

Lecture 8. Kamp-Heim III. Definite NPs as Anaphoric Expressions. Parallels between Anaphora and Presupposition.

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Readings: Full references and links are in References at the end. These are all on the CD.

- (1) (Heim 1983a) On the projection problem for presuppositions.
- (2) (Kamp 1981) A theory of truth and semantic representation.

Optional readings:

- (3) (Heim 1982) Heim dissertation, Chapter 3.
- (4) (Heim 1983b) File change semantics and the familiarity theory of definiteness.
- (5) (Stalnaker 1978) Assertion.
- (6) (van der Sandt 1992) Presupposition projection as anaphora resolution.

1. Kamp's Discourse Representation Theory.

See Appendix to Lecture 7: We didn't have time for it last week, and can start with it this week.

2. File Change Semantics and the Anaphoric Theory of Definiteness: Heim Chapter III

Informal summary: In Chapter II, much of the work was done by the "Rules of Construal" that constructed a Logical Form for each sentence (and for discourses consisting of a sequence of sentences, a "text".) Logical Form is a syntactic level of representation. Heim provided compositional interpretation rules that apply to Logical Forms. A notion of "context" was included, so that non-anaphoric pronouns could be interpreted if the context provided a value to the corresponding index (indexed variable). This notion of "context" is not dynamic: A sentence or text is evaluated with respect to a model, an interpretation function, and a context, but the context does not "change" during the interpretation process.

In Chapter III, Heim introduces "File Change Semantics", a dynamic theory in which the very notion of what the basic semantic value of a sentence is is changed. In this theory, sentences are interpreted in contexts, but sentences also cause changes in the context. The idea that sentences not only depend on the context for their interpretation but also cause changes in the context goes back to Stalnaker (1978). Stalnaker developed Grice's notion of *common ground*, the presuppositions (assumed by the speaker to be) shared by the speaker and hearer at any point in a conversational exchange. Stalnaker models the common ground as a set of possible worlds: those possible worlds compatible with everything the speaker presupposes. Heim wants to enrich the notion of common ground to include not only what the speaker and hearer believe to

be true, but what "discourse referents" are active at a given point in the conversation. Both for Stalnaker and for Heim, the common ground can change as the conversation progresses. For Stalnaker, the common ground changes as new propositions are asserted and accepted: as more 'facts' enter the common ground, the corresponding set of possible worlds gets smaller. (The participants get gradually closer to pinning down 'which world' they believe is the actual world. Bigger set of facts = smaller set of possible worlds.) For Heim, the common ground can change in that way, but also in the introduction of 'discourse referents' and the information associated with them (and in the elimination of discourse referents whose life span has ended.)

The basic semantic value of a sentence in Heim's File Change Semantics is not its truth-conditions, but its "file change potential": A sentence is evaluated with respect to a file, and can cause changes in the file. But truth-conditions are not gone: file-change potential is "truth conditions and more". A whole *file* is now true or false with respect to a model and an interpretation (and a context). And we can still define what it is for a *sentence* to be true with respect to a context, a model, and an interpretation. Oversimplifying:

- (1) A **file F** is true if there is some sequence **a** that satisfies it.
- (2) A **formula ϕ** is true with respect to a file F if $F + \phi$ is true, and false with respect to F if F is true and $F + \phi$ is false. (I.e. a formula is true if adding it to a true file gives another true file. It's false if adding it to a true file makes a false file.)

But we need to look more closely at files and their 'satisfaction sets' to understand this better.

Caveat: The treatment of quantified sentences with tripartite structures is a bit complex, and I'm not going to go over the details: see Section 4 of Chapter III. We have seen how quantified sentences work in Heim's Chapter II theory and in DRT; in Heim's Chapter III theory, files are dynamically manipulated with the same net effect but with more of the work in the semantics.

2.1. Informative discourse and file-keeping.

2.1.1. Introduction

Metaphorically speaking, if A is speaking and B is trying to understand what A is saying, B's job is to construct and update a 'file' that contains, at any point in the conversation, the information that A has conveyed up to that point. Heim considers an example, in which A utters a 4-sentence text.

- (3) (a) A woman was bitten by a dog.
- (b) She hit him with a paddle.
- (c) It broke in half.
- (d) The dog ran away.

