Anaphora, The Compositionality Requirement, and The Semantics-Pragmatics Distinction

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I The Problem: Parallels Between Discourse Anaphora and Bound Variable Anaphora

This paper presents a data problem and a methodology problem, the first being symptomatic of the second. The data problem is the parallellism between bound-variable and discourse anaphora as displayed by pronouns and definite NPs: the methodology problem is the semantics-pragmatics demarcation. The solution to be proposed involves modification of the current assumptions both about anaphoric binding and about the semantics-pragmatics boundary. Furthermore, the unitary analysis I propose for pronoun and definite NP anaphora has consequences for the compositionality requirement on meaning.

It is almost universally agreed that the two processes, bound-variable anaphora, as in (1), and discourse anaphora, as in (2) have to be characterised discretely.

(1) Every female worries that she's boring.
(2) She's boring.

What is less commonly recognised is that every phenomenon which indicates the pragmatic nature of discourse anaphora is displayed also by bound-variable anaphora. There are at least four such properties:
(A) The phenomenon of bridging cross-reference. This is where the use of an anaphoric expression is licensed by a preceding non-coreferring expression in virtue of some link between the objects those expressions describe. Thus in (3) and (4) there is no relation of identity between a car and its driver, and yet the

introduction of the term car allows one to use a definite NP in virtue of the link between cars and drivers:

(3) John lifted a car. The driver was underneath.

(4) John lifted a car with the driver.

Exactly parallel is (5) except that the expression a car can be interpreted within the scope of the quantifying expression everyone and the term the driver is accordingly interpreted as a variable bound by the expression a car itself sensitive to the outermost quantifier.

(5) Everyone who was able to lift a car found the driver underneath.

(6) John's house is a mess. The roof needs mending.

(7) Every house needs the roof mended.

A similar set of examples is (6) and (7). The introduction of the expression house licenses the use of the roof both in examples of discourse anaphora and in examples of bound-variable anaphora. And that this is not simply a matter of lexical specification of hidden arguments is shown by (8): singer does not have accompanist as a lexically specified argument.

(8) Every accompanist needs the singer to be quiet in the opening bars.

(B) The use of anaphoric expressions can be licensed by extra information made available by the total implicit content of the preceding sentence and not any one constituent. Thus (9) allows the term the insult on the basis of the assumption that calling someone a Conservative is an insult. This has long been recognised as a pragmatic phenomenon. But there are exactly parallel examples with bound-variable anaphora which are not recognised as a pragmatic phenomenon: as in (10).

(9) Jake called Jess a Conservative. The insult made him bristle.

(10) Everyone who called his neighbour a Conservative later apologised for the insult.

(C) One may have to manipulate extra premises and principles of deduction in order to establish an antecedent. And this, too, is possible with bound-variable anaphora. The restriction is a complexity one, rather than an all-or-nothing one (cf. the detailed discussion of (24) below). Thus in (11) we have to know that Jaguars make cars and two negatives make a positive in order to use the first disjunct in (11) to provide an antecedent for the definite NP the car. And exactly parallel is (12).

(11) Either my friend hasn't bought a Jaguar, or the car'll be in the garage by now.

(12) Each of my millionaire friends who isn't so anti-British that they haven't bought a Rolls-Royce will soon be fed up with the car's gas consumption.

Moreover as in (13) the principles involved may be quite complex, yet in this case even a mere pronoun can establish a successful antecedent from the information presented by the first, complex, disjunct.

(13) Either her father's mean and she hasn't a car or it's in the garage.

All we have to reconstruct is the implied relation between her having or not having a car and her father being mean or not. I shall come back to this example in detail later on. For the present, the immediate understanding as 'Either her father's mean and she hasn't a car, or he isn't mean and she has a car and it's in the garage' is at least suggestive of the point that definite NP and pronominal anaphora may depend on extra premises and principles of deduction; and in the case of (12) this process is relative to some quantified expression further up the tree.
(D) In Comparison to (A)-(C), the phenomenon of the "given" nature of pronouns and definite NPs as opposed to the "newness" of indefinite NPs is familiar, but it is not so often pointed out that this concept of picking out something already "given"/previously established is displayed equally by bound-variable anaphora. (14) and (15) are the straightforward cases of definite NP and pronominal anaphora. But (16) and (1) above present the same phenomenon for bound-variable anaphora.

(14) John bought a house and discovered later that the house needed damp-proofing.

(15) A man came in. He sat down.

(16) Everyone who bought a house discovered later that the house needed damp-proofing.

In these cases, the definite NP and pronoun are licensed and in some sense given by the preceding quantified expression. The difference is of course that with a quantified antecedent, the bound-variable anaphor is in some sense given by each instantiation of the quantified expression. Notice that the converse pragmatic phenomenon of indefinite NPs that they present a "new" individual is, equally, shared by quantified expressions. (17) directs the hearer to construe the situation as involving more than one man. (18) directs the hearer to construe the situation as involving the children as having each to tidy some other child's work pile (cf. Heim 1982 for a detailed account):

(17) A man came in. A man sat down.

(18) Every child had to tidy a child's work pile.

(E) Referring uses of definite NPs and pronouns have classically associated with them the property of uniqueness. This problem is widely recognised to be pragmatic, relative to the circumstances in some unanalysed way. Thus in (2) above there is only one female assumed to be under consideration, in (3) and (4) only one driver, and in (6) only one roof. What is less commonly recognised is that this phenomenon is displayed equally by bound-variable anaphora cases such as (1), (5), (7), (8) and (16) above, though in these cases the value of the interpretation of the pronoun or definite NP is uniquely determined by each instantiation of the quantifying expression. In (1) for example, for example, for each instantiation of the subject quantifying expression there is only one possible object picked out by she; for each instantiation of car in (5) there is only one possible object picked out by the driver; and so on. Of course, we analyse these in terms of identity of variables, but the pretheoretic phenomenon of the anaphoric expression being on each interpretation uniquely identified as something is exactly parallel in both referring and bound-variable uses of definite NPs and pronouns.

Finally, it has recently been pointed out by Maclaran (1982) and Partee (forthcoming) that directly referential expressions, almost without exception, have a corresponding bound-variable analogue:

(19) Everyone I play duets with seems relieved when we stop. (Partee)

(20) Every day she woke up sweating, she knew that later that day she'd have a migraine. (Maclaran)

Both we and that are normally directly referential expressions picking out a fixed set or individual from the context. Yet (19) and (20) are instances of bound-variable interpretations, the interpretation of we and that in (19) and (20) being dependent on the superordinate quantifying expression. Thus for all the listable, apparently pragmatic properties of referring, discourse-anaphoric uses of pronouns and definite NPs, there is a direct analogue for bound-variable uses. Yet it is these pragmatic properties which provide the motivation for analysing discourse anaphora as a pragmatic phenomenon. But quantifier binding, which displays the same properties, is universally assumed to be a phenomenon of grammar. It looks as though if we're to give a unitary account of problems of anaphora we have to assume a pragmatic basis to bound-variable anaphora as well. This is what I am going to propose. It is not however a waste-paper-basket manoeuvre. On the contrary, I provide a set of rules which purport to capture the phenomenon in a unitary way. What I shall argue is the methodological point mentioned at the outset, that our assumptions about the concepts of semantics and pragmatics need to be altered. In particular I shall argue that all that goes into the semantic component of a grammar is a set of instructions on the construction of logical forms - equivalently, a set of instructions on indexing, but not the actual indexing. This constitutes the output of a grammar, a different set of instructions defined for each sentence. It is only by the interaction of such instructions with pragmatic principles that determine logical forms - the output of the indexing mechanism, and it is these forms for which an orthodox, non-context-dependent model-theoretic interpretation is available. From this it follows that model theory is not a semantics of natural language expressions themselves but only of the propositional objects they are used to construct.

