Semanticists have tended to concentrate their efforts on the production of a "sentence-level" semantics (i.e. an assignment of meanings to all the individual sentences of a language). Surely that is the proper starting point for semantics. Yet as the following discourse fragments illustrate, what is expressed by a given sentence – token in a given discourse is often partly determined by the discourse itself:

(F1) (1) Every doctor$_i$ in the Cardiff clinic employs a receptionist$_j$.
   (2) The receptionist$_j$ must record every message$_k$ that comes in for the doctor$_i$.
   (3) The receptionist$_j$ must then inform the doctor$_i$ of the message$_k$ at the appropriate time.
   (4) Suppose, for example, the message$_k$ concerns what the doctor$_i$ is to bring home for dinner.
   (5) The receptionist$_j$ will not bother the doctor$_i$ with the message$_k$ until the doctor$_i$ has some free time.
   (6) Suppose, by contrast, the message$_k$ concerns a patient's reaction to some medication the doctor$_i$ prescribed.
   (7) The receptionist$_j$ may well interrupt the doctor$_i$ to deliver it$_k$.
   (8) The receptionist$_j$ is provided with an office$_m$.
   (9) It$_m$ comes with a typewriter.
   (10) Every lawyer in Cardiff employs a receptionist$_n$ too.
   (11) But the doctor's receptionist$_j$ makes more money than the lawyer's receptionist$_n$.

(F2) (1) Every cop$_i$ knows an informer$_j$.
   (2) The informer$_j$ gives the cop$_i$ tips.
(3) *The cop* overlooks the informer's minor crimes.

(4) Suppose the informer helps the cop prevent a murder.

(5) Then suppose that the cop pulls the informer over for reckless driving.

(6) *The cop* will give the informer a breath test.

(7) But if it is positive, the cop won't arrest the informer.

(8) Or suppose the informer tells the cop who is behind a big drug deal.

(9) *The cop* might ignore the informer's use of drugs.

(10) In general, the informer's information is more important than his crimes.

That the sentence – token (F1-9), for example, expresses whatever it does express in (F1) is at least partly due to features of (F1) itself. The skeptic can be convinced of this by contrasting the import of (F1-9) with that of line (4) in the following discourse:

(F3) (1) As you know, each contestant on "Let's Deal" receives a wonderful prize.

(2) The prize includes a set of office furniture.

(3) The furniture is made of solid oak.

(4) It comes with a typewriter.

(F1-9) and (F3-4), though tokens of the same sentence, express quite different claims due to differences in (F1) and (F3), viz: (F1-9) expresses the claim that every doctor in the Cardiff clinic employs a receptionist who must record every message the doctor receives and inform the doctor of the message at the appropriate time and who is provided with an office that comes with a telephone; whereas (F3-4) expresses the claim that every contestant on "Let's Deal" receives a prize which includes a set of solid oak office furniture which comes with a typewriter. Similar reasoning shows that the import of each of the sentence – tokens in the above discourses containing an underlined occurrence of a pronoun or definite description is partially determined by features of the discourse it occurs in. Changing appropriate features of these discourses changes the import of the sentence – tokens in question.

Phenomena such as this demonstrate the need for something
other than sentence-level semantics. What is needed is an account of exactly how discourse structure affects the import of sentences occurring in the discourse. Of course there are various mechanisms by which this occurs; and the underlined pronouns/descriptions in (F1)–(F3) represent only one such mechanism. Thus the present paper, which attempts to construct an account of this latter mechanism, can be viewed as a step towards the production of a comprehensive semantics of discourse.

The underlined occurrences of pronouns and descriptions in (F1)–(F3) are examples of what linguists and philosophers of language call anaphoric pronouns/descriptions. We shall not need a rigorous definition of this term for our purposes. It is enough if the reader appreciates that an anaphoric pronoun or definite description is an occurrence of a pronoun or description that, in some sense, "looks back" to another occurrence of an expression in its linguistic environment. This latter expression—occurrence is usually called the antecedent of the anaphoric pronoun/description in question.

The anaphoric pronouns/descriptions in (F1)–(F3) are rather novel for several reasons. First, their antecedents are quantifier phrases which occur in sentences other than those in which the anaphoric pronouns/descriptions themselves occur. Second, in some cases the quantifier antecedent doesn't have wide scope in the sentence it occurs in (e.g. 'The receptionist' in (F1-2) is anaphoric to 'a receptionist' in (F1-1) which takes narrow scope with respect to 'Every doctor' in (F1-1)). Third, in some cases a sentence contains pronouns/descriptions anaphoric to quantifier phrases in different sentences (e.g. (F1-1) contains a description anaphoric to a quantifier in (F1-10) and a description anaphoric to a quantifier in (F1-1)). Finally, some sentences contain pronouns/descriptions anaphoric to quantifiers in previous sentences as well as quantifiers which serve as antecedents for pronouns/descriptions in subsequent sentences (e.g. (F1-3)). The author knows of no semantic theory capable of handling such anaphoric phenomena.

Rather than attempting to construct a semantic theory of these anaphoric pronouns/descriptions right off, we do better first to consider a simple device by means of which discourse structure affects the import of sentences in the discourse. Getting clear about this
simple device will prove to be good preparation for tackling the pronouns/descriptions in (F1)–(F3). The device I wish to consider is that of temporary supposition. Let us look at the following discourse:

(F4) (1) There is a crazed killer in the hallway leading to Charlie’s apartment.
(2) And Sue’s house was just hit by a bomb.
(3) Now we know that Jay is either at Charlie’s apartment or Sue’s house.
(4) Suppose Jay is at Charlie’s apartment.
(5) Then he has walked down the hallway to the apartment.
(6) So the crazed killer got Jay.
(7) Suppose, on the other hand, he is at Sue’s.
(8) Then the bomb killed Jay.
(9) It appears that Jay is dead.

