Semantics of Anaphora and its History

Lecture 1. Reference, Coreference, and Variable-Binding up to the 1980s.

1. What is Anaphora?

Anaphora as traditionally viewed as a phenomenon refers to the relationship between a “referentially dependent” expression (the anaphoric expression, or anaphor) and a “referentially independent” expression that serves as its antecedent and from which the anaphoric expression gets its reference (or other semantic value). Examples:

(1) a. John left because he was tired. **Pronominal anaphora**; antecedent a DP.

b. Mary went to California because Susan did __. **VP anaphora**. The anaphoric expression is a null VP; the antecedent is the VP go to California.

c. Tom may arrive this evening. If so, I’ll be very happy. **Sentential anaphora**; antecedent Tom arrive(s) this evening.

d. Some careless driver backed into our car. **Adjectival anaphora**, antecedent a property-denoting expression.

e. No one wanted to admit that he might be wrong. **Pronominal anaphora with a quantified DP as antecedent: a clear case of “bound-variable anaphora”**.

To determine the semantic value of an anaphoric expression such as he, so, such, or anaphoric ∅, we typically need to know what its antecedent is, and what semantic rules determine the value of the anaphor in terms of the value of its antecedent. In a simple case like John and he in (1a), the antecedent refers to an individual, and the pronoun refers to the same individual. The examples in (1b-d) show that anaphora is not always a relation between individual-denoting expressions, and example (1e) shows that the anaphoric relation is not always a relation of “coreference”, as it seems to be in (1a). We will see that even the notion of “antecedent” is not always straightforward.

The study of anaphora involves both syntax and semantics. We need syntax to describe the distribution of anaphoric expressions and their antecedents, and we need semantics to describe the semantic contribution of an anaphoric expression. And we need pragmatics as well, because there is presumably a close connection between the anaphoric use of he in (1a)
and what is sometimes called a deictic use\(^1\) of he in (2), as it might be uttered while looking at someone who just walked by, where there is no linguistic antecedent.

(2) \(\text{He looks lost.}\)

Pragmatics may also be needed to explain examples where the “antecedent” has at most an indirect relation to the pronoun, as in (3).

(3) \(\text{No students came to the party. They thought they weren’t invited. (Partee 1978)}\)

Two notes on terminology. In the broad sense of the term anaphora, all of the examples above as well as the ones in (4) below involve anaphora. There are two narrower senses in which anaphora or anaphor are distinguished from other terms.

Narrow sense \#1: Anaphora vs. cataphora. In the examples above, the anaphor follows the antecedent. But sometimes it precedes, as in (4); that is known as backwards anaphora (the more common term in contemporary western syntax) or cataphora (a classic term).

(4) a. If you can find it, I would recommend buying the 1977 Vishnevskaya recording.
   b. You must remember this: A kiss is just a kiss; a sigh is just a sigh. (from Casablanca, the song “As Time Goes By”)

(A note about English: at least in the standard English of my generation, that can be anaphoric but not cataphoric, and this can be cataphoric but not anaphoric. A common way for politicians to begin a reply to an interviewer’s question – I remember it from Kennedy, I think -- was, “I have this to say about that: ….”, where that refers to the question, and this to the answer he’s about to give. (Perhaps that this is a demonstrative.)

Narrow sense \#2: Anaphors vs. pronominals. In his “Binding Theory”, (Chomsky 1980, 1981) emphasized the difference in syntactic distribution among three classes of expressions, which he calls “anaphors”, “pronominals”, and “R-expressions” (“referential expressions”). Reflexive pronouns like himself, myself, Russian sebja and –sja are called “anaphors”, while ordinary personal pronouns like he, him are called “pronominals”. The term “anaphor” therefore has a much narrower meaning in post-1980 Chomskian syntax than in other work. If we followed Chomsky’s terminology, none of the anaphoric expressions in the examples above would be called anaphors, but the anaphoric expressions in (5) below would be.

(5) a. Bill loves only himself.
   b. Vanja ljubit sebja. ‘Vanya loves himself’
   c. Oni čitali žaloby drug na druga. ‘They read complaints against each other (?)’

