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)

$$\begin{bmatrix}\text{noun: apple}\\ \text{fnc: give}\\ \text{mdr:}\\ \text{prn: 1}\end{bmatrix} \begin{bmatrix}\text{noun: child}\\ \text{fnc: give}\\ \text{mdr:}\\ \text{prn: 1}\end{bmatrix} \begin{bmatrix}\text{verb: give}\\ \text{arg: man child apple}\\ \text{mdr:}\\ \text{prn: 1}\end{bmatrix} \begin{bmatrix}\text{noun: man}\\ \text{fnc: give}\\ \text{mdr:}\\ \text{prn: 1}\end{bmatrix}$$

2. Representing The little black dog barked (adnominal adjectives)

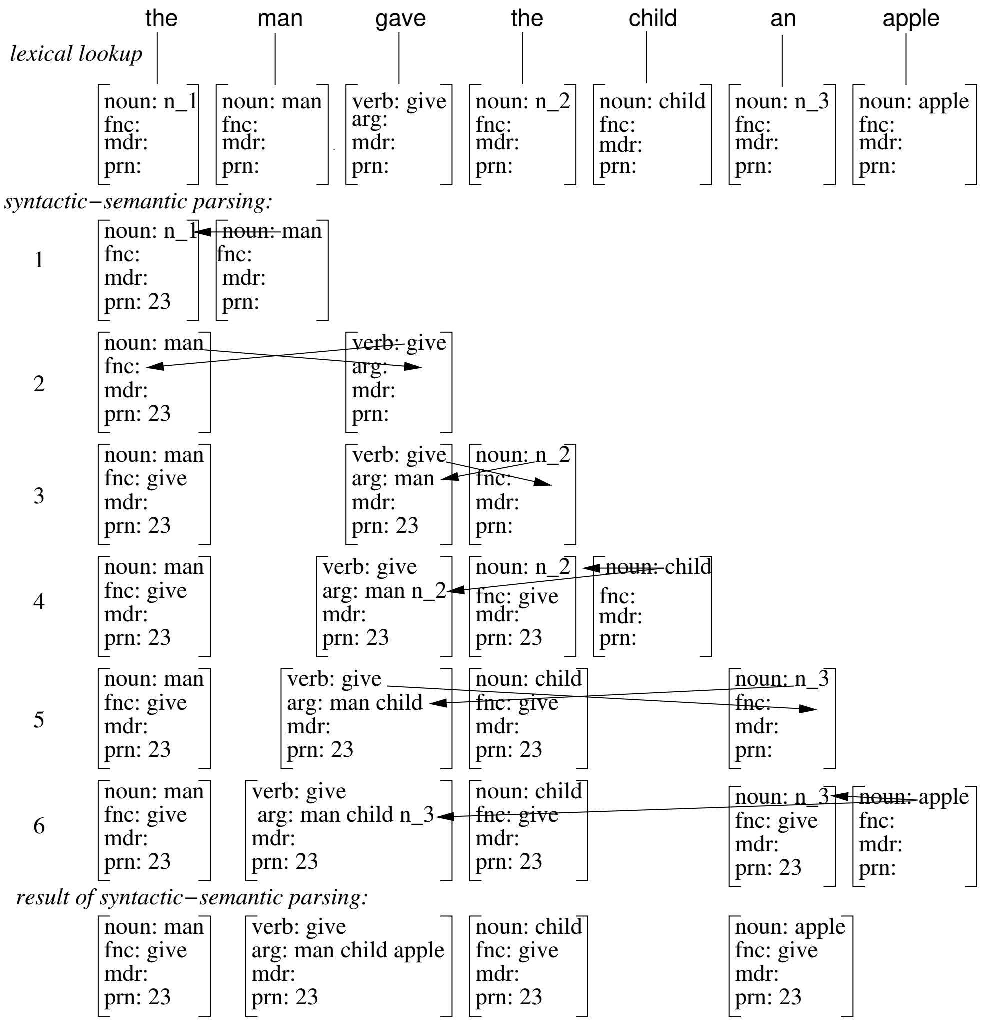
$$\begin{bmatrix}\text{verb: bark}\\ \text{arg: dog}\\ \text{mdr:}\\ \text{prn: 2}\end{bmatrix} \begin{bmatrix}\text{adj: black}\\ \text{mdd: dog}\\ \text{mdr:}\\ \text{prn: 2}\end{bmatrix} \begin{bmatrix}\text{adj: little}\\ \text{mdd: dog}\\ \text{mdr:}\\ \text{prn: 2}\end{bmatrix} \begin{bmatrix}\text{noun: dog}\\ \text{fnc: bark}\\ \text{mdr: little black}\\ \text{prn: 2}\end{bmatrix}$$

3. Representing Julia has been sleeping deeply (adverbial adjective)

$$\begin{bmatrix}\text{adj: deep}\\ \text{mdd: sleep}\\ \text{mdr:}\\ \text{prn: 3}\end{bmatrix} \begin{bmatrix}\text{noun: Julia}\\ \text{fnc: sleep}\\ \text{mdr:}\\ \text{prn: 3}\end{bmatrix} \begin{bmatrix}\text{verb: sleep}\\ \text{arg: Julia}\\ \text{mdr: deep}\\ \text{prn: 3}\end{bmatrix}$$

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

activated sequence					*realization*
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 [girl(x) $\rightarrow$ sleep(x)]

6.2.4 Interpretation relative to a model

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

6.2.5 Elimination of the outermost quantifier

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

6.2.6 Analyzing Every man loves a woman in Predicate Calculus

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

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

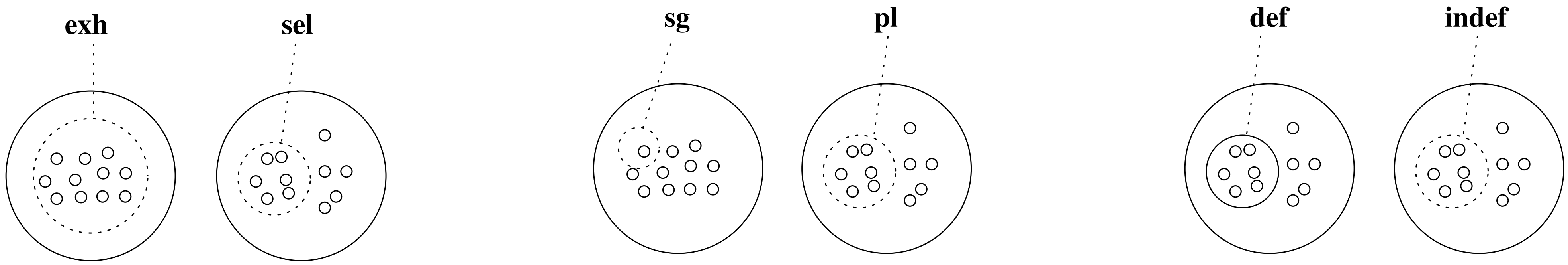
6.2.7 RESULT OF PARSING Every man loves a woman IN DBS

sur: noun: *man* cat: snp sem: pl exh mdr: fnc: love idy: 1 prn: 1	sur: verb: *love* cat: v sem: pres mdr: arg: man woman prn: 1	sur: noun: *woman* cat: snp sem: indef sg mdr: fnc: love idy: 2 prn: 1

6.2.8 THE sem VALUES OF DIFFERENT DETERMINER-NOUN COMBINATIONS

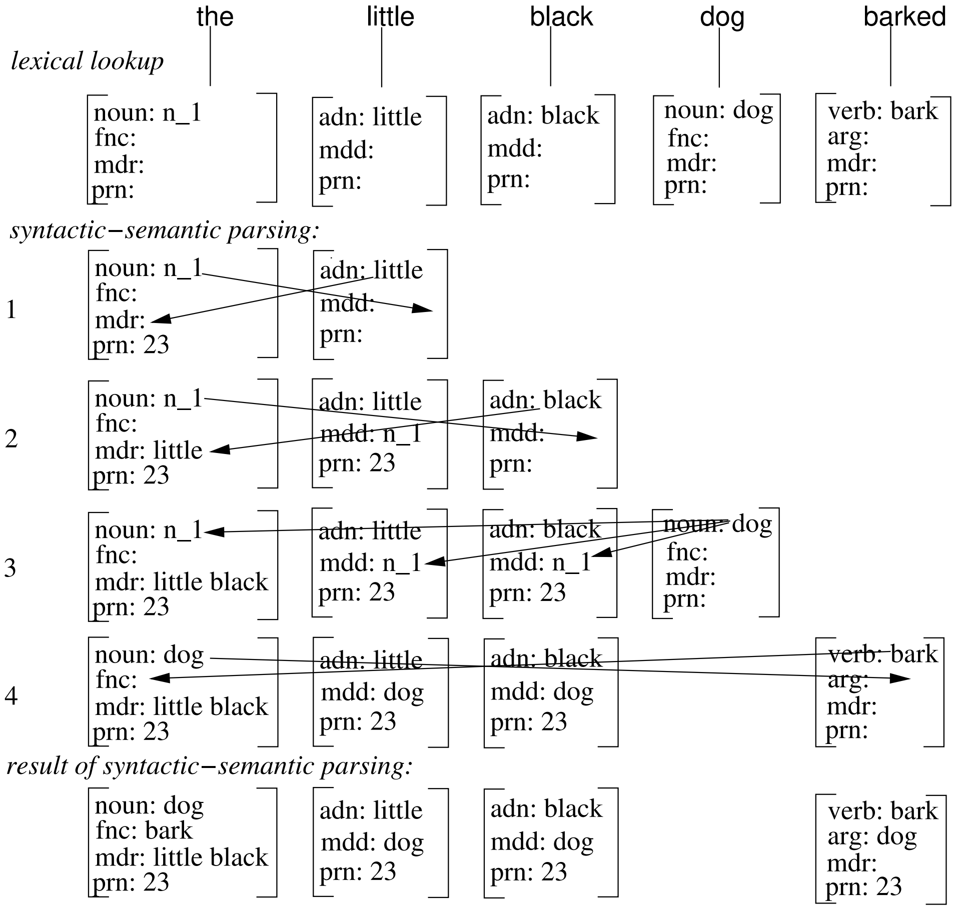
a girl	[sem: indef sg]
some girls	[sem: indef pl sel]
all girls	[sem: pl exh]
the girl	[sem: def sg]
the girls	[sem: def pl]

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



6.3 Adjectives

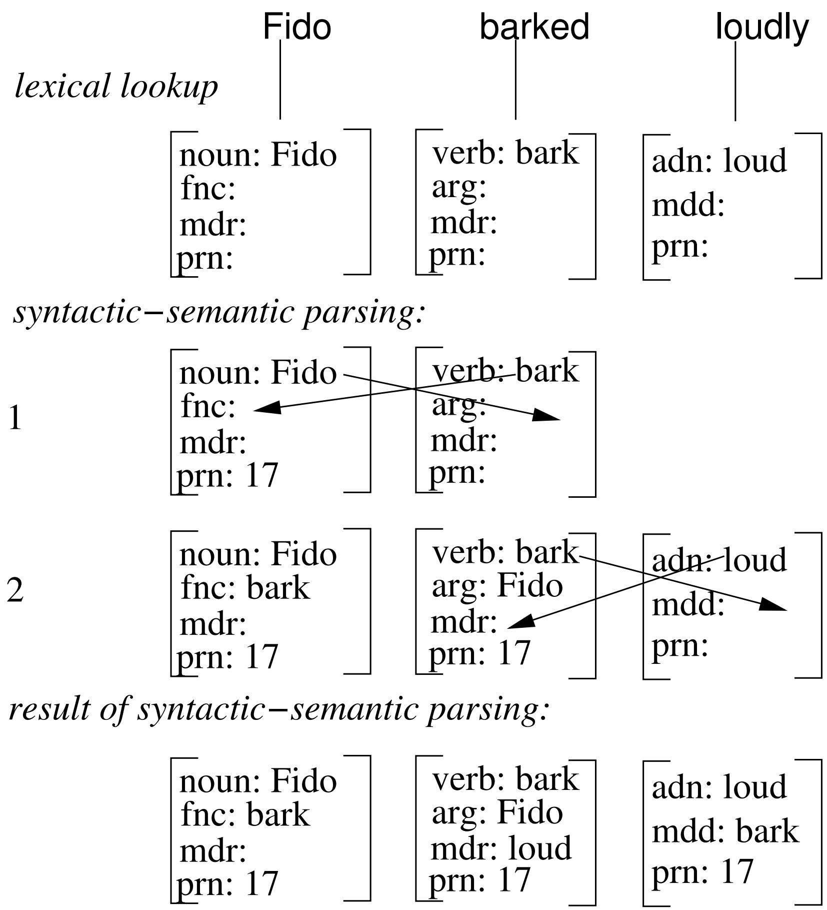
6.3.1 Parsing The little black dog barked in the hearer-mode



6.3.2 Schematic production of the The little black dog barked.

activated sequence		*realization*
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	

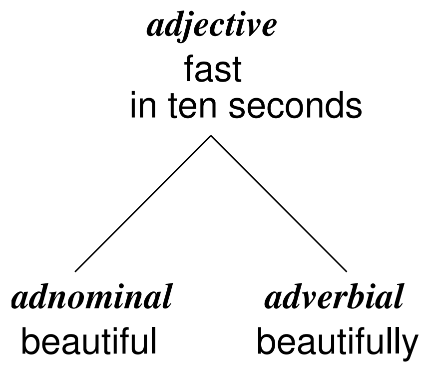
6.3.3 PARSING Fido barked loudly IN THE HEARER-MODE



6.3.4 Schematic production of the Fido barked loudly.

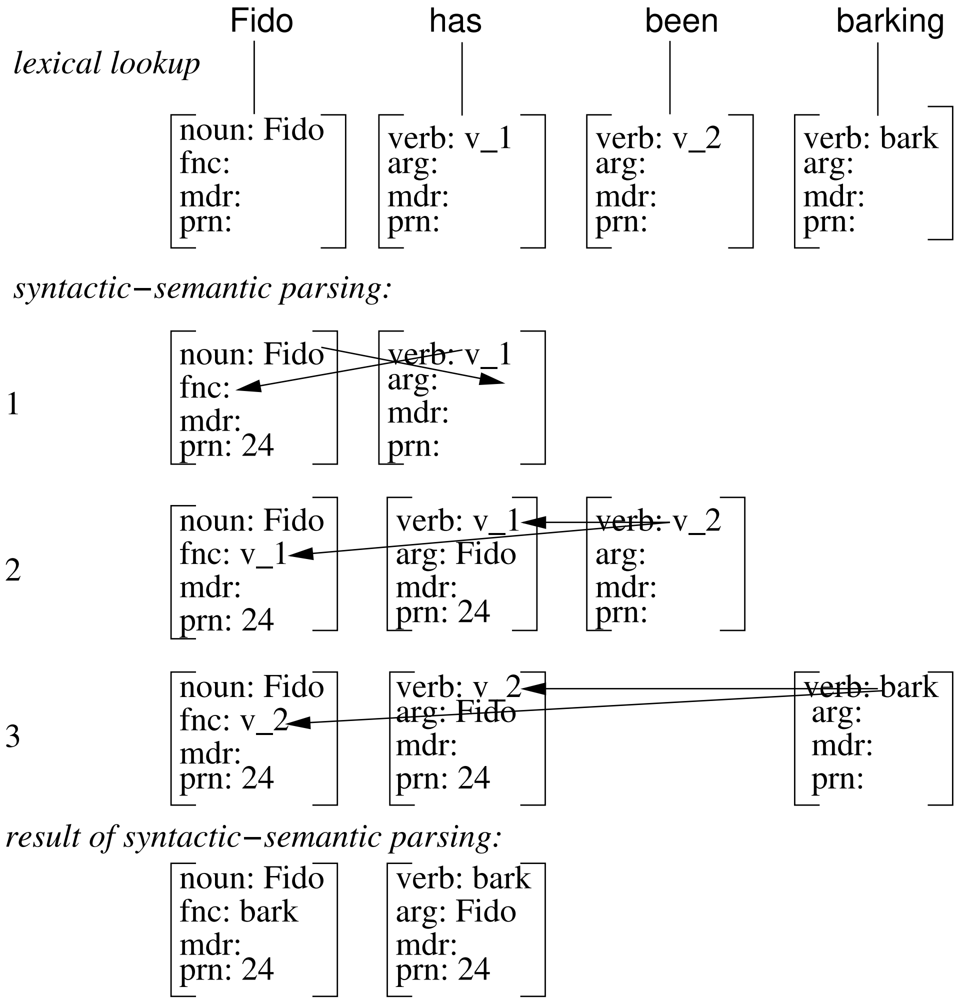
	activated sequence			*realization*
i				
	V			
i.1		n		n
	V	N		
i.2	fv	n		n fv
	V	N		
i.3	fv	n	av	n fv av
	V	N	A	
i.4	fv p	n	av	n fv av p
	V	N	A	

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.

