Referential Dependence in Language and Mind

Lecture 1.

An Outline of MSDRT and DRT: Architecture and Motivations

Hans Kamp

University of Stuttgart
University of Texas, Austin

Referential Dependence

- 'Referential Dependence' can mean various things.

  We will use it in three senses.

  The first two concern objects of thoughts.

  - 1.1 How the objects our thoughts are about may depend on how our mind is connected with the 'world'.
  - 1.2 How one of our thoughts may be about an object that is part of another of our thoughts.

Referential Dependence

- The third sense concerns the use that a speaker S can make of 'denoting expressions' – definite noun phrases like proper names, definite descriptions, pronouns, demonstrative phrases.
  - The reference of the use speaker S makes of a denoting expression α often depends on how S takes her use of α to denote an object of one of her thoughts.

Referential Dependence 1.b

- An example of Referential Dependence of type (1.b):

  Scenario: *A* is walking along the sidewalk of some street and thinks she sees a gold coin lying in the middle of the street. She believes it is a gold coin, wants to pocket it and intends to go to the middle of the street to pick it up.

(1)
$$\left\{ \begin{array}{l} \left\langle BEL, \begin{array}{|c|}\hline x \\ \hline \text{gold-coin'}(x) \\ \text{lie-in-front-of'}(x,i) \\ \hline \end{array} \right\rangle \\ \left\langle DES, \begin{array}{|c|}\hline \\ \hline \text{have'}(i,x) \\ \hline \end{array} \right\rangle \\ \left\langle INT, \begin{array}{|c|}\hline \\ \hline \text{pick-up'}(i,x) \\ \hline \end{array} \right\rangle \end{array} \right\}$$

Referential Dependence 1.a

- An example of Referential Dependence of type (1.a):

(2)
$$\left\{ \begin{array}{l} \left\langle [ENT, x], \dfrac{\quad}{\text{lie-in-front-of'}(x,i)}, \left\{ \boxed{\text{see}(i,x)} \right\} \right\rangle \\ \left\langle BEL, \dfrac{\quad}{\text{gold coin'}(x)} \right\rangle \\ \left\langle DES, \dfrac{\quad}{\text{have'}(i,x)} \right\rangle \\ \left\langle INT, \dfrac{\quad}{\text{pick-up'}(i,x)} \right\rangle \end{array} \right\}$$

Referential Dependence (1.a)

- Representations like (1) and (2) are called MSDs.

  (MSD is short for 'mental state descriptions').

- Both MSD (1) and MSD (2) contain descriptions of the belief, the desire and the intention mentioned.

  But (2) differs from (1) in having an *Entity Representation* (ER) for the object that our agent takes herself to be seeing.

- This difference is crucial for the following reason:

  In (1) the thing that A believes is lying in front of her is represented by the symbol x in the content representation following BEL.

  (Such symbols are *discourse referents* in thr sense of DRT, or *drefs*, for short.)

  x recurs in the content representations following DES and INT.

- This renders the desire and the intention *referentially dependent on* **the belief**.

Referential Dependence (1.b)

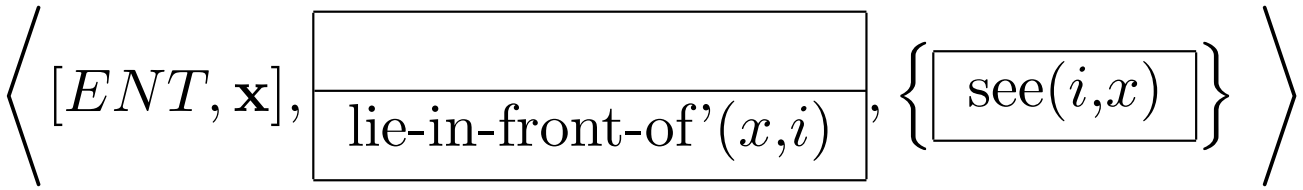
- MSD (2) has its *Entity Representation* (‘*ER*’) in addition to the belief, desire and intention of MSD (1) and x occurs as the *distinguished discourse referent* of the ER.

