

Lecture 13 Reference in Discourse Representation Theory

Discourse Representation Theory

1. ‘If a farmer owns a donkey, he beats it.’

“...a theory of meaning must explain what it is for a linguistic expression to have a certain meaning *for the language user*, who grasps that meaning when he reads or hears the expression or chooses the expression as a carrier for the meaning he wants to convey.” Kamp & Reyle (1993: 7-8)

“...this description is conceived as an (idealized) analysis of the process whereby the recipient of an utterance comes to grasp the thoughts that the utterance contains.” K&R (1993: 8)

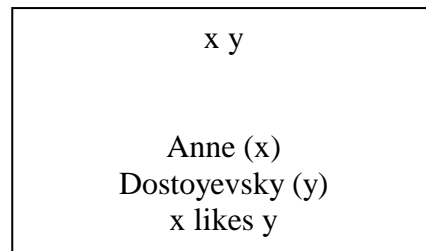
2. Discourse Representation Structures (DRSs) are given by DRS Construction Rules
Interpretation of discourse is *incremental* and discourse is *cohesive*.

‘Anne₁ likes Dostoyevsky₂. He₂ fascinates her₁.’

x stands for the individual denoted by a particular PN

x likes Dostoyevsky

Anne (*x*)



“...discourse representations can be regarded as the mental representations which speakers form in response to the verbal inputs they receive.” Kamp (1984: 5).

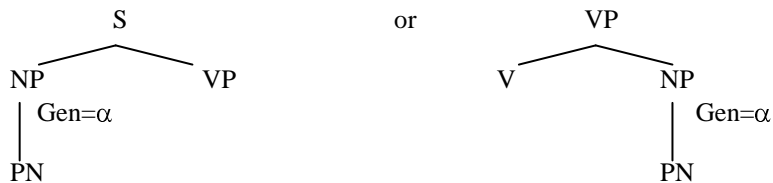
A DRS consists of two components: a set of discourse referents (the *universe* of the DRS) and a set of DRS-conditions.

3. *The Construction Rule for Proper Names:*

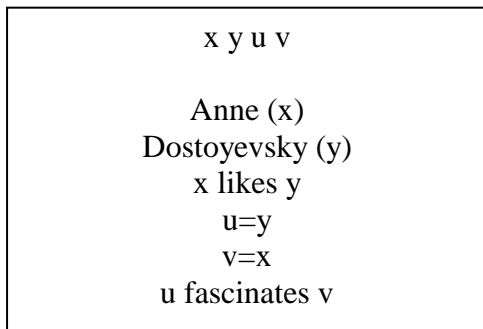
1. Introduce a new discourse referent into the universe.
2. Introduce into the condition set a condition formed by placing the discourse referent in parentheses behind the proper name which, in the syntactic structure (of the sentence or DRS-condition) from which the triggering configuration [see below] is drawn, is inserted below the PN-node of the configuration.
3. Introduce into the condition set a condition obtained by replacing, in the syntactic structure referred to (under 2), the NP-constituent by the new discourse referent.
4. Delete the syntactic structure containing the triggering configuration from the DRS.

K&R (1993: 65)

–the triggering configuration:

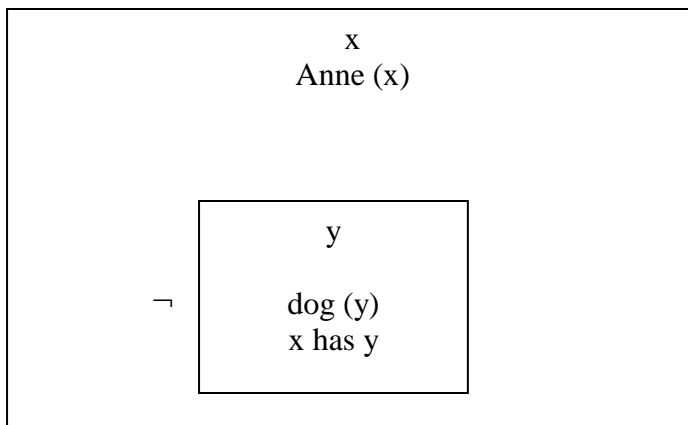


4.

