A Syntax-Semantics Interface in the Light of Ambiguity, Discontinuity, Redundancy, and Distributed Marking

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(based on joint work with Frank Richter and Bob Levine)

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Overview

Outline

Goal of this talk

Observations:
Basic properties of sentence interpretation are problematic for many concepts of compositionality:

- ambiguity
- discontinuous meaning contribution
- redundant marking/concord
- distributed marking/joint interpretation of constituents
- (idioms)
- (interpretation of fragmentary utterances)

Goal of this talk

Thesis:

An adequate syntax-semantics interface should

- treat syntax and semantics as separate modules of grammars
- not tie semantic ambiguity to syntactic ambiguity
- not force the grammar writer to turn semantic distinctions into syntactic features
- keep a computationally feasible architecture in sight.

Strategy:

- semantic representation instead of direct interpretation
- systematicity instead of compositionally
- techniques of semantic underspecification

Compositionality

- The meaning of a complex expression is a function of the meanings of its component parts and the way in which they are combined.
- Usually this is taken to imply:
  - Not only words and utterances, but also intermediate nodes in a syntactic structure have meaning.
  - We do not need a semantic representation language/ a translation into some semantic representation language.
  - Persistence: Every contributed operator will be interpreted.
  - Context freeness: The interpretation of two expressions does not (heavily) depend on each other.

Outline

Empirical challenges

- Scope ambiguity: Same words, same structure, more than one reading:

  (1) Every critic reviewed four films.

- Discontinuous semantic contribution:

  (2) Alex braucht keine Krawatte zu tragen. ($\neg > \text{brauch} > \exists$)

- Redundant marking: Several words contribute the same semantics:

  (3) Nikto ničevo ne zdelal.
  noone nothing not did 'Noone did anything.'

- Distributed marking: Various expressions contribute to one operator:

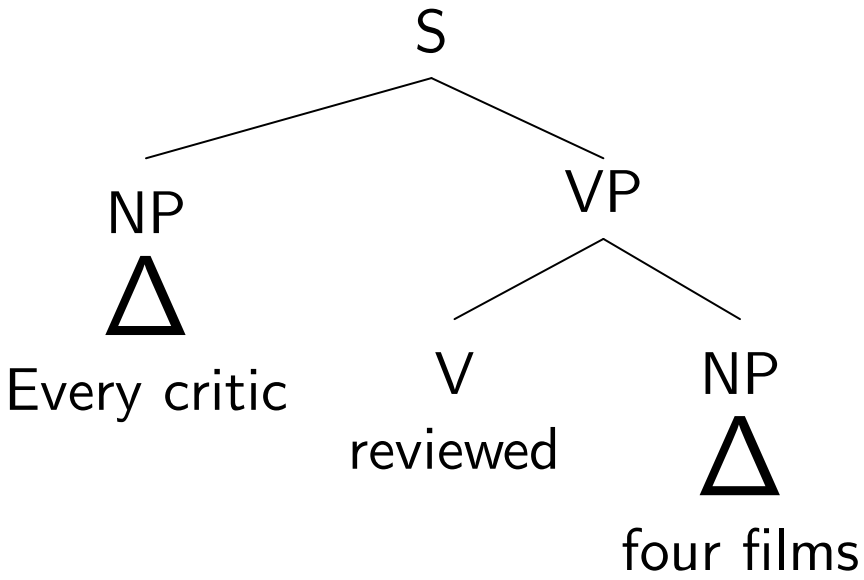
  (4) Several agencies spy on different politicians.

- Distorted utterances: interpretation without clear structure

  (5) Frankfurt, 2.2.14: Turm gesprengt — keine Zwischenfälle.

Scope ambiguity

Same lexical meaning, same syntactic structure, but different readings



Reading 1: every > four
Reading 2: four > every

- Different structure for the different readings? Syntactic evidence?
- Compositionality: Form to meaning as relation instead of function?