(2)
$$\left\{ \begin{array}{l} \left\langle [ENT, \mathbf{x}], \dfrac{\quad}{\text{lie-in-front-of'}(x,i)}, \left\{ \boxed{\text{see}(i,x)} \right\} \right\rangle \\ \left\langle BEL, \dfrac{\quad}{\text{gold coin'}(x)} \right\rangle \\ \left\langle DES, \dfrac{\quad}{\text{have'}(i,x)} \right\rangle \\ \left\langle INT, \dfrac{\quad}{\text{pick-up'}(i,x)} \right\rangle \end{array} \right\}$$

- Here belief, desire and intention are all *referentially dependent on* the ER, and *referentially independent from* each other.

Referential Dependence 1.a

- The Entity representation of (2):



- The general form of Entity Representations:
  $\langle [ENT, \alpha]\ ,\ K\ ,\ \mathcal{K}\ \rangle$

- An Entity Representation consists of three components:
  - 1 [ENT, α]. ENT: the Mode Indicator of the ER;
    α: the distinguished discourse referent of the ER.
  - 2 K: A Discourse Representation Structure (DRS);
    K gives descriptive information about the represented entity.
  - 3 $\mathcal{K}$: the *Anchor Set*; the anchors in $\mathcal{K}$ link the ER to the entity it represents.

    (More about the forms of anchors will follow.)

Referential Dependence of type 2.

- An example of Referential Dependence of type 2

  (Referential Dependence of denoting expressions on causal links between the user's mind and the world.)

  Consider the following utterance by A:

  (3) On my walk yesterday afternoon I saw **what looked like a gold coin** lying in the middle of the road and I wanted to take **it** home. But I had to give up on my intention to go and pick **it** up, because there was too much traffic. So in the end I just walked on.

- Assumption: A has an ER for the gold coin she sees lying on the street.

  This ER serves her as basis for her use of **what looked like a gold coin** and the two occurrences of **it** in (3).

Use and Interpretation of Proper Names

- Utterance interpreters also link entities represented in their interpretations to ERs in their own minds.
- Good examples of this are the interpretations of sentences with proper names. Example: Interpretation of an utterance of (4).

  (4) Mary is in Paris.

- The 'standard' use of a proper name N by a speaker S is legitimate only if S bases her use of N on an *N-labeled Entity Representation* for the entity she wants to refer to with N. (Kamp (2015)).

Proper Use and Interpretation of Proper Names

- So when S utters (4), then her mental state must contain ERs for Mary and for Paris, as in (5):

  And if her utterance is to be sincere, she must also have a belief of the kind shown in (5).

(5)
$$\left\{ \left\langle [ENT, m], \begin{array}{|c|}\hline \\ \hline \text{person}(m) \\ \text{Named}(m, Mary) \\ \hline \end{array}, \mathcal{K}_m \right\rangle, \left\langle [ENT, p], \begin{array}{|c|}\hline \\ \hline \text{city}(p) \\ \text{Named}(p, Paris) \\ \hline \end{array}, \mathcal{K}_p \right\rangle, \left\langle BEL, \begin{array}{|c|}\hline \\ \hline \text{in'}(m,p) \\ \hline \end{array} \right\rangle \right\}$$

Proper Use and Interpretation of Proper Names

- Likewise, an interpreter H of S's utterance of (4) must have ERs for Mary and Paris to interpret S's uses of the names *Mary* and *Paris*:

(6)
$$\left\{ \left\langle [ENT, m_H], \begin{array}{|c|}\hline \\ \hline \text{person}(m_H) \\ \text{Named}(m_H, Mary) \\ \hline \end{array}, \mathcal{K}_{m_H} \right\rangle, \left\langle [ENT, p_H], \begin{array}{|c|}\hline \\ \hline \text{city}(p_H) \\ \text{Named}(p_H, Paris) \\ \hline \end{array}, \mathcal{K}_{p_H} \right\rangle \right\}$$

- If H lacks either of these ERs, then he can *accommodate* such an ER.

  (Recall what Kripke says in *Naming and Necessity* about the spreading of names through a speech community.)