II The solution : A Relevance-Based Account of Anaphora

The conception of linguistic semantics I defend in general, and the unitary analysis of discourse and bound-variable anaphora I defend in particular, are both dependent on the pragmatic theory of Sperber and Wilson (forthcoming). There are five main claims[1] of the theory that I shall make direct use of:

1) Utterance interpretation is an inferential, largely deductive, exercise which involves the construction by the hearer of a context set of premises which combine with the propositional form of what he hears to yield indirect implications (the implicit content of the utterance - roughly equivalent to implicatures). Thus contextual information is not in general antecedently given, nor accumulated throughout a discourse: it is the construction of the context that is an essential part of utterance interpretation.

2) The linguistic content of sentences of natural language are under-determined with respect to propositional content and both the construction of a context set of premises, the decision as to the propositional content expressed by the sentence, and the consequent deduction of contextual implications are driven by a single principle, that of relevance.

3) The principle of relevance is defined as: The speaker has done his best in the circumstances to say something of maximal relevance to the hearer. This is the sole maxim of the theory. It needs some explication. Relevance itself is defined as the nontrivial deduction of contextual implications from a pair comprising a context-set of premises, and a proposition expressed. The hearer's task is to select what that pair should be. The principle of relevance is the guarantee that the speaker believes that the form which he has uttered makes immediately accessible to the hearer a context set and a proposition from which he can derive contextual implications. Implicit in the concept of maximal relevance is a trade-off between maximum amount of information (contextual implications) for minimal processing cost. (The motivation behind this is the stated aim of Sperber and Wilson to provide a theory of pragmatics which is not yet another module, but a theory of performance in which memory storage, processing costs, inferential properties of the central cognitive mechanism, information presented in a grammar, all come together.)

4) Linguistic specification of elements of language may involve a dual specification (i) their contribution to propositional content, (ii) their contribution to what information is made accessible for purposes of context construction.

5) The only factor that constrains the construction of contexts in addition to any relevant specification of elements of the language and the principle of relevance is the assumption that certain types of information are immediately accessible, viz. the preceding utterance, the scenario of the utterance itself, and information associated with concepts expressed by the lexical items used (this last stored in a mental lexicon of discrete concepts

with both encyclopaedic and analytic knowledge entered with such concepts). Thus the preceding utterance U_{i-1} for some utterance U_i contributes to what is immediately accessible to U_i but by no means fully determines it since not only may the scenario facts alter, but the concepts of U_i itself and encyclopaedic information associated with them contribute to what is accessible in U_i.

It is this concept of accessibility that is central to my analysis of anaphora. What I propose is that the concept of definiteness associated with both pronouns and definite NPs simply is that of guaranteed accessibility. If a speaker uses a pronoun or a definite NP then he is indicating to the hearer that a representation of an NP type is immediately accessible to him in the sense specified - either from the scenario of the utterance itself, or from the preceding utterance, or from preceding parts of the same utterance, or from concepts expressed by what precedes the anaphor. Thus in (2) the referent of she has to be accessible from the immediate scenario. In (15) it is provided by the previous utterance, in (14) by some previous representation in the same utterance, and in the bridging cross-reference cases of (3) and (4) by a premise accessible from the conceptual address associated with car that cars normally have a driver. The bridging cases and cases where extra premises are required, i.e. (A)-(C) above, are straightforwardly predicted on this analysis given the Sperber and Wilson framework. Since the content of ALL anaphoric expressions is that of a guarantee that an antecedent is immediately available, we can predict that where no such antecedent is provided by the explicit content of the discourse, nor indexically, the anaphor will act as an instruction to the hearer to construct a context premise which will provide that antecedent as the implicit content of the discourse. Take (3). On this analysis, the use of an anaphoric expression is by the principle of relevance a guarantee of instant accessibility of some representation of an individual described by the predicate 'driver' about which the speaker is making some assertion. But the immediately accessible environment (in this case just the preceding utterance) does not provide such a representation. Yet the speaker is using an anaphor as the guarantee of such a representation. He must therefore be using the anaphor as an indication to the hearer that he should construct a context premise such that the appropriate representation is derived as a contextual implication. In other words, the very use of the expression the driver indicates to the hearer that he construct a context premise to the preceding utterance to the effect that cars have a driver so that he can deduce as the implicit content of what he hears that the car John lifted had a driver. This effect is directly predictable from the proposed analysis in terms of accessibility and the principle of relevance, without any further postulation.

Cases such as (9) are simply the same. The only difference is that the contextual premise required (triggered by use of the predicate insult) cannot be accessed from any particular constituent of the preceding utterance. It is the whole of Jake called Jess a Conservative, that combines with 'To call someone a Conservative is to give them an insult' to provide by deduction the contextual implication 'Jake gave Jess an insult'. And the only way to construe (9) so that the expression <u>the insult</u> fulfils the guarantee of accessibility of its antecedent is to construct such a context set. Hence the account of anaphora in terms of accessibility enables us to predict that in cases where accessibility is not fulfilled by the explicit content of an utterance, the anaphor will act as a trigger for the construction of a context premise such that an antecedent is provided as part of the implicit content of what IS immediately accessible.

I have so far characterised a definite NP as expressing as its intrinsic content a guarantee of instant accessibility of its antecedent. But the guarantee of immediate accessibility simply is an intrinsic part of the principle of relevance. It is this that determines the context set of propositions and the propositional content the hearer selects. Thus all we require of an analysis of anaphora is that an anaphor is some expression whose value is not given by rules of grammar.[2] For all the rest will fall out from the application of the principle of relevance. And this is what my analysis will provide. An anaphor will be represented as a metavariable whose value is not determined by any principle of grammar. Given my assumption of the Sperber-Wilson framework it follows that it will have to be identified by a relevance-controlled principle of antecedent identification.

Now in order to get this account to extend to sequences relative to the binding of a quantifier, all we need to do is to assume that we can manipulate a name-like entity which can stand arbitrarily for any one of the individuals over which the domain of the quantifier ranges. Arbitrary names, manipulated in natural deduction systems, do just this. And this is what I shall do. Given then that a quantifier introduces an arbitrary name, this name will be accessible in just the same way as a referring expression, and can enter into deductive and context-specifying processes. The only difference is that its availability is restricted to the scope of the quantifier that introduced it, so it is not invariably available like a name. And this is just the distinction we want. It is no coincidence that the ontology I am assuming is explicitly deductive and computational in the Jerry Fodor sense. For the formal syntactic nature of the explanation it is critical to my proposal that arbitrary names can provide an antecedent for an anaphor. These are syntactic, representational constructs and not genuine individuals in a set-theoretic sense. Thus the simplicity of this analysis is made possible by the representational, deductive framework of the assumed pragmatic theory.[3]

We now come to the form of the proposal itself. What it does is to provide a mapping from the surface sequence of a sentence onto a GB-style of LF by the construction rules R1-5; and from that to provide a mapping onto an LF' which is a standard predicate calculus formula containing no anaphors and no unbound variables (and in fact no contradictions). This second part of the mapping is compositional from bottom to top (rules P1-6) and is only partially linguistically controlled. Lexical items are projected onto predicate calculus elements or configurations; and then progressively up the tree each configuration defined at LF is projected onto the required predicate calculus configuration. This progressive projection of predicate calculus constructs up the tree interacts with a pragmatic relevance-driven rule of antecedent identification (P7); and the rule binding variables to a quantifier (P5) depends on this. (The reason for this bottom to top projection is that in order to be able to identify the antecedent of a complex anaphoric expression such as the man with brown hair half way down his back we need to have a representation of ITS parts which, as in this case, may involve identifying a pronoun. So in order for the antecedent identification rule to apply correctly, at this stage of the projection the system has to work from the representation of the elementary parts onto the representation of the whole.) In effect, the proposal is an argument that a Haik or Higginbotham mechanism for the indexing of pronouns or definite NPs is not part of the grammar (Haik forthcoming; Higginbotham 1980, 1983). For what I am giving is an explicit pragmatic mapping from LF onto LF', and the LF defined here by the rules of the grammar does not provide the binding of ANY pronoun or definite NP.

