

**Part II.**  
**The Major Constraints of Natural Language**

## 6. Intra-Propositional Functor-Argument Structure

### 6.1 Overview

#### 6.1.1 Examples of intra-propositional functor-argument structure

1. Representing The man gave the child an apple (3-place verb)

[noun: apple fnc: give mdr: prn: 1]	[noun: child fnc: give mdr: prn: 1]	[verb: give arg: man child apple mdr: prn: 1]	[noun: man fnc: give mdr: prn: 1]
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2. Representing The little black dog barked (adnominal adjectives)

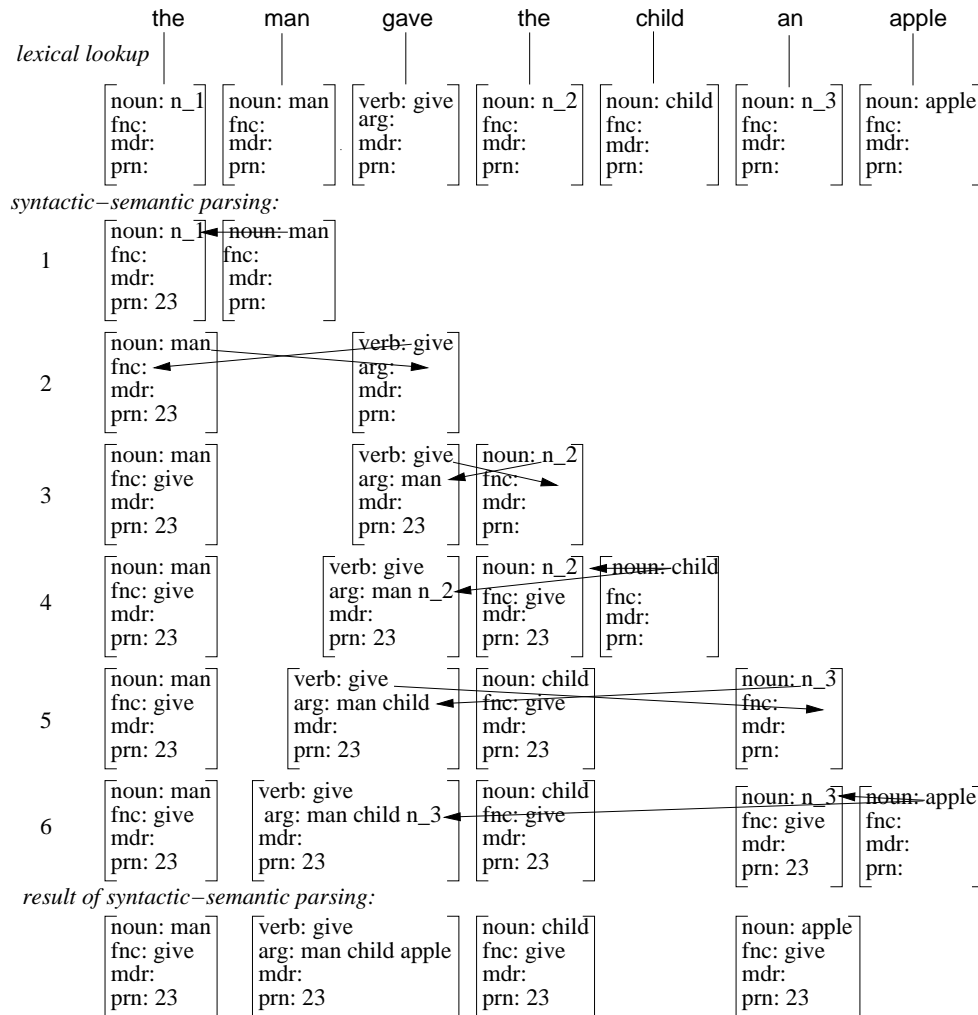
[verb: bark arg: dog mdr: prn: 2]	[adj: black mdd: dog mdr: prn: 2]	[adj: little mdd: dog mdr: prn: 2]	[noun: dog fnc: bark mdr: little black prn: 2]
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3. Representing Julia has been sleeping deeply (adverbial adjective)

[adj: deep mdd: sleep mdr: prn: 3]	[noun: Julia fnc: sleep mdr: prn: 3]	[verb: sleep arg: Julia mdr: deep prn: 3]
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## 6.2 Determiners

### 6.2.1 3-PLACE PROPOSITION: The man gave the child an apple



## 6.2.2 SCHEMATIC PRODUCTION FROM A 3-PLACE PROPOSITION

	<i>activated sequence</i>	<i>realization</i>
i		
	... V	
i.1	d	d
	V N	
i.2	d nn	d nn
	V N	
i.3	fv d nn	d nn fv
	V N	
i.4	fv d nn d	d nn fv d
	V N N	
i.5	fv d nn d nn	d nn fv d nn
	V N N	
i.6	v d nn d nn d	d nn v d nn d
	V N N N	
i.7	fv d nn d nn d nn	d nn fv d nn d nn
	V N N N	
i.8	fv p d nn d nn d nn	d nn fv d nn d nn p
	V N N N	

### 6.2.3 PREDICATE CALCULUS ANALYSIS OF All girls sleep

$$\forall x [\text{girl}(x) \rightarrow \text{sleep}(x)]$$

### 6.2.4 INTERPRETATION RELATIVE TO A MODEL

$$\forall x [\text{girl}(x) \rightarrow \text{sleep}(x)]^{\textcircled{a},g}$$

### 6.2.5 ELIMINATION OF THE OUTERMOST QUANTIFIER

$$[\text{girl}(x) \rightarrow \text{sleep}(x)]^{\textcircled{a},g'}$$

### 6.2.6 ANALYZING Every man loves a woman IN PREDICATE CALCULUS

Reading 1:  $\forall x [\text{man}(x) \rightarrow \exists y [\text{woman}(y) \ \& \ \text{love}(x,y)]]$

Reading 2:  $\exists y [\text{woman}(y) \ \& \ \forall x [\text{man}(x) \rightarrow \text{love}(x,y)]]$

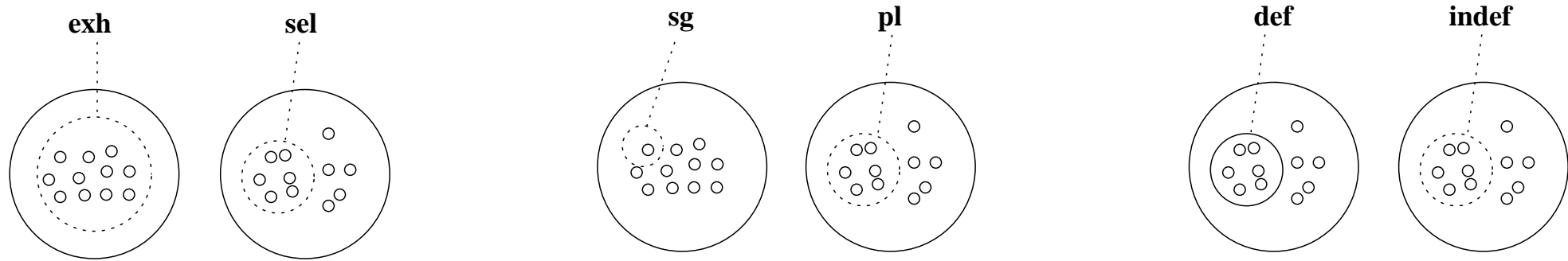
### 6.2.7 RESULT OF PARSING Every man loves a woman IN DBS

sur: noun: <i>man</i> cat: snp sem: pl exh mdr: fnc: love idy: 1 prn: 1	sur: verb: <i>love</i> cat: v sem: pres mdr: arg: man woman prn: 1	sur: noun: <i>woman</i> cat: snp sem: indef sg mdr: fnc: love idy: 2 prn: 1
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### 6.2.8 THE *sem* VALUES OF DIFFERENT DETERMINER-NOUN COMBINATIONS

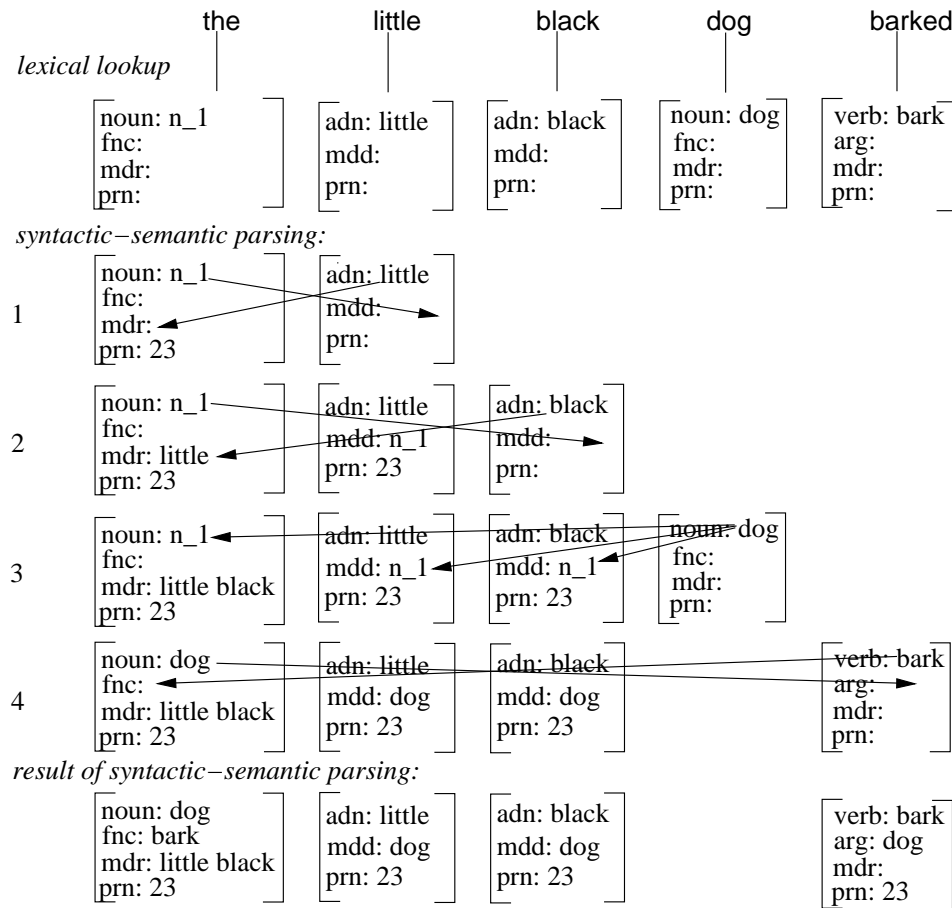
a girl	[sem: indef sg]
some girls	[sem: indef pl sel]
all girls	[sem: pl exh]
the girl	[sem: def sg]
the girls	[sem: def pl]

### 6.2.9 SET-THEORETIC INTERPRETATION OF **exh**, **sel**, **sg**, **pl**, **def**, **indef**



## 6.3 Adjectives

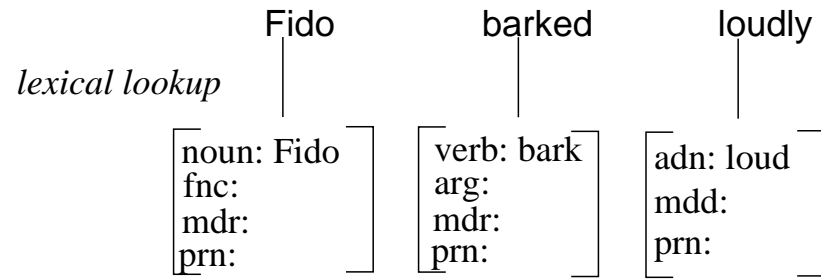
### 6.3.1 PARSING The little black dog barked IN THE HEARER-MODE



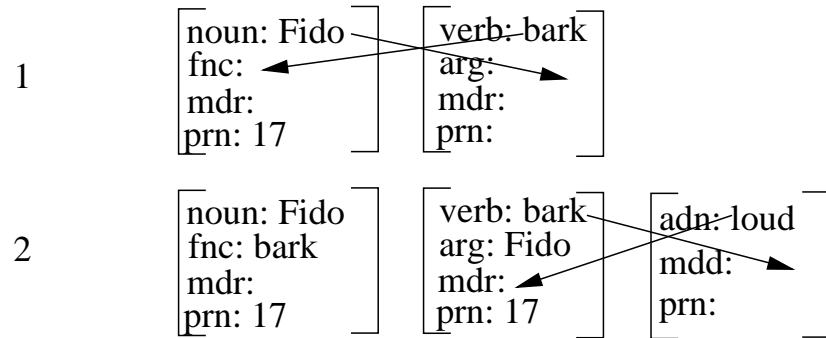
### 6.3.2 SCHEMATIC PRODUCTION OF THE The little black dog barked.

	<i>activated sequence</i>	<i>realization</i>
i	V	
i.1	d	d
	V N	
i.2	d an	d an
	V N A	
i.3	d an an	d an an
	V N A A	
i.4	d nn an an	d an an nn
	V N A A	
i.5	fv d nn an an	d an an nn fv
	V N A A	
i.6	fv p d nn an an	d an an nn fv p
	V N A A	

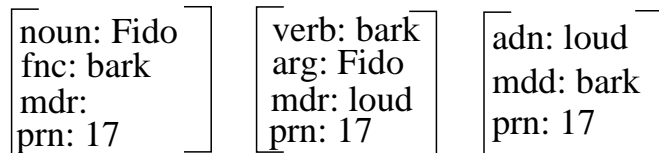
### 6.3.3 PARSING Fido barked loudly IN THE HEARER-MODE



*syntactic-semantic parsing:*



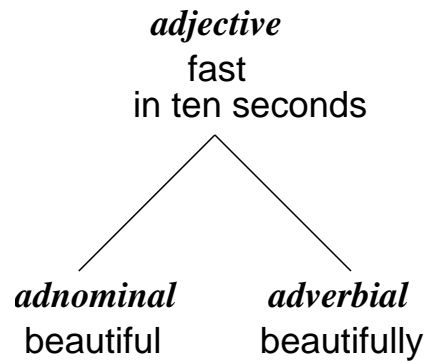
*result of syntactic-semantic parsing:*



### 6.3.4 SCHEMATIC PRODUCTION OF THE Fido barked loudly.

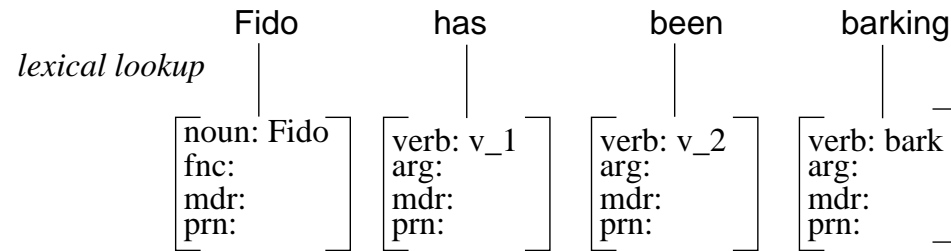
	<i>activated sequence</i>			<i>realization</i>
i				
	V			
i.1		n		n
	V	N		
i.2	fv	n		n fv
	V	N		
i.3	fv	n	av	n fv av
	V	N	A	
i.4	fv p	n	av	n fv av p
	V	N	A	

### 6.3.5 Relation of the terms Adjective, Adnominal, and Adverbial in DBS

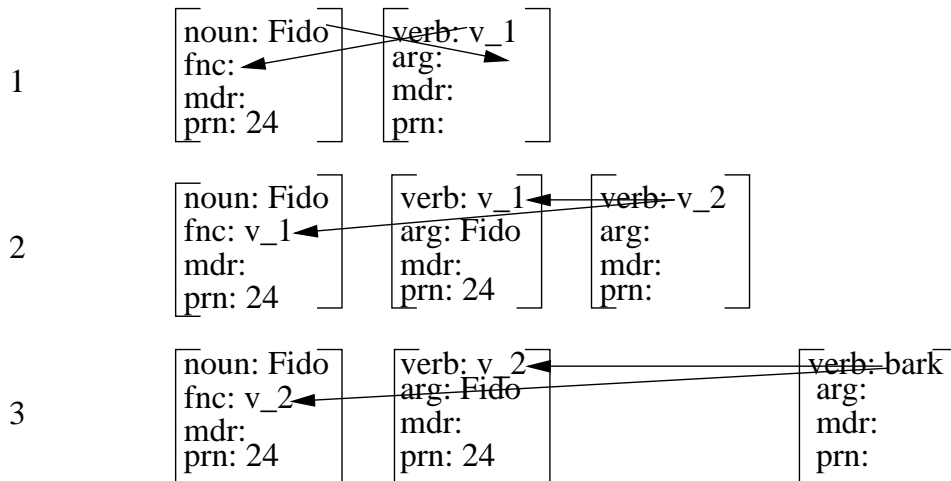


## 6.4 Auxiliaries

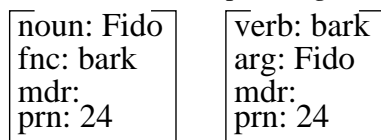
### 6.4.1 COMPLEX VERB PHRASE: Fido has been barking.



*syntactic–semantic parsing:*



*result of syntactic–semantic parsing:*

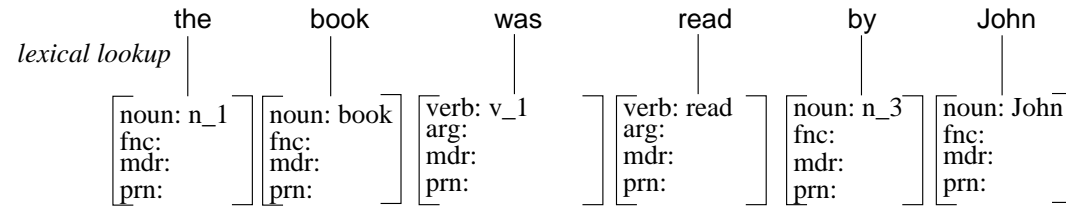


### 6.4.2 SCHEMATIC PRODUCTION OF Fido has been barking

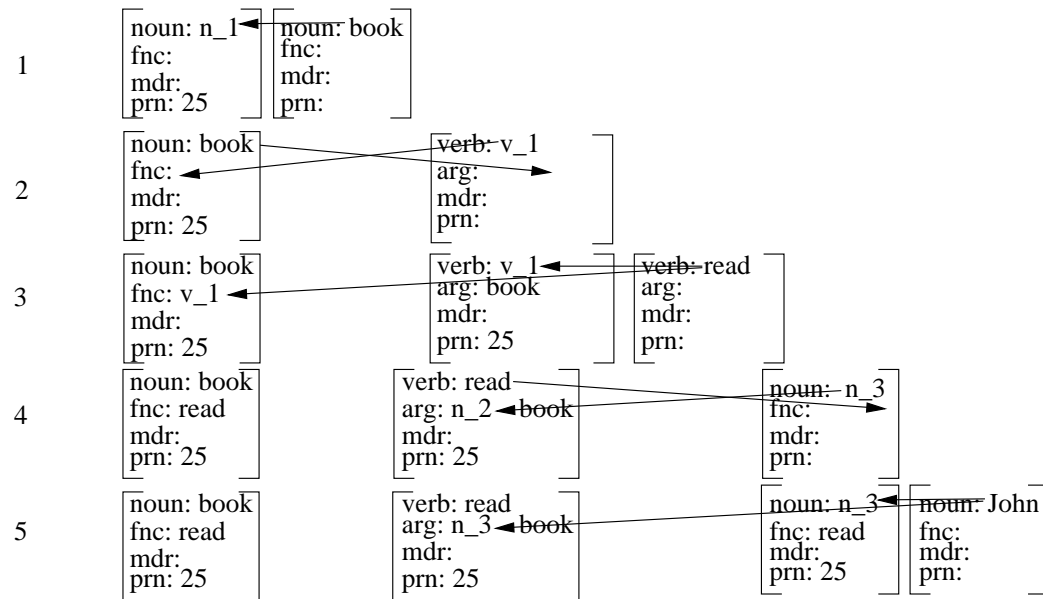
	<i>activated sequence</i>	<i>realization</i>
i.		
	V	
i.1	n	n
	V N	
i.2	ax n	n ax
	V N	
i.3	ax ax n	n ax ax
	V N	
i.4	ax ax nv n	n ax ax nv
	V N	
i.6	ax ax nv p n	n ax ax nv p
	V N	

# 6.5 Passive

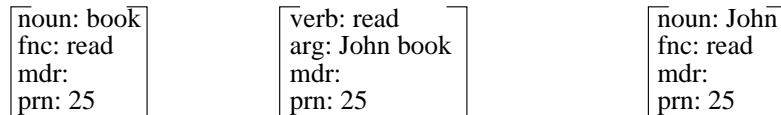
## 6.5.1 INTERPRETATION OF PASSIVE: The book was read by John.



syntactic-semantic parsing:



result of syntactic-semantic parsing:

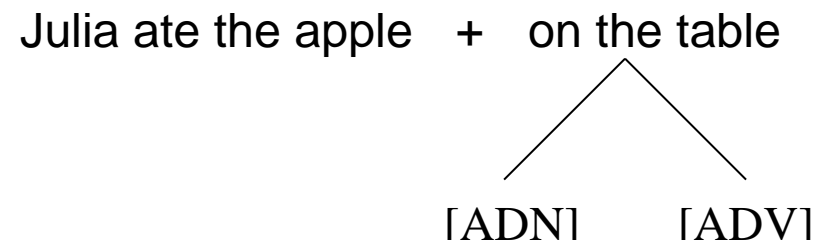


## 6.5.2 SCHEMATIC PRODUCTION OF The book was read by John.

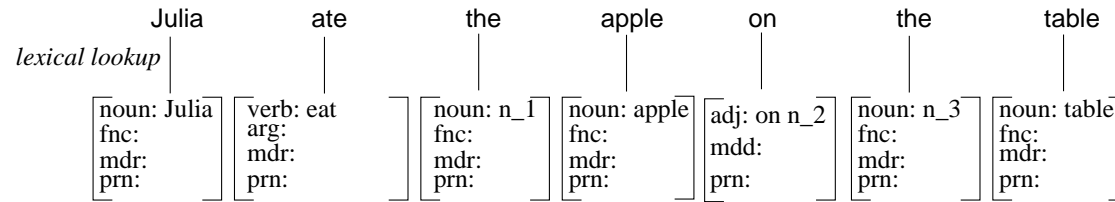
	<i>activated sequence</i>			<i>realization</i>
i				
	V			
i.1			d	d
	V		N	
i.2			d nn	d nn
	V		N	
i.3	ax		d nn	d nn ax
	V		N	
i.4	ax nv		d nn	d nn ax nv
	V		N	
i.5	ax nv	by	d nn	d nn ax nv by
	V	N	N	
i.6	ax nv	by n	d nn	d nn ax nv by n
	V	N	N	
i.7	ax nv p	by n	d nn	d nn ax nv by n p
	V	N	N	

## 6.6 Prepositions

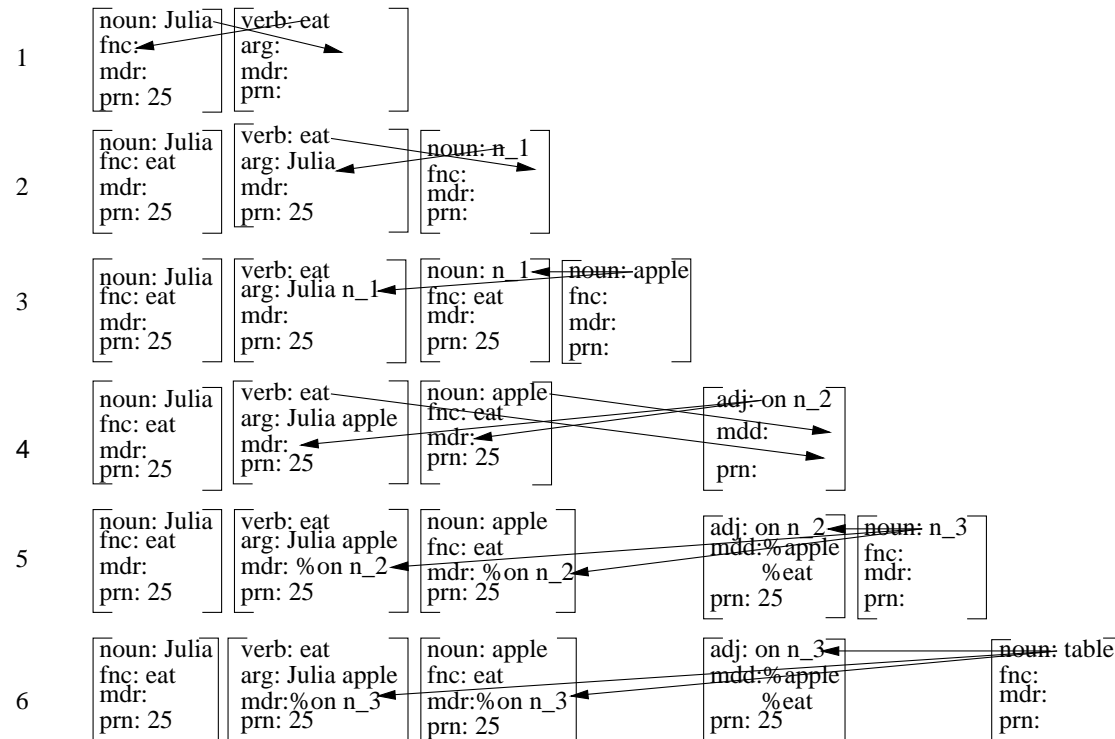
### 6.6.1 SEMANTIC DOUBLING OF A PREPOSITIONAL PHRASE



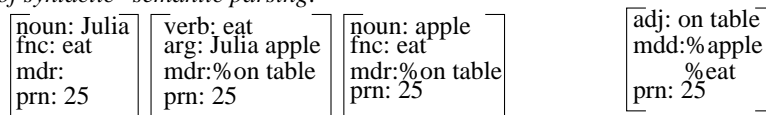
### 6.6.2 ADJECTIVAL PHRASE: Julia ate the apple on the table.