Proper Use and Interpretation of Proper Names

- If H then interprets S's utterance following the rules of English and accepts what S has said as true, then this will lead to an update of his mental state with a belief representation resembling S's.

(7)
$$\left\{ \begin{array}{l} \left\langle [ENT, m_H], \begin{array}{|c|}\hline \\ \hline \text{person}(m_H) \\ \text{Named}(m_H, Mary) \\ \hline \end{array}, \mathcal{K}_{m_H} \right\rangle \\ \\ \left\langle [ENT, p_H], \begin{array}{|c|}\hline \\ \hline \text{city}(p_H) \\ \text{Named}(p_H, Paris) \\ \hline \end{array}, \mathcal{K}_{p_H} \right\rangle \\ \\ \left\langle BEL, \begin{array}{|c|}\hline \\ \hline \text{in'}(m_H, p_H) \\ \hline \end{array} \right\rangle \end{array} \right\}$$

Utterance Interpretation and Logical Form

- The treatment just sketched of the production and interpretation of "Mary is in Paris" can be seen as an instance of a *communication-theoretic* way of doing natural language semantics.
- The communication-theoretic approach to the analysis of meaning in language is one of the options that is offered by MSDRT.
- This will a central theme especially in the third lecture.

Utterance Interpretation and Logical Form

- But our treatment of the interpretation of "Mary is in Paris" can also be seen is an instance of a more abstract way of doing semantics.

  If H computes his utterance representation by correctly applying the rules of the 'grammar' of the language to the utterance he receives, then this representation may be considered the *Logical Form* for the utterance, irrespective of who H is.

- Utterance representations that are computed in accordance with the rules of the grammar can be regarded as *Logical Forms* for their utterances.

- A formal semantics for these Logical Forms can then be regarded as giving the truth-conditional semantics for their utterances.

- This is the *Logical Form approach* to natural language semantics.

The Logical Form Approach

- In a Logical Form approach to natural language semantics the truth conditions of sentences from some natural language fragment L are captured by:
  - translating those sentences into some *Logical Form Language* LFL, and
  - providing a generative syntax and model-theoretic semantics for LFL.
- The choice of LFL varies depending on the choice of L and the semantic properties of L on which the application focuses.
- The formal specification of LFL is an essential part of this approach.

The Logical Form Approach of DRT

- DRT is a Logical Form type approach to natural language semantics. But is one with some distinctive properties.
- These properties have to do with two types of phenomena that are prominent in European languages like English, French, German, and many other languages as well.
  - the temporal and aspectual properties of certain tense forms, and
  - pronominal anaphora.
- Both these types of phenomena are prominent *cross-sententially*:
  - Tenses connect the eventualities (events and states) described by their sentences or clauses temporally and aspectually with eventualities introduced by earlier sentences of an ongoing discourse.
  - Pronouns often find their antecedents in earlier sentences.

The Logical Form Approach of DRT

- The next slides present some of DRT's classical illustrations of these phenomena

(8) (Passé Simple and Imparfait)

a. Alain ouvrit les yeux et vit sa femme, qui était assise près de son lit. Elle luit **sourit**.

Alain opened his eyes and saw his wife, who was sitting by his bedside. She **smiled** at him.

b. Alain ouvrit les yeux et vit sa femme, qui était assise près de son lit. Elle luit **souriait**.

Alain opened his eyes and saw his wife, who was sitting by his bedside. She **was smiling** at him.

The Logical Form Approach of DRT

(9) (Simple Past, Past Progressive and Past Perfect)
(from Kamp et al. (2011))

a. Joseph turned around. The man pulled a gun from his belt.

b. Joseph turned around. The man was pulling a gun from his belt.

c. Joseph turned around. The man had pulled a gun from his belt. He was pointing it at Joseph.

The Logical Form Approach of DRT

(10) (Donkey sentences and Donkey discourses)

((10.a) from Geach (1962 (Third revised edition: 1980), (10.b,c) from Kamp (1981)))

a. Every farmer who owns a donkey beats **it**.

b. If Pedro owns a donkey, he beats **it**.

c. Pedro owns a donkey. He beats **it**.