(Testelets 2001, p.602)

We will use the terms anaphora and anaphor in the broad sense in which they apply to all the examples in (1-5), except when explicitly discussing Chomskian Binding Theory.

2. Puzzles of identity, coreference, and binding

2.1. The Stoics, and early generative grammar: what is identity?

Even today, a popular notion of what pronouns do is “replace a noun or noun phrase”. The very name pronoun (like местоимение) seems to be based on such an idea. In early transformational grammar, both plain and reflexive pronouns were derived from a full noun

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\(^1\) There are a pair of rare terms that are useful here: endophora for the case where a referentially dependent sentence gets its value from a linguistic expression within the same text, and exophora for a case like that in (2) where it gets its value from outside the linguistic context. But those terms are very rarely used.
phrase identical to an antecedent noun phrase, via transformations of Pronominalization and Reflexivization (Lees and Klima 1963, p.23).

(6) Lees and Klima’s 1963 Reflexive Rule and Pronoun Rule:

\[ (A) \text{ Reflexive Rule: } X\text{-Nom}-Y\text{-Nom}'-Z \rightarrow X\text{-Nom}-Y\text{-Nom}'+\text{Self-Z} \]
\[ \text{ where Nom} = \text{ Nom}' = \text{ a nominal, and where Nom and Nom}' \text{ are within the same simplex sentence. [Note: “Nom” later became NP, and still later became DP]} \]

\[ (B) \text{ Pronoun Rule: } X\text{-Nom}-Y\text{-Nom}'-Z \rightarrow X\text{-Nom}-Y\text{-Nom}'+\text{Pron-Z} \]
\[ \text{ where Nom} = \text{ Nom}', and where Nom is in a matrix sentence while Nom}' is in a constituent sentence embedded within that matrix sentence. \]

Lees and Klima focused on the differences in distribution between pronouns and reflexives, arguing with many interesting examples for the claim that the antecedent to a reflexive pronoun in English is always in the same clause, and the antecedent to a pronoun is always within a higher clause. Their work was the earliest precursor to Chomsky’s Binding Theory, and some of their examples remain classic. There are many interesting and relevant constructions discussed in their work. Much of the syntactic work on pronouns has focused on these issues -- what are the structural conditions that determine the distribution of pronouns vs. reflexives?

(12) The men threw a smokescreen around themselves. (p.18)
(13) The men found a smokescreen around them. (p.18)
(14) I told John to protect himself. (p.18) [“deep” subject of protect is John]
(15) I told John to protect me. (p.18)
(16)*I told John to protect myself. (p.18)
(29) John bought Mary a car to drive herself around in. (p.20)
(30) John bought Mary a car to drive him around in. (p.20)

But in their work, and even with the later addition of “referential indices” on noun phrases to indicate coreference in (Chomsky 1965), almost all the examples used proper names. Thus the history of generative grammar had to repeat the history of the Stoics (4th – 3rd centuries BCE), as noted by (Egli 2000). This is where the semantic issues come in.

(4) If somebody [or: a man] is in Athens, it is not the case that he is in Rhodes.
(5) If Socrates is in Athens, it is not the case that he is in Rhodes.

One may compare sentence (4) with sentence (5). In considering such sentences the following problem arises: The pronoun in sentence (5) may be explained easily in its semantic function by a theory of substitution of proper names for pronouns. It stands for the name “Socrates”, because it can be replaced by this name without change of meaning. We may guess that this is the origin of the name “pronoun” for designating pronouns: pro nomine stat, “the pronoun stands for a name”. If I try to apply this theory to sentence (4), I quickly come to a kind of paradox for which the Stoics had a proper designation: it is the nobody paradox. Whereas in (5) the substitution yields (6a), which is semantically equivalent to (5), the substitution of “somebody” for “he” in (4) yields (6b), which is not semantically equivalent to (4).

(6) a. If Socrates is in Athens, it is not the case that Socrates is in Rhodes.
    b. If somebody is in Athens, it is not the case that somebody is in Rhodes.

