Formální a experimentální sémantika I

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Modification

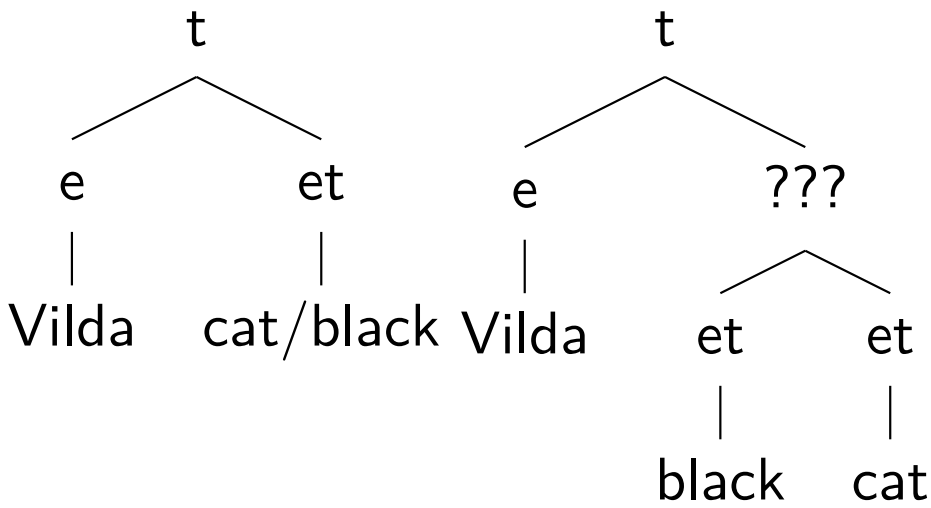
Adjectives + Nouns

- so far, saturation was the only semantic operation
- traditional grammatical distinction: modification – adjective + noun, adverb + verb
- question: can modification be conceived as saturation?

(1)
a. Vilda is black.
b. Vilda is a cat.
c. Vilda is a black cat.

- Both NP and AP in (1-a) and (1-b) are predicates, i.e., of type et

(2)



- according to rule (3), the meaning of NP [black cat] is not composable

(3) If a mother node (γ) has two daughter nodes (α and β), then the meaning of γ is either i) $[\![\alpha]\!]([\![\beta]\!])$, or ii) $[\![\beta]\!]([\![\alpha]\!])$: either the meaning of α is saturated by the meaning of β, or vice versa.

- solution: a new rule of semantic composition

- this corresponds to intuitions:

(4) Vilda is a black cat.

a. $\rightarrow$ Vilda is black.

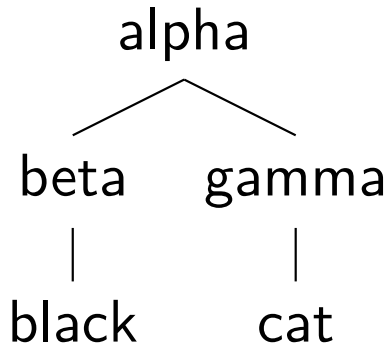
b. $\rightarrow$ Vilda is a cat.

- formalization (Heim&Kratzer 1998:65):

(5) Predicate Modification (PM):

If α is a branching node, $\{\beta,\gamma\}$ is the set of α's daughters, and $[\![\beta]\!]$ and $[\![\gamma]\!]$ are both in $D_{<e,t>}$ then $[\![\alpha]\!] =$
$\lambda x \in D_e.[\![\beta]\!](x) = [\![\gamma]\!](x) = 1$

(6)



(7) $[\![\textit{black cat}]\!] = \lambda x.[\![\textit{black}]\!](x) = [\![\textit{cat}]\!](x) = 1$

a. $= \lambda x.x \textit{ is black} \wedge x \textit{ is a cat}$

- intuitive, but at the cost of introducing a new operation
- second option: keep saturation as the only operation and change the type of the adjective:

(8) a. $[\![\textit{black}]\!] = \lambda x.x \textit{ is black} \ldots$ type <e,t> $\rightarrow$

b. $[\![\textit{black}]\!] = [\lambda P.[\lambda x.P(x) \wedge x \textit{ is black}]] \ldots$ type «e,t>,<e,t»

- saturation by individuals: <e,t> or by properties: «e,t>,<e,t»
- but a new operation is not necessary
- disadvantages:

- unintuitive meaning
- this meaning doesn't fit with the predicative use of adjectives:

(9) Vilda is black.

- three possible solutions:

1) return to modification
2) adjectives are systematically ambiguous
3) keep only the higher-order meaning and change the interpretation for predicative use of adjectives

- the decision must be based on empirical evidence
- is any solution more intuitive?

