Lecture 7. Kamp-Heim II. Heim's theory in Chapter II and Kamp's Discourse Representation Theory

Readings: Full references and links are in References at the end. These are all on the CD.
(1) (Heim 1982) Heim dissertation, Chapter 2.
(2) (Kamp 1981) A theory of truth and semantic representation.
(3) (Karttunen 1976) Discourse referents.
Optional readings:
(4) (Heim 1983) File change semantics and the familiarity theory of definiteness.
(5) (Lewis 1979) Scorekeeping in a language game.
(6) (Stalnaker 1978) Assertion.

1. The semantic problems of indefinites, quantification, discourse anaphora, donkey sentences.

Discourse anaphora
(1) *John /the man/ a man walked in. He looked tired.*
(2) *Every man /no man/ more than one man walked in. *He looked tired.*

> Natural question: But isn't *they* ok in (2)? Answer: Yes, but plural pronouns are a different story. See (4). The argument here rests on the contrast in the use of **singular** pronouns. We may come back to plural pronouns later.

Bound variable anaphora
(3) {*John /the man/ a man/ every man /no man/ more than one man* } *was sure that he would win.* Antecedent 'higher' in tree than bound variable pronoun. All OK.

"Pragmatic" anaphora with 'constructed' antecedent
(4) {*Every man /no man/ more than one man*} *voted for the second proposal. They (all) regretted having to make a choice.*

We will probably return to pragmatic" anaphora and possibly to plural pronouns this semester. In the meantime, avoid examples with plural pronouns, and focus on the contrast between (1-2) and (3).

Different "discourse" behavior of logically equivalent sentences.
(Argues against a purely pragmatic account of the differences in (1-2).)

(5) a. *One of the ten marbles is not in the bag. It is probably under the sofa.*
b. *Nine of the ten marbles are in the bag. ??It is probably under the sofa.*
(Partee examples, approximately cited by Heim, p.21)

Informal generalization: (Karttunen 1976) An indefinite NP introduces a "new discourse referent", which has a "limited lifespan."

Examples that show "limited lifespan" of a 'discourse referent' introduced by an indefinite:

(6) a. *John wants to catch a fish and eat it.*
b. *Maybe he would share it with me.* (An example of "modal subordination": (Roberts 1989))
c. **It's probably under the boat now.*

If (6a) is about a 'non-specific'1 fish, i.e. a situation in which the speaker does not attribute to John an attitude toward a particular fish, then the "discourse referent" corresponding to *a fish* exists only within the hypothetical situation2 corresponding to John's desire. On this interpretation of (6a) it is possible to follow (6a) by (6b) but not by (6c). Sentence (6c) would be fine as a continuation of (6a) if (6a) is interpreted as being about an attitude of John toward a specific fish (i.e., that there's a fish which John wants to catch and eat).

> Heim's and Kamp's work provided formal foundations for the notion of "discourse referent" and laid the basis for the transition to "dynamic semantics", in which the meaning of a sentence is its "context change potential".

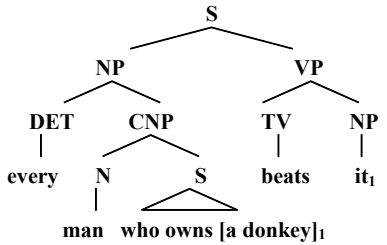
The problem of "donkey sentences"

(7) a. *Every man who owns a donkey beats it.*
b. *If a man owns a donkey, he always beats it.*

How to explain that *it* can be anaphoric to *a donkey* in these sentences?
How to explain that *a donkey* seems in effect to act like a *universally* quantified NP in these sentences?

Structure of (7a) below in (8). Coindexing indicates "intended coreference", but syntactic coindexing doesn't guarantee the desired semantic "identity", as we will see in (9).

(8)



If the VP were just *is happy*, with no pronoun to worry about, we could do a straightforward compositional semantic interpretation of the subject NP on the classic analysis (as in Lecture 3, with the generalized quantifier interpretation of *a donkey*) with no problem. On that analysis, the

1 In the literature, this use of *a fish* is often called "non-referential", and the context in which it occurs is called "referentially opaque".
2 In Haspelmath (1997), see the discussion of (Fauconnier 1985) and the concept of "mental spaces": if a fish exists only in the 'mental space' or the 'possible worlds' of John's desires, then corresponding "discourse referent" is limited to John's desire-worlds.

indefinite NP is interpreted with narrow scope (scope confined to the relative clause) and an existential interpretation. (Review Relative Clause rule for steps a-b.)