Start with empty file F_0 .

First sentence (a) *A woman was bitten by a dog.*

The two indefinite NPs cause the introduction of two new "file cards" 1, 2, on which we enter the following information:

F₁:

1		2
➤ woman	➤ dog	
➤ bitten by 2	➤ bit 1	

Second sentence (b): *She hit him with a paddle.* The indefinite *a paddle* leads to the creation of a new file card 3, and we add the information of this sentence to all three cards, since all 3 ‘discourse referents’ are mentioned in the sentence.

F₂:

1	2	3
➤ woman	➤ dog	➤ paddle
➤ bitten by 2	➤ bit 1	➤ was used by
➤ hit 2 with 3	➤ hit by 1 with 3	1 to hit 2

Third sentence (c): *It broke in half.* We add this information just to card 3.

F₃:

1	2	3
➤ woman	➤ dog	➤ paddle
➤ bitten by 2	➤ bit 1	➤ was used by
➤ hit 2 with 3	➤ hit by 1 with 3	1 to hit 2
		➤ broke in half

Fourth sentence (d): *The dog ran away.* A definite NP refers to an existing file card. We add the information just to that card, since none of the other entities are mentioned in this sentence.

F₄:

1	2	3
➤ woman	➤ dog	➤ paddle
➤ bitten by 2	➤ bit 1	➤ was used by
➤ hit 2 with 3	➤ hit by 1 with 3	1 to hit 2
	➤ ran away	➤ broke in half

File card *n* represents the *n*th new discourse entity introduced, and contains all the information that has been given about that entity at a given point in the discourse.

The whole file, consisting of a sequence of file cards, represents the common ground of speaker and hearer, containing both *information* and *discourse entities*.

How do indefinite and definite NPs lead to updates of the file? By the following rule: **For every indefinite NP, start a new card. For every definite NP, update a suitable old card.**

This is the most basic metaphor behind the anaphoric theory of definiteness and the file change theory. Now we have to clarify what lies behind the metaphor, and how it connects to truth-conditional semantics.

2.1.2. How files relate to facts, and how utterances change files.

First of all, let’s go back to the semantics of first-order predicate logic for a minute. Remember our assignments *g*? In logic it’s common to say that a formula like *love(x,y)* is true or false with respect to an model *M* and an assignment *g*, where *M* specifies a domain of entities *D* and includes an interpretation function *I* (a “lexicon”) that assigns semantic values to basic terms and predicates; it assigns some set of ordered pairs of elements of *D* to a two-place predicate like *love*. We write all of that as

$$[[love(x,y)]]^{M,g} = 1 \quad (\text{or } 0, \text{ as the case may be}).$$

Another way to say the same thing is to say that *g* satisfies the formula *love(x,y)*. An assignment satisfies a formula if the values it assigns to the free variables in the formula make the formula true. (A formula with no free variables is either satisfied by every assignment or is satisfied by no assignment. That’s why a formula with no free variable can be simply true with respect to *M*.)

For Heim, because of the way indefinites introduce new discourse referents that may have a limited lifespan, it is easier to work with *finite* assignment functions which assign values only to the ‘currently active’ variables, or discourse referents.

And because she equates the discourse referents with natural numbers 1, 2, 3 (you can think of them as *x*₁, *x*₂, *x*₃), her assignment functions take the form of (finite) *sequences*. The assignment function which we might think of as

$$x_1 \rightarrow \text{John}, x_2 \rightarrow \text{John}, x_3 \rightarrow \text{Mary}$$

is encoded as the 3-membered sequence <John, John, Mary>. (Two of the crucial differences between a *sequence* and a *set* are that in a sequence, order matters, and (as a result) in a sequence, repetitions are not redundant.)

Heim defines the *satisfaction* of a file in terms of sequences. A file is satisfied by a sequence of individuals if all the open sentences on the file cards are true with respect to the assignment of the first individual in the sequence to “1”, the second individual to “2”, etc. We write *a*_{*N*} to represent a sequence with *N* members; its members will be picked out as *a*₁, *a*₂, ..., *a*_{*n*}, where *n* = *N*.

Consider file **F**₂ above. Any sequence *A*_{*N*} whose first member, *a*₁, is a woman, whose second member *a*₂, is a dog, and such that *a*₂ bit *a*₁, satisfies that file **F**₂.