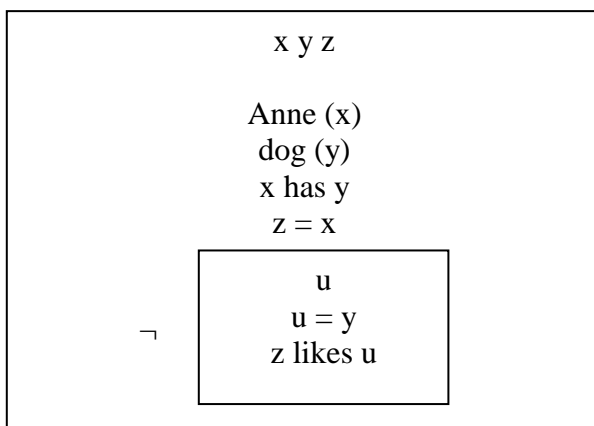


5. “A DRS is true provided we can find individuals for each of the discourse referents in its universe in such a way that the conditions which the DRS contains for particular discourse referents are satisfied by the corresponding individuals.” K&R (1993: 73)

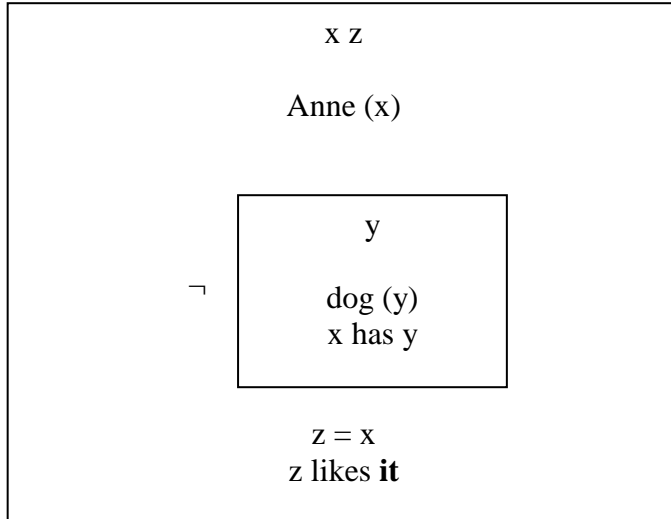
6. Some more DRSs (anaphora and negation):
‘Anne doesn’t have a dog.’



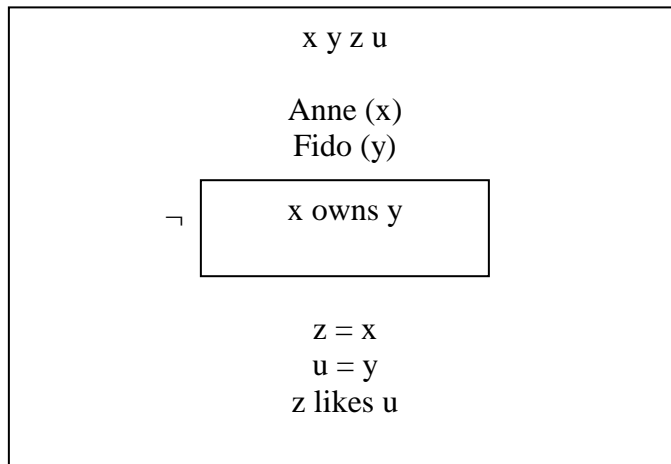
‘Anne has a dog. She doesn’t like it.’



‘Anne doesn’t have a dog. She likes it.’



‘Anne doesn’t own Fido. She likes him.’