Let me now get rather more precise. What my proposal reconstructs are the claims of Sperber & Wilson listed above as (2), (4), and (5). That is, with respect to (2), since an anaphor is under-determined with respect to its contribution to propositional form, my analysis gives a single specification of the content that a pronoun or definite article contributes to propositional forms, in the form of a metavariable, a place-holding device labelled as β; and I predict the various uses to which pronouns and definite NPs are put by a specified pragmatic principle of antecedent identification which interacts with the process of quantifier binding, which may follow it. Indeed the principle of antecedent identification selecting some accessible representation as antecedent applies blindly without distinguishing between what are going to be bound-variable interpretations, and what are going to be discourse-anaphoric or indexical interpretations. And, with respect to Sperber & Wilson claims (4) and (5), the linguistic contribution to the concept of accessibility made by any string is reconstructed by the recursive specification of the set of accessible concepts which each node makes available for this rule of antecedent identification. The principle of antecedent identification makes use of this set of accessible concepts in selecting an antecedent. What this means is that each node of a tree has associated with it a pair: a structured specification of its predicate calculus form, and an unordered set of concepts which have been used up to that point in the tree. (In fact I have three sets of concepts for each node, storing separately, traces, arbitrary names and untreated metavariables, and a general concept store. But this separation is merely for clarity.)

The formal framework I propose has the following properties:
1) It specifies a QR version of LF as the output of the syntactic component of the grammar. This is rule R1.
2) It has a set of translation instructions, called projections, associated with each syntactically defined configuration which make explicit how the projected predicate-calculus parts combine together to form a wellformed formula with no unbound variables. These are the projections P2-6.
3) It has a storage system which provides a history not only of what traces and unbound or metavariables are available at any stage, but also a history of what concepts, both simple and complex, have been used and are accessible in the required sense at any stage.[4] Though the projection of accessibility stores is normally accumulative, it involves extraction from the stores in three cases: (i) the binding of a trace by its antecedent NP (P4), (ii) the binding of an arbitrary name by its associated quantifier (P5), (iii) the identification of a metavariable by the principle of antecedent identification (P7).
4) It has an analysis of indefinite NPs (incorporated from Heim 1982) in terms of an arbitrary name not so far selected, which has subsequently to be bound by a coindexed superordinate quantifier.[5]
5) It has an analysis of all quantifying expressions (here just <u>every</u>) in terms of a superordinate operator, the quantifier, and an arbitrary name which acts as a placeholder for the quantified variable which will eventually fill the slot in question. This separation of the quantifier from its position in the surface syntactic tree is effected by rule R2: this rule leaves an NP with a blank determiner, a configuration which, like indefinite NPs, is assigned an arbitrary name as its argument.
6) It has an analysis of definite NPs and pronouns as metavariables, placeholders whose value is determined by the principle of antecedent identification (P7).
7) It has the principle of antecedent identification which can apply at any point to determine what the value of that placeholder shall be out of what is accessible to it. And what is accessible to it is either the storage system of the preceding propositional constituent or its own storage system as accumulated at the point at which the rule applies, or from some other nonlinguistic source.

III <u>The Formalism</u>

Assumptions:
1) A universe containing a countably infinite set of individuals, U, to which I make no direct reference.
2) A metalanguage which contains:
- (i) the quantifiers, variables and operators of predicate calculus: $\forall$, $\exists$, x, y, ..., &, –, V, $\rightarrow$
- (ii) a countable set of names of individuals (assigned to some subset of U): m_1, m_2 ......
  a countable set of names of subsets of U
  a countable set of names of sets of ordered pairs of individual members of U. And so on.
  This total set is the set M.

(in other words, a set of metalinguistic names which pick out individuals, a set of one-place predicate names which pick out sets of individuals, a set of two-place predicate names, and so on)

(iii) a countable set of arbitrary names, whose value ranges over individual members of U: $a_1, a_2, \ldots \in A$

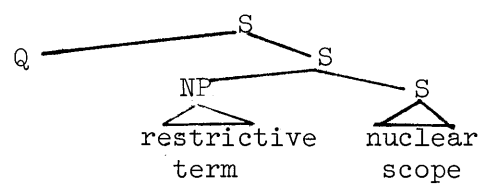
(iv) a countable set of metavariables whose value when assigned is one out of either (i), the set M, or (ii), the set A. In other words, they are term variables: $\alpha_1, \alpha_2, \ldots \beta_1, \beta_2, \ldots$

(v) a set of traces - variables which take as value the variable or constant assigned as argument position to the projection of the NP subject to NP Prefixing (QR). These therefore have to range over $\beta_1, \beta_2, \ldots$ assigned as argument position to definite NPs and $a_1, a_2, \ldots$ assigned as argument position to indefinite and quantified NPs: $t_1, t_2, \ldots$

Construction Rules:

R1) NP Prefixing (QR): Chomsky-adjoin every NP other than pronouns and proper names to S leaving behind a coindexed trace.

R2) Quantifier Construal: Chomsky-adjoin every Q (<u>a</u> and <u>the</u> do not have Q associated with them directly since they are projected onto variables) to the immediately dominating S. If the quantifier is <u>every</u>, <u>each</u>, <u>all</u>, insert → between its restrictive term and nuclear scope (all quantifiers have the associated structure:



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(This rule is generalised to adverbial quantifiers and negation.)

R3) Existential closure: (a) Chomsky-adjoin a quantifier $\exists x$ to the nuclear scope of every operator, and in the case of symmetrical connectives, & and V, to both conjuncts.

R3b) (optional) For any sequence of sentences where the leftmost contains an existential quantifier, Chomsky-adjoin the quantifier to the immediately superordinate S:

$$[_{S_m} [_{S_k} \exists x(\ldots \psi(x) \ldots)] \text{ Op } S_j] \Rightarrow$$

$$[_{S_{m'}} \exists_n [_{S_m} [_{S_{k'}} \ldots \psi(a_n) \ldots] \text{ Op } S_j]]$$

$$a_n \notin PST(NP_{n-i})$$

$$PST(S_{k'}) = PST(S_k) \cup \{a_n\}$$

$$ACC(S_{k'}) = \{ACC(S_k) - \exists x(\ldots \psi(x) \ldots)\} \cup \{a_n, (\ldots \psi(x/a_n) \ldots)\}$$

R4) Selectivity of quantifiers is guaranteed by selection indices:

(i) when Q moves out by R2 it takes the referential index as a selection index

(ii) copy the referential index of every indefinite NP as a selection index on the lowest c-commanding quantifier (so a quantifier may have more than one).

I assume that every NP has assigned to it a referential index which percolates down to the head. In all cases the index j assigned must not be a member of the set of indices assigned to arbitrary names in any previous constituent:

$j \notin \{i: i \text{ assigned to members of } PST(X_{i-n})\} \quad n < i$

R5) For two sister nodes of the same logical category not otherwise conjoined (i.e. quantifier-raised NP, and S), insert &.