The substitution theory of pronouns is invalid in this case. This forces us to distinguish deictic occurrences of pronouns and anaphoric occurrences of pronouns. Previous to the discussion of these data definite pronouns were all treated [by the Stoics] as deictic – demonstrative –, but
then the Stoics had to consider two uses of pronouns: a deictic one and an anaphoric one; the latter being anaphorically related to an antecedent. (Egli 2000, pp. 19-20)

In the case of the Stoics, solving the pronoun problem led “the Stoics [to invent] a variant of predicate logic, in addition to the propositional logic contained in their theory of syllogisms, as they used both constants going beyond propositional logic, as well as predicate and subject variables in the form of demonstratives in their texts” (Egli 2000, p.20).

In the case of generative grammar, the “discovery” of sentences with quantifiers rather than proper names led to the breakdown of Chomsky’s 1965 Aspects theory with its two key hypotheses from the Katz-Postal theory: (i) the level of Deep Structure can be the input to semantic interpretation, because (ii) all transformations preserve meaning. (Partee In Press)

Transformations from the 1960’s which preserve meaning if the examples have proper names but not if they contain quantifiers include the following; each is illustrated with a meaning-preserving example with proper names and a meaning-changing example with quantifiers.

**Pronominalization**

(7)  a. John thinks that John will win → John thinks that he will win.
    b. No runner thinks that no runner will win →[!] No runner thinks that he will win.

**Reflexivization**

(8)  a. John loves John → John loves himself
    b. Everyone loves everyone → [!] Everyone loves himself (McCawley 1970)

**Equi-NP Deletion** (the modern “PRO”)

(9)  a. John wanted John to go → John wanted to go
    b. Everyone wanted everyone to go → [!] Everyone wanted to go (Bach 1968)

**Conjunction Reduction**

(10) a. Mary is pretty and Mary is smart → Mary is pretty and smart
    b. Some numbers are even and some numbers are odd → [!] Some numbers are even and odd.

**Tough-Movement**

(11) a. To please John is hard → It is hard to please John → John is hard to please
    b. To please everyone is hard → It is hard to please everyone →[!] Everyone is hard to please.

**Historical note**

An interesting historical snapshot can be seen in the Pronominalization chapter of the book (Stockwell et al. 1973), written from 1966 to 1968 and then slightly revised and shortened for publication. That work was a big grammar of English that discussed and attempted to synthesize just about everything that had been done in transformational syntax (of English) up until late 1966, with the addition of Fillmore’s Case Grammar (Fillmore 1968) (circulated

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2 In contemporary terminology the two uses are coreferential vs. bound variable uses.

3 Bach says in a footnote, “A number of similar examples were discussed by Paul Postal at the La Jolla conference referred to above.”, referring to the 1967 La Jolla Conference on English Syntax. Postal, Bach, McCawley, Karttunen, Lakoff, and Ross all discussed and wrote about such examples around 1967-69. Linguists had discovered (Geach 1962) around then; Geach had examples from the Stoics and medieval logicians.
in 1967) and the lexicalist hypothesis of (Chomsky 1970) (circulated in early 1968). Although the linguistic wars had begun in earnest by then, we tried to stick to syntax, and to be relatively faithful to the Aspects model (Chomsky 1965), with only a few post-1966 innovations.

It is interesting to look back at the chapter on pronominalization there, for which I was the team leader. The problem examples noted above were known by then, but no good solutions. The kinds of solutions being proposed by the Generative Semanticists required a radical revision of “Deep Structure” and of the transformational operations. Bach (1968) argued for having variables in argument positions in deep structure, proposing that the deep structure for Everyone loves himself should be “Every x such that x is a person loves x”. Whether we might have sympathized with such proposals or not, it was impossible to try to incorporate such radical changes in a project like ours.

We discussed the problems raised by examples like (7b) and (8b). Our solution was to adopt rules like those of Lees and Klima (1963), without Chomsky’s referential indices, and we gave up the Katz-Postal hypothesis. We were committed to making the best grammar we could within the Aspects framework, and we that meant that some transformations must change meaning.