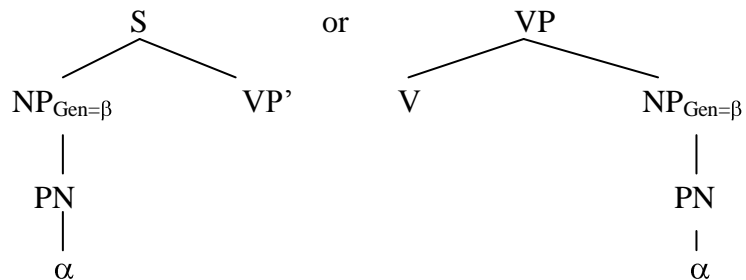
Directly referential expressions such as proper names establish the referent in the main representation.

7. *Construction rules for proper names and indefinite descriptions* (Kamp & Reyle 1993)

CR.PN

Triggering configuration

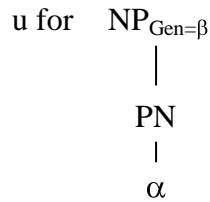
$\gamma \subseteq \gamma' \in \text{Con}_K$:



Introduce into the universe of the main DRS: **new discourse referent u**

Introduce into the condition set of the main DRS: **new conditions $\alpha(u)$, $\text{Gen}(u)=\beta$**

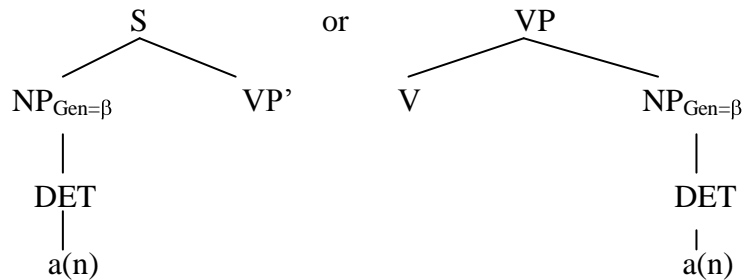
Substitute in γ' :



CR.ID

Triggering configuration

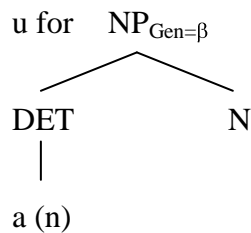
$\gamma \subseteq \gamma' \in \text{Con}_K$:



Introduce in U_K : **new discourse referent u**

Introduce in CON_K : **new conditions $[\text{N}](u)$, $\text{Gen}(u)=\beta$**

Substitute in γ' :



cf.: $\text{Anne}(a) \wedge \exists y (\text{Dog}(y) \wedge \text{Owns}(a,y))$

8. *Donkey anaphora:*

Overview of dynamic solutions to donkey anaphora

Coindexing in syntax and *coreference* in semantics

'If a farmer₁ owns a donkey₂, he₁ beats it₂.'

$\exists x \exists y (\text{Farmer}(x) \ \& \ \text{Donkey}(y) \ \& \ \text{Owns}(x,y)) \rightarrow \text{Beats}(\mathbf{x},\mathbf{y})$

'Anne₁ likes Dostoyevsky₂. He₂ fascinates her₁.'

Pronouns dependent on quantificational expressions:

Anaphoric relations between pronouns and quantificational antecedents end at sentence boundary.

Every boy₁ thought he₁ was the smartest.

*Every boy₁ turned up. He₁ smiled.

$\forall x (\text{Boy}(x) \rightarrow \text{TurnedUp}(x) \ \& \ \text{Smiled}(\mathbf{x}))$

But:

A boy turned up. He smiled.

$\exists x (\text{Boy}(x) \ \& \ \text{TurnedUp}(x)) \ \& \ \text{Smiled}(x)$

We need an account of *incremental interpretation*. We need to design a logic that handles discourse anaphora and donkey anaphora (in both cases, the anaphoric pronoun is outside the scope of the indefinite NP).

Donkey anaphora

‘If a farmer owns a donkey, he beats it.’

