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THE PATH CONTAINMENT CONDITION AND ARGUMENT STRUCTURE

Thomas Stroik

Abstract: This study investigates the internal structure of verb phrases (VPs). Using the Path Containment Condition as developed by May (1985) to establish relations between (quantified) arguments, this study draws two conclusions about the structure of argument-relations within VPs. First, arguments have binary relations with projections of the verb. And second, verbal modifiers have more proximate D-Structure relations with the verb than do the subcategorized arguments of the verb.

Introduction

May (1985) develops a theory of logical form that expresses the logical representation of a sentence syntactically. His theory, which is grounded in the Government and Binding framework, derives the logical form of a sentence from its S-structure through the free adjunstion of logical operators to the categorial nodes stated at S-structure. According to May, it is only at this syntactically-derived level of logical form that the logical properties of a sentence--its scopal and binding relations--can be explained. However, since the free adjunction of operators creates structures that overgenerate logical properties, May posits a well-formedness condition on LF-representations, the Path Containment Condition (PCC), that constrains permissable logical forms.

In this paper, I will use the two major assumptions of May's theory--free operator adjunction and the PCC--to investigate the structure of Verb Phrases (VPs). I will show that, within May's theory, VPs have binary branching structures and adverbial adjunctions are the most proximate arguments of a verb.

May's Theory of Logical Form

May (1977) argues that the ambiguity of (1) follows from the fact that the rule of Quantifier Raising can derive two different logical forms for (1), namely (2a,b).

(1) Some man loves every woman

(2a) $[_{S'}[_{S}$every woman$_3[_{S}$some man$_2[_{S}e_2$ loves $e_3]]]]$

(2b) $[_{S'}[_{S}$some man$_2[_{S}$every woman$_3[_{S}e_2$ loves $e_3]]]]$

As (2) shows, Quantifier Raising (QR), a rule that adjoins a logical operator to an S-node, can generate LF-structures that assign broad scope to either quantifier (where the outside quantifier is said to have broad scope). Hence, the ambiguity of (1) obtains from the two syntactic representations that are derivable for (1).

May (1985) revises his account of the ambiguity of (1). Noting that the Empty Category Principle, a locality principle on admissable relations between antecedents or heads and their arguments,[1] requires empty categories to be properly governed at LF, May shows that LF (2a) is well-formed but LF (2b) is not. That is, (2a) satisfies the ECP because all of its empty categories (ECs) are locally governed; on the other hand, (2b) violates the ECP because one of its ECs, viz. e_2, is prohibited from being locally governed by its A'-antecedent by the presence of an intervening A'-operator (the quantifier <u>some</u>).[2] Consequently, (1) has only one well-formed logical representation--(2a). To account for the ambiguity of (1), May employs the Scope Principle (3).

(3) The Scope Principle (SP). In a class of occurrences of Operators X, if O_i,O_j are elements of X and O_i governs O_j, then O_i, O_j have free scope;
where A governs B iff A c-commands B and B c-commands A, and there are no maximal projection boundaries between A and B; and
where A c-commands B iff every maximal projection dominationg A dominates B , and A does not dominate B.

Applied to (2a), an LF-representation in which the operator <u>every</u> governs the operator <u>some</u>, the Scope Principle gives free scope to the quantifiers, allowing multiple readings to be assigned to (1). The SP also successfully predicts the lack of ambiguity for (4), which has LF (5).

(4) Someone believes that everyone left.

(5) $[_{S'}$someone$_2[_{S}e_2$ believes $[_{S'}$everyone$_3[e_3$ left$]]]]$

In (5), since a maximal projection boundary (S') intervenes between the two operators, <u>someone</u> does not govern <u>everyone</u>; therefore, the Scope Principle does not apply to (5). The only scopal relation that can be assigned to (5) is the one defined configurationally, the one that gives broad scope to someone.

What May's theory fails to predict correctly, however, is an example like (6).

(6) Who bought everything for Max?

QR will generate LF (7) for sentence (6). Unfortunately, (7) is an ill-formed logical representation: it violates the ECP because the quantifier prevents the wh-operator from locally governing e_2. This leaves (6) without a well-formed LF, making the sentence uninterpretable.