P1) Projection Rules for Terminal Elements: (TST = Trace Store, PST = Pronoun Store, ACC = Accessibility Store)

		TST	PST	ACC
$[t_j]_{NP_i}$	$\rightarrow t_j$	t_j	$\emptyset$	$\emptyset$
$[he]_{NP_i}$	$\rightarrow \beta_i$	$\emptyset$	β_i	$\{\beta_i, male'(\beta_i)\}$
$[a\_\_]_{NP_i}$	$\rightarrow \bar{N}'(a_i)$	$\emptyset$	a_i	$\{a_i, NP_i'\} \cup ACC(\bar{N})$
$[\_\_\bar{N}]_{NP_i}$	$\rightarrow \bar{N}'(a_i)$	$\emptyset$	a_i	$\{a_i, NP_i'\} \cup ACC(\bar{N})$
$[the\_\_]_{NP_i}$	$\rightarrow \bar{N}'(\beta_i)$	$\emptyset$	β_i	$\{\beta_i, NP_i'\} \cup ACC(\bar{N})$
$[John]_{NP_i}$	$\rightarrow m_k$	$\emptyset$	$\emptyset$	$\{m_k, John(m_k)\}$
every	$\rightarrow \forall$			
hit	$\rightarrow$ hit'	$\emptyset$	$\emptyset$	hit'
run	$\rightarrow$ run'	$\emptyset$	$\emptyset$	run'
man	$\rightarrow$ man'	$\emptyset$	$\emptyset$	man'
$[..not..]_{S_i}$	$\rightarrow -(S_i)$	$TST(S_i)$	$PST(S_i)$	$\{ACC(S_i) - S_i'\}$ (inadequate, but will not be used)

$S_h[S_i \text{ and } S_j] \rightarrow [S_i \;\&\; S_j]$

$$TST(S_h) = TST(S_i) \cup TST(S_j)$$
$$PST(S_h) = PST(S_i) \cup PST(S_j)$$
$$ACC(S_h) = ACC(S_i) \cup ACC(S_j)$$

$S_h[S_i \text{ or } S_j] \rightarrow [S_i \vee S_j]$

$$TST(S_h) = TST(S_i) \cup TST(S_j)$$
$$PST(S_h) = PST(S_i) \cup PST(S_j)$$
$$ACC(S_h) = ACC(S_i) \cap ACC(S_j)$$

$a_i \in A$ such that $a_i \notin PST(NP_{i-n})$

$m_k \in N \subset M$

$\alpha_i\ \beta_i$ variables which range over $A \cup N \subset M$

For any category or expression X, X' is the metalanguage projection of X

Projection Rules for Configurations defined by R1-R5:

P2) $[V\ NP]_{VP} \rightarrow V'(NP')$

$$TST(VP) = TST(V) \cup TST(NP)$$
$$PST(VP) = PST(V) \cup PST(NP)$$
$$ACC(VP) = ACC(V) \cup ACC(NP) \cup VP'$$

P3) $[NP\ VP]_S \rightarrow VP'(NP')$

$$TST(S) = TST(NP) \cup TST(VP)$$
$$PST(S) = PST(NP) \cup PST(VP)$$
$$ACC(S) = ACC(NP) \cup ACC(VP) \cup S'$$

P4) $[_{S_o}\ NP_i\ (op)\ [_{S_p}\ ..t_i..]] \rightarrow NP_i\ (op')\ [_{S_p}\ ...\ t_i/\alpha_i ...]$

$TST(S_o) = TST(NP_i) \cup TST(S_p) - t_i$

$PST(S_o) = PST(NP_i) \cup PST(S_p)$

$ACC(S_o) = ACC(S_p) \cup ACC(NP_i)$ except that all conditions $\psi(t_i)$ are replaced by conditions $\psi(t_i/\alpha_i)$

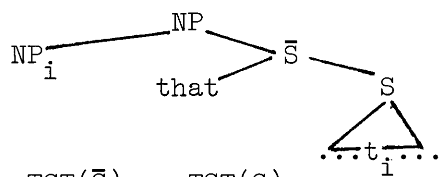
P5) $[_{S_o}\ Q_j\ [_{S_p}\ ...\ a_j ...]] \rightarrow Q(x)(\ ...\ a_j/x\ ...)$

$TST(S_o) = TST(S_p)$

$PST(S_o) = PST(S_p) - a_j$

$ACC(S_o) = ACC(S_p) - \psi(a_j)$ for arbitrary ψ $\cup \{Q(x)(..a_j/x...)\}$

(In the case of relative clauses, I am assuming a configuration which parallels NP prefixing):



P6) $_{\bar{S}}[\text{that } S] \rightarrow S'$ $\quad TST(\bar{S}) = TST(S)$

$PST(\bar{S}) = PST(S)$

$ACC(\bar{S}) = ACC(S)$

P7) Antecedent Identification (F_{AI}):

$[....\ \beta_i ...]_{X_j} \rightarrow [....\ \beta_i/\alpha_k ...]_{X_j}$

where $\alpha_k \in ACC(X_n) \cup PST(X_n) \cup ACC(X_j) \cup PST(X_j) \cup N \subset M$

X_n is left sister to X_j

$[\beta_i/\alpha_k]$ must be free in its governing category

$\beta_i \neq \alpha_k$

$TST(F_{AI}(X_j)) = TST(X_j)$

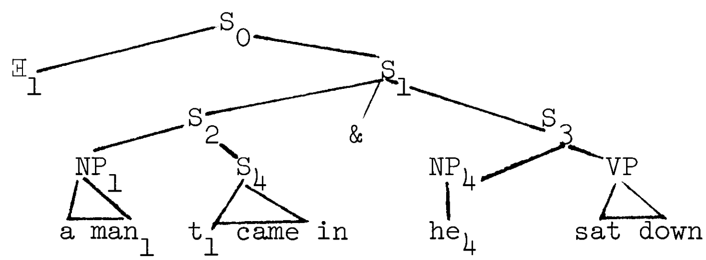
$PST(F_{AI}(X_j)) = PST(X_j) - \beta_i$

$ACC(F_{AI}(X_j)) = ACC(X_j)$ except that all conditions $\psi(\beta_i)$ are replaced by conditions $\psi(\beta_i/\alpha_k^i)$

IV : Derivations

The immediate point of the system is that it allows us to give a unitary account of anaphora, predicting the phenomena listed as A-E. This is demonstrated by the following derivations. (In each case the exposition follows the derivation itself.) (15) is the simplest:

(15) A man came in. He sat down.



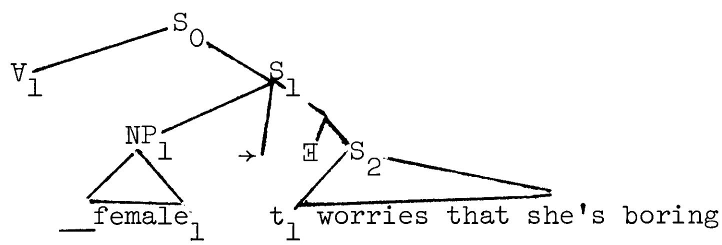
Step	Rule	Constituent	Projection	TST	PST	ACC
1.		a man_1	$man'(a_1)$		a_1	$\{a_1$, man', $man'(a_1)\}$
2.	P3	t_1 came in	came $in'(t_1)$	t_1		{came in', came $in'(t_1)\}$
3.	P4	S_2	$man'(a_1)$ & came $in'(a_1)$		a_1	$\{a_1$, man', $man'(a_1)$, came in', came $in'(a_1)\}$
4.		NP_4	β_4		β_4	$\{\beta_4$, $male'(\beta_4)\}$
5.	P3	S_3	sat $down'(\beta_4)$		β_4	$\{\beta_4$, $male'(\beta_4)$, sat down', sat $down'(\beta_4)\}$
6.	P7	$F_{AI}(S_3)$	sat $down'(a_1)$			$\{a_1$, $male'(a_1)$, sat down', sat $down'(a_1)\}$
7.		S_1	$man'(a_1)$ & came $in'(a_1)$ & sat $down'(a_1)$			
8.	P5	S_0	$\exists x$ man'(x) & came in'(x) & sat down'(x)			