Either:

(i) $\exists x \exists y (\text{Farmer}(x) \ \& \ \text{Donkey}(y) \ \& \ \text{Owns}(x,y)) \rightarrow \text{Beats}(x,y)$

We can derive the meaning compositionally but the formula does not give the required interpretation.

or:

(ii) $\forall x \forall y ((\text{Farmer}(x) \ \& \ \text{Donkey}(y) \ \& \ \text{Owns}(x,y)) \rightarrow \text{Beats}(x,y))$

The formula has the required interpretation but cannot be derived compositionally.

Solutions:

(a) *E-type* pronoun:

anaphoric pronoun has a special property – is not bound (e-type pronoun, Evans). E-type anaphor is a disguised description (for every case we examine, the farmer who owns a donkey; for every case we examine, a donkey owned by a farmer). Pronoun is a disguised description:

‘A farmer came in. He had a donkey with him.’

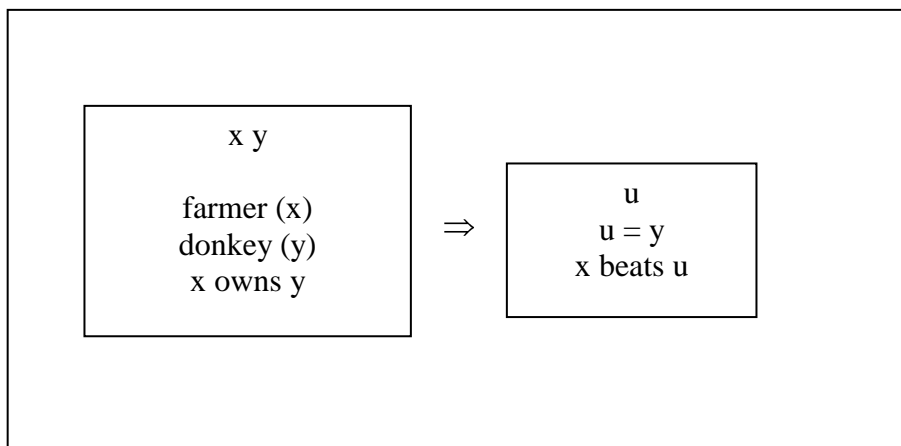
‘he’ = ‘the farmer who came in’.

(b) DRT:

the indefinite NP is not translated as an existential quantifier but as a variable.

Unselective binding, both x and y are bound (‘For every farmer x and for every donkey y that x owns, x beats y .’)

‘Every farmer who owns a donkey beats it.’



- (c) Dynamic Predicate Logic: extending the scope of the indefinite NP, dynamic binding
J. Groenendijk and M. Stokhof 1991.

Dynamic semantic interpretation of the language of first-order predicate logic
– in order to arrive at ‘a compositional, *non-representational* [vs. DRT] theory of discourse semantics’.

‘A man walks in the park. He whistles.’

‘Every farmer who owns a donkey beats it.’

‘If a farmer owns a donkey he beats it.’

The meaning of the sentence is the way this sentence changes the information state of the addressee. Meaning is a relation between information states.

Dynamic conjunction:

$$\llbracket \Phi \wedge \Psi \rrbracket = \{ \langle g, h \rangle \mid \exists k: \langle g, k \rangle \in \llbracket \Phi \rrbracket \ \& \ \langle k, h \rangle \in \llbracket \Psi \rrbracket \}$$

The interpretation of $\Phi \wedge \Psi$ with input g may result in output h iff there is some k such that interpreting Φ in g may lead to k and interpreting Ψ in k enables us to reach h .

Conjunction is *internally dynamic* – reference is passed on from left to right:

$\exists x P(x) \wedge Q(x)$. It is also *externally dynamic* – reference is passed on to conjuncts yet to come in the discourse.

Dynamic existential quantifier:

$$\llbracket \exists x \Phi \rrbracket = \{ \langle g, h \rangle \mid \exists k: k[x]g \ \& \ \langle k, h \rangle \in \llbracket \Phi \rrbracket \}$$

The dynamic interpretation of $\exists x \Phi$ consists of such pairs of assignments $\langle g, h \rangle$ that there is some assignment k which differs from g at most in x and which together with h forms a possible input-output pair for Φ . Existential quantifier is internally and externally dynamic.

$$\exists x (P(x) \wedge Q(x)) \text{ equals } \exists x P(x) \wedge Q(x)$$

Implication $\llbracket \Phi \rightarrow \Psi \rrbracket$ is internally dynamic – passing referents left to right, but not to the following pronouns:

‘If a farmer owns a donkey, he beats it. *He hates it.’

