A semantics for temporally dependent referring expressions

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Overview

- what are the problems considered
- some existing answers
- the problem in a different ontological framework
- semantic consequences
Interpreting some noun phrases

(1) Every art student visited the Musée d’Orsay.
(2) The hostage attended the party in her/his honor.
(3) Most lawyers had an unhappy childhood.

- Is every art student a student at the time of the visit of the MO?
- When is the “hostage” actually detained?

→ interaction between the time of an event and the time of other predications
Putting time into NPs

If we assume:
x is an hostage at \( t_1 \) and attend the party at \( t_2 \)

- what are the constraints on the relation between \( t_1 \) and \( t_2 \) ?

Phenomenon not restricted to nouns:

(4) A drunk\((t_1)\) hostage\((t_2)\) missed\((t_3)\) the party\((t_4)\)

(5) The woman (on the deck)\( t_1 \) dove\( t_2 \) (into the water)\( t_3 \).
An essentially ontological problem

some solutions given to the temporal interpretation of noun phrases in the literature:

- Enç: time index for every predication
- Tonhauser: time index for every predication (pragmatically constrained)
- Carlson, Musan: time index for some predication

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  life-time properties vs. temporary properties

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The usual ontology

- a domain of entities \( D \)
- a domain for times (instants e.g.) \( T \)
- a domain for space \( S \)
- predicates either atemporal or temporalised: subsets of \( D \) or \( D \times T \)

then interpretation with temporal effects (Musan, 1999):

\[
\left[ P(x, t) \land PAST(t) \right] = 1 \text{ iff } x \text{ is } P \text{ at } t \text{ & } t < TU
\]
One or two existences?

problem: a lot of predicates deal with questions of material existence

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- so material referent is function of \((D \times T) \to S\)
- but function is *partial*: most things have a (limited) life-span.
- this usual ontological framework needs a predicate of existence at a time.
  (to distinguish being \(not(P)\) at \(t\) with not being at \(t\))
One or two existences?

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- So material referent is function of \((D \times T) \rightarrow S\)
- But function is *partial*: most things have a (limited) life-span.
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(9) The King of France is bald.
One or two existences?

problem: a lot of predicates deal with questions of material existence

- so material referent is function of $\langle D \times T \rangle \rightarrow S$
- but function is *partial*: most things have a (limited) life-span.
- this usual ontological framework needs a predicate of existence at a time.

(10) The King of France is bald.

\[ \exists x(...king\_of\_france(x) \land bald(x) \land exists(x, now)) \]

So there are two kinds of existence, one logical and one material.
An alternative ontology

Inspired by Russell, Quine.

- everything is a spatio-temporal region (Russell: a S-T event, Quine: a “worm”)

what does it mean?

- predicates hold of “stages”
- persistent objects are mental reconstructions of “reality”

Ontology semantics

\[ \mathcal{M} = \langle E, \prec, \approx, [\cdot] \rangle \text{ a model} \]

- \( g \) a variable assignment \( g : D \rightarrow X \in P(E) \).
- \( D \) is the set of variables of the language.
- \( E \) is a set of spatio-temporal “points” (the most fine-grained spatio-temporal events),
- \( \approx \) is a contemporaneity relation on spatio-temporal points
- \( \prec \) is a total linear ordering on classes of equivalence of \( E \) with respect to \( \approx \)
- \([\cdot]\) is an interpretation function.

A maximal set of contemporaneous points can be interpreted as an “instant”.

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Formal vocabulary

- \(<\) “is before”
- stage “is a stage of”
- \(\subseteq_t\) “is temporally included in”

\[ [x < y]_g = \text{true} \iff \forall \alpha \in [x]_g \forall \beta \in [y]_g (\alpha < \beta) \]

\[ [x \subseteq_t y]_g = \text{true} \iff \forall \alpha \in [x]_g (\exists \beta \in [y]_g \alpha \approx \beta) \]

\[ [\text{stage}(x, y)]_g = \text{true} \iff [x]_g \subseteq [y]_g \land \forall \alpha \in [y]_g [(\exists \beta \in [x]_g \land \beta \approx \alpha) \rightarrow \alpha \in [x]_g] \]

in addition, the sum of objects (+) is defined as set union: \([x + y]_g = [x]_g \cup [y]_g\).

\[ [P(x, y)]_g = \text{true} \text{ if and only if } [x]_g \subseteq [y]_g. \]
The dog walked in the park.
Types of predication

stage-level (temporary property) vs individual level (essential property).

(11) Most lawyers had an unhappy childhood.

(12) Most human beings had an happy childhood.

Also, a-temporal properties:

(13) Frege is famous.

Other?

(14) Frege is dead.

\[ \text{frege} < \text{now} \]
Syntax/semantics interface (classical ontology+events)

(15) Fred slept.

\[ \text{IP : } \exists e (\text{sleep}(e, \text{fred}) \land e < \text{now}) \]

\[ \text{NP : } \lambda P (P(\text{fred})) \]

\[ \text{PN : } \lambda P (P(\text{fred})) \]

\[ \text{I' : } \lambda x (\exists e (\text{sleep}(e, x) \land e < \text{now})) \]

Fred \quad \text{past : } \lambda P \lambda x (\exists e (P(e)(x) \land e < \text{now}))

\[ \text{VP} \]

\[ \text{sleep : } \lambda e \lambda x (\text{sleep}(e, x)) \]

A semantics for temporally dependent referring expressions – p.13/24
The syntax-semantics interface revisited