TST = $\emptyset$
PST = $\emptyset$
ACC = {man', came in', sat down', $\exists x$ man'(x) & came in'(x) & sat down'(x)}

The rules of NP prefixing and quantifier construal and indexing give the LF tree as displayed. The indexing on the quantifier is given by rule R3b. The indexing of the NPs themselves is guaranteed as distinct in the normal way and this in its turn guarantees that the arbitrary name associated with the indefinite article is distinct from any other arbitrary name. Thus at line 1 we have the projection onto $man'(a_1)$ where a_1 is an indexed arbitrary name, the pronoun store contains a_1, and the ACC store contains both the parts from which the projection was computed and the result. Similarly in line 2, except that I assume traces have their own store. At line 3, the rule projecting a quantifier raised structure then guarantees that the trace is removed from its store and replaced by the arbitrary name whose index it bears with substitution of a_1 for t_1. S_3 is projected in a similar fashion, lines 4-5, but in this case the argument is a metavariable β_4. Then in computing S_1 at line 6, we find that the ACC store of S_2 contains a representation uniquely accessible, viz. a_1. If we look at the conditions on the application of antecedent identification, we see that it requires that an antecedent either be a member of the storage system of its sister node or be a member of its own storage system or be a member of some set $N \subset M$ which is a subset of the total set of names available in the metalanguage. And this is fulfilled by a_1 a member of the ACC store of S_2. Hence the rule of Antecedent Identification can apply to yield as a projection of S_1, line 7. Then at line 8, the quantifier rule has the effect of replacing all arbitrary names coindexed with the quantifier by a variable and removing all trace of the ar bitrary name from the stores, leaving only the concepts that did not involve the arbitrary name, together with the quantified formula itself.

The derivation of (1) is parallel. (I ignore the existential quantifier following the connective. This is a consequence of adopting Heim's analysis of indefinites, and plays no part in the derivation.)

(1) Every female worries that she's boring.



Step	Rule	Constituent	Projection	TST	PST	ACC
1.		NP_1	female'(a_1)		a_1	{female', a_1, female'(a_1)}
2.		S_2	t_1 worries that β_3 boring	t_1	β_3	{worries', boring', worries that β_3 boring, female'(β_3), boring'(β_3), t_1 worries that β_3 boring}
3.	P4	S_1	female'(a_1)→ a_1 worries that β_3 boring		{a_1,β_3}	{a_1, female', female'(a_1), worries', boring', β_3, boring'(β_3), worries that boring(β_3), female'(β_3), a_1 worries that β_3 boring, female'(a_1) → a_1 worries that β_3 boring}
4.	$P7F_{AI}(S_1)$		female'(a_1)→ a_1 worries that a_1 boring		a_1	{a_1, female', female'(a_1), worries', boring', boring'(a_1), worries that boring(a_1), female'(a_1) → a_1 worries that a_1 boring}
5.	P5	S_0	∀x(female'(x)→ x worries that x boring)			{female', worries', boring', ∀x(female'(x)→ x worries that x boring)}

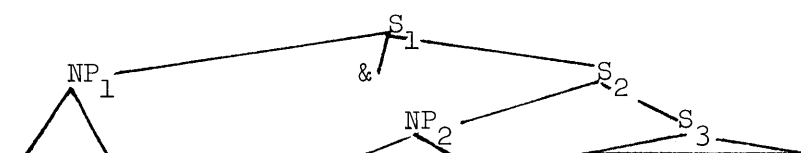
The extraction of the quantifier ∀ from NP_1 is effected by the quantifier construal rule, which also inserts →. The projection of NP_1 has a_1, the arbitrary name in the PST, and the ACC store, made up of the parts of its translation. Similarly S_2. Then at line 3, rule P4 combines the projection of NP_1 and S_2 to form the projection of S_1, and now we have a representation in store which the principle of Antecedent Identification can manipulate, viz. a_1. Hence the rule applies giving as projection of S_1 line 4. The quantifier projection rule then guarantees that the arbitrary name is bound as a variable with all trace of the name removed from the stores. Incidentally, it is this removal from the store which enables one to make correct predictions about the structural restrictions on bound-variable anaphora. Since the rule P7 depends on the content of the stores, as long as the quantifier binding has taken place, the variable will not be available as antecedent. Hence the predicted effects, (21) acceptable on a reading with the pronoun bound by the quantified expression; but (22) not.

(21) A woman grinned at every man_x who bought a donkey that smiled at him_x.

(22) A woman grinned at every man_x. He_x smiled back.

Rather than establish this in detail, I give derivations involving the injection of extra contingent premises since it is these my analysis particularly purports to explain. Thus (4):[6]

(4) John lifted the car with the driver.



the car_1	the $driver_2$	John lifted t_1 with t_2
$car'(\beta_1)$	$driver'(\beta_2)$	j lifted t_1 with t_2
TST=$\emptyset$	TST=$\emptyset$	TST=$\{t_1, t_2\}$
PST=β_1	PST=β_2	PST=$\emptyset$
ACC=$\{\beta_1$, car', $car'(\beta_1)\}$	ACC=$\{\beta_2$, driver', $driver'(\beta_2)\}$	ACC=$\{$j, John(j), lifted', j lifted t_1 with $t_2\}$

Step	Rule	Constituent	Projection	TST	PST	ACC
1.		NP_1	$car'(\beta_1)$		β_1	$\{\beta_1$, car', $car'(\beta_1)\}$
2.	P4	S_2	$driver'(\beta_2)$ & j lifted t_1 with β_2	t_1	β_2	$\{\beta_2$, driver', $driver'(\beta_2)$, lifted', j, John(j), j lifted t_1 with $\beta_2\}$
3.	P4	S_1	$car'(\beta_1)$ & $driver'(\beta_2)$ & j lifted β_1 with β_2		$\{\beta_1, \beta_2\}$	$\{$car', β_1, β_2, $car'(\beta_1)$, driver', $driver'(\beta_2)$, lifted', j, John(j), j lifted β_1 with $\beta_2\}$
4.	P7 $F_{AI}(S_1)$ applied to β_1 yields from $N \subset M$:		$car'(m_{21})$ & $driver'(\beta_2)$ & j lifted m_{21} with β_2		β_2	$\{m_{21}$, car', $car'(m_{21})$, driver', β_2, $driver'(\beta_2)$, j, John(j), lifted', j lifted m_{21} with $\beta_2\}$

5. In the case of β_2 no antecedent is directly available except from N⊂M. So we separate the two conjuncts by &E:

&E (i) $car'(m_{21})$

&E (ii) $driver'(\beta_2)$ & j lifted m_{21} with β_2

From car' ε $ACC(S_1)$ we obtain as context premise for NP_2' (viz. $car'(m_{21})$):

(iii) $\forall x(car'(x) \rightarrow \exists y$ y driver of x)

$\forall E$ (iv) $car'(m_{21}) \rightarrow \exists y$ y driver of m_{21}

MPP (v) $\exists y$ y driver of m_{21} (Add to $ACC(S_1)$: $\exists y$ y driver of m_{21})

&I (vi) $car'(m_{21})$ & $\exists y$ y driver of m_{21} & $driver'(\beta_2)$ & j lifted m_{21} with β_2

R3b (vii) $car'(m_{21})$ & $\exists_3$ [a_3 driver of m_{21} & $driver'(\beta_2)$ & j lifted m_{21} with β_2] $PST(S_1) = \{a_3, \beta_2\}$

P7 $F_{AI}(S_1)$ in case of β_2:

(viii) $car'(m_{21})$ & $\exists_3$ [a_3 driver of m_{21} & $driver'(a_3)$ & j lifted m_{21} with a_3] $PST(S_1) = a_3$

EE (ix) $car'(m_{21})$ & $\exists y$ (y driver of m_{21} & $driver'(y)$ & j lifted m_{21} with y) $PST(S_1) = \emptyset$

$ACC(S_1) = \{m_{21}$, car', $car'(m_{21})$, driver', j, John(j), lifted', $\exists y$(y driver of m_{21} & driver'(y) & j lifted m_{21} with y)$\}$

($ACC(S_1)$ ignored in intermediate stages for simplicity. Here and in all subsequent derivations, I omit the vacuous $\exists$ quantifiers.)

