Lecture 9

Discourse and Donkey Anaphora 2
Discourse and Donkey Anaphora

We will look at two strategies to provide an account of ‘donkey’ sentences:

• **E-type anaphora**: It assumes that there is *something special about the anaphoric pronoun*, which is outside of its binding operator, that is, outside of the *if*-clause or relative clause which contains its antecedent indefinite NP.

• **Discourse Representation Theory (and File Change Semantics)**: It assumes that there is *something special about the indefinite NP* which is inside an *if*-clause or a relative clause.

It does not behave like a quantificational NP at all, and therefore, it should not be translated with the existential quantifier.

Indefinite noun phrases are not existentially quantified (contra Russell 1919), but introduce individual variables into the logical representation.
Discourse and Donkey Anaphora

• E-type anaphora

[A farmer]_i came in. He\textsubscript{i} had a donkey.
[A farmer]_i came in. [The farmer who came in]_i had a donkey.

\[\text{He}_i = \text{the farmer who came in} = \text{an E-type pronoun}\]
Discourse and Donkey Anaphora

• E-type anaphora

If Bill owns a donkey_i, he beats it_i.
If Bill owns a donkey_i, he beats [the donkey he owns]_i.
Discourse and Donkey Anaphora

- **E-type anaphora**

E-type anaphora solution was proposed by Evans (1977, 1980) to solve the problem of anaphoric pronouns that are outside the scope of their binding operator:

1. Such pronouns introduce individual variables that are not bound by the quantifier.

2. Such pronouns are **description-like**:
   E-type anaphor is a disguised singular definite description, e.g., he = the farmer who came in, which often consists of a common noun and a predicate.
Discourse and Donkey Anaphora

E-type anaphora

• Question:
  How do we reconstruct the descriptive content of the e-type pronoun?

• Answer 1:
  – Evans proposed that the description we recover to interpret the pronoun is constructed from the linguistic material in the sentence.
  – E-type anaphora reconstruct their descriptive content on the basis of the antecedent NP (which may be an indefinite NP).
Discourse and Donkey Anaphora

E-type anaphora

• Question:
  How do we reconstruct the descriptive content of the e-type pronoun?

• Answer 2:
  Cooper (1979) suggests that we do not specify what the interpretation of E-type anaphoric pronouns is at the level of the grammar. We let the context take care of it - just as we do with normal unbound pronouns. We assume their interpretation is ‘salient’ or ‘accessible’ in some sense. I.e., the reconstruction of the content of E-type anaphoric pronouns is dependent on a contextually salient function.
Discourse and Donkey Anaphora

- **Question:**
  How do we reconstruct the descriptive content of the e-type pronoun?

- **Answer:**
  Cooper (1979) suggests that reconstruction is dependent on a contextually salient function.

- **Problem with Cooper’s (1979) proposal:**
  There are data that suggest that an e-type pronoun needs to be licensed by a ‘real’ antecedent, given by an indefinite NP, for example.

(1)  
  a. Bill owns [a cat]_i. Max takes care of it_i.  
  b. Bill is a cat-owner. # Max takes care of it_i.

(2)  
  a. Everyone who owns a cat takes good care of it_i.  
  b. *Every cat-owner takes good care of it_i.
Discourse and Donkey Anaphora

- Coindexing in syntax can be interpreted in one of the three ways:

  1. coreference
  2. binding
  3. e-type anaphora
Discourse and Donkey Anaphora

Among cases in which e-type pronoun strategy may be applied are sentences like

*The man who gave [his paycheck]$_i$ to his wife is wiser than the man who gave it$_i$ to his mistress.*  
Karttunen 1969
Discourse and Donkey Anaphora

The man who gave *his paycheck* to his wife is wiser than
the man who gave *it* to his mistress.  

Karttunen 1969

• The antecedent of the pronoun *it* is the NP *his paycheck*.