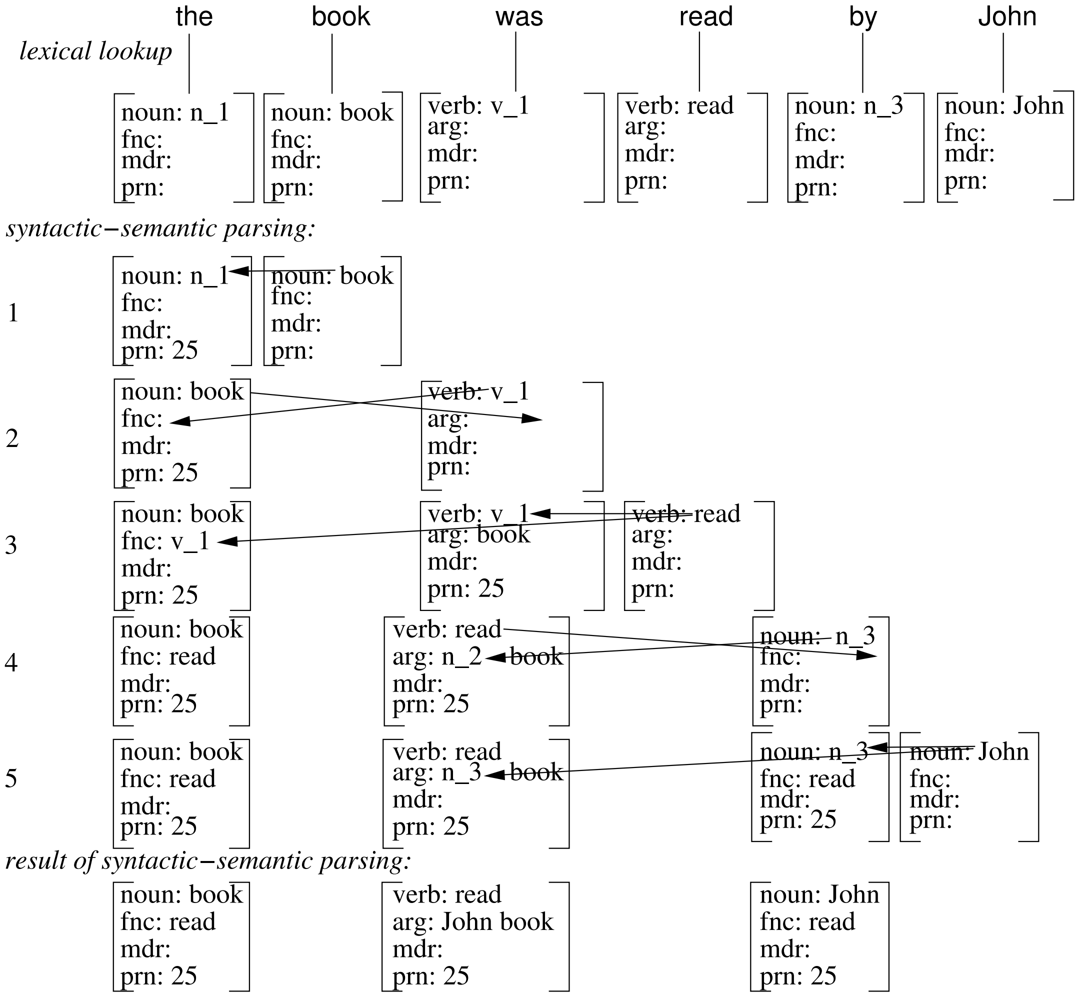


6.4.2 SCHEMATIC PRODUCTION OF Fido has been barking

	activated sequence		*realization*
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.

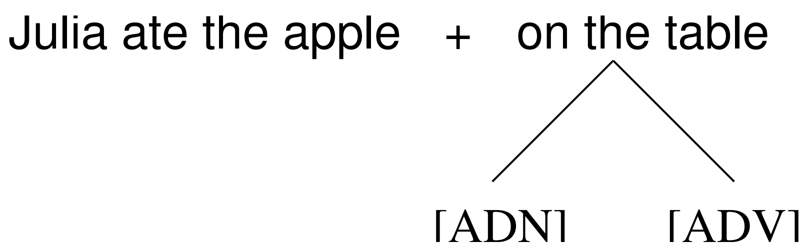


6.5.2 SCHEMATIC PRODUCTION OF The book was read by John.

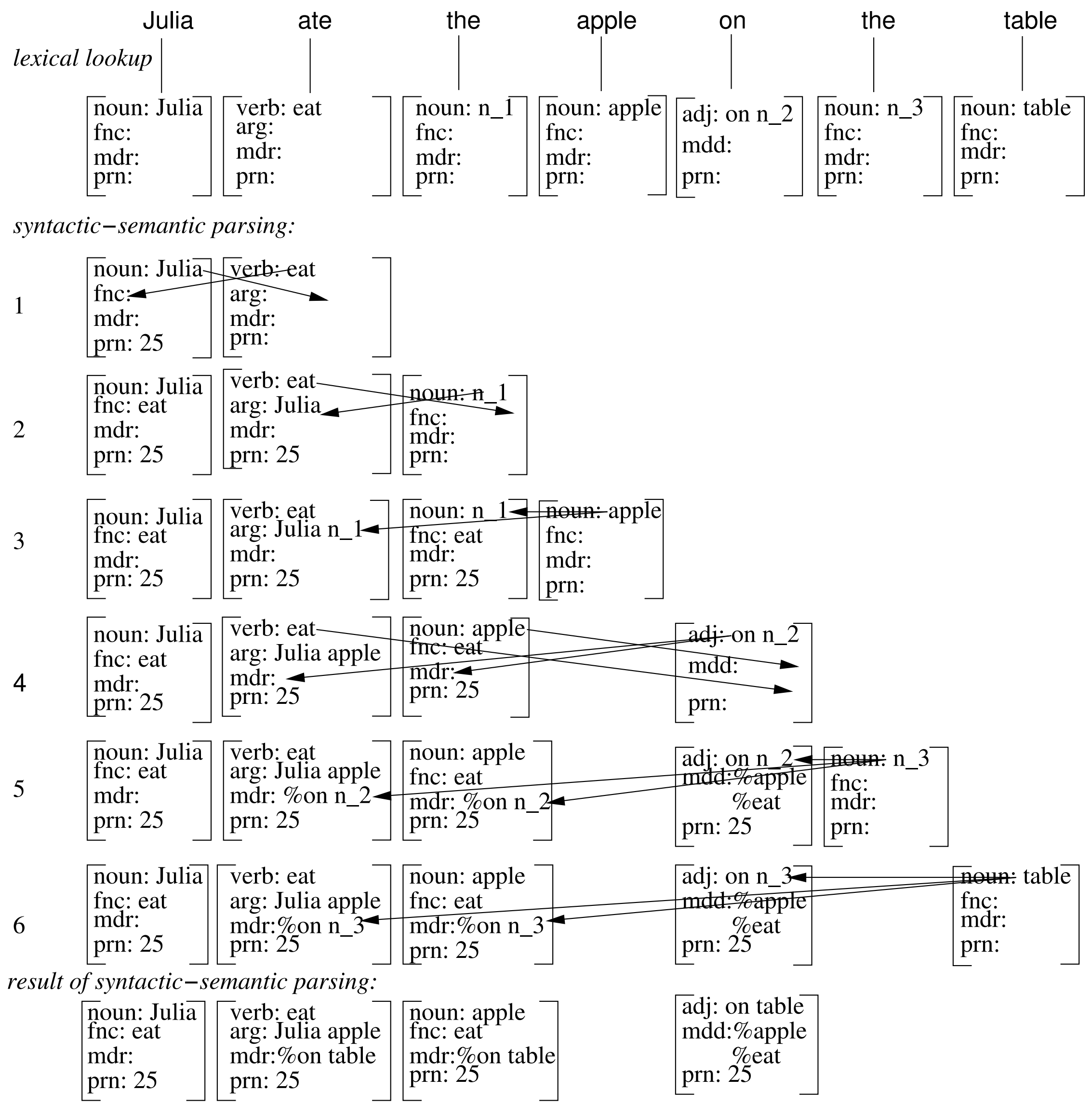
	activated sequence			*realization*
i				
	V			
i.1			d	d
	V		N	
i.2			d nn	d nn
	V		N	
i.3	ax		d nn	d nn ax
	V		N	
i.4	ax nv		d nn	d nn ax nv
	V		N	
i.5	ax nv	by	d nn	d nn ax nv by
	V	N	N	
i.6	ax nv	by n	d nn	d nn ax nv by n
	V	N	N	
i.7	ax nv p	by n	d nn	d nn ax nv by n p
	V	N	N	

6.6 Prepositions

6.6.1 SEMANTIC DOUBLING OF A PREPOSITIONAL PHRASE



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



6.6.3 RETRIEVAL DURING NAVIGATION

$$
\begin{bmatrix}\text{noun: Julia}\\ \text{fnc: eat}\\ \text{mdr:}\\ \text{prn: 25}\end{bmatrix}
\begin{bmatrix}\text{verb: eat}\\ \text{arg: Julia apple}\\ \text{mdr:\%on table}\\ \text{prn: 25}\end{bmatrix}
\begin{bmatrix}\text{noun: apple}\\ \text{fnc: eat}\\ \text{mdr:\%on table}\\ \text{prn: 25}\end{bmatrix}
\begin{bmatrix}\text{adj: on table}\\ \text{mdd:\%apple}\\ \quad\text{\%eat}\\ \text{prn: 25}\end{bmatrix}
$$

6.6.4 PRODUCTION OF Julia ate the apple on the table.

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

7. Extra-Propositional Functor-Argument Structure

7.1 Overview

7.1.1 Verb proplets of subordinate clauses

subject or object sentence	*adverbial sentence*	*adnominal sentence*
n/v: verb of the sub-clause	**a/v**: verb of the sub-clause	**a/v**: verb of the sub-clause
arg: noun(s) of the sub-clause	arg: noun(s) of the sub-clause	arg: noun(s) of the sub-clause
fnc: verb of the higher clause	**mdd: verb** of the higher clause	**mdd: noun** of the higher clause
prn: number of the sub-clause	prn: number of the sub-clause	prn: number of the sub-clause

7.1.2 Examples of extra-propositional functor-arg. structure

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

n/v: that bark	noun: Fido	verb: amuse	noun: Mary
arg: Fido	fnc: bark	arg: 27 bark Mary	fnc: amuse
fnc: 28 amuse	mdr:	mdr:	mdr:
prn: 27	prn: 27	prn: 28	prn: 28

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

$$\begin{bmatrix}\text{noun: John}\\ \text{fnc: hear}\\ \text{mdr:}\\ \text{prn: 30}\end{bmatrix} \begin{bmatrix}\text{verb: hear}\\ \text{arg: John 31 bark}\\ \text{mdr:}\\ \text{prn: 30}\end{bmatrix} \begin{bmatrix}\text{n/v: that bark}\\ \text{arg: Fido}\\ \text{fnc: 30 hear}\\ \text{prn: 31}\end{bmatrix} \begin{bmatrix}\text{noun: Fido}\\ \text{fnc: bark}\\ \text{mdr:}\\ \text{prn: 31}\end{bmatrix}$$

3. Representing The dog which saw Mary barked (adnominal sent., subject gap)

$$\begin{bmatrix}\text{noun: dog}\\ \text{fnc: bark}\\ \text{mdr: 33 see}\\ \text{prn: 32}\end{bmatrix} \begin{bmatrix}\text{a/v: see}\\ \text{arg: \# Mary}\\ \text{mdd:32 dog}\\ \text{prn: 33}\end{bmatrix} \begin{bmatrix}\text{noun: Mary}\\ \text{fnc: see}\\ \text{mdr:}\\ \text{prn: 33}\end{bmatrix} \begin{bmatrix}\text{verb: bark}\\ \text{arg: dog}\\ \text{mdr:}\\ \text{prn: 32}\end{bmatrix}$$

4. Representing The dog which Mary saw barked (adnominal sent., object gap)

$$\begin{bmatrix}\text{noun: dog}\\ \text{fnc: bark}\\ \text{mdr: 35 see}\\ \text{prn: 34}\end{bmatrix} \begin{bmatrix}\text{a/v: see}\\ \text{arg: Mary \#}\\ \text{mdd:34 dog}\\ \text{prn: 35}\end{bmatrix} \begin{bmatrix}\text{noun: Mary}\\ \text{fnc: see}\\ \text{mdr:}\\ \text{prn: 35}\end{bmatrix} \begin{bmatrix}\text{verb: bark}\\ \text{arg: dog}\\ \text{mdr:}\\ \text{prn: 34}\end{bmatrix}$$

5. Representing When Fido barked Mary smiled (adverbial sentence)

$$\begin{bmatrix}\text{a/v: when bark}\\ \text{arg: Fido}\\ \text{mdd:37 smile}\\ \text{prn: 36}\end{bmatrix} \begin{bmatrix}\text{noun: Fido}\\ \text{fnc: bark}\\ \text{mdr:}\\ \text{prn: 36}\end{bmatrix} \begin{bmatrix}\text{noun: Mary}\\ \text{fnc: smile}\\ \text{mdr:}\\ \text{prn: 37}\end{bmatrix} \begin{bmatrix}\text{verb: smile}\\ \text{arg: Mary}\\ \text{mdr: 36 bark}\\ \text{prn: 37}\end{bmatrix}$$

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 #

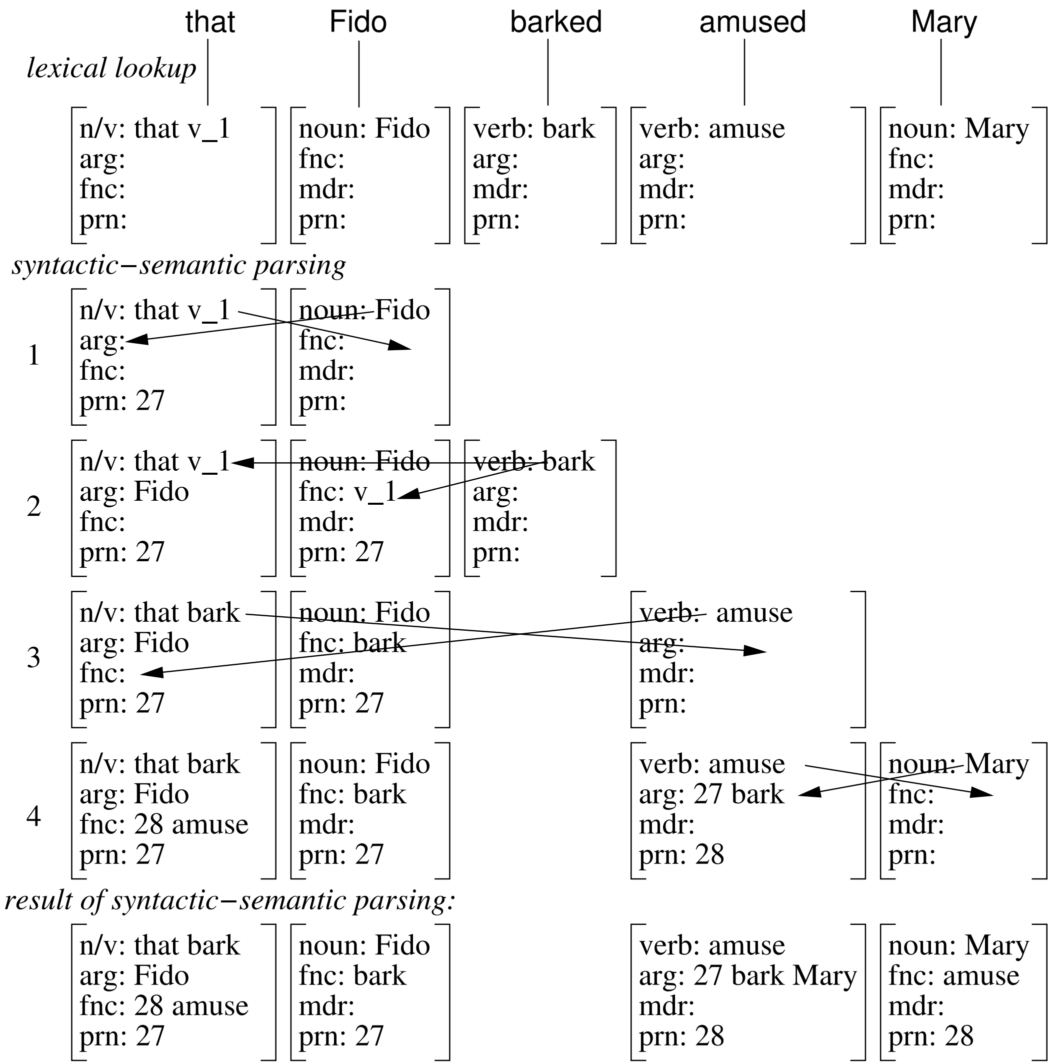
(iii) sentential modifier, adverbial

(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.

	activated sequence					*realization*
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.

