

## Background

Hauser et al's (2002) hypothesis:  
Recursion is a property of human languages, not of other animal languages.

What should "recursion" here mean?  
Probably some sort of embedding that is characteristic of CFGs and not of regular grammars.

Structural-semantic ambiguity is one of the best indications of CFG-style embedding.  
*I doubt that John or Bill and Mary could do the job.*  
NP → NP and/or NP

Do we need any kind of semantic embedding that is not reflected in the syntax?

## Multiple Coordination:

### Recursion and the Syntax-Semantics Interface

Yoad Winter

Technion/NIAS/Utrecht University

August 5, 2007 – Formal Grammar, Dublin

Paper draft downloadable at: [www.cs.technion.ac.il/~winter](http://www.cs.technion.ac.il/~winter)

1

## Multiple Coordination in English

### Repeated coordinator (RC):

*John or Mary or Bill*  
*talk and sing and dance*

### Single coordinator (SC):

*John, Mary or Bill*  
*talk, sing and dance*

### Main claims:

1. RC-coordination involves syntactic embedding.  
SC-coordination does not – it is flat.
2. But flat constructions may involve embedding at a semantic level, via recursion at the composition stage.

3

## Paradigms of Coordination

### Paradigm I – Monosyndetic coordination:

*talk and-sing*      or      *talk-and sing*

SC-coordination often exists, as in English, but not always.

- Tibeto-Burman (Peterson and VanBik 2004):

farmer market go-*and* chicken buy-*and* house return  
“the farmer went to the market, bought a chicken *and* returned home”

\*farmer market go chicken buy-*and* house return

\*farmer market go-*and* chicken buy house return

2

4

# Paradigms of Coordination

## Paradigm II – Bisyndetic coordination:

*talk-and sing-and* = “talk and sing”

SC-coordination probably does not exist in bisyndetic constructions (Haspelmath 2004):

talk-and (sing-and) dance-and  
\*talk (sing) dance-and

## Paradigm III – Asyndetic coordination

(parataxis/juxtaposition):

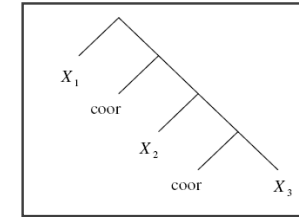
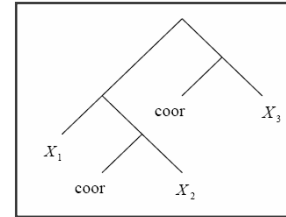
*talk sing* = “talk and sing”

**Conclusion: RC/SC contrasts are cross-linguistically common, though not universal.**

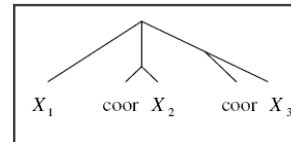
5

# Recursion in Syntax – RC-coordination

In CFG-based accounts, RC-coordination invariably involves embedding.



Does it also involve flat structures?



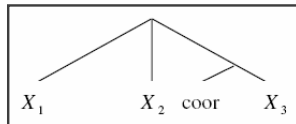
**Proposed answer (remarked below): Quite possibly.**

6

# Recursion in Syntax – SC-coordination

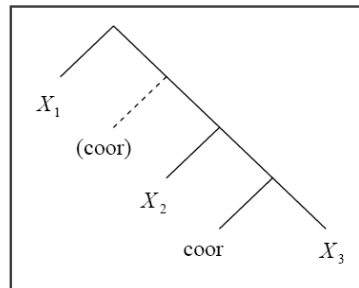
## Is it iteration?

Jackendoff 1977,  
Sag et al. 1985...



## Or embedding?

Munn 1993,  
Johannessen 1998...

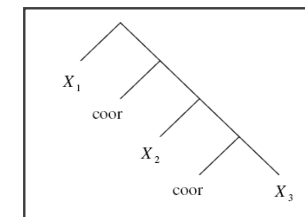
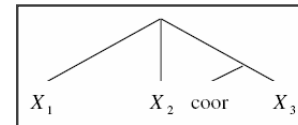


**Proposed answer: Semantic evidence for iteration.**

7

# Recursion in Semantics?

Both flat and embedded structures can do without semantic recursion.