• Yet, it seems impossible to analyze *it* as being bound by or coreferential with *his paycheck*, because *his paycheck* refers to the paycheck of the first man:

*The man*₁ who gave *[his paycheck]₁* to his wife is wiser than
the man who gave *it* to his mistress.
Discourse and Donkey Anaphora

Therefore, it is more plausible to assume that it stands for another occurrence of his paycheck, one where the pronoun his is bound by a different NP:

\[ \text{The man}_i \text{ who gave [his}_i \text{ paycheck] to his wife is wiser than the man}_j \text{ who gave it[= his}_j \text{ paycheck = the paycheck of x}_j \text{] to his mistress.} \]

The content of the pronoun it, namely the paycheck of x, is reconstructed from the previous explicit occurrence of his paycheck.

- These pronouns are also sometimes called ‘pronouns of laziness’ (Geach 1962), besides e-type pronouns.
Discourse and Donkey Anaphora

- **E-type strategy and uniqueness presupposition**
  
  - The e-type strategy in analyzing donkey anaphora assumes that pronouns are analyzed as *disguised definite descriptions*.
  
  - Definite descriptions presuppose a uniqueness condition, according to Russell’s (1905) analysis of definite descriptions.
  
  - This means that the e-type strategy requires a uniqueness presupposition to be associated with the pronoun.
Discourse and Donkey Anaphora

Bertrand Russell’s (1905) treatment of definite descriptions

The present king of France is bald.

\[ \exists x \left[ \text{PKF}(x) \land \forall y \left[ \text{PKF}(y) \rightarrow y = x \right] \land \text{bald}(x) \right] \]

The formula has 3 parts:

• there is at least one individual \( x \) that satisfies the condition of being PKF (existence condition)

• any \( y \) / all \( y \)’s satisfying the condition of being PKF must be identical with \( x \), so that \( x \) is the only individual satisfying the condition of being PKF (uniqueness condition)

• this individual satisfies the condition of being bald
Discourse and Donkey Anaphora

• Problems for e-type strategy
• The e-type strategy in analyzing donkey anaphora faces a number of problems due to the fact that it requires a uniqueness presupposition to be associated with the pronoun.

• The uniqueness presupposition is systematically present in examples we gave at the outset, which involve coordinated narrative sequences:

  [A farmer]_i came in. He
  [A farmer]_i came in. [The farmer who came in]_i had a donkey.
Discourse and Donkey Anaphora

• However, consider the following donkey sentence (Chierchia 1995, pp.18ff):

  a. Every farmer who owns a donkey beats it.
  b. Every farmer who owns a donkey beats [= the donkey he owns].

• According to the e-type analysis provided for (a), namely (b), (a) is interpreted as saying something about farmers who own exactly one unique donkey, which does not comply with our intuitions about (a).

• Intuitively, it = for every farmer, a donkey a farmer owns
Discourse and Donkey Anaphora

• Other counterexamples to the claim that the pronoun carries a uniqueness presupposition:

Every man who bought a sage plant here bought five others with it.
Heim 1982

This sentence would be appropriate in a situation in which sage plants are only sold in cartons of six.
Therefore, in such a situation, it does not make sense to reconstruct the descriptive content of it here as ‘the sage plant that x bought’.
Discourse and Donkey Anaphora

*Every house around here that has a barn has another one next to it.*
Kratzer 1988

- no uniqueness presupposition related to the interpretation of *it*
- *it* cannot be interpreted as ‘the (unique) barn that is next to a house’ because there is another barn next to it
Discourse and Donkey Anaphora

No father with a teenage son lends him the car on weekdays.

Rooth 1987

• Here, there is no uniqueness presupposition either.
• In uttering the above sentence, we do not confine our attention to fathers who have just one unique teenage son.
Discourse and Donkey Anaphora

Summary: E-type pronoun approach

(Evans, Cooper, and also Parsons)

• Pronouns are disguised definite descriptions.
• Indefinites NPs are uniformly interpreted as expressing existential quantification.
• No special rules for the interpretation of the indefinites.
• All the work goes into the interpretation of the pronouns: they are of the third kind, neither bound variable nor referential, with the characteristics of a Russellian definite description.