	John	heard	that	Fido	barked
lexical lookup	noun: John fnc: mdr: prn:	verb: hear arg: mdr: prn:	n/v: that v_1 arg: fnc: prn:	noun: Fido fnc: mdr: prn:	verb: bark arg: mdr: prn:

syntactic−semantic derivation

1	noun: John fnc: mdr: prn: 30	verb: hear arg: mdr: prn:			
2	noun: John fnc: hear mdr: prn: 30	verb: hear arg: John mdr: prn: 30	n/v: that v_1 arg: fnc: prn:		
3	noun: John fnc: hear mdr: prn: 30	verb: hear arg: John 31 v_1 mdr: prn: 30	n/v: that v_1 arg: fnc: 30 hear prn: 31	noun: Fido fnc: mdr: prn:	
4	noun: John fnc: hear mdr: prn: 30	verb: hear arg: John 31 v_1 mdr: prn: 30	n/v: that v_1 arg: Fido fnc: 30 hear prn: 31	noun: Fido fnc: v_1 mdr: prn: 31	verb: bark arg: mdr: prn:

result of syntactic−semantic parsing:

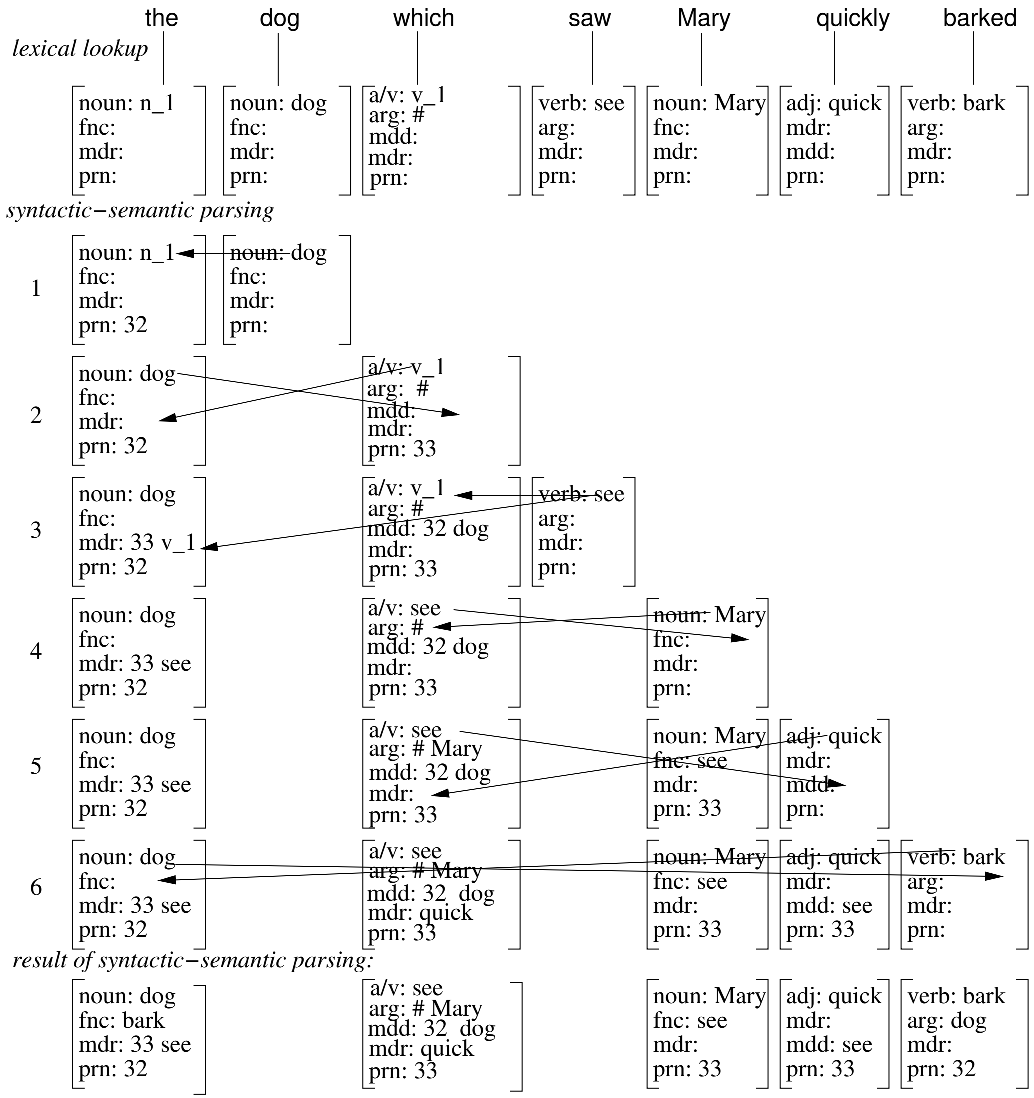
noun: John fnc: hear mdr: prn: 30	verb: hear arg: John 31 bark mdr: prn: 30	n/v: that bark arg: Fido fnc: 30 hear prn: 31	noun: Fido fnc: bark mdr: prn: 31

7.3.2 Schematic production of John heard that Fido barked.

	activated sequence				*realization*
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

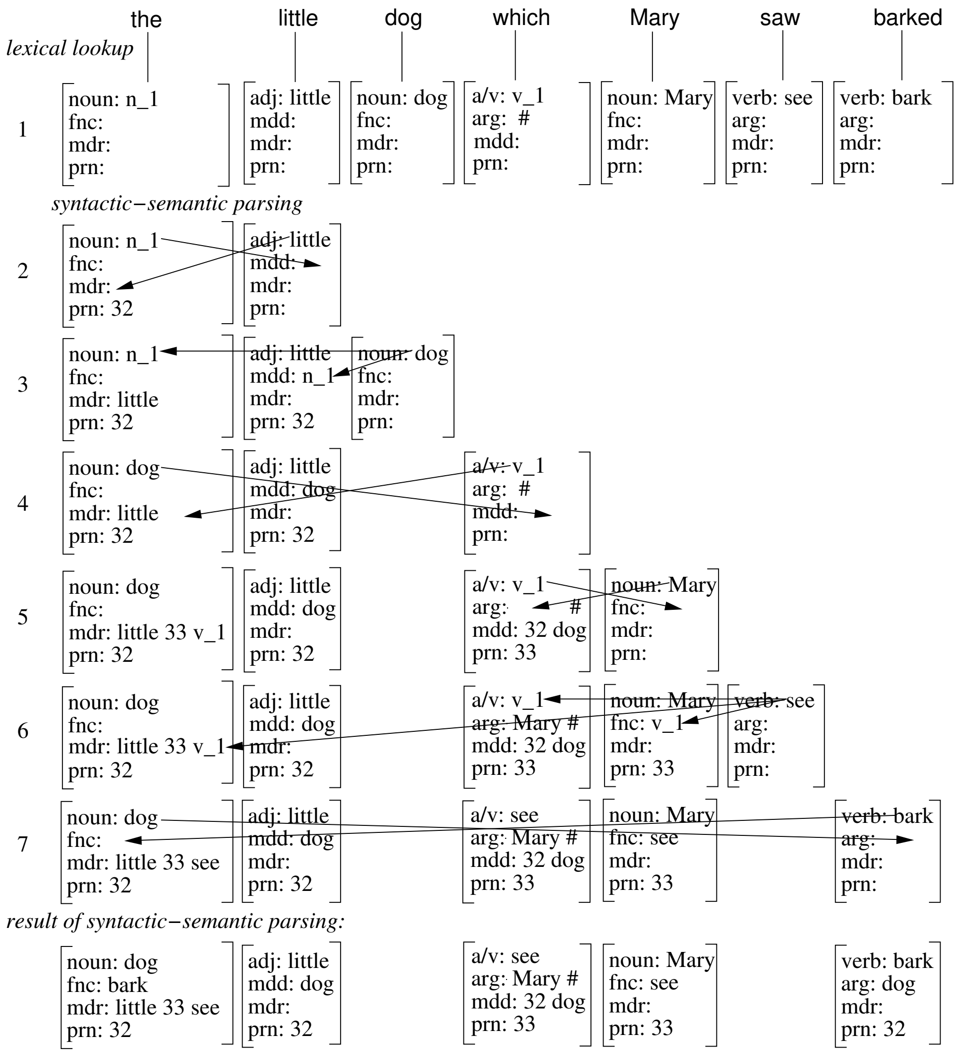
noun: dog	a/v: see	noun: Mary	adj: quick	verb: bark
fnc: bark	arg: # Mary	fnc: see	mdd: bark	arg: dog
mdr: 33 see	mdd: 32 dog	mdr:	mdr:	mdr: quick
prn: 32	mdr:	prn: 33	prn: 32	prn: 32
	prn: 33			

7.4.3 PRODUCTION OF The dog which saw Mary quickly barked

	activated sequence					*realization*
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.

activated sequence						*realization*
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.

	when	Fido	barked	Mary	smiled
lexical lookup	a/v: when v_1 arg: mdd: prn:	noun: Fido fnc: mdr: prn:	verb: bark arg: mdr: prn:	noun: Mary fnc: mdr: prn:	verb: smile arg: mdr: prn:
syntactic−semantic parsing					
1	a/v: when v_1 arg: mdd prn: 27	noun: Fido fnc: mdr: prn:			
2	a/v: when v_1 arg: Fido mdd: prn: 27	noun: Fido fnc: v_1 mdr: prn: 27	verb: bark arg: mdr: prn:		
3	a/v: when bark arg: Fido mdd: prn: 27	noun: Fido fnc: bark mdr: prn: 27		noun: Mary fnc: mdr: prn:	
4	a/v: when bark arg: Fido mdd: prn: 27	noun: Fido fnc: bark mdr: prn: 27		noun: Mary fnc: mdr: prn:	verb: smile arg: mdr: prn: 28
result of syntactic−semantic parsing:	a/v: when bark arg: Fido mdd: 28 smile prn: 27	noun: Fido fnc: bark mdr: prn: 27		noun: Mary fnc: smile mdr: prn: 28	verb: smile arg: Mary mdr: 27 bark prn: 28

7.6.2 Production of When Fido barked Mary smiled.

	activated sequence					*realization*
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

noun: man &	noun: woman	noun: child
fnc:	fnc:	fnc:
mdr:	mdr:	mdr:
nc: woman	nc: child	nc:
pc:	pc: man	pc: woman
prn: 26	prn: 26	prn: 26

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

noun: man &	noun: woman	noun: child	verb: sleep
fnc: sleep	fnc:	fnc:	arg: man &
mdr:	mdr:	mdr:	mdr:
nc: woman	nc: child	nc:	nc:
pc:	pc: man	pc: woman	pc:
prn: 26	prn: 26	prn: 26	prn: 26

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.

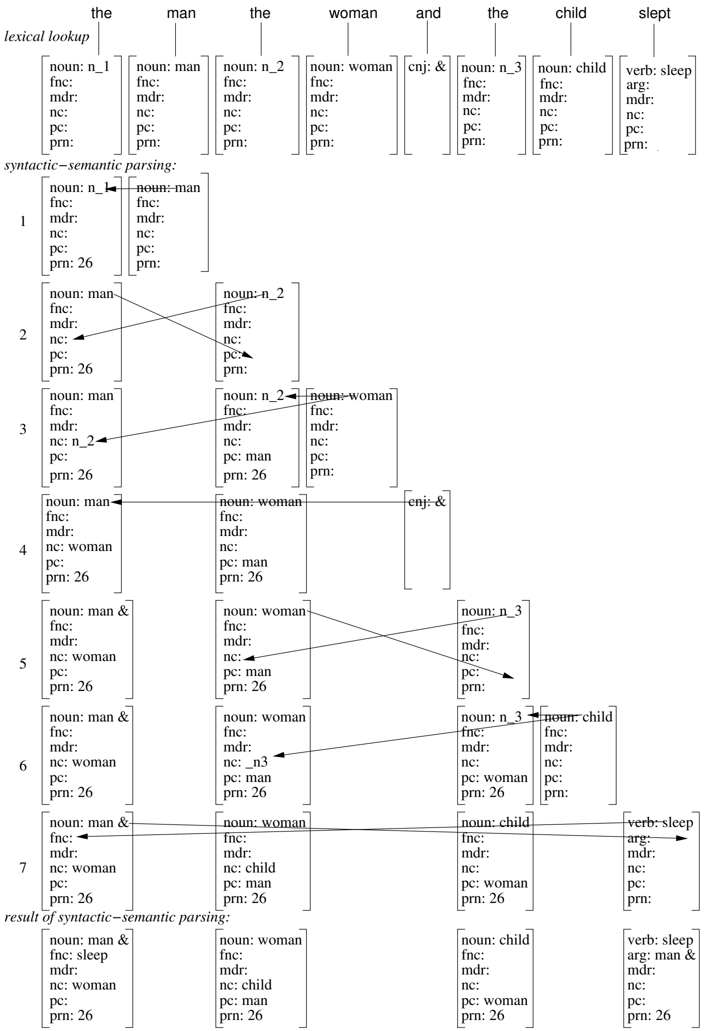
8.1.4 Comparing simple and complex coordination

(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.

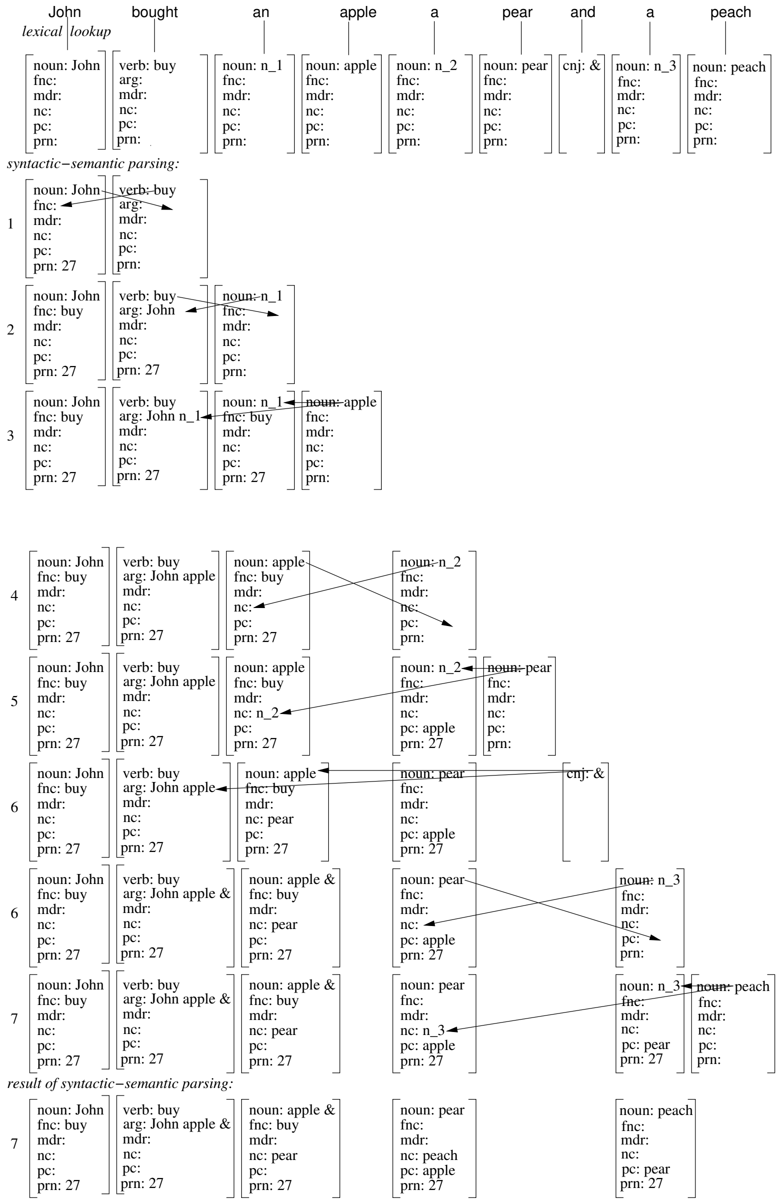
activated sequence *realization*

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

noun: man &	noun: woman	noun: child	verb: buy	noun: apple &	noun: pear	noun: peach
fnc: buy	fnc:	fnc:	arg: man & apple &	fnc: buy	fnc:	fnc:
nc:	nc:	nc:		nc:	nc:	nc:
pc:	pc:	pc:		pc:	pc:	pc:

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.