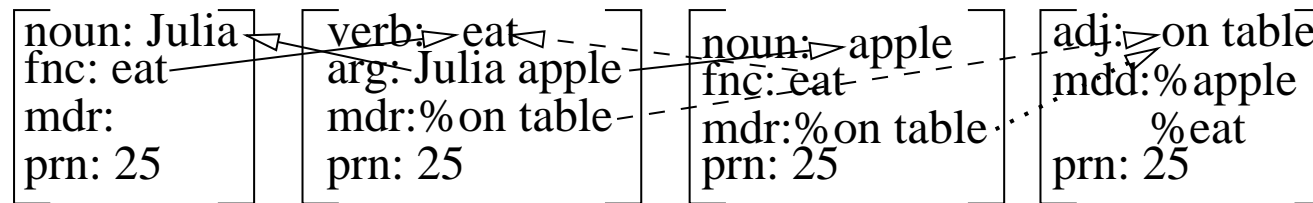
syntactic-semantic parsing:



result of syntactic-semantic parsing:



### 6.6.3 RETRIEVAL DURING NAVIGATION



## 6.6.4 PRODUCTION OF Julia ate the apple on the table.

	<i>activated sequence</i>	<i>realization</i>
i		
	V	
i.1	n	n
	V N	
i.2	fv n	n fv
	V N	
i.3	fv n d	n fv d
	V N N	
i.4	fv n d n	n fv d n
	V N N	
i.5	fv n d n pp	n fv d n pp
	V N N A	
i.6	fv n d n pp d	n fv d n pp d
	V N N A	
i.7	fv n d n pp d nn	n fv d n pp d nn
	V N N A	
i.8	fv p n d n pp d nn	n fv d n pp d nn p
	V N N A	

# 7. Extra-Propositional Functor-Argument Structure

## 7.1 Overview

### 7.1.1 Verb proplets of subordinate clauses

*subject or object sentence*

$\left[ \begin{array}{l} \mathbf{n/v:} \text{ verb of the sub-clause} \\ \text{arg: noun(s) of the sub-clause} \\ \mathbf{fnc: verb} \text{ of the higher clause} \\ \text{prn: number of the sub-clause} \end{array} \right]$

*adverbial sentence*

$\left[ \begin{array}{l} \mathbf{a/v:} \text{ verb of the sub-clause} \\ \text{arg: noun(s) of the sub-clause} \\ \mathbf{mdd: verb} \text{ of the higher clause} \\ \text{prn: number of the sub-clause} \end{array} \right]$

*adnominal sentence*

$\left[ \begin{array}{l} \mathbf{a/v:} \text{ verb of the sub-clause} \\ \text{arg: noun(s) of the sub-clause} \\ \mathbf{mdd: noun} \text{ of the higher clause} \\ \text{prn: number of the sub-clause} \end{array} \right]$

### 7.1.2 Examples of extra-propositional functor-arg. structure

#### 1. Representing That Fido barked amused Mary (subject sentence)

$\left[ \begin{array}{l} \text{n/v: that bark} \\ \text{arg: Fido} \\ \text{fnc: 28 amuse} \\ \text{prn: 27} \end{array} \right]$

$\left[ \begin{array}{l} \text{noun: Fido} \\ \text{fnc: bark} \\ \text{mdr:} \\ \text{prn: 27} \end{array} \right]$

$\left[ \begin{array}{l} \text{verb: amuse} \\ \text{arg: 27 bark Mary} \\ \text{mdr:} \\ \text{prn: 28} \end{array} \right]$

$\left[ \begin{array}{l} \text{noun: Mary} \\ \text{fnc: amuse} \\ \text{mdr:} \\ \text{prn: 28} \end{array} \right]$

## 2. Representing John heard that Fido barked (object sentence)

noun: John fnc: hear mdr: prn: 30	verb: hear arg: John 31 bark mdr: prn: 30	n/v: that bark arg: Fido fnc: 30 hear prn: 31	noun: Fido fnc: bark mdr: prn: 31
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## 3. Representing The dog which saw Mary barked (adnominal sent., subject gap)

noun: dog fnc: bark mdr: 33 see prn: 32	a/v: see arg: # Mary mdd:32 dog prn: 33	noun: Mary fnc: see mdr: prn: 33	verb: bark arg: dog mdr: prn: 32
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## 4. Representing The dog which Mary saw barked (adnominal sent., object gap)

noun: dog fnc: bark mdr: 35 see prn: 34	a/v: see arg: Mary # mdd:34 dog prn: 35	noun: Mary fnc: see mdr: prn: 35	verb: bark arg: dog mdr: prn: 34
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## 5. Representing When Fido barked Mary smiled (adverbial sentence)

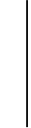
a/v: when bark arg: Fido mdd:37 smile prn: 36	noun: Fido fnc: bark mdr: prn: 36	noun: Mary fnc: smile mdr: prn: 37	verb: smile arg: Mary mdr: 36 bark prn: 37
--	--	---	---

### 7.1.3 EXTRA-PROPOSITIONAL FUNCTOR-ARGUMENT STRUCTURES

(i) *sentential argument*

(1) *subject:*

# amused Mary



Fido barked

(2) *object:*

John heard #



Fido barked

(ii) *sentential modifier, adnominal* (relative clause)

(3) *subject*

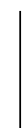
the dog barked



# saw Mary

(4) *object:*

the dog barked



Mary saw #

(iii) *sentential modifier, adverbial*

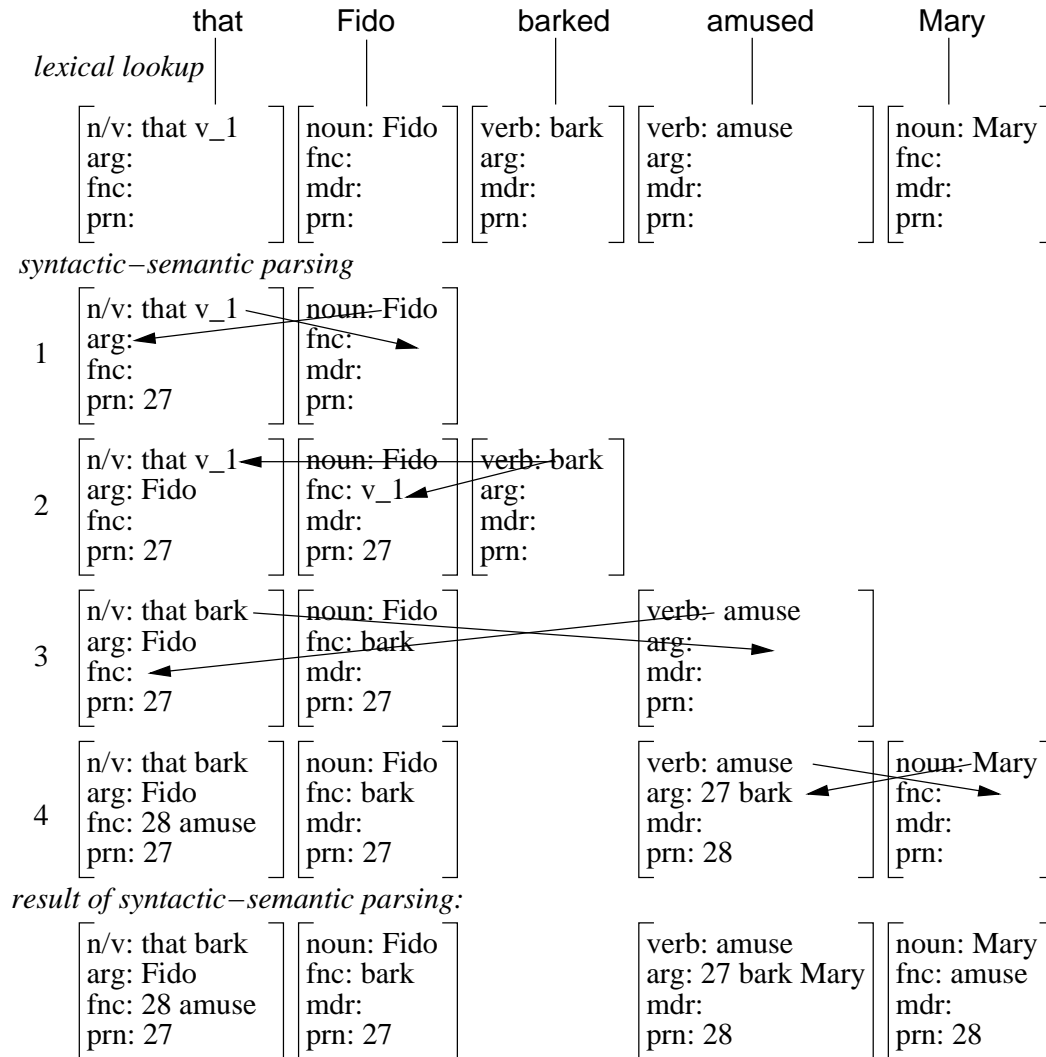
(5) Mary smiled



when Fido barked

## 7.2 Sentential Argument as Subject

### 7.2.1 INTERPRETATION OF That Fido barked amused Mary.

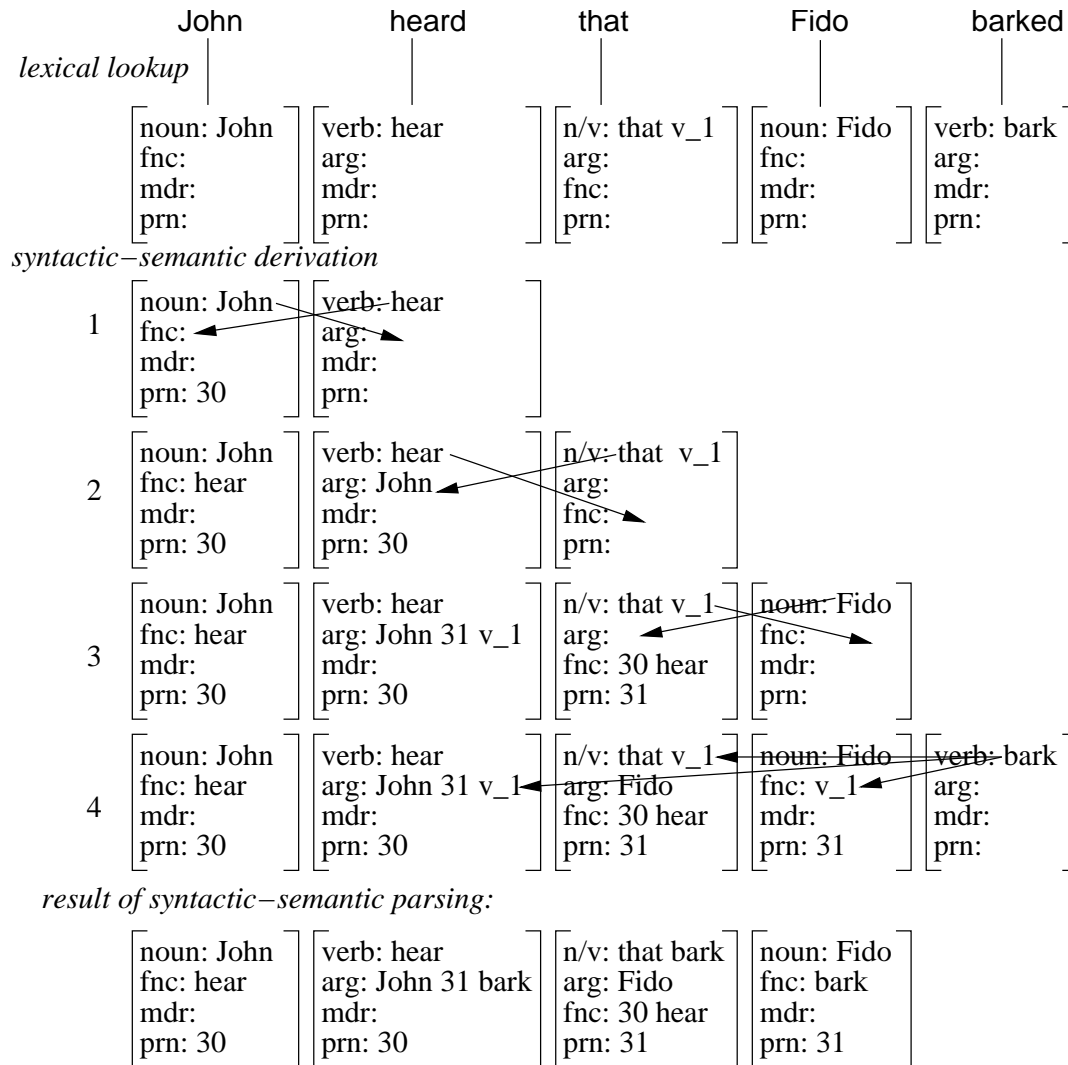


## 7.2.2 PRODUCTION OF That Fido barked amused Mary.

	<i>activated sequence</i>				<i>realization</i>			
1								
	V							
1.1	sc				sc			
	V	N						
1.2	sc	n			sc	n		
	V	N						
1.3	sc fv	n			sc	n	fv	
	V	N						
2.1	sc fv	n	fv		sc	n	fv	fv
	V	N	V					
2.2	sc fv	n	fv	n	sc	n	fv	fv n
	V	N	V	N				
2.3	sc fv	n	fv p	n	sc	n	fv	fv n p
	V	N	V	N				

# 7.3 Sentential Argument as Object

## 7.3.1 INTERPRETATION OF John heard that Fido barked.

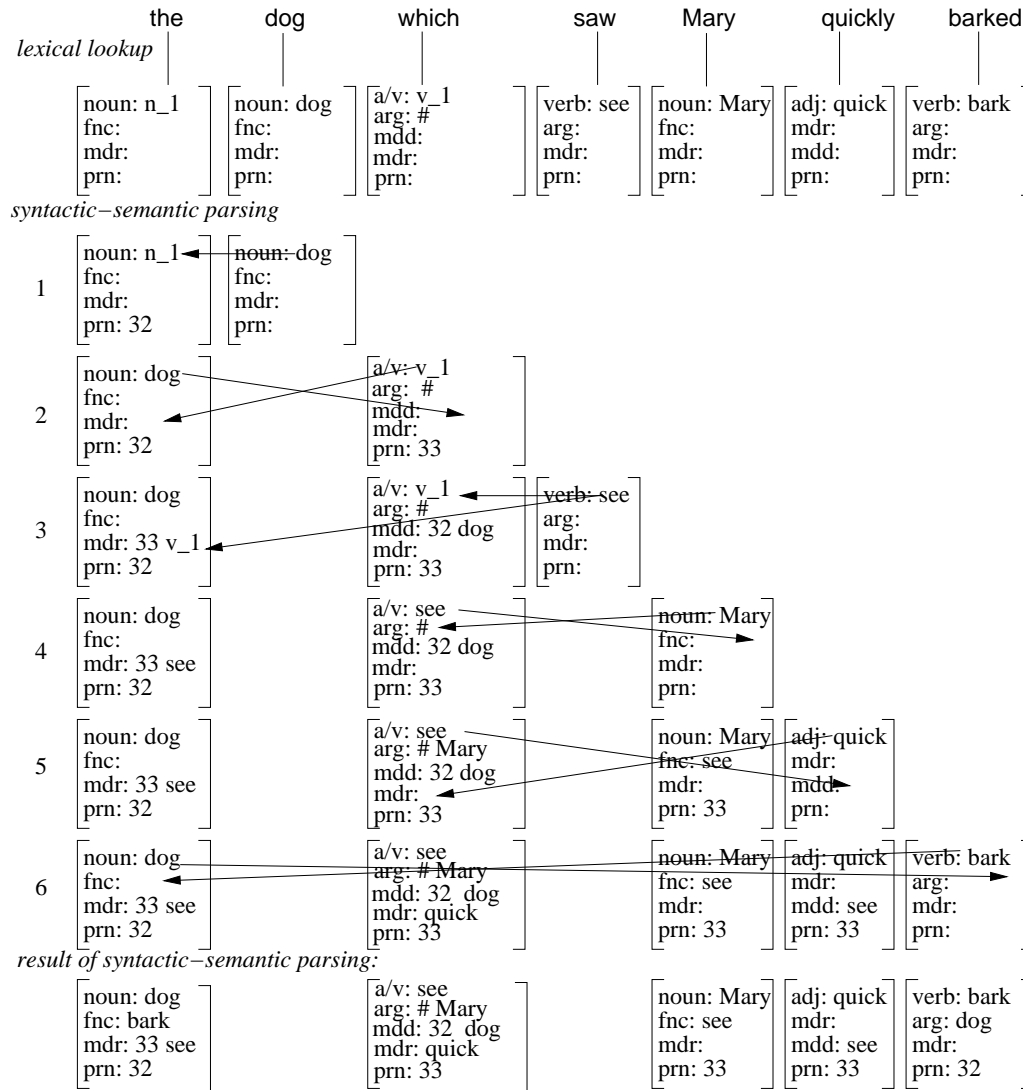


## 7.3.2 SCHEMATIC PRODUCTION OF John heard that Fido barked.

	<i>activated sequence</i>					<i>realization</i>				
1										
	V									
1.1		n				n				
	V	N								
1.2	fv	n				n	fv			
	V	N								
2.1	fv	n	sc			n	fv	sc		
	V	N	V							
2.2	fv	n	sc	n		n	fv	sc	n	
	V	N	V	N						
2.3	fv	n	sc fv	n		n	fv	sc	n	fv
	V	N	V	N						
2.4	fv p	n	sc fv	n		n	fv	sc	n	fv p
	V	N	V	N						

# 7.4 Adnominal Sentential Modifier with Subject Gap

## 7.4.1 INTERPRETATION OF The dog which saw Mary quickly barked



### 7.4.2 SECOND READING OF 7.4.1, WITH quickly MODIFYING bark

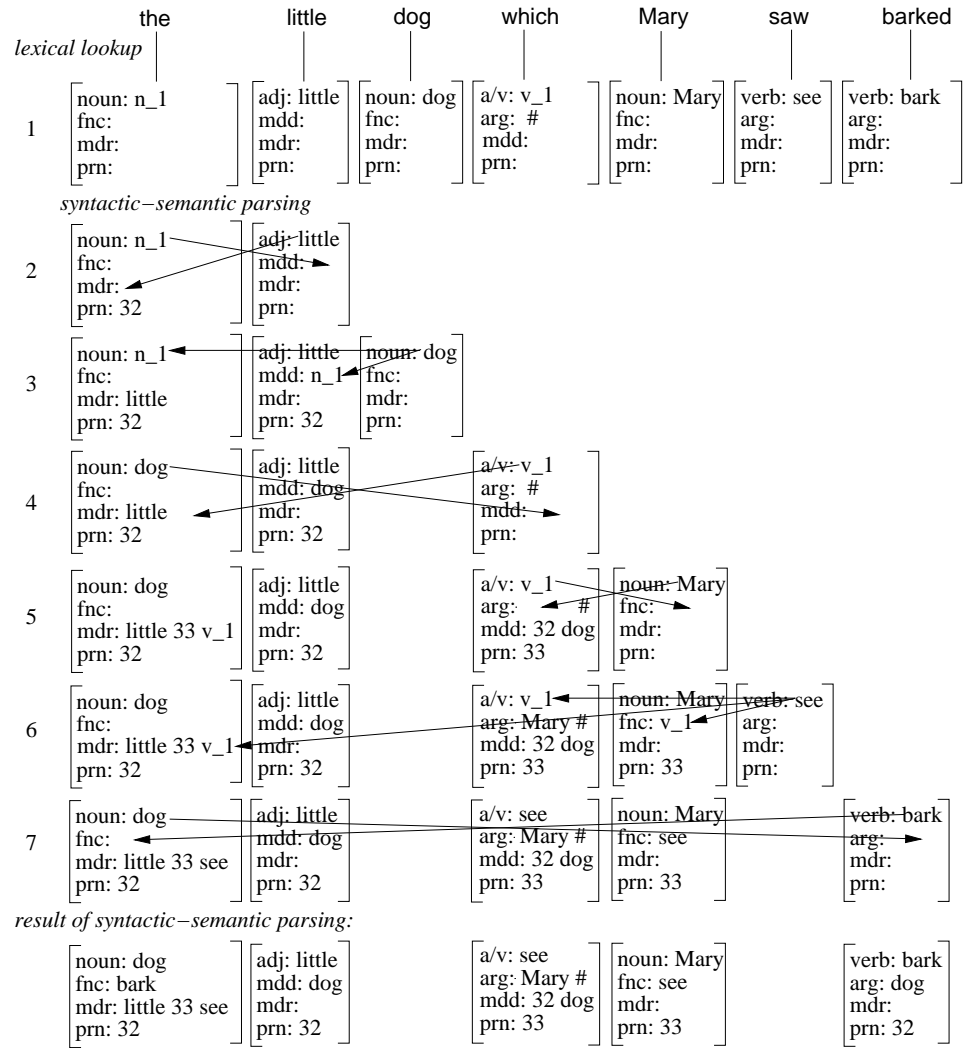
noun: dog fnc: bark mdr: 33 see prn: 32	a/v: see arg: # Mary mdd: 32 dog mdr: prn: 33	noun: Mary fnc: see mdr: prn: 33	adj: quick mdd: bark mdr: prn: 32	verb: bark arg: dog mdr: quick prn: 32
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## 7.4.3 PRODUCTION OF The dog which saw Mary quickly barked

	<i>activated sequence</i>	<i>realization</i>
1	V	
1.1	d	d
	V N	
1.2	d nn	d nn
	V N V	
2.1	d nn wh	d nn wh
	V N V	
2.2	d nn wh fv	d nn wh fv
	V N V	
2.3	d nn wh fv n	d nn wh fv n
	V N V N	
1.3	d nn wh fv n av	d nn wh fv n av
	V N V N A	
1.4	fv d nn wh fv n av	d nn wh fv n av fv
	V N V N A	
1.5	fv p d nn wh fv n av	d nn wh fv n av fv p
	V N V N A	

# 7.5 Adnominal Sentential Modifier with Object Gap

## 7.5.1 INTERPRETATION OF The little dog which Mary saw barked.

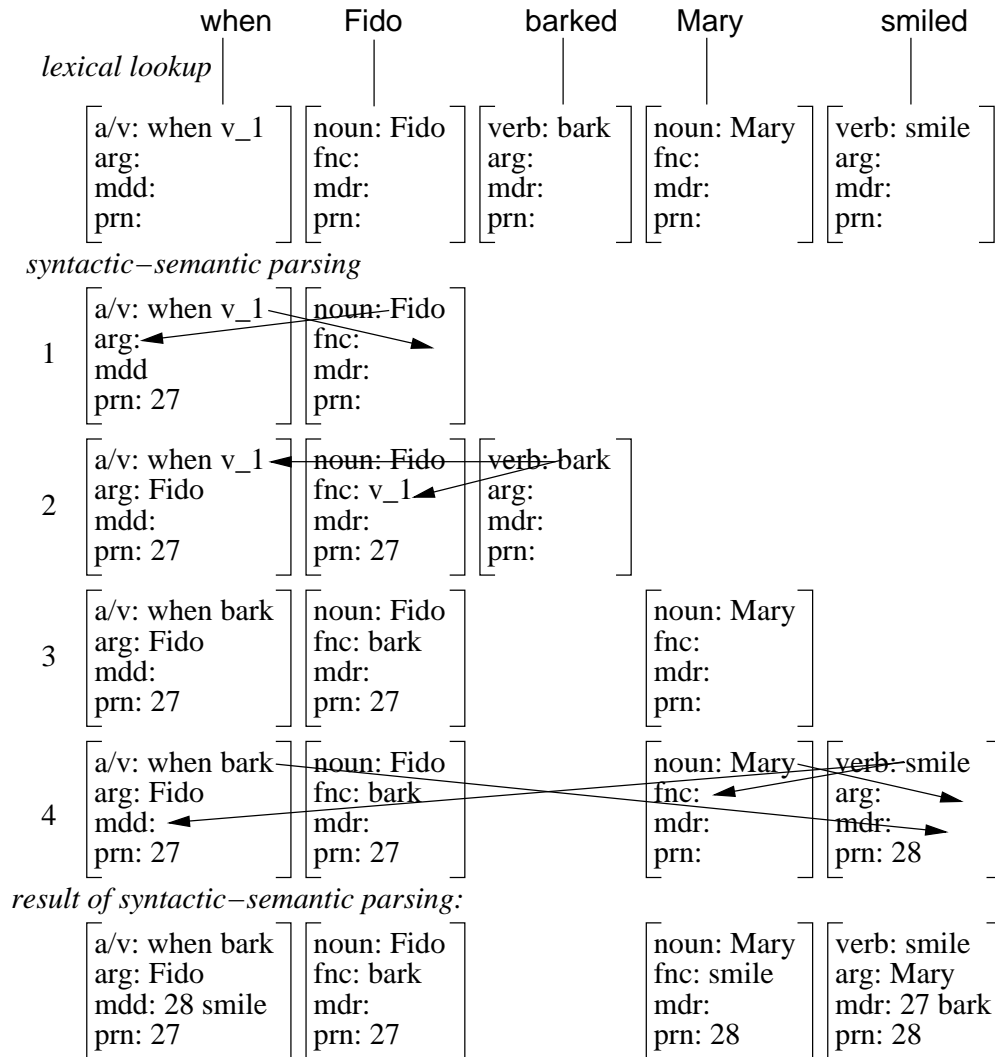


## 7.5.2 PRODUCTION OF The little dog which Mary saw barked.

	<i>activated sequence</i>	<i>realization</i>
	1	
	V	
1.1	d	d
	V N	
1.2	d an	d an
	V N A	
1.3	d nn an	d an nn
	V N A	
2.1	d nn an wh	d an nn wh
	V N A V	
2.2	d nn an wh n	d an nn wh n
	V N A V N	
2.3	d nn an wh fv n	d an nn wh n fv
	V N A V N	
1.4	fv d nn an wh fv n	d an nn wh n fv fv
	V N A V N	
1.5	fv p d nn an wh fv n	d an nn wh n fv fv p
	V N A V N	

## 7.6 Adverbial Sentential Modifier

### 7.6.1 INTERPRETATION OF When Fido barked Mary smiled.



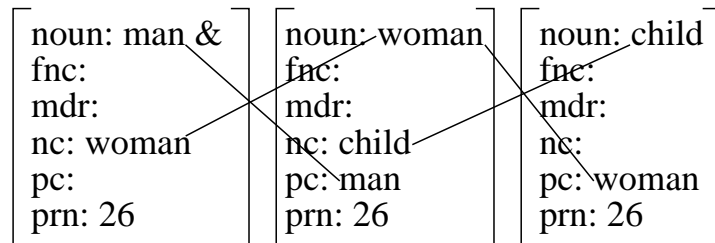
## 7.6.2 PRODUCTION OF When Fido barked Mary smiled.