Truth: A file is said to be *true*, or “consistent with the facts” (this could easily be amended to “true with respect to a model *M*”) if there is *some* sequence that satisfies it.

NOTE carefully the implicit ∃: Both in the definition above and in Kamp’s definition of what it is for a DRS to be embeddable in a model, there is a “metalinguistic” or “implicit” existential quantifier. This eliminates the need for a text-level existential closure rule at the level of logical form.

Satisfaction sets: In order to define satisfaction for complex sentences recursively, we need to introduce the notion of a *satisfaction set*, the set of sequences that satisfy a given file. We write Sat (**F**₀), Sat (**F**₁), etc.

How utterances lead to context-change: As we add sentences to the discourse (look again at our first sample text), each sentence leads to a change in the file, and the satisfaction set of each successive file is smaller than that of the preceding one.

$\text{Sat}(\mathbf{F}_0) = A^N$, the set of all sequences whatsoever.

$\text{Sat}(\mathbf{F}_1) = \{a_N: a_1 \text{ is a woman, } a_2 \text{ is a dog, and } a_2 \text{ bit } a_1\}$

$\text{Sat}(\mathbf{F}_2) = \{a_N: a_1 \text{ is a woman, } a_2 \text{ is a dog, } a_3 \text{ is a paddle, } a_2 \text{ bit } a_1, \text{ and } a_1 \text{ hit } a_2 \text{ with } a_3\}$
etc.

The change from \mathbf{F}_1 to \mathbf{F}_2 can be described as follows: $\text{Sat}(\mathbf{F}_2) = \text{Sat}(\mathbf{F}_1) \cap \{a_N: a_N \text{ satisfies } S^b\}$, where S^b is the disambiguated logical form of sentence (b). As Heim puts it (p.280):

In general terms, the satisfaction condition of an utterance relates in the following way to the file change which that utterance brings about:

- (A) If sentence S is uttered under the reading represented by logical form ϕ , and \mathbf{F} is the file that obtains at that stage of the conversation at which the utterance occurs, and \mathbf{F}' is the file that obtains after that utterance, then the following relation holds between \mathbf{F} and \mathbf{F}' :

$$\text{Sat}(\mathbf{F}') = \text{Sat}(\mathbf{F}) \cap \{a_N: a_N \text{ satisfies } \phi\}$$

2.1.3. File cards as discourse referents.

Heim discusses the fact that her “file cards” are designed to capture what Karttunen had in mind in his paper on “Discourse referents” (Karttunen 1976).

Later work such as (Vallduví 1992, Vallduví and Engdahl 1996, Erteschik-Shir 1997) suggests formulating further rules that impose more structure on a file, moving active file cards to the “top of the file”, etc. See also related work on “centering” and anaphora resolution (Walker and Prince 1996, Walker et al. 1997, Roberts 1998).

2.1.4. Files as common grounds.

Files are not really satisfied just by sequences but by ordered pairs of a possible world and a sequence (one might add: relative to a model). This is how sequences can be seen as enrichments of Stalnaker’s notion of a *common ground* discussed at the beginning of section 2 above.

2.1.5. File change potentials and satisfaction conditions.

The relation between the semantic interpretation of a sentence in terms of satisfaction conditions (the classic semantic value for sentences) and its interpretation in terms of *file change potential* can be expressed in the following reformulation of Principle A:

- (A) $\text{Sat}(\mathbf{F} + \phi) = \text{Sat}(\mathbf{F}) \cap \{a_N: a_N \text{ satisfies } \phi\}$

This treats classical satisfaction conditions as basic and defines file change potential in terms of them. But Heim argues for going a step farther and taking file change potential as basic. I won’t repeat the details here, but by the end of the chapter she develops arguments for preferring to take file change potential as basic and to define truth and satisfaction derivatively from file change potential.

2.2. Novelty and Familiarity

2.2.1. The domain of a file; how definiteness affects file change.

If we know only the satisfaction set of a file, we can’t determine how many cards and which cards it contains. We need to keep track of the *domain* of a file as well as of its satisfaction set. $\text{Dom}(\mathbf{F})$ is the set that contains every number which is the number of some file card in \mathbf{F} .