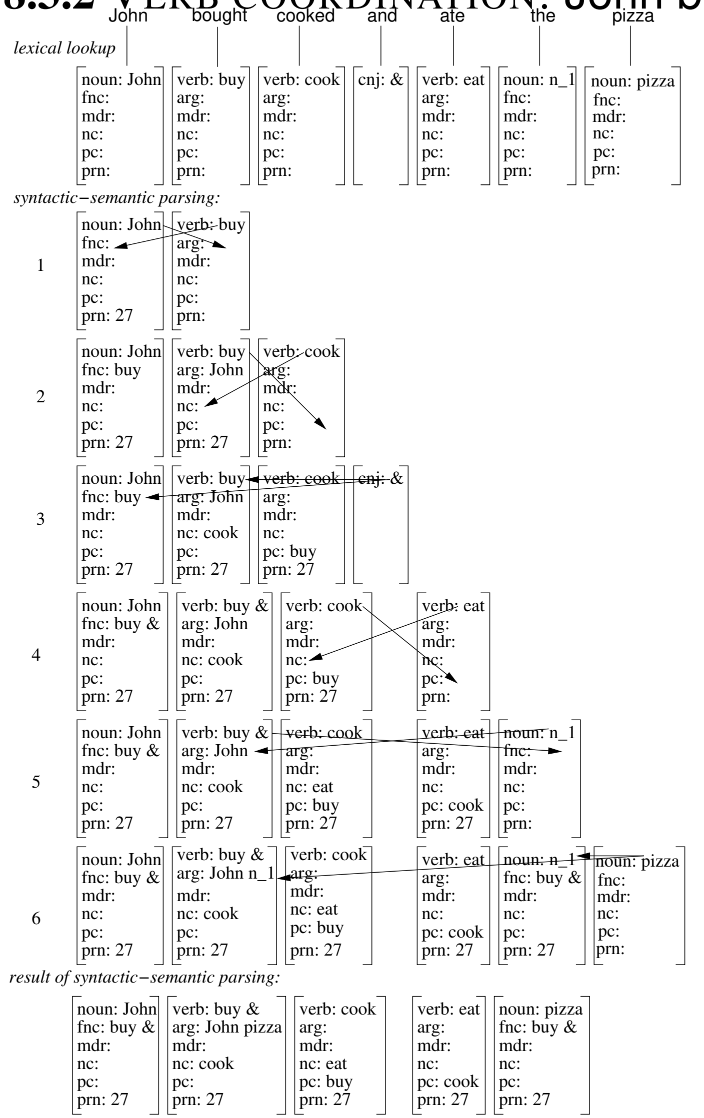
	activated sequence					*realization*
i.						
	V					
i.1		n				n
	V	N				
i.2	fv	n				n fv
	V	N				
i.3	fv	n	d			n fv d
	V	N	N			
i.4	fv	n	d nn			n fv d nn
	V	N	N			
i.5	fv	n	d nn	d		n fv d nn d
	V	N	N			
i.6	fv	n	d nn	d nn		n fv d nn d nn
	V	N	N	N		
i.7	fv	n	d nn cc	d nn		n fv d nn d nn cc
	V	N	N	N		
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

$$
\begin{bmatrix} \text{noun: John} \\ \text{fnc: buy \&} \\ \text{nc:} \\ \text{pc:} \end{bmatrix}
\begin{bmatrix} \text{verb: buy \&} \\ \text{arg: John pizza} \\ \text{nc:} \\ \text{pc:} \end{bmatrix}
\begin{bmatrix} \text{verb: cook} \\ \text{arg:} \\ \text{nc:} \\ \text{pc:} \end{bmatrix}
\begin{bmatrix} \text{verb: eat} \\ \text{arg:} \\ \text{nc:} \\ \text{pc:} \end{bmatrix}
\begin{bmatrix} \text{noun: pizza} \\ \text{fnc: buy \&} \\ \text{nc:} \\ \text{pc:} \end{bmatrix}
$$

8.3.2 Verb coordination: John bought, cooked, and ate the pizza



8.3.3 Production of John bought, cooked, and ate the pizza.

activated sequence						*realization*
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

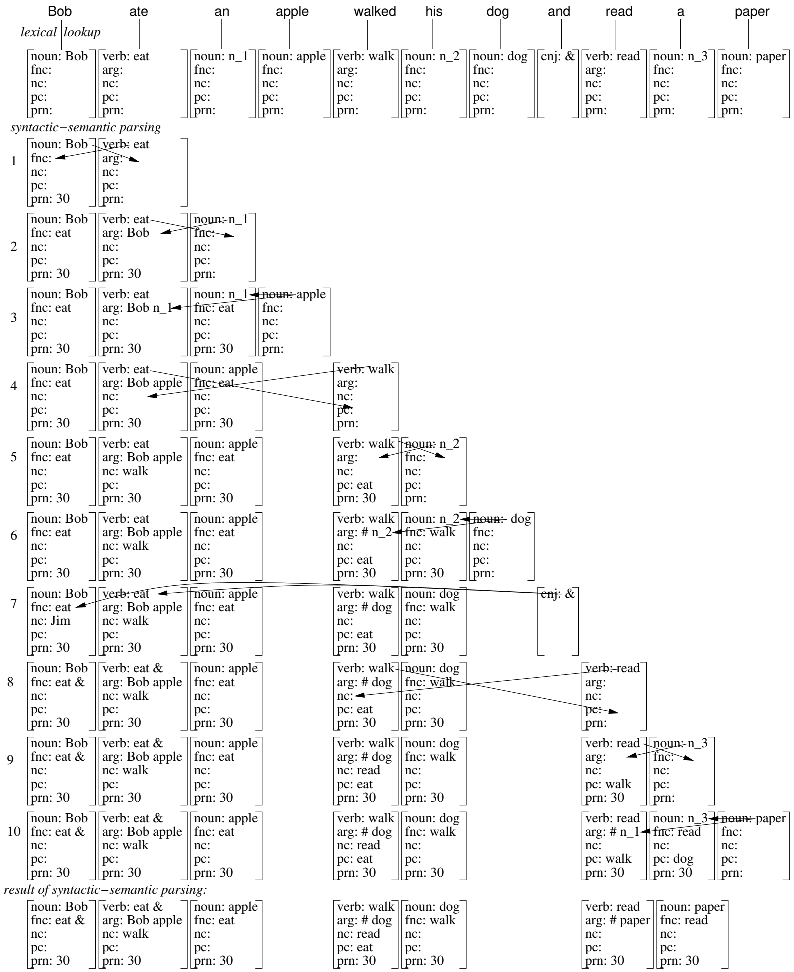
noun: John	verb: love	noun: girl	adj: smart &	adj: pretty	adj: rich
fnc: love	arg: John girl	fnc: love	mdr: B	mdr: B	mdr: B
mdr:	mdr::	mdr: smart &	mdd: girl	mdd:	mdd:
nc:	nc:	nc:	nc: pretty	nc: rich	nc:
pc:	pc:	pc:	pc:	pc: smart	pc: pretty
prn: 21	prn: 21	prn: 21	prn: 21	prn: 21	prn: 21

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

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

noun: Bob	verb: buy &	verb: peel	verb: eat
fnc: buy &	arg: Bob apple	arg: # pear	arg: # peach
nc:	nc: peel	nc: eat	nc:
pc:	pc:	pc: buy	pc: peel
shared subject	noun: apple	noun: pear	noun: peach
	fnc: buy	fnc: peel	fnc: eat
	nc:	nc:	nc:
	pc:	pc:	pc:

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

noun: Bob	verb: buy &	verb: peel	verb: eat
fnc: buy &	arg: Bob apple	arg: # pear	arg: # peach
nc:	nc: peel	nc: eat	nc:
pc:	pc:	pc: buy	pc: peel
shared subject	noun: apple	noun: pear	noun: peach
	fnc: buy	fnc: peel	fnc: eat
	nc:	nc:	nc:
	pc:	pc:	pc:

8.4.4 Corresponding simple verb and object coordinations

shared subject

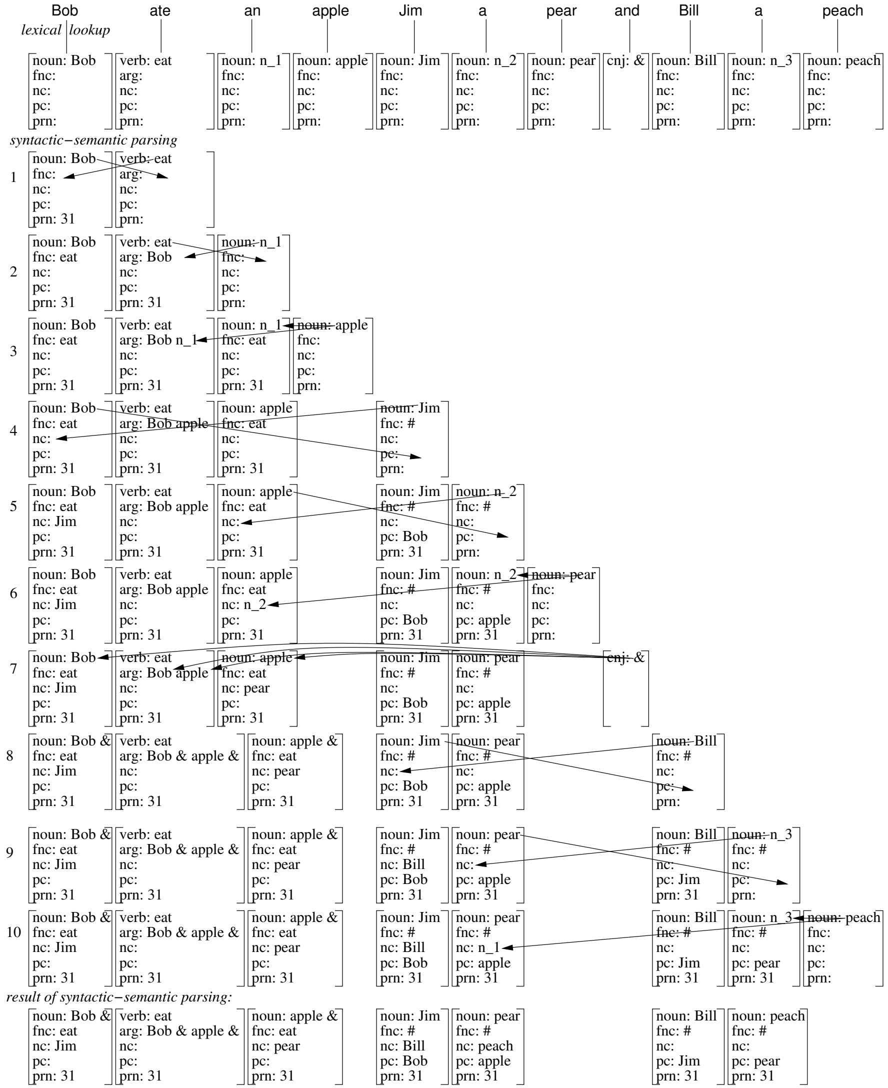
noun: Bob	verb: buy &	verb: peel	verb: eat	noun: apple &	noun: pear	noun: peach
fnc: buy &	arg: Bob apple &	arg:	arg:	fnc: buy &	fnc:	fnc:
nc:	nc: peel	nc: eat	nc:	nc: pear	nc: peach	nc:
pc:	pc:	pc: buy	pc: peel	pc: apple	pc: apple	pc: pear

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

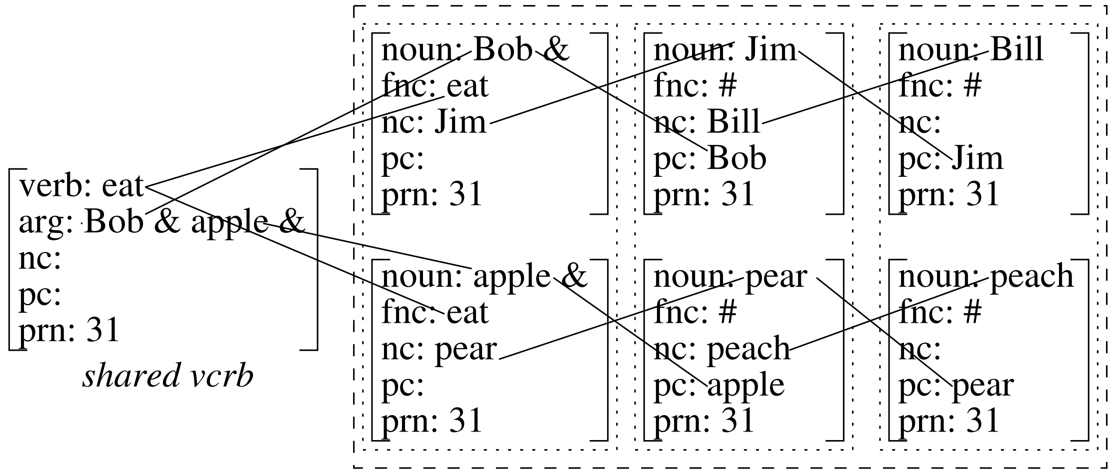
activated sequence								*realization*
i								
	V							
i.1		n						n
	V	N						
i.2	fv	n						n fv
	V	N						
i.3	fv	n	d					n fv d
	V	N	N					
i.4	fv	n	d nn					n fv d nn
	V	N	N					
i.5	fv	n	d nn	fv				n fv d nn fv
	V	N	N	V				
i.6	fv	n	d nn	fv	d			n fv d nn fv d
	V	N	N	V	N			
i.7	fv	n	d nn	fv	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

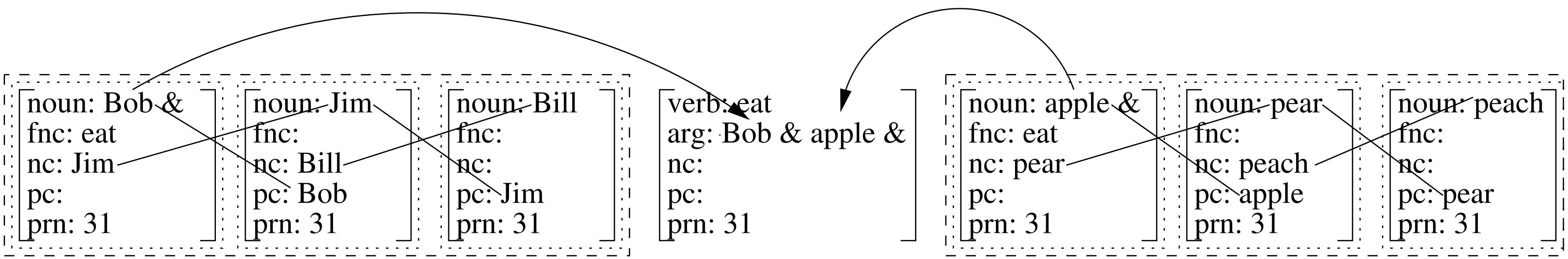
8.5.1 Verb gapping: Bob ate an apple, Jim # a pear, and Bill # a peach



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.

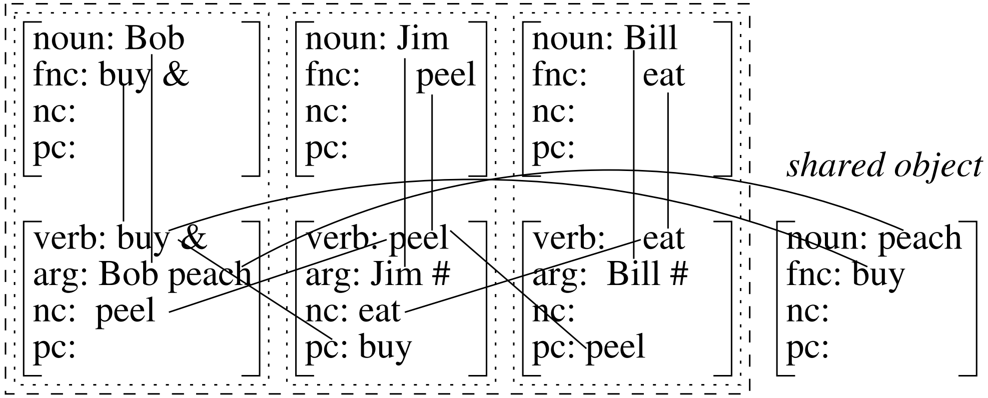
activated sequence								*realization*
i								
	V							
i.1		n						n
	V	N						
i.2	fv	n						n fv
	V	N						
i.3	fv	n	d					n fv d
	V	N	N					
i.4	fv	n	d nn					n fv d nn
	V	N	N					
i.5	fv	n	d nn	n				n fv d nn n
	V	N	N	N				
i.6	fv	n	d nn	n	d			n fv d nn n d
	V	N	N	N	N			
i.7	fv	n	d nn	n	d nn			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

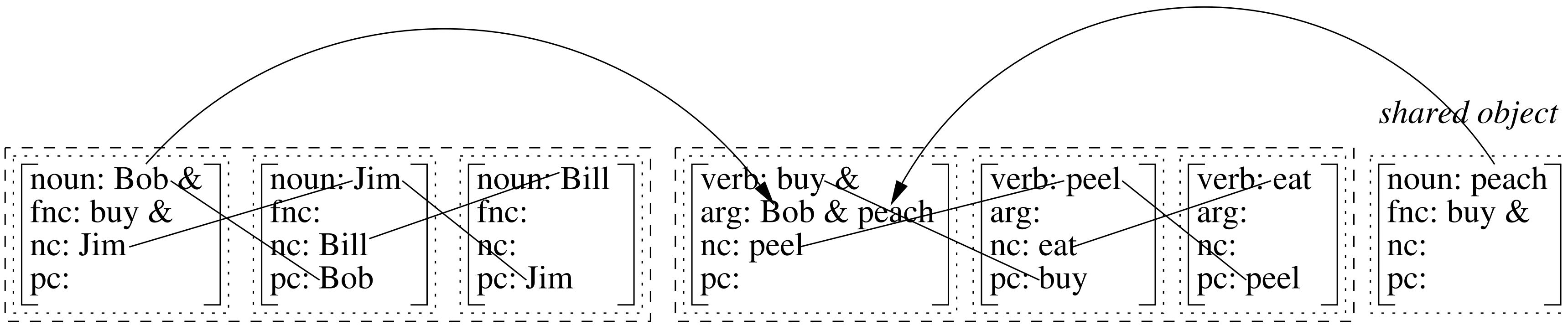
8.6.1 Object gapping: Bob bought #, Jim peeled #, and Bill ate the peach