## But do they?

**Proposed Answer: No – Iterative (flat) structures are interpreted recursively.**

8

# Syntax-Semantics of SC-coordination

## Talk Plan

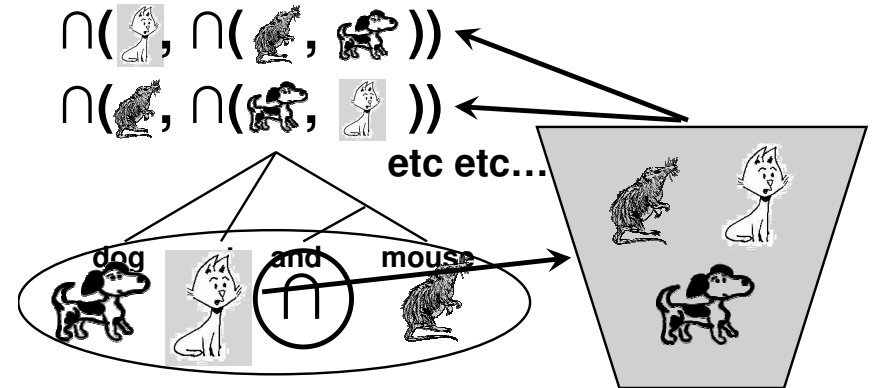
1. SC-coordination needs flat syntax-semantics interface.
2. But embedding is sometimes useful.
3. Solution:
 

Syntax	–	iterative (flat)
Semantics	–	recursive (embedded)

9

## In a Nutshell

- 1) A flat structure
- 2) Interpret daughters
- 3) Binary interpretation of *n*-ary coordination
- 4) Shake-n-Bake or...

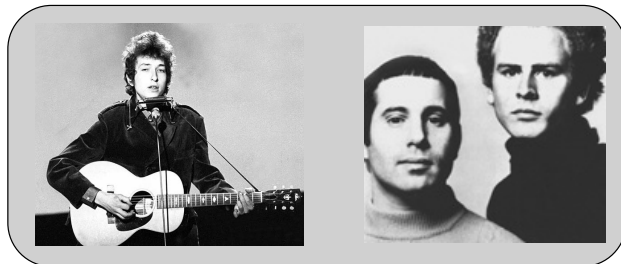


10

## SC-Coordination – flat Syntax-Semantics

Collective DP conjunctions – RC vs. SC:

- ✓ (1) Dylan, and Simon and Garfunkel wrote many hits in the 60s. (Hoeksema 1988)
- ✗ (2) Dylan, Simon and Garfunkel wrote many hits in the 60s. (Winter 1998,2001)



11

## SC-Coordination – flat Syntax-Semantics

Wide scope conjunction:

- (3) Here you're not allowed to dance and (to) stamp your feet. (cf. Oehrle 1987)



Narrow Scope Conjunction



Wide Scope Conjunction

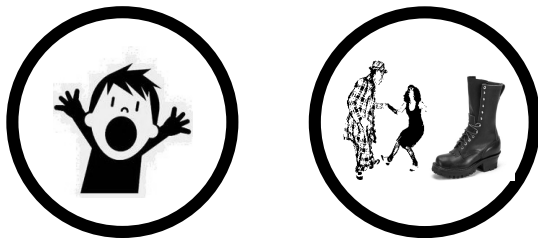
12

## SC-Coordination – flat Syntax-Semantics

Wide scope conjunction – RC vs. SC:

✓ (4) Here you're not allowed to sing aloud, **and** dance **and** stamp your feet. wide  
narrow

✗ (5) Here you're not allowed to sing aloud, dance and stamp your feet.



13

## SC-Coordination – flat Syntax-Semantics

Adverbs of alternation:

(6) John's swagger alternately bemused, and/?Φ irritated and infuriated his soldiers.

DP-internal Conjunction:

(7) This Batman film features every foe, and/?Φ friend and colleague he ever faced.

Left-subordinating *and*: (Culicover and Jackendoff 2005)

(8) You drink another can of beer and I'm leaving.

(9) You drink another can of beer, and/?Φ Bill eats more pretzels and I'm leaving.

14

## SC-Coordination – flat Syntax-Semantics

Conclusion: Prosody matches syntax-semantics.