(7) $[_{S'}who_2[_S everything_3[_S\ e_2$ bought e_3 for Max]]]

To derive a grammatical logical representation for (6), May replaces QR with a more general rule of free operator adjunction. Such a rule permits not just S-adjunction, but adjunction to any categorial node. Since free adjunction allows VP-adjunction, LF (8) can be derived for (6).

(8) $[_{S'}who_2[_S e_2[_{VP} everything_3[_{VP}$bought e_3 for Max]]]]

Sentence (6) now has a well-formed LF because (8) satisfies the ECP. A further consequence of LF (8) is that the scopal relations of (6) are correctly predicted by it. That is, in (8) the wh-operator does not govern the quantifier because the maximal projection boundary VP intervenes between these operators, so when the SP is applied to (8), it correctly predicts that there will only be configurationally defined scope.

Support for the above analysis comes from the contrast between (6) and (9).

(9) What did everyone buy for Max?

Unlike (6), (9) is ambiguous. It permits the reading in which everyone bought one particular item and the reading in which every individual each bought something (this thing could be different for each person) for Max. An account for the scopal properties just described follows from the rule of free adjunction and the Scopal Principle. In (10), the LF of (9), the wh-operator governs the quantifier; so these operators, given the SP, can engage in free scopal relations.

(10) $[_{S'}what_2[_S everyone_3[e_3[_{VP}\ e_2\ [_{VP}$ buy e_2 for Max]]]]]

LF (10) then is a logical representation that is well-formed, because it satisfies the ECP, and that permits scopal ambiguity under the Scopal Principle.

Besides arguing for the SP and for free operator adjunction, May (1986) also argues that the ECP should be replaced by the Path Containment Condition (PCC). May notes that the ECP makes several incorrect, grammatical predictions. For one, the ECP incorrectly predicts a scopal difference between (11a) and (11b); it predicts that (11a) should permit ambiguity but (11b) should not, since the subject-trace is properly governed in (11a) but not in (11b).

(11a) Who do you think everyone saw at the rally

(11b) Who do you think that everyone saw at the rally

For another, because the wh-traces created by LF-movement of the wh-operators in (12a) and (12b) are all properly governed, (12a) and (12b) should both be well-formed. However, there is an obvious difference in the grammaticality of the sentences.

(12a) ?Whom did you tell that Harry saw who

(12b) *Who did you tell whom that Harry saw

May accounts for the fact that both sentences in (11) are ambiguous by replacing the empirically inadequate ECP with Pesetsky's Path Containment Condition (13).

(13) Path Containment Condition (PCC).
Intersecting A'-categorial paths must embed, not overlap--
Where a path is a set of occurrences of successively immediately dominating categorial nodes connecting a binder to a bindee.

Opposed to the ECP, the PCC allows the rule of free operator adjunction to derive LF-representations (14a) and (14b), the LFs of (11a) and (11b) respectively.

(14a) $[_{S'}who_2[_{S^4}$ everyone$_3[_{S^3}$ you think $[_{S^2}\ e_3\ [_{VP}$saw e_2 at the rally]]]]]
Path(2) = {VP, S^2, S^3, S^4, S'}
Path(3) = { S^2, S^3, S^4 }

(14b) $[_{S'}who_2[_{S^4}$ $everyone_3$ $[_{S^3}$ you think $[_{S'}that[_{S^2}$ $e_3[_{VP}saw$ e_2 at the rally]]]]]]
Path(2) = {VP, S^2, S', S^3, S^4, S'}
Path(3) = { S^2, S', S^3, S^4 }

(Note: read Path(n) as the path for $Operator_n$.) In (14a,b), Path(3) embeds in Path(2). Therefore, according to the PCC, these LF-representations are well-formed. Notice that (14a) and (14b) make the same prediction about scopal relations. That is, since the wh-operator governs the quantifier in both of LF-representations specified in (14), the Scope Principle predicts that both LFs allow free scopal relations between the operators. The PCC, then, can account for data that escapes the ECP.

Of equal importance to the fact that the PCC explains data that resists the ECP is the fact that the PCC can account for all the data that the ECP serves to explain. In particular, the PCC, like the ECP, distinguishes (2a) from (2b)--repeated here as (15 a,b).