(9) a. **TR(** [*who owns* [*a donkey*]$_1$]**) = λ*z*** [**∃x_1 [donkey(x_1) & own (*z*, x_1)]]**

b. **TR(**[*man who owns* [*a donkey*]$_1$]**) = λ*w*[man(*w*) & λ*z*** [**∃x_1 [donkey(x_1) & own (*z*, x_1)]] (*w*)]**
= **λ*w*[man(*w*) & ∃x_1 [donkey(x_1) & own (*w*, x_1)]]**

c. TR([*every man who owns* [*a donkey*]$_1$]**)**
= **TR(***every***)(TR(**[*man who owns* [*a donkey*]$_1$]**))**
= **λ*P*[∀*y*(λ*w*[man(*w*) & ∃x_1 [donkey(x_1) & own (*w*, x_1)]] (*y*) → *P*(*y*))]**
= **λ*P*[∀*y*([man(*y*) & ∃x_1 [donkey(x_1) & own (*y*, x_1)]] →*P*(*y*))]**

d. TR(*every man who owns a donkey beats it*$_1$**)**
= **TR(**[*every man who owns* [*a donkey*]$_1$]**) (TR(***beats it*$_1$**))**
= **λ*P*[∀*y*([man(*y*) & ∃x_1 [donkey(x_1) & own (*y*, x_1)]] →*P*(*y*))](beat(x_1))**
= **∀*y*([man(*y*) & ∃x_1 [donkey(x_1) & own (*y*, x_1)]] → beat(x_1)(*y*))]**
= **∀*y*([man(*y*) & ∃x_1 [donkey(x_1) & own (*y*, x_1)]] → beat(*y*, x_1))]**

[Exercise for the reader: fill in the reasons for every step of the derivation, and fill in any missing steps. And practice **type-checking:** draw a derivation tree for this sentence, and fill in the types of the expressions at each node.]

This corresponds to the 'standard' belief that indefinite NPs are interpreted as 'existential quantifier phrases'. And it would be fine, except **there is no reasonable compositional way to get this indefinite phrase connected to the pronoun *it* in the VP**. (This is discussed in detail in Heim Chapter 1.) Can *it* be a bound variable? Discourse pronoun? Note that in the formulas above, the variable x_1 in the translation of the VP is **not** bound by the quantifier **∃x_1** in the translation of *a donkey*, because it's not in the scope of the quantifier. This is the problem that was faced by formal semantics (and all semantics, but it was not recognized until semantics became sufficiently explicit) before Heim's and Kamp's work.

2. The main ideas of Heim's solution. (Chapter II)

2.1. Indefinite NPs: What is their semantics?

In predicate position, as in (10), uncontroversially of type <e,t>, as in our fragment in Lecture 3. Not discussed by Heim. (Montague had a different treatment, which we'll ignore. It's discussed and argued against in (Partee 1986).)

(10) a. *John is a man.*
b. **TR(***is* a_{pred} *man***) = man** (Lecture 3)

In subject or object or other positions ("argument positions"), as in (11), it's more controversial.

(11) a. *If a man owns a donkey, he always beats it.* (Heim p.123, from (Geach 1962))
b. *A cat was at the door. It wanted to be fed.* (Heim p.166)

Classical Montague: A generalized quantifier with ∃ as part of its meaning, as illustrated above.

Heim (building on (Lewis 1975)); similar theory independently developed by (Kamp 1981). See also (Heim 1983). **Indefinite as a free variable.**
The indefinite is like a free variable x_i, with no quantificational force of its own, which gets bound in one of two ways3:

(a) by being under the scope of an *unselective quantifier*, as in (11a, 12) (more in Sec 2.2), or
(b) by an operation of *existential closure*, which puts an implicit unselective ∃ on texts and on the "Nuclear Scope" of tripartite structures. See example (11b) and Sec. 2.3.

(12) a. *In most cases, if a table has lasted for 50 years, it will last for another 50.*
b. *Sometimes, if a cat falls from the fifth floor, it survives.*
c. *If a person falls from the fifth floor, he or she will very rarely survive.*

The examples above, from Heim p. 123, illustrate the "**quantificational variability**" of the interpretation of an indefinite NP. The examples have paraphrases involving 'most tables', 'some cats', 'very few people' respectively.

2.2 Adverbs of quantification, and quantificational determiners, as unselective binders.

Lewis's treatment of Q-adverbs as "**unselective quantifiers**" (Lewis 1975).

(13) "always (φ, ψ)" is true if every assignment to the free variables in φ which makes φ true also makes ψ true. (Heim p.125)

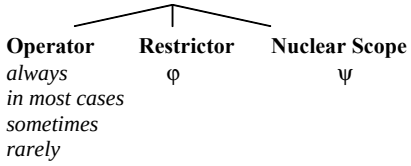
Applied to (7b), this rule gives truth conditions equivalent to those of (14) below, where the unselective quantifier is paraphrased by a pair of selective ones:

(14) ∀*x*∀*y*((*x* is a man & *y* is a donkey & *x* owns *y*) → *x* beats *y*)

Tripartite structures

In the structure "always (φ, ψ)", φ plays the role of <u>*restricting*</u> the domain of quantification. It has thus become common since Heim's work4 to follow her terminology and view unselective quantificational structures as having the following three parts:

Tripartite structure:
(15)



***Every*, etc as unselective binders.**

3 Later theories have proposed other ways that implicit variables get introduced and get bound; see, for instance, Igor Yanovich's SALT 15 paper (Yanovich 2006), as well as Kratzer and Shimoyama (Kratzer and Shimoyama 2002).
4 See, for instance:

Heim argues that not only the adverbs of quantification act as unselective binders, binding all indefinites in their scope, but so do the determiner quantifiers like *every*. She solves the problem of the donkey-sentences by treating the "logical form" of (7b) as very similar to that of (7a), even though on the surface the two sentences are quite different.