Then file change potential has two dimensions: the way the satisfaction set changes and the way the domain changes.

2.2.2. Deixis and familiarity with respect to the file.

The Chapter 2 theory included two kinds of definite NPs: anaphoric definites which pick up old indices, and deictic pronouns whose indices may be new: they may be viewed as novel definites whose value is provided by the context. In Chapter 3, where novelty and familiarity are considered not in terms of logical forms but in terms of properties of files, Heim says that both deictic reference and anaphoric reference presuppose that the referent be already “familiar” to the audience. Cards can be added to the file by virtue of contextual salience.

The Novelty-Familiarity Condition: Suppose something is uttered under the reading represented by ϕ , and the file prior to the utterance is \mathbf{F} . Then for every NP_i in ϕ , it must be the case that: $i \in \text{Dom}(\mathbf{F})$ if NP_i is definite, and $i \notin \text{Dom}(\mathbf{F})$ if NP_i is indefinite. Otherwise, the utterance is not felicitous under this reading.

2.3. Truth

- (4) A **file** \mathbf{F} is true if there is some sequence \mathbf{a} that satisfies it.
(5) A **formula** ϕ is true with respect to a file \mathbf{F} if $\mathbf{F} + \phi$ is true, and false with respect to \mathbf{F} if \mathbf{F} is true and $\mathbf{F} + \phi$ is false. (I.e. a formula is true if adding it to a true file gives another true file. It’s false if adding it to a true file makes a false file.)

Omitted: How the context-change potential of quantified sentences works. Roughly: a sequence satisfies a universally quantified formula if every way it can be extended to satisfy the restrictor clause has a further extension that also satisfies the nuclear scope. (This is more complex because if we try to think of this in terms of files and updates to files, we are really having to quantify over possible updates to files, just as in classical logic we have to quantify over assignments.)

2.4. Conclusion: Motivation for the File Change Model of Semantics.

Heim concludes with four arguments in favor of the file change model of Chapter III over both the Chapter II “logical form” approach and previous treatments.

Argument 1: File change semantics treats conjunction very differently from any of the other “logical connectives” like negation or disjunction. Conjunction is simpler than the others. Negation and disjunction are like quantification in requiring the construction of auxiliary files. This seems to fit the facts. Conjunction is psychologically the simplest; and when we just string sentences together, we interpret them as conjoined.

Argument 2: File change semantics offers a solution to the projection problem for presuppositions. (See Section 3 below.) The projection problem provides both a general argument for context-change semantics (now often known as dynamic semantics) and a specific

argument for characterizing arguments as files, since this lets us assign context-change potentials to units as small as open formulas.

Argument 3. File change semantics offers a good account of the interaction of semantics and pragmatics, via operations of interpretation (semantic) and accommodation (pragmatic) in the updating of files. [We haven't illustrated accommodation very much here, but it is at work in many instances where a definite NP doesn't have an explicit antecedent but is 'inferable', as in *John bought a car. The windshield was cracked.*

Argument 4. File change semantics provides a framework in which the theory of definiteness can be stated in a single principle, the Extended Novelty-Familiarity Condition.

Summary of most important issues in Heim's dissertation and the Kamp-Heim approach:

- **Non-uniform treatment of NPs:** indefinites (and all weak NPs)/ definites/ pronouns/ essentially quantificational NPs with operator, restrictor, nuclear scope
- **Unselective binding**
- **Quantified formulas vs. "cumulative" (conjunctive) formulas**
- **Text vs. sentence**
- **Non-linguistic antecedents accommodated in files, not in LFs**
- **Meaning is context-change potential; anaphora and presupposition unified**
- **The relation between pragmatics and semantics – the crucial role of context**

3. Presuppositions and their parallels to anaphora

3.1. Background on presuppositions

(Levinson 1983, Chs. 3,4, Chierchia and McConnell-Ginet 1990, Ch. 6, Kadmon 2001)

A **presupposition** is (a) backgrounded and (b) taken for granted, i.e. assumed by the speaker to be already assumed by the hearer to be true.