Problem: the uniqueness implication is too strong.
Discourse and Donkey Anaphora

• One possible way out of this problem and making the e-type strategy viable is to assume that donkey pronouns are not singular definite descriptions, but instead plural or number-neutral description.

• For example, a. might be analyzed as b.:
  a. Every farmer who owns a donkey beats it.
  b. Every farmer who owns a donkey\textsubscript{i} beats [the donkeys he owns]\textsubscript{i}.

• This analysis is defended by Lappin (1989) and Neale (1990). According to this analysis,
  – the pronoun \textit{it} in (a) is morphologically singular, but
  – semantically it is neutral as to whether it ranges over a single individual or a group of individuals.
  – Notice also that this analysis assigns to (a) virtually the same truth conditions Geach proposed (i.e., translatoin of an indefinite NP with a universal quantifier).
Discourse Representation Theory

The main ideas of what constitutes the classical *Discourse Representation Theory* (DRT) have their origin in the works of

- David Lewis (1975) “Adverbs of quantification”
Discourse Representation Theory

The fundamental assumptions of DRT:

1. The meaning of a sentence is not determined in isolation, but rather with respect to the preceding discourse. The meaning of a sentence consists of the change it makes to the set of possible worlds defined by the discourse. In this sense, the meaning is built \textit{incrementally}, and the proposed theory of meaning is \textit{dynamic}. 
Discourse Representation Theory

The fundamental assumptions of DRT:

2. Indefinite noun phrases are not existentially quantified (contra Russell 1919), but introduce individual variables into the logical representation.
   Indefinites have no quantificational force of their own.
   They are, in this respect, like free variables.
Discourse Representation Theory

The fundamental assumptions of DRT:

3. The quantificational force of indefinites is determined by the first available binder:
   that is, the lowest c-commanding quantifying determiner (*every, no, most, etc.*) or adverb of quantification (*always, usually, etc.*).
   These quantifying elements are **unselective**. They bind all free variables in their domain.
Predicate Logic - Lecture 5

• **Scope of a quantifier defined in terms of c-command**

**C-command:**
A node $A$ c-commands a node $B$ iff the first branching node that dominates $A$ also dominates $B$.

You can find c-commanded nodes visually by following a simple rule: Go up one then down one or more, and any node you land at will be c-commanded by the node you started at.
Discourse Representation Theory

The fundamental assumptions of DRT:

4. A binder quantifier sets up a tripartite structure of the form \( Q[A][B] \), where A is the restriction of the binder and B its nuclear scope.
Discourse Representation Theory

The fundamental assumptions of DRT:

5. A rule of *existential closure* assigns existential force to indefinites that are not otherwise quantified.
Discourse Representation Theory

Discourse Representation Structures, or DRSs

- DRT is a quite radical departure from previous semantic frameworks, since the very concept of meaning is seen under a different angle. Kamp (1981 and elsewhere) argues that there are at least two perspectives under which we can view the meaning of a sentence or a text:
  
  - its truth conditions: this is the traditional view to be found in logic and analytic philosophy, with its origins in the work of Frege (1879, 1892)
  
  - the information embodied in it: “that which a language user grasps when he understands the words he hears or reads”.

This view is familiar in psychology, various branches of linguistics, computer science.
Discourse Representation Theory

• Kamp argues that both aspects of meaning are important, related to
  – truth-conditions
  – incremental discourse processing
• Kamp proposes a new level of semantic representation for both
• This level of semantic representation consists of
  \textit{Discourse Representation Structures}, or DRSs.
Discourse Representation Theory

*Discourse Representation Structures, or DRSs*

- often represent larger linguistic units, multisentential passages, discourses or texts.
- As each sentence gets processed, it contributes its information to the DRS that has already been constructed from the preceding sentences.
- Typically, the sentences that make up a coherent piece of discourse are connected by various kinds of cross-reference.
Discourse Representation Theory

*Discourse Representation Structures, or DRSs*

- DRS construction
Discourse Representation Theory

First Example: Proper names, indefinites and pronouns

*Jones* owns *a car*. *It* fascinates *him*.