The Logical Form Approach of DRT

(11) (The 'Partee marble' examples, Partee,1971(?))
(From Partee, p.c., 1980)

a. Exactly one of the ten marbles is not in the bag. **It** is under the sofa.

b. Exactly nine of the ten marbles are in the bag. **It** is under the sofa.

c. Exactly nine of the ten marbles are in the bag. **The missing marble** is under the sofa.

Time and Tense in DRT

- Tense and Aspect are not a central topic of these lectures.
- But the temporal and aspectual dimensions of meaning are always there in the background, and as much for MSDRT as for DRT.
- To give an impression of how tense and aspect are handled in DRT, I show its Logical Form construction for the second sentence of (9.a).

  (9.a) Joseph turned around. The man pulled a gun from his belt.

  Assume that the Logical Form for the first sentence of (9.a) has been computed and that it is as in (12).

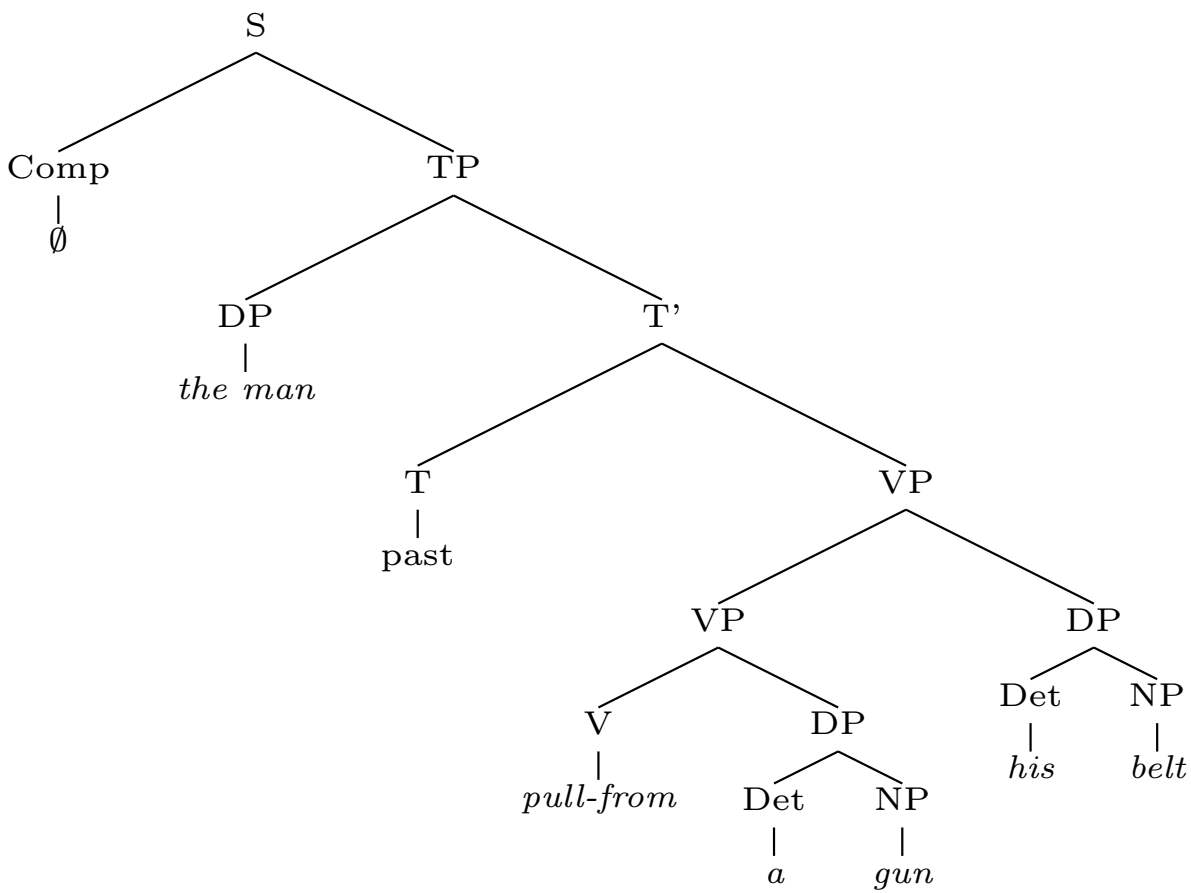
(12)

t	e	j
$t \prec n$	$e \subseteq t$	Joseph'(j)
	e: turn-around'(j)	

Time and Tense in DRT

- Assume the following syntactic structure (LF) for the second sentence.