A classic definition of **semantic presupposition**: A sentence S presupposes a proposition *p* if *p* must be true in order for S to have a truth-value (to be true or false). *Note that this requires that we allow some sentences to lack a truth-value; this definition does not make sense if we work with a strictly bivalent logic, in which each sentence must be either true or false.

An approximate definition of **pragmatic presupposition**: A use of sentence S in context C pragmatically presupposes *p* if *p* is backgrounded and taken for granted by the speaker in C.

Test for backgrounding: *p* is in the background of S if *p* is implied by all of the sentences in the "S family":

- (6)
- a. S
 - b. It is not the case that S.
 - c. Is it the case that S?
 - d. If S, then S'.

Example: Presupposition of stop VP-ing.

(7) "Joan has stopped drinking wine for breakfast."

- Presupposition: Joan used to drink wine for breakfast.

Contrast: Non-restrictive relative clauses vs. pseudo-cleft sentences

Backgrounded but *not presupposed*: non-restrictive relative clauses.

(8) Jill, who lost something on the flight from Ithaca to New York, likes to travel by train.

- A number of authors have considered the embedded proposition, that Jill lost something on the flight from Ithaca to New York, to be a presupposition (Keenan 1971, Levinson 1983), but arguments against considering it a presupposition can be found in Padučeva (1985, p.65) and later in (Chierchia and McConnell-Ginet 1990) and (Kadmon 2001).

Contrasting sentence with a real presupposition: Pseudo-cleft construction.

(9) What Jill lost on the flight from Ithaca to New York was her new flute.

Example: Presuppositions of factive verbs

Another classic case of presuppositions much studied by linguists are the presuppositions of factive verbs (Kiparsky and Kiparsky 1970). Let's consider two sets of verbs and compare their behavior in the sentences in the "S family".

Non-factive verbs	Factive verbs
believe	know
say	regret
hope	be surprised
deny	notice
claim	discover

non-factive:

- (10)
- (a) John said that Bill is a spy.
 - (b) John didn't say that Bill is a spy.
 - (c) Did John say that Bill is a spy?
 - (d) If John said that Bill is a spy, Mary will be unhappy.

None of the sentences in (10) imply that the speaker takes for granted, or even believes, that Bill is a spy, not even the positive assertion (10a). In contrast, all of the sentences in (11) require for appropriate use that the speaker takes for granted that Bill is a spy.

factive:

- (11)
- (a) John knows that Bill is a spy.
 - (b) John doesn't know that Bill is a spy.
 - (c) Does John know that Bill is a spy?
 - (d) If John knows that Bill is a spy, Mary will be unhappy.

We get similar results putting any non-factive verb in (10) and any factive verb in (11). The classic work is (Kiparsky and Kiparsky 1970); there has been much important work since then, including (Karttunen 1971, Karttunen 1973, Gazdar 1979, Karttunen and Peters 1979, Heim 1992).

Example: definite NPs and possessive NPs

We have already discussed the presuppositionality of *the king*, and Heim extended that discussion to include definites that contain or by themselves function as 'bound variables', like *the capital* in example (12a), or *the donkey he owns* in a typical donkey-sentence – these

definites are not “referential”, but they are still presuppositional. [Exercise for you: if they are not referential, how do we describe what their presuppositions are?] Another example of the same sort is possessive NPs: *John’s son* or *his son*, when it occurs in argument position (rather than predicate position) presupposes that John or “he” has a son, and in an example like (13b1313), *he* may be a bound variable. (In the examples I have indicated optional negation to test for the relevant presuppositions.)

- (12) a. (Not) in every country is *the capital* the largest city.
b. (Not) every_i woman loves *the city where she_i was born*.
- (13) a. John’s son is (not) at home.
b. (Not) every_i one of those men was looking at his_i son.

Example: Presuppositional vs. assertive components in lexical meanings

The division of “components” of lexical meaning into assertive and presuppositional has been emphasized both in the work of Fillmore (1971) and in the work of Apresjan (1974) and his colleagues. Good examples include the contrast discussed by Fillmore among the verbs *blame*, *criticize*, *accuse*, all involving an agent *X*, an addressee or patient *Y*, and an action *P*, and the different status of the components ‘*X says/believes that Y did P*’, ‘*X says/judges that P is/was a bad action*’, and ‘*X says/believes that P happened*’, and the similar contrast discussed by Padučeva (1985, p.67) among the Russian verbs *obvinjat* ‘accuse’ (*X obvinjaet Y v P*) and *osuzdat* ‘criticize’ (*X osuzdaet Y za P*), noting an observation of Langendoen that when an adverb such as *spravedlivo* ‘justly’ is added to a sentence containing one of these verbs, what is asserted to be “just” is only the asserted part, not the presupposed part.