Each of the two suppositions (lines 4 & 7) governs a stretch of discourse in (F4). Sentences occurring in a stretch of discourse governed by one of these suppositions must not be taken as being unconditionally asserted. For example, sentence (6), as it occurs in (F4), is not being used to express the (unconditional) claim that the crazed killer got Jay. Someone who, upon hearing this discourse, takes (6) to assert the (unconditional) claim that the crazed killer got Jay will have misunderstood that utterance. (F4-6) should rather be taken as asserting that, on the assumption that Jay is at Charlie’s apartment, the crazed killer got Jay. It is in just this way that temporary suppositions affect the import of utterances occurring in the stretches of discourse they govern. And certainly which suppositions govern which stretches of a discourse is a structural feature of the discourse. Indeed we can make this structural feature perspicuous by borrowing the scope lines common to many systems of natural deduction and inserting them appropriately into the discourse. In the case of (F4), we get:

(1) There is a crazed killer in the hallway leading to Charlie’s apartment.
(2) Sue’s house was just hit by a bomb.
(3) Jay is either at Charlie’s apartment or Sue’s house.
Suppose he is at Charlie’s apartment. 
Then he has walked down the hallway to the apartment. 
So the crazed killer got Jay. 
Suppose, on the other hand, he is at Sue’s house. 
Then the bomb killed Jay. 
It appears that Jay is dead.

These scope lines enhance the readability of a discourse by allowing us to quickly determine which suppositions govern which stretches of the discourse, and thus to quickly calculate the intuitive import of a given utterance in the discourse. Looking at the following discourse with scope lines inserted, for example,

1. Professor Jones is very patient.  
2. Suppose she has a student who is having trouble.  
3. She tries to help the student during office hours.  
4. She doesn’t just let the student flounder.  
5. And suppose that the instruction during office hours doesn’t help.  
6. Then Professor Jones will set up extra meetings.  
7. She will also make the student do some extra homework.  
8. Professor Jones really goes out of her way.

it is easy to see that the import of (6) is that if Professor Jones has a student who is having trouble and who isn’t helped by instruction during office hours, she will set up extra meetings.

Perhaps I seem to belabor the obvious. But here we have a clear and very simple case in which structural features of a discourse affect the import of utterances in the discourse. Understanding a given utterance in such a discourse requires a hearer to have grasped certain structural features of the discourse in which the utterance occurs.

Consider now an English argument which invokes quantificational rules of inference.

(F5) Premise 1: Every dog loves at least one cat.  
Premise 2: Every cat loves every dog which loves it.  
3. Take any dog.  
4. By (1), it loves at least one cat.
(5) Take the cat the dog loves.
(6) By (2), the cat loves the dog.
(7) Thus every dog is loved by at least one cat.

The first thing to notice is that the italicized pronouns/descriptions here have the same sort of semantic significance as those italicized in (F1)–(F3) have. The pronouns/descriptions italicized in (F1)–(F3) have the force of existential and universal quantifiers. For example, (F1-2) makes the claim that every doctor in the Cardiff clinic employs a receptionist who has certain responsibilities. Thus, in (F1-2) 'the doctor' has the force of a universal quantifier, and 'the receptionist' has the force of an existential quantifier (in the scope of a universal quantifier). Similarly, in (F5) occurrences of 'it' and 'the dog' have the force of universal quantifiers; and 'the cat' has the force of an existential quantifier (in the scope of a universal quantifier). For the speaker who utters (F5-6) (having uttered lines 1–5) is committed to the claim that every dog is loved by at least one cat. Given these similarities, we might expect a single account to capture the semantic behavior of the pronouns/descriptions in (F1)–(F3) and those in (F5).

As in (F1)–(F3), the pronouns/descriptions in (F5) have the peculiar semantic significance they do in virtue of features of the discourse they are embedded in. In particular, consider sentences (3) and (5) in (F5). Sentence (3) marks the beginning of an application of "English universal generalization" which is completed at line (7); sentence (5) marks the beginning of "English existential instantiation" which also is completed at line (7). Such sentences mark the fact that information about particular dogs and cats cannot be invoked in subsequent reasoning. And it is clear that the occurrences in (F5) of 'it' and 'the dog' on the one hand, and 'the cat' on the other, have the quantifier-like significance they have in (F5) in virtue of occurring subsequent to, and being somehow connected to, the sentences 'Take any dog' and 'Take the cat the dog loves' respectively. We shall call sentences such as the latter (and others which serve the same role – e.g. 'Let ___ be an arbitrary ___, etc.) announcements.

Like temporary suppositions, announcements govern stretches of
discourse and affect the import of sentences occurring in the stretches they govern. Unlike suppositions, they achieve this by endowing certain singular terms (pronouns, descriptions, etc.) occurring in the stretches of discourse they govern with a quantifierlike semantic significance. Here again, we can use scope lines to make explicit which announcements govern which stretches of discourse. We shall use dashed scope lines here to distinguish those headed by suppositions from those headed by announcements. Inserting scope lines into (F5), for example, we get the following:

(F5a) (1) Every dog loves at least one cat.
    (2) Every cat loves every dog which loves it.
    (3) \( \text{Take any dog.} \)
    (4) \( \text{By (1), it loves at least one cat.} \)
    (5) \( \text{Take the cat the dog loves.} \)
    (6) \( \text{By (2), the cat loves the dog.} \)
    (7) Thus every dog is loved by at least one cat.

As before, the scope lines help us to determine the import of the utterances in the discourse. Line (6), for example, is clearly governed by the announcements at lines (3) and (5). This, in turn, tells us that both 'the cat' and 'the dog' in line (6) are to be given the quantifierlike significance that we noted earlier. Further, the fact that the announcement at line (5) is subordinate to the announcement at line (3) gives us information that we require to correctly read line (6). As was said earlier, the import of line (6) is that every dog is loved by at least one cat. Thus 'the dog' has the force of a universal quantifier with \textit{wide scope} and 'the cat' has the force of an existential quantifier with \textit{narrow scope}. It is the subordination of the announcement at line (5) to the announcement at line (3) which tells us to read 'the dog' much as a quantifier with wide scope and 'the cat' as a quantifier with narrow scope. For consider the following argument:

(F6) (1) At least one cat is loved by every dog.
    (2) Every cat loves every dog which loves it.
    (3) \( \text{Take the cat which every dog loves.} \)
    (4) \( \text{Take any dog.} \)
    (5) \( \text{By (3) the dog loves the cat.} \)
By (2) the cat loves the dog.