Now, with our ontology where every object has a life-span and can be predicated over by temporal relations:

\[
[past] = \lambda Q \lambda x (\exists y \ Q(y)(x) \land y < now)
\]

\[
[sleep] = \lambda y \lambda x (stage(y, x) \land sleep(y))
\]

\[
[Fred] = \lambda P \ P(fred)
\]

\[
[Fred] ([past] ([sleep]))
\]

\[\rightarrow \exists y \ stage(y, fred) \land y < now \land sleep(y)\]
The syntax-semantics interface re-visited

For nouns:

\[
[man] = \lambda x (\exists t \ stage(t, x) \land man(t))
\]

\[
[a] = \lambda P \lambda R (\exists x (P(x) \land R(x)))
\]

A man slept:

\[\exists x \exists t \exists e \ (stage(t, x) \land man(t) \land stage(e, x) \land sleep(e) \land e < now)\]

A hostage slept:

\[\exists x \exists t \exists e \ (stage(t, x) \land hostage(t) \land stage(e, x) \land sleep(e) \land e < now)\]

\[\Rightarrow \text{ not constrained enough}\]
**Individual vs stage : nouns**

Semantic difference between the two kinds:

- **hostage** $: \lambda y (\exists x \text{ hostage}(x) \land \text{stage}(x, y) \land x \neq y)$

- **man** $: \lambda y (\exists x \text{ man}(x) \land \text{stage}(x, y) \land x = y)$

then "a man slept" becomes simply

$\exists x \exists e (\text{man}(x) \land \text{sleep}(e) \land \text{stage}(e, x) \land e < \text{now})$

but:

$\exists x \exists t \exists e (\text{stage}(t, x) \land \text{hostage}(t) \land x \neq t \land \text{stage}(e, x) \land \text{sleep}(e) \land e < \text{now})$
Adjectives

(16) Olga was sick/Polish.

\([be] = \lambda P \cdot P\]
\([sick] = \lambda y(\exists z \text{sick}(z) \land \text{stage}(z, y))\]

\(\text{PN(I(V(A))))}\:
\(\exists z (z < \text{now} \land \text{sick}(z) \land \text{stage}(z, o))\)
Individual vs. stage: adjectives

Distinction between types of predicates and semantics as nominal predicate:

- sick: $\lambda y (\exists z \text{sick}(z) \land \text{stage}(z, y) \land z \neq y)$
- Polish: $\lambda y (\exists z \text{polish}(z) \land \text{stage}(z, y) \land z = y)$

This correctly predicts (Vendler, 1967, Larson, 1998):

(17) # Olga was sick and Polish.

because the coordination of the two adjectives yields a contradiction (the sick stage must be the same stage as the Polish stage, which is the whole entity).

$\exists s (s < \text{now} \land \text{sick}(s) \land \text{stage}(s, o)) \land s = o \land s \neq o \models \bot$
Another prediction:

(18) Olga was Polish/a woman ⇒ Olga is dead
because then

\[(s < now \land polish(s) \land stage(s, o) \land s = o)\]

is equivalent to

\[polish(o) \land o < now\]

if Olga’s history is in the past of the speech time, it means she’s dead.
"Non-intersective" readings (Larson, 1998):

(19) Olga is a beautiful dancer.

Event or object?

(1) beautiful(x) \land olga(x) \land dancer(x)

(2) olga(x) \land (\forall e(dance(x, e) \rightarrow beautiful(e))

Within our semantics: just different stages

... \land stage(z, o) \land dancer(z) \land beautiful(z)

... \land stage(z, o) \land dancer(z) \land beautiful(o)

Assuming:

dancer(z) \leftrightarrow \exists u(stage(u, z) \land dance(u))

(vs. dancer(x) \leftrightarrow \exists e\ dance(x, e))
(20) Every man has one drink.
Universal quantification and the question of identity across time

(21) Every man has one drink.

classical \([every] = \lambda P \lambda Q(\forall x(P(x) \rightarrow Q(x)))\)
yields:
\[\forall x (\text{man}(x) \rightarrow \text{has\_one\_drink}(x))\]
Every man has one drink.

**Classical** $\left[\text{every}\right] = \lambda P \lambda Q (\forall x (P(x) \rightarrow Q(x)))$

yields:

$\forall x (\text{man}(x) \rightarrow \text{has\_one\_drink}(x)))$

revised with stages (maximality of the stage):

$\forall x (\text{man}(x) \rightarrow$

$\text{has\_one\_drink}(x)$

$\wedge \exists y \text{ stage}(y, x) \wedge \text{has\_one\_drink}(y) \rightarrow x = y)$

(inspired by analysis of [Noonan, 1976])
Open questions

- life-independent predicates
  
  *Frege is famous. Frege is dead.*
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- adjectives and proper names
  A happy Olga entered the room. The joking Woody Allen is no more.
  # A Polish Olga entered the room.
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- possessives
  *My (then) wife went to college in Australia.*
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- semantic vs syntactic dependance
  *We had a sad party*
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- semantic vs syntactic dependance
  We had a sad party

- a. Tired, the boys didn’t go to the party. (didn’t)
  b. The boys didn’t go to the party tired. (did)
Open questions

Anaphora and predicate types

- The man was drunk an hour ago. He is sober now.
Open questions

Anaphora and predicate types

- The man was drunk an hour ago. He is sober now.
- The man was drunk an hour ago. # He is a woman now.
Open questions

Anaphora and predicate types

- The man was drunk an hour ago. He is sober now.
- The man was drunk an hour ago. # He is a woman now.
- The man had an operation. He is a woman now.
Open questions

Anaphora and predicate types

- The man was drunk an hour ago. He is sober now.
- The man was drunk an hour ago. # He is a woman now.
- The man had an operation. He is a woman now.
- The drunk jumped into the pool. ? He is sober now.
Conclusion

that was in the past, this should be in the future:

- preposition phrases
  "The woman on the deck dove into the water"

- discursive effects

- temporal modifiers as "previous", "former", etc
Références