If we follow Frege and take the denotations of most words to be *functions*, then semantic presuppositions can be treated formally as **conditions on the well-definedness of functions**. Recall, for instance, our definition of the iota-operator used for the referential sense of the definite article: $\iota x[\text{king}(x)]$ is defined iff there is one and only one king, and undefined otherwise. Heim’s anaphoric theory of definites does not involve an iota operator, but it shares with that analysis the requirement that the descriptive content of the definite NP must be presupposed: if *the king* bears index *n*, then the *n*th file card in the current file must already contain (or entail) the information that *n* is a king. (A good (non-formal) discussion of *referential status* of a variety of kinds of noun phrases, and their associated presuppositions, can be found in Chapter 4 of (Padučeva 1985).)

In general, when a presupposition (precondition) of a function is not satisfied, the function is not defined and it is impossible to compute a value. (Heim 1983a)

3.2. The projection problem for presuppositions

In our initial examples, we have looked only at presuppositions of whole sentences. When presuppositional constructions occur in embedded contexts, we find that sometimes the presupposition of an embedded part survives as a presupposition of the whole sentence, and sometimes it does not. The problem of which presuppositions are “projected” to the top level and which are not is known as the “projection problem” for presuppositions; it is part of the broader problem of compositionality. Two of the earliest works on the problem are (Langendoen and Savin 1971) and most influentially (Karttunen 1973). Karttunen’s classic examples include the following.

- (14) a. Jack has children and *all of Jack’s children* are bald.

- b. If Jack has children, then *all of Jack’s children* are bald.
c. Either Jack has no children or *all of Jack’s children* are bald.

- (15) *All of Jack’s children* are bald.

- (16) Jack has children.

Whereas *all of Jack’s children* in a simple sentence like (15) presupposes (16), none of the sentences in (14) carry that presupposition. In (14a), (16) is asserted in the first clause, and the presupposition of the second clause is satisfied in its local context by the fact of that assertion in the first clause. In (14b), the presupposition in the consequent is satisfied by the content of the antecedent, and therefore does not survive as a presupposition of the whole. Example (14c) is the most complex, and we won’t discuss it in detail: the combination of negation and disjunction has properties that neither one has alone. But here too, the presupposition of the second clause is satisfied locally and does not become a presupposition of the whole.

Note that whether a presupposition of an embedded clause becomes a presupposition of the whole sentence depends on the content as well as the form of the whole sentence. The sentences in (17) have the same ‘form’ as those in (14), but because they do not provide an ‘antecedent’ proposition to satisfy the presupposition, the presupposition (16) is projected upwards and becomes a presupposition of the entire sentence. Those in (18) have a potential ‘antecedent’ for the presupposition, but because of the different form, that ‘antecedent’ is not in a position where it can satisfy the presupposition, so again (16) becomes a presupposition of the entire sentence.

- (17) a. Jack himself has lots of hair but *all of Jack’s children* are bald.
b. If I am not mistaken, then *all of Jack’s children* are bald.
c. Either none of Mary’s children are fat or *all of Jack’s children* are bald.
- (18) a. #*All of Jack’s children* are bald, and Jack has children. (Anomalous)
b. If Jack’s first wife claims that Jack has children, then *all of Jack’s children* are bald.
c. #Either Jack has children or *all of Jack’s children* are bald. (Anomalous)

3.3. Anaphoric properties of presuppositions and other context-dependent phenomena

As noted by Heim (1982, 1983a), Zeevat (1992), van der Sandt (1989, 1992), Partee (1993), there is a virtually perfect correspondence between the structural and semantic contexts in which anaphoric expressions can find their antecedents and the structural and semantic contexts in which presuppositions can ‘find’ the propositions that satisfy them.

Van der Sandt (1992) compares the sentences in (14) above with the sentences in (19):

- (19) a. John owns a donkey. He beats it.
b. If John owns a donkey, he beats it.
c. Either John does not own a donkey or he beats it.