Here the projection of NP_1, S_2 and S_1 is straightforward for steps (1)-(3), giving both β_1 and β_2 in place of their traces by step 3. Given the configuration, the identification of the antecedent for the metavariable β_1 could only be from a source outside the sentence and since we have no preceding utterance can only assume this to be from the context of utterance, here given as N⊂M. This is step 4. But step 5 is more complex. With respect to β_2, it is NP_1 which presents the most immediately accessible information (apart from N⊂M). However the linguistic content of NP_2 guarantees that in order for some representation to be an antecedent to β_2 it must have predicated of it the predicate driver'. Moreover the use of the definite article is a guarantee that such information is accessible. This therefore triggers the premise accessed from car'ε $ACC(S_1)$, as at (iii):

$\forall x$ car'(x) $\rightarrow \exists y$ y driver of x

which by universal elimination, given '$car'(m_{21})$', yields (iv), and by Modus Ponendon Ponens, at (v):

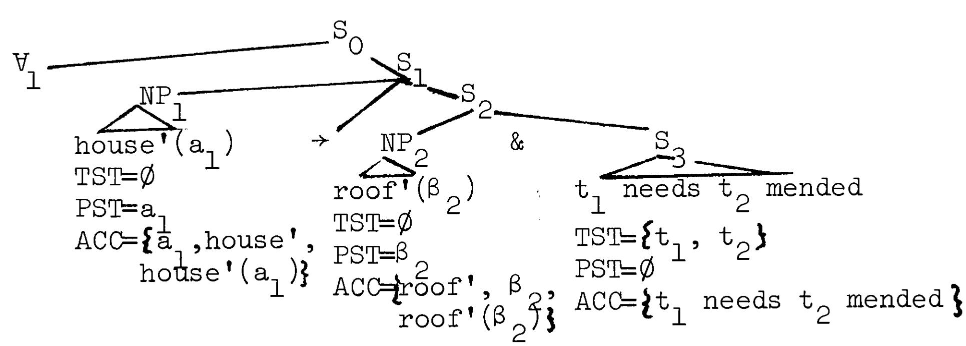
$\exists y$ y driver of m_{21}

which does provide an antecedent for the anaphor β_2. This use of contingent premises, recall, is altogether predicted from the theory of relevance. All I have done is to construct as a context set for the proposition associated with NP_1 the proposition ' $\forall x(car'(x) \rightarrow \exists y$ y driver of x)' which combines with 'car'(m_{21})' to give as a contextual implication ' $\exists y$ y driver of m_{21}' and it is thus the implicit content of the projection of NP_2 which in this case provides the antecedent for 'driver'(β_2)'. The only extra piece of machinery I have to assume at step (vii) is the ability to extend the bracket of an existential quantifier, stated as rule R3b. This is unorthodox but a phenomenon which has often been pointed out and awkward only in so far as predicate calculus itself is awkward.[7] With a newly introduced arbitrary name, we have a boosted Pronoun Store (PST) and hence an introduced antecedent that enables the rule of Antecedent Identification (P7) to apply to β_2 at (vii). All we then have to do is reintroduce the existential quantifier at line (ix).

Notice the conclusion this forces on us - that the process of context construction and deduction of contextual implications (i.e. implicit content) has to be carried out with respect to subparts of a surface sentential string. Thus the proposal that context premises be constructed and principles of deduction manipulated with respect to subparts of a sentence has motivation quite independently of the problems of quantifier binding, to which I now turn.

The derivation of (7) exactly parallels that of (6) except that the quantifier involved is $\forall$ and the connective $\rightarrow$. The accessing of contingent premises is predictable from the assumed pragmatic framework; and the principle of antecedent identificaton and the progressive incrementation of the accessibility store all operate precisely as before. Nothing particular to this type of sentence needs to be stipulated. So I give the derivation with no further comment:

(7) Every house needs the roof mended.



Step	Rule	Constituent	Projection	TST	PST	ACC
1.	P4	S_2	roof'(β_2) & t_1 needs β_2 mended	t_1	β_2	{roof', β_2, roof'(β_2), t_1 needs β_2 mended}
2.		NP_1	house'(a_1)		a_1	{house', a_1, house'(a_1)}

3\. P4 S_1 house'(a_1)→(roof'(β_2) & a_1 needs β_2 mended) $\{\beta_2, a_1\}$ $\{a_1, \beta_2$, house', house'(a_1), roof', roof'(β_2), a_1 needs β_2 mended$\}$

4\. $F_{AI}(S_1)$ cannot apply directly except from N ⊂ M. However from house' ε ACC(S_1) we obtain:

ASS (i) ∀x(house'(x)→∃y y roof of x)
∀E (ii) house'(a_1)→∃y y roof of a_1
ASS (iii) house'(a_1)
MPP (iv) ∃y y roof of a_1 (Add to ACC(S_1): ∃y y roof of a_1)
MPP (v) roof'(β_2) & a_1 needs β_2 mended
&I (vi) ∃y(y roof of a_1) & roof'(β_2) & a_1 needs β_2 mended
R3b (vii) $∃_3$(a_3 roof of a_1 & roof'(a_3) & a_1 needs β_2 mended)
PST=$\{\beta_2, a_1, a_3\}$
P7$F_{AI}(S_1)$(viii) $∃_3$(a_3 roof of a_1 & roof'(a_3) & a_1 needs a_3 mended)
PST=$\{a_1, a_3\}$
EE (ix) ∃y(y roof of a_1 & roof'(y) & a_1 needs y mended)
PST= a_1

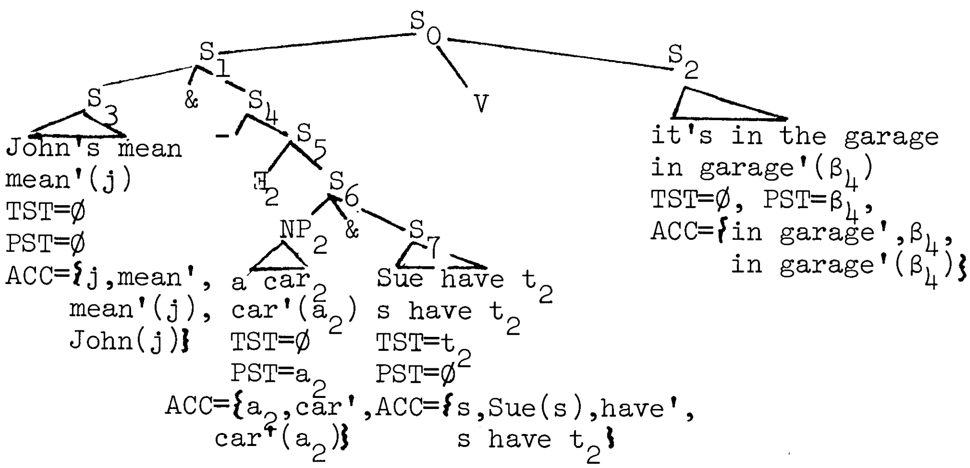
5\. P5 S_0 ∀x(house'(x)→∃y(y roof of x & roof'(y) & x needs y mended))
ACC(S_0)=$\{$house', roof', ∀x(house'(x)→ ∃y(y roof of x & x needs y mended))$\}$

I have so far only dealt with noncompound cases. But it is a consequence of my proposal that the presupposition projection phenomena require no separate stipulation. I do not have the space to argue this in detail so I merely show how this analysis predicts the asymmetry between two such compound examples, (13) (repeated here) and (24):

(13) Either John's mean and Sue hasn't a car, or it's in the garage.