	<i>activated sequence</i>	<i>realization</i>
1	V	
1.1	sc	sc
	V N	
1.2	sc n	sc n
	V N	
1.3	sc fv n	sc n fv
	V N	
2.1	sc fv n n	sc n fv n
	V N V N	
2.2	sc fv n fv n	sc n fv n fv
	V N V N	
2.3	sc fv n fv p n	sc n fv n fv p
	V N V N	

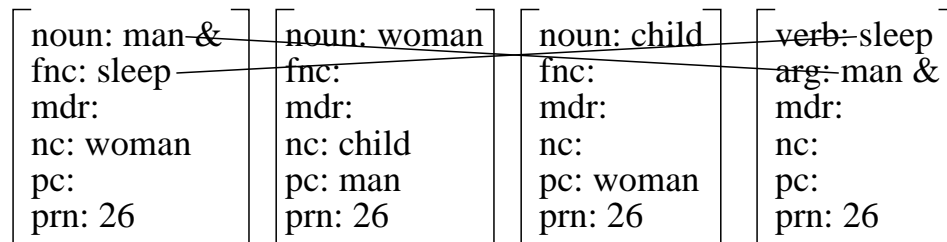
## 8. Intra-Propositional Coordination

### 8.1 Overview

#### 8.1.1 GRAMMATICAL RELATIONS OF the man, the woman, and the child



#### 8.1.2 GRAMMATICAL RELATIONS OF The man, the woman, and the child slept



### 8.1.3 Different kinds of coordinations

1. *One simple noun coordination* (subject, cf. 8.2.1, 8.2.2)  
The man, the woman, and the child slept.
2. *One simple noun coordination* (object, 8.2.4, 8.2.5)  
John bought an apple, a pear, and a peach.
3. *Two simple noun coordinations* (subject object, cf. 8.2.3)  
The man, the woman, and the child bought an apple, a pear, and a peach.
4. *One simple verb coordination* (cf. 8.3.1, 8.3.2, 8.3.3)  
John bought, cooked, and ate the pizza.
5. *Three simple coordinations of noun, verb, and noun* (subject verb object)  
The man, the woman, and the child bought, cooked, and ate the steak, the potatoes, and the broccoli.
6. *One simple adjective coordination* (adnominal, cf. 8.3.4)  
John loves a smart, pretty, and rich girl.
7. *One simple adjective coordination* (adverbial, cf. 8.3.5)  
John talked gently, slowly, and seriously.

8. *One simple noun coordination in a prepositional phrase*  
The company has offices in London, Paris, and New York.
9. *One simple noun coordination in a genitive construction*  
John visited the house of Julia, Susanne, and Mary.
10. *One complex verb-object coordination* (subject gapping, cf. 8.4.1, 8.4.5)  
Bob ate an apple, # walked his dog, and # read a paper.
11. *One complex subject-object coordination* (verb gapping, cf. 8.5.1, 8.5.4)  
Bob ate an apple, Jim # a pear, and Bill # a peach.
12. *One complex subject-verb coordination* (object gapping,  
Bob bought #, Jim peeled #, and Bill ate the peach.

### 8.1.4 Comparing simple and complex coordination

(i) *two simple coordinations*

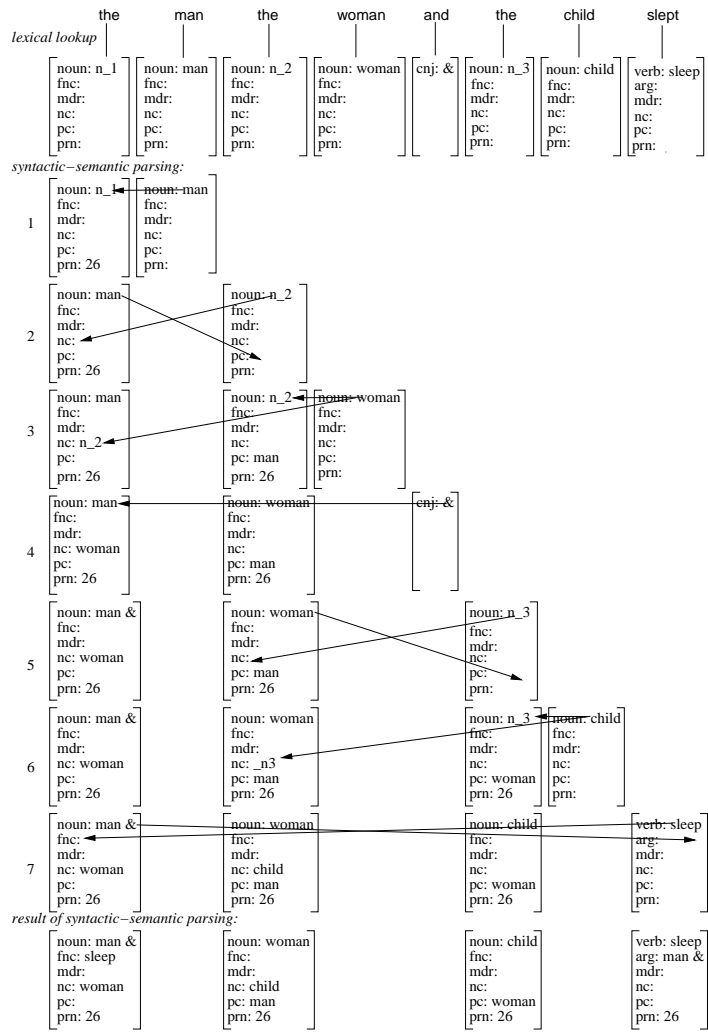
Bob, Jim, and Bill bought, peeled, and ate the peach.

(ii) *one complex coordination*

Bob bought #, Jim peeled #, and Bill ate the peach.

## 8.2 Simple Coordination of Nouns in Subject and Object Position

### 8.2.1 NOUN COORDINAT. (SUBJECT): The man, the woman, and the child slept



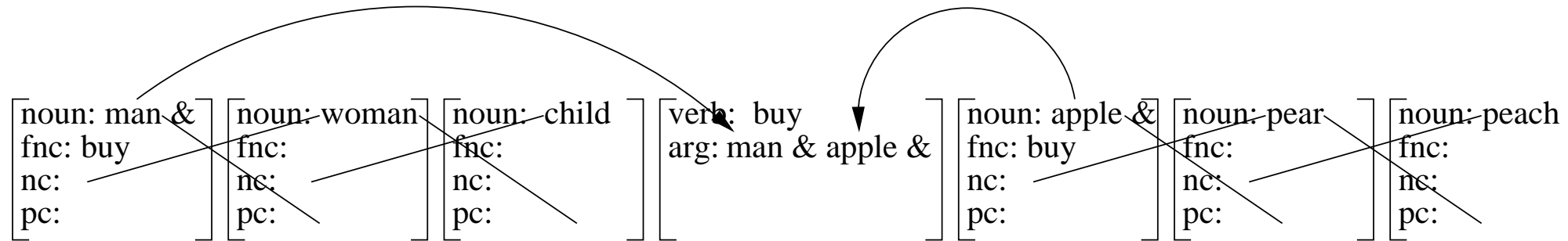
### 8.2.2 PRODUCTION OF The man the woman and the child slept.

*activated sequence*

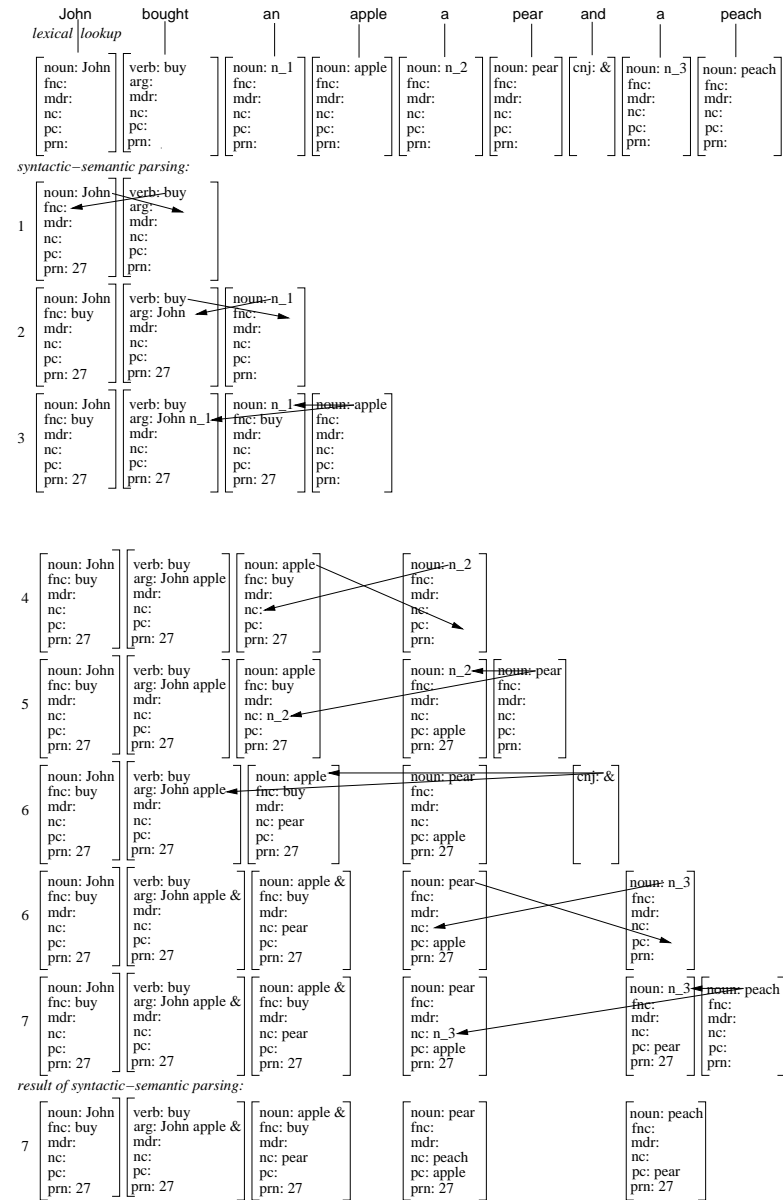
*realization*

i.	V				
i.1		d			d
	V	N			
i.2		d nn			d nn
	V	N			
i.3		d nn	d		d nn d
	V	N	N		
i.4		d nn	d nn		d nn d nn
	V	N	N		
i.5		d nn cc	d nn		d nn d nn cc
	V	N	N		
i.6		d nn cc	d nn	d	d nn d nn cc d
	V	N	N	N	
i.7		d nn cc	d nn	d nn	d nn d nn cc d nn
	V	N	N	N	
i.8	fv	d nn cc	d nn	d nn	d nn d nn cc d nn fv
	V	N	N	N	
i.9	fv p	d nn cc	d nn	d nn	d nn d nn cc d nn fv p
	V	N	N	N	

### 8.2.3 Simple coordinations of subject and object nouns



### 8.2.4 Noun coordination (object): John bought an apple, a pear, and a peach

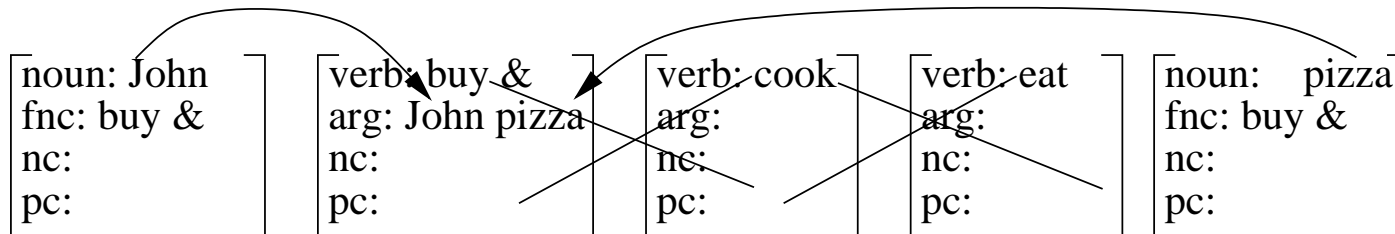


## 8.2.5 PRODUCTION OF John bought an apple, a pear, and a peach.

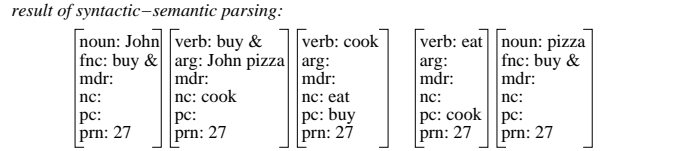
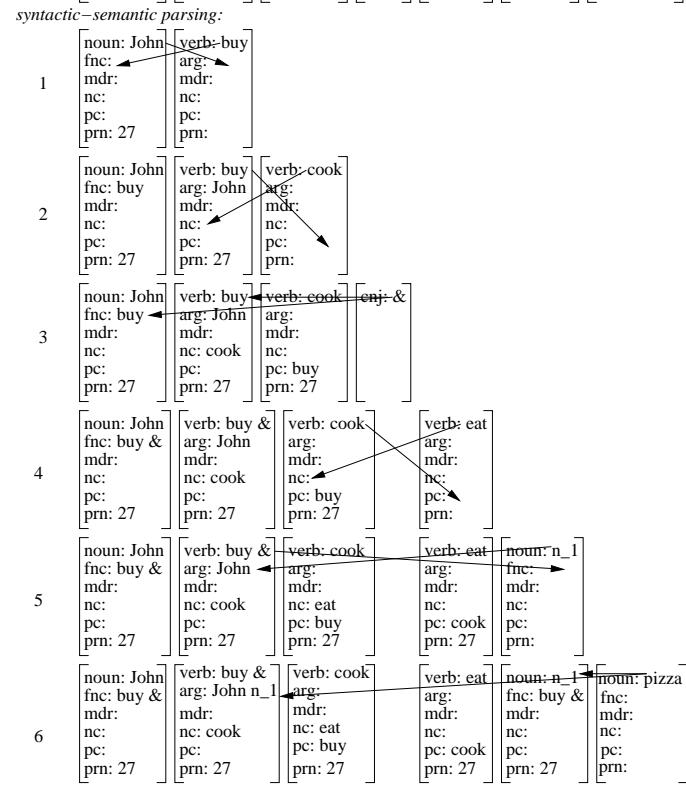
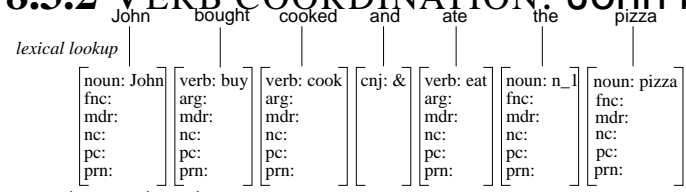
	<i>activated sequence</i>	<i>realization</i>
i.	V	
i.1	n	n
	V N	
i.2	fv n	n fv
	V N	
i.3	fv n d	n fv d
	V N N	
i.4	fv n d nn	n fv d nn
	V N N	
i.5	fv n d nn d	n fv d nn d
	V N N	
i.6	fv n d nn d nn	n fv d nn d nn
	V N N N	
i.7	fv n d nn cc d nn	n fv d nn d nn cc
	V N N N	
i.8	fv n d nn cc d nn d	n fv d nn d nn cc d
	V N N N N	
i.9	fv n d nn cc d nn d nn	n fv d nn d nn cc d nn
	V N N N N	
i.10	fv p n d nn cc d nn d nn	n fv d nn d nn cc d nn p
	V N N N N	

## 8.3 Simple Coordination of Verbs and of Adjectives

### 8.3.1 Coordination of two-place verbs



### 8.3.2 VERB COORDINATION: John bought, cooked, and ate the pizza



### 8.3.3 PRODUCTION OF John bought, cooked, and ate the pizza.

	<i>activated sequence</i>						<i>realization</i>
i							
	V						
i.1		n					n
	V	N					
i.2	fv	n					n fv
	V	N					
i.3	fv	n	fv				n fv fv
	V	N	V				
i.4	fv cc	n	fv				n fv fv cc
	V	N	V				
i.5	fv cc	n	fv	fv			n fv fv cc fv
	V	N	V	V			
i.6	fv cc	n	fv	fv	d		n fv fv cc fv d
	V	N	V	V	N		
i.7	fv cc	n	fv	fv	d nn		n fv fv cc fv d nn
	V	N	V	V	N		
i.8	fv cc p	n	fv	fv	d nn		n fv fv cc fv d nn p
	V	N	V	V	N		

### 8.3.4 Adnominal coordination: John loves a smart, pretty, and rich girl

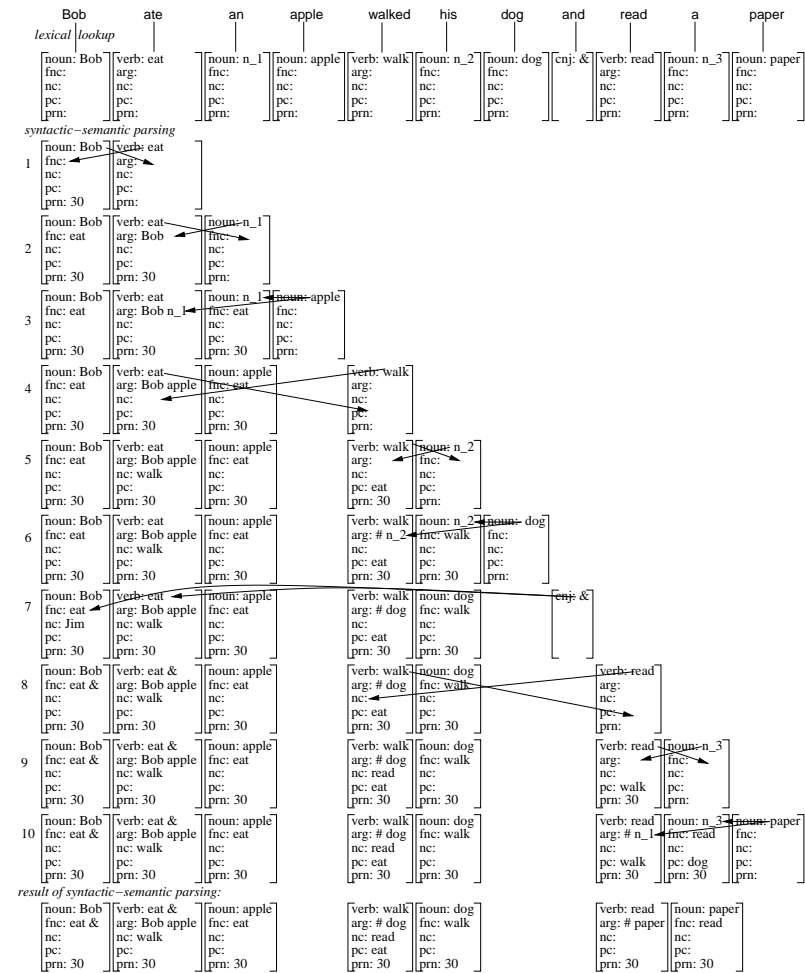
[noun: John] fnc: love mdr: nc: pc: prn: 21	[verb: love arg: John girl mdr:: nc: pc: prn: 21	[noun: girl fnc: love mdr: smart & nc: pc: prn: 21	[adj: smart & mdr: B mdd: girl nc: pretty pc: prn: 21	[adj: pretty mdr: B mdd: nc: rich pc: smart prn: 21	[adj: rich mdr: B mdd: nc: pc: pretty prn: 21
--	---	---	--	--	--

### 8.3.5 Adverbial coordination: John talked slowly, gently, and seriously

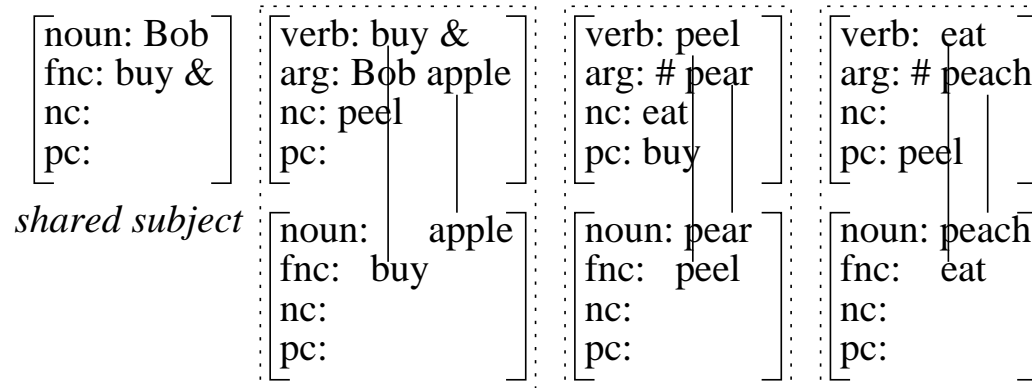
[noun: John] fnc: talk mdr: nc: pc: prn: 29	[verb: talk arg: John mdr: slow & nc: pc: prn: 29	[adj: slow & mdr: B mdd: talk nc: gentle pc: prn: 29	[adj: gentle mdr: B mdd: nc: serious pc: slow prn: 29	[adj: serious mdr: B mdd: nc: pc: gentle prn: 29
--	--	---	--	---

# 8.4 Complex Coordination of Verbs and Objects: Subject Gapping

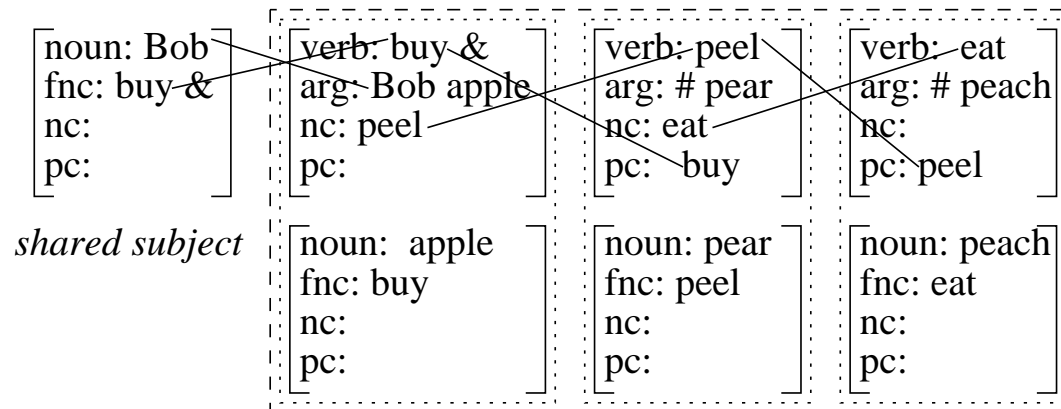
## 8.4.1 Bob ate an apple, # walked his dog, and # read a paper



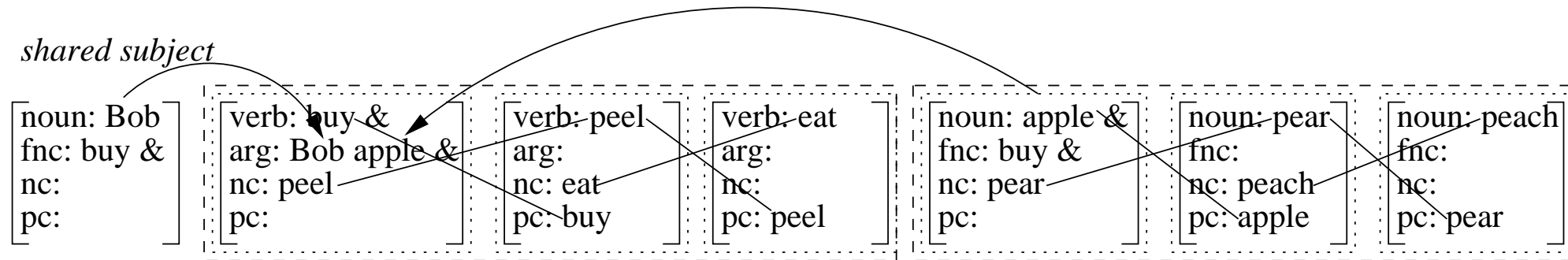
### 8.4.2 Intra-conjunct relations of complex verb-object coordinat.