Types of Adjectives

- adjectives like *tall, black-haired* are **intersective**:

(10) a. Peter is a black-haired student. $\rightarrow$
   (i) Peter is black-haired.
   (ii) Peter is a student.

- **non-intersective** adjectives:

(11) former teacher, fake president, counterfeit banknote, possible solution, mere mistake

- many adjectives are **vague**:

(12) Vilda is big (cat).

a. context: Vilda among hippos

b. context: Vilda among cats

- context specifies what *big* is relative to

- this contextual set is necessarily selected from $[\![NP]\!]$:

(13) Vilda is a big cat.

a. context: V. stands among kittens

- taken as an argument for analyzing adjectives as higher-order predicates:
- P provides the contextual/NP standard

(14) a. $[\![big]\!] = [\lambda P.[\lambda x.P(x) \wedge x \textit{ is bigger} > \textit{average\_P}]]$ ...
type «e,t>,<e,t»

- problem: non-vague adjectives like *clean, dead, closed, healthy, ...* – rather <e,t> type
- 2 ways of combination depending on the semantics of the adjective?

- moreover, even vague adjectives (mostly) allow predicative use:

(15) a. Peter is big/tall/satisfied/...

b. vs: That problem is ??possible/??fake/...

- one solution (B. H. Partee): type-shifting: operations systematically changing types:

(16)
a. Napoleon <e> was small.
b. You're a real Napoleon. <e,t>
c. <e> → <e,t>

- analogously: *small* «e,t>,<e,t» → <e,t>
- another solution: covert noun – morphological evidence?

(17) Being small is nice.

- still open so far

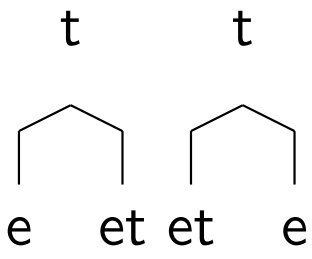
Relative Clauses as Modifiers

- predicative/attributive use (same as with adjectives):

(18)
a. predicative: Mice are what interests Vilda most.
b. attributive: Mice are animals that interest Vilda most.

- both are predicates of <e,t> type
- unlike adjectives, they are postnominal in attributive use
- in many cases, linearity is irrelevant for semantics

(19)



Comparatives and Degree Semantics

- another semantic type: some expressions in natural language utilize scales
- a scale (degree sets) is an ordered triple $\langle D, <_O, \psi \rangle$:

1. D ... set of points
2. $<_O$ ... total ordering
3. ψ ... dimension (height, speed, ...)

- the difference between gradable and non-gradable adjectives is that gradable ones have a degree argument:

(20) a. Peter is very/this/2 meters/... tall/wide/...
b. Peter is ?very/??this/10 years Moravian/black-haired.

Classic argument for degree analysis:

- allows explaining comparison of objects on different scales:

(21)
a. The bed is longer than the door is wide.
b. The drawer is deeper than the shoes are long.
c. The tree is more massive than the rope is long.
d. He is wider than taller.

- in all cases: degree on scale X is higher than degree on scale Y

Naše řeč – Širší než delší

- basic numerals count type <n> – numbers without scale:

(22)
a. Peter had 3 beers.
b. 3 cars arrived.
c. Peter bought 3 ropes.

- 'degree'-numerals require a scale and don't count cardinality/magnitude, but degree on a scale that is specified by a measure noun:

(23)
a. Peter drank triple the amount of beers/*triple beers as Karel.
b. Cars arrived with triple speed/volume/. . . /*triple cars.
c. Peter bought triple the length of rope/*triple rope.

(24) a. Peter is taller than Marie.

b. ??Peter is more Moravian than Marie.

- formalization:

(25) a. $[\![tall]\!] = \lambda d.\lambda x.tall(d, x)$

b. $[\![Moravian]\!] = \lambda x.Moravian(x)$

- measure phrases like *2 meters* directly specify degree

(26) Peter is 2 m tall.

a. $[\![2m]\!] = 2m$

b. $[\![tall(2m)]\!] = \lambda x.tall(x, 2m)$

c. $[\![tall(2m)(Peter)]\!] = tall(Peter, 2m)$

Comparatives and Equatives

- degree quantifiers of type «d,t>,<d,t»
- standard analysis assumes that phrasal and clausal comparatives are syntactically identical (ellipsis):

(27) a. Peter is taller than Marie.
b. Peter is taller than Marie is tall.