Thus, at least one cat loves every dog.

Line (6) in (F6) is an occurrence of the same sentence as occurs at line (6) in (F5). Yet a speaker asserting (F6-6) (having uttered (1-5)) would be committed to the claim that at least one cat loves every dog. Thus in (F6-6) 'the cat' has the force of an existential quantifier with wide scope and 'the dog' has the force of a universal quantifier with narrow scope. This is because in (F6) the announcement associated with ‘the dog’ (line (4)) is subordinate to the announcement associated with ‘the cat’ (line (3)).

So the scope lines in (F5a) and (F6) help us read utterances in those discourses correctly by: (i) showing us exactly which announcements (and temporary suppositions) govern which portions of the discourse; and (ii) by showing us the order of subordination of the announcements (and suppositions). Of course this doesn’t tell us how announcements and suppositions work in actual English discourses (without scope lines). For I haven’t discussed, and won’t discuss here, the clues present in an English discourse which tip off the audience to the structural features which we have formally represented by means of scope lines. So for the present, questions such as What tells a speaker whether an announcement signals the beginning of EI or UG? What tells a speaker which stretch of discourse an announcement or a supposition governs? remain unanswered. My claim is that to understand an utterance in a discourse of the sort under consideration, a speaker must grasp certain structural features of that discourse. Scope lines, dashed and solid, simply are a means of providing a graphic formal representation of these structural features.

It is worth mentioning that scope lines are a rather crude device for formally representing which announcements and suppositions govern which utterances in a discourse. Imagine someone saying:

Suppose Russia attacks the U.S.
The U.S. would have to retaliate.
Of course we all know that our current stock of missiles is
While both (2) and (4) are to be taken as asserted only on the condition specified in (1), (3) seems to be asserted *unconditionally*. Representing the dependency of (2) and (4) on (1) with a scope line, (while retaining the order in which the sentences actually occurred in the discourse) requires us to insert the scope line as follows:

(1) Suppose Russia attacks the U.S.
(2) The U.S. would have to retaliate.
(3) Of course, we all know that our current stock of missiles is obsolete.
(4) So we wouldn't destroy much of anything in Russia.

But this makes it appear as though (3) is to be understood as being asserted on the condition that (1). There is no way to tell that we intend (2) and (4), but not (3), to be understood on the supposition that (1). To avoid this, we would need a more subtle device for registering whether a given line in a discourse is governed by a given announcement or supposition. Ideally, we would like a device which would allow us to indicate *for each line separately* the announcements and suppositions governing it. Benson Mates makes use of such a device for recording dependency on suppositions in his system of natural deduction.\(^6\) We could adopt a similar device suited to our purposes and dispense with the scope lines. But for present concerns, the crudity of the scope lines is outweighed by their perspicuousness. Thus we shall stick with them.

Having discussed English UG and EI, we can formulate versions of UG and EI for a system of natural deduction which resemble their English counterparts more closely than is usual. We shall formulate these rules for a formal system whose language has individual parameters as well as individual constants. The individual parameters shall be the singular terms used in applications of EI and UG.\(^7\) Let \(\phi\) and \(\psi\) be formulas, \(\beta\) a variable and \(\alpha\) an individual parameter:
We shall add, as a general constraint on derivations, that an individual parameter $\alpha$ can occur only in a formula subordinate to a dashed scope line headed by $E\alpha$ or $U\alpha$. An array of formulas failing to conform to this requirement shall not qualify as a derivation of our system. Like announcements in English arguments, the headings $E\alpha$ and $U\alpha$ serve to indicate that occurrences of appropriate singular terms in the stretches of discourse they govern are to be given a quantifier-like semantic significance. Because of this similarity of function, we shall call the headings $E\alpha$ and $U\alpha$ announcements as well.

Earlier we mentioned the similarity in semantic behavior between pronouns/descriptions such as those underlined in (F5) and the pronouns/descriptions underlined in (F1)-(F3). And we have now seen how scope lines headed by suppositions and announcements can be used to formally represent those structural features of a discourse that affect the semantic significance of pronouns/descriptions such as those in (F5). Thus, the idea of using such scope lines to the same effect in (F1)-(F3) suggests itself. Consider the result of inserting scope lines into (F2):

(F2a) (1) Every cop knows an informer
(2) $U v$
(3) $v$ is a cop.
(4) $E u$
(5) $u$ is an informer $v$ knows.
(6) $u$ gives $v$ tips.
(7) v repays u by overlooking u’s minor crimes.
(8) u helps v present a murder.
(9) v pulls u over for reckless driving.
(10) u will give v a breath test.
(11) E_w
(12) w is a breath test and u gives w to v.
(13) If w is positive, u won’t arrest v.
(14) u will give v a ticket.
(15) u tells v who is behind a big drug deal.
(16) v might ignore u’s use of drugs.
(17) In general u’s information is more important than u’s crimes.