### 8.4.3 Extra-conjunct relations of complex verb-object coordinat.



### 8.4.4 Corresponding simple verb and object coordinations

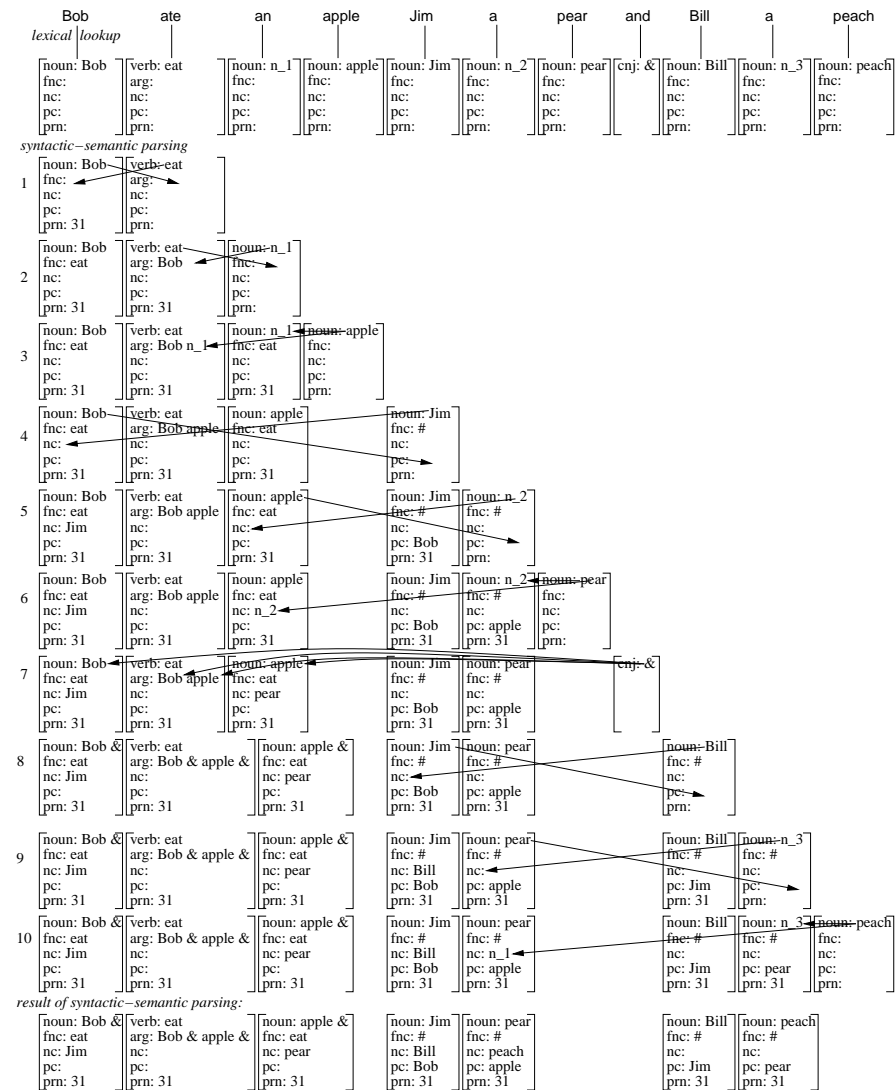


### 8.4.5 PRODUCTION OF Bob ate an apple, walked his dog, and read a paper.

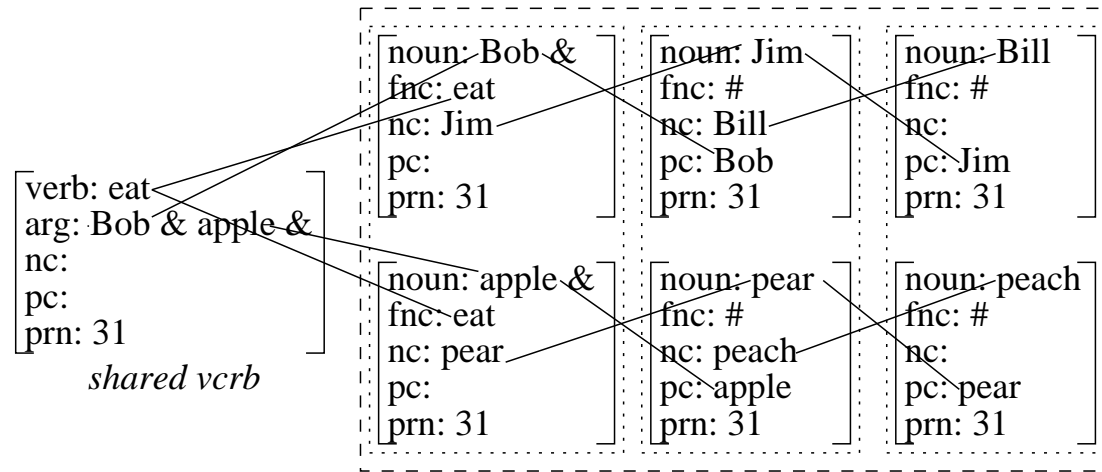
	<i>activated sequence</i>	<i>realization</i>
i		
	V	
i.1	n	n
	V N	
i.2	fv n	n fv
	V N	
i.3	fv n d	n fv d
	V N N	
i.4	fv n d nn	n fv d nn
	V N N	
i.5	fv n d nn fv	n fv d nn fv
	V N N V	
i.6	fv n d nn fv d	n fv d nn fv d
	V N N V N	
i.7	fv n d nn fv d nn	n fv d nn fv d nn
	V N N V N	
i.8	fv cc n d nn fv d nn	n fv d nn fv d nn cc
	V N N V N	
i.9	fv cc n d nn fv d nn fv	n fv d nn fv d nn cc fv
	V N N V N V	
i.10	fv cc n d nn fv d nn fv d	n fv d nn fv d nn cc fv d
	V N N V N V N	
i.11	fv cc n d nn fv d nn fv d nn	n fv d nn fv d nn cc fv d nn
	V N N V N V N	
i.12	fv cc p n d nn fv d nn fv d nn	n fv d nn fv d nn cc fv d nn p
	V N N V N V N	

# 8.5 Complex Coordination of Subjects and Objects: Verb Gapping

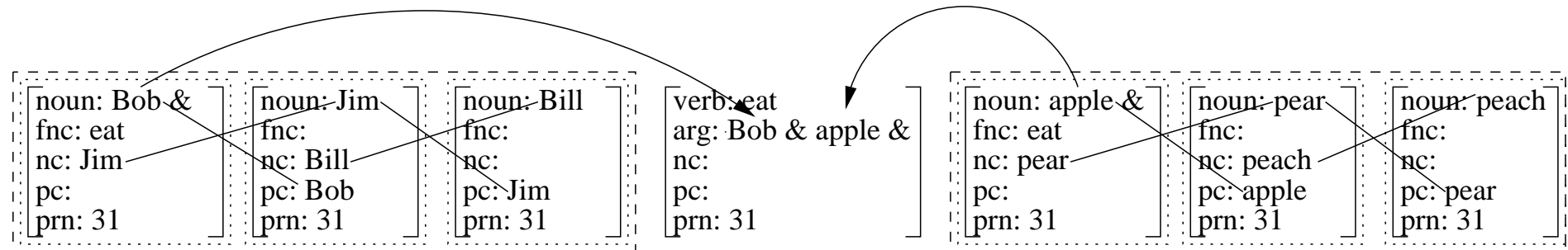
## 8.5.1 Verb gapping: Bob ate an apple, Jim # a pear, and Bill # a peach



### 8.5.2 Grammatical relations in complex subject-object coordinat.



### 8.5.3 Grammatical relations in simple subject and object coordinat.

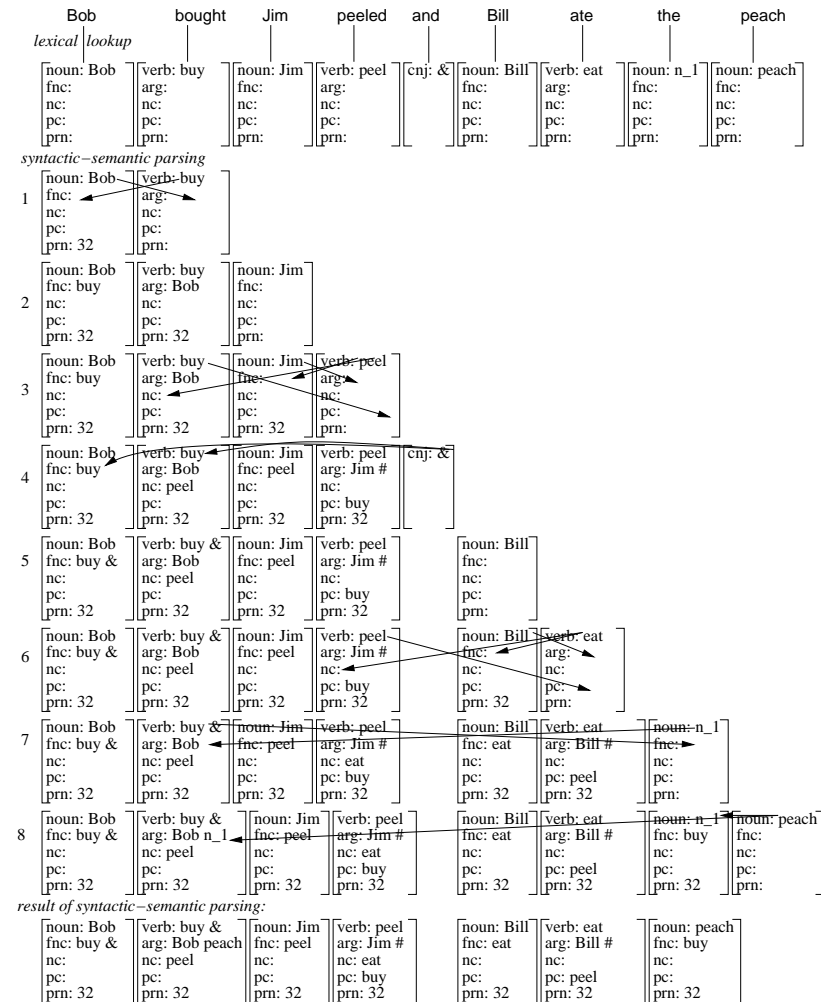


### 8.5.4 PRODUCTION OF Bob ate an apple, Jim a pear, and Bill a peach.

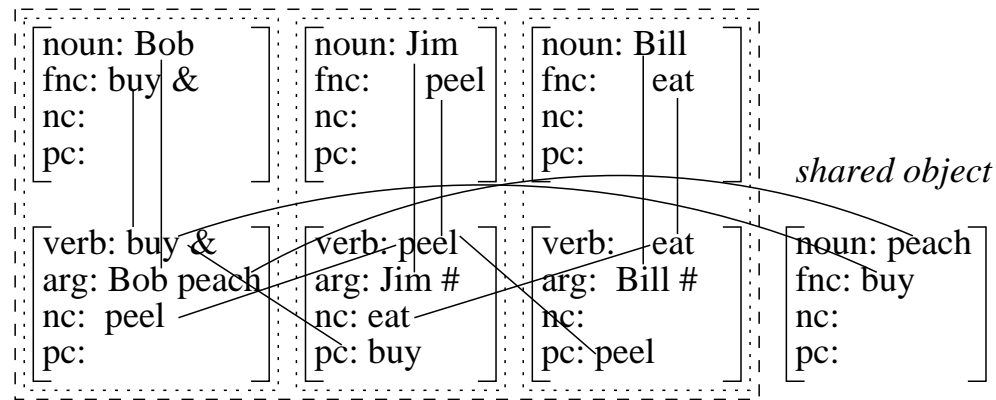
	<i>activated sequence</i>							<i>realization</i>
i	V							
i.1		n						n
	V	N						
i.2	fv	n						n fv
	V	N						
i.3	fv	n	d					n fv d
	V	N	N					
i.4	fv	n	d nn					n fv d nn
	V	N	N					
i.5	fv	n	d nn	n				n fv d nn n
	V	N	N	N				
i.6	fv	n	d nn	n	d			n fv d nn n d
	V	N	N	N	N			
i.7	fv	n	d nn	n	d nn			n fv d nn n d nn
	V	N	N	N	N			
i.8	fv cc	n	d nn	n	d nn			n fv d nn n d nn cc
	V	N	N	N	N			
i.9	fv cc	n	d nn	n	d nn	n		n fv d nn fv d nn cc n
	V	N	N	N	N	N		
i.10	fv cc	n	d nn	n	d nn	n	d	n fv d nn n d nn cc n d
	V	N	N	N	N	N	N	
i.11	fv cc	n	d nn	n	d nn	n	d nn	n fv d nn n d nn cc n d nn
	V	N	N	N	N	N	N	
i.12	fv cc p	n	d nn	n	d nn	n	d nn	n fv d nn n d nn cc n d nn p
	V	N	N	N	N	N	N	

# 8.6 Complex Coordination of Subjects and Verbs: Object Gapping

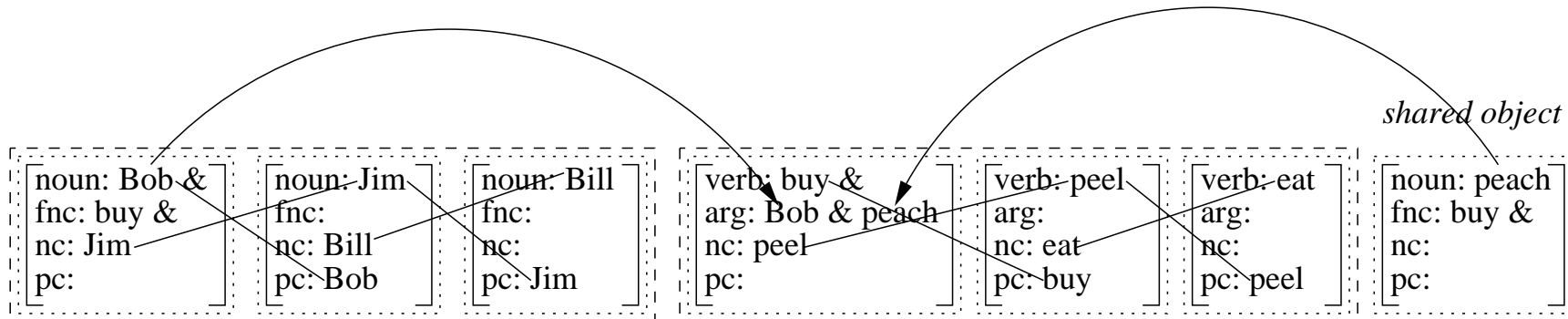
## 8.6.1 Object gapping: Bob bought #, Jim peeled #, and Bill ate the peach



### 8.6.2 Grammatical relations in complex subject-verb coordination



### 8.6.3 Relations in simple subject and verb coordinations



## 8.6.4 PRODUCTION OF Bob bought, Jim peeled, and Bill ate the peach.

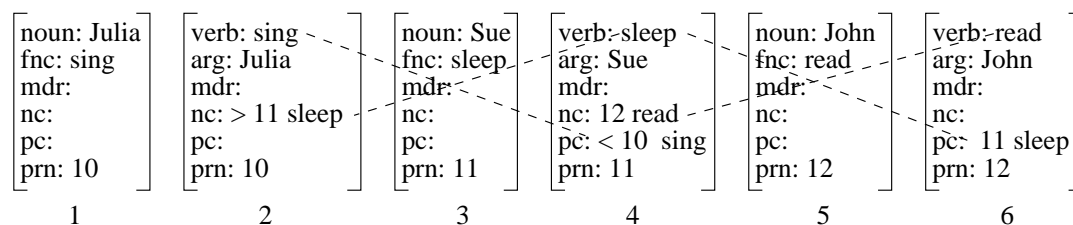
	<i>activated sequence</i>								<i>realization</i>
i									
	V								
i.1		n							n
	V	N							
i.2	fv	n							n fv
	V	N							
i.3	fv	n		n					n fv n
	V	N	V	N					
i.4	fv	n	fv	n					n fv n fv
	V	N	V	N					
i.5	fv cc	n	fv	n					n fv n fv cc
	V	N	V	N					
i.6	fv cc	n	fv	n		n			n fv n fv cc n
	V	N	V	N	V	N			
i.7	fv cc	n	fv	n	fv	n			n fv n fv cc n fv
	V	N	V	N	V	N			
i.8	fv cc	n	fv	n	fv	n	d		n fv n fv cc n fv d
	V	N	V	N	V	N	N		
i.9	fv cc	n	fv	n	fv	n	d		n fv n fv cc n fv d nn
	V	N	V	N	V	N	N		
i.10	fv cc p	n	fv	n	fv	n	d nn		n fv n fv cc n fv d nn p
	V	N	V	N	V	N	N		

## 9. Extra-Propositional Coordination

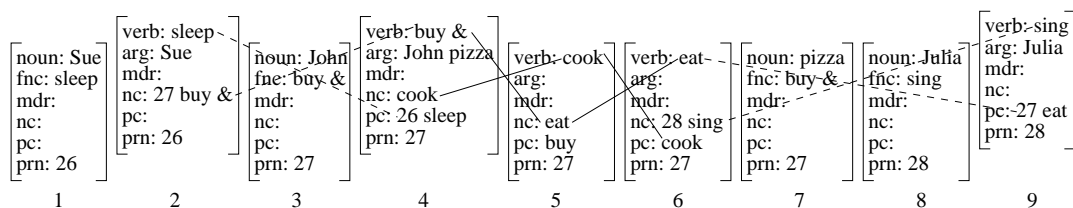
### 9.1 Overview

In Database Semantics, the coordination of propositions is coded in their verb proplets' nc and pc attributes. Consider the following set of proplets representing Julia sang. Then Sue slept. John read.:

#### 9.1.1 Grammatical relations between concatenated propositions



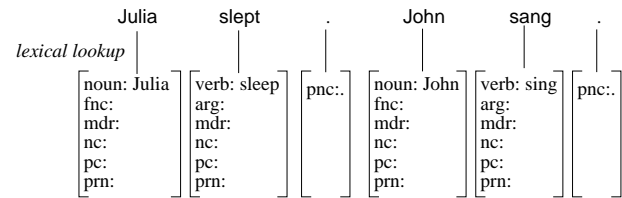
#### 9.1.2 COMBINING INTRA- AND EXTRA-PROPOSITIONAL COORDINATIONS



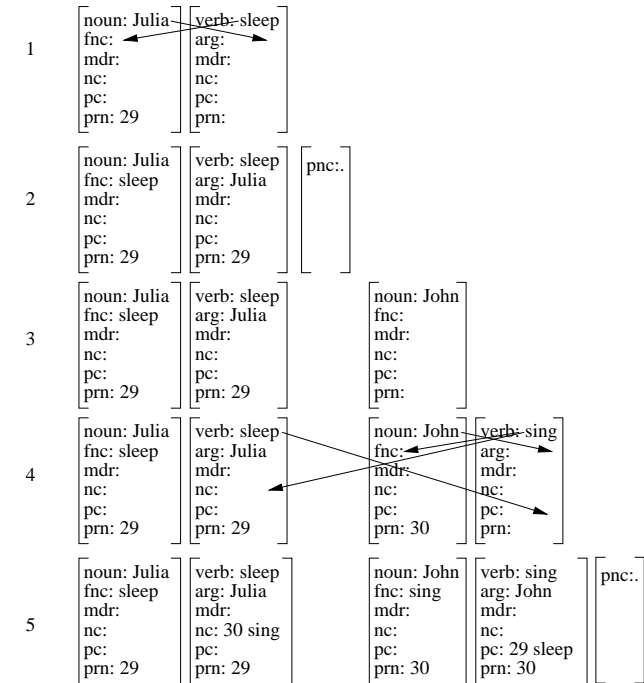
The relations of extra-propositional coordination are indicated by dashed lines, while those of the intra-propositional coordination are indicated by solid lines.

# 9.2 Interpretation and Production of Extra-Propositional Coordination

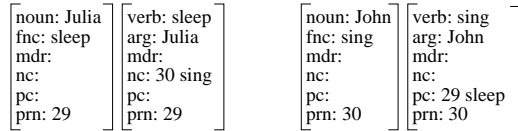
## 9.2.1 DERIVATION OF Julia slept. John sang.



syntactic-semantic parsing:



result of syntactic-semantic parsing:



### 9.2.2 PRODUCTION OF *Julia slept. John sang.*

	<i>activated sequence</i>	<i>realization</i>
1	V	
1.1	n	n
	V N	
1.2	fv n	n fv
	V N	
1.3	fv p n	n fv p
	V N	
2.1	fv p n n	n fv p n
	V N V N	
2.2	fv p n fv n	n fv p n fv
	V N V N	
2.3	fv p n fv p n	n fv p n fv p
	V N V N	

After the initial LA-think navigation from V to N, LA-speak produces the abstract *n fv p* surface in lines 1.1 – 1.3. Thereby the sentence-final punctuation mark is lexicalized using the sentence mood specified in the verb proplet. Then LA-think traverses the second VN proplet sequence, from which LA-speak produces the second abstract *n fv p* surface in lines 2.1 – 2.3. The suspension shows up in line 2.1 in a way similar to example 7.6.2. See Chapters 11. and 12. for the explicitly defined LA-hear, LA-think, and LA-speak grammars handling extra-propositional coordination.

## 9.3 Simple Coordinations as Sentential Arguments and Modifiers

### 9.3.1 Simple coordinations in sentential arguments 1

1. Noun coordination as the subject of a subject sentence:

That the man, the woman, and the child slept surprised Mary.

$\left[ \begin{array}{l} \text{n/v: that sleep} \\ \text{arg: man \&} \\ \text{fnc: 9 surprise} \\ \text{prn: 8} \end{array} \right]$	$\left[ \begin{array}{l} \text{noun: man \&} \\ \text{fnc: sleep} \\ \text{nc: woman} \\ \text{pc:} \\ \text{prn: 8} \end{array} \right]$	$\left[ \begin{array}{l} \text{noun: woman} \\ \text{fnc:} \\ \text{nc: child} \\ \text{pc: man} \\ \text{prn: 8} \end{array} \right]$	$\left[ \begin{array}{l} \text{noun: child} \\ \text{fnc:} \\ \text{nc:} \\ \text{pc: woman} \\ \text{prn: 8} \end{array} \right]$
$\left[ \begin{array}{l} \text{verb: surprise} \\ \text{arg: 8 sleep Mary} \\ \text{prn: 9} \end{array} \right]$	$\left[ \begin{array}{l} \text{noun: Mary} \\ \text{fnc: surprise} \\ \text{prn: 9} \end{array} \right]$		

## 2. Verb coordination in a subject sentence:

That the man bought, cooked, and ate the pizza surprised Mary.

[noun: man fnc: buy & prn: 10]	[n/v: that buy & arg: man pizza fnc: 11 surprise nc: cook pc: prn: 10]	[verb: cook arg: nc: eat pc: buy prn: 10]	[verb: eat arg: nc: pc: cook prn: 10]	[noun: pizza fnc: buy & prn: 10]
[verb: surprise arg: 10 buy & Mary prn: 11]	[noun: Mary fnc: surprise prn: 11]			

## 3. Noun coordination as the object of a subject sentence:

That Bob ate an apple, a pear, and a peach, surprised Mary.