Looking back at the sentences in (14) in light of the analogies with anaphora, we can say that in (14b) and (14c), the proposition that satisfies the presupposition has a “limited lifespan”. In (14a), as in cases of ‘discourse anaphora’, the proposition has been added to the common ground of the whole discourse, and its lifespan would be unlimited.

The parallels extend to binding phenomena. We have seen in Heim’s original work that an anaphoric definite may be interpreted as a bound variable, as in (12a-b), and other kinds of presuppositions as well can have “bound variable” instances, as in (20).

- (20) a. Every girl who started to smoke in high school has *stopped smoking*.

- b. If anyone, lost anything, *what they_i lost* will be recovered in 24 hours.
- c. If a boy smokes, his mother always *knows that he smokes*.

Partee (1984) shows that the same kinds of phenomena can be found in the domain of temporal anaphora and can be analyzed well in the Kamp-Heim framework. Partee (1989) builds on work of Mitchell (1986) to extend similar considerations to the binding of implicit variables in words like *local*, *home*, *nearby*. We'll look at those later this semester.

4. Dynamic semantics

All of these parallels give added support to some version of *dynamic semantics*. Truth-conditional semantics and context-dependent phenomena cannot be “modular”; not only whole sentences but also their parts can add “discourse referents” or propositional content to the “local context”, and compositional semantics must have access to all of these kinds of content. Context-change and context-dependence are recursive in the same way as more traditional semantic content.

There has been much more work on this whole family of problems since the original work of Heim and Kamp. One issue that has been interestingly controversial is the status of intermediate representations like Kamp's Discourse Representation Structures: they seem to be syntactic rather than semantic objects: is it indispensable to have some such “representation” level in between the syntax proper and the model-theoretic semantics? Kamp argued “yes”, while Groenendijk and Stokhof (Groenendijk and Stokhof 1990, 1991) argued “no”, and proposed a dynamic variant of first-order logic and a dynamic variant of Montague Grammar to capture the main properties of the Kamp-Heim theory. Muskens (1993) showed how Kamp's theory could be made compositional in the classical sense. (Note that in Montague's theory, compositionality required that any intermediate representational language should be in principle dispensable.) See also (Muskens et al. 1997), (Chierchia 1992, Dekker 1993, Chierchia 1995, Dekker 1996).

Appendix: Comparing Heim's Ch. II and Ch. III theories

(This is only a partial description; not very much is said here about definiteness.)

Chapter II: What are the rules and constraints?

(This list gives part of the answer to question 1 of Homework 3.)

Construal Rules

1. **NP-Indexing:** Assign every NP a referential index. (p. 132)
2. **NP-Prefixing:** Adjoin every non-pronominal NP to S. (p. 132)
3. **Quantifier (Operator) Construal:** Attach every quantifier (operator¹) as a leftmost immediate constituent of S. (p. 133) (Applies both to *every* and to *always*; and to *not*, *must*, ...)
4. **Position if-clause in the position of “restrictor”,** between quantifier and the rest of the sentence. (p. 134) (not given full status as a rule of construal)
5. **Existential closure 1:** Adjoin a quantifier \exists to the nuclear scope of every quantifier. (p. 138)
6. **Text formation:** Attach a sequence of sentences under a T-node. (p. 139)
7. **Existential closure 2:** Adjoin the quantifier \exists to T. (p. 140)
8. **Quantifier (Operator) Indexing:** Copy the referential index of every indefinite NP as a selection index onto the lowest c-commanding quantifier (operator). (It applies to \exists as well as to other quantifiers and operators.) (p. 146)

¹ On p. 143, “quantifier” is generalized to “operator”, which includes quantifiers, negation, and temporal and modal operators (quantifiers over times and worlds).

Wellformedness conditions:

1. **Novelty Condition:** An indefinite NP must not have the same referential index as any NP to its left. (p.151)

Chapter III.

Simplify the “construal” component, provide an enriched theory of semantic interpretation that takes over some of the burden carried by the construal component of Chapter II. In particular, eliminate Existential Closure, Quantifier Indexing, and the Novelty Condition. Build a theory of definiteness into the principles which interpret logical form.

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