Occurrences of ‘u’, ‘v’ and ‘w’ represent occurrences of the pronouns/descriptions under study. Prior to the first occurrence of each of these “pronouns/descriptions” is an announcement announcing that pronoun/description. If the announcement of α is universal (i.e. Uα), a supposition containing an occurrence of α subordinate to the announcement tells us what domain subsequent occurrences of α will range over. Thus lines (2) and (3) of (F2a) tell us that subsequent occurrences ‘v’ will range universally over cops (i.e. subsequent sentences containing occurrences of ‘v’ will make claims about every cop). If the announcement of α is existential, the sentence immediately following the announcement Eα specifies the domain within which subsequent occurrences of α will have existential force. For example, lines (4) and (5) tell us that subsequent sentences containing occurrences of ‘u’ will make claims about some informer v knows. Notice that the announcement at (4) is subordinate to the one at (2). Recall that in arguments (and derivations) the order of subordination of announcements determined the required order of semantic treatment of the singular terms announced. Thus if ‘Eu’ were subordinate to ‘Uv’, ‘v’ would have the force of a quantifier with wide scope with respect to ‘u’. Here the order of subordination of announcements will serve the same function. We therefore have to insure that in the above case ‘Eu’ is subordinate to ‘Uv’; for ‘v’ at line (6) must be read as if a quantifier with wide scope, and ‘u’ as taking narrow scope.
Once we are used to focusing on the appropriate features, we are able to quickly interpret the “pronouns/descriptions” and thus determine the intuitive import of a “sentence” in a discourse with announcements and suppositions inserted. In order to produce a systematic account of the behavior of the pronouns/descriptions under study, then, we need to assign truth conditions to each utterance in each discourse such that the truth conditions so assigned capture the intuitive claim someone would make in uttering that utterance in that discourse. On this plan, (F1-9) and (F3-4) would be assigned different truth conditions owing to the different claims those utterances make.  

One way to assign such truth conditions to these utterances is to characterize a method of mechanical translation: viz. a method which, given an occurrence of a sentence $S$ in a discourse, effectively translates $S$ into $S'$ such that the truth conditions of $S'$ outside of any context are the intuitive truth conditions of $S$ as it occurs in the discourse. Though motivated by concerns other than ours, Quine has outlined something like such a method of translation. For a system of natural deduction with EI and UG formulated as in the previous pages, one translational scheme runs as follows. If $S$ at line $i$ in $F$ is subordinate to no temporary suppositions or announcements, $S$'s translation at $i$ in $F$ is $S$ itself. If $S$ at $i$ is subordinate to at least one temporary supposition or announcement, consider the scope line to which $S$ is immediately subordinate (i.e. the scope line to the immediate left of $S$ at $i$). If this scope line marks a temporary supposition, form the conditional $A \rightarrow S$, where $A$ is the formula heading the scope line in question. If this scope line marks an announcement $U\alpha$, form the formula $(\beta)S\beta/\alpha$ (where $\beta$ is an individual variable not occurring in $S$). If this scope line marks an announcement $E\alpha$, form the formula $(\exists\beta) (A \& S) \beta/\alpha$ (where $A$ is the formula resulting from stripping off an existential quantifier from the formula to which EI was applied when the announcement $E\alpha$ was entered and substituting occurrences of $\alpha$ for variables bound by this quantifier, and $\beta$ is a variable occurring in neither $A$ nor $S$). Call the result of this first step of translation $S_1$. If $S$ at $i$ is subordinate to no scope line other than that to its immediate left, $S_1$ is the translation of $S$ at $i$ in $F$. If there are others, consider the scope line to which *the scope*
line to the immediate left of $S$ at $i$ is immediately subordinate. Repeat the translational moves outlined above (depending on what heads this scope line) with regard to $S_1$. Continuing in this manner until each of the scope lines to which $S$ at $i$ is subordinate has made its contribution, we end up with the translation of $S$ at $i$ in $F$. It should be fairly clear that the truth conditions of the formula we end up with are those of $S$ as it occurs at $i$ in $F$.

Though this method is beyond reproach so far as the truth conditions it assigns are concerned, there is reason to take another tack. The translational scheme we have described does not capture certain features of the semantic behavior of the pronouns/descriptions under study. "Locally" we manipulate such singular terms as if they are names. For example, when we move from a line in an argument which is governed by certain suppositions and announcements to another line governed by the same suppositions and announcements, (and so don't "change contexts") we treat the pronouns/descriptions under study as if they are names. In particular, inferences involving names can be carried through with our pronouns/descriptions. One can use these pronouns/descriptions as the instantial singular terms in universal instantiation (this occurs at line (6) in (F6)), and one can existentially generalize on them. Thus one could say after (F1-11): 'So someone makes more money than the lawyer's receptionist', existentially generalizing on 'the doctor's receptionist'. "Globally", however, we don't understand such pronouns/descriptions as names at all. In the first place, when we step back and look at the setting of sentences containing such pronouns/descriptions in discourses and consider the intuitive import of the sentences, we read the pronouns/descriptions as expressing generality. Further when we invoke rules which allow us to move from a line in an argument governed by certain announcements to a line governed by different announcements (thus "changing contexts"), our pronouns/descriptions don't behave as names at all. In particular, one uses such pronouns/descriptions as the instantial singular terms in EI and one can universally generalize on them, (as occurs in the move from line (6) to line (7) in (F5)).

The translational semantics described above gives no semantical explanation of any of this. What we would like is a semantics which makes sense of the local name-
like behavior of our pronouns/descriptions and their global behavior.\textsuperscript{11}

In order to sidestep difficulties not germane to the aims of the present effort, we shall produce a semantics for discourses constructed out of sentences of a formal language. We shall use the language outlined by Richmond Thomason but shall call the language $L$.\textsuperscript{12} As before, occurrences of individual parameters shall represent occurrences of pronouns/descriptions such as those underlined in (F1)–(F3). The rules of construction for our discourses shall be as follows. (1) A formula containing no individual parameters may be entered at any point in the discourse. (2) An individual parameter not previously announced in a given discourse may be announced at any point in the discourse. (3) Temporary suppositions may be made at any point, so long as the formula supposed occurs subordinate to each announcement announcing an individual parameter occurring in it. (4) Formulas containing individual parameters must be entered subordinate to each announcement announcing an individual parameter occurring in them. Using these rules, we can generate analogues of discourses such as (F1)–(F3). An analogue of (F3), for example, would run as follows:

(F3a) \( (1) (x) \ (Cx \rightarrow (Ey) \ (Py \ & \ Rxy) \)

\( (2) \ Uv \)

\( (3) \ Cv \)

\( (4) \ Eu \)

\( (5) \ Pu \ & \ Rvu \)

\( (6) \ (Ex) \ (Ox \ & \ Iux) \)

\( (7) \ Ew \)

\( (8) \ Ow \ & \ Iuw \)

\( (9) \ Sw \)

\( (10) \ (Ex) \ (Tx \ & \ Bxw) \)

(with ‘C____’ for ‘____ is a contestant on “Let’s Deal”’; ‘P____’ for ‘____ is a wonderful prize’; ‘R____ ____’ for ‘____ receives ____’; ‘O____’ for ‘____ is some office furniture’; ‘I____ ____’ for __ includes ____’; ‘S____’ for ‘____ is made of solid oak’; ‘T____’ for ‘____ is a typewriter’; ‘B___ ____’ for ‘____ comes with ____’).