[noun: Bob fnc: eat prn: 12]	[n/v: that eat arg: Bob apple & fnc: 13 surprise prn: 12]	[noun: apple & fnc: eat nc: pear pc: prn: 12]	[noun: pear fnc: nc: peach pc: apple prn: 12]	[noun: peach fnc: nc: pc: pear prn: 12]
[verb: surprise arg: 12 eat Mary prn: 13]	[noun: Mary fnc: surprise prn: 13]			

### 9.3.2 Simple coordinations in sentential arguments 2

The crucial difference between the following three examples and those in 9.3.1 above is that the sentential and non-sentential **arg** values of the higher verb proplets (*surprise*, *see*) are in inverse order: in 9.3.1(1) they are [arg: 8 sleep Mary] (subject sentence), while in 9.3.2(1) they are [arg: Mary 15 sleep] (object sentence); in 9.3.1(2) they are [arg: 10 buy & Mary] (subject sentence), while in 9.3.2(2) they are [arg: Mary 17 buy &] (object sentence); and in 9.3.1(3) they are [arg: 12 buy Mary] (subject sentence), while in 9.3.2(3) they are [arg: Mary 19 buy] (object sentence).

1. Noun coordination as the subject of an object sentence:

Mary saw that the man, the woman and the child slept.

[noun: Mary fnc: see prn: 14]	[verb: see arg: Mary 15 sleep prn: 14]			
[n/v: that sleep arg: man & fnc: 14 see prn: 15]	[noun: man & fnc: sleep nc: woman pc: prn: 15]	[noun: woman fnc: nc: child pc: man prn: 15]	[noun: child fnc: nc: pc: woman prn: 15]	

## 2. Verb coordination in an object sentence:

Mary saw that the man bought, cooked, and ate the pizza.

[noun: Mary fnc: see prn: 16]	[verb: see arg: Mary 17 buy & prn: 16]				
[noun: man fnc: buy & prn: 17]	[n/v: that buy & arg: man pizza fnc: 16 see nc: cook pc: prn: 17]	[verb: cook arg: nc: eat pc: buy prn: 17]	[verb: eat arg: nc: pc: cook prn: 17]	[noun: pizza fnc: buy & prn: 17]	

## 3. Noun coordination as the object of an object sentence::

Mary saw that Bob bought an apple, a pear, and a peach.

[noun: Mary fnc: see prn: 18]	[verb: see arg: Mary 19 buy prn: 18]				
[noun: Bob fnc: buy prn: 19]	[n/v: that buy arg: Bob apple & fnc: 18 see prn: 19]	[noun: apple & fnc: buy nc: pear pc: prn: 19]	[noun: pear fnc: nc: peach pc: apple prn: 19]	[noun: peach fnc: nc: pc: pear prn: 19]	

### 9.3.3 Simple coordinations in sentential modifiers 1

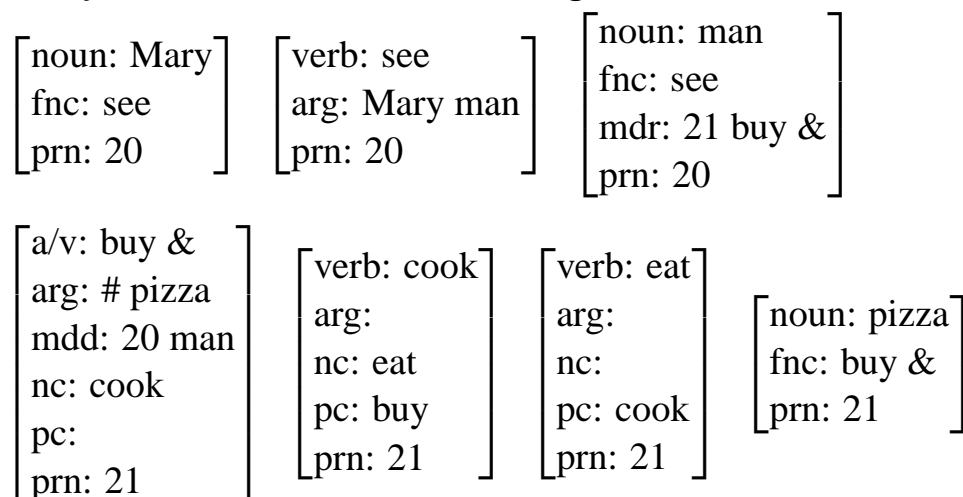
1. Noun coordination as the subject of an adnominal sentence with a subject gap:

*structurally excluded!*

A relative clause with a subject gap cannot have a subject coordination because the gap (represented in English by a relative pronoun) cannot be part of a noun coordination.

2. Verb coordination in an adnominal sentence with a subject gap:

Mary saw the man who bought, cooked, and ate the pizza.



## 3. Noun coordination as the object of an adnominal clause with a subject gap:

Mary saw the man who bought an apple, a pear, and a peach.

[ noun: Mary fnc: see prn: 22 ]	[ verb: see arg: Mary man prn: 22 ]	[ noun: man fnc: see mdr: 23 buy prn: 22 ]			
[ a/v: buy arg: # apple & mdd: 22 man prn: 23 ]	[ noun: apple & fnc: buy nc: pear pc: prn: 23 ]	[ noun: pear fnc: nc: peach pc: apple prn: 23 ]	[ noun: peach fnc: nc: pc: pear prn: 23 ]		

### 9.3.4 Simple coordinations in sentential modifiers 2

1. Noun coordination as the subject of an adnominal clause with an object gap:

Mary saw the pizza which Bob, Jim, and Bill ate.

[noun: Mary fnc: see prn: 24]	[verb: see arg: Mary pizza prn: 24]	[noun: pizza fnc: see mdr: 25 eat prn: 24]		
[a/v: eat arg: Bob & # mdd: 24 pizza prn: 25]	[noun: Bob & fnc: eat nc: Jim pc: prn: 25]	[noun: Jim fnc: nc: Bill pc: Bob prn: 25]	[noun: Bill fnc: nc: pc: Jim prn: 25]	

## 2. Verb coordination in an adnominal clause with an object gap:

Mary saw the pizza which the man bought, cooked, and ate.

[ noun: Mary fnc: see prn: 26 ]	[ verb: see arg: Mary pizza prn: 26 ]	[ noun: pizza fnc: see mdr: 27 buy & prn: 26 ]		
[ noun: man fnc: buy & prn: 27 ]	[ a/v: buy & arg: man # mdd: 26 pizza nc: cook pc: prn: 27 ]	[ verb: cook arg: nc: eat pc: buy prn: 27 ]	[ verb: eat arg: nc: pc: cook prn: 27 ]	

## 3. Noun coordination as the object of the adnominal clause with an object gap:

*structurally excluded!*

A relative clause with an object gap cannot have an object coordination because the gap (represented in English by a relative pronoun) cannot participate in a coordination.

### 9.3.5 Simple coordinations in sentential modifiers 3

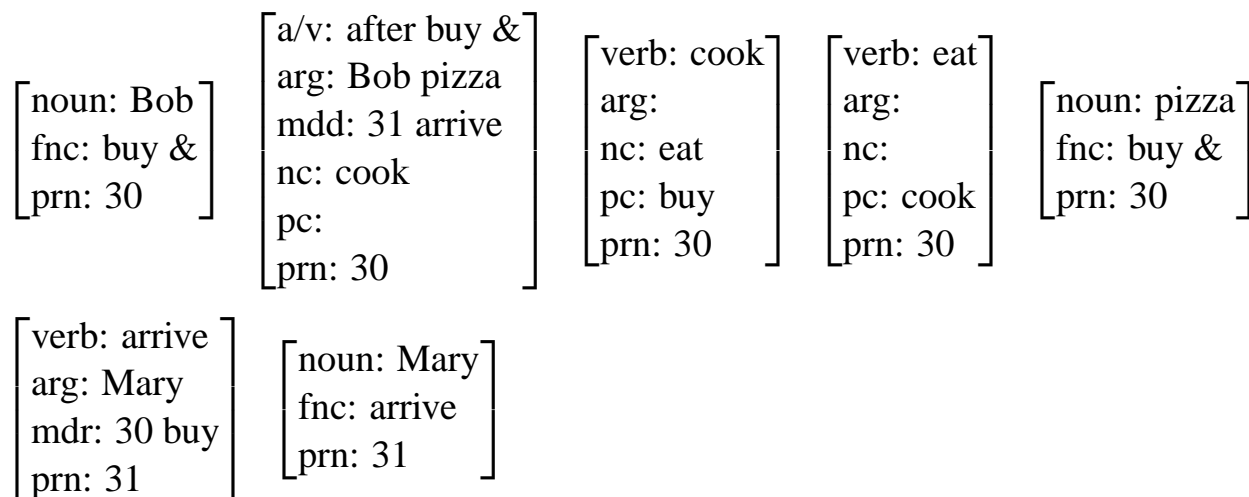
1. Noun coordination as the subject of an adverbial sentence:

Mary arrived after Bob, Jim, and Bill had eaten a pizza.

[noun: Mary fnc: arrive prn: 28]	[verb: arrive arg: Mary mdr: 29 eat prn: 28]	[a/v: after eat arg: Bob & pizza mdd: 28 arrive prn: 29]	
[noun: Bob & fnc: eat nc: Jim pc: prn: 29]	[noun: Jim fnc: nc: Bill pc: Bob prn: 29]	[noun: Bill fnc: nc: pc: Jim prn: 29]	[noun: pizza fnc: eat prn: 29]

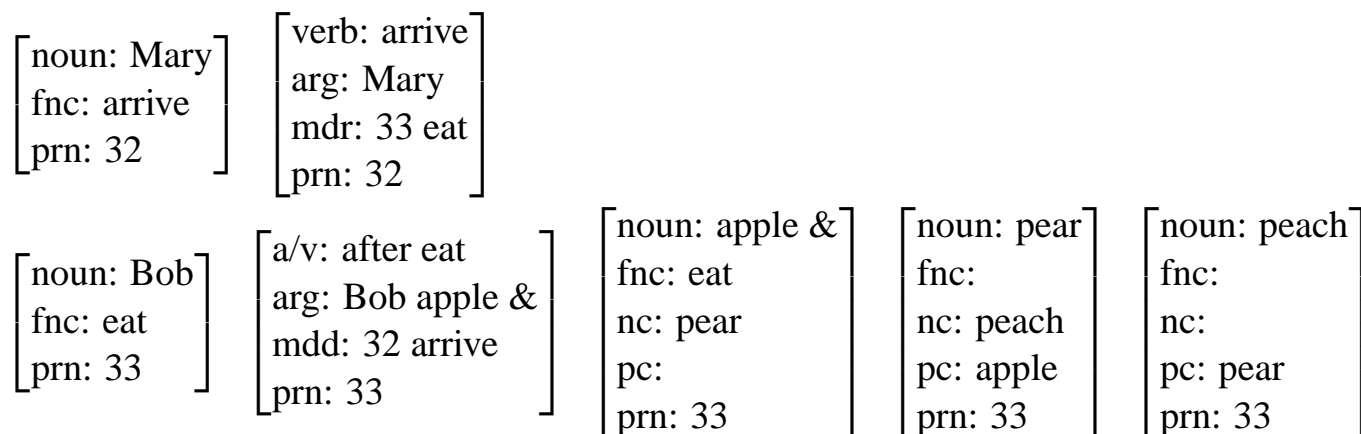
## 2. Verb coordination in an adverbial sentence:

After Bob had bought, cooked, and eaten the pizza, Mary arrived.



## 3. Noun coordination as the object of an adverbial sentence:

Mary arrived after Bob had eaten an apple, a pear, and a peach.



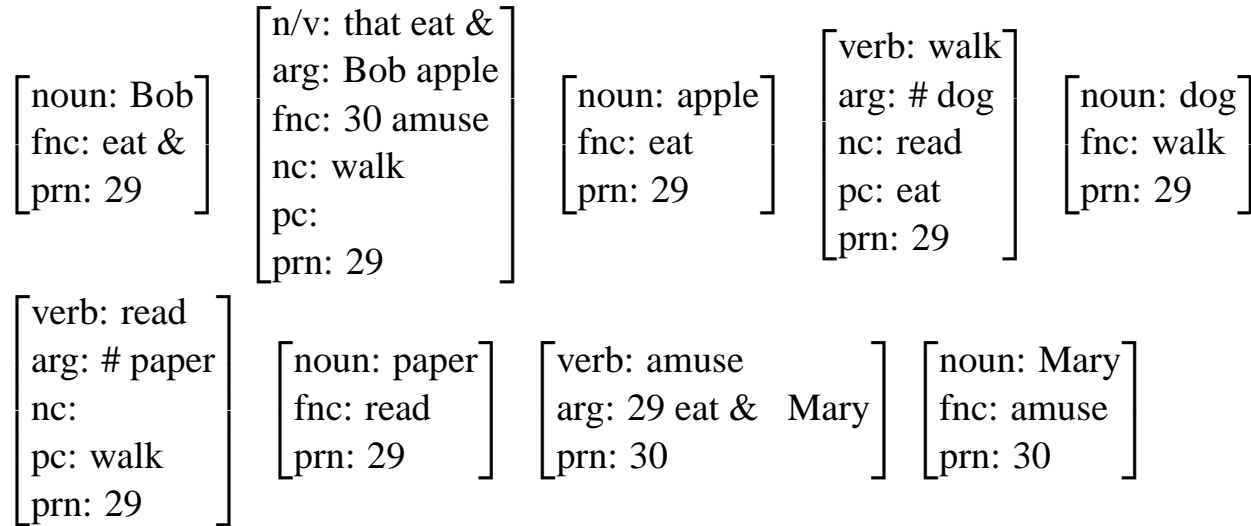
## 9.4 Complex Coordinations as Sentential Arguments and Modifiers

Corresponding to the grammatical analysis of simple subject, verb, and object coordinations in extra-propositional functor-argument structures, we turn now to complex verb-object, subject-object, and subject-verb coordinations (i.e. subject, verb, and object gapping, respectively). As before, their grammatical function is investigated in a (i) subject sentence, (ii) an object sentence, (iii) an adnominal sentence with subject gap, (iv) an adnominal sentence with object gap, and (v) an adverbial sentence.

### 9.4.1 Complex coordinations in sentential arguments 1

1. Verb-object coordination in a subject sentence:

That Bob ate an apple, walked his dog, and read a paper, amused Mary.



## 2. Subject-object coordination in a subject sentence:

That Bob ate an apple, Jim a pear, and Bill a peach, amused Mary.

[n/v: that eat arg: Bob & apple & fnc: 32 amuse prn: 31]	[noun: Bob & fnc: eat nc: Jim pc: prn: 31]	[noun: apple & fnc: eat nc: pear pc: prn: 31]	[noun: Jim fnc: # nc: Bill pc: Bob prn: 31]	[noun: pear fnc: # nc: peach pc: apple prn: 31]
[noun: Bill fnc: # nc: pc: Jim prn: 31]	[noun: peach fnc: # nc: pc: pear prn: 31]	[verb: amuse arg: 31 eat Mary prn: 32]	[noun: Mary fnc: amuse prn: 32]	

## 3. Subject-verb coordination in a subject sentence:

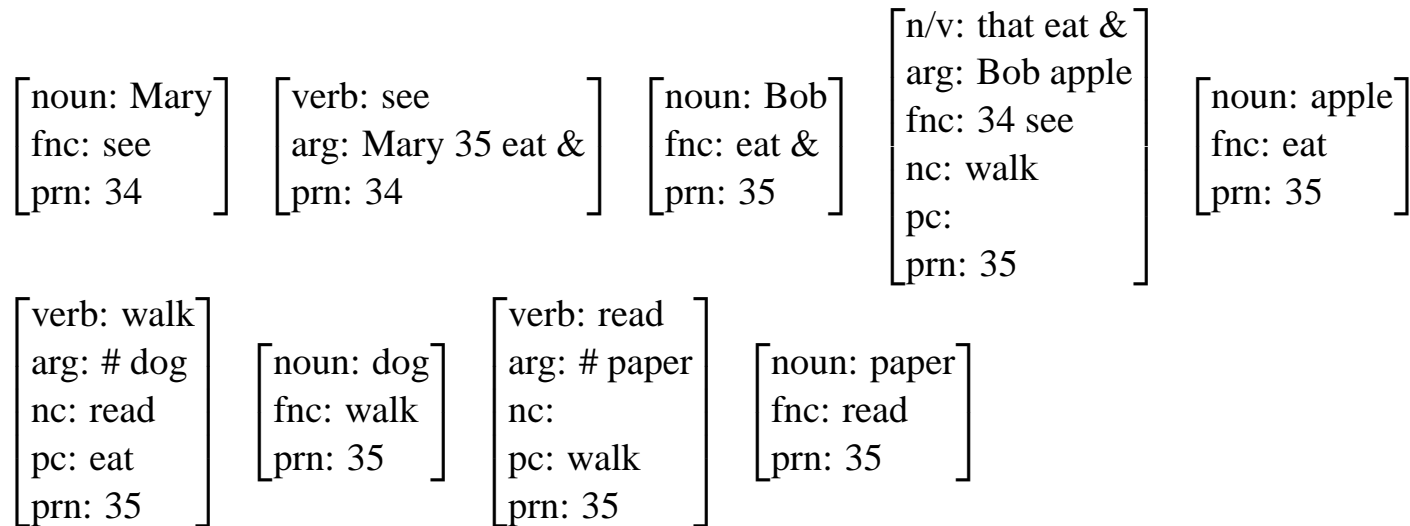
That Bob bought, Jim peeled, and Bill ate the peach, amused Mary.

[noun: Bob fnc: buy & prn: 33]	[n/v: that buy & arg: Bob peach fnc: 34 amuse nc: peel pc: prn: 33]	[noun: Jim fnc: peel prn: 33]	[verb: peel arg: Jim # nc: eat pc: buy prn: 33]	[noun: Bill fnc: eat prn: 33]	[verb: eat arg: Bill # nc: pc: peel prn: 33]
[noun: peach fnc: buy prn: 33]	[verb: amuse arg: 33 buy & Mary prn: 34]	[noun: Mary fnc: amuse prn: 34]			

## 9.4.2 Complex coordinations in sentential arguments 2

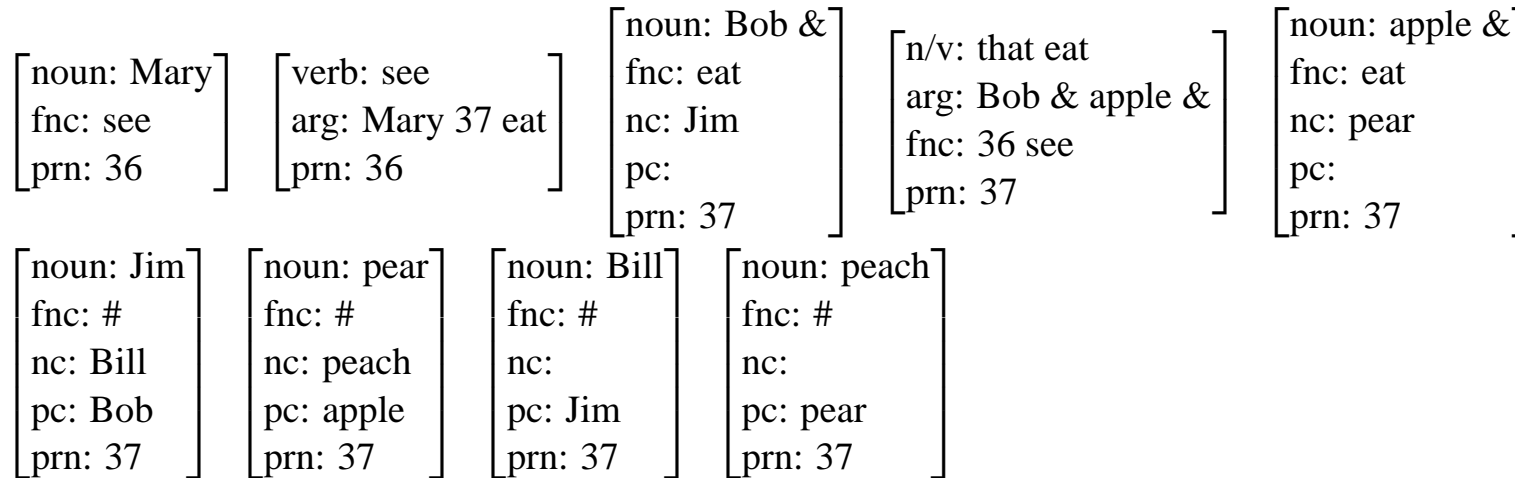
### 1. Verb-object coordination in an object sentence:

Mary saw that Bob ate an apple, walked his dog, and read a paper.



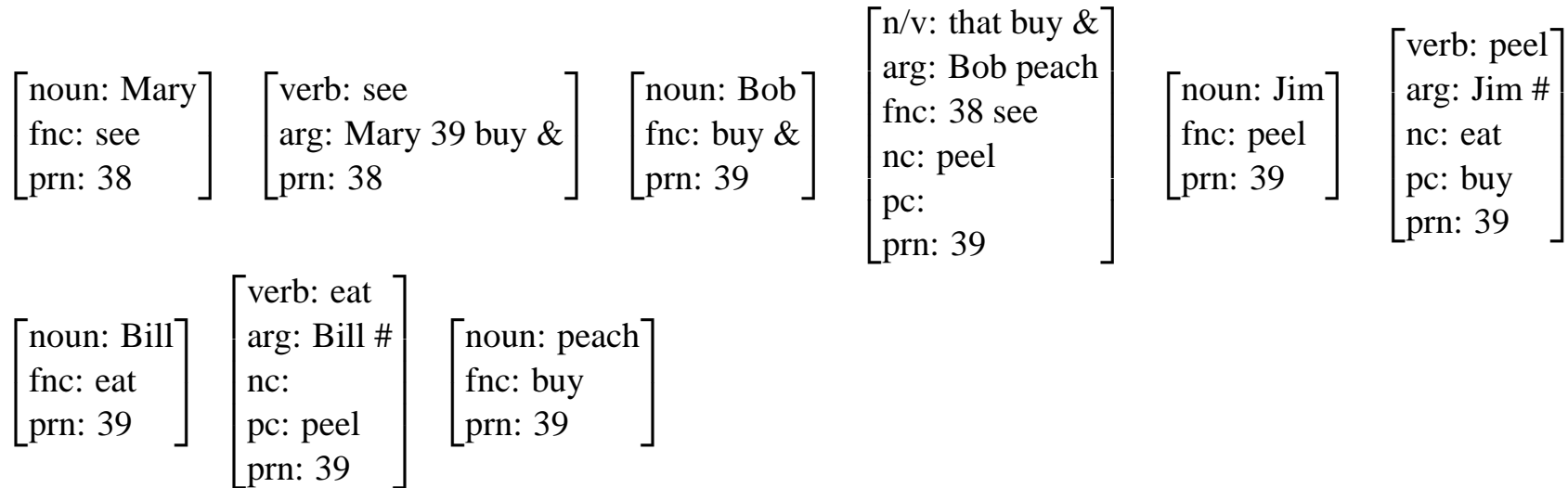
## 2. Subject-object coordination (verb gapping, cf. 8.5) in an object sentence:

Mary saw that Bob ate an apple, Jim a pear, and Bill a peach.



## 3. Subject-verb coordination (object gapping, cf. 8.6) in an object sentence:

Mary saw that Bob bought, Jim peeled, and Bill ate the peach .

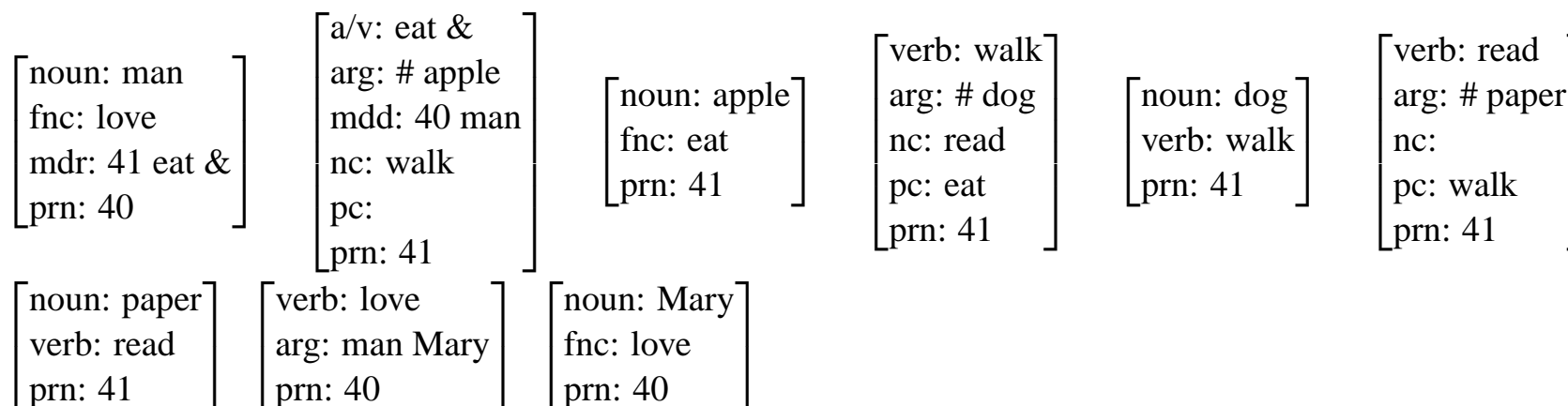


### 9.4.3 Complex coordination in sentential modifiers 1

The following relative clause example(s) containing complex coordinations are analogous to those in 9.3.3, which contain simple coordinations. However, in relative clauses with complex coordinations two constructions are structurally excluded, in contrast to simple coordinations, which exclude only one.