(13)

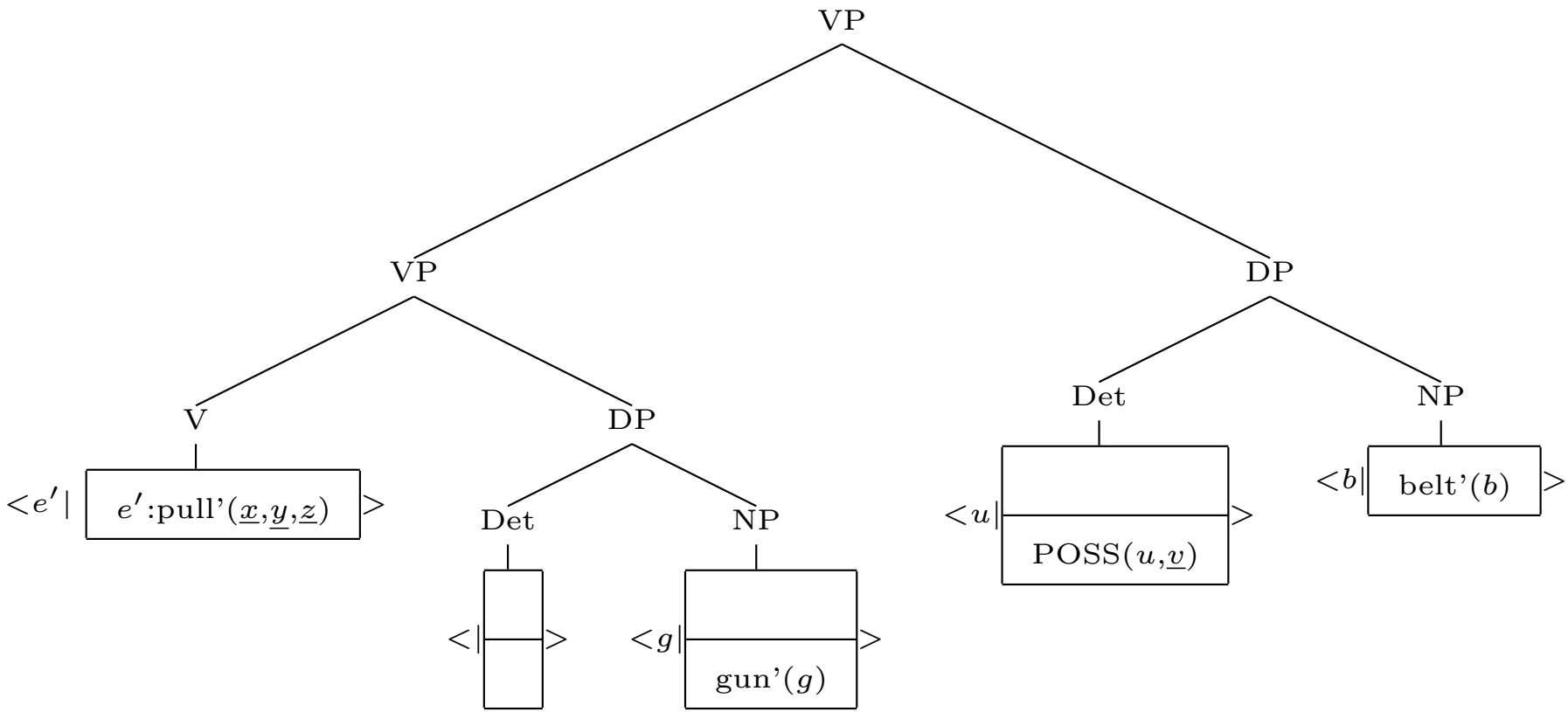


Time and Tense in DRT

- Logical Form Computation proceeds 'bottom up'.