Line (6) of (F3a) corresponds to line (2) of (F3), line (9) of (F3a) corresponds to line (3) of (F3) and so on. The semantics we formulate
shall assign intuitively correct truth conditions to the lines of such discourses and to the lines of derivations of a system of natural deduction whose UG and EI rules are formulated as indicated several pages back. Indeed our semantics will serve to justify the rules of such a system by showing the derivations of the system to be sound at every line. Thus a single account will handle both the pronouns/descriptions in (F1)–(F3) and those in (F5)–(F6), as we thought it should.

We have emphasized how scope lines headed by suppositions and announcements enable us to correctly read the sentences/formulas of our discourses. We now need to encode information concerning the suppositions and announcements a given occurrence of a formula in a discourse depends on in a way that will facilitate the construction of a semantic theory of all of this. The simplest way to do this is to define the context of the formula A at i in F to be an n-tuple, the elements of which are the suppositions and announcements A at i depends on. In particular, the first member of the n-tuple comprising the context of A at i in F shall be the first supposition or announcement to occur in F which governs A at i. The second member of the n-tuple is the second such supposition or announcement to occur in F, and so on until we reach the supposition or announcement to which A at i is immediately subordinate (i.e. the supposition or announcement heading the scope line to the immediate left of A at i). This latter shall be the nth element of the n-tuple which is the context of A at i in F. The context of ‘Sw’ at line (9) in (F3a), for example, is ⟨Uv, Cv, Eu, Ew⟩. Before proceeding with the rest of the semantics, we must address a minor complication. Consider the following discourse fragment:

(F7) (1) Some prime number is greater than two million.
(2) It is less than three million.
(3) Its final digit is a seven.

Intuitively sentence (2) is true in (F7) just in case there is a prime number less than three million and greater than two million. So the predicative material in sentence (1) (‘— is a prime number greater than two million’) is relevant to the import of sentence (2). But what about (3)? The view that only the predicative material in
(1) affects (3)'s import in (F7) (as is the case in (2)) leads to the claim that (3) is true in (F7) just in case there is a prime number greater than two million whose final digit is a seven. But then, given what we have said about (2), all the sentences of (F7) would be true if (e.g.): there is a prime number greater than two million and less than three million and there is a prime number greater than two million whose final digit is a seven, but no prime number is greater than two million, less than three million and has seven as its final digit! This is obviously incorrect. The sentences of (F7) should not all be true unless some prime number whose final digit is seven is greater than two million and less than three million. This observation suggests that we see the predicative material in both (1) and (2) as relevant to the import of (3) in (F7).\(^{16}\) On this view, (F3-7) expresses the claim that some prime number is greater than two million, less than three million and has seven as its final digit. Thus it is that other sentences occurring in a discourse (which are not temporary suppositions) may be relevant to the truth conditions of a sentence A at i in F. To accommodate this fact, in defining the truth conditions of A at i in F we shall have to consider not merely A and the suppositions and announcements it depends on, but sets of formulas which occur in F. Toward this end, we introduce the following sets of formulas: Let the context of A at i in F be \langle c_1, \ldots, c_n \rangle. Then for \(k\) such that \(1 \leq k \leq n\)

\[
(A_{i,F})_k = \{B \mid B \text{ contains an occurrence of an individual parameter announced in } F \\
\text{by } E\alpha \text{ and } B \text{ occurs prior to } i \text{ other than as a supposition in } F \text{ immediately subordinate to the scope line headed by } c_k \}
\]

For an occurrence of A at i in F whose context in \langle c_1, \ldots, c_n \rangle, this definition obviously characterizes \(n\) sets of formulas (though an arbitrary number of these can, of course, be the empty set). For each \(c_k\), the set \((A_{i,F})_k\) is the set of formulas immediately subordinate to \(c_k\) containing a parameter \(\alpha\) announced by \(E\alpha\). To illustrate, looking at (F3a) and considering 'Sw' at line (9) and its context \langle Uv, Cv, Eu, Ew \rangle: \((Sw_{9,(F3a)})_4 = \{O\omega \& Iu\}\); \((Sw_{9,(F3a)})_3 = \{Pu \& Rv, (Ex)(O\omega \& Iu)\}\); \((Sw_{9,(F3a)})_2 = \{\}\), etc.

An interpretation of our language is a pair \langle D, f \rangle where D is a set of objects and f is a function such that (i) if a is an individual
constant of our language, \( f(a) \in D \); and (ii) if \( P^0 \) is a zero-place predicate of our language \( f(P^0) = T \) or \( F \); and (iii) if \( P^n \) is an \( n \)-place predicate of our language, \( f(P^n) \subseteq D^n \). An extended interpretation is a pair \( \langle D, f \rangle, g \rangle \) where \( \langle D, f \rangle \) is an interpretation and \( g \) is a function such that if \( u \) is an individual parameter of our language, \( g(u) \in D \).