1. Verb-object coordination (subject gapping) in an adnom. sent. with subject gap:

The man who ate an apple, walked his dog, and read a paper loves Mary.



2. Subject-object coordination (verb gapping) in an adnom. sent. with subject gap: *structurally excluded!*

A subject-object coordination as the subject of a relative clause with the head serving as the subject is excluded, because the subject position is taken by the gap (represented in English by a relative pronoun) – which cannot participate in a coordination.

3. Subject-verb coordination (object gapping) in a adnominal sent. with subject gap: *structurally excluded!*

This construction is excluded for the same reason as the one above.

## 9.4.4 Complex coordination in sentential modifiers 2

The following relative clause example(s) containing complex coordinations are analogous to those in 9.3.4, which contain simple coordinations. However, as in the subject-gap relative clauses 9.4.3 with complex coordinations, two constructions are excluded, in contrast to simple coordinations, which exclude only one.

1. Verb-object coordination (subject gapping) in an adnominal sent. with object gap:

*structurally excluded!*

A verb-object coordination as the object of a relative clause with the head serving as the object is excluded, because the object position is taken by the gap (represented in English by a relative pronoun) – which cannot participate in a coordination.

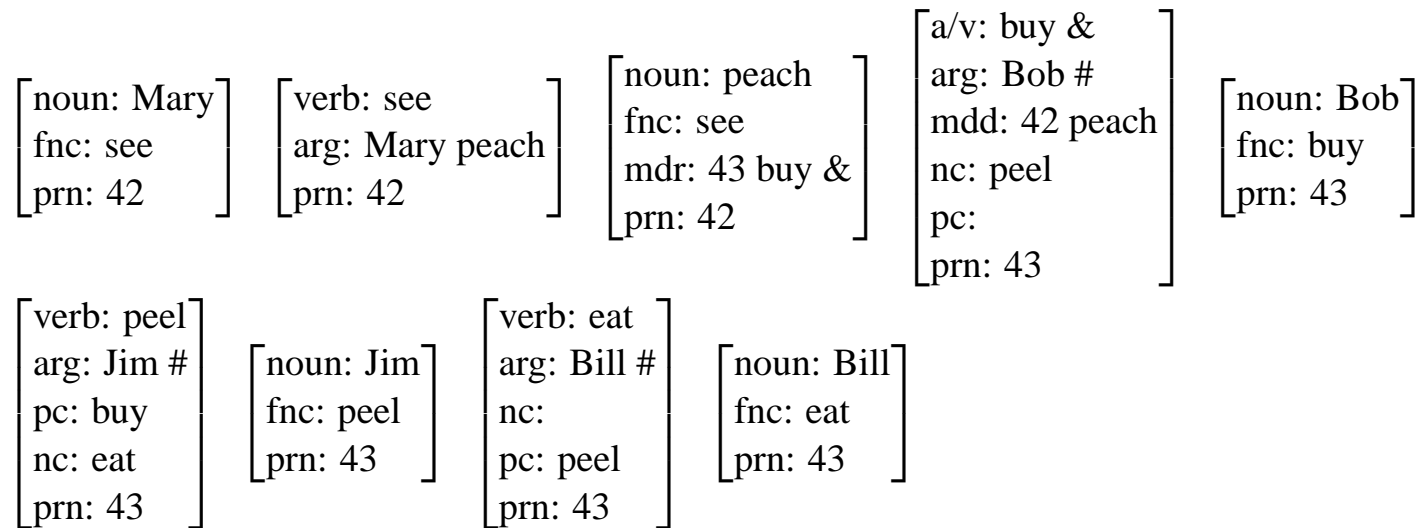
2. Subject-object coordination (verb gapping) in an adnominal sentence with object gap:

*structurally excluded!*

This construction is excluded for the same reason as the one above.

## 3. Subject-verb coordination (object gapping) in an adnominal sent. with object gap:

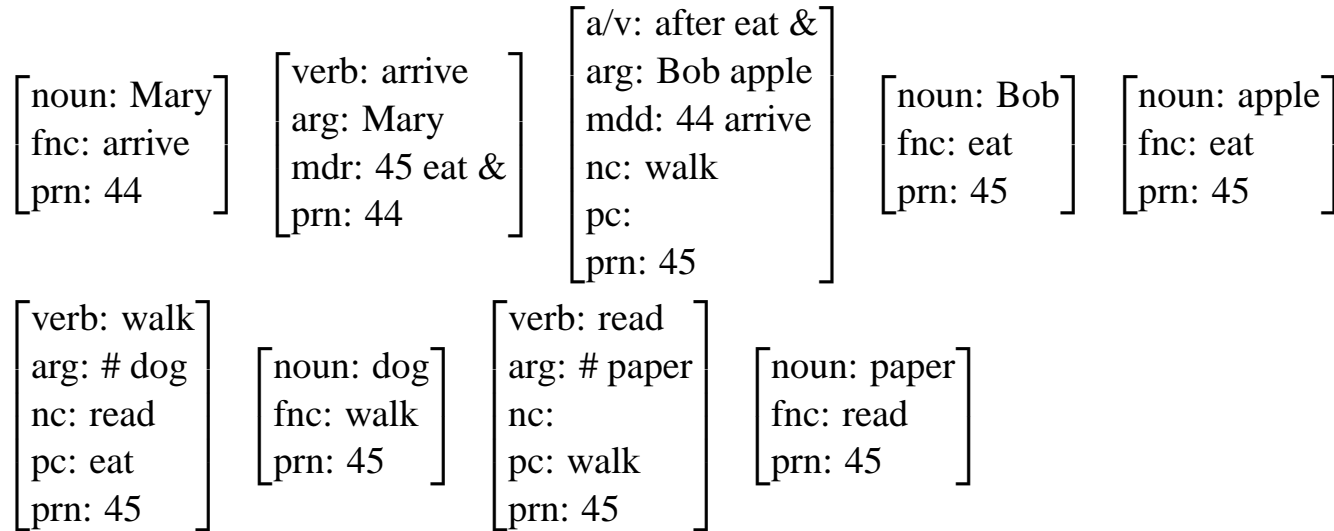
Mary saw the peach which Bob bought, Jim peeled, and Bill ate.



### 9.4.5 Complex coordinations in sentential modifiers 3

1. Verb-object coordination (subject gapping, cf. 8.4) in an adverbial sentence:

Mary arrived after Bob had eaten an apple, walked his dog, and read a paper.



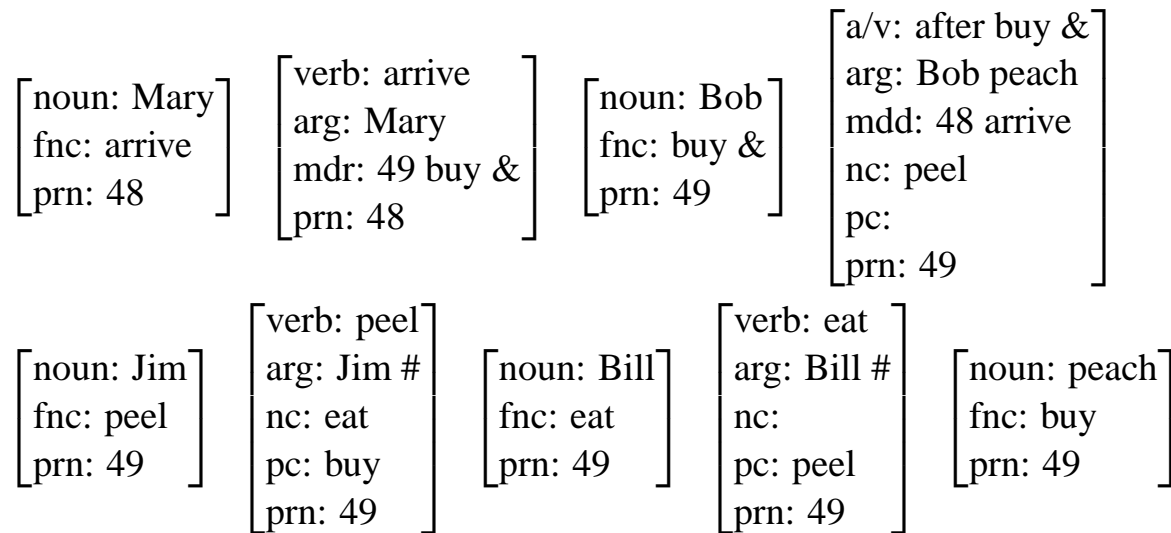
## 2. Subject-object coordination (verb gapping, cf. 8.5) in an adverbial sentence:

After Bob had eaten an apple, Jim a pear, and Bill a peach, Mary arrived.

$\left[ \begin{array}{l} \text{a/v: after eat} \\ \text{arg: Bob \& apple \&} \\ \text{mdd: 47 arrive} \\ \text{prn: 46} \end{array} \right]$	$\left[ \begin{array}{l} \text{noun: Bob \&} \\ \text{fnc: eat} \\ \text{nc: Jim} \\ \text{pc:} \\ \text{prn: 46} \end{array} \right]$	$\left[ \begin{array}{l} \text{noun: apple \&} \\ \text{fnc: eat} \\ \text{nc: pear} \\ \text{pc:} \\ \text{prn: 46} \end{array} \right]$	$\left[ \begin{array}{l} \text{noun: Jim} \\ \text{fnc: \#} \\ \text{nc: Bill} \\ \text{pc: Bob} \\ \text{prn: 46} \end{array} \right]$	$\left[ \begin{array}{l} \text{noun: pear} \\ \text{fnc: \#} \\ \text{nc: peach} \\ \text{pc: apple} \\ \text{prn: 46} \end{array} \right]$
$\left[ \begin{array}{l} \text{noun: Bill} \\ \text{fnc: \#} \\ \text{nc:} \\ \text{pc: Jim} \\ \text{prn: 46} \end{array} \right]$	$\left[ \begin{array}{l} \text{noun: peach} \\ \text{fnc: \#} \\ \text{nc:} \\ \text{pc: pear} \\ \text{prn: 46} \end{array} \right]$	$\left[ \begin{array}{l} \text{noun: Mary} \\ \text{fnc: arrive} \\ \text{prn: 47} \end{array} \right]$	$\left[ \begin{array}{l} \text{verb: arrive} \\ \text{arg: Mary} \\ \text{mdr: 46 eat} \\ \text{prn: 47} \end{array} \right]$	

## 3. Subject-verb coordination (object gapping, cf. 8.6) in an adverbial sentence:

Mary arrived after Bob had bought, Jim had peeled, and Bill had eaten the peach.



## 9.5 Turn-Taking in Questions and Answers

While in a text, the sequence of propositions is produced by the same agent, in a dialog the propositions, or even just parts of propositions, in the sequence are produced by different agents.

This difference is formally characterized by the STAR of the propositions (cf. 2.6.2).

### 9.5.1 Comparing coordination in a text and a dialog

1. *Coordination of two propositions in a text*

Julia ate an apple.<sup>STAR</sup> Susanne ate a pear.<sup>(STAR)</sup>

2. *Coordination of two propositions in a dialog*

Julia ate an apple.<sup>STAR</sup> Susanne ate a pear.<sup>STAR'</sup>

3. *Coordination of a question and an answer in a dialog*

Who is singing?<sup>STAR</sup> Julia.<sup>STAR'</sup>

## 9.5.2 Illustrating kinds of coordination as sets of proplets

1. Julia is singing.<sup>STAR</sup>

noun: Julia
fnc: sing
nc:
pc:
STAR:
prn: 4

verb: sing
arg: Julia
nc: 5 dream
pc:
STAR: s t John Bill
prn: 4

Susanne is dreaming.<sup>(STAR)</sup>

noun: Susanne
fnc: dream
nc:
pc:
STAR:
prn: 5

verb: dream
arg: Susanne
nc:
pc: 4 sing
STAR:
prn: 5

2. Julia is singing.<sup>STAR</sup>

noun: Julia
fnc: sing
nc:
pc:
STAR:
prn: 4

verb: sing
arg: Julia
nc: 5 dream
pc:
STAR: s t John Bill
prn: 4

Susanne is dreaming.<sup>STA'R'</sup>

noun: Susanne
fnc: dream
nc:
pc:
STAR:
prn: 5

verb: dream
arg: Susanne
nc:
pc: 4 sing
STAR: s t Bill John
prn: 5

3. Who is singing?<sup>STAR</sup>

noun: q_1
fnc: sing
nc: Julia
pc:
STAR:
prn: n

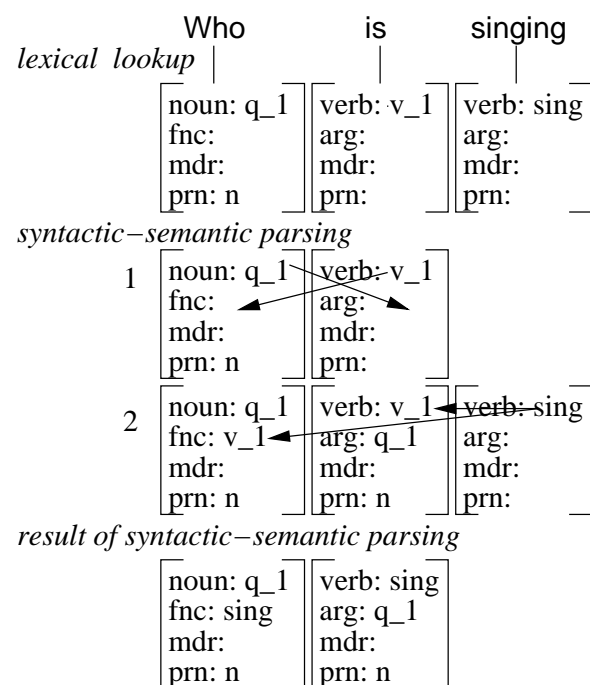
verb: sing
arg: q_1
nc:
pc:
STAR: s t John Bill
prn: n

Julia.<sup>STA'R'</sup>

noun: Julia
fnc: sing
nc:
pc: q_1
STAR: s t Bill John
prn: n

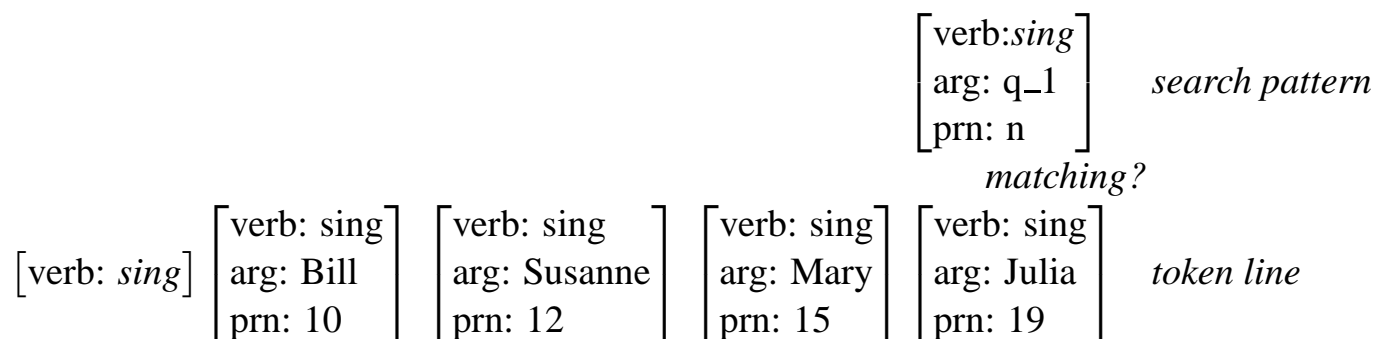
The interpretation and production of a question-answer pair may be experienced by an agent in the following constellations: (i) as the hearer of the question and the speaker of the answer, (ii) as the speaker of the question and the hearer of the answer, and (iii) as the hearer of the question and the answer (i.e. as an observer). These differences appear only in the STAR and the prn values, without affecting the grammatical analysis of the expressions used.

### 9.5.3 Derivation of a Wh-interrogative in the hearer-mode



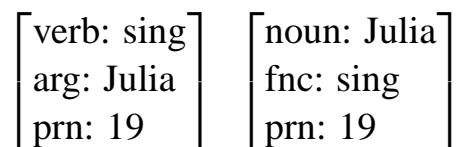
The hearer's pragmatic use of this expression for querying consists in applying the verb proplet to the token line of *sing* (cf. Section 5.1):

## 9.5.4 FINDING THE ANSWER



Given the present progressive tense of the question, the search pattern is matched with the last (and thus most recent) item in the token line of *sing*, thereby binding the variable *q\_1* to **Julia** and the variable *n* to **19**. Thus the proplet underlying the answer to the question may be derived by navigating from *sing* to *Julia*, using the latter to produce the answer:

### 9.5.5 Derivation of the answer



The interrogatives used in Wh-questions and yes/no-questions (cf. Section 5.1) may be arbitrarily complex, based on sentential arguments and modifiers. ‘Long distance dependencies’ are particularly interesting constructions in English:

## 9.6 Complex Propositions as Thought Structures

### 9.6.1 Simple extra-propositional coordinat. of simple propositions

1. Extra-propositional forward navigation:

Peter left the house. Then Peter crossed the street.

[noun: Peter fnc: leave nc: pc: prn: 1	[verb: leave arg: Peter house nc: > 2 cross pc: prn: 1	[noun: house fnc: leave nc: pc: prn: 1	[noun: Peter fnc: cross nc: pc: prn: 2	[verb: cross arg: Peter street nc: pc: < 1 leave prn: 2	[noun: street fnc: cross nc: pc: prn: 2
--	--	--	--	---	---

2. Extra-propositional backward navigation:

Peter crossed the street. Before that Peter left the house.

[noun: Peter fnc: cross nc: pc: prn: 2	[verb: cross arg: Peter street nc: < 1 leave pc: prn: 2	[noun: street fnc: cross nc: pc: prn: 2	[noun: Peter fnc: leave nc: pc: prn: 1	[verb: leave arg: Peter house nc: > 2 cross pc: prn: 1	[noun: house fnc: leave nc: pc: prn: 1
--	---	---	--	--	--

The surfaces differ (i) in the order of the two sentences and (ii) in the realization of the coordinating conjunction, i.e. **then** (forward navigation) vs. **before that** (backward navigation). The distinction between forward and backward navigation arises also intra-propositionally, as shown by the alternative between active and passive (cf. Section 6.5).

## 9.6.2 DIFFERENT EXTRA-PROPOSITIONAL FUNCTOR-ARGUMENT STRUCTURES

1. Adnominal sentence with subject gap:

Peter, who had left the house, crossed the street.

[noun: Peter fnc: cross mdr: 2 leave prn: 1]	[a/v: leave arg: # house mdd: 1 Peter prn: 2]	[noun: house fnc: leave prn: 2]	[verb: cross arg: Peter street prn: 1]	[noun: street fnc: cross prn: 1]
---	--	---------------------------------------	--	--

2. Adverbial sentence:

After Peter had left the house, he crossed the street.

[noun: Peter fnc: leave prn: 1]	[a/v: leave arg: Peter house mdd: > 2 cross prn: 1]	[noun: house fnc: leave prn: 1]	[noun: Peter fnc: cross prn: 2]	[verb: cross arg: Peter street mdr: < 1 leave prn: 2]	[noun: street fnc: cross prn: 2]
---------------------------------------	--	---------------------------------------	---------------------------------------	--	--

These two representations are different from those in 9.6.1, and different from each other.

More specifically, as extra-propositional functor-argument structures, both examples in 9.6.2 background the content of proposition 2 (hypotaxis) – in contradistinction to the examples of extra-propositional coordination in 9.6.1 (parataxis). The two examples in 9.6.2 differ from each other, furthermore, in that they represent alternative perspectives on the content: the adnominal (or relative) clause attaches the background content to the noun *Peter* while the adverbial clause attaches it to the verb *cross*.

Alternative (ii) has the disadvantage that it requires a transformation of a complex proposition (language level) into a simple coordination of simple propositions (context level) during language interpretation, and a transformation of a simple coordination of simple propositions (context level) into a complex proposition (language level) during language production. Moreover, the contents represented by simple coordinations of simple propositions and by the related special representations as complex propositions are not really the same, making the required transformations awkward and unnatural. The apparent advantage of this costly procedure, however, would be that inferencing at the context level would not have to deal with complex propositions.

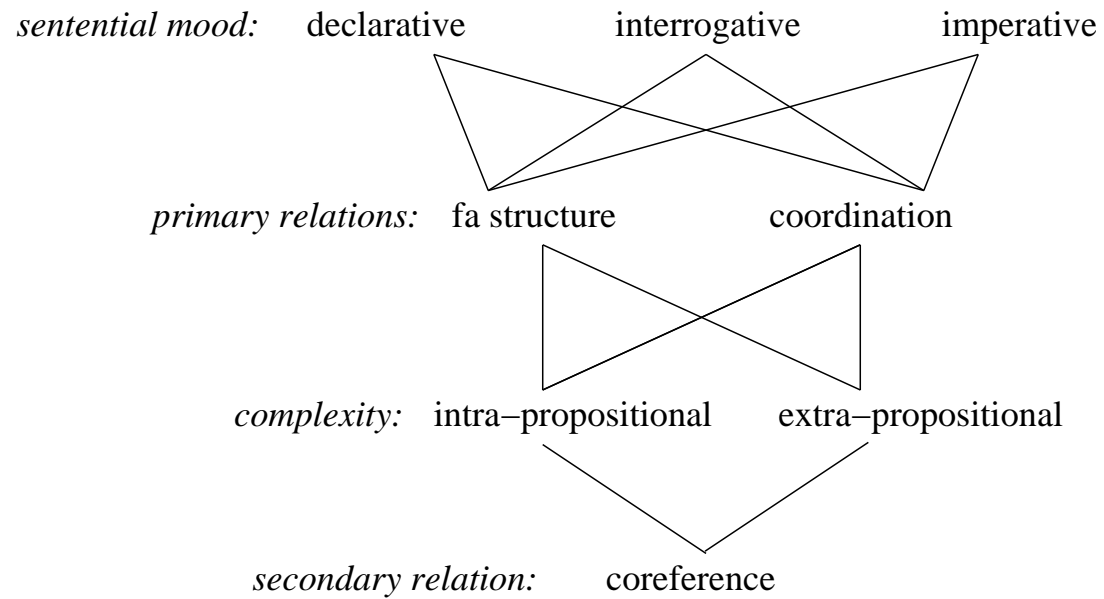
Alternative (i) has the advantage that the language and the context level use the same coding, thus making any transformations unnecessary. Furthermore, the inferencing in LA-grammar (cf. Section 5.3) is sufficiently powerful to derive all the required conclusions from the simple as well as from the special representations. For example, both special representations in 9.6.2 support inferring the answer **yes** to the question **Did Peter leave the house** – just as both simple representations in 9.6.1.

Our choice of alternative (i) implies that the perspectives represented by extra-propositional functor-argument structure (cf. Chapter 7.), complex intra-propositional coordination (cf. Sections 8.4 –8.6) and their combination (cf. Section 9.4) are essentially thought structures. They are perspectives which arise already at the level of context and are merely reflected in language – just as the secondary coding underlying indirect (e.g. metaphoric) uses of language described in Sections 5.4 and 5.5.

# 10. Intra- and Extra-Propositional Coreference

## 10.1 Overview

### 10.1.1 CORRELATING THE MAJOR CONSTRUCTIONS



### 10.1.2 Different kinds of coreference

#### 1. Name-based coreference in an extra-sentential coordination

Julia ate an apple. Then Julia took a nap.

[noun: Julia fnc: eat mdr: idy: 1 prn: 36]	[verb: eat arg: Julia apple pc: nc: > 37 take prn: 36]	[noun: apple fnc: eat mdr: idy: 2 prn: 36]	[noun: Julia fnc: take mdr: idy: 3 (=1) prn: 37]	[verb: take arg: Julia nap pc: < 36 eat nc: prn: 37]	[noun: nap fnc: take mdr: idy: 4 prn: 37]
--	--	--	--	--	---

#### 2. Pronoun-based coreference in an extra-sentential coordination

Julia ate an apple. Then she took a nap.

[noun: Julia fnc: eat mdr: idy: 5 prn: 38]	[verb: eat arg: Julia apple pc: nc: > 39 take prn: 38]	[noun: apple fnc: eat mdr: idy: 6 prn: 38]	[noun: pro_1 fnc: take mdr: idy: 7 (=5) prn: 39]	[verb: take arg: pro_1 nap pc: < 38 eat nc: prn: 39]	[noun: nap fnc: take mdr: idy: 8 prn: 39]
--	--	--	--	--	---

#### 3. Blocked intra-propositional coreference between two equal names

John shaved John.

