NP₁] *[Verb]▲ *[CNJ] *[NP1'] *[NP2'] [Verb'] + [NP₂]

1↑

\implies *[NP₁] *[Verb]▲ *[CNJ] *[NP1'] *[NP2'] [Verb'] [NP₂]

24.4.12 Multiple center embeddings in German

Peter, der den Salat, den er gegessen hatte, bezahlt hatte, verließ das Restaurant.
(Peter, who the salad, which he paid-had, eaten-had, left the restaurant.)

▼ <i>leave</i>	<i>Peter</i>	NP+id:				<i>restaurant</i>
prn:7	prn:7	▼ <i>pay</i>	<i>salad</i>	▲		▲ prn: 7
	id: 1	prn:6	prn:6	▼ <i>eat</i>	<i>Peter</i>	▲ id: 4
			id:5	prn: 5	id:1	

24.5 LA-search and LA-inference

24.5.1 Basic types of questions in natural language

Wh-question

Who entered the restaurant?

Yes/no-question

Did Peter enter the restaurant?

24.5.2 Search coplets of the two basic types of queries

Wh-question

$$\left[\begin{array}{l} \text{I-concept}_{loc}: \textit{enter} \\ \text{E:} \\ \text{F: } \left[\begin{array}{l} \text{MOD:} \\ \text{NP: } \sigma\text{-1, restaurant} \end{array} \right] \\ \text{I: } \left[\text{prn: } \sigma\text{-2} \right] \end{array} \right]$$

Yes/no-question

$$\left[\begin{array}{l} \text{I-concept}_{loc}: \textit{enter} \\ \text{E:} \\ \text{F: } \left[\begin{array}{l} \text{MOD:} \\ \text{NP: Peter, restaurant} \end{array} \right] \\ \text{I: } \left[\text{prn: } \sigma\text{-2} \right] \end{array} \right]$$

24.5.3 LA-Q1 (WH-questions)

$ST_S: \{([a]\{1 r_1, 2 r_2\})\}$

$$r_1: \begin{bmatrix} \text{M-verb: } a \\ \neg\text{NP: } y \sigma z \\ \text{prn: } m \end{bmatrix} \begin{bmatrix} \text{M-verb: } a \\ \neg\text{NP: } y \sigma z \\ \text{prn: } m - 1 \end{bmatrix} \implies \begin{bmatrix} \text{M-verb: } a \\ \neg\text{NP: } y \sigma z \\ \text{prn: } m - 1 \end{bmatrix} \{3 r_1 4 r_2\}$$

$$r_2: \begin{bmatrix} \text{M-verb: } a \\ \neg\text{NP: } y \sigma z \\ \text{prn: } m \end{bmatrix} \begin{bmatrix} \text{M-verb: } a \\ \text{NP: } y \sigma z \\ \text{prn: } m - 1 \end{bmatrix} \implies \begin{bmatrix} \text{M-verb: } a \\ \text{NP: } y \sigma z \\ \text{prn: } m - 1 \end{bmatrix} \{5 r_3\}$$

$$r_3: \begin{bmatrix} \text{M-verb: } a \\ \text{NP: } y \sigma z \\ \text{prn: } n \end{bmatrix} \begin{bmatrix} \text{M-np: } \sigma \\ \text{VERB: } a \\ \text{prn: } n \end{bmatrix} \implies \begin{bmatrix} \text{M-np: } \sigma \\ \text{VERB: } a \\ \text{prn: } n \end{bmatrix} \{ \}$$

$ST_F: \{([M\text{-np: } \sigma] rp_3)\}$

24.5.4 LA-Q2 (yes/no-questions)

$ST_S: \{([a]\{1 r_1, 2 r_2\})\}$

$$r_1: \begin{bmatrix} \text{M-verb: } a \\ \neg\text{NP: } x \\ \text{prn: } m \end{bmatrix} \begin{bmatrix} \text{M-verb: } a \\ \neg\text{NP: } x \\ \text{prn: } m - 1 \end{bmatrix} \implies \begin{bmatrix} \text{M-verb: } a \\ \neg\text{NP: } x \\ \text{prn: } m - 1 \end{bmatrix} \{3 r_1 4 r_2\}$$

$$r_2: \begin{bmatrix} \text{M-verb: } a \\ \neg\text{NP: } x \\ \text{prn: } m \end{bmatrix} \begin{bmatrix} \text{M-verb: } a \\ \text{NP: } x \\ \text{prn: } m - 1 \end{bmatrix} \implies \begin{bmatrix} \text{M-verb: } a \\ \text{NP: } x \\ \text{prn: } m - 1 \end{bmatrix} \{ \}$$

$ST_F: \{([\text{verb: } a] rp_1) ([\text{verb: } a] rp_2)\}$

24.5.5 Inference schemata of propositional calculus

1. $\frac{A, B}{\vdash A \& B}$
2. $\frac{A \vee B, \neg A}{\vdash B}$
3. $\frac{A \rightarrow B, A}{\vdash B}$
4. $\frac{A \rightarrow B, \neg B}{\vdash \neg A}$
5. $\frac{A \& B}{\vdash A}$
6. $\frac{A}{\vdash A \vee B}$
7. $\frac{\neg A}{\vdash A \rightarrow B}$
8. $\frac{\neg \neg A}{\vdash A}$

24.5.6 LA-rule for the propositional inference of conjunction

$$\text{inf1: } \begin{bmatrix} \text{M-verb: } a \\ \text{prn: } m \end{bmatrix} \begin{bmatrix} \text{M-verb: } b \\ \text{prn: } n \end{bmatrix} \implies \begin{bmatrix} \text{M-verb: } a \\ \text{prn: } m \\ \text{epr: } m \text{ and } n \end{bmatrix} \begin{bmatrix} \text{M-verb: } b \\ \text{prn: } n \\ \text{epr: } m \text{ and } n \end{bmatrix}$$

24.5.7 Coplets of an absolute proposition

$\left[\begin{array}{l} \text{I-concept}_{loc}: be \\ \text{NP: dog, animal} \\ \text{prn: abs327} \end{array} \right]$	$\left[\begin{array}{l} \text{I-concept}_{loc}: dog \\ \text{VERB: be} \\ \text{prn: abs327} \end{array} \right]$	$\left[\begin{array}{l} \text{I-concept}_{loc}: animal \\ \text{VERB: be} \\ \text{prn: abs327} \end{array} \right]$
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24.5.8 Coplet of an episodic proposition

$$\left[\begin{array}{l} \text{I-concept}_{loc}: see \\ \text{NP: Peter, dog} \\ \text{prn: 969} \end{array} \right]$$

24.5.9 Inference rule inf2 for absolute propositions

$$\text{inf2: } \left[\begin{array}{l} \text{M-verb: } a \\ \text{NP: } x b y \\ \text{prn: } n \end{array} \right] \left[\begin{array}{l} \text{M-verb: } be \\ \text{NP: } b c \\ \text{prn: } abs \end{array} \right] \implies \left[\begin{array}{l} \text{M-verb: } a \\ \text{NP: } x c y \\ \text{prn: } n \end{array} \right]$$