More scope ambiguity

- Negation and quantifier

  (6) a. Everything that glitters isn't gold.
  b. What almost everyone didn't know about Malaysian waters' wealth (www)

- Negation and modal verbs

  (7) Alex hat das Buch nicht lesen wollen.
  (**want**(¬**read**); ¬**want**(**read**))

Discontinuous semantic contribution

Semantic contribution of the words in a sentence is mixed.

(8) a. Alex braucht keine Krawatte zu tragen.
$\neg$ (**Need**(**alex**, $^{\wedge}\exists x$(**tie**(x) $\wedge$ **wear**(**alex**, x)))

b. Chris sucht kein Einhorn.
$\neg$ **search**(**chris**, $^{\wedge}\lambda P.\exists x$(**unicorn**($x$) $\wedge$ $P(x)$))

- Semantic contribution of *kein-*: negation, existential quantification
- No obvious evidence for syntactic decomposition (historical/morphological case for *kein*, but no synchronic syntactic argument)

Semantic concord

(9) a. Personne (n') a dormi.
nobody (ne) has slept 'Nobody slept.'

b. Personne (n') a vu personne.
nobody (ne) has seen nobody
R1 (double negation): $\neg\exists x \neg\exists y \textbf{see}(x, y)$
R2 (negative concord): $\neg\exists x \exists y \textbf{see}(x, y)$

- Several words contribute the same semantic operator, but it is interpreted only once.
- Reasonable semantics of *personne*: $\neg\exists x(\ldots)$
- Very common among the languages of the world

More semantic concord phenomena

- Tense/sequence of tense:

(10) a. Jan wou die boek kon lees.
Jan wanted the book could read
'Jan wanted to be able to read the book.'

b. Marie het gesê dat Piet die boek kon lees.
Marie has said that Piet the book could read
'Marie said that Piet could read the book.'

- Cognate object construction:

(11) Pat slept a peaceful sleep. = Pat slept peacefully.

- Modal concord Zeijlstra (2007)

(12) You may possibly have read my little monograph on the subject.
'The speaker thinks that it is possible that you read her little monograph.'

(13) Power carts must mandatorily be used on cart paths where provided
'It is oblig. that power cats are used on cart paths where provided'

Distributed marking

Various words contribute differently to a complex operator

(14) Polyadic quantifiers

a. Pat knows two men with the same name.

b. Two agencies in my country spy on different citizens.
$\langle 2, \Delta \rangle x, y(\textbf{agency}(x), \textbf{citizen}(y) : \textbf{spy-on}(x, y))$

- Barker (2007): *same/different* takes scope just below another quantifier (parasitic scope) $\longrightarrow$ highly non-standard syntactic movement
- Alternative: These adjectives contribute to a complex polyadic quantifier
- Denotation: $\langle Quant, \Delta \rangle\, x, y(\phi_1, \phi_2 : \psi)$: There is a set X containing $Quant$-many x that are ϕ_1 and for each x in X there is a unique y which is ϕ_2 such that ψ holds for x and y.

Other phenomena of distributed marking

- Other adjectives (Barker, 2007): *similar*, *distinct*, *different*, *identical, unrelated, mutually incompatible*, *opposite*
- Negative Concord in Romanian (Iordăchioaia, 2009)
- Inverse linking (Moltmann, 1995)

(15) A candidate from every city supported the proposal.

Distorted utterances

Interpretation is possible even if there is no (correct/complete) syntactic structure

- Headlinese (telegraphic style, sms?):

  (16) Governor signs bill (en.wikipedia.org/wiki/Headlinese)

- Understanding child language

  (17) Daddy ball (Carroll, 1994)

- Understanding unknown dialects

  (18) The movie don't know whether good or not. (Singapore English, Wee (2008))

- Interpretation is systematic even at the absence of syntax!

Outline

Surface-oriented syntax

- Surface oriented (for example Pollard and Sag (1994))
- Syntactic nodes are justified on the basis of syntactic arguments, not to safe some version of compositionality.
- Avoid abstract (phonologically empty) nodes to express semantics.

