Constraint-Based Underspecified Semantic Combinatorics

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Overview

Outline

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 carry 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.

Goal of this talk

Observations (for ex. Sailer 2016b)
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
- reusing meaning contributions
- (idioms)
- (interpretation of ill-formed or 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 compositionality
- techniques of semantic underspecification

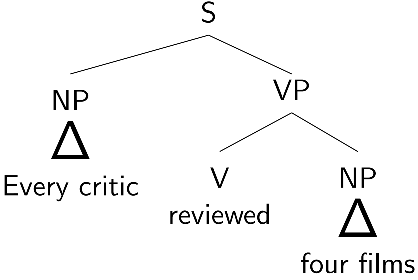
Outline

Empirical challenges

- Scope ambiguity: Same words, same structure, more than one reading.
- Discontinuous semantic contribution: Meaning contributions of words are intertwined.
- Redundant marking: Several words contribute the same semantics.
- Distributed marking: Various expressions contribute to one operator.
- Reusing contributions: The contribution of an expression is used more than once.

Scope ambiguity 1

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?

Scope ambiguity 2

Egg (2007, 2010)

(1) John's former car

a. The x which used to be John's car

b. The x which belongs to John and used to be car.

(2) a beautiful dancer

a. a dancer who is beautiful

b. a person who dances beautifully

Discontinuous semantic contribution 1

Semantic contribution of the words in a sentence is mixed.

(3) a. Alex braucht keine Krawatte zu tragen.
Alex need no tie wear
'Alex need wear no tie.'
$\neg\ (\mathbf{Need}(\mathbf{alex}, {}^\wedge\exists x(\mathbf{tie}(x) \wedge \mathbf{wear}(\mathbf{alex}, x)))$

b. Chris sucht kein Einhorn.
Chris searches no unicorn
$\neg\ \mathbf{search}(\mathbf{chris}, {}^\wedge\lambda P.\exists x(\mathbf{unicorn}(x) \wedge P(x)))$

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

Discontinuous semantic contribution 2

- Nonlocal *right/wrong* (Schwarz, 2006)

(4) Alex opened the wrong bottle.
= Alex opened a bottle for which it was wrong for Alex to open it.

- Alternative analysis:
Presupposes: There is a bottle that Alex should open.
Assertion: Alex opened something and this something was not the (presupposed) bottle that Alex should open.
- Discontinuous, modal interpretation:

(5) Alex opened some x and x is not the bottle that Alex should open.
$\exists x(\textbf{open}(\textbf{alex}, x)$
$\quad \wedge \neg(x = (\iota x : \underline{\textbf{bottle}(x) \wedge \textbf{SHOULD}(\textbf{open}(\textbf{alex}, x))})))$

Semantic concord

(6) 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): $\neg\exists x \neg\exists y \mathbf{see}(x, y)$
R2 (negative concord): $\neg\exists x \exists y \mathbf{see}(x, y)$

- 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 (Afrikaans, Ponelis 1979):

(7) 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 (Jones, 1988):

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

- Modal concord (Zeijlstra, 2007)

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

(10) 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 1

Various words contribute differently to a complex operator

(11) Polyadic quantifiers

a. Pat knows two men with the same name.

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

- Barker (2007): *same/different* takes scope just below another quantifier (parasitic scope) $\longrightarrow$ highly non-standard syntactic movement or rather complex syntactic category (in Categorial Grammar)
- Alternative: These adjectives contribute to a complex polyadic quantifier
- Denotation: $\langle Quant, \Delta \rangle \, (\phi_1, \phi_2 : \psi)$: There is a subset X' of ϕ_1 such that $Quant(\phi_1, X')$, and for each pair of distinct $x, x' \in X'$, the elements in $[[\phi_2]] \cap [[\psi]](x)$ are distinct from those in $[[\phi_2]] \cap [[\psi]](x')$.

Distributed marking 2

- Other adjectives (Barker, 2007): *similar*, *distinct*, *different*, *identical, unrelated, mutually incompatible*, *opposite*
- Inverse linking (Moltmann, 1995)

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

- Sailer (2015)

(13) $\langle\forall,\exists\rangle(\lambda x.\mathbf{city}(x), \lambda y.\mathbf{cand\text{-}from}(y,x); \mathbf{support\text{-}prop}(y))$

Distributed marking 2

Arguments for a unit-like behavior (Sailer, 2015):

- No definiteness effect (Woisetschlaeger, 1983):

  (14) There was the proof of a theorem on page 331.