[noun: John fnc: shave idy: 9 prn: 40]	[verb: shave arg: John John mdr: prn: 40]	[noun: John fnc: shave idy: 10 prn: 40]
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## 4. Intra-propositional coreference between a name and a reflexive pronoun

%John shaved himself.

noun: John	verb: shave	noun: rfl_1
fnc: shave	arg: John rfl_1	fnc: shave
idy: 1	mdr:	idy: 2
prn: 1	prn: 1	prn: 1

## 5. Coreference between a nominal symbol and an intra-propositional coordination

The man washed his hands, clipped his nails, and shaved himself.

noun: man	verb: wash &	noun: hand	verb: clip	noun: nail	verb: shave	noun: rfl_2
fnc: wash	arg: man hand	fnc: wash	arg: # nail	fnc: clip	arg: # rfl_2	fnc: shave
mdr:	nc: clip	mdr:	nc: shave	mdr:	nc:	mdr:
idy: 13	pc:	idy: 14	pc: wash	idy: 15	pc: clip	idy: 16(=13)
prn: 42	prn: 42	prn: 42	prn: 42	prn: 42	prn: 42	prn: 42

## 10.2 Intra-Propositional Coreference

### 10.2.1 DEFINITION OF LA-think.pro-1

$$ST_S =_{def} \{ ( [noun: RFL\_n] \{ rfl-0 \ rfl-1 \} ) \}$$

$$rfl-0: \left[ \begin{array}{l} \text{noun: RFL\_n} \\ \text{cat: X'} \\ \text{idy: j} \\ \text{prn: k} \end{array} \right] \left[ \begin{array}{l} \text{noun: } \alpha \\ \text{cat: X} \\ \text{idy: i} \\ \text{prn: k} \end{array} \right] \begin{array}{l} \text{if X is not compatible with X'} \\ \text{set } nw = \text{preceding noun} \end{array} \quad \{ rfl-0, rfl-1 \}$$

$$rfl-1: \left[ \begin{array}{l} \text{noun: RFL\_n} \\ \text{cat: X'} \\ \text{idy: j} \\ \text{prn: k} \end{array} \right] \left[ \begin{array}{l} \text{noun: } \alpha \\ \text{cat: X} \\ \text{idy: i} \\ \text{prn: k} \end{array} \right] \begin{array}{l} \text{if X is compatible with X'} \\ \text{set } j = i \end{array} \quad \{ \}$$

$$ST_F =_{def} \{ ( [noun: } \alpha ] rp_{rfl-1} ) \}$$

### 10.2.2 APPLYING THE INFERENCE RULE **rfl-1**

<i>rule level</i>	rfl-1:	$\left[ \begin{array}{l} \text{noun: RFL\_n} \\ \text{cat: X'} \\ \text{idy: j} \\ \text{prn: k} \end{array} \right]$	$\left[ \begin{array}{l} \text{noun: } \alpha \\ \text{cat: X} \\ \text{idy: i} \\ \text{prn: k} \end{array} \right]$	if X is compatible with X' set j = i	{ }
<i>language level</i>		$\left[ \begin{array}{l} \text{noun: rfl\_1} \\ \text{fnc: shave} \\ \text{cat: m sg} \\ \text{idy: 2} \\ \text{prn: 1} \end{array} \right]$	$\left[ \begin{array}{l} \text{noun: John} \\ \text{fnc: shave} \\ \text{cat: m sg} \\ \text{idy: 1} \\ \text{prn: 1} \end{array} \right]$		

### 10.2.3 INTERPRETATION OF John shaved himself AFTER INFERENCE

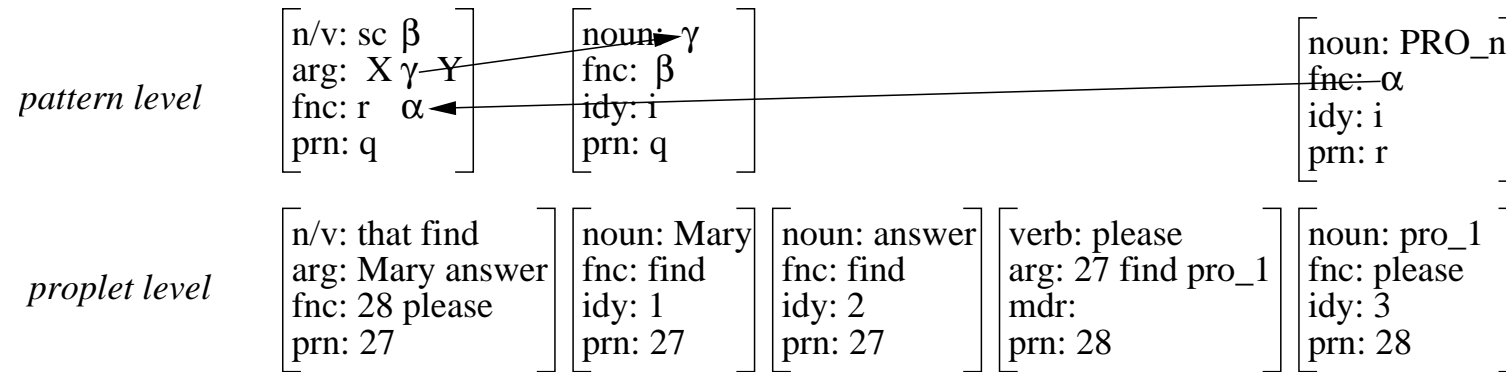
$\left[ \begin{array}{l} \text{noun: John} \\ \text{cat: m sg} \\ \text{fnc: shave} \\ \text{idy: 1} \\ \text{prn: 1} \end{array} \right]$	$\left[ \begin{array}{l} \text{verb: shave} \\ \text{arg: John, rfl\_1} \\ \text{prn: 1} \end{array} \right]$	$\left[ \begin{array}{l} \text{noun: rfl\_1} \\ \text{cat: m sg} \\ \text{fnc: shave} \\ \text{idy: 2 (=1)} \\ \text{prn: 1} \end{array} \right]$
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## 10.3 Langacker-Ross Constraint for Sentential Arguments

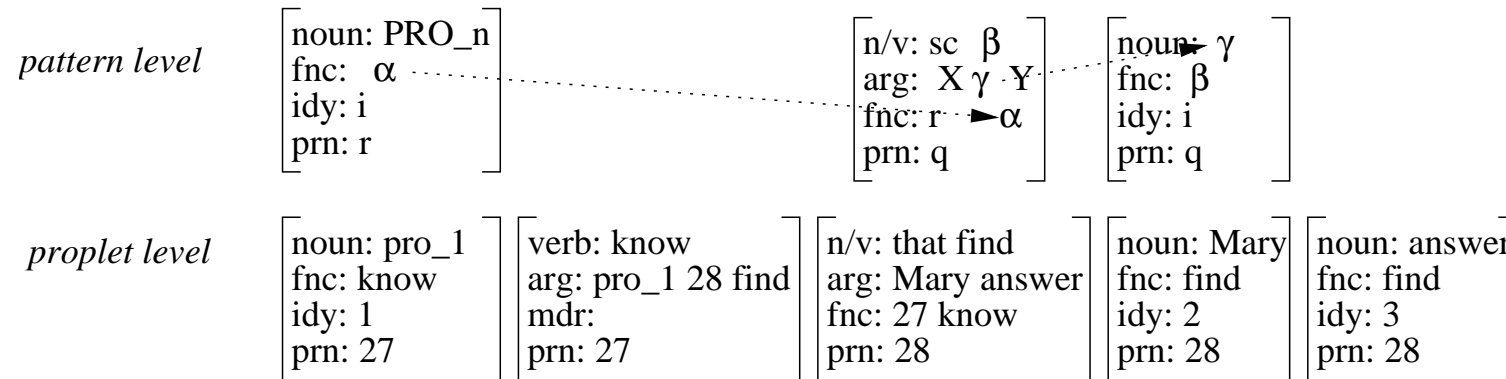
### 10.3.1 LANGACKER-ROSS CONSTRAINT IN SENTENTIAL ARGUMENTS

1. **LH'**: That *Mary* had found the answer pleased *her*.
2. **H'L**: %*She* knew that *Mary* had found the answer.
3. **L'H**: That *she* had found the answer pleased *Mary*.
4. **HL'**: *Mary* knew that *she* had found the answer.

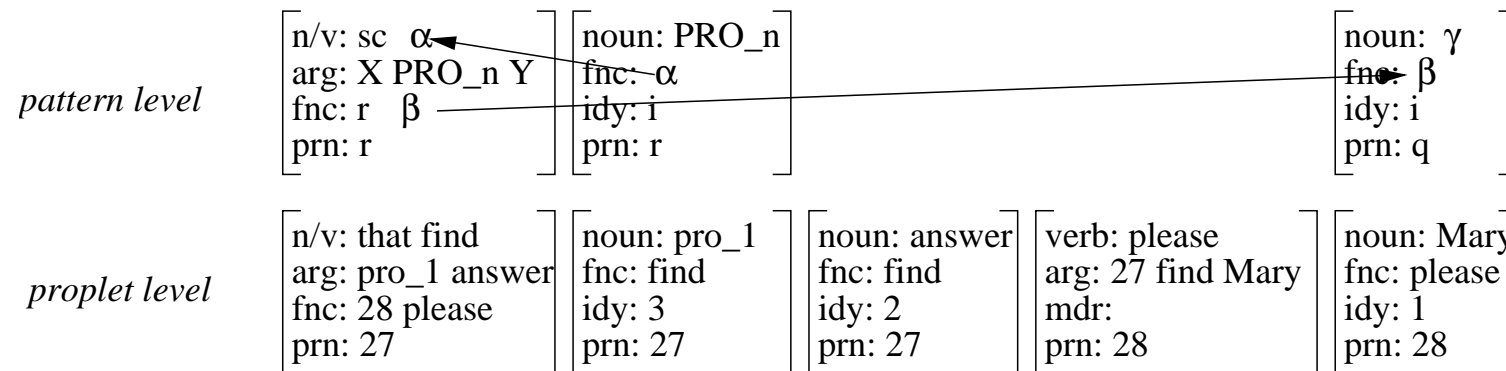
### 10.3.2 LH': That *Mary* had found the answer pleased *her*. (n/v-cnn)



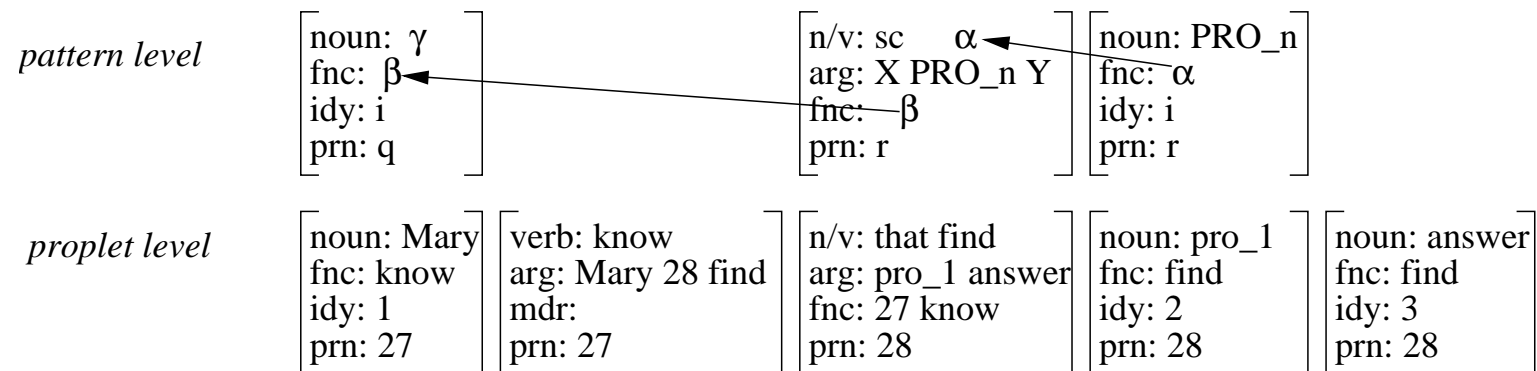
### 10.3.3 H'L: %*She* knew that *Mary* had found the answer.



### 10.3.4 L'H: That *she* had found the answer pleased *Mary*. (n/v-pro)



### 10.3.5 HL': *Mary* knew that *she* had found the answer. (n/v-pro)



### 10.3.6 DEFINITION OF **LA-think.pro-2** (SENTENTIAL ARGUMENTS)

$$ST_S =_{def} \{ ( [noun: PRO\_n] \{n/v-cnn, n/v-pro\} ) \}$$

$$n/v-cnn: \left[ \begin{array}{l} noun: PRO\_n \\ fnc: \alpha \\ idy: i \\ prn: r \end{array} \right] \left[ \begin{array}{l} n/v: sc \beta \\ arg: X \gamma Y \\ fnc: r \alpha \\ prn: q \end{array} \right] \left[ \begin{array}{l} noun: \gamma \\ fnc: \beta \\ idy: j \\ prn: q \end{array} \right] \quad \begin{array}{l} \text{if } q \text{ and } r \text{ are adjacent, } q < r, \text{ and} \\ PRO\_n \text{ and } \gamma \text{ are compatible, set } i = j \end{array} \quad \{ \}$$

$$n/v-pro: \left[ \begin{array}{l} noun: PRO\_n \\ fnc: \alpha \\ idy: i \\ prn: r \end{array} \right] \left[ \begin{array}{l} n/v: sc \alpha \\ arg: X PRO\_n Y \\ fnc: r \beta \\ prn: r \end{array} \right] \left[ \begin{array}{l} noun: \gamma \\ fnc: \beta \\ idy: j \\ prn: q \end{array} \right] \quad \begin{array}{l} \text{if } q \text{ and } r \text{ are adjacent and} \\ PRO\_n \text{ and } \gamma \text{ are compatible, set } i = j \end{array} \quad \{ \}$$

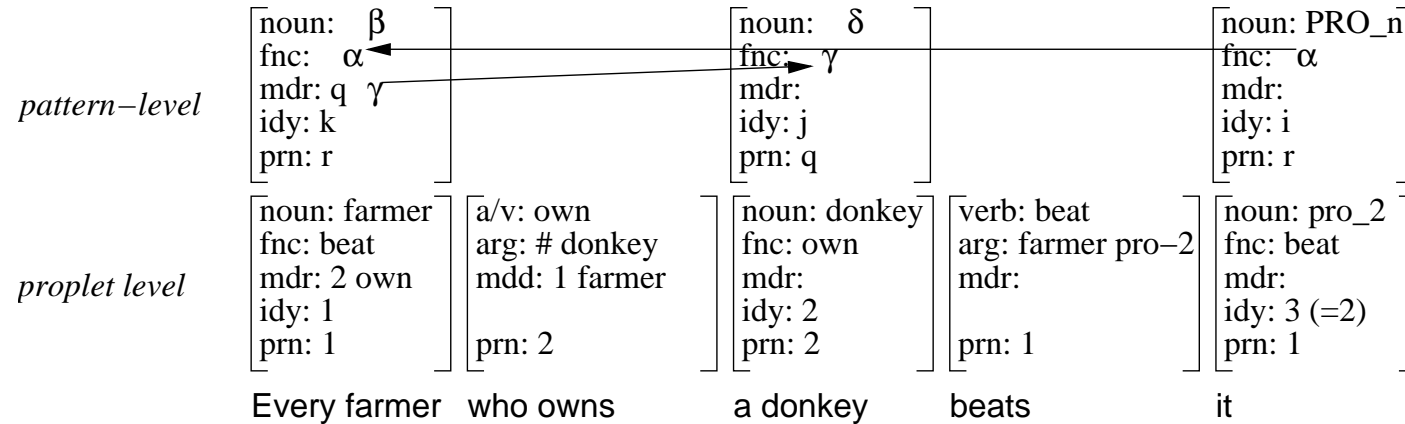
$$ST_F =_{def} \{ ( [noun: \alpha] rp_{n/v-cnn} ), ( [noun: \alpha] rp_{n/v-pro} ) \}$$

## 10.4 Langacker-Ross Constraint for Adnominal Sentential Modifiers

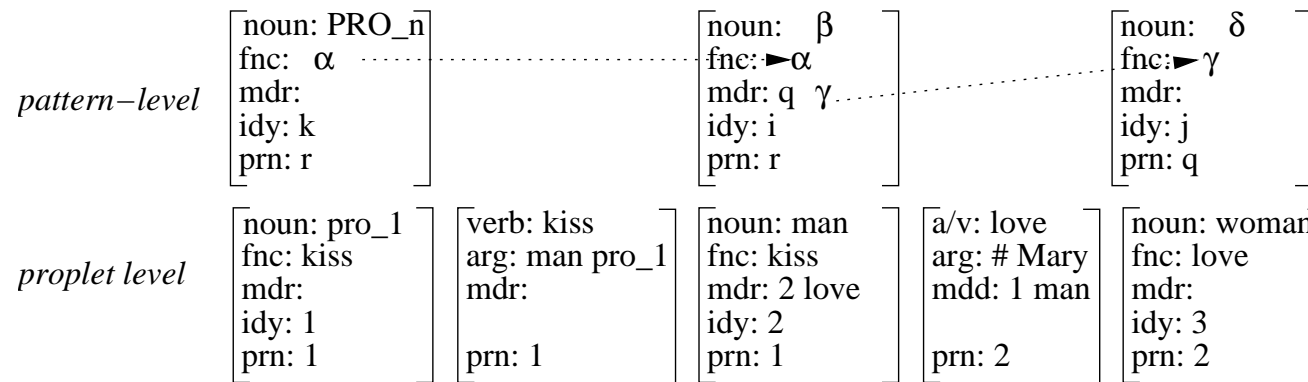
### 10.4.1 LANGACKER-ROSS CONSTRAINT IN ADNOMINAL SUB-CLAUSES

1. **LH'**: The man who loves *the woman* kissed *her*.
2. **H'L**: %*She* was kissed by the man who loves *the woman*.
3. **L'H**: The man who loves *her* kissed *the woman*.
4. **HL'**: *The woman* was kissed by the man who loves *her*.

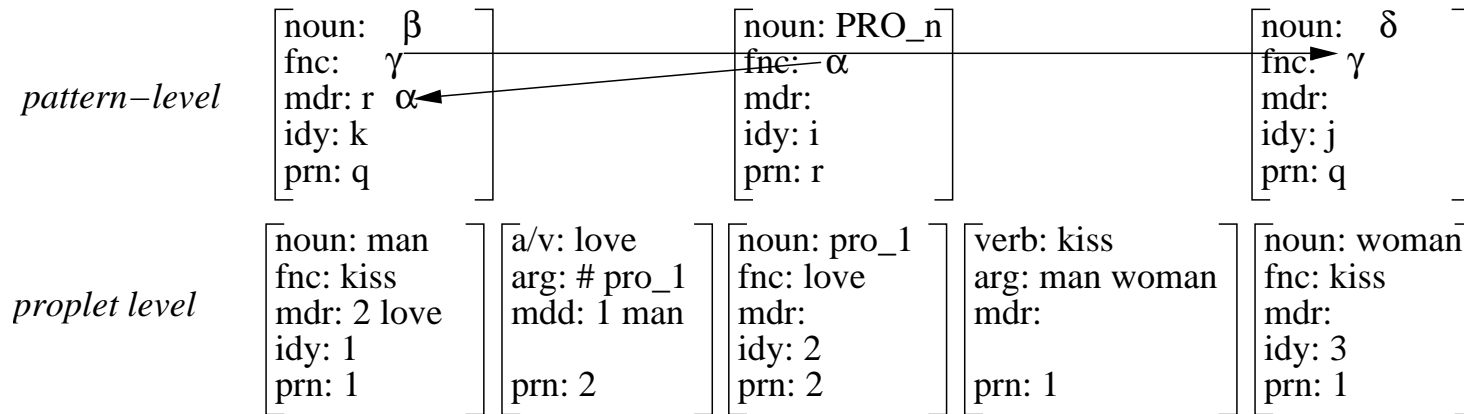
### 10.4.2 LH': Every farmer who owns a donkey beats it. (adn-cnn)



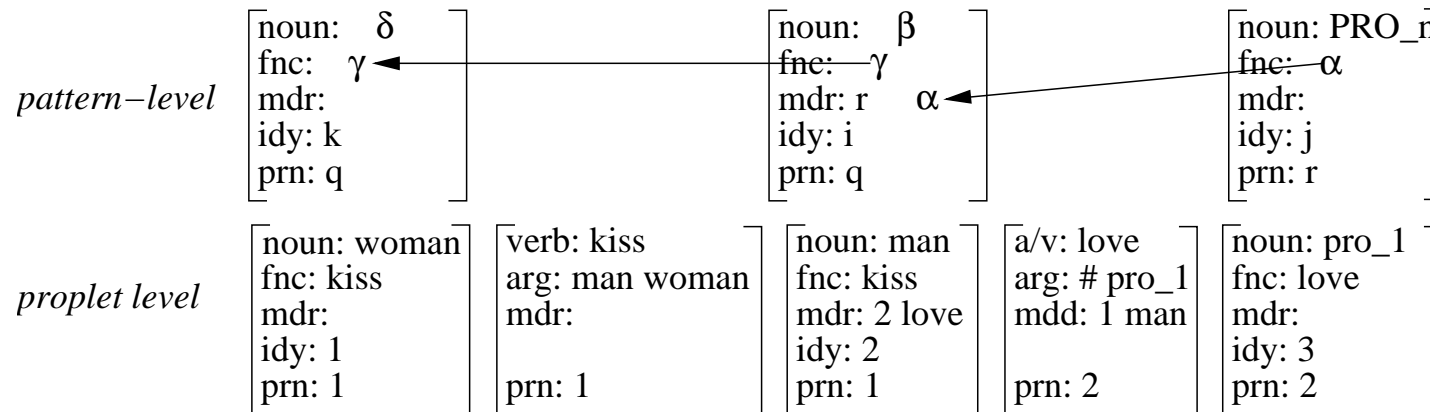
### 10.4.3 H'L: %She was kissed by the man who loves the woman.



### 10.4.4 L'H: The man who loves *her* kissed *the woman*. (adn-pro)



### 10.4.5 HL': *The woman* was kissed by the man who loves *her*. (adn-pro)



### 10.4.6 DEFINITION OF **LA-think.pro-3** (ADNOMINAL SENTENTIAL MODIFIERS)

$ST_S =_{def} \{ ( [noun: PRO\_n] \{adn-cnn\ adn-pro\} ) \}$

adn-cnn:  $\left[ \begin{array}{l} [noun: PRO\_n] \\ fnc: \alpha \\ mdr: \\ idy: i \\ prn: r \end{array} \right] \left[ \begin{array}{l} [noun: \beta] \\ fnc: \alpha \\ mdr: q \ \gamma \\ idy: k \\ prn: r \end{array} \right] \left[ \begin{array}{l} [noun: \delta] \\ fnc: \gamma \\ mdr: \\ idy: j \\ prn: q \end{array} \right] \left. \begin{array}{l} \text{if } q \text{ and } r \text{ are adjacent, } q < r, \text{ and} \\ \text{PRO\_n and } \alpha \text{ are compatible, set } i = j \end{array} \right\} \{ \}$

adn-pro:  $\left[ \begin{array}{l} [noun: PRO\_n] \\ fnc: \alpha \\ mdr: \\ idy: i \\ prn: r \end{array} \right] \left[ \begin{array}{l} [noun: \beta] \\ fnc: \gamma \\ mdr: r \ \alpha \\ idy: k \\ prn: q \end{array} \right] \left[ \begin{array}{l} [noun: \delta] \\ fnc: \gamma \\ mdr: \\ idy: j \\ prn: q \end{array} \right] \left. \begin{array}{l} \text{if } q \text{ and } r \text{ are adjacent and} \\ \text{PRO\_n and } \gamma \text{ are compatible, set } i = j \end{array} \right\} \{ \}$

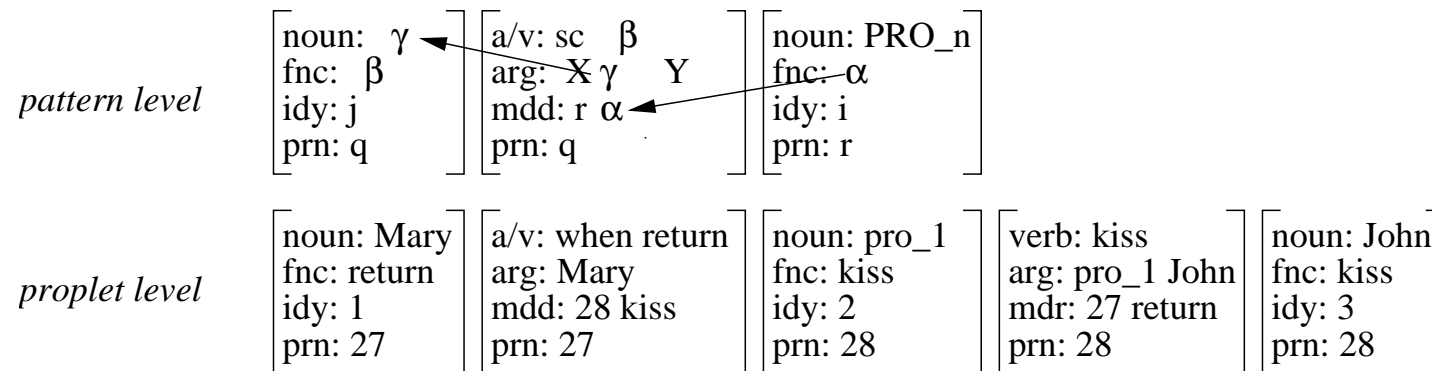
$ST_F =_{def} \{ ( [noun: \alpha] rp_{adn-fnc} ), ( [noun: \alpha] rp_{adn-mdr} ) \}$

## 10.5 Langacker-Ross Constraint for Adverbial Sentential Modifiers

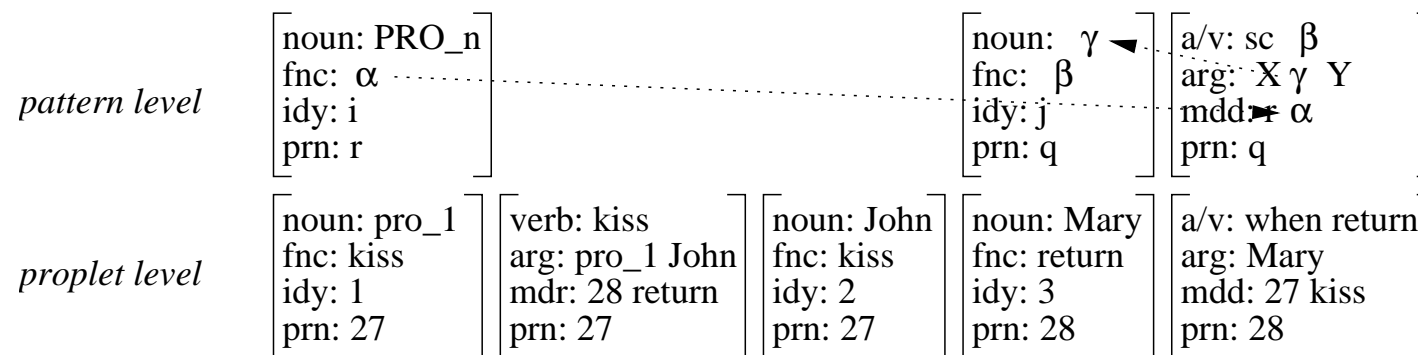
### 10.5.1 LANGACKER-ROSS CONSTRAINT IN ADVERBIAL SUB-CLAUSES

1. **LH'**: When *Mary* returned *she* kissed John.
2. **H'L**: %*She* kissed John when *Mary* returned.
3. **L'H**: When *she* returned *Mary* kissed John.
4. **HL'**: *Mary* kissed John when *she* returned.