  This turns the VP into the structure (14).

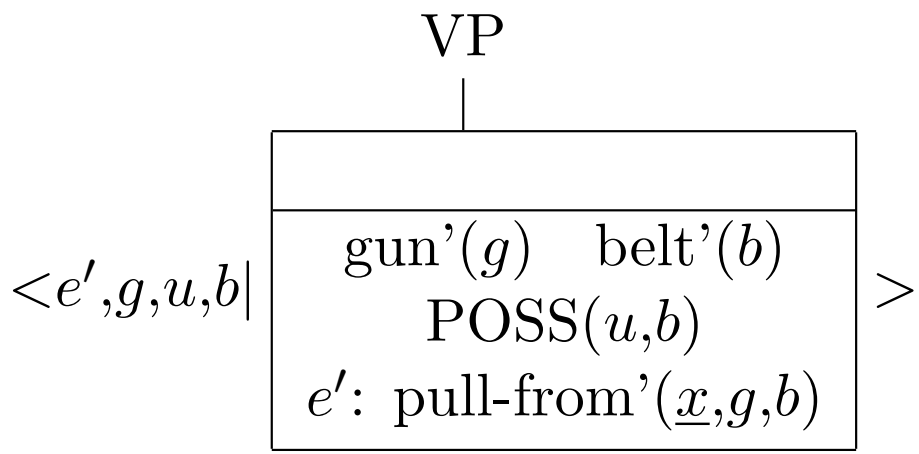
  (14)



Time and Tense in DRT

- Argument insertion into the argument slots $\underline{y}$ and $\underline{b}$ of the Logical Form for the verb then turns (14) into the VP representation (15).

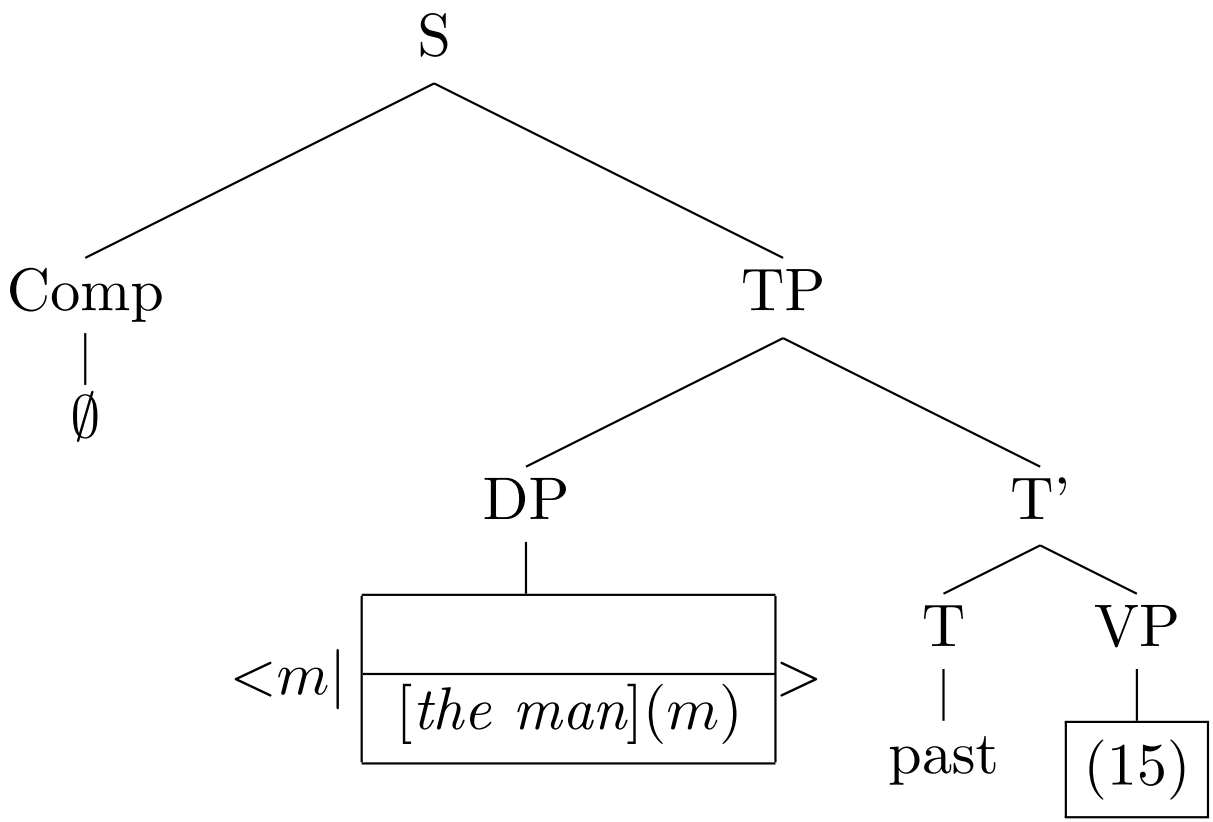
(15)