- *except* phrases (Moltmann, 1995)

  (15) the wife of every president except Hilary

- semantically embedded quantifier influences restrictor of higher quantifier (Champollion & Sauerland, 2011)

  (16) An apple in every basket is rotten.
  (only about baskets containing apples)

- no intermediate quantifiers allowed Larson (1985)

  (17) Two policemen spy on [someone from [every city]]
  no reading: **Every** > **Two** > **Some**

Reusing material 1

Nonlocal *right*/*wrong* (Schwarz, 2006)

(18) Alex opened the wrong bottle.

(19) Alex opened some x and x is not the bottle that Alex should open.

$$\exists x(\mathbf{open}(\mathbf{alex}, x) \\ \quad \wedge \neg(x = (\iota x : \underline{\mathbf{bottle}(x) \wedge \mathbf{SHOULD}(\mathbf{open}(\mathbf{alex}, x))})))$$

Reusing material 2

Coordination: NP-coordination in syntax, proposition conjunction in semantics

(20) Alex wrote [NP: [no letter] and [no postcard]].
$\neg\exists x(\mathbf{letter}(x) \wedge \mathbf{write}(\mathbf{alex}, x)) \wedge\neg\exists x(\mathbf{pc}(x) \wedge \mathbf{write}(\mathbf{alex}, x))$

Distorted utterances

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

- Headlinese (telegraphic style, texting):

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

- Understanding child language

  (22) Daddy ball (Carroll, 1994)

- Understanding unknown dialects

  (23) 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 & Sag (1994))
- Syntactic nodes are justified on the basis of syntactic reasoning, they do not serve to maintain some version of semantic 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
- Distributed marking: No syntactic movement to unite expressions that are not syntactically connected

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

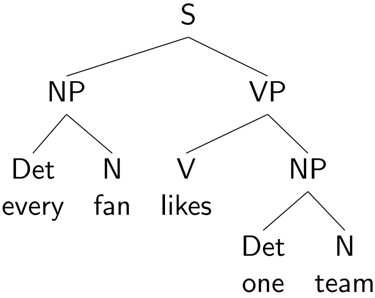
- Semantic metalanguage:
  - ordinary expressions denote ordinary expressions
  - metavariables: $A, B, \ldots$ denote arbitrary expressions
  - for every metavariable A and every expression from the metalanguage $\phi_1, \ldots, \phi_n$: $A[\phi_1, \ldots, \phi_n]$ is an expression that contains at 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: $^\wedge\chi$

Example

(24) Every fan likes one team.

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

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



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

team: $^{\wedge}B[\{\underline{\mathbf{team}}(y)\}]$

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

fan: $^{\wedge}C[\{\underline{\mathbf{fan}}(x)\}]$

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

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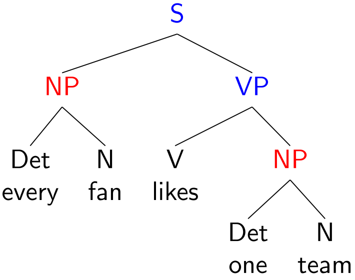

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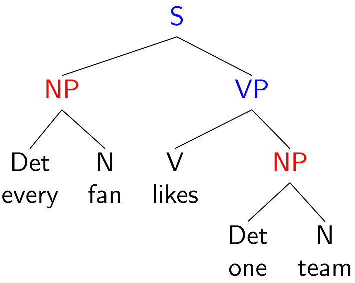

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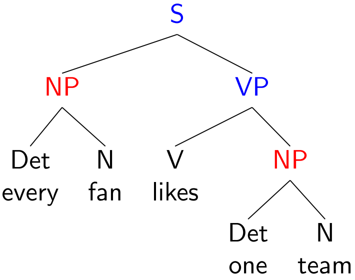
every: $^\wedge\forall x(C'[x] \rightarrow C''[x])$

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

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

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

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

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.

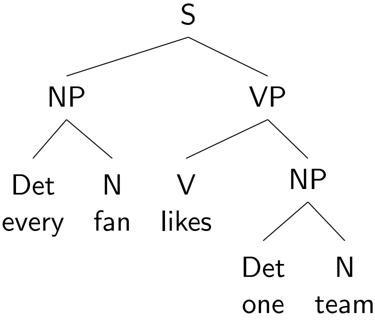
Example

(25) Every fan likes one team.

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

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

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



External Content Principle:
At an utterance, the sem.repr. is an interpretation of the meta-expression with no added object expressions.