Syntax for our phenomena

- Ambiguity: Identical syntactic structure for scopally ambiguous sentences
- Discontinuitiy: No additional abstract nodes in the syntactic tree.
- Redundancy: No additional abstract nodes
- Disjoint marking: No syntactic movement to unite expressions that are not syntactically connected
- Distorted utterances: No postulation of a full underlying syntactic analysis

Lexical Resource Semantics: Basics

Semantic representations in LRS

- Lexical signs exhaustively contribute all meaning components of utterances
- Signs contribute constraints on the relationships between (pieces of) their semantic contributions
- Semantic constraints *denote* semantic representations

Our semantic metalanguage

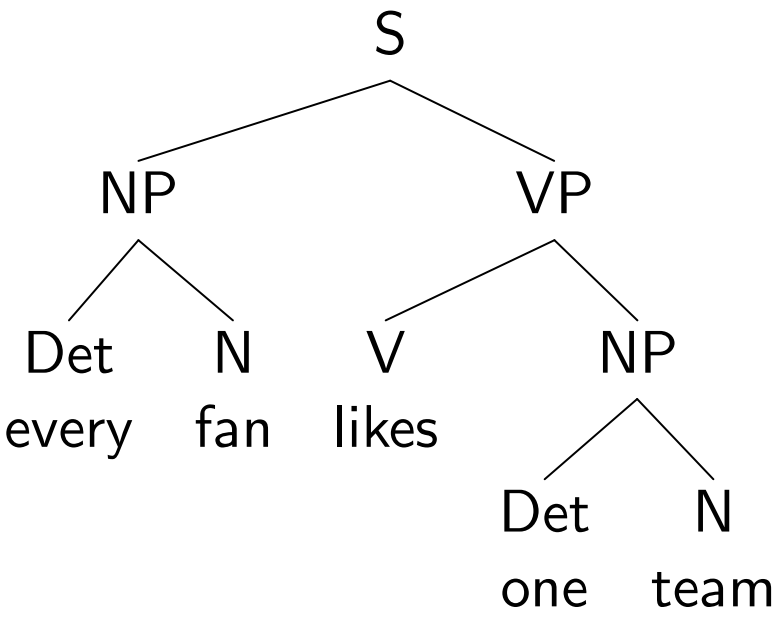
- Semantic metalanguage:
  - ordinary expressions denote ordinary expressions
  - metavariables: $A, B, \ldots$ denote arbitrary expressions
  - for each metavariable A and each expressions from the metalanguage ϕ_1, ϕ_n: $A[\phi_1, \phi_n]$ is some expression that contains at least the interpretation of ϕ_1, ..., and ϕ_n as subexpressions.
- Fundamental distinction between various aspects of meaning contributions:
  - main content, underlined: $\underline{\phi}$
  - internal content, between curly braces: $\{\psi\}$
  - external content, preceeded by hash: $^{\#}\chi$

Example

(19) Every fan likes one team.

a. $\forall x(\textbf{fan}(x) \rightarrow \exists y(\textbf{team}(y) \wedge \textbf{like}(x, y)))$

b. $\exists y(\textbf{team}(y) \wedge \forall x(\textbf{fan}(x) \rightarrow \textbf{like}(x, y)))$