‘A man walks in the park. He whistles.’

$\exists x (\text{Man}(x) \wedge \text{Walk-in-the-park}(x)) \wedge \text{Whistle}(x)$

(from the dynamic treatments of the existential quantifier and conjunction)

‘If a farmer owns a donkey, he beats it.’

$\exists x (\text{Farmer}(x) \wedge \exists y (\text{Donkey}(y) \wedge \text{Own}(x,y))) \rightarrow \text{Beat}(x,y)$

(from the dynamic treatments of the existential quantifier and implication)

‘Every farmer who owns a donkey beats it.’

$\forall x ((\text{Farmer}(x) \wedge \exists y (\text{Donkey}(y) \wedge \text{Own}(x,y))) \rightarrow \text{Beat}(x,y))$

(from the dynamic treatments of the existential quantifier and implication)

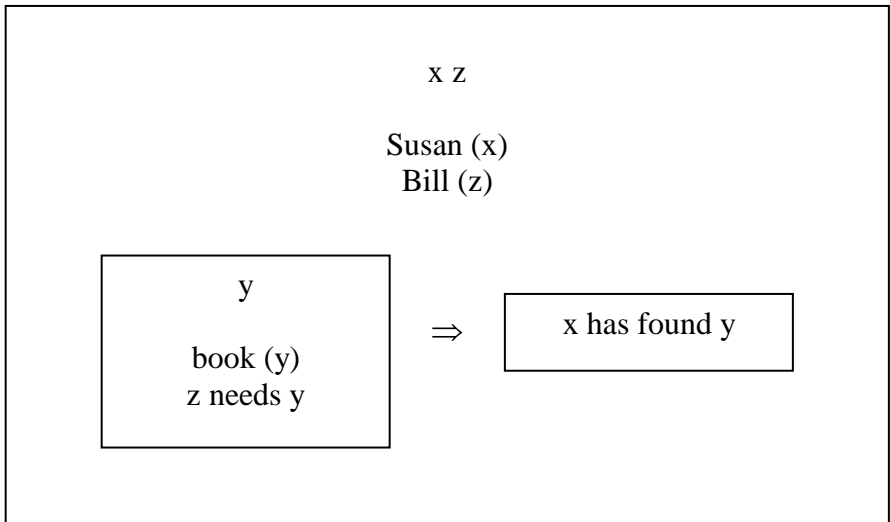
$\forall x (\mathbf{P(x)} \rightarrow \mathbf{Q(x)})$ equals $\exists x \mathbf{P(x)} \rightarrow \mathbf{Q(x)}$

‘A distinctive feature of DPL is that it allows for existential quantifiers to bind variables which are outside their syntactic scope.’ (G&S 1991: 58)

The *syntax* of DPL is the same as that of ordinary predicate logic. The *semantics* is dynamic. This alternative to DRT achieves compositionality without invoking mental representations. Instead, it alters the language of predicate logic (its semantics). So, it is sometimes regarded as truly compositional, as opposed to DRT.