Time and Tense in DRT

- With a simplified treatment of the definite description in subject position this gives the abridged sentence tree in (16).

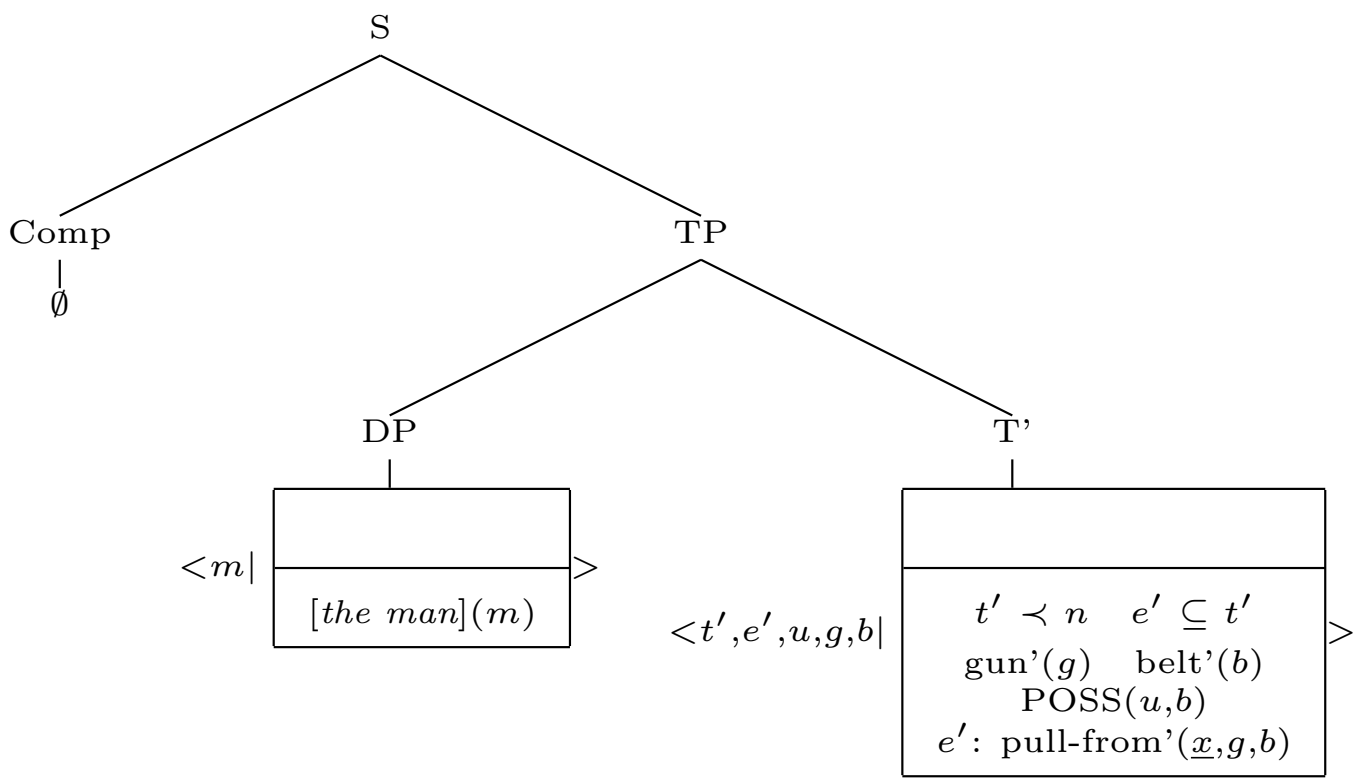
(16)