likes: ${}^{\#}A[\{\underline{\textbf{like}}(x, y)\}]$

team: ${}^{\#}B : [\{\underline{\textbf{team}}(y)\}]$

one: ${}^{\#}\exists y(B' : [y] \wedge B''[y])$

fan: ${}^{\#}C : [\{\underline{\textbf{fan}}(x)\}]$

every: ${}^{\#}\forall x(C' : [x] \rightarrow C''[x])$

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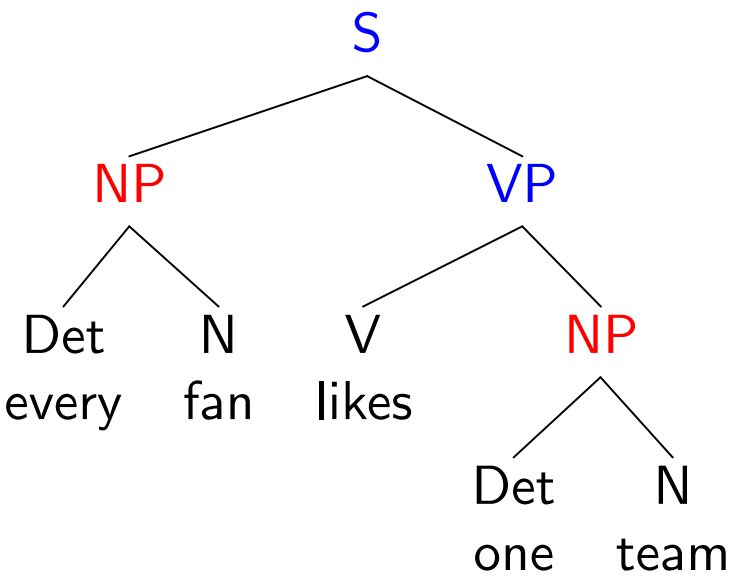

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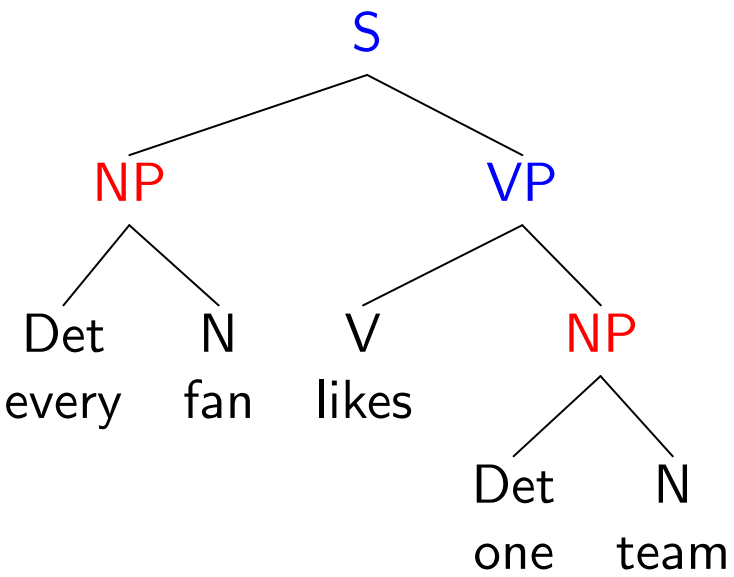

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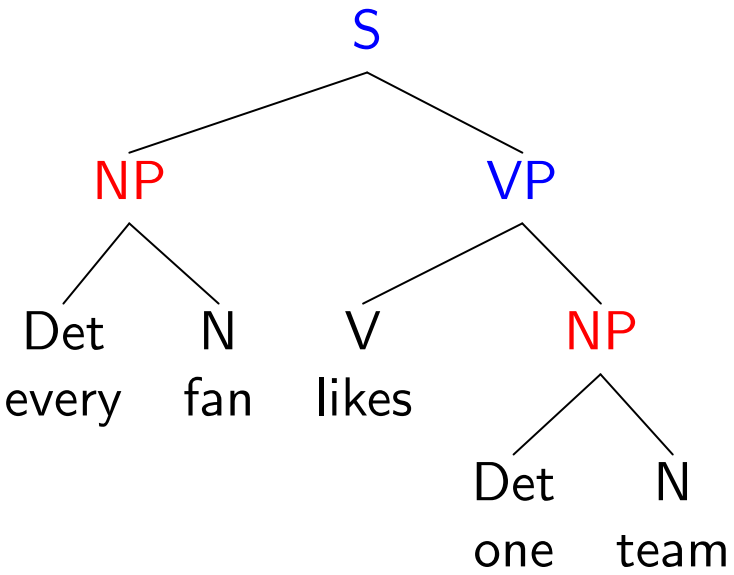
every: $^{\wedge}\forall x(C' : [x] \rightarrow C''[x])$

one team: $^{\#}\exists y(B' : [y, \textbf{team}(y)] \wedge B''[y])$

every fan: $^{\#}\forall x(C' : [x, \textbf{fan}(x)] \rightarrow C''[x])$

Determiner-Head Principle, DHP: If a quantifier combines with a head noun, they have the same external content and the noun's internal content is a subexpression of the quantifier's restrictor.