(24)?Either it's not the case that John isn't mean or Sue has a car, or it's in the garage.

What this pair demonstrates is how antecedent identification is not predictable solely on structural grounds but on the basis of interaction between principles of deduction, triggered accessibility of particular contingent premises, and the principle of relevance. What I have to do is make two assumptions. First I assume that a pair of disjuncts, S_1 or S_2, is characteristically interpreted by the hearer as 'S_1 V ($-S_1$ & S_2)'. That's to say, I assume the elimination rule listed at the beginning of the derivation for (13).[8] My second assumption is as before, that where the explicit content of a sequence fails to provide an antecedent, a pronoun can act as a trigger to construct a premise which will provide the antecedent as the implicit content of that sequence. These two assumptions taken together lead to the prediction that a pronoun in the second of a pair of disjuncts, if not identified indexically, will act as a trigger for the hearer to construct a context premise of the form '$-S_1$ → ∃xψx', thus providing the necessary antecedent as the implicit content of '$-S_1$' for the interpretation of S_2. The derivation spells this out:



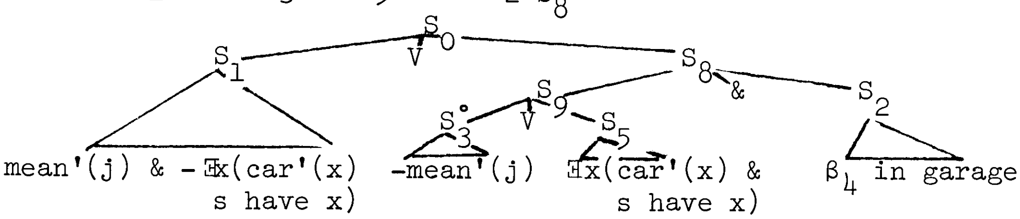
1. $S_1 \rightarrow$ mean'(j) & −∃x car'(x) & s have x   TST=∅, PST=∅
   ACC={mean',j,mean'(j),car',have', −∃x(car'(x) & s have x), s, John(j), Sue(s)}

By elimination rule associated with 'V' (the projection of <u>or</u>):
$S_1 \vee S_2 \equiv S_1 \vee (-S_1 \;\&\; S_2)_{S_8}$

2. $S_0 = S_1 \vee (\,-(S_3 \;\&\; S_4) \;\&\; S_2)^8$

3. $\equiv S_1 \vee ((-S_3 \;\vee\; --S_5) \;\&\; S_2)$

4. $\equiv S_1 \vee ((-S_3 \;\vee\; S_5) \;\&\; S_2)_{S_8}$



5.

ASS	(i)	Assume 2nd disjunct,S_8: (−mean'(j) V ∃x car'(x) & s have x) & β_4 in garage
&E	(ii)	−mean'(j) V ∃x car'(x) & s have x
&E	(iii)	β_4 in garage
ASS	(iv)	Assumption from ACC(S_8): −mean'(j)↔∃ x car'(x) & s have x
ASS	(v)	Assume 1st disjunct of (ii): −mean'(j)
MPP	(vi)	∃ x car'(x) & s have x
ASS	(vii)	Assume 2nd disjunct of (ii): ∃ x car'(x) & s have x
VE	(viii)	Deduce (vi) direct from (ii): ∃ x car'(x) & s have x (Add (viii) to ACC(S_8))
&I	(ix)	Implicit content of S_8: ∃ x car'(x) & s have x & β_4 in garage
R3b	(x)	$\exists_{21}$(car'(a_{21}) & s have a_{21} & β_4 in garage) PST={a_{21},β_4}
$P7F_{AI}(S_8)$	(xi)	$\exists_{21}$(car'(a_{21}) & s have a_{21} & a_{21} in garage) PST= a_{21}

ACC(S_8)={car',a_{21},car'(a_{21}),s,have',s have a_{21},garage',a_{21} in garage}

EE	(xii)	∃x car'(x) & s have x & x in garage

ACC(S_8)={car',s,have',garage', ∃x car'(x) & s have x & x in garage}

6. The initial disjunction is reintroduced:
   (mean'(j) & −∃x(car'(x) & s have x)) V ∃x(car'(x) & s have x & x in garage)

In this particular case S_1 itself is compound, so the elimination rule associated with the projection of or, 'V', plus the listed de Morgan equivalences, lead to line 4, which I also give in tree form. As the second disjunct, we now have a conjunction of a disjunction and 'β_4 in garage', which we assume at line 5. We separate these at 5(ii) and 5(iii). Now we will only get a premise from the ACC store of the disjunction S_9 (and therefore indirectly from S_8) if it is shared by both disjuncts and therefore the premise has to be of the form in 5(iv). This is because of the projections given to and and in particular or (cf. the projections listed for terminal elements: P1). With this premise '-mean'(j) $\leftrightarrow$ ∃x car'(x) & s have x' we can deduce 'Sue has a car' from both of the disjuncts S_3° and S_5 (where we have it direct) and thus arrive at the implicit content of S_8 at 5(ix). All the remaining moves are as in earlier derivations. Taking the sentence as a whole, in effect what we have is surprisingly uncomplicated. We have the balancing of two simple disjuncts, 'John's mean' and 'The car's in the garage', and given the premise that is required, the second conjunction of what is the actual compound disjunct is an explicit spelling out of what would otherwise only be the implicit content of that first disjunct. Since this leads to greater explicitness as to what contingent premise is required, the additional complexity of processing the falsity of a compound is outweighed by the greater explicitness.

The difference in anaphor-antecedent linkage between (13) and its equivalent (24) should now be virtually self-explanatory. (13) presents the information in the way most likely to lead the hearer to the interpretation intended. Even the contingent premise required is indicated by the spelling out of the contextual implication that should be derived from the first disjunct itself (a common use of and). (24) stands in marked contrast to this.[9] Though the de Morgan equivalences we would need to apply to this are themselves no more complex than those required for (13) the very use of the disjunction between 'John isn't mean' and 'Sue has a car' suggests the separateness of these two pieces of information rather than their relation. The deliberate avoiding of the use of and buttresses this. Furthermore even negation in otherwise simple clauses is known to be relatively hard to process, double negation yet more so. Similar processing difficulties accrue to more than one disjunction. Yet the principle of relevance is a guarantee that the speaker believes he is expressing himself in the way which most efficiently indicates to the hearer what it is he is trying to say. In contrast with its logically equivalent (13), (24) fails to fulfil this requirement. Thus (13) presents the information to be conveyed in a way compatible with the principle of relevance and succeeds in establishing an antecedent-anaphor linkage; (24) does not. The style of explanation here is important. This is not merely a deductive analysis in which principles of deduction are freely available and no other criterion is applicable. On the contrary, the analysis I am proposing assumes the principle of relevance whose operation depends both on the form of presentation, the accessibility of contingent information in a specified way, and principles of deduction.[10]