RC: [ X<sub>1</sub> coor X<sub>2</sub> ] coor X<sub>3</sub>  
 X<sub>1</sub> coor [ X<sub>2</sub> coor X<sub>3</sub> ]

SC: [ X<sub>1</sub> X<sub>2</sub> coor X<sub>3</sub> ]

Simple implementation:

*n*-ary syntax → *n*-ary semantics

SC-coordination involves no recursion, in either syntax or semantics ???

15

Partee and Rooth's verb-obj. composition (1)

Intensional+Extensional Transitive Verbs:

(2) Mary sought and found a fish.

Mary sought a fish (*de dicto*) **and** found a fish.  
wide

Deriving Wide Scope *and*:

[sought and found] [a fish]

(sought and AR(found))(a fish)

16

## Partee and Rooth's verb-obj. composition (2)

### Extensional+Extensional Transitive Verbs:

- (1) Mary found and ate a fish. narrow
- (a) There is a fish that Mary found and ate. wide
- (b) ?Mary found a fish and ate a fish. wide

### Deriving Narrow Scope *and*:

[found and ate] [a fish]

(AR(found and ate))(a fish) (Argument Raising)

### Deriving Wide Scope *and*? P&R: no! Hendriks: why not?

~~(AR(found) and AR(ate))(a fish) ???~~

To say the least: we need narrow scope and<sub>17</sub>

## Embedding is useful – SC-coordination

### ITV + 2 x ETV:

- (3) Mary sought, found and ate a fish.
- Mary sought a fish (*de dicto*) and then
- [found and ate] a fish. wide
- narrow

(4) John needed, bought and wore a coat.

(5) Sue ordered, got and used a new PC.

## Partee and Rooth's verb-obj. composition (3)

### Intermediate conclusions:

1. We need a principle like AR for intensional-extensional TV conjunctions.
2. We need to apply AR to a whole conjunction in order to get narrow scope *and* in extensional-extensional TV conjunctions.
3. Whether we need to block AR from applying separately to the conjuncts is still debatable (and irrelevant for our main purposes).

## Embedding is useful – *n*-ary semantics fails

[sought, found and ate]

### N-ary analysis:

and<sub>3</sub> (sought, AR(found), AR(ate))  
 = sought a fish, found a fish and ate a fish  
 → Back to P&R's problem

### But a binary analysis would work fine:

(sought and AR(found and ate))  
 = sought a fish, [and found a fish and ate it]

How can we get a binary interpretation in a trinary structure?

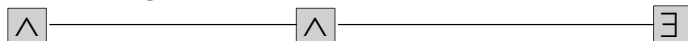
## Recursive Semantics of Iterated Structures

**Hypothesis:** Any coordinator, also an  $n$ -ary one, is a direction to use the respective binary operation (recursively) on the conjuncts.

$$\text{and}_n(x_1, x_2, \dots, x_n) = \text{and}_2(x_1, \text{and}_{n-1}(x_2, \dots, x_n))$$

[sought, found and ate]:

and( sought , AR(and ( found , ate ))) (a fish)



A critical assumption: AR applies at the same semantic level where *and* is interpreted.

Other examples for such operators?



21

## SC-Disjunction and Universal Quantification (1)

Predicate distributivity:

(1) The girls met in the bar and had a glass of beer.

(Dowty 1986, Roberts 1987, Lasersohn 1995)

meet and D(have a glass of beer)

(2) Every time they meet, Mary and Sue eat chocolate, lick a lolly or share a pizza.

One of two conditions holds at every meeting:

(i) Mary eats chocolate or licks a lolly, and Sue eats chocolate or licks a lolly.

(ii) Mary and Sue share a pizza.

22

## SC-Disjunction and Universal Quantification (2)

(2) Every time they meet, Mary and Sue eat chocolate, lick a lolly or share a pizza.

N-ary analysis:

$\text{or}_3(\text{D}(\text{eat chocolate}), \text{D}(\text{lick lolly}), \text{share pizza})$

– Mary and Sue do the same thing

→ too weak interpretation

But a binary analysis would work fine:

$\text{D}(\text{eat chocolate or lick lolly})$  or share pizza

→ universal scope over disjunction, as needed

23

## SC-Disjunction and Universal Quantification (3)

More examples:

*Mary and Sue will be watching cartoons together in the room upstairs, playing quietly downstairs or drawing a picture.*