Time and Tense in DRT

- Combining the VP representation with the feature 'past' specified by T locates the event e' in the past of the utterance time n. The result is shown in (17).

(17)



Time and Tense in DRT

- The next two construction steps:

  (i) Insertion of the subject argument dref m into its slot:

  (ii) 'Existential closure' triggered by Comp:
  Transfer of the drefs in the store to the DRS on its right.

(18)

t' e' m g b u
$t' \prec n$ $e' \subseteq t'$
$[the\ man](m)$ gun'(g) belt'(b)
$u = m$
POSS(u,b)
e': pull-from'($\underline{x}$,g,b)

Time and Tense in DRT

- This gives most of what we need.

  But for our present purposes the most important part is missing:

  The DRS (18) doesn't say anything about how the event e' fits within the discourse context provided by the DRS (12) for the 1st sentence, repeated here:

(12)

t e j
$t \prec n$ $e \subseteq t$ Joseph'(j)
e: turn-around'(j)

- Intuitively it is clear what *is* missing:

  e' is understood as following e and that needs to be represented too.

Time and Tense in DRT

- One way to represent this is by adding the Condition: '$e \prec e'$' to the DRS in (18):

  This turns the DRS (18) of the second sentence into (19).

(19)

t' e' m g b u
$t' \prec n$ $e' \subseteq t'$
[*the man*](m) gun'(g) belt'(b)
$u = m$
POSS(u,b)
e': pull-from'($\underline{x}$,g,b)
$e \prec e'$

But what *licenses* the adding of this Condition?

Time and Tense in DRT

- This is where I want to leave things for today.

  But let me give you a brief flavor of what is still in store about the treatment of Time and Tense in DRT.

- One of the first tasks DRT took on was a justification for the adding of sentence-connecting Conditions like '$e \prec e'$'.

- A second task was to explain a well-known observation from Romance Linguists about the French Passé Simple:

  Events introduced by Passé Simple sentences typically are 'points'.

- But what is it for an event to be a 'point'?

Time and Tense in DRT

- DRT's answers to these questions largely determined its over-all architecture as a semantic theory:

  DRT is a Logical Form theory whose semantic representations are computed incrementally, going from sentence to sentence.

- Next week, after winding up today's review of DRT's treatment of tense and aspect, we will return to MSDRT and have a serious look at its form and uses

- We will start with the way it handles the semantics of complex attitude attributions, which involve more than one propositional attitude.

- My last words for today are

End of Today

THANK YOU

Geach, P. (1962 (Third revised edition: 1980)), *Reference and Generality : An Examination of Some Medieval and Modern Theories*, Cornell University Press, Ithaca.

Kamp, H. (1981), A theory of truth and semantic representation, *in* J. Groenendijk et al., eds, 'Formal Methods in the Study of Language', Mathematisch Centrum, Amsterdam.

Kamp, H. (2015), 'Using proper names as intermediaries between labelled entity representations', *Erkenntnis* **80**, 263–312.

Kamp, H., van Genabith, J. & Reyle, U. (2011), Discourse representation theory: An updated survey, *in* D. Gabbay, ed., 'Handbook of Philosophical Logic, Vol. XV', Elsevier, pp. 125 – 394.

Lascarides, A. & Asher, N. (2001), 'Segmented discourse representation theory: Dynamic semantics with discourse structure', *COMPUTING MEANING* **3**.

Partee, B. (1984), 'Nominal and temporal anaphora', *Linguistics and Philosophy* **7**.

Russell, B. (1936), 'On order in time', *Mathematical Proceedings of the Cambridge Philosophical Society* **32**, 216–228.