But they are not semantically so different, if we remember that a Det could be looked at as taking two <e,t> arguments. In Heim's approach, we replace the <e,t> arguments by *open sentences*, type t but with one or more free variables. And the Det becomes a variable-binding operator, but an unselective binder.

Compare the two treatments of (7a): what gets bound by what, and how.

MG semantics corresponding to tree (8):

(16) **Every' (CNP')(VP')** Types: CNP', VP': <e,t>. **Every':** <<e,t>,<<e,t>,t>>
Every' (λ*w*[man(*w*) & …]) (beat'(x_i))
(See complete derivation in (9).)

Heim semantics corresponding to tripartite structure:

(17) **Every' (CNP')(S')** Types: CNP', S': t. **Every':** An unselective variable-binder.
No MG type ("syncategorematic")

Note that Heim's unselective *every* operator binds both the 'man-variable' and the 'donkey-variable', unlike Montague's *every* (which doesn't directly bind anything; but indirectly it causes the 'man-variable' to get bound, but not the 'donkey-variable.')

2.3. Existential closure.

Heim's strategy: consider the complex sentences first, to understand the true nature of the indefinite NP and to see arguments for believing that it has no quantificational force of its own, but gets its quantificational force from various unselective quantifiers that can bind it.

But then what about the simple sentences where the indefinite looks like it has an existential quantifier as part of its meaning, like (11b)?

Idea: existential closure at the level of texts.

Interpretation of (11b) before existential closure, treating sequences of sentences as conjoined (Simplest "rhetorical structure"; there are other possibilities as well.):

(18) **(cat(x_1) & be-at-the-door(x_1) & wanted-to-be-fed(x_1))**

Existential closure: Unselective binder ∃ binds all variables free in its scope, in this case just x_1. (For interpretation of subscript on $\exists_1$, see Heim p.166-167)

(19) **$\exists_1$ (cat(x_1) & be-at-the-door(x_1) & wanted-to-be-fed(x_1))**

2.4. Other important aspects of Heim's system.

The interpretation of Definites: Indefinites introduce *new* variables ("discourse referents") and put restrictions on their domain; definites are also interpreted as variables, but *old* variables, and their descriptive content is presupposed rather than acting as a domain restrictor. This is a formalization of the "familiarity theory" of definites, which is in competition with the "uniqueness theory" of definites. The familiarity theory treats definites as anaphoric, with much appeal to accommodation for apparently novel definites. The debate continues. More on definites next week.

Heim's most famous example in support of the familiarity theory, against the uniqueness theory:

(20) Everybody who bought a sage plant here bought eight others along with it. (p.89)

3. Kamp's Discourse Representation Theory – see APPENDIX

See separate **Appendix: a**n excerpt from (Partee 1984), "Nominal and temporal anaphora": Section II, pp. 247-252. We will return to this article later; now I just want to use the part that gives an introduction to Kamp's Discourse Representation Theory as it is described in (Kamp 1981), which is identical to (Kamp 1984), and I'm copying the pdf pages as an Appendix so that I don't have to try to redraw the diagrams by hand.

Homework #3: Heim's theory of indefinites, definites, quantifiers, and anaphora. Due April 8.

Read Heim's Chapter II. This is a classic work, and well worth studying. Then answer at least one of the following questions. (One could be enough, because reading will take a lot of time.)

1. Write down a list of the rules of construal introduced in Ch.II, Sec.2. Then show the steps of the derivation of (5') from (5), p.137; (8') from (8), p.141; (2') from (2), pp. 171.
2. Do for sentence (3), p.133 (*Every man arrived*), what Heim does for *She met a cat* on pp. 160-162. First fill out tree (3''), p.133, so that it's comparable in detail to tree (1'), p.155. [Call the expanded tree (3''*).
3. Answer the following questions both for tree (1'), p.155, and tree (3''*), your expansion of tree (3''), p.133.
   a. To which of the nodes of the trees is there a "semantic category" assigned (see pp. 154-156), and what is it? And to what things other than nodes (e.g. certain indices) is there also a semantic category assigned, and what is it?
   b. For which of those *semantic categories* can you find a corresponding *semantic type* (or set of semantic types) in the type system of Montague's Intensional Logic? (You can look at what the semantic rules on pp. 159 ff. do to help figure out what the types would be.) Note: the operator *every*, and other such operators in Heim's system, are not like the DETs of MG; they are "syncategorematic" and probably must be considered not to have any type. (Optional: Do you agree?)
   c. There is clearly not a 1-1 correspondence between the syntactic categories of Heim's logical forms of Ch. II and semantic types; what **is** the correspondence, according to what you found in answering parts **a, b**?
4. Summarize Heim's grounds for her claim on p.215, optionally adding any comments of your own, "Whereas the scope of a proper name has no semantic significance, the scope of an indefinite does. This puts indefinites on a par with quantifying NP's, but it does not mean that they are quantifying."

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