*In each of the pictures, the two teddy bears are singing, dancing or hugging each other.*

sing-sing	sing-dance	hug
dance-dance	hug	dance-dance
dance-sing	sing-sing	hug

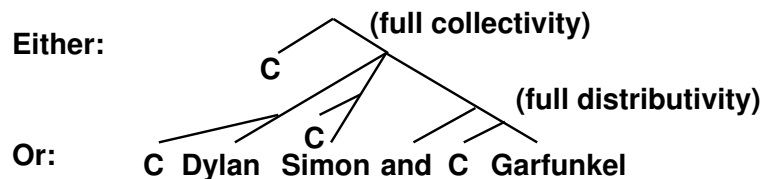
24

## Non-Recursive Semantics of Iterated Struct.

Dylan, Simon and Garfunkel wrote many hits in the 60s.

**Boolean Hypothesis: Collectivity with DP conjunction is *syntactically* triggered.**

(Winter 1998,2001)



But not “mixed” collectivity.

25

## Summary

1. When the semantics gets a series of denotations generated by a flat (iterative) syntactic mechanism, it can still glue them recursively using embedding.
2. But in many cases the hierarchical syntax-semantics interface gives no chance for semantic embedding.

This allows us to distinguish purely-semantic operators from operators at the syntax-semantics interface.

27

## Remarks

### I - Semantic composition is non-directional:

- (1) Mary and Sue have a sandwich, build a raft together or drink a glass of milk.  
(distribution over a non-constituent disjunction)

### II - RC coordination may allow SC-type interpretation:

- (2) Mary and Sue have a sandwich or build a raft together or drink a glass of milk.  
(distribution over a non-constituent RC disjunction)
- (3) A | (and) B | and C  
\*A | and B | or C
- (4) Between A and B and C

26

## References

- Culicover, P. W. and Jackendoff, R. (2005). *Simpler Syntax*. Oxford University Press, Oxford.
- Dowty, D. (1986). Collective predicates, distributive predicates and all. In *Proceedings of the Eastern States Conference on Linguistics, ESCOL3*. Cascadilla Press.
- Haspelmath, M. (2004). Coordinating constructions: an overview. In M. Haspelmath, editor, *Coordinating Constructions*. John Benjamins Publishing Company, Amsterdam/Philadelphia.
- Hauser, M. D., N. Chomsky and W. T. Fitch (2002). The faculty of language: what is it, who has it, and how did it evolve? *Science* 298:1569-1579.
- Hendriks, H. (1993). *Studied Flexibility: categories and types in syntax and semantics*. PhD thesis, University of Amsterdam.
- Hoeksema, J. (1988). The semantics of non-boolean and. *Journal of Semantics* 6:19-40.
- Jackendoff, R. (1977). *Xbar-Syntax: A study of phrase structure*. MIT Press, Cambridge, Massachusetts.
- Johannessen, J. B. (1998). *Coordination*. Oxford University Press, New York/Oxford.
- Lasnik, S. (1995). *Plurality, Conjunction and Events*. Kluwer, Dordrecht.
- Munn, A. (1993). *Topics in the Syntax and Semantics of Coordinate Structures*. PhD thesis, U. of Maryland.
- Oehrle, R. T. (1987). Boolean properties in the analysis of gapping. In G. J. Huck and A. E. Ojeda, editors, *Syntax and Semantics* (vol. 20) – *Discontinuous Constituency*. Academic Press, Orlando.
- Partee, B. and Rooth, M. (1983). Generalized conjunction and type ambiguity. In R. Bauerle et al, editors, *Meaning, Use and Interpretation of Language*. De Gruyter, Berlin.
- Peterson, D. A. and VanBik, K. (2004). Coordination in Hakha Lai (Tibeto-Burman). In M. Haspelmath, editor, *Coordinating Constructions*. John Benjamins Publishing Company, Amsterdam/Philadelphia.
- Roberts, C. (1987). *Modal Subordination, Anaphora, and Distributivity*. PhD thesis, UMass.
- Sag, I., Gazdar, G., Wasow, T., and Weisler, S. (1985). Coordination and how to distinguish categories. *Natural Language and Linguistic Theory* 3:117.171.
- Winter, Y. (1998). *Flexible Boolean Semantics: coordination, plurality and scope in natural language*. PhD thesis, Utrecht University.
- Winter, Y. (2001). *Flexibility Principles in Boolean Semantics: coordination, plurality and scope in natural language*. MIT Press, Cambridge, Massachusetts.

28