Example



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VP: $^{\#}A : [\exists y(B' : [y, \textbf{team}(y)] \wedge B''[y, \{\underline{\textbf{like}}(x,y)\}])]$
S: $^{\#}A : [\ldots, \forall x(C' : [x, \textbf{fan}(x)] \rightarrow C''[x, \{\underline{\textbf{like}}(x,y)\}])]$

Quantifier-Head Principle,QHP: If a quantified NP combines with a head, the head's internal content is a subexpression of the NP's scope.

Example

(20) Every fan likes one team.

$^{\#}A : [\exists y(B' : [y, \mathbf{team}(y)] \wedge B''[y, \{\underline{\mathbf{like}}(x, y)\}]),$
$\forall x(C' : [x, \mathbf{fan}(x)] \rightarrow C''[x, \{\underline{\mathbf{like}}(x, y)\}])]$

a. $\forall x(\mathbf{fan}(x) \rightarrow \exists y(\mathbf{team}(y) \wedge \mathbf{like}(x, y)))$

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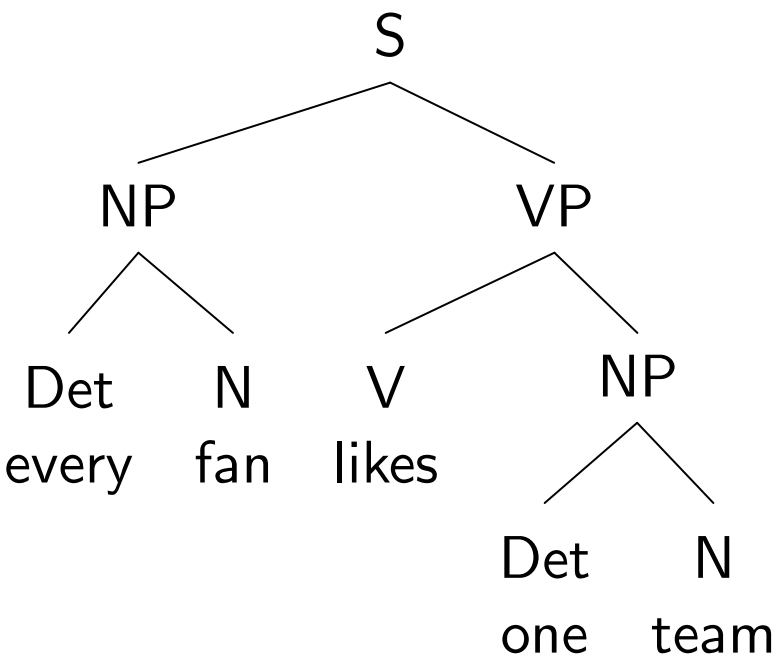

Outline

Consequences of the framework

- Ambiguity: The combined constraints on the interpretation of a sentence may be compatible with various readings.
- Discontinuity: Lexical elements may introduce "holes, i.e., space for additional semantic material.
- Redundant marking: Several expressions may introduce the same semantics constraint.
- Distributed marking: If there is a distributed representation for a complex operator, its parts may be introduced by distinct words.
- Distorted utterances: Semantic combinatorics does not depend on defined syntactic structure.

Ambiguity

Example discussed

Discontinuous semantic contribution

(21) Alex braucht keine Krawatte zu tragen.