	Bob	bought	Jim	peeled	and	Bill	ate	the	peach
lexical lookup	noun: Bob fnc: nc: pc: prn:	verb: buy arg: nc: pc: prn:	noun: Jim fnc: nc: pc: prn:	verb: peel arg: nc: pc: prn:	cnj: &	noun: Bill fnc: nc: pc: prn:	verb: eat arg: nc: pc: prn:	noun: n_1 fnc: nc: pc: prn:	noun: peach fnc: nc: pc: prn:
syntactic−semantic parsing									
1	noun: Bob fnc: nc: pc: prn: 32	verb: buy arg: nc: pc: prn:							
2	noun: Bob fnc: buy nc: pc: prn: 32	verb: buy arg: Bob nc: pc: prn: 32	noun: Jim fnc: nc: pc: prn:						
3	noun: Bob fnc: buy nc: pc: prn: 32	verb: buy arg: Bob nc: pc: prn: 32	noun: Jim fnc: nc: pc: prn: 32	verb: peel arg: nc: pc: prn:					
4	noun: Bob fnc: buy nc: pc: prn: 32	verb: buy arg: Bob nc: peel pc: prn: 32	noun: Jim fnc: peel nc: pc: prn: 32	verb: peel arg: Jim # nc: pc: buy prn: 32	cnj: &				
5	noun: Bob fnc: buy & nc: pc: prn: 32	verb: buy & arg: Bob nc: peel pc: prn: 32	noun: Jim fnc: peel nc: pc: prn: 32	verb: peel arg: Jim # nc: pc: buy prn: 32		noun: Bill fnc: nc: pc: prn:			
6	noun: Bob fnc: buy & nc: pc: prn: 32	verb: buy & arg: Bob nc: peel pc: prn: 32	noun: Jim fnc: peel nc: pc: prn: 32	verb: peel arg: Jim # nc: pc: buy prn: 32		noun: Bill fnc: nc: pc: prn: 32	verb: eat arg: nc: pc: prn:		
7	noun: Bob fnc: buy & nc: pc: prn: 32	verb: buy & arg: Bob nc: peel pc: prn: 32	noun: Jim fnc: peel nc: pc: prn: 32	verb: peel arg: Jim # nc: eat pc: buy prn: 32		noun: Bill fnc: eat nc: pc: prn: 32	verb: eat arg: Bill # nc: pc: peel prn: 32	noun: n_1 fnc: nc: pc: prn:	
8	noun: Bob fnc: buy & nc: pc: prn: 32	verb: buy & arg: Bob n_1 nc: peel pc: prn: 32	noun: Jim fnc: peel nc: pc: prn: 32	verb: peel arg: Jim # nc: eat pc: buy prn: 32		noun: Bill fnc: eat nc: pc: prn: 32	verb: eat arg: Bill # nc: pc: peel prn: 32	noun: n_1 fnc: buy nc: pc: prn: 32	noun: peach fnc: nc: pc: prn:
result of syntactic−semantic parsing:	noun: Bob fnc: buy & nc: pc: prn: 32	verb: buy & arg: Bob peach nc: peel pc: prn: 32	noun: Jim fnc: peel nc: pc: prn: 32	verb: peel arg: Jim # nc: eat pc: buy prn: 32		noun: Bill fnc: eat nc: pc: prn: 32	verb: eat arg: Bill # nc: pc: peel prn: 32	noun: peach fnc: buy nc: pc: prn: 32	

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.

activated sequence								*realization*
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

noun: Julia	verb: sing	noun: Sue	verb: sleep	noun: John	verb: read
fnc: sing	arg: Julia	fnc: sleep	arg: Sue	fnc: read	arg: John
mdr:	mdr:	mdr:	mdr:	mdr:	mdr:
nc:	nc: > 11 sleep	nc:	nc: 12 read	nc:	nc:
pc:	pc:	pc:	pc: < 10 sing	pc:	pc: 11 sleep
prn: 10	prn: 10	prn: 11	prn: 11	prn: 12	prn: 12
1	2	3	4	5	6

9.1.2 Combining intra- and extra-propositional coordinations

noun: Sue	verb: sleep	noun: John	verb: buy &	verb: cook	verb: eat	noun: pizza	noun: Julia	verb: sing
fnc: sleep	arg: Sue	fnc: buy &	arg: John pizza	arg:	arg:	fnc: buy &	fnc: sing	arg: Julia
mdr:	mdr:	mdr:	mdr:	mdr:	mdr:	mdr:	mdr:	mdr:
nc:	nc: 27 buy &	nc:	nc: cook	nc: eat	nc: 28 sing	nc:	nc:	nc:
pc:	pc:	pc:	pc: 26 sleep	pc: buy	pc: cook	pc:	pc:	pc: 27 eat
prn: 26	prn: 26	prn: 27	prn: 27	prn: 27	prn: 27	prn: 27	prn: 28	prn: 28
1	2	3	4	5	6	7	8	9

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.

	Julia	slept	.	John	sang	.
lexical lookup	noun: Julia fnc: mdr: nc: pc: prn:	verb: sleep arg: mdr: nc: pc: prn:	pnc:.	noun: John fnc: mdr: nc: pc: prn:	verb: sing arg: mdr: nc: pc: prn:	pnc:.
syntactic−semantic parsing:						
1	noun: Julia fnc: mdr: nc: pc: prn: 29	verb: sleep arg: mdr: nc: pc: prn:				
2	noun: Julia fnc: sleep mdr: nc: pc: prn: 29	verb: sleep arg: Julia mdr: nc: pc: prn: 29	pnc:.			
3	noun: Julia fnc: sleep mdr: nc: pc: prn: 29	verb: sleep arg: Julia mdr: nc: pc: prn: 29		noun: John fnc: mdr: nc: pc: prn:		
4	noun: Julia fnc: sleep mdr: nc: pc: prn: 29	verb: sleep arg: Julia mdr: nc: pc: prn: 29		noun: John fnc: mdr: nc: pc: prn: 30	verb: sing arg: mdr: nc: pc: prn:	
5	noun: Julia fnc: sleep mdr: nc: pc: prn: 29	verb: sleep arg: Julia mdr: nc: 30 sing pc: prn: 29		noun: John fnc: sing mdr: nc: pc: prn: 30	verb: sing arg: John mdr: nc: pc: 29 sleep prn: 30	pnc:.
result of syntactic−semantic parsing:	noun: Julia fnc: sleep mdr: nc: pc: prn: 29	verb: sleep arg: Julia mdr: nc: 30 sing pc: prn: 29		noun: John fnc: sing mdr: nc: pc: prn: 30	verb: sing arg: John mdr: nc: pc: 29 sleep prn: 30	

9.2.2 PRODUCTION OF Julia slept. John sang.

	activated sequence				*realization*
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.

$$
\begin{bmatrix}\text{n/v: that sleep}\\ \text{arg: man \&}\\ \text{fnc: 9 surprise}\\ \text{prn: 8}\end{bmatrix}
\begin{bmatrix}\text{noun: man \&}\\ \text{fnc: sleep}\\ \text{nc: woman}\\ \text{pc:}\\ \text{prn: 8}\end{bmatrix}
\begin{bmatrix}\text{noun: woman}\\ \text{fnc:}\\ \text{nc: child}\\ \text{pc: man}\\ \text{prn: 8}\end{bmatrix}
\begin{bmatrix}\text{noun: child}\\ \text{fnc:}\\ \text{nc:}\\ \text{pc: woman}\\ \text{prn: 8}\end{bmatrix}
$$

$$
\begin{bmatrix}\text{verb: surprise}\\ \text{arg: 8 sleep Mary}\\ \text{prn: 9}\end{bmatrix}
\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: surprise}\\ \text{prn: 9}\end{bmatrix}
$$

2. Verb coordination in a subject sentence:

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

$$\begin{bmatrix}\text{noun: man}\\ \text{fnc: buy \&}\\ \text{prn: 10}\end{bmatrix} \begin{bmatrix}\text{n/v: that buy \&}\\ \text{arg: man pizza}\\ \text{fnc: 11 surprise}\\ \text{nc: cook}\\ \text{pc:}\\ \text{prn: 10}\end{bmatrix} \begin{bmatrix}\text{verb: cook}\\ \text{arg:}\\ \text{nc: eat}\\ \text{pc: buy}\\ \text{prn: 10}\end{bmatrix} \begin{bmatrix}\text{verb: eat}\\ \text{arg:}\\ \text{nc:}\\ \text{pc: cook}\\ \text{prn: 10}\end{bmatrix} \begin{bmatrix}\text{noun: pizza}\\ \text{fnc: buy \&}\\ \text{prn: 10}\end{bmatrix}$$

$$\begin{bmatrix}\text{verb: surprise}\\ \text{arg: 10 buy \& Mary}\\ \text{prn: 11}\end{bmatrix} \begin{bmatrix}\text{noun: Mary}\\ \text{fnc: surprise}\\ \text{prn: 11}\end{bmatrix}$$

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

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

$$\begin{bmatrix}\text{noun: Bob}\\ \text{fnc: eat}\\ \text{prn: 12}\end{bmatrix} \begin{bmatrix}\text{n/v: that eat}\\ \text{arg: Bob apple \&}\\ \text{fnc: 13 surprise}\\ \text{prn: 12}\end{bmatrix} \begin{bmatrix}\text{noun: apple \&}\\ \text{fnc: eat}\\ \text{nc: pear}\\ \text{pc:}\\ \text{prn: 12}\end{bmatrix} \begin{bmatrix}\text{noun: pear}\\ \text{fnc:}\\ \text{nc: peach}\\ \text{pc: apple}\\ \text{prn: 12}\end{bmatrix} \begin{bmatrix}\text{noun: peach}\\ \text{fnc:}\\ \text{nc:}\\ \text{pc: pear}\\ \text{prn: 12}\end{bmatrix}$$

$$\begin{bmatrix}\text{verb: surprise}\\ \text{arg: 12 eat Mary}\\ \text{prn: 13}\end{bmatrix} \begin{bmatrix}\text{noun: Mary}\\ \text{fnc: surprise}\\ \text{prn: 13}\end{bmatrix}$$

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.

$$\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: see}\\ \text{prn: 14}\end{bmatrix} \begin{bmatrix}\text{verb: see}\\ \text{arg: Mary 15 sleep}\\ \text{prn: 14}\end{bmatrix}$$

$$\begin{bmatrix}\text{n/v: that sleep}\\ \text{arg: man \&}\\ \text{fnc: 14 see}\\ \text{prn: 15}\end{bmatrix} \begin{bmatrix}\text{noun: man \&}\\ \text{fnc: sleep}\\ \text{nc: woman}\\ \text{pc:}\\ \text{prn: 15}\end{bmatrix} \begin{bmatrix}\text{noun: woman}\\ \text{fnc:}\\ \text{nc: child}\\ \text{pc: man}\\ \text{prn: 15}\end{bmatrix} \begin{bmatrix}\text{noun: child}\\ \text{fnc:}\\ \text{nc:}\\ \text{pc: woman}\\ \text{prn: 15}\end{bmatrix}$$

2. Verb coordination in an object sentence:

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

$$\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: see}\\ \text{prn: 16}\end{bmatrix} \begin{bmatrix}\text{verb: see}\\ \text{arg: Mary 17 buy \&}\\ \text{prn: 16}\end{bmatrix}$$

$$\begin{bmatrix}\text{noun: man}\\ \text{fnc: buy \&}\\ \text{prn: 17}\end{bmatrix} \begin{bmatrix}\text{n/v: that buy \&}\\ \text{arg: man pizza}\\ \text{fnc: 16 see}\\ \text{nc: cook}\\ \text{pc:}\\ \text{prn: 17}\end{bmatrix} \begin{bmatrix}\text{verb: cook}\\ \text{arg:}\\ \text{nc: eat}\\ \text{pc: buy}\\ \text{prn: 17}\end{bmatrix} \begin{bmatrix}\text{verb: eat}\\ \text{arg:}\\ \text{nc:}\\ \text{pc: cook}\\ \text{prn: 17}\end{bmatrix} \begin{bmatrix}\text{noun: pizza}\\ \text{fnc: buy \&}\\ \text{prn: 17}\end{bmatrix}$$

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

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

$$\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: see}\\ \text{prn: 18}\end{bmatrix} \begin{bmatrix}\text{verb: see}\\ \text{arg: Mary 19 buy}\\ \text{prn: 18}\end{bmatrix}$$

$$\begin{bmatrix}\text{noun: Bob}\\ \text{fnc: buy}\\ \text{prn: 19}\end{bmatrix} \begin{bmatrix}\text{n/v: that buy}\\ \text{arg: Bob apple \&}\\ \text{fnc: 18 see}\\ \text{prn: 19}\end{bmatrix} \begin{bmatrix}\text{noun: apple \&}\\ \text{fnc: buy}\\ \text{nc: pear}\\ \text{pc:}\\ \text{prn: 19}\end{bmatrix} \begin{bmatrix}\text{noun: pear}\\ \text{fnc:}\\ \text{nc: peach}\\ \text{pc: apple}\\ \text{prn: 19}\end{bmatrix} \begin{bmatrix}\text{noun: peach}\\ \text{fnc:}\\ \text{nc:}\\ \text{pc: pear}\\ \text{prn: 19}\end{bmatrix}$$

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.

$$
\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: see}\\ \text{prn: 20}\end{bmatrix}
\begin{bmatrix}\text{verb: see}\\ \text{arg: Mary man}\\ \text{prn: 20}\end{bmatrix}
\begin{bmatrix}\text{noun: man}\\ \text{fnc: see}\\ \text{mdr: 21 buy \&}\\ \text{prn: 20}\end{bmatrix}
$$

$$
\begin{bmatrix}\text{a/v: buy \&}\\ \text{arg: \# pizza}\\ \text{mdd: 20 man}\\ \text{nc: cook}\\ \text{pc:}\\ \text{prn: 21}\end{bmatrix}
\begin{bmatrix}\text{verb: cook}\\ \text{arg:}\\ \text{nc: eat}\\ \text{pc: buy}\\ \text{prn: 21}\end{bmatrix}
\begin{bmatrix}\text{verb: eat}\\ \text{arg:}\\ \text{nc:}\\ \text{pc: cook}\\ \text{prn: 21}\end{bmatrix}
\begin{bmatrix}\text{noun: pizza}\\ \text{fnc: buy \&}\\ \text{prn: 21}\end{bmatrix}
$$

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.

$$
\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: see}\\ \text{prn: 22}\end{bmatrix}
\begin{bmatrix}\text{verb: see}\\ \text{arg: Mary man}\\ \text{prn: 22}\end{bmatrix}
\begin{bmatrix}\text{noun: man}\\ \text{fnc: see}\\ \text{mdr: 23 buy}\\ \text{prn: 22}\end{bmatrix}
$$

$$
\begin{bmatrix}\text{a/v: buy}\\ \text{arg: \# apple \&}\\ \text{mdd: 22 man}\\ \text{prn: 23}\end{bmatrix}
\begin{bmatrix}\text{noun: apple \&}\\ \text{fnc: buy}\\ \text{nc: pear}\\ \text{pc:}\\ \text{prn: 23}\end{bmatrix}
\begin{bmatrix}\text{noun: pear}\\ \text{fnc:}\\ \text{nc: peach}\\ \text{pc: apple}\\ \text{prn: 23}\end{bmatrix}
\begin{bmatrix}\text{noun: peach}\\ \text{fnc:}\\ \text{nc:}\\ \text{pc: pear}\\ \text{prn: 23}\end{bmatrix}
$$

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.

$$
\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: see}\\ \text{prn: 24}\end{bmatrix}
\begin{bmatrix}\text{verb: see}\\ \text{arg: Mary pizza}\\ \text{prn: 24}\end{bmatrix}
\begin{bmatrix}\text{noun: pizza}\\ \text{fnc: see}\\ \text{mdr: 25 eat}\\ \text{prn: 24}\end{bmatrix}
$$

$$
\begin{bmatrix}\text{a/v: eat}\\ \text{arg: Bob \& \#}\\ \text{mdd: 24 pizza}\\ \text{prn: 25}\end{bmatrix}
\begin{bmatrix}\text{noun: Bob \&}\\ \text{fnc: eat}\\ \text{nc: Jim}\\ \text{pc:}\\ \text{prn: 25}\end{bmatrix}
\begin{bmatrix}\text{noun: Jim}\\ \text{fnc:}\\ \text{nc: Bill}\\ \text{pc: Bob}\\ \text{prn: 25}\end{bmatrix}
\begin{bmatrix}\text{noun: Bill}\\ \text{fnc:}\\ \text{nc:}\\ \text{pc: Jim}\\ \text{prn: 25}\end{bmatrix}
$$

2. Verb coordination in an adnominal clause with an object gap:
   Mary saw the pizza which the man bought, cooked, and ate.

$$\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: see}\\ \text{prn: 26}\end{bmatrix} \begin{bmatrix}\text{verb: see}\\ \text{arg: Mary pizza}\\ \text{prn: 26}\end{bmatrix} \begin{bmatrix}\text{noun: pizza}\\ \text{fnc: see}\\ \text{mdr: 27 buy \&}\\ \text{prn: 26}\end{bmatrix}$$

$$\begin{bmatrix}\text{noun: man}\\ \text{fnc: buy \&}\\ \text{prn: 27}\end{bmatrix} \begin{bmatrix}\text{a/v: buy \&}\\ \text{arg: man \#}\\ \text{mdd: 26 pizza}\\ \text{nc: cook}\\ \text{pc:}\\ \text{prn: 27}\end{bmatrix} \begin{bmatrix}\text{verb: cook}\\ \text{arg:}\\ \text{nc: eat}\\ \text{pc: buy}\\ \text{prn: 27}\end{bmatrix} \begin{bmatrix}\text{verb: eat}\\ \text{arg:}\\ \text{nc:}\\ \text{pc: cook}\\ \text{prn: 27}\end{bmatrix}$$

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.

$$\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: arrive}\\ \text{prn: 28}\end{bmatrix} \begin{bmatrix}\text{verb: arrive}\\ \text{arg: Mary}\\ \text{mdr: 29 eat}\\ \text{prn: 28}\end{bmatrix} \begin{bmatrix}\text{a/v: after eat}\\ \text{arg: Bob \& pizza}\\ \text{mdd: 28 arrive}\\ \text{prn: 29}\end{bmatrix}$$

$$\begin{bmatrix}\text{noun: Bob \&}\\ \text{fnc: eat}\\ \text{nc: Jim}\\ \text{pc:}\\ \text{prn: 29}\end{bmatrix} \begin{bmatrix}\text{noun: Jim}\\ \text{fnc:}\\ \text{nc: Bill}\\ \text{pc: Bob}\\ \text{prn: 29}\end{bmatrix} \begin{bmatrix}\text{noun: Bill}\\ \text{fnc:}\\ \text{nc:}\\ \text{pc: Jim}\\ \text{prn: 29}\end{bmatrix} \begin{bmatrix}\text{noun: pizza}\\ \text{fnc: eat}\\ \text{prn: 29}\end{bmatrix}$$