- Proper names (*Jones*), indefinites (*a car*) and pronouns (*it*, *him*) introduce **DISCOURSE REFERENTS**

\[
\text{Jones}(x) \quad \text{car}(y) \quad x \text{ owns } y \quad y \text{ fascinates } x \\
\uparrow \text{discourse referent} \uparrow
\]

- Discourse referents are introduced as the discourse unfolds, and they are ‘stand-ins’ for real individuals in the representation of the discourse.
Discourse Representation Theory

First Example: Proper names, indefinites and pronouns

• ‘Discourse referents’ are also called ‘discourse markers’, a concept that was introduced by Lauri Karttunen in a 1968 paper, published as “Discourse Referents” in 1976

• Discourse Representation Theory, or DRT, is a theory of such discourse referents and possible ways to refer to them.
Discourse Representation Theory

Proper names

• The proper name *Jones* introduces a discourse referent into the universe of discourse and a condition: *Jones*(x).
• The condition consists of the proper name *Jones* followed by the new discourse referent in parentheses.
• The condition *Jones*(x) says that the individual *x* stands for the individual denoted by the proper name *Jones*. 
Discourse Representation Theory

Indefinites

• The information which the indefinite NP \textit{a car} contains is that the individual must be of the kind indicated by the noun, in other words that it must satisfy the predicate \textit{car} (i.e., it must have the property of being a car)
• This is represented by means of the condition \textit{car}(y)
Discourse Representation Theory

Verbs

• The verb *owns* introduces the DRS condition \( x \ owns \ y \).

• That is, it introduces a two-place relation that holds between discourse referents.
Discourse Representation Theory

• The result of a DRS construction for the first sentence is represented as follows, as a ‘box’ representation:

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jones(x)</td>
<td>car(y)</td>
</tr>
<tr>
<td>x owns y</td>
<td></td>
</tr>
</tbody>
</table>

universe of the DRS

a set of discourse referents

a set of DRS-conditions
Discourse Representation Theory

• A DRS (discourse representation structure) contains two types of things:
  (i) a set of discourse referents: \{x,y\}
  (ii) a set of DRS-conditions:
    Jones(x)
    car(y)
    x owns y

• Jones(x): A proper name picks out the unique intended bearer of the name.
• car(y): An indefinite NP accepts any individual which satisfies the conditions in question.
Discourse Representation Theory

• **Pronouns:** Each pronoun introduces a new discourse referent into the DRS.
• The felicity and interpretation of the anaphoric pronouns in cases of cross-sentential anaphoric relations depends on the anaphoric pronouns picking out discourse referents already introduced in the discourse.
• This is expressed by the fact that they are interpreted by the same discourse referents as their antecedents.
• This information is represented in the form of a DRS-condition that involves an equation: \( \alpha = \beta \), where \( \alpha \) is a new discourse referent and \( \beta \) is a suitable discourse referent chosen from the universe of the DRS.
Discourse Representation Theory

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Discourse Representation Theory

• This means that **anaphora** are not analyzed as a relation between pronouns and other NPs, but as a relation between pronouns and discourse referents that are already present in the semantic representation under construction.
Discourse Representation Theory

*Jones owns a car. It fascinates him.*

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
<th>u</th>
<th>v</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jones(x)</td>
<td>car(y)</td>
<td>x owns y</td>
<td>u fascinates v</td>
</tr>
<tr>
<td></td>
<td></td>
<td>u = y</td>
<td>v = x</td>
</tr>
</tbody>
</table>

universe of the DRS

a set of discourse referents

a set of DRS-conditions
Discourse Representation Theory

Jones owns a car. It fascinates him.

The incremental interpretation of the discourse means that the second sentence adds more discourse referents and more conditions to the same DRS. Thus we extend the interpretation built up so far.
Discourse Representation Theory

• Indefinite NPs are treated as free variables.