So we made both the pronominalization rule and the reflexivization rule optional, and the choice to apply the rule corresponded to a decision to regard the two noun phrases as coreferential⁴. The part of our discussion relevant to the present historical point is this (p. 178 in the 1973 book):

One negative reason for taking the [Lees and Klima 1963] approach, letting the reflexive rule be optional, no indices involved] was that the Index approach [of Chomsky 1965] runs into very complex problems with plural and quantified NP’s. Thus for example no simple unitary referential index feature will account properly for the following:

(44) (a) Every philosopher argues with himself.
    (b) Every philosopher argues with every philosopher.
(45) (a) Only Lucifer pities himself. (Geach 1962)
    (b) Only Lucifer pities Lucifer.
(46) (a) Most of the boys expect most of the boys to pass.
    (b) Most of the boys expect the boys to pass.
    (c) Most of the boys expect to pass.

2.2. Coreference vs. Variable Binding: A Basic Distinction

The main question in the semantics of anaphora is this: What is the semantic relation between an anaphoric expression and its antecedent? Is it always the same, or is there more than one kind of anaphora from a semantic point of view?

One relation: Coreference
When the antecedent is a proper name, as in (1a) and (5a), a natural first hypothesis is that the relation is one of coreference: the antecedent is an e-type (entity-denoting) expression that denotes (refers to) an individual, and the pronoun “picks up the reference of” its antecedent.

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⁴ The analysis did not actually claim “coreference” in all those cases, but in some ways resembled that of (Elbourne 2005); a sentence like Every philosopher argues with himself was actually derived from Every philosopher argues with the philosopher, and the choice to reflexivize would then amount to a kind of binding rather than coreference – but we purposely refrained from trying to give any semantic analyses.
Another kind of semantics: Bound variable anaphora
But we can see in examples (1e), (7b), (8b) that sometimes a pronoun is interpreted as a bound variable, not as a referring expression that is “coreferential” with its antecedent.

Does that mean that we need two different interpretation rules for pronouns?
Montague (1973): All pronouns are treated as bound variables. (including in (1a), (5a).)

What does the binding in bound variable anaphora? We’ll discuss this in Lecture 2. It’s not directly the “antecedent”; the actual binding is always done by a lambda-operator!

Argument for two different interpretation rules: the strict-sloppy identity problem. The problem was introduced in (Ross 1967 [1986]) and solved by several authors around 1970.
Sentence (12) has one obvious ambiguity – “his” can mean “John’s”, or it can refer to someone else we’ve been talking about, for instance Max. Such an ambiguity is sometimes noted as follows, making use of “referential indices”:

(12) John \(_i\) loves his \(_{ij}\) wife. (I.e. his can have the same “referential index” as John or a different one.)

But the ambiguity of (13) raises a further puzzle. (13) involves “VP (Verb Phrase) anaphora”: “so does” is anaphoric to the VP of the first sentence, “loves his wife”.

(13) John loves his wife and so does Bill. Possible interpretations:
   (i) John loves Max’s wife, and Bill loves Max’s wife. ("loves his\(_j\) wife", he\(_j\) = Max)
   (ii) John loves John’s wife, and Bill loves John’s wife. ("loves his\(_i\) wife", he\(_i\) = John )
   (iii) John loves John’s wife, and Bill loves Bill’s wife. (?? “loves self’s wife”? )

The contrast between (ii) and (iii) arises even when we understand the first clause to say that John loves John’s wife. Is that first clause actually ambiguous? In what way?

The readings in (i) and (ii) are called “strict identity” readings, and (iii) “sloppy identity”. Why “sloppy”? (It’s J.R. ("Haj") Ross’s term, from his classic dissertation.) Because there isn’t always exact morpho-syntactic identity; cf. (14).

(14) John can stand on his head, and Mary can too. (= “can stand on her head too”)

McCawley (1967), (Keenan 1971), and others\(^5\) argued that so-called “sloppy identity” is strict semantic identity involving bound variable readings of pronouns.

There is much more history about VP-deletion and strict vs. sloppy identity (see my RGGU 2008 course, lecture 15, for a brief summary and some references), but on one approach which was advocated by semanticists in the 1970’s and 80’s, there are two different interpretations for the VP in the first clause of (13ii) and of (13iii), namely (15a) and (15b); in each case the second clause is interpreted as predicating that same property of Bill.