Outline

Consequences of the framework

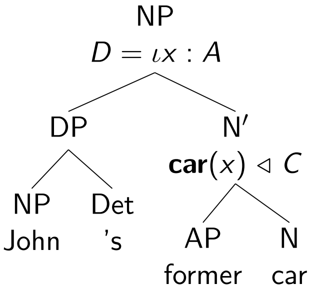
- Ambiguity: The combined constraints on the interpretation of a sentence may be compatible with various readings.
- Discontinuity: Lexical elements may introduce “holes”, i.e., space for additional semantic material.
- Redundant marking: Several expressions may introduce the same semantic constraint.
- 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 a well-articulated syntactic structure.)

Ambiguity

(26) John's former car

John: ${}^\wedge\{\underline{\mathbf{john}}\}$'s: ${}^\wedge\iota x : (A[A'[x] \wedge \{\underline{\mathbf{Poss}}(x, \mathbf{john})\}])$

former: ${}^\wedge B[\underline{\mathbf{Past}}(C[x])]$ car: ${}^\wedge D[\{\underline{\mathbf{car}}(x)\}]$



In an head-modifier combination:
if the external cont of the modifier is ${}^\wedge\alpha(\beta)$,
the internal content of the head is in β.

$\iota x : (\mathbf{Past}(\{\mathbf{car}(x)\} \wedge \mathbf{Poss}(x, \mathbf{john})))$

$\iota x : (\mathbf{Past}(\{\mathbf{car}(x)\}) \wedge \mathbf{Poss}(x, \mathbf{john}))$

Discontinuous semantic contribution

(27) Alex braucht keine Krawatte zu tragen.
Alex need no tie to wear
'Alex need wear no tie.'

- Lexical constraints:
  - Alex: $^\wedge\{\underline{\textbf{alex}}\}$
  - braucht: $^\wedge A[\underline{\textbf{need}}(\textbf{alex}, {}^\wedge B[\{B'\}])]$
    (B' is the complement VP's internal content)
  - keine: $\neg C[{}^\wedge\exists x(D \wedge D')]$
  - Krawatte: $^\wedge E[\{\underline{\textbf{tie}}(x)\}]$
  - (zu) tragen: $^\wedge F[\{\underline{\textbf{wear}}(\textbf{alex}, y)\}]$
- keine Krawatte: $\neg C[{}^\wedge\exists x(D[\{\underline{\textbf{tie}}(x)\}] \wedge D')]$
- keine Krawatte zu tragen:
  $^\wedge F[\neg C[{}^\wedge\exists x(D[\textbf{tie}(x)] \wedge D'[\{\underline{\textbf{wear}}(\textbf{alex}, y)\}])]]$
- braucht keine Krawatte zu tragen:
  $^\wedge A[\underline{\textbf{need}}(\textbf{alex}, {}^\wedge\lambda B[\{\textbf{wear}(\textbf{alex}, x)\}]),$
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Discontinuous semantic contribution

- Alex braucht keine Krawatte zu tragen:
  $^{\wedge}A[\underline{\mathbf{need}}(\mathbf{alex}, {}^{\wedge}B[\{\mathbf{wear}(\mathbf{alex}, x)\}]),$
  $F[\neg C[^{\wedge}\exists x(D[\mathbf{tie}(x)] \wedge D'[\{\mathbf{wear}(\mathbf{alex}, y)\}])]]]$
- Potentially ambiguous:
  Reading 1 ($\neg >$ need $> \exists$): $\neg\mathbf{need}(\mathbf{alex}, {}^{\wedge}\exists x(\mathbf{tie}(x) \wedge \mathbf{wear}(\mathbf{alex}, x)))$
  Reading 2 ($\neg > \exists >$ need): $\neg\exists x(\mathbf{tie}(x) \wedge \mathbf{need}(\mathbf{alex}, {}^{\wedge}\mathbf{wear}(\mathbf{alex}, x)))$
  Reading 3 (need $> \neg > \exists$): $\mathbf{need}(\mathbf{alex}, {}^{\wedge}\neg\exists x(\mathbf{tie}(x) \wedge \mathbf{wear}(\mathbf{alex}, x)))$

Redundant marking

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

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

(29) Personne$_1$ (n') a vu personne$_2$:

$^\wedge C[\neg D[\exists y(E[\mathbf{pers}(y)] \wedge E'[\{\underline{see}(x,y)\}])],$
$\neg A[\exists x(B[\mathbf{pers}(x)] \wedge B'[\{\underline{see}(x,y)\}])]]$

a. Reading 1 (non-concord):
$\neg\exists x(\mathbf{pers}(x) \wedge \neg\exists y(\mathbf{pers}(y) \wedge \mathbf{see}(x,y)))$

b. Reading 2 (concord):
$\neg(\exists x(\mathbf{pers}(x) \wedge \exists y(\mathbf{pers}(y) \wedge \mathbf{see}(x,y)))$

Distributed marking

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

- Richter (2016)
- Lexical constraints:
  - Two: $^\wedge \langle \ldots, \mathbf{2}, \ldots \rangle\, (\ldots, \lambda x.A, \ldots : \lambda x.A')$
  - agencies: $^\wedge B[\{\underline{\mathbf{agency}(x)}\}]$
  - spy: $^\wedge C[\{\underline{\mathbf{spy}}(x, y)\}]$
  - different: $^\wedge \langle \ldots, \Delta, \ldots \rangle\, (\ldots, \lambda y.D, \ldots : \ldots \lambda y.D')$
  - citizens: $^\wedge E[\{\underline{\mathbf{citizen}}(y)\}]$
- different citizens:
  $^\wedge \langle \ldots, \Delta, \ldots \rangle\, (\ldots, \lambda y.D[\{\underline{\mathbf{citizen}}(y)\}], \ldots : \ldots \lambda y.D')$
- two agencies:
  $^\wedge \langle \ldots, \mathbf{2}, \ldots \rangle\, (\ldots, \lambda x.A[\{\underline{\mathbf{agency}}(x)\}], \ldots : \lambda x.A')$
- Two agencies spy on different citizens:
  $^\wedge C[\langle \ldots, \Delta, \ldots \rangle\, (\ldots, \lambda y.D[\mathbf{citizen}(y)], \ldots : \ldots \lambda y.D'[\{\underline{\mathbf{spy}}(x, y)\}]),$
  $\langle \ldots, \mathbf{2}, \ldots \rangle\, (\ldots, \lambda x.A[\mathbf{agency}(x)], \ldots : \lambda x.A'[\{\underline{\mathbf{spy}}(x, y)\}]))]$

Distributed marking

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

- Richter (2016)
- Lexical constraints:
  - Two: $^\wedge \langle \ldots, \mathbf{2}, \ldots \rangle \, (\ldots, \lambda x.A, \ldots : \lambda x.A')$
  - agencies: $^\wedge B[\{\underline{\mathbf{agency}(x)}\}]$
  - spy: $^\wedge C[\{\underline{\mathbf{spy}}(x, y)\}]$
  - different: $^\wedge \langle \ldots, \Delta, \ldots \rangle \, (\ldots, \lambda y.D, \ldots : \ldots \lambda y.D')$
  - citizens: $^\wedge E[\{\underline{\mathbf{citizen}}(y)\}]$
- different citizens:
  $^\wedge \langle \ldots, \Delta, \ldots \rangle \, (\ldots, \lambda y.D[\{\underline{\mathbf{citizen}}(y)\}], \ldots : \ldots \lambda y.D')$
- two agencies:
  $^\wedge \langle \ldots, \mathbf{2}, \ldots \rangle \, (\ldots, \lambda x.A[\{\underline{\mathbf{agency}}(x)\}], \ldots : \lambda x.A')$
- Two agencies spy on different citizens:
  $^\wedge C[\langle \ldots, \Delta, \ldots \rangle \, (\ldots, \lambda y.D[\mathbf{citizen}(y)], \ldots : \ldots \lambda y.D'[\{\underline{\mathbf{spy}}(x, y)\}]),$
  $\langle \ldots, \mathbf{2}, \ldots \rangle \, (\ldots, \lambda x.A[\mathbf{agency}(x)], \ldots : \lambda x.A'[\{\underline{\mathbf{spy}}(x, y)\}]))]$