• They are “not existential quantifiers. When an indefinite has existential force it has that force in virtue of the particular role played by the clause containing it within the sentence or discourse of which it is part” (Kamp 1981, p. 5).
Discourse Representation Theory

• The logical form of our sentence can be represented as:

\[ Jones \; owns \; a \; car. \; It \; fascinates \; him. \]
\[ jones(x) \land car(y) \land owns(x,y) \land fascinates(y,x) \]

• Since there are no quantifying elements in this sentence, the indefinites get existential force by default.

• This default quantification, also called “**existential closure**”, can be thought of as an existential quantifier that operates globally on the discourse as a whole and binds all free variables associated with indefinites.
Discourse Representation Theory

• In other words, the existential quantifier *unselectively binds* all the free variables in its scope:

  \[ \exists x, y \ [ \text{jones}(x) \land \text{car}(y) \land \text{owns}(x,y) \land \text{fascinates}(y,x) ] \]

• Default existential quantification (“generalized existential closure” at the discourse level, see Heim 1982):
Discourse Representation Theory

Embedding function

• The DRS is true if and only if we can find an embedding function \( f \) which assigns individual values to all the discourse referents in such a way that each individual has the properties described by the conditions in the DRS.

• For our above example this means that there has to exist some individual who bears the name \( Jones \) and an individual that satisfies the description \( a \) car and the car is owned by Jones and it fascinates Jones.
Discourse Representation Theory

Second Example:
Universal quantification and accessibility of discourse referents

*Every farmer who owns a donkey beats it.*

- We have a quantifying element in a sentence, the universal quantifier *every*.
- In general, quantifying elements take two arguments: a restriction and a (nuclear) scope.
- That is, they induce a tripartite structure:

  \[
  \forall x,y \ [\text{farmer}(x) \land \text{donkey}(y) \land \text{owns}(x,y)] \ [\text{beats}(x,y)]
  \]

  \[
  Q \quad \text{restriction} \quad \text{nuclear scope}
  \]
Discourse Representation Theory

Every farmer who owns a donkey beats it.

\[ \forall x,y \ [ \text{farmer}(x) \land \text{donkey}(y) \land \text{owns}(x,y)] \ [ \text{beats}(x,y) ] \]

restriction

nuclear scope
Discourse Representation Theory

\[ \forall x, y \ [\text{farmer}(x) \land \text{donkey}(y) \land \text{owns}(x, y)] \ [\text{beats}(x, y)] \]

Q \hspace{1cm} \text{restriction} \hspace{1cm} \text{nuclear scope}

- The restriction specifies the cases to quantify over: farmer-donkey pairs.
- The sentence is true iff the nuclear scope ‘x beats y’ is true for all such pairs.
- Moreover, in the above example we see that the universal quantifier is an \underline{unselective binder}: It binds all the free variables which are free in the restrictive clause.
Discourse Representation Theory

- The contribution of *every* $\alpha$ to the clause in which it occurs is that
- whatever satisfies the condition expressed by $\alpha$ also satisfies the predicate expressed by the rest of the clause.
- The interpretation of a universal and other quantifiers involves a box-splitting construction rule, which introduces two sub boxes related by the connective $\Rightarrow$. 
Discourse Representation Theory

\[ \forall x,y \ [\text{farmer}(x) \land \text{donkey}(y) \land \text{owns}(x,y)] \ [\text{beats}(x,y)] \]

Q restriction nuclear scope
Discourse Representation Theory

• An indefinite NP *a donkey* is embedded under a universal quantifier and the pronoun is a ‘donkey pronoun’:
• Recall that ‘donkey pronouns’ are pronouns that introduce variables that are outside of the traditional scope domain of the indefinite NP, which is their antecedent.
• The indefinite NP antecedent is inside an *if*-clause or a relative clause, and it is related to the ‘donkey pronoun’ which is outside that *if*-clause or relative clause.
Discourse Representation Theory

Every farmer who owns a donkey beats it.