The definition of truth under an interpretation is standard, except that because interpretations don’t assign anything to individual parameters, formulas containing occurrences of individual parameters are neither true nor false under interpretations. Such formulas will be true or false under extended interpretations. 17

Several pages back I suggested that pronouns/descriptions such as those underlined in (F1)–(F3) and (F5), and thus the sentences containing them, have both a local and a global reading. That was actually a bit of an oversimplification. Consider a formula/sentence \( A \) at line \( i \) in \( F \) (henceforth \( A_{i,F} \)) and its context \( \langle c_1, \ldots, c_n \rangle \). That the context of \( A_{i,F} \) has \( n \) elements indicates that \( A_{i,F} \) is subordinate to \( n \) suppositions and announcements. This in turn means that there are \( n + 1 \) different levels on which to understand \( A_{i,F} \) or \( n + 1 \) different readings! For I can read \( A_{i,F} \) “completely locally”, as it were, not taking cognizance of any of the suppositions and announcements governing \( A_{i,F} \). I read a sentence in this way, for example, if I am engaged in the construction of an argument and am not ready to conditionalize, universally generalize nor complete existential instantiation, but am trying to reach the point at which I do one of these. Here I ignore the larger context and concentrate on what I have, and what I need to get, locally. In so doing I need not even be aware of which suppositions and announcements the sentence depends on. Or I can, in effect, take “one step back”, noting the supposition or announcement to which \( A_{i,F} \) is immediately subordinate (while ignoring the others) and read \( A_{i,F} \) accordingly. I can then take another “step back”, if I wish, and so on. Or finally, I can take account of the entire context in which \( A_{i,F} \) is embedded, reading \( A_{i,F} \) “completely globally”. This reading will represent the claim a speaker intuitively makes in uttering \( A_{i,F} \).

If this is correct, as I think it is, our semantics needs to capture not merely a local and a global reading of \( A_{i,F} \) in \( \langle c_1, \ldots, c_n \rangle \), but
rather these \(n + 1\) different readings. To achieve this, given \(A_{i,F}\) and its context \(\langle c_1, \ldots, c_n \rangle\) we define \(n + 1\) levels of information as follows (recall the sets of formulas \((A_{i,F})_n, (A_{i,F})_{n-1}\), etc. discussed a few pages ago):

1. The 0th level of information given by \(A_{i,F} = \{I | I\) is an extended interpretation of \(L\) and \(A\) is true under \(I\)\}
2. The \(m + 1\)st level of information given by \(A_{i,F} (0 \leq m \leq n - 1) = \)
   - case (a): \(c_{n-m}\) is a formula: \(\{I | I\) is an extended interpretation and \(I )m\)th level of information given by \(A_{i,F}\) and each member of \((A_{i,F})_{n-m}\) is true under \(I\), or \(c_{n-m}\) is false under \(I\)\}
   - case (b): \(c_{n-m}\) is Ex: \(\{I | I\) is an extended interpretation of \(L\) and \(I )m\)th level of information given by \(A_{i,F}\) and each member of \((A_{i,F})_{n-m}\) is true under \(I\), or \(I'\) is an extended interpretation and \(I' )m\)th level of information given by \(A_{i,F}\) and each member of \((A_{i,F})_{n-m}\) is true under \(I'\) and \(I\) is exactly like \(I'\) except at most in what \(I'\) assigns to \(\alpha\)\}
   - case (c): \(c_{n-m}\) is U\(\alpha\): \(\{I | I\) is an extended interpretation and \(I )m\)th level of information given by \(A_{i,F}\) and each member of \((A_{i,F})_{n-m}\) is true under \(I\) and every \(I'\) exactly like \(I\) except in what it assigns to \(\alpha\) belongs to the \(m\)th level of information given by \(A_{i,F}\) and each member of \((A_{i,F})_{n-m}\) is true under \(I'\)\}

Note that at 0th level of information given by \(A\) at \(i\) in \(F\), all individual parameters are treated semantically just like individual constants. This captures the local name-like reading of the individual parameters. But when an announcement is encountered in forming some higher level of information given by \(A\) at \(i\) in \(F\), the individual parameter it announces is treated semantically as an expression of generality. (See cases (b) and (c) under 2 above). So the various levels of information given by \(A\) at \(i\) in \(F\) capture the various more or less local and global readings of \(A\) at \(i\) in \(F\).

The definition of truth in a discourse assigns to each line in each discourse truth conditions which capture the claim a speaker intuitively makes in uttering that line (i.e. the "completely global" reading). If \(\langle D, f\rangle\) is an interpretation of \(L\), call \(\langle \langle D, f\rangle, g \rangle\) an extension of \(\langle D, f\rangle\) whenever \(g\) is a function such that if \(u\) is an individual parameter of \(L\), \(g(u) \in D\). Let the context of \(A_{i,F}\) be \(\langle c_1, \ldots, c_n \rangle\). Then:

\(A\) is true at \(i\) in \(F\) under \(\langle D, f\rangle\) iff every extension of \(\langle D, f\rangle\) belongs to the \(n\)th level of information given by \(A\) at \(i\) in \(F\).
Returning at last to (F1) and (F2), our account predicts, in effect, that (e.g.) (F1-3) is true just in case every doctor in the Cardiff clinic employs a receptionist who must record all the doctor’s messages and inform the doctor of them at the proper time; and that (F2-6) is true just in case every cop knows an informer who gives the cop tips and whose minor crimes the cop overlooks such that if the informer helps the cop prevent a murder and if the cop pulls the informer over for drunk driving, the cop will give the informer a breath test. It is important to appreciate the generality of the view we have developed. It can handle a sentence containing an arbitrary number \( n \) of pronouns/descriptions anaphoric to quantifier phrases, which may or may not have wide scope, in (possibly) \( n \) different sentences which themselves may contain an arbitrary number of anaphoric pronouns/descriptions.\(^{18}\)

In conclusion, the present study brings to the fore some features of language and language understanding which have implications beyond the interpretation of pronouns and descriptions. First, it forces us to see discourses as entities with highly complicated structures, capable of dramatically influencing what is expressed by occurrences of sentences in them. Again, I wish to emphasize that the pronouns/descriptions considered here are only one device by means of which discourse structure affects the import of utterances in the discourse. Much more work needs to be, and is being, done in this area. Second, the fact that the pronouns/descriptions we have been studying admit of an assortment of more or less global and local readings has implications for our understanding of language understanding, and thus for philosophy of mind. In grasping a “completely local” reading (i.e. 0th level of information), one is by no means assured of having grasped any of the more global readings. If one does grasp the most local reading but not any more global reading, one has certainly understood something; but one has also failed to understand something in an important sense.\(^{19}\) Thus sentences containing these pronouns/descriptions seem to admit different levels of understanding. Obviously much more needs to be said here, but these difficult issues require separate treatment.
NOTES

* I should like to express my gratitude to Mark Wilson, who first brought the issues addressed in this paper to my attention and whose comments and suggestions have deeply influenced the final result; to George Wilson, whose paper 'Pronouns and Pronominal Descriptions: A New Semantical Category' (Philosophical Studies 45 (1984), 1-30) showed me how to view the phenomena discussed herein; to Zeno Vendler for his insightful comments and guidance; and to Michael Liston.