2. Verb coordination in an adverbial sentence:

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

$$\begin{bmatrix}\text{noun: Bob}\\ \text{fnc: buy \&}\\ \text{prn: 30}\end{bmatrix}
\begin{bmatrix}\text{a/v: after buy \&}\\ \text{arg: Bob pizza}\\ \text{mdd: 31 arrive}\\ \text{nc: cook}\\ \text{pc:}\\ \text{prn: 30}\end{bmatrix}
\begin{bmatrix}\text{verb: cook}\\ \text{arg:}\\ \text{nc: eat}\\ \text{pc: buy}\\ \text{prn: 30}\end{bmatrix}
\begin{bmatrix}\text{verb: eat}\\ \text{arg:}\\ \text{nc:}\\ \text{pc: cook}\\ \text{prn: 30}\end{bmatrix}
\begin{bmatrix}\text{noun: pizza}\\ \text{fnc: buy \&}\\ \text{prn: 30}\end{bmatrix}$$

$$\begin{bmatrix}\text{verb: arrive}\\ \text{arg: Mary}\\ \text{mdr: 30 buy}\\ \text{prn: 31}\end{bmatrix}
\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: arrive}\\ \text{prn: 31}\end{bmatrix}$$

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

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

$$\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: arrive}\\ \text{prn: 32}\end{bmatrix}
\begin{bmatrix}\text{verb: arrive}\\ \text{arg: Mary}\\ \text{mdr: 33 eat}\\ \text{prn: 32}\end{bmatrix}$$

$$\begin{bmatrix}\text{noun: Bob}\\ \text{fnc: eat}\\ \text{prn: 33}\end{bmatrix}
\begin{bmatrix}\text{a/v: after eat}\\ \text{arg: Bob apple \&}\\ \text{mdd: 32 arrive}\\ \text{prn: 33}\end{bmatrix}
\begin{bmatrix}\text{noun: apple \&}\\ \text{fnc: eat}\\ \text{nc: pear}\\ \text{pc:}\\ \text{prn: 33}\end{bmatrix}
\begin{bmatrix}\text{noun: pear}\\ \text{fnc:}\\ \text{nc: peach}\\ \text{pc: apple}\\ \text{prn: 33}\end{bmatrix}
\begin{bmatrix}\text{noun: peach}\\ \text{fnc:}\\ \text{nc:}\\ \text{pc: pear}\\ \text{prn: 33}\end{bmatrix}$$

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.

$$\begin{bmatrix}\text{noun: Bob}\\ \text{fnc: eat \&}\\ \text{prn: 29}\end{bmatrix}\begin{bmatrix}\text{n/v: that eat \&}\\ \text{arg: Bob apple}\\ \text{fnc: 30 amuse}\\ \text{nc: walk}\\ \text{pc:}\\ \text{prn: 29}\end{bmatrix}\begin{bmatrix}\text{noun: apple}\\ \text{fnc: eat}\\ \text{prn: 29}\end{bmatrix}\begin{bmatrix}\text{verb: walk}\\ \text{arg: \# dog}\\ \text{nc: read}\\ \text{pc: eat}\\ \text{prn: 29}\end{bmatrix}\begin{bmatrix}\text{noun: dog}\\ \text{fnc: walk}\\ \text{prn: 29}\end{bmatrix}$$

$$\begin{bmatrix}\text{verb: read}\\ \text{arg: \# paper}\\ \text{nc:}\\ \text{pc: walk}\\ \text{prn: 29}\end{bmatrix}\begin{bmatrix}\text{noun: paper}\\ \text{fnc: read}\\ \text{prn: 29}\end{bmatrix}\begin{bmatrix}\text{verb: amuse}\\ \text{arg: 29 eat \& Mary}\\ \text{prn: 30}\end{bmatrix}\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: amuse}\\ \text{prn: 30}\end{bmatrix}$$

2. Subject-object coordination in a subject sentence:
   That Bob ate an apple, Jim a pear, and Bill a peach, amused Mary.

$$\begin{bmatrix}\text{n/v: that eat}\\ \text{arg: Bob \& apple \&}\\ \text{fnc: 32 amuse}\\ \text{prn: 31}\end{bmatrix} \begin{bmatrix}\text{noun: Bob \&}\\ \text{fnc: eat}\\ \text{nc: Jim}\\ \text{pc:}\\ \text{prn: 31}\end{bmatrix} \begin{bmatrix}\text{noun: apple \&}\\ \text{fnc: eat}\\ \text{nc: pear}\\ \text{pc:}\\ \text{prn: 31}\end{bmatrix} \begin{bmatrix}\text{noun: Jim}\\ \text{fnc: \#}\\ \text{nc: Bill}\\ \text{pc: Bob}\\ \text{prn: 31}\end{bmatrix} \begin{bmatrix}\text{noun: pear}\\ \text{fnc: \#}\\ \text{nc: peach}\\ \text{pc: apple}\\ \text{prn: 31}\end{bmatrix}$$

$$\begin{bmatrix}\text{noun: Bill}\\ \text{fnc: \#}\\ \text{nc:}\\ \text{pc: Jim}\\ \text{prn: 31}\end{bmatrix} \begin{bmatrix}\text{noun: peach}\\ \text{fnc: \#}\\ \text{nc:}\\ \text{pc: pear}\\ \text{prn: 31}\end{bmatrix} \begin{bmatrix}\text{verb: amuse}\\ \text{arg: 31 eat \quad Mary}\\ \text{prn: 32}\end{bmatrix} \begin{bmatrix}\text{noun: Mary}\\ \text{fnc: amuse}\\ \text{prn: 32}\end{bmatrix}$$

3. Subject-verb coordination in a subject sentence:
   That Bob bought, Jim peeled, and Bill ate the peach, amused Mary.

$$\begin{bmatrix}\text{noun: Bob}\\ \text{fnc: buy \&}\\ \text{prn: 33}\end{bmatrix} \begin{bmatrix}\text{n/v: that buy \&}\\ \text{arg: Bob peach}\\ \text{fnc: 34 amuse}\\ \text{nc: peel}\\ \text{pc:}\\ \text{prn: 33}\end{bmatrix} \begin{bmatrix}\text{noun: Jim}\\ \text{fnc: peel}\\ \text{prn: 33}\end{bmatrix} \begin{bmatrix}\text{verb: peel}\\ \text{arg: Jim \#}\\ \text{nc: eat}\\ \text{pc: buy}\\ \text{prn: 33}\end{bmatrix} \begin{bmatrix}\text{noun: Bill}\\ \text{fnc: eat}\\ \text{prn: 33}\end{bmatrix} \begin{bmatrix}\text{verb: eat}\\ \text{arg: Bill \#}\\ \text{nc:}\\ \text{pc: peel}\\ \text{prn: 33}\end{bmatrix}$$

$$\begin{bmatrix}\text{noun: peach}\\ \text{fnc: buy}\\ \text{prn: 33}\end{bmatrix} \begin{bmatrix}\text{verb: amuse}\\ \text{arg: 33 buy \& \quad Mary}\\ \text{prn: 34}\end{bmatrix} \begin{bmatrix}\text{noun: Mary}\\ \text{fnc: amuse}\\ \text{prn: 34}\end{bmatrix}$$

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.

$$
\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: see}\\ \text{prn: 34}\end{bmatrix}
\begin{bmatrix}\text{verb: see}\\ \text{arg: Mary 35 eat \&}\\ \text{prn: 34}\end{bmatrix}
\begin{bmatrix}\text{noun: Bob}\\ \text{fnc: eat \&}\\ \text{prn: 35}\end{bmatrix}
\begin{bmatrix}\text{n/v: that eat \&}\\ \text{arg: Bob apple}\\ \text{fnc: 34 see}\\ \text{nc: walk}\\ \text{pc:}\\ \text{prn: 35}\end{bmatrix}
\begin{bmatrix}\text{noun: apple}\\ \text{fnc: eat}\\ \text{prn: 35}\end{bmatrix}
$$

$$
\begin{bmatrix}\text{verb: walk}\\ \text{arg: \# dog}\\ \text{nc: read}\\ \text{pc: eat}\\ \text{prn: 35}\end{bmatrix}
\begin{bmatrix}\text{noun: dog}\\ \text{fnc: walk}\\ \text{prn: 35}\end{bmatrix}
\begin{bmatrix}\text{verb: read}\\ \text{arg: \# paper}\\ \text{nc:}\\ \text{pc: walk}\\ \text{prn: 35}\end{bmatrix}
\begin{bmatrix}\text{noun: paper}\\ \text{fnc: read}\\ \text{prn: 35}\end{bmatrix}
$$

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.

$$
\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: see}\\ \text{prn: 36}\end{bmatrix}
\begin{bmatrix}\text{verb: see}\\ \text{arg: Mary 37 eat}\\ \text{prn: 36}\end{bmatrix}
\begin{bmatrix}\text{noun: Bob \&}\\ \text{fnc: eat}\\ \text{nc: Jim}\\ \text{pc:}\\ \text{prn: 37}\end{bmatrix}
\begin{bmatrix}\text{n/v: that eat}\\ \text{arg: Bob \& apple \&}\\ \text{fnc: 36 see}\\ \text{prn: 37}\end{bmatrix}
\begin{bmatrix}\text{noun: apple \&}\\ \text{fnc: eat}\\ \text{nc: pear}\\ \text{pc:}\\ \text{prn: 37}\end{bmatrix}
$$

$$
\begin{bmatrix}\text{noun: Jim}\\ \text{fnc: \#}\\ \text{nc: Bill}\\ \text{pc: Bob}\\ \text{prn: 37}\end{bmatrix}
\begin{bmatrix}\text{noun: pear}\\ \text{fnc: \#}\\ \text{nc: peach}\\ \text{pc: apple}\\ \text{prn: 37}\end{bmatrix}
\begin{bmatrix}\text{noun: Bill}\\ \text{fnc: \#}\\ \text{nc:}\\ \text{pc: Jim}\\ \text{prn: 37}\end{bmatrix}
\begin{bmatrix}\text{noun: peach}\\ \text{fnc: \#}\\ \text{nc:}\\ \text{pc: pear}\\ \text{prn: 37}\end{bmatrix}
$$

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 .

$$\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: see}\\ \text{prn: 38}\end{bmatrix} \begin{bmatrix}\text{verb: see}\\ \text{arg: Mary 39 buy \&}\\ \text{prn: 38}\end{bmatrix} \begin{bmatrix}\text{noun: Bob}\\ \text{fnc: buy \&}\\ \text{prn: 39}\end{bmatrix} \begin{bmatrix}\text{n/v: that buy \&}\\ \text{arg: Bob peach}\\ \text{fnc: 38 see}\\ \text{nc: peel}\\ \text{pc:}\\ \text{prn: 39}\end{bmatrix} \begin{bmatrix}\text{noun: Jim}\\ \text{fnc: peel}\\ \text{prn: 39}\end{bmatrix} \begin{bmatrix}\text{verb: peel}\\ \text{arg: Jim \#}\\ \text{nc: eat}\\ \text{pc: buy}\\ \text{prn: 39}\end{bmatrix}$$

$$\begin{bmatrix}\text{noun: Bill}\\ \text{fnc: eat}\\ \text{prn: 39}\end{bmatrix} \begin{bmatrix}\text{verb: eat}\\ \text{arg: Bill \#}\\ \text{nc:}\\ \text{pc: peel}\\ \text{prn: 39}\end{bmatrix} \begin{bmatrix}\text{noun: peach}\\ \text{fnc: buy}\\ \text{prn: 39}\end{bmatrix}$$

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.

$$
\begin{bmatrix}\text{noun: man}\\ \text{fnc: love}\\ \text{mdr: 41 eat \&}\\ \text{prn: 40}\end{bmatrix}
\begin{bmatrix}\text{a/v: eat \&}\\ \text{arg: \# apple}\\ \text{mdd: 40 man}\\ \text{nc: walk}\\ \text{pc:}\\ \text{prn: 41}\end{bmatrix}
\begin{bmatrix}\text{noun: apple}\\ \text{fnc: eat}\\ \text{prn: 41}\end{bmatrix}
\begin{bmatrix}\text{verb: walk}\\ \text{arg: \# dog}\\ \text{nc: read}\\ \text{pc: eat}\\ \text{prn: 41}\end{bmatrix}
\begin{bmatrix}\text{noun: dog}\\ \text{verb: walk}\\ \text{prn: 41}\end{bmatrix}
\begin{bmatrix}\text{verb: read}\\ \text{arg: \# paper}\\ \text{nc:}\\ \text{pc: walk}\\ \text{prn: 41}\end{bmatrix}
$$

$$
\begin{bmatrix}\text{noun: paper}\\ \text{verb: read}\\ \text{prn: 41}\end{bmatrix}
\begin{bmatrix}\text{verb: love}\\ \text{arg: man Mary}\\ \text{prn: 40}\end{bmatrix}
\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: love}\\ \text{prn: 40}\end{bmatrix}
$$

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 a 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.

$$\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: see}\\ \text{prn: 42}\end{bmatrix} \begin{bmatrix}\text{verb: see}\\ \text{arg: Mary peach}\\ \text{prn: 42}\end{bmatrix} \begin{bmatrix}\text{noun: peach}\\ \text{fnc: see}\\ \text{mdr: 43 buy \&}\\ \text{prn: 42}\end{bmatrix} \begin{bmatrix}\text{a/v: buy \&}\\ \text{arg: Bob \#}\\ \text{mdd: 42 peach}\\ \text{nc: peel}\\ \text{pc:}\\ \text{prn: 43}\end{bmatrix} \begin{bmatrix}\text{noun: Bob}\\ \text{fnc: buy}\\ \text{prn: 43}\end{bmatrix}$$

$$\begin{bmatrix}\text{verb: peel}\\ \text{arg: Jim \#}\\ \text{pc: buy}\\ \text{nc: eat}\\ \text{prn: 43}\end{bmatrix} \begin{bmatrix}\text{noun: Jim}\\ \text{fnc: peel}\\ \text{prn: 43}\end{bmatrix} \begin{bmatrix}\text{verb: eat}\\ \text{arg: Bill \#}\\ \text{nc:}\\ \text{pc: peel}\\ \text{prn: 43}\end{bmatrix} \begin{bmatrix}\text{noun: Bill}\\ \text{fnc: eat}\\ \text{prn: 43}\end{bmatrix}$$

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.

$$
\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: arrive}\\ \text{prn: 44}\end{bmatrix}
\begin{bmatrix}\text{verb: arrive}\\ \text{arg: Mary}\\ \text{mdr: 45 eat \&}\\ \text{prn: 44}\end{bmatrix}
\begin{bmatrix}\text{a/v: after eat \&}\\ \text{arg: Bob apple}\\ \text{mdd: 44 arrive}\\ \text{nc: walk}\\ \text{pc:}\\ \text{prn: 45}\end{bmatrix}
\begin{bmatrix}\text{noun: Bob}\\ \text{fnc: eat}\\ \text{prn: 45}\end{bmatrix}
\begin{bmatrix}\text{noun: apple}\\ \text{fnc: eat}\\ \text{prn: 45}\end{bmatrix}
$$

$$
\begin{bmatrix}\text{verb: walk}\\ \text{arg: \# dog}\\ \text{nc: read}\\ \text{pc: eat}\\ \text{prn: 45}\end{bmatrix}
\begin{bmatrix}\text{noun: dog}\\ \text{fnc: walk}\\ \text{prn: 45}\end{bmatrix}
\begin{bmatrix}\text{verb: read}\\ \text{arg: \# paper}\\ \text{nc:}\\ \text{pc: walk}\\ \text{prn: 45}\end{bmatrix}
\begin{bmatrix}\text{noun: paper}\\ \text{fnc: read}\\ \text{prn: 45}\end{bmatrix}
$$

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.

$$\begin{bmatrix}\text{a/v: after eat}\\ \text{arg: Bob \& apple \&}\\ \text{mdd: 47 arrive}\\ \text{prn: 46}\end{bmatrix} \begin{bmatrix}\text{noun: Bob \&}\\ \text{fnc: eat}\\ \text{nc: Jim}\\ \text{pc:}\\ \text{prn: 46}\end{bmatrix} \begin{bmatrix}\text{noun: apple \&}\\ \text{fnc: eat}\\ \text{nc: pear}\\ \text{pc:}\\ \text{prn: 46}\end{bmatrix} \begin{bmatrix}\text{noun: Jim}\\ \text{fnc: \#}\\ \text{nc: Bill}\\ \text{pc: Bob}\\ \text{prn: 46}\end{bmatrix} \begin{bmatrix}\text{noun: pear}\\ \text{fnc: \#}\\ \text{nc: peach}\\ \text{pc: apple}\\ \text{prn: 46}\end{bmatrix}$$

$$\begin{bmatrix}\text{noun: Bill}\\ \text{fnc: \#}\\ \text{nc:}\\ \text{pc: Jim}\\ \text{prn: 46}\end{bmatrix} \begin{bmatrix}\text{noun: peach}\\ \text{fnc: \#}\\ \text{nc:}\\ \text{pc: pear}\\ \text{prn: 46}\end{bmatrix} \begin{bmatrix}\text{noun: Mary}\\ \text{fnc: arrive}\\ \text{prn: 47}\end{bmatrix} \begin{bmatrix}\text{verb: arrive}\\ \text{arg: Mary}\\ \text{mdr: 46 eat}\\ \text{prn: 47}\end{bmatrix}$$