V The Consequences: The Compositionality Requirement Revisited

There was one overall purpose in constructing this framework - to spell out the consequences of taking the Sperber-Wilson pragmatic theory seriously. The more particular purpose was to provide a unitary account of anaphora. I am painfully aware that the formalism falls far short of ideal. In particular the adoption of predicate calculus for the specific purpose of manipulating an orthodox deductive system leaves me open to familiar objections. But there are consequences for everyone in semantics if my proposal is even in the right direction. One of the major problems in formal semantics is the principle of compositionality. If the meaning of a sentence is given in terms of truth conditions directly (say along model-theoretic lines), then the problem appears to be that the meaning of a sentence is not merely made up of its parts, but by those parts, various hidden contextual variables, and on occasion by the incorporation of contingent information clearly not part of the linguistic information presented by the sentence. In effect, this is the core of problems (A)-(C) I presented initially. If I am right, there is a resolution to this problem. For model theory, simply, is not a semantics for natural language sequences directly. Rather it provides a set-theoretic interpretation of a construct which is not the natural language itself but a metalanguage which both linguistic principles and pragmatic principles of relevance have played a part in constructing. This then is the reason why the compositionality requirement cannot be simultaneously applied strictly to natural language sequences directly and construed truth-theoretically. The correct conclusion to draw, on this view, is that the specifiable content of linguistic expressions is a set of instructions on constructing the metalanguage object, as in P1-6 above, and model theory and its associated compositionality requirement only applies to the completed construction of the metalanguage sequence (where it is applied strictly with no context dependence). It follows that we must necessarily have two syntactic objects - call them LF and LF' (though the former might only be that of surface structure) - one the output of the grammar and one the articulated metalanguage sequence. In particular the latter is not a dispensable construct of convenience.

The lack of any application of concepts of model theory may seem barrenly solipsistic. But I am not in any way seeking to deny the status of model theory as a necessary part of an account of natural language. What I am denying is that it is a semantics of any such language directly. And what I am asserting is that the account of the interpretation of natural language sentences themselves - call this the semantic component of a grammar if you like - is nothing but a set of syntactic instructions. On this view, impoverished perhaps, the semantic specification as contained within a grammar is clearly separable from and the input to pragmatics. Given this linguistic conception of semantics, the methodology problem of the relation between semantics and pragmatics disappears. The mistake that we have made has been in thinking that real semantics, the semantics of truth conditions, was a part of grammar in any sense at all.[11]

FOOTNOTES

[1]I shall not be making use of their claim that the logic of the central cognitive mechanism involves a restricted concept logic. Indeed I make free use of the introduction rule of &-Introduction debarred by that logic. However my use of this rule is a consequence of adopting Predicate Calculus, which I adopt in order to manipulate a familiar deductive system. It remains an open question whether &-Introduction is required in the optimal deductive system. Cf. Rips 1983 who advocates the use of introduction rules but restricts their use to derivations in which the form of the conclusion explicitly indicates the need to manipulate these rules.

[2]There is no stipulation of uniqueness as an intrinsic property of definiteness either. Antecedent identification is made in virtue of the guarantee of the principle of relevance that a representation of an individual is immediately accessible to the hearer about whom he is to understand the speaker as making an assertion. If there were any doubt as to which individual that should be, the hearer would have to put processing effort into deciding which individual it was. But the speaker's utterance in that form is a guarantee that he believes no such processing cost is necessary. Given the principle of relevance then, the speaker must be intending to convey that there is only one such individual.

[3]Fine (forthcoming) proposes a natural deduction system involving arbitrary names directly, with an associated semantics in terms of arbitrary objects. Should Fine's proposals be straightforwardly applicable to the problems addressed here, we would have an explication of the phenomena both in the syntactic terms of natural deduction, and in terms of the corresponding model-theoretic image.

[4]This storage system is modelled on that of Bach and Partee 1980.

[5]In many ways the formalism proposed is a syntactic image of Heim 1982. One obvious difference is that my proposal is totally syntactic, hers essentially semantic. Moreover, her concept of context change is relentlessly incremental, whereas I am reconstructing the Sperber-Wilson concept of accessibility at any given point as in part independently selectible. And I am invoking a relevance-controlled principle of antecedent identification.

[6]The characterisation of proper names throughout is simplistic. An additional metavariable is required, say $\gamma_1, \gamma_2, \ldots$, ranging over the set of constants of the language, the principle of relevance supplying from that set what representation is picked out. This extra step in their derivation is independently required to characterise the ambiguity of <u>John washed his dog and so did Bill</u>. The relevant steps in the derivation are schematically presented without details of stores:

(i) LF input: John (γ_1) & washed(γ_1, β's dog)
(ii) Identify β either from $N \subset M$ or as γ_1 (P7)
  (a) John (γ_1) & washed (γ_1, m_3's dog)
  (b) John (γ_1) & washed (γ_1, γ_1's dog)
(iii) Derived Verb Phrase rule: (cf. Williams 1977)
  (a) $\lambda x[x$ washed m_3's dog$](\gamma_1)$
  (b) $\lambda x[x$ washed x's dog$](\gamma_1)$
(iv) Reconstruct the VP anaphor:
  (a) John (γ_1) & $\lambda x[x$ washed m_3's dog$](\gamma_1)$ &
    Bill (γ_2) & $\lambda x[x$ washed m_3's dog$](\gamma_2)$
  (b) John (γ_1) & $\lambda x[x$ washed x's dog$](\gamma_1)$ &
    Bill (γ_2) & $\lambda x[x$ washed x's dog$](\gamma_2)$
(v) Identify γ_1, γ_2 from $N \subset M$ as m_3, m_4 respectively:
  (a) John (m_3) & $\lambda x[x$ washed m_3's dog$](m_3)$ &
    Bill (m_4) & $\lambda x[x$ washed m_3's dog$](m_4)$
  (b) John (m_3) & $\lambda x[x$ washed x's dog$](m_3)$ &
    Bill (m_4) & $\lambda x[x$ washed x's dog$](m_4)$

[7]The incidental effect of this rule is to undermine Heim's claim that indefinite NPs are not quantified, since the rule attributes the scope-extending possibilities associated with indefinite NPs to the existential quantifier itself, and not to the translation from English onto the metalanguage (as Heim does). But in these cases, where the existential quantifier is deduced, the analogue of the Heim analysis of indefinites is not open to us, as one cannot claim that a quantifier is not a quantifier. However I shall not draw out the consequences of this further (though cf. fn.3.)

[8]Given the tendency to interpret or exclusively, I stipulate this on the basis of its intuitive plausibility, though it is in fact compatible with 'V' itself. (Its justification would be on the basis of the intrinsic content of 'V' and the communicative function of disjunction.)

[9]These examples were suggested to me by Mats Rooth as a potential counterexample for this analysis, on the grounds that if an anaphor-antecedent relation in (13) can be established by the availability of de Morgan equivalences, the analysis will wrongly predict an anaphor-antecedent relation in the equivalent (24) by a similar chain of de Morgan equivalences. That this argument does not go through is the burden of this section.

[10]A similar explanation can be given for the asymmetry in the pair of examples posed by B. Partee as a problem for all pragmatic analyses of anaphora:
(i) I've dropped 10 marbles and found all of them except for one. It's probably under the sofa.
(ii) ?I've dropped 10 marbles and found 9 of them. It's probably under the sofa.

[11]The ideas in this paper were first aired in a course at the University of Massachusetts Amherst, Spring 1983. I am grateful to all those who patiently listened to that first informal account; and to Toni Borowsky, Diane Brockway, Robyn Carston, Wynn Chao, Annabel Cormack, Hans Kamp, Craige Roberts, Mats Rooth, and Deirdre Wilson for various extensive conversations leading up to the writing of this paper. In particular, I am indebted to Deirdre Wilson for two major improvements of content on an earlier version of this paper, and to Annabel Cormack for goading me into whatever degree of explicitness this paper has achieved. This paper was in part supported by SSRC Research grant HR8635.

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