- Lexical constraints:
  - Alex: $^{\#}\{\underline{\textbf{alex}}\}$
  - braucht: $^{\#}A[\underline{\textbf{need}}(\textbf{alex}, ^{\wedge}.B[\{B'\}])]$
    (B' is the complement VP's internal content)
  - keine: $\neg C[^{\#}\exists x(D \wedge D')]$
  - Krawatte: $^{\#}E[\{\underline{\textbf{tie}}(x)\}]$
  - (zu) tragen: $^{\#}F[\{\underline{\textbf{wear}}(\textbf{alex}, y)\}]$
- keine Krawatte: $\neg C[^{\#}\exists x(D[\{\underline{\textbf{tie}}(x)\}] \wedge D')]$
- keine Krawatte zu tragen:
  $^{\#}F[\neg C[^{\#}\exists x(D[\textbf{tie}(x)] \wedge D'[\{\underline{\textbf{wear}}(\textbf{alex}, y)\}])]]$
- braucht keine Krawatte zu tragen:
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  $F[\neg C[{}^{\#}\exists x(D[\textbf{tie}(x)] \wedge D'[\{\textbf{wear}(\textbf{alex}, y)\}])]]]$
- Potentially ambiguous:
  Reading 1 ($\neg > \text{need} > \exists$): $\neg\textbf{need}(\textbf{alex}, {}^{\wedge}\exists x(\textbf{tie}(x) \wedge \textbf{wear}(\textbf{alex}, x)))$
  Reading 2 ($\neg > \exists > \text{need}$): $\neg\exists x(\textbf{tie}(x) \wedge \textbf{need}(\textbf{alex}, {}^{\wedge}\textbf{wear}(\textbf{alex}, x)))$
  Reading 3 ($\text{need} > \neg > \exists$): $\textbf{need}(\textbf{alex}, {}^{\wedge}\neg\exists x(\textbf{tie}(x) \wedge \textbf{wear}(\textbf{alex}, x)))$

Redundant marking

(22) Personne$_1$ (n') a vu personne$_2$.
noone ne has seen noone

- LRS analysis in Richter and Sailer (2001, 2006); Sailer (2004)
- Lexically contributed constraints:
  - personne$_1$: $\neg A[^{\#}\exists x(B[\{\underline{\textbf{person}}(x)\}] \wedge B')]$
  - (n')a vu: $^{\#}C[\{\underline{\textbf{see}}(x,y)\}]$
  - personne$_2$: $\neg D[^{\#}\exists y(E[\{\underline{\textbf{person}}(y)\}] \wedge E')]$
- (n') a vu personne$_2$: $^{\#}C[\neg D[\exists y(E[\textbf{pers}(y)] \wedge E'[\{\underline{see}(x,y)\}])]]$
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Redundant marking (cont.)

- Personne$_1$ (n') a vu personne$_2$:
  $^{\#}C[\neg D[\exists y(E[\mathbf{pers}(y)] \wedge E'[\{\underline{see}(x,y)\}])],$
  $\neg A[\exists x(B[\mathbf{pers}(x)] \wedge B'[\{\underline{see}(x,y)\}])]]$
  Reading 1 (non-concord): $\neg\exists x(\mathbf{pers}(x) \wedge \neg\exists y(\mathbf{pers}(y) \wedge \mathbf{see}(x,y)))$
  Reading 2 (concord): $\neg(\exists x(\mathbf{pers}(x) \wedge \exists y(\mathbf{pers}(y) \wedge \mathbf{see}(x,y)))$

Distributed marking

(23) Two agencies spy on different citizens.
$\langle \mathbf{2}, \Delta \rangle\, x, y(\mathbf{agency}(x), \mathbf{citizen}(y) : \mathbf{spy\text{-}on}(x, y))$