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
<th>⇒</th>
<th>u</th>
</tr>
</thead>
<tbody>
<tr>
<td>farmer(x)</td>
<td>donkey(y)</td>
<td></td>
<td>x beats u</td>
</tr>
<tr>
<td>x owns y</td>
<td></td>
<td></td>
<td>u = y</td>
</tr>
</tbody>
</table>

- In DRT, it is assumed that discourse referents introduced in boxes to the left and up of the discourse referent $u$ introduced by the anaphoric pronoun *it* provide accessible referents for the anaphoric pronoun.
- The pronoun *it* is interpreted as picking out the same discourse referent as the indefinite NP *a donkey*. The discourse referent $y$ is accessible to $u$.
- This is expressed by the condition $u = y$. 
Every farmer who owns a donkey beats it.

- **$u = y$**: The identification of $u$ with $y$ brings the pronoun under the scope of the universal quantifier, and the donkey pronoun is interpreted as a regular bound pronoun.
- **Given the universal force of the binder, the meaning of the sentence can be paraphrased** as ‘for every farmer $x$, and every donkey $y$ that $x$ owns, $x$ beats $y$’.
Discourse Representation Theory

Every farmer who owns a donkey beats it.

<table>
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</table>

⇒

<table>
<thead>
<tr>
<th>u</th>
</tr>
</thead>
<tbody>
<tr>
<td>x beats u</td>
</tr>
<tr>
<td>u = y</td>
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</table>

- The connective ⇒ is defined in such a way that for all embedding functions which make the left box true it should be possible to extend them to one which makes the right box true.
- Because the embedding function assigns individuals to all the discourse referents in the left box, this formulation amounts to universal quantification over all the discourse referents in the left box.
Discourse Representation Theory

Every farmer who owns a donkey beats it.

<p>| | |</p>
<table>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>y</td>
</tr>
<tr>
<td>farmer(x)</td>
<td>donkey(y)</td>
</tr>
<tr>
<td>x owns y</td>
<td></td>
</tr>
</tbody>
</table>

\[ \Rightarrow \]

<p>| |</p>
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<th></th>
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</thead>
<tbody>
<tr>
<td>u</td>
</tr>
</tbody>
</table>

- x beats u
- u = y

- The right-hand side DRS provides a situational description which extends that given by the DRS on the left.
- It is this intuition that justifies the asymmetry in accessibility: discourse referents on the left are accessible as antecedents for pronouns on the right, because they are as much part of the right-hand side DRS as the discourse referents on the right themselves.
Discourse Representation Theory

Third Example: Inaccessible Discourse Referents

- Discourse referents in the right-hand side of the DRS are not accessible to the discourse referents on the left, because they are not part of the left-hand side DRS in any sense whatever.
Discourse Representation Theory

• The assumption that discourse referents on the right are not accessible to the discourse referents on the left has implications for the treatment of anaphora, and explains the difference in licensing of discourse anaphora between NPs like *a farmer* and *every farmer*.

[A farmer]_i gets up early. He\_i likes it.
[Every farmer]_i gets up early. #He\_i likes it.

[Every farmer]_i gets up early. They\_i like it.
Discourse Representation Theory

\[\text{Every farmer}_i \text{ gets up early. } \#\text{He}_i \text{ likes it.}\]

- \textit{he} cannot be interpreted as anaphorically related to \textit{every farmer}.
- The reason is that the discourse referent introduced by the quantified NP \textit{every farmer} cannot be mapped onto some specific individual in the universe of discourse.
- The result is that a discourse referent is introduced in a \textit{subordinate DRS (box)}. In this position it is inaccessible to \textit{He likes it}, which introduces a condition belonging to the \textit{main DRS}, while \textit{x} belongs to a subordinate DRS.
Discourse Representation Theory

Every farmer$_i$ gets up early. #He$_i$ likes it.

\[
\begin{array}{c|c|c}
\text{x} & \text{farmer(x)} & \Rightarrow \\
\hline
\text{He likes it.} & \text{x gets up early} & \\
\end{array}
\]
Discourse Representation Theory

Every professor owns \([a \text{ book}]^i\) on semantics. #It\(_i\) is bizarre.