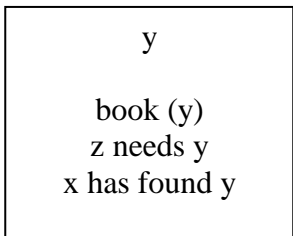
9. *The Plural*

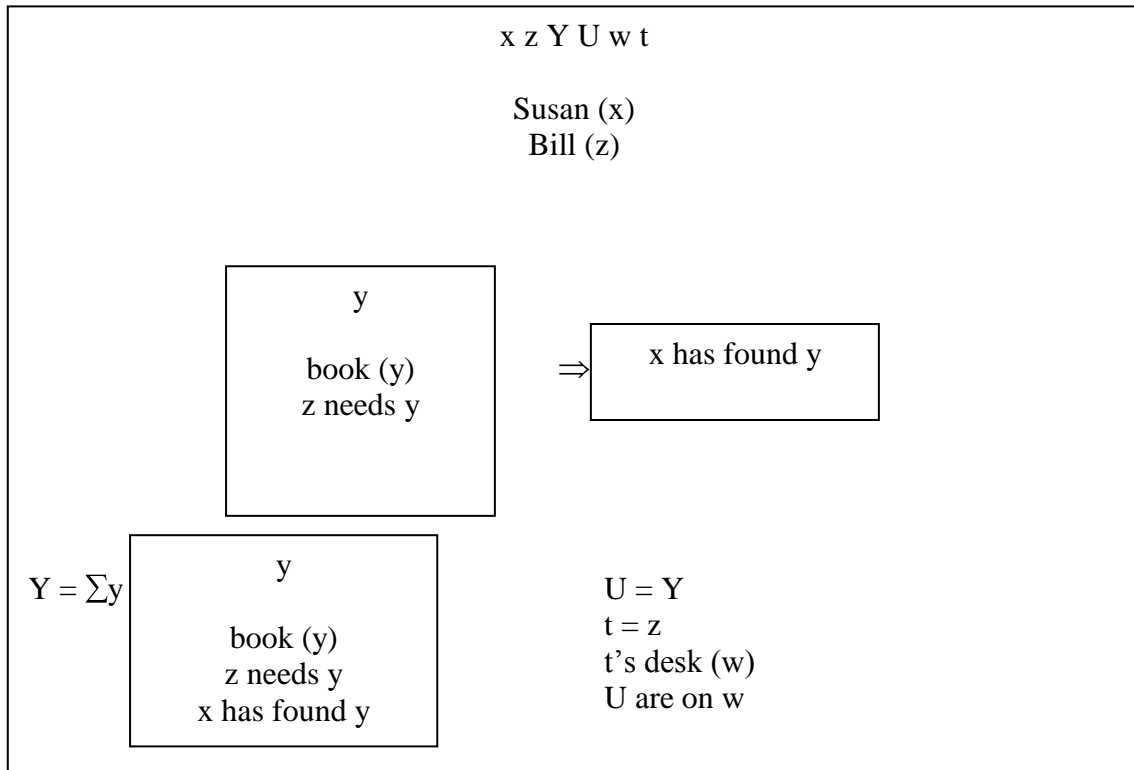
‘Susan has found every book which Bill needs. They are on his desk.’
K&R (1993: 309)