- Richter (talk given at Düsseldorf, January 2014)
- Lexical constraints:
  - Two: $^{\#} \langle \ldots, \mathbf{2}, \ldots \rangle \ldots, x, \ldots (\ldots, A, \ldots : A')$
  - agencies: $^{\#} B[\{\underline{\mathbf{agency}}(x)\}]$
  - spy: $^{\#} C[\{\underline{\mathbf{spy}}(x, y)\}]$
  - different: $^{\#} \langle \ldots, \Delta, \ldots \rangle \ldots, y, \ldots (\ldots, D, \ldots : D')$
  - citizens: $^{\#} E[\{\underline{\mathbf{citizen}}(y)\}]$
- different citizens:
  $^{\#} \langle \ldots, \Delta, \ldots \rangle \ldots, y, \ldots (\ldots, D[\{\underline{\mathbf{citizen}}(y)\}], \ldots : D')$
- two agencies:
  $^{\#} \langle \ldots, \mathbf{2}, \ldots \rangle \ldots, x, \ldots (\ldots, A[\{\underline{\mathbf{agency}}(x)\}], \ldots : A')$
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- two agencies:
  $^{\#} \langle \ldots, \mathbf{2}, \ldots \rangle \ldots, x, \ldots (\ldots, A[\{\underline{\mathbf{agency}}(x)\}], \ldots : A')$
- Two agencies spy on different citizens:
  $^{\#} C[\langle \ldots, \Delta, \ldots \rangle \ldots, y, \ldots (\ldots, D[\mathbf{citizen}(y)], \ldots : D'[\{\underline{\mathbf{spy}}(x, y)\}]),$
  $\langle \ldots, \mathbf{2}, \ldots \rangle \ldots, x, \ldots (\ldots, A[\mathbf{agency}(x)], \ldots : A'[\{\underline{\mathbf{spy}}(x, y)\}])]$

Constraint on polyadic readings

- A strong quantifier (including polyadic quantifiers) cannot take scope outside the clause in which it appears.
- In every clause: The external content of a strong quantifier is a component of the clause's external content if all variables bound by the quantifier are introduced inside the clause.
- Predicts possibility of telescoping (Barker, 2012; Sternefeld, ta):

(24) [The grade [that each$_i$ student receives]] is recorded in his$_i$ file.
$\langle \iota, \forall \rangle\, x, y(\textbf{grade}(x), (\textbf{stud}(y) \wedge \textbf{receive}(y, x)) : \textbf{rec-in-file}(x, y))$

Distorted utterances (very tentative)

(25) Daddy ball.

- Lexical constraints:
  - Daddy: $^{\#}\{\underline{\textbf{daddy}}\}]$
  - ball: $^{\#}A[\{\underline{\textbf{ball}}(x)\}]$
- Daddy ball: $B[\textbf{daddy}, \textbf{ball}(x)]$
- No way to build a formula of just these parts!
- But: Cooperativeness: Look for a contextually relevant formula ϕ that satisfies this constraint.
- Plausible candidates:
  $\phi = \textbf{give}(\textbf{daddy}, (\iota x : \textbf{ball}(x)), \textbf{Speaker})$
  $\phi = \exists x(\textbf{ball}(x) \wedge \textbf{hold}(\textbf{daddy}, x))$

Summary

- Ambiguity: The combined constraints on the interpretation of a sentence may be compatible with various readings.
- Discontinuity: Lexical elements may introduce "holes, i.e., space for additional semantic material.
- Redundant marking: Several expressions may introduce the same semantics constraint.
- Distributed marking: If there is a distributed representation for a complex operator, its parts may be introduced by distinct words.
- Distorted utterances: Semantic combinatorics does not depend on defined syntactic structure.

Outline

Conclusions

- Syntactic structure of a sentence should not depend on interpretation of scopal elements.
- Semantic interpretation of a scope-taking expression should not necessarily affect the syntactic representation.
- Generalizations at the interface should not mess with the internal structure of independently motivated grammar modules.
- Techniques:
  - constraint-based semantic representations
  - underspecification
  - suitable for computational implementation
- More phenomena (discussed by Sascha + please ask!):
  Idioms, collocations, constructions
- Allows a fresh look at phenomena such as sequence of tense, telescoping, ...

Compositionality?

- Strong empirical problems and rather baroque proposals to save it
- Words/phrases contribute constraints on possible readings rather than meaning functions.
- Systematicity: The possible readings in which a complex expression can occur is systematically constrained by the possible readings in which its component parts can occur and by the syntactic combination.

- Do intermediate nodes in a tree have meaning?
  (Analogy to phonology (Höhle, 1999): Reading is like a phonological realization)
- Semantic representation language necessary? Yes! (Kamp and Reyle, 1993)

Thank you!

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