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.

$$
\begin{bmatrix}\text{noun: Mary}\\ \text{fnc: arrive}\\ \text{prn: 48}\end{bmatrix}
\begin{bmatrix}\text{verb: arrive}\\ \text{arg: Mary}\\ \text{mdr: 49 buy \&}\\ \text{prn: 48}\end{bmatrix}
\begin{bmatrix}\text{noun: Bob}\\ \text{fnc: buy \&}\\ \text{prn: 49}\end{bmatrix}
\begin{bmatrix}\text{a/v: after buy \&}\\ \text{arg: Bob peach}\\ \text{mdd: 48 arrive}\\ \text{nc: peel}\\ \text{pc:}\\ \text{prn: 49}\end{bmatrix}
$$

$$
\begin{bmatrix}\text{noun: Jim}\\ \text{fnc: peel}\\ \text{prn: 49}\end{bmatrix}
\begin{bmatrix}\text{verb: peel}\\ \text{arg: Jim \#}\\ \text{nc: eat}\\ \text{pc: buy}\\ \text{prn: 49}\end{bmatrix}
\begin{bmatrix}\text{noun: Bill}\\ \text{fnc: eat}\\ \text{prn: 49}\end{bmatrix}
\begin{bmatrix}\text{verb: eat}\\ \text{arg: Bill \#}\\ \text{nc:}\\ \text{pc: peel}\\ \text{prn: 49}\end{bmatrix}
\begin{bmatrix}\text{noun: peach}\\ \text{fnc: buy}\\ \text{prn: 49}\end{bmatrix}
$$

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.$^{\mathrm{STAR}}$ Susanne ate a pear.$^{\mathrm{(STAR)}}$
2. *Coordination of two propositions in a dialog*
   Julia ate an apple.$^{\mathrm{STAR}}$ Susanne ate a pear.$^{\mathrm{STA'R'}}$
3. *Coordination of a question and an answer in a dialog*
   Who is singing? $^{\mathrm{STAR}}$ Julia.$^{\mathrm{STA'R'}}$

9.5.2 Illustrating kinds of coordination as sets of proplets

1. Julia is singing.$^{\text{STAR}}$ Susanne is dreaming.$^{\text{(STAR)}}$

$$\begin{bmatrix}\text{noun: Julia}\\ \text{fnc: sing}\\ \text{nc:}\\ \text{pc:}\\ \text{STAR:}\\ \text{prn: 4}\end{bmatrix} \begin{bmatrix}\text{verb: sing}\\ \text{arg: Julia}\\ \text{nc: 5 dream}\\ \text{pc:}\\ \text{STAR: s t John Bill}\\ \text{prn: 4}\end{bmatrix} \begin{bmatrix}\text{noun: Susanne}\\ \text{fnc: dream}\\ \text{nc:}\\ \text{pc:}\\ \text{STAR:}\\ \text{prn: 5}\end{bmatrix} \begin{bmatrix}\text{verb: dream}\\ \text{arg: Susanne}\\ \text{nc:}\\ \text{pc: 4 sing}\\ \text{STAR:}\\ \text{prn: 5}\end{bmatrix}$$

2. Julia is singing.$^{\text{STAR}}$ Susanne is dreaming.$^{\text{STA}'\text{R}'}$

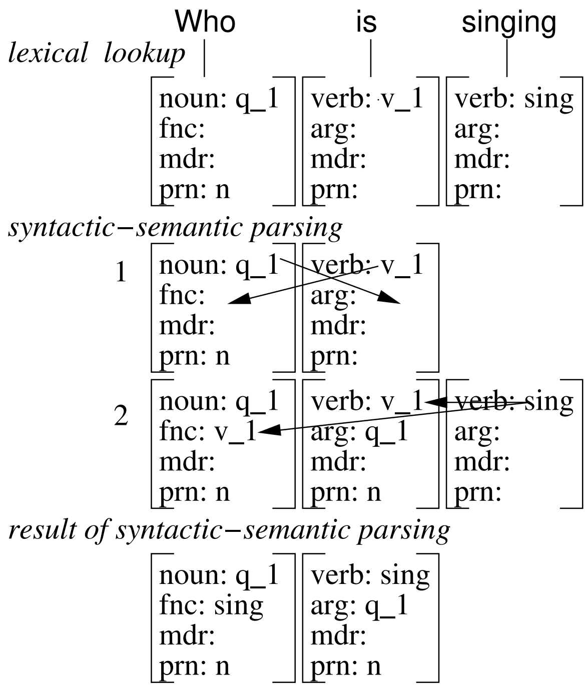
$$\begin{bmatrix}\text{noun: Julia}\\ \text{fnc: sing}\\ \text{nc:}\\ \text{pc:}\\ \text{STAR:}\\ \text{prn: 4}\end{bmatrix} \begin{bmatrix}\text{verb: sing}\\ \text{arg: Julia}\\ \text{nc: 5 dream}\\ \text{pc:}\\ \text{STAR: s t John Bill}\\ \text{prn: 4}\end{bmatrix} \begin{bmatrix}\text{noun: Susanne}\\ \text{fnc: dream}\\ \text{nc:}\\ \text{pc:}\\ \text{STAR:}\\ \text{prn: 5}\end{bmatrix} \begin{bmatrix}\text{verb: dream}\\ \text{arg: Susanne}\\ \text{nc:}\\ \text{pc: 4 sing}\\ \text{STAR: s t Bill John}\\ \text{prn: 5}\end{bmatrix}$$

3. Who is singing?$^{\text{STAR}}$ Julia.$^{\text{STA}'\text{R}'}$

$$\begin{bmatrix}\text{noun: q\_1}\\ \text{fnc: sing}\\ \text{nc: Julia}\\ \text{pc:}\\ \text{STAR:}\\ \text{prn: n}\end{bmatrix} \begin{bmatrix}\text{verb: sing}\\ \text{arg: q\_1}\\ \text{nc:}\\ \text{pc:}\\ \text{STAR: s t John Bill}\\ \text{prn: n}\end{bmatrix} \begin{bmatrix}\text{noun: Julia}\\ \text{fnc: sing}\\ \text{nc:}\\ \text{pc: q\_1}\\ \text{STAR: s t Bill John}\\ \text{prn: n}\end{bmatrix}$$

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

$$\begin{array}{llllll}
 & & & & \begin{bmatrix}\text{verb:}\textit{sing}\\ \text{arg: q_1}\\ \text{prn: n}\end{bmatrix} & \textit{search pattern}\\
 & & & & \quad\textit{matching?} & \\
\begin{bmatrix}\text{verb: }\textit{sing}\end{bmatrix} & \begin{bmatrix}\text{verb: sing}\\ \text{arg: Bill}\\ \text{prn: 10}\end{bmatrix} & \begin{bmatrix}\text{verb: sing}\\ \text{arg: Susanne}\\ \text{prn: 12}\end{bmatrix} & \begin{bmatrix}\text{verb: sing}\\ \text{arg: Mary}\\ \text{prn: 15}\end{bmatrix} & \begin{bmatrix}\text{verb: sing}\\ \text{arg: Julia}\\ \text{prn: 19}\end{bmatrix} & \textit{token line}
\end{array}$$

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

$$\begin{bmatrix}\text{verb: sing}\\ \text{arg: Julia}\\ \text{prn: 19}\end{bmatrix} \quad \begin{bmatrix}\text{noun: Julia}\\ \text{fnc: sing}\\ \text{prn: 19}\end{bmatrix}$$

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

2. Extra-propositional backward navigation:
   Peter crossed the street. Before that Peter left the house.

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

$$\begin{bmatrix}\text{noun: Peter}\\ \text{fnc: cross}\\ \text{mdr: 2 leave}\\ \text{prn: 1}\end{bmatrix} \begin{bmatrix}\text{a/v: leave}\\ \text{arg: \# house}\\ \text{mdd: 1 Peter}\\ \text{prn: 2}\end{bmatrix} \begin{bmatrix}\text{noun: house}\\ \text{fnc: leave}\\ \text{prn: 2}\end{bmatrix} \begin{bmatrix}\text{verb: cross}\\ \text{arg: Peter street}\\ \text{prn: 1}\end{bmatrix} \begin{bmatrix}\text{noun: street}\\ \text{fnc: cross}\\ \text{prn: 1}\end{bmatrix}$$

2. Adverbial sentence:
   After Peter had left the house, he crossed the street.

$$\begin{bmatrix}\text{noun: Peter}\\ \text{fnc: leave}\\ \text{prn: 1}\end{bmatrix} \begin{bmatrix}\text{a/v: leave}\\ \text{arg: Peter house}\\ \text{mdd: > 2 cross}\\ \text{prn: 1}\end{bmatrix} \begin{bmatrix}\text{noun: house}\\ \text{fnc: leave}\\ \text{prn: 1}\end{bmatrix} \begin{bmatrix}\text{noun: Peter}\\ \text{fnc: cross}\\ \text{prn: 2}\end{bmatrix} \begin{bmatrix}\text{verb: cross}\\ \text{arg: Peter street}\\ \text{mdr: < 1 leave}\\ \text{prn: 2}\end{bmatrix} \begin{bmatrix}\text{noun: street}\\ \text{fnc: cross}\\ \text{prn: 2}\end{bmatrix}$$

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.

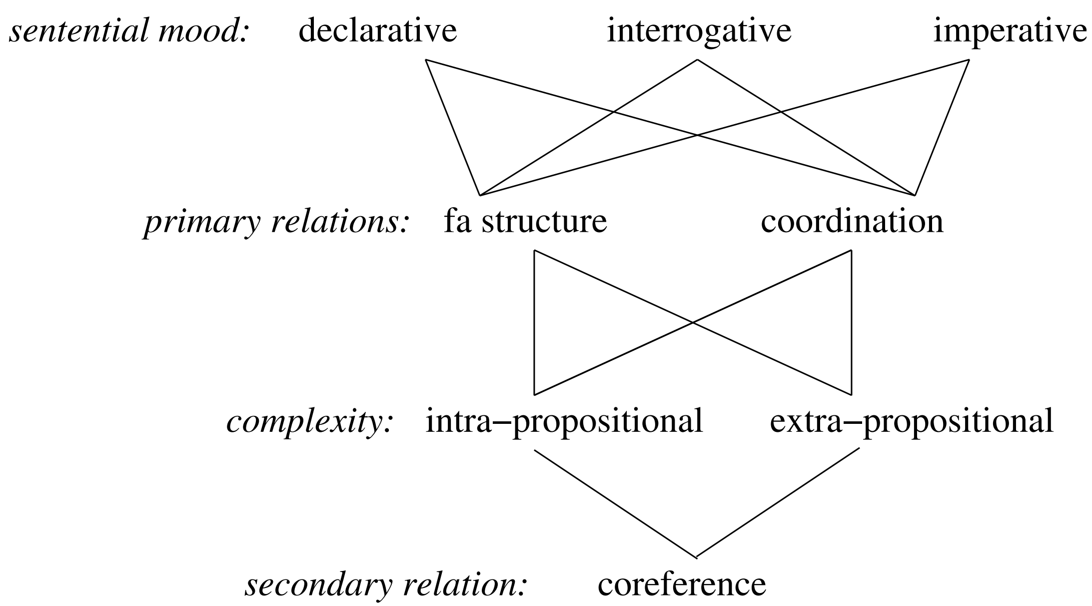
Alternative (i) has the advantage that the language and the context level use the same coding, thus making any transformations unnecessary. Furthermore, the inferencing in LA-grammar (cf. Section 5.3) is sufficiently powerful to derive all the required conclusions from the simple as well as from the 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.

$$\begin{bmatrix}\text{noun: Julia}\\ \text{fnc: eat}\\ \text{mdr:}\\ \text{idy: 1}\\ \text{prn: 36}\end{bmatrix}\begin{bmatrix}\text{verb: eat}\\ \text{arg: Julia apple}\\ \text{pc:}\\ \text{nc: > 37 take}\\ \text{prn: 36}\end{bmatrix}\begin{bmatrix}\text{noun: apple}\\ \text{fnc: eat}\\ \text{mdr:}\\ \text{idy: 2}\\ \text{prn: 36}\end{bmatrix}\begin{bmatrix}\text{noun: Julia}\\ \text{fnc: take}\\ \text{mdr:}\\ \text{idy: 3 (=1)}\\ \text{prn: 37}\end{bmatrix}\begin{bmatrix}\text{verb: take}\\ \text{arg: Julia nap}\\ \text{pc: < 36 eat}\\ \text{nc:}\\ \text{prn: 37}\end{bmatrix}\begin{bmatrix}\text{noun: nap}\\ \text{fnc: take}\\ \text{mdr:}\\ \text{idy: 4}\\ \text{prn: 37}\end{bmatrix}$$

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

   Julia ate an apple. Then she took a nap.

$$\begin{bmatrix}\text{noun: Julia}\\ \text{fnc: eat}\\ \text{mdr:}\\ \text{idy: 5}\\ \text{prn: 38}\end{bmatrix}\begin{bmatrix}\text{verb: eat}\\ \text{arg: Julia apple}\\ \text{pc:}\\ \text{nc: > 39 take}\\ \text{prn: 38}\end{bmatrix}\begin{bmatrix}\text{noun: apple}\\ \text{fnc: eat}\\ \text{mdr:}\\ \text{idy: 6}\\ \text{prn: 38}\end{bmatrix}\begin{bmatrix}\text{noun: pro\_1}\\ \text{fnc: take}\\ \text{mdr:}\\ \text{idy: 7 (=5)}\\ \text{prn: 39}\end{bmatrix}\begin{bmatrix}\text{verb: take}\\ \text{arg: pro\_1 nap}\\ \text{pc: < 38 eat}\\ \text{nc:}\\ \text{prn: 39}\end{bmatrix}\begin{bmatrix}\text{noun: nap}\\ \text{fnc: take}\\ \text{mdr:}\\ \text{idy: 8}\\ \text{prn: 39}\end{bmatrix}$$

3. Blocked intra-propositional coreference between two equal names

   John shaved John.

$$\begin{bmatrix}\text{noun: John}\\ \text{fnc: shave}\\ \text{idy: 9}\\ \text{prn: 40}\end{bmatrix}\begin{bmatrix}\text{verb: shave}\\ \text{arg: John John}\\ \text{mdr:}\\ \text{prn: 40}\end{bmatrix}\begin{bmatrix}\text{noun: John}\\ \text{fnc: shave}\\ \text{idy: 10}\\ \text{prn: 40}\end{bmatrix}$$

4. Intra-propositional coreference between a name and a reflexive pronoun

%John shaved himself.

$$
\begin{bmatrix} \text{noun: John} \\ \text{fnc: shave} \\ \text{idy: 1} \\ \text{prn: 1} \end{bmatrix}
\begin{bmatrix} \text{verb: shave} \\ \text{arg: John rfl\_1} \\ \text{mdr:} \\ \text{prn: 1} \end{bmatrix}
\begin{bmatrix} \text{noun: rfl\_1} \\ \text{fnc: shave} \\ \text{idy: 2} \\ \text{prn: 1} \end{bmatrix}
$$

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

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

$$
\begin{bmatrix} \text{noun: man} \\ \text{fnc: wash} \\ \text{mdr:} \\ \text{idy: 13} \\ \text{prn: 42} \end{bmatrix}
\begin{bmatrix} \text{verb: wash \&} \\ \text{arg: man hand} \\ \text{nc: clip} \\ \text{pc:} \\ \text{prn: 42} \end{bmatrix}
\begin{bmatrix} \text{noun: hand} \\ \text{fnc: wash} \\ \text{mdr:} \\ \text{idy: 14} \\ \text{prn: 42} \end{bmatrix}
\begin{bmatrix} \text{verb: clip} \\ \text{arg: \# nail} \\ \text{nc: shave} \\ \text{pc: wash} \\ \text{prn: 42} \end{bmatrix}
\begin{bmatrix} \text{noun: nail} \\ \text{fnc: clip} \\ \text{mdr:} \\ \text{idy: 15} \\ \text{prn: 42} \end{bmatrix}
\begin{bmatrix} \text{verb: shave} \\ \text{arg: \# rfl\_2} \\ \text{nc:} \\ \text{pc: clip} \\ \text{prn: 42} \end{bmatrix}
\begin{bmatrix} \text{noun: rfl\_2} \\ \text{fnc: shave} \\ \text{mdr:} \\ \text{idy: 16(=13)} \\ \text{prn: 42} \end{bmatrix}
$$

10.2 Intra-Propositional Coreference

10.2.1 Definition of **LA-think.pro-1**

$\mathrm{ST}_S =_{def} \{ (\begin{bmatrix}\text{noun: RFL\_n}\end{bmatrix} \{ \text{rfl-0 rfl-1}\}) \}$

rfl-0: $\begin{bmatrix}\text{noun: RFL\_n}\\ \text{cat: X'}\\ \text{idy: j}\\ \text{prn: k}\end{bmatrix} \begin{bmatrix}\text{noun: } \alpha\\ \text{cat: X}\\ \text{idy: i}\\ \text{prn: k}\end{bmatrix}$ if X is not compatible with X' set *nw* = preceding noun {rfl-0, rfl-1}

rfl-1: $\begin{bmatrix}\text{noun: RFL\_n}\\ \text{cat: X'}\\ \text{idy: j}\\ \text{prn: k}\end{bmatrix} \begin{bmatrix}\text{noun: } \alpha\\ \text{cat: X}\\ \text{idy: i}\\ \text{prn: k}\end{bmatrix}$ if X is compatible with X' set j = i { }