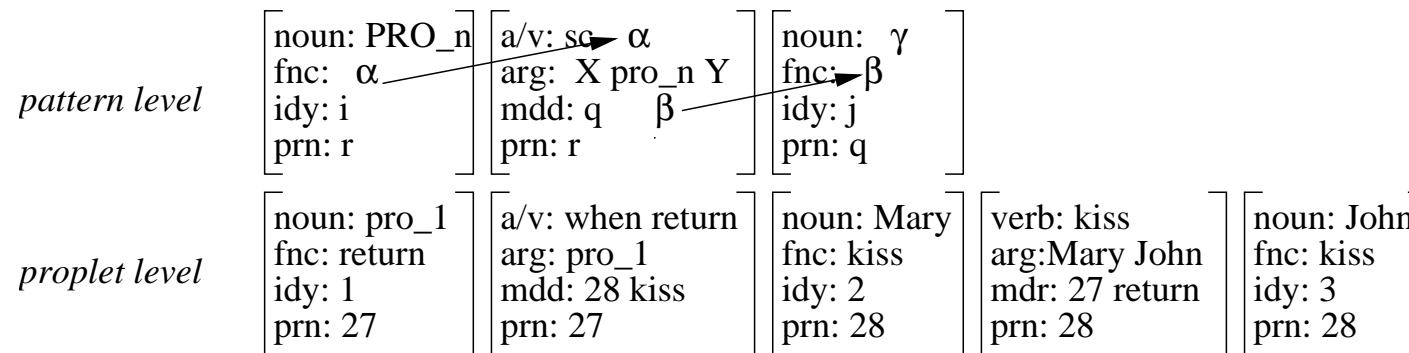
### 10.5.2 LH': When *Mary* returned *she* kissed John. (adv-cnn)



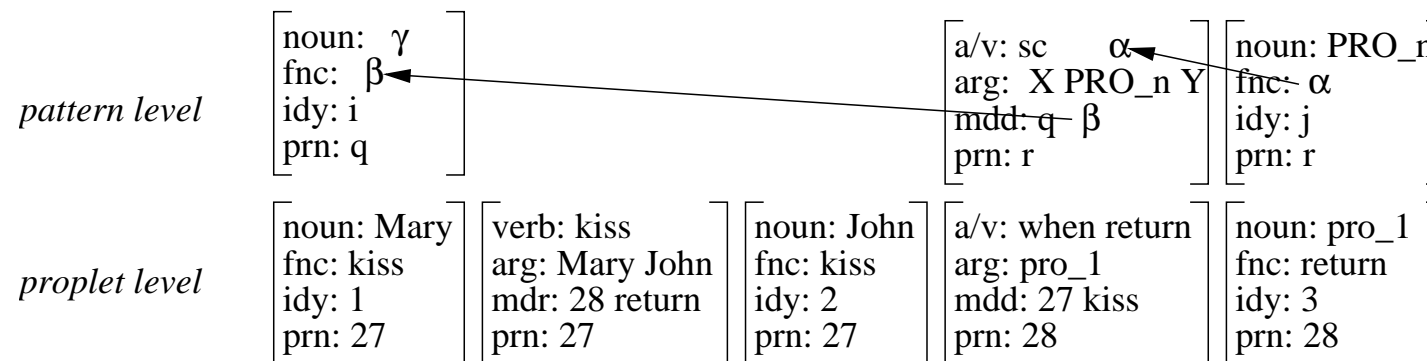
### 10.5.3 H'L: %*She* kissed John when *Mary* returned.



### 10.5.4 L'H: When *she* returned *Mary* kissed John. (adv-pro)



### 10.5.5 HL': *Mary* kissed John when *she* returned. (adv-pro)



### 10.5.6 DEFINITION OF **LA-think.pro-4** (ADVERBIAL SENTENTIAL MODIFIERS)

$$ST_S =_{def} \{ ( [noun: PRO\_n] \{adv-cnn\ adv-pro\} ) \}$$

$$\text{adv-cnn: } \left[ \begin{array}{l} \text{noun: PRO\_n} \\ \text{fnc: } \alpha \\ \text{idy: } i \\ \text{prn: } r \end{array} \right] \left[ \begin{array}{l} \text{a/v: sc } \beta \\ \text{arg: X } \gamma \text{ Y} \\ \text{mdd: } r \alpha \\ \text{prn: } q \end{array} \right] \left[ \begin{array}{l} \text{noun: } \gamma \\ \text{fnc: } \beta \\ \text{idy: } j \\ \text{prn: } q \end{array} \right] \quad \begin{array}{l} \text{if } q \text{ and } r \text{ are adjacent, } q < r, \text{ and} \\ \text{PRO\_n and } \gamma \text{ are compatible, set } i = j \end{array} \quad \{ \}$$

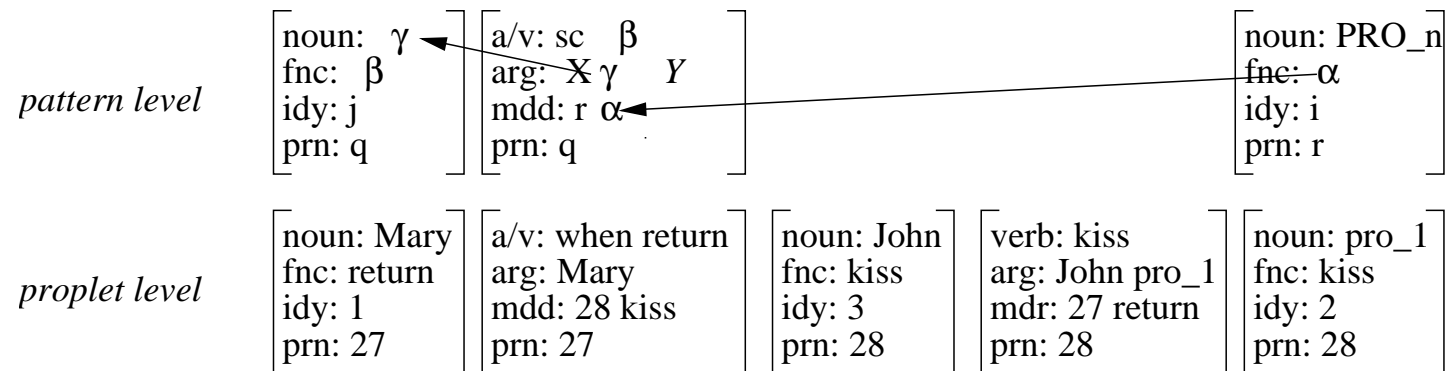
$$\text{adv-pro: } \left[ \begin{array}{l} \text{noun: PRO\_n} \\ \text{fnc: } \alpha \\ \text{idy: } i \\ \text{prn: } r \end{array} \right] \left[ \begin{array}{l} \text{a/v: sc } \alpha \\ \text{fnc: X PRO\_n Y} \\ \text{mdd: } q \beta \\ \text{prn: } r \end{array} \right] \left[ \begin{array}{l} \text{noun: } \gamma \\ \text{fnc: } \beta \\ \text{idy: } j \\ \text{prn: } q \end{array} \right] \quad \begin{array}{l} \text{if } q \text{ and } r \text{ are adjacent and} \\ \text{PRO\_n and } \gamma \text{ are compatible, set } i = j \end{array} \quad \{ \}$$

$$ST_F =_{def} \{ ( [noun: \alpha] rp_{adv-cnn} ), ( [noun: \alpha] rp_{adv-pro} ) \}$$

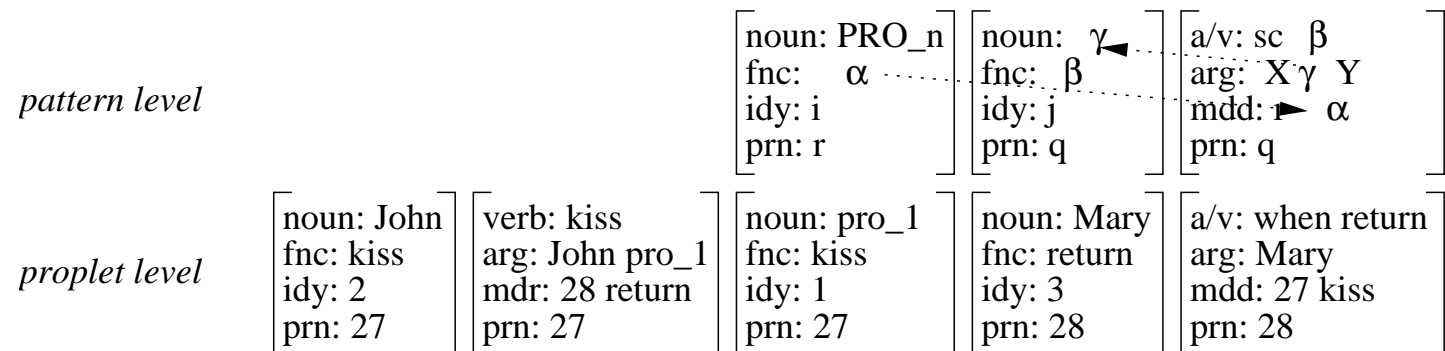
### 10.5.7 LANGACKER-ROSS CONSTRAINT FOR OBLIQUE COREFERENTS

1. **LH'**: When *Mary* returned John kissed *her*.
2. **H'L**: %John kissed *her* when *Mary* returned.
3. **L'H**: When *she* returned John kissed *Mary*.
4. **HL'**: John kissed *Mary* when *she* returned.

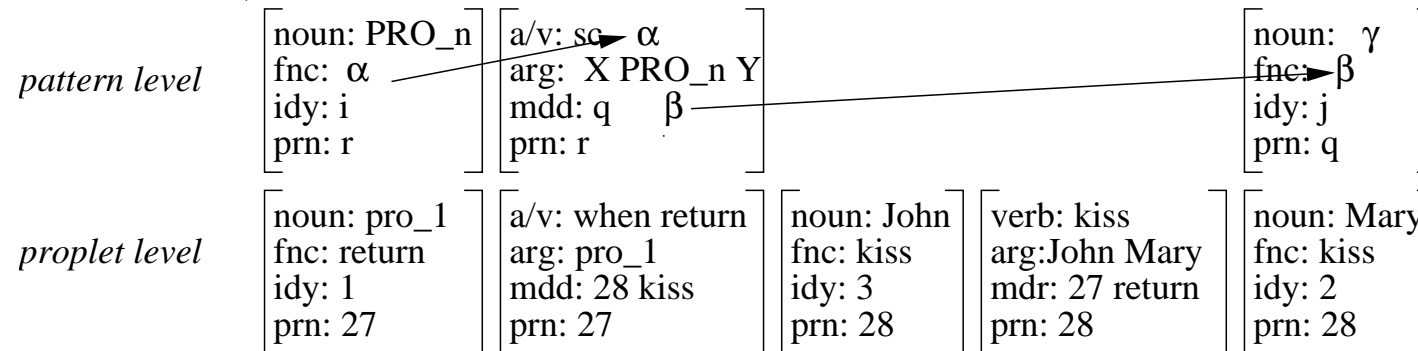
### 10.5.8 LH': When *Mary* returned John kissed *her*. (adv-cnn)



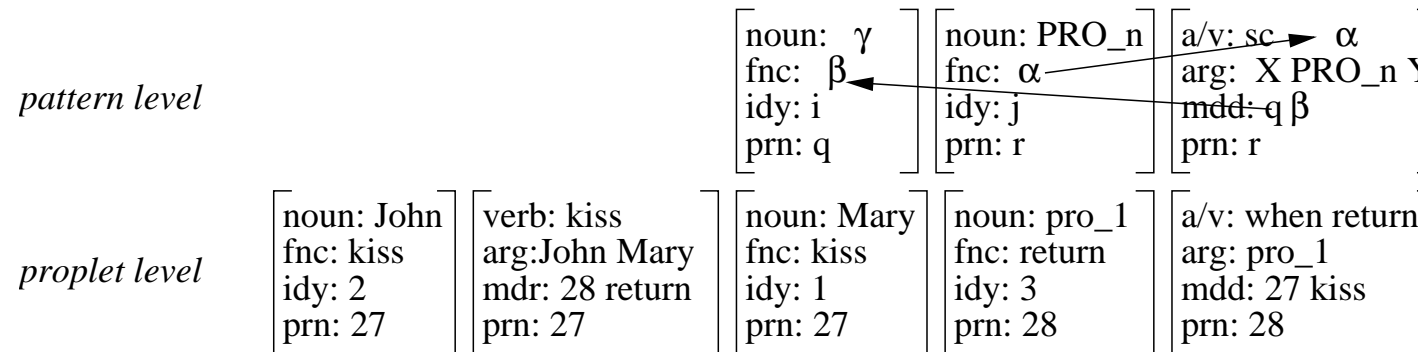
### 10.5.9 H'L: %John kissed *her* when *Mary* returned.



### 10.5.10 L'H: When *she* returned John kissed *Mary* (adv-pro)



### 10.5.11 H'L: John kissed *Mary* when *she* returned (adv-pro)



## 10.6 Handling Pronominal Coreference by means of Inference

### 10.6.1 DEFINITION OF LA-think.pro

$ST_S =_{def} \{ ( [noun: PRO\_n] \{pro-0\ rfl-1\ n/v-cnn\ n/v-pro\ adn-cnn\ adn-pro\ adv-cnn\ adv-pro\} ) \}$

pro-0:	$\begin{bmatrix} \text{noun: PRO\_n} \\ \text{idy: j} \\ \text{prn: r} \end{bmatrix}$	$\begin{bmatrix} \text{noun: } \alpha \\ \text{idy: i} \\ \text{prn: q} \end{bmatrix}$	PRO_n and $\alpha$ are not compatible, set $nw$ = preceding noun in the input sequence	$\{pro-0\ rfl-1$ $n/v-cnn\ n/v-PRO$ $adn-cnn\ adn-PRO$ $adv-cnn\ adv-PRO\}$
rfl-1:	$\begin{bmatrix} \text{noun: PRO\_n} \\ \text{idy: j} \\ \text{prn: r} \end{bmatrix}$	$\begin{bmatrix} \text{noun: } \alpha \\ \text{idy: i} \\ \text{prn: r} \end{bmatrix}$	if PRO_n is a reflexive pronoun, and PRO_n and $\alpha$ are compatible, set $j = i$	$\{ \}$
n/v-cnn:	$\begin{bmatrix} \text{noun: PRO\_n} \\ \text{fnc: } \alpha \\ \text{idy: i} \\ \text{prn: r} \end{bmatrix}$	$\begin{bmatrix} \text{n/v: sc } \beta \\ \text{arg: X } \gamma \text{ Y} \\ \text{fnc: r } \alpha \\ \text{prn: q} \end{bmatrix}$	$\begin{bmatrix} \text{noun: } \gamma \\ \text{fnc: } \beta \\ \text{idy: j} \\ \text{prn: q} \end{bmatrix}$ if PRO_n is a non-reflexive personal pronoun, PRO_n and $\gamma$ are compatible, $q$ and $r$ are adjacent, and $q < r$ , set $i = j$	$\{ \}$
n/v-pro:	$\begin{bmatrix} \text{noun: PRO\_n} \\ \text{fnc: } \alpha \\ \text{idy: i} \\ \text{prn: r} \end{bmatrix}$	$\begin{bmatrix} \text{n/v: sc } \alpha \\ \text{arg: X PRO\_n Y} \\ \text{fnc: r } \beta \\ \text{prn: r} \end{bmatrix}$	$\begin{bmatrix} \text{noun: } \gamma \\ \text{fnc: } \beta \\ \text{idy: j} \\ \text{prn: q} \end{bmatrix}$ if PRO_n is a non-reflexive personal pronoun, PRO_n and $\gamma$ are compatible, and $q$ and $r$ are adjacent, set $i = j$	$\{ \}$

adn-cnn:	$\begin{bmatrix} \text{noun: PRO\_n} \\ \text{fnc: } \alpha \\ \text{mdr:} \\ \text{idy: i} \\ \text{prn: r} \end{bmatrix}$	$\begin{bmatrix} \text{noun: } \beta \\ \text{fnc: } \alpha \\ \text{mdr: q } \gamma \\ \text{idy: k} \\ \text{prn: r} \end{bmatrix}$	$\begin{bmatrix} \text{noun: } \delta \\ \text{fnc: } \gamma \\ \text{mdr:} \\ \text{idy: j} \\ \text{prn: q} \end{bmatrix}$	if PRO_n is a non-reflexive personal pronoun, PRO_n and $\alpha$ are compatible, q and r are adjacent, and $q < r$ , set $i = j$	{ }
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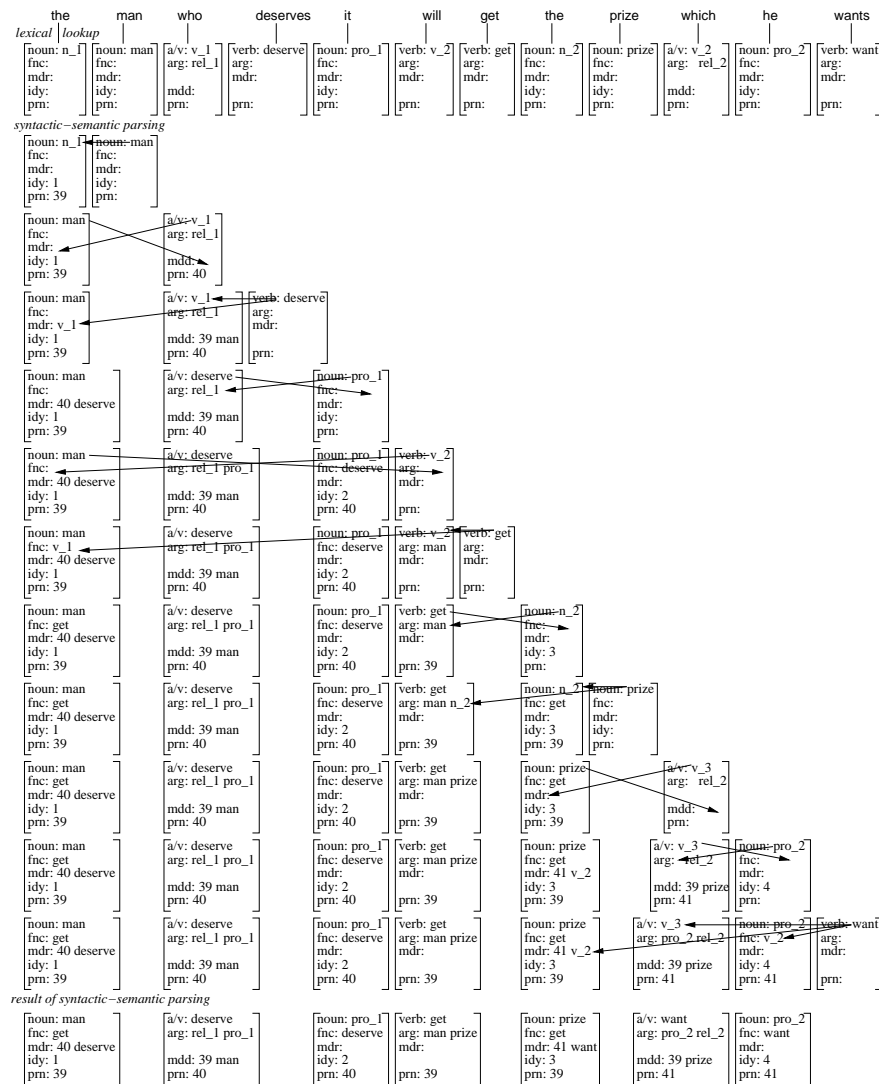
adn-pro:	$\begin{bmatrix} \text{noun: PRO\_n} \\ \text{fnc: } \alpha \\ \text{mdr:} \\ \text{idy: i} \\ \text{prn: r} \end{bmatrix}$	$\begin{bmatrix} \text{noun: } \beta \\ \text{fnc: } \gamma \\ \text{mdr: r } \alpha \\ \text{idy: k} \\ \text{prn: q} \end{bmatrix}$	$\begin{bmatrix} \text{noun: } \delta \\ \text{fnc: } \gamma \\ \text{mdr:} \\ \text{idy: j} \\ \text{prn: q} \end{bmatrix}$	if PRO_n is a non-reflexive personal pronoun, PRO_n and $\gamma$ are compatible, and q and r are adjacent, set $i = j$	{ }
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adv-cnn:	$\begin{bmatrix} \text{noun: PRO\_n} \\ \text{fnc: } \alpha \\ \text{idy: i} \\ \text{prn: r} \end{bmatrix}$	$\begin{bmatrix} \text{a/v: sc } \beta \\ \text{arg: X } \gamma \text{ Y} \\ \text{mdd: r } \alpha \\ \text{prn: q} \end{bmatrix}$	$\begin{bmatrix} \text{noun: } \gamma \\ \text{fnc: } \beta \\ \text{idy: j} \\ \text{prn: q} \end{bmatrix}$	if PRO_n is a non-reflexive personal pronoun, PRO_n and $\gamma$ are compatible, q and r are adjacent, and $q < r$ , set $i = j$	{ }
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adv-pro:	$\begin{bmatrix} \text{noun: PRO\_n} \\ \text{fnc: } \alpha \\ \text{idy: i} \\ \text{prn: r} \end{bmatrix}$	$\begin{bmatrix} \text{a/v: sc } \alpha \\ \text{fnc: X PRO\_n Y} \\ \text{mdd: q } \beta \\ \text{prn: r} \end{bmatrix}$	$\begin{bmatrix} \text{noun: } \gamma \\ \text{fnc: } \beta \\ \text{idy: j} \\ \text{prn: q} \end{bmatrix}$	if PRO_n is a non-reflexive personal pronoun, PRO_n and $\gamma$ are compatible, and q and r are adjacent, set $i = j$	{ }
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$$ST_F = \text{def} \{ ( [ \text{noun: } \alpha ] \text{ rp}_{\text{rfl-1}} ), ( [ \text{noun: } \alpha ] \text{ rp}_{\text{n/v-cnn}} ), ( [ \text{noun: } \alpha ] \text{ rp}_{\text{n/v-pro}} ), \\ ( [ \text{noun: } \alpha ] \text{ rp}_{\text{adn-cnn}} ), ( [ \text{noun: } \alpha ] \text{ rp}_{\text{adn-pro}} ), ( [ \text{noun: } \alpha ] \text{ rp}_{\text{adv-cnn}} ) \\ ( [ \text{noun: } \alpha ] \text{ rp}_{\text{adn-pro}} ) \}$$

### 10.6.2 HEARER-MODE DERIVATION OF THE BACH-PETERS SENTENCE



### 10.6.3 The HL' constellation

**H:** The *man* will get the prize  
**L':** which *he* wants

### 10.6.4 The L'H constellation

The man **H:** will get the *prize*  
**L':** who deserves *it*

### 10.6.5 THE COREFERENCE INFERENCES