- does not allow it to be read as anaphorically linked with a book.
Discourse Representation Theory

*Every professor owns [a book]* \(_i\) *on semantics. #It\(_i\) is bizarre.*

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>professor(x)</td>
<td>book-on-semantics(y)</td>
</tr>
<tr>
<td></td>
<td>x owns y</td>
</tr>
</tbody>
</table>

It is bizarre.

- The discourse referent \(_y\) is in a subordinate DRS and so, the pronoun *it*, which is part of a condition belonging to the main DRS, has no access to it.
Discourse Representation Theory

*Bill owns [a book]$_i$ on semantics. It$_i$ is bizarre.*

- Here the anaphoric link can be established between *it* and *a book on semantics*, because the indefinite NP *a book on semantics* introduces a discourse referent in the main DRS (just like *Bill does*).

- For these examples, see Kamp and Reyle (1993, p. 169ff.)
Discourse Representation Theory

• One important contribution of DRT is a different treatment of quantified NPs like *every farmer* and indefinite NPs:

  - quantified NPs are quantifiers that induce a tripartite structure and binding operators,
  - indefinite NPs have no quantificational force of their own, they introduce free variables.
Discourse Representation Theory

A farmer who owns a donkey always beats it.

David Lewis (1975) Adverbs of Quantification proposes that such sentences have a tripartite structure, which has the following form:

always [if x is a man, if y is a donkey, and if x owns y] [ x beats y ]

which amounts to the representation

always_{x,y} [farmer(x) \land donkey(y) \land owns(x,y)] [ beats(x,y) ]
Discourse Representation Theory

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always [if $x$ is a man, if $y$ is a donkey, and if $x$ owns $y$] [ $x$ beats $y$ ]

which amounts to the representation

always $x,y$ [farmer($x$) ∧ donkey($y$) ∧ owns($x,y$)] [ beats($x,y$) ]
Discourse Representation Theory

Notice that the only difference between the following sentences

Every farmer who owns a donkey beats it.
\[ \forall x, y \ [ \text{farmer}(x) \land \text{donkey}(y) \land \text{owns}(x,y)] \ [ \text{beats}(x,y) ] \]

A farmer who owns a donkey always beats it.
\[ \text{always}_x y \ [ \text{farmer}(x) \land \text{donkey}(y) \land \text{owns}(x,y)] \ [ \text{beats}(x,y) ] \]

is the quantifying element:

In the second sentence we have the adverb of quantification always.

The truth conditions for both the above sentences are almost the same:

They are true iff every pair of a farmer and a donkey that satisfies the restriction also satisfies the nuclear scope, \( x \ beats \ y \).
Discourse Representation Theory

A farmer who owns a donkey always beats it.
always_{x,y} [farmer(x) \land donkey(y) \land owns(x,y)] [ beats(x,y) ]

• The logical representation has a tripartite structure consisting of the universal quantifier always, a restriction expressed by the relative clause, and a nuclear scope $x$ beats $y$.
• The restriction specifies the cases to quantify over, namely the man-donkey pairs.
• The sentence is true iff the sentence $x$ beats $y$ is true in all such admissible cases.
• Most importantly, the universal quantifier always here unselectively binds all the free variables $x, y$ in its scope.
Discourse Representation Theory

Lewis’s (1975, p.7) definition of unselective universal quantification:

∀Φ is true iff Φ is true under every admissible assignment of values to all variables free in Φ.
Discourse Representation Theory

*Every orange is sweet.*                *Oranges are always sweet.*

Tripartite structure

\[ S \]

<table>
<thead>
<tr>
<th>Operator</th>
<th>Restriction</th>
<th>Nuclear Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>(A,</td>
<td>B)</td>
</tr>
<tr>
<td>every(_x)</td>
<td>orange(x)</td>
<td>sweet(x)</td>
</tr>
<tr>
<td>always(_x)</td>
<td>orange(x)</td>
<td>sweet(x)</td>
</tr>
</tbody>
</table>
Discourse Representation Theory