(28) a. Peter is as tall as Marie.
b. Peter is as tall as Marie is tall.

(29) -er/as ([Op$_d$ Peter d-tall])([Op$'_d$ Marie is d'-tall]) (plus ellipsis)

- the semantics of equative is logically weaker than comparative:

(30) a. $[\![-er]\!] = \lambda D' \lambda D.MAX(D) > MAX(D')$

b. $[\![as]\!] = \lambda D' \lambda D.MAX(D) \geq MAX(D')$

(31) Peter is as tall/taller as/than Marie.

a. MAX(λd.tall(p,d))>MAX(λd'.tall(m,d'))

b. MAX(λd.tall(p,d))$\geq$MAX(λd'.tall(m,d'))

- the weak semantics of equative is supported by sentences like:

(32) The children traveled as many kilometers as the parents: the parents traveled 20 km and the children 30 km.

- in most contexts strengthening occurs:
- implication from (33-a) to (33-b), but not vice versa, same relationship as with conjunction and disjunction
- uttering (33-b) implies negation of (33-a) (cancellable scalar implicature)

(33) a. Peter is taller than Marie.
b. $\rightarrow$ Peter is as tall as Marie.

(34) a. Peter invited Klára and Bára.
b. Peter invited Klára or Bára.

Adverbs

- classic standard grammatical rule: adjectives modify nouns, adverbs modify verbs
- formalization: modification should be the same operation in both cases
- two approaches: formalization using events vs. formalization using higher-order meanings

Adverbs as Event Modifiers

- intuition: (35) describes a meowing event and a loud event

(35) Vilda meowed loudly.

a. $\exists e[\mathit{Agent}(e, \mathit{Vilda}) \wedge \mathit{Meowing}(e) \wedge \mathit{Loudly}(e)]$

- advantages: intuitive, allows simple explanation of entailment from (35) to (36-a), because (36-b)

(36) a. Vilda meowed. $(\exists e[\mathit{Agent}(e, \mathit{Vilda}) \wedge \mathit{Meowing}(e)])$

b. $p \wedge q \models p / p \wedge q \models q$

- type-wise: *loudly* <v,t> vs. loud <e,t>
- combination using predicate modification
- similarly for other types of adverbs:

(37) [Yesterday] Vilda [loudly] meowed [in the garden], [because he was hungry].

- however, some types of adverbs don't modify only events:

(38) a. Peter intentionally kicked Marie.
b. Peter chopped the vegetables finely.
c. Surprisingly, Peter arrived late.

- Peter's intentional kicking of Marie $\neq$ Marie's intentional being kicked by Peter
- similarly:

(39) a. Peter intentionally sold Karel a fake. $\neq$
b. Karel intentionally bought a fake from Peter.

- *intentionally* is a subject-oriented adverb
- formalization: <e,<v,t» – analogously to transitive verbs
- similarly for object-oriented adverbs like *finely*
- simple adverbs like *loudly* correspond to intransitive verbs
- similarly for speaker-oriented adverbs (*unfortunately*, *surprisingly*, . . .)

Adverbs as Higher-Order Modifiers

- in case of a "poorer" ontology, we can make do with objects:

(40) meow ... <e,t> ... set of objects (not events!)

a. loudly(meow) ... <e,t> ... set of loudly meowing objects

- compositionally «e,t>,<e,t»
- similarly to adjectives modeled by higher order

(41) $[\![\textit{loudly}]\!] = [\lambda P.[\lambda x.P(x) \wedge x \textit{ loudly } P]]$ ... type «e,t>,<e,t»

- less intuitive, but works directly for more kinds of adverbs:

(42) a. intentionally(kick_Marie) . . . property

b. finely(x chop y) . . . relation

c. surprisingly(Peter_shouted) . . . proposition

Formal vs. Lexical Semantics

- formal semantics focuses on combinatorics of composition
- not on lexical semantics proper:

(43)
a. sleep ... $\lambda x.[x$ *sleeps*$]$ <e,t>
b. black $\lambda x.[x$ *is black*$]$ <e,t>
c. tall $\lambda x.[x$ *is tall*$]$ <e,t>

- lexical semantics: the actual meaning of words
- mostly outside the competence of linguistics: difference between cheetah and leopard
- however, several lexical semantic topics also in formal semantics: aspect (Dowty, Verkuyl, Krifka, ...), adjectives (McNally, Kennedy), ...

First Experiment

- reading: Berlin + Key
- corpus: Levshin
- Czech application
- grammatical reflexes: deadjectival verbs (*whiten*, *turn green* vs. *??turn pink*)

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