1 On my use of the term 'discourse', discourses come with anaphoric relations given. In (F1)–(F3) lower case letters of the alphabet as subscripts specify anaphoric relations. An underlined pronoun/description is anaphoric to the quantifier phrase sharing the same subscript. I shall not address the question of how such anaphoric relations are determined. Further, I shall omit subscripts if the intended anaphoric relations are sufficiently obvious.

2 In saying this I am assuming that the indefinite noun phrases in (F1)–(F3) (e.g. 'a receptionist' in (F1-1)) are existential quantifiers. Though some philosophers may not agree with this assumption, considerations of space prevent me from defending it here.

3 Consider an example such as:

'Some senator or some governor will join us. He will meet us in my office'.

Here the antecedent of 'He' contains more than one quantifier, and so one cannot speak of the quantifier antecedent. Such examples were suggested to me in conversation by Lauri Kartunnen. It seems that one can even construct examples in which the antecedent contains both a universal and an existential quantifier:

Each player with less than two cards or some player with more than two cards may be asked to pass a card to the right. The player must then pass a card or draw three cards.

Though these cases don't introduce any theoretical difficulties for my view, handling them would require introducing some complexities which would render exposition more difficult. I shall therefore ignore such examples.

4 Of course some philosophers will think that the underlined occurrences of pronouns and descriptions in (F1)–(F3) are simply functioning as variables bound by their quantifier antecedents. Though I cannot address this issue fully here, I can indicate one reason why I think the pronouns and descriptions in (F1)–(F3) are not bound variables. A bound variable treatment would require us to say that quantifiers (or pairs, triplets, etc. of quantifiers) which clearly don't have scopes relative to each other, do have scopes relative to each other. Consider, for example, (F1). (F1-1) contains a pair of quantifiers ('Every doctor in the Cardiff clinic' taking wide scope and 'a receptionist' taking narrow scope), as does (F1-10), ('every lawyer in Cardiff' taking wide scope and 'a receptionist' taking narrow scope). It seems clear that these quantifier pairs do not have scopes relative to each other. That is, the correct answer to the question "which pair has wide scope with respect to the other pair?" is clearly "neither pair has wide nor narrow scope with respect to the other pair". In (F1-11), however, there is an occurrence of a description ('the doctor's receptionist') anaphoric to the quantifier 'a receptionist' in (F1-1). So if this description is a bound variable, the scope of that quantifier must extend to (F1-11). But then (F1-10) occurs within the scope of the quantifiers in (F1-1) (since that of 'a receptionist' must extend to (F1-11) to bind the description, and 'Every doctor in the Cardiff clinic' has wide scope with respect to 'a receptionist' in (F1-1)). Thus, on the assumption that the descriptions in (F1-11) are
bound variables, the quantifiers in (F1-1) turn out to have wide scope with respect to those in (F1-10) after all. But of course this is wrong. This is only one of many arguments which could be offered against a bound variable treatment of the underlined pronouns/descriptions in (F1)-(F3). See, for example, the arguments in George Wilson's paper mentioned in Note (1) against a bound variable treatment of relevantly similar data; or Hintikka's arguments against a bound variable treatment of data that the view developed here will handle in 'Quantifiers in Natural Languages: Some Logical Problems'. This paper can be found in Game Theoretical Semantics, Reidel, Dordrecht, 1978, edited by Esa Saarinen.

Actually the explanation of why 'the cat' is read as if a quantifier with wide scope in these cases is a bit more subtle than that given above. But it introduces complexities which cannot be fully handled in this paper.

5 Actually the explanation of why 'the cat' is read as if a quantifier with wide scope in these cases is a bit more subtle than that given above. But it introduces complexities which cannot be fully handled in this paper.

6 Elementary Logic, Oxford, 1972. Mates associates with each line in a derivation a set of numbers which are the line numbers of the formulas the line in question depends upon.

7 The language Thomason uses in Symbolic Logic: An Introduction, MacMillan, 1970 is of this sort.

8 Richmond Thomason, op cit., assigns truth conditions to formulas containing occurrences of individual parameters (pp. 240–242), but these do not in general represent the intuitive claims occurrences of such formulas make as they occur in derivations or our discourses. For Thomason's valuations treat individual parameters as individual constants, assigning members of the associated domains to expressions of both these sorts.


10 I am indebted to Mark Wilson for proposing the notion of a local versus a global reading of the pronouns/descriptions being considered and for suggestions and comments concerning the form of the semantics to follow.

11 I believe that it is the apparent tension between the local and global understandings of these pronouns/descriptions that led Kit Fine to his doctrine of arbitrary objects (see 'A Defence of Arbitrary Objects', Proceedings of the Aristotelian Society, Supplementary Volume LVII, pp. 55–57; 'Natural Deduction and Arbitrary Objects', Journal of Philosophical Logic 14 (1985), 57–107; and Reasoning With Arbitrary Objects (Basil Blackwell, 1985)). I take it that on Fine's view the underlined descriptions in (F5) refer to arbitrary objects. And Fine hints that the account of arbitrary objects he develops, which he applies mainly to systems of natural deduction, could have application to the sort of data in (F1)-(F3). Though Fine has not yet published papers in which he actually applies his account to such data, I am presently working on a paper comparing Fine's interesting approach to my own.