- We find clear correspondences between the meanings of adverbs of quantification (most frequency adverbs) and determiner quantifiers in the following cases: *always/all, usually/most, sometimes/some, never/no, often/many, hardly ever/few.*

<table>
<thead>
<tr>
<th>adverbs of quantification</th>
<th>determiner quantifiers</th>
</tr>
</thead>
<tbody>
<tr>
<td>always</td>
<td>all</td>
</tr>
<tr>
<td>usually</td>
<td>most</td>
</tr>
<tr>
<td>sometimes</td>
<td>some</td>
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<tr>
<td>never</td>
<td>no</td>
</tr>
<tr>
<td>often</td>
<td>many</td>
</tr>
<tr>
<td>hardly ever</td>
<td>few</td>
</tr>
</tbody>
</table>
Discourse Representation Theory

• The view that adverbs of quantification, as originally proposed by Lewis (1975), Kamp (1981) and Heim (1982) are unselective binders over individual variables is criticized by Chierchia (1988, 1991, 1995), for example.

Every farmer who owns a donkey beats it with a stick.
∧x,y [farmer(x) ∧ donkey(y) ∧ owns(x, y)] ∃z[stick(z) ∧ beats(x, y)]

• The variable z introduced by the indefinite a stick, does not occur in the restriction, therefore, is not bound by the universal quantifier and is ‘left over’.
• It receives existential force by default, i.e., by an automatically inserted existential quantifier.
Discourse Representation Theory

Proportion Problem

• If we analyze *most* on a par with *every*, as is done in DRT, we run into what has come to be known as the proportion problem:

  Most farmers who own a donkey beat it.

  most $x,y [\text{farmer}(x) \land \text{donkey}(y) \land \text{owns}(x,y)] \land [\text{beats}(x,y)]$

• The interpretation of donkey pronouns (here *it*) presupposes that indefinites (here *a donkey*) always take over the quantificational force of their binder.

• In the above sentence, *most* is an unselective binder that binds all the free variables introduced into the restriction: namely, $x$ and $y$ introduced by *farmers* and *donkey*. 
Discourse Representation Theory

Most farmers who own a donkey beat it.

most $x, y [\text{farmer}(x) \land \text{donkey}(y) \land \text{owns}(x, y)] [\text{beats}(x, y)]$

- This formula is true just in case most of the pairs that satisfy the restriction (the antecedent), satisfy the nuclear scope (the consequent).
- The interpretation of the sentence amounts to quantifying over pairs of farmers and donkeys and to the claim that for most of these pairs, it is true that the farmer beats the donkey.
Discourse Representation Theory

*Most farmers who own a donkey beat it.*

\[
\text{most } x, y \left[ \text{farmer}(x) \land \text{donkey}(y) \land \text{owns}(x, y) \right] \left[ \text{beats}(x, y) \right]
\]

- But suppose that we have a situation in which there are
  - 9 farmers who own 1 donkey each and they do not beat it.
  - 1 farmer owns 50 donkeys, and beats them all.
- The DRT analysis would yield the result that the sentence is true in this situation, because *most pairs of farmers and donkeys* are such that the farmer beats the donkey.
- This conflicts with our intuitions, we would consider the sentence to be false in this situation: most farmers are such that they do not beat the donkey they own.
Discourse Representation Theory

Most farmers who own a donkey beat it.

most \( x,y \) [farmer(x) \& donkey(y) \& owns(x,y)] [ beats(x,y) ]

- The problem has to do with the fact that *most* is taken to quantify over pairs, over donkey-farmer pairs.
- As *most* is assumed to be an unselective binder, it quantifies symmetrically over all variables free in its scope.
- That is, we treated this example as a case of symmetric quantification.
- However, the sentence seems to quantify asymmetrically over the variable that corresponds to the head noun *farmer*: What counts for quantification is the farmer discourse referent.
Discourse Representation Theory

• This problem, which was pointed out by Kadmon (1987), is known as the *proportion problem*.
• It shows that determiners are not (uniformly) unselective binders.