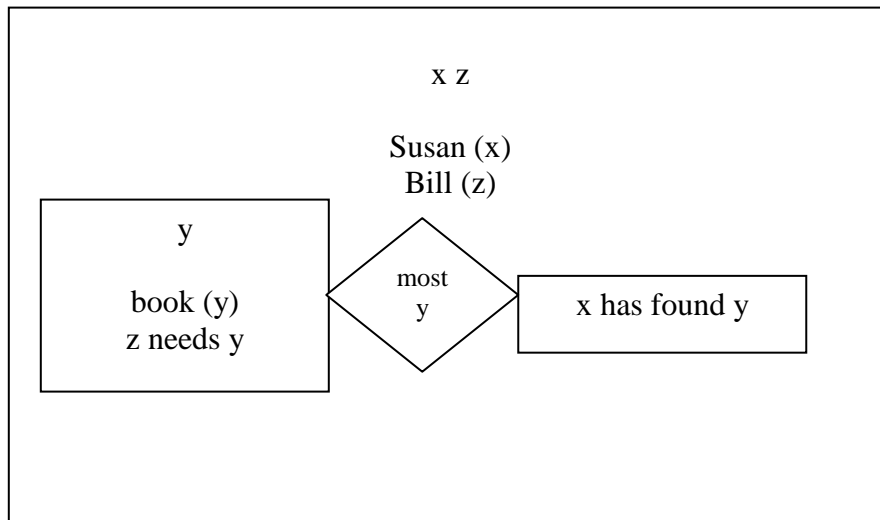
Abstraction: $Y = \Sigma y$

‘ Σ ’ = a summation sign





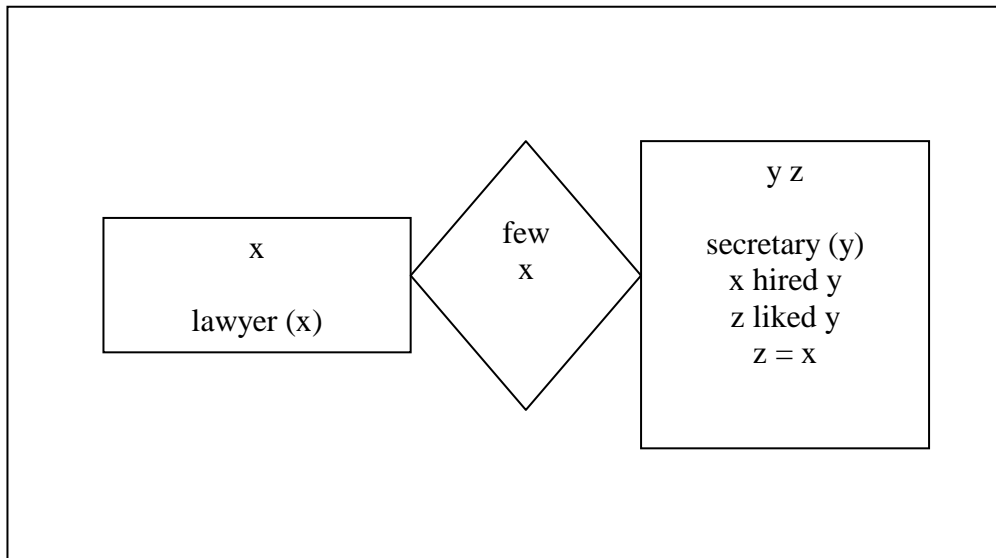
most:



Binary quantifiers, where a quantifier combines with a pair of predicates:
[most x] (men x: mortal x)

‘Three lawyers hired a new secretary.’ – distributive or collective
‘Few lawyers hired a secretary they liked.’ – only distributive.

K&R (1993: 325):



10. *Interim summary:*

- Meaning as processing;
- Meaning of an expression is an instruction to the hearer to construct a representation.
- Updating: the context is updated with new information from consecutive sentences.
- Meaning is a relation between the input and output conditions (meaning as context change).
- Distinguishes old and new information (indefinite NP – new discourse referent). Universe of discourse is open, can grow (= a partial theory, incomplete models).
- Incorporates pragmatics into semantics in order to achieve the dynamic view.

Advantage: asymmetric conjunction $p \wedge q \neq q \wedge p$; ‘A boy turned up. He smiled.’ \neq *‘He smiled. A boy turned up.’. (* = incoherent).

S_2 is an *update* of S_1 . The interpretation of S_2 is restricted to contexts which make S_1 true.

Merging DRSs:

Since merging DRSs proceeds in the order of producing the sentences (‘left-to-right’), then the first DRS D is interpreted in the initial context and brings about context s'' which is an initial context for interpreting D'

$$s \llbracket [D;D'] \rrbracket_{s'}^M \text{ iff there is } s'' \text{ where } s \llbracket [D] \rrbracket_{s''}^M \text{ and } s'' \llbracket [D'] \rrbracket_{s'}^M$$

‘;’ = sequencing operator for merging *proto-DRSs*.