12 op cit., pp. 143–174. Thomason does not give a recursive definition of well-formed formula for this language, instead introducing the language informally. However, adding the appropriate clauses for 'v' '=>' '!' and the existential quantifier to the definition on pp. 210–211 yields a satisfactory definition.

13 That is to say, the truth of the premises above the main (i.e. leftmost) scope line of a derivation (if any) under an interpretation \( \langle D, f \rangle \) will require that the truth conditions assigned by our account to an occurrence of a formula in the derivation under \( \langle D, f \rangle \) obtain.

14 The context \( \langle c_1, \ldots, c_n \rangle \) of \( A \) at \( i \) in \( F \) could be defined recursively as follows:

\[ c_1 = \text{The supposition or announcement to which } A \text{ at } i \text{ is subordinate occurring at line } j, j \leq i, \text{ in } F \text{ such that no supposition or announcement to which } A \text{ at } i \text{ is subordinate occurs at a line prior to } j \text{ in } F. \text{ If there is no such } c_1, \text{ the context of } A \text{ at } i \text{ in } F = \langle \rangle. \]
Suppose $c_{n-1}$ was taken from line $g$ in $F$.

$c_n$ = The supposition or announcement to which $A$ at $i$ is subordinate occurring at line $h$, $g < h < i$, such that no supposition or announcement to which $A$ at $i$ is subordinate occurs in $F$ at a line $k$, $g < k < h$. If there is no such $c_n$, the context of $A$ at $i$ in $F = \langle c_1, \ldots, c_{n-1} \rangle$.

Some philosophers would claim that (in at least some cases) when a pronoun is anaphoric to 'a(n)' or 'some', the pronoun is a referring term. Gareth Evans, Charles Chastain and Keith Donnellan have all advocated such views in writing (though their views are importantly different). I believe that in a discourse of the form:

(A)  
A(n)/Some $F$ is $G$.  
He/she/it is $H$.  
He/she/it is $J$.  
etc.

the anaphoric pronouns in these sentences are not referring terms, but have the force of existential quantifiers. I cannot fully defend this view here, but I can suggest the lines along which I would argue. There are discourses of the form of (A) in which the anaphoric pronouns cannot be viewed as referring terms. For surely I can say (perhaps instructing a child):

Some prime number is greater than one million.  
It is greater than one hundred thousand too.

even if I know of no particular prime number with the properties in question. So we cannot appeal to the number I “have in mind” to fix the referent of the pronoun. And since there isn’t a unique prime number greater than one million, the predicative material in the first sentence can’t fix the referent of the pronoun in the second sentence. In short, there does not seem to be any mechanism connecting this occurrence of ‘It’ to a particular prime number greater than one million. Thus it is simply implausible to suppose that the pronoun refers in such a case. If we now claim that in some discourses of the form of (A) the anaphoric pronouns do refer, we cannot give a unitary account of the semantic behavior of anaphoric pronouns in discourses of this form. On the other hand, if we apply the account which works for the cases in which the anaphoric pronouns clearly can’t be referring terms to the anaphoric pronouns in all discourses of the form of (A), we have a unitary account. Of course we would nevertheless be justified in favoring the non-unitary account if there were important phenomena that it could explain and that the unitary account couldn’t. But I don’t think there are any such phenomena and that we should therefore favor a unitary account.

Though in (F7) the existential quantifier antecedent of the pronouns in (2) and (3) has wide scope, exactly similar remarks apply to a case in which the quantifier antecedent occurs within the scope of other quantifiers.

The definitions of truth under interpretations and extended interpretations run as follows. Let $\langle D, f \rangle$ be an interpretation of $L$.

1. If $P^0$ is a zero place predicate of $L$, then $P^0$ is true under $\langle D, f \rangle$ if $f(P^0) = T$. Otherwise, $P^0$ is false under $\langle D, f \rangle$.

2. If $P^n$ is an $n$-place predicate of $L$, and $a_1, \ldots, a_n$ are $n$ individual constants of $L$, then $P^n a_1, \ldots, a_n$ is true under $\langle D, f \rangle$ if $(f(a_1), \ldots, f(a_n)) \in f(P^n)$. Otherwise, $P^n a_1, \ldots, a_n$ is false under $\langle D, f \rangle$.

The clauses for the sentential connectives and quantifiers read as expected, so I shall not bother to repeat them. The definition of truth under an extended interpretation
would differ from the above definition in only one respect. If \( \langle D, f \rangle, g \) is an extended interpretation, we define the function \( h \) as follows:

\[
\begin{align*}
h(x) = \text{case 1: } & \quad \text{If } x \text{ is an individual constant of } L, \ h(x) = f(x). \\
& \text{case 2: } \quad \text{If } x \text{ is an individual parameter of } L, \ h(x) = g(x).
\end{align*}
\]

Then the clause in our definition of truth under an extended interpretation corresponding to (2) above would read:

\[
(2') \quad \text{If } P^n \text{ is an } n\text{-place predicate of } L, \text{ and } t_1, \ldots, t_n \text{ are } n \text{ terms (individual constants or individual parameters) of } L, \text{ then } P^n(t_1, \ldots, t_n) \text{ is true under } \langle D, f \rangle, g \text{ if } \langle h(t_1), \ldots, h(t_n) \rangle \in f(P^n). \text{ Otherwise } P^n(t_1, \ldots, t_n) \text{ is false under } \langle D, f \rangle, g.
\]

The rest of the clauses read exactly like the clauses in the definition of truth under an interpretation.

18 At the same time I must acknowledge the limitations of this account. It will not handle the underlined description in the following fragment:

A circus was in town last week. The trapeze artist was phenomenal.

though the description does seem to look back to 'A circus' in some way. Zeno Vendler and Richard Grandy independently suggested examples of this sort to me.

19 An example of a speaker grasping the most local reading but failing to grasp more global readings would be a case in which a hearer realizes that (F2-6) says that the cop will give the informer a breath test, but, whether because of not quite remembering the discourse to that point or other reasons, is unable to correctly interpret 'the cop' and 'the informer'.

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