$\mathrm{ST}_F =_{def} \{(\begin{bmatrix}\text{noun: } \alpha\end{bmatrix} \text{rp}_{\text{rfl}-1})\}$

10.2.2 Applying the inference rule **rfl-1**

rule level rfl-1: $\begin{bmatrix} \text{noun: RFL\_n} \\ \text{cat: X'} \\ \text{idy: j} \\ \text{prn: k} \end{bmatrix} \begin{bmatrix} \text{noun: } \alpha \\ \text{cat: X} \\ \text{idy: i} \\ \text{prn: k} \end{bmatrix}$ if X is compatible with X' set j = i { }

language level $\begin{bmatrix} \text{noun: rfl\_1} \\ \text{fnc: shave} \\ \text{cat: m sg} \\ \text{idy: 2} \\ \text{prn: 1} \end{bmatrix} \begin{bmatrix} \text{noun: John} \\ \text{fnc: shave} \\ \text{cat: m sg} \\ \text{idy: 1} \\ \text{prn: 1} \end{bmatrix}$

10.2.3 Interpretation of John shaved himself after inference

$$\begin{bmatrix} \text{noun: John} \\ \text{cat: m sg} \\ \text{fnc: shave} \\ \text{idy: 1} \\ \text{prn: 1} \end{bmatrix} \begin{bmatrix} \text{verb: shave} \\ \text{arg: John, rfl\_1} \\ \text{prn: 1} \end{bmatrix} \begin{bmatrix} \text{noun: rfl\_1} \\ \text{cat: m sg} \\ \text{fnc: shave} \\ \text{idy: 2 (=1)} \\ \text{prn: 1} \end{bmatrix}$$

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)

pattern level	n/v: sc β arg: X γ Y fnc: r α prn: q	noun: γ fnc: β idy: i prn: q			noun: PRO_n fnc: α idy: i prn: r
proplet level	n/v: that find arg: Mary answer fnc: 28 please prn: 27	noun: Mary fnc: find idy: 1 prn: 27	noun: answer fnc: find idy: 2 prn: 27	verb: please arg: 27 find pro_1 mdr: prn: 28	noun: pro_1 fnc: please idy: 3 prn: 28

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

pattern level	noun: PRO_n fnc: α idy: i prn: r		n/v: sc β arg: X γ Y fnc: r α prn: q	noun: γ fnc: β idy: i prn: q	
proplet level	noun: pro_1 fnc: know idy: 1 prn: 27	verb: know arg: pro_1 28 find mdr: prn: 27	n/v: that find arg: Mary answer fnc: 27 know prn: 28	noun: Mary fnc: find idy: 2 prn: 28	noun: answer fnc: find idy: 3 prn: 28

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

pattern level	n/v: sc α arg: X PRO_n Y fnc: r β prn: r	noun: PRO_n fnc: α idy: i prn: r			noun: γ fnc: β idy: i prn: q
proplet level	n/v: that find arg: pro_1 answer fnc: 28 please prn: 27	noun: pro_1 fnc: find idy: 3 prn: 27	noun: answer fnc: find idy: 2 prn: 27	verb: please arg: 27 find Mary mdr: prn: 28	noun: Mary fnc: please idy: 1 prn: 28

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

pattern level	noun: γ fnc: β idy: i prn: q		n/v: sc α arg: X PRO_n Y fnc: β prn: r	noun: PRO_n fnc: α idy: i prn: r	
proplet level	noun: Mary fnc: know idy: 1 prn: 27	verb: know arg: Mary 28 find mdr: prn: 27	n/v: that find arg: pro_1 answer fnc: 27 know prn: 28	noun: pro_1 fnc: find idy: 2 prn: 28	noun: answer fnc: find idy: 3 prn: 28

10.3.6 Definition of **LA-think.pro-2** (sentential arguments)

$ST_S =_{def} \{ (\begin{bmatrix}\text{noun: PRO\_n}\end{bmatrix} \{\text{n/v-cnn, n/v-pro}\}) \}$

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

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

$ST_F =_{def} \{(\begin{bmatrix}\text{noun: } \alpha\end{bmatrix} rp_{\text{n/v-cnn}}), (\begin{bmatrix}\text{noun: } \alpha\end{bmatrix} rp_{\text{n/v-pro}})\}$

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)

pattern−level	noun: β fnc: α mdr: q γ idy: k prn: r		noun: δ fnc: γ mdr: idy: j prn: q		noun: PRO_n fnc: α mdr: idy: i prn: r
proplet level	noun: farmer fnc: beat mdr: 2 own idy: 1 prn: 1	a/v: own arg: # donkey mdd: 1 farmer prn: 2	noun: donkey fnc: own mdr: idy: 2 prn: 2	verb: beat arg: farmer pro−2 mdr: prn: 1	noun: pro_2 fnc: beat mdr: idy: 3 (=2) prn: 1
	Every farmer	who owns	a donkey	beats	it

10.4.3 H’L: *%She* was kissed by the man who loves *the woman*.

pattern−level	noun: PRO_n fnc: α mdr: idy: k prn: r		noun: β fnc: α mdr: q γ idy: i prn: r		noun: δ fnc: γ mdr: idy: j prn: q
proplet level	noun: pro_1 fnc: kiss mdr: idy: 1 prn: 1	verb: kiss arg: man pro_1 mdr: prn: 1	noun: man fnc: kiss mdr: 2 love idy: 2 prn: 1	a/v: love arg: # Mary mdd: 1 man prn: 2	noun: woman fnc: love mdr: idy: 3 prn: 2

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

pattern−level	noun: β fnc: γ mdr: r α idy: k prn: q	noun: PRO_n ~~fnc:~~ α mdr: idy: i prn: r	noun: δ fnc: γ mdr: idy: j prn: q

proplet level	noun: man fnc: kiss mdr: 2 love idy: 1 prn: 1	a/v: love arg: # pro_1 mdd: 1 man prn: 2	noun: pro_1 fnc: love mdr: idy: 2 prn: 2	verb: kiss arg: man woman mdr: prn: 1	noun: woman fnc: kiss mdr: idy: 3 prn: 1

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

pattern−level	noun: δ fnc: γ mdr: idy: k prn: q	noun: β ~~fnc:~~ γ mdr: r α idy: i prn: q	noun: PRO_n ~~fnc:~~ α mdr: idy: j prn: r

proplet level	noun: woman fnc: kiss mdr: idy: 1 prn: 1	verb: kiss arg: man woman mdr: prn: 1	noun: man fnc: kiss mdr: 2 love idy: 2 prn: 1	a/v: love arg: # pro_1 mdd: 1 man prn: 2	noun: pro_1 fnc: love mdr: idy: 3 prn: 2

10.4.6 Definition of **LA-think.pro-3** (adnominal sentential modifiers)

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

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

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

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

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)

pattern level	noun: γ fnc: β idy: j prn: q	a/v: sc β arg: X γ Y mdd: r α prn: q	noun: PRO_n fnc: α idy: i prn: r		
proplet level	noun: Mary fnc: return idy: 1 prn: 27	a/v: when return arg: Mary mdd: 28 kiss prn: 27	noun: pro_1 fnc: kiss idy: 2 prn: 28	verb: kiss arg: pro_1 John mdr: 27 return prn: 28	noun: John fnc: kiss idy: 3 prn: 28

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

pattern level	noun: PRO_n fnc: α idy: i prn: r			noun: γ fnc: β idy: j prn: q	a/v: sc β arg: X γ Y mdd: r α prn: q
proplet level	noun: pro_1 fnc: kiss idy: 1 prn: 27	verb: kiss arg: pro_1 John mdr: 28 return prn: 27	noun: John fnc: kiss idy: 2 prn: 27	noun: Mary fnc: return idy: 3 prn: 28	a/v: when return arg: Mary mdd: 27 kiss prn: 28

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

pattern level	noun: PRO_n fnc: α idy: i prn: r	a/v: sc α arg: X pro_n Y mdd: q β prn: r	noun: γ fnc: β idy: j prn: q		
proplet level	noun: pro_1 fnc: return idy: 1 prn: 27	a/v: when return arg: pro_1 mdd: 28 kiss prn: 27	noun: Mary fnc: kiss idy: 2 prn: 28	verb: kiss arg:Mary John mdr: 27 return prn: 28	noun: John fnc: kiss idy: 3 prn: 28

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

pattern level	noun: γ fnc: β idy: i prn: q			a/v: sc α arg: X PRO_n Y mdd: q β prn: r	noun: PRO_n fnc: α idy: j prn: r
proplet level	noun: Mary fnc: kiss idy: 1 prn: 27	verb: kiss arg: Mary John mdr: 28 return prn: 27	noun: John fnc: kiss idy: 2 prn: 27	a/v: when return arg: pro_1 mdd: 27 kiss prn: 28	noun: pro_1 fnc: return idy: 3 prn: 28

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

$\text{ST}_S =_{def} \{ (\begin{bmatrix}\text{noun: PRO\_n}\end{bmatrix} \{\text{adv-cnn adv-pro}\}) \}$

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

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

$\text{ST}_F =_{def} \{(\begin{bmatrix}\text{noun: } \alpha\end{bmatrix} \text{rp}_{\text{adv-cnn}}), (\begin{bmatrix}\text{noun: } \alpha\end{bmatrix} \text{rp}_{\text{adv-pro}})\}$

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)

pattern level	noun: γ fnc: β idy: j prn: q	a/v: sc β arg: X γ *Y* mdd: r α prn: q			noun: PRO_n fnc: α idy: i prn: r
proplet level	noun: Mary fnc: return idy: 1 prn: 27	a/v: when return arg: Mary mdd: 28 kiss prn: 27	noun: John fnc: kiss idy: 3 prn: 28	verb: kiss arg: John pro_1 mdr: 27 return prn: 28	noun: pro_1 fnc: kiss idy: 2 prn: 28

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

pattern level			noun: PRO_n fnc: α idy: i prn: r	noun: γ fnc: β idy: j prn: q	a/v: sc β arg: X γ Y mdd: r α prn: q
proplet level	noun: John fnc: kiss idy: 2 prn: 27	verb: kiss arg: John pro_1 mdr: 28 return prn: 27	noun: pro_1 fnc: kiss idy: 1 prn: 27	noun: Mary fnc: return idy: 3 prn: 28	a/v: when return arg: Mary mdd: 27 kiss prn: 28

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

pattern level	noun: PRO_n fnc: α idy: i prn: r	a/v: sc α arg: X PRO_n Y mdd: q β prn: r			noun: γ fnc: β idy: j prn: q
proplet level	noun: pro_1 fnc: return idy: 1 prn: 27	a/v: when return arg: pro_1 mdd: 28 kiss prn: 27	noun: John fnc: kiss idy: 3 prn: 28	verb: kiss arg:John Mary mdr: 27 return prn: 28	noun: Mary fnc: kiss idy: 2 prn: 28

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

pattern level			noun: γ fnc: β idy: i prn: q	noun: PRO_n fnc: α idy: j prn: r	a/v: sc α arg: X PRO_n Y mdd: q β prn: r
proplet level	noun: John fnc: kiss idy: 2 prn: 27	verb: kiss arg:John Mary mdr: 28 return prn: 27	noun: Mary fnc: kiss idy: 1 prn: 27	noun: pro_1 fnc: return idy: 3 prn: 28	a/v: when return arg: pro_1 mdd: 27 kiss prn: 28

10.6 Handling Pronominal Coreference by means of Inference

10.6.1 Definition of **LA-think.pro**

$ST_S =_{def}$ { ($\begin{bmatrix}\text{noun: PRO\_n}\end{bmatrix}$ {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 α 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 α 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 γ 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 γ are compatible,
and q and r are adjacent,
set i = j
{ }

$$\text{adn-cnn: } \begin{bmatrix}\text{noun: PRO\_n}\\ \text{fnc: } \alpha\\ \text{mdr:}\\ \text{idy: i}\\ \text{prn: r}\end{bmatrix} \begin{bmatrix}\text{noun: } \beta\\ \text{fnc: } \alpha\\ \text{mdr: q } \gamma\\ \text{idy: k}\\ \text{prn: r}\end{bmatrix} \quad \begin{bmatrix}\text{noun: } \delta\\ \text{fnc: } \gamma\\ \text{mdr:}\\ \text{idy: j}\\ \text{prn: q}\end{bmatrix} \begin{array}{l}\text{if PRO\_n is a non-reflexive personal pronoun,}\\ \text{PRO\_n and } \alpha \text{ are compatible,}\\ \text{q and r are adjacent, and q < r,}\\ \text{set i = j}\end{array} \quad \{\}$$

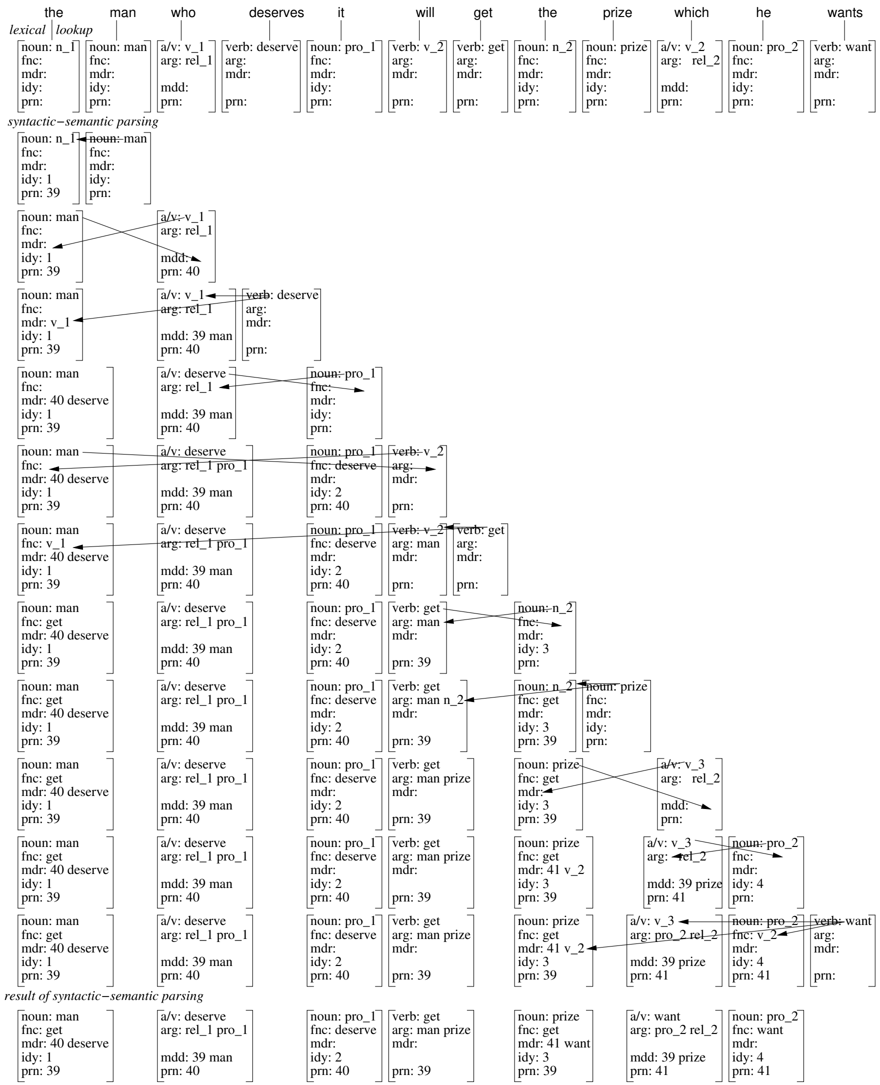
$$\text{adn-pro: } \begin{bmatrix}\text{noun: PRO\_n}\\ \text{fnc: } \alpha\\ \text{mdr:}\\ \text{idy: i}\\ \text{prn: r}\end{bmatrix} \begin{bmatrix}\text{noun: } \beta\\ \text{fnc: } \gamma\\ \text{mdr: r } \alpha\\ \text{idy: k}\\ \text{prn: q}\end{bmatrix} \quad \begin{bmatrix}\text{noun: } \delta\\ \text{fnc: } \gamma\\ \text{mdr:}\\ \text{idy: j}\\ \text{prn: q}\end{bmatrix} \begin{array}{l}\text{if PRO\_n is a non-reflexive personal pronoun,}\\ \text{PRO\_n and } \gamma \text{ are compatible,}\\ \text{and q and r are adjacent,}\\ \text{set i = j}\end{array} \quad \{\}$$

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

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

$$\begin{aligned}\text{ST}_F =_{def} \{&([\text{noun: } \alpha]\ \text{rp}_{\text{rfl}-1}), ([\text{noun: } \alpha]\ \text{rp}_{\text{n/v}-\text{cnn}}), ([\text{noun: } \alpha]\ \text{rp}_{\text{n/v}-\text{pro}}),\\ &([\text{noun: } \alpha]\ \text{rp}_{\text{adn}-\text{cnn}}), ([\text{noun: } \alpha]\ \text{rp}_{\text{adn}-\text{pro}}), ([\text{noun: } \alpha]\ \text{rp}_{\text{adv}-\text{cnn}})\\ &([\text{noun: } \alpha]\ \text{rp}_{\text{adn}-\text{pro}})\}\end{aligned}$$

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