11. *Propositional attitude reports in DRT*

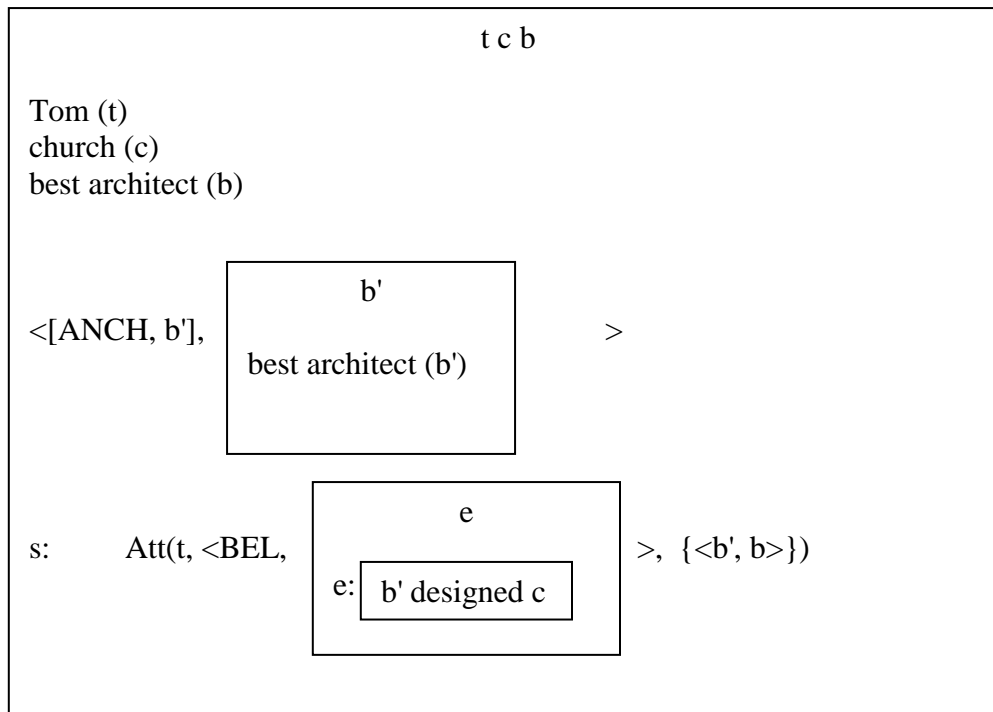
‘Tom believes that the best architect designed this church.’

Internal and external anchors for discourse referents:

$\langle [ANCH, x], DRS \rangle$ is an *internal anchor* for the discourse referent x (anchoring to a concept; information about the referent). External anchor (EA) is a function whose domain is the set of internally anchored discourse referents in the DRS. External anchors are required because the DRS can only have truth conditions if it is connected with the entities in the domain to

which the conversation pertains. Square brackets are used in order to signal the special type of condition that is used here: a condition that specifies how a discourse referent relates to the object it represents. Kamp (1990: 55) calls conditions of the type ‘ANCH[x]’ *formal* conditions, and other conditions such as ‘best architect (x)’ *predicative* conditions. A predicate *Att* (‘attitude’) is added to the vocabulary of the DRT language. Attitudes are states represented as s : $Att(x, DRS, EA)$

‘Tom believes that the best architect designed this church.’



In the DRS, b' is internally and externally anchored. It represents a reading on which ‘the best architect’ is used referentially.

If an internally anchored discourse referent is not also externally anchored, then the DRS does not express any proposition. When there is a referential mistake or imagining a referent: a belief is formally anchored, but there is no external object that it is anchored to.

Suggested reading

Introductory:

Kamp & Reyle 1993, chs 1; 4.1; 5.1-5.3

de Swart 1998, ch 6 (on solutions to donkey anaphora)

Jaszczolt 2002, ch 13

Kadmon 2001, ch 2

Geurts, B. & D. I. Beaver. 2007. Discourse Representation Theory. In: E.N. Zalta (ed.). *Stanford Encyclopedia of Philosophy*. <http://plato.stanford.edu>

More advanced/detailed:

Groenendijk and Stokhof 1991

van Eijck 2006

van Eijck & Kamp 1997

Kamp 1984, 1990

Kamp & Partee (eds) 2004