Distributed marking

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- Richter (2016)
- Lexical constraints:
  - Two: $^\wedge \langle \ldots, \mathbf{2}, \ldots \rangle\, (\ldots, \lambda x.A, \ldots : \lambda x.A')$
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  - spy: $^\wedge C[\{\underline{\mathbf{spy}}(x, y)\}]$
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  - citizens: $^\wedge E[\{\underline{\mathbf{citizen}}(y)\}]$
- different citizens:
  $^\wedge \langle \ldots, \Delta, \ldots \rangle\, (\ldots, \lambda y.D[\{\underline{\mathbf{citizen}}(y)\}], \ldots : \ldots \lambda y.D')$
- two agencies:
  $^\wedge \langle \ldots, \mathbf{2}, \ldots \rangle\, (\ldots, \lambda x.A[\{\underline{\mathbf{agency}}(x)\}], \ldots : \lambda x.A')$
- Two agencies spy on different citizens:
  $^\wedge C[\langle \ldots, \Delta, \ldots \rangle\, (\ldots, \lambda y.D[\mathbf{citizen}(y)], \ldots : \ldots \lambda y.D'[\{\underline{\mathbf{spy}}(x, y)\}]),$
  $\langle \ldots, \mathbf{2}, \ldots \rangle\, (\ldots, \lambda x.A[\mathbf{agency}(x)], \ldots : \lambda x.A'[\{\underline{\mathbf{spy}}(x, y)\}]))]$

Reusing material: *wrong*

(31) Alex opened the wrong bottle.
$=$ Alex opened some x and x is not the bottle that Alex should open.

(32) $\exists x(\mathbf{open}(\mathbf{a}, x) \wedge \neg(x = (\iota x : \mathbf{bottle}(x) \wedge \mathbf{SHOULD}(\mathbf{open}(\mathbf{a}, x)))))$

- *wrong* has a discontinuous semantics
- we need to re-use semantic material ($\mathbf{open}(\mathbf{alex}, x)$)

Reusing material: *wrong*

(33) Alex opened the wrong bottle.
$=$ Alex opened some x and x is not the bottle that Alex should open.

(34) $\exists x(\mathbf{open}(\mathbf{a}, x) \wedge \neg(x = (\iota x : \mathbf{bottle}(x) \wedge \mathbf{SHOULD}(\mathbf{open}(\mathbf{a}, x)))))$

Lexical semantic constraints:

Alex:	$^\wedge\{\underline{\mathbf{alex}}\}$	opened:	$^\wedge A[\{\underline{open}(\mathbf{alex}, x)\}]$
the:	$^\wedge\iota x : B[x]$	bottle:	$^\wedge C[\{\underline{bottle}(x)\}]$

wrong: $D[\exists x(E[x] \wedge \neg(x = (\iota x : {}^\wedge(F[x] \wedge \mathbf{SHOULD}(E)))))]$

In a head-modifier constellation:
If the modifier's external cont. is $^\wedge(\alpha \wedge \beta)$, the head's internal cont. is in α.

Distorted utterances (very tentative)

(35) Daddy ball.

- Lexical constraints:
  - Daddy: $^\wedge\{\underline{\textbf{daddy}}\}]$
  - ball: $^\wedge A[\{\underline{\textbf{ball}}(x)\}]$
- 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 semantic constraint.
- Distributed marking: If there is a distributed representation for a complex operator, its parts may be introduced by distinct words.
- Reusing material: The same semantic material can be occur as often as needed.
- Distorted utterances: Semantic combinatorics does not depend on well-articulated 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 manipulate the internal structure of independently motivated grammar modules.
- Techniques:
  - constraint-based semantic representations
  - underspecification
  - suitable for computational implementation
- More phenomena: idioms, collocations, constructions
- Allows a fresh look at phenomena such as sequence of tense, telescoping, . . .

Compositionality?

- Compositionality: Strong empirical problems; rather baroque proposals to save it
- Constraint-based semantics: Words/phrases contribute constraints on possible readings rather than meaning functions.
- Systematicity: The possible readings in which a complex expression can occur are 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)
- Semantic representation language necessary? Yes! (Kamp & Reyle, 1993)

LRS activities

- Wiki: https://www.lexical-resource-semantics.de
- English linguistics blog: https://www.english-linguistics.de

- grammar implementation (Gerald Penn [Toronto], Richter)
- typology of definiteness marking (Assif Am-David [Hamburg] & Sailer)
- idioms (Sascha Bargmann, Gert Webelhuth, Richter, Sailer)
- extraposition (Webelhuth)
- negation, negative concord, negative polarity items (Gianina Iordăchioaia [Stuttgart], Richter, Sailer)
- polyadic quantification (Iordăchioaia, Richter)
- plurals, *different* (David Lahm [Frankfurt])
- semantic combinatorics in Oneida (Jean-Pierre Koenig [Buffalo])
- gapping (Sang-Hee Park, Koenig, Rui Chaves [Buffalo])
- computer-aided language learning (Detmar Meurers [Tübingen], Michael Hahn [Stanford])

Thank you!

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LRS wiki: https://www.lexical-resource-semantics.de

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