(15) a. \(\lambda x \ [\text{likes} (x, \text{wife-of} (\text{john}))]\) (strict; referential or ‘free variable’ pronoun)
    b. \(\lambda x \ [\text{likes} (x, \text{wife-of} (x))]\) (sloppy; bound variable pronoun)

Conclusions:
Syntactic “sloppy identity” is semantic strict identity with bound variable pronoun.
Syntactic “strict identity” is semantic strict identity with coreferential pronoun.

Pragmatic anaphora

Partee (1978) argued that “coreferential” anaphora should be viewed as just one subcase of a more general phenomenon of “pragmatic anaphora”, unifying examples like (1a), (2) and (16) below as a variety of ways in which a pronoun can get its reference “from the context”, including both linguistic and non-linguistic context (antecedent in same sentence, different sentence, or not in a sentence at all.)

(16) I couldn’t reach Elliot last night. He is probably in Boston.

Partee (1978) argued:

Where I do want to draw a sharp line is between the bound variable use and the pragmatic use of pronouns. The bound variable use is best described at the level of syntactic form and semantic interpretation of single sentences, and the relevant question is not what the pronoun refers to, but what quantifier phrase [in later work: or lambda operator] is binding it. The pragmatic use is best described at the pragmatic level, where the full context of the sentence in use is considered; on the syntactic level, these pronouns are really no different from proper names, and at the semantic level, they can be viewed as free variables or as dummy names. (p.112 in 2004 reprint; p.3 in the pdf file.)

This is not an entirely standard position, but it is close in spirit to Reinhart’s work (Grodzinsky and Reinhart 1993, Reinhart 1976, 1983a, 1983b, 1993); see also (Bach and Partee 1980, Partee and Bach 1981). In any case, every theory has to have something to say about the basic differences between “coreferential anaphora” and “bound variable anaphora”, and every theory has to have something to say about the relation between the anaphoric use(s) of pronouns and their “free” uses.

2.3. Syntax, Semantics, Pragmatics.

Early transformational grammar: Sentence grammar only. Anaphora treated only inside the sentence, based on syntactic identity (Lees & Klima 1963). Chomsky 1965 added referential indices -- $John_i$ – with the idea that syntactic identity = semantic coreference.

Then came the semantic recognition that coreference and bound variable anaphora are very different phenomena, and the realization that they have different syntactic constraints. Some of the strongest linguistic arguments for limiting sentence-grammar to dealing with bound variable anaphora came from Tanya Reinhart (1983a, 1983b). Strong constraints concerning c-command, etc., can be found for bound variable anaphora, but much less clearly so for coreferential anaphora. A good reference is (Büring 2004).

And the need to bring pragmatics into the picture comes particularly clearly from thinking about “deictic” or “demonstrative” uses of pronouns.

(17) Who is HE? (pointing or gesturing to the referent)

A deictic or demonstrative expression has no “antecedent”. For felicitous use, the speaker must make the referent salient. We can think of the pronoun then as a free variable for which the context provides a suitable assignment, which the speaker should indicate by some explicit or implicit gesture.

Then it is only a small step to thinking similarly about anaphoric, non-deictic, uses of pronouns with no overt antecedent, or with only an indirect relation to some prior linguistic expression, as in examples (2) and (3) above. Coreferential anaphoric pronouns can then be
just a special case of such “pragmatic” pronouns, as argued in (Partee 1978). And apparently the Stoics made such a unification, according to the Egli quotes above.

**Conclusions:** Bound variable anaphora belongs to sentence-level syntax and semantics. Coreferential anaphora belongs to discourse-level (syntax?,) semantics and pragmatics.

**For next time:** Next time we will look more explicitly at variables and variable-binding, including a little bit of the lambda calculus, so that we can say more about how bound variable anaphora works, and so that we can describe two basically different possible ways of looking at how reflexives do what they do. We’ll close lecture 2 with a set of puzzles about kinds of pronouns that don’t fit the basic canonical classification of coreference vs. bound variables. Those puzzles will set the stage for discussion of the Kamp-Heim theories that led to the dynamic turn in semantics.

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