(15a) $[_{S^4}$ every $woman_3[_{S^3}$ some $man_2[_{S^2}$ $e_2[_{VP}loves$ $e_3]]]]$

(15b) $[_{S^4}$ some $man_2[_{S^3}$ every $woman_3[_{S^2}$ $e_2[_{VP}loves$ $e_3]]]]$

The paths for (15a) are stated in (16).

(16) Path(2) = { S^2, S^3 }
Path(3) = {VP, S^2, S^3, S^4}

LF (15a) is well-formed because its paths satisfy the PCC; that is, Path(2) is properly embedded in Path(3). The paths for (15b), on the other hand, violate the PCC. (17)--which defines the paths for (15b)--shows that the paths intersect; however, they overlap rather than embed.

(17) Path(2) = { S^2, S^3, S^4}
Path(3) = {VP, S^2, S^3 }

Consequently, in accordance with the PCC, (15b) is an ill-formed LF-representation.

The PCC also makes correct predictions about the scopal differences between (6) and (9), repeated here in (18).

(18a) Who bought everything for Max.

(18b) What did everyone buy for Max

The LF-representation derived by operator adjunction for (18b) is expressed in (19).

(19) $[_{S'}what_2[_{S^3}\ everyone_3[_{S^2}\ e_3\ [_{VP}buy\ e_2$ for Max]]]]
Path(2) = {VP, S^2, S^3, S'}
Path(3) = { S^2, S^3 }

LF (19) is well-formed; its paths satisfy the PCC because they embed. (Note the wh-operator governs the quantifier, in (19), so the ambiguity of (18b) follows from the SP.) Further, operator adjunction forms two possible LF-structures for (18a). These LFs are given in (20).

(20a) $[_{S'}who_2[_{S^3}\ everything_3[_{S^2}\ e_2\ [_{VP}buy\ e_3$ for Max]]]]
Path(2) = { S^2, S^3, S'}
Path(3) = {VP, S^2, S^3 }

(20b) $[_{S'}who_2[_{S}\ e_2\ [_{VP}\ everything_3[_{VP}buy\ e_3$ for Max]]]]
Path(2) = { S, S'}
Path(3) = {VP, VP }

Of the two LF-structures, only one--(20b)--is an acceptable LF. (20a) is an ungrammatical LF because its paths overlap, in violation of the PCC. On the other hand, the paths in (20b) vacuously satisfy the PCC; they do not intersect so the PCC does not rule them out. Since (18a) has (20b) as its logical representation, the SP applies to (20b) predicting correctly that, given the fact that a VP-boundary separates the wh-operator and the quantifier, (18a) has scopal ambiguity.

Some Consequences of May's Theory of Logical Form

In this section, I will apply May's theory as outlined above to sentences with VPs that take multiple arguments. I will show that, under May's analysis, such VPs must be binary branching structures.[3]

Let us consider a multiple-argument predicate like read. In sentences such as (21) the operators/arguments of the verb have ambiguous scope. These scopal relations result from the application of the SP to (22), an LF-repesentation of (21).[4]

(21) What did John read to everyone

(22) $[_{S'}what_2[_{S^3}\ everyone_3[_{S^2}\ John\ [_{VP}\ read\ e_3$
$to\ e_2]]]]$
Path(2) = {VP, S^2, S^3, S'}
Path(3) = {VP, S^2, S^3 }

Now (22), which is a well-formed LF because it satisfies the PCC, gives the VP a nonbinary branching structure. Yet, it is also possible to give a binary branching structure for the VP, as in (23).

(23) $[_{S'}what_2[_{S^3}\ everyone_3\ [_{S^2}\ John\ [_{V''}\ [_{V'}read\ e_3]$
$to\ e_2]]]]$
a. Path(2) = {VP, S^2, S^3, S'}
Path(3) = {VP, S^2, S^3 }
b. Path(2) = {V' , V'', S^2, S^3, S'}
Path(3) = { V'', S^2, S^3 }

As (23) demonstrates, a binary branching structure for the VP, regardless of whether it is assumed that only maximal categorial nodes are specified in a path or that all categorial nodes are so specified, also produces a well-formed LF-structure.[5] So (23a,b), like (22), not only satisfies the PCC--since Path(3) is embedded in Path(2) in both path-structures stated in (23)--but also permits the SP to account for the ambiguous readings assignable to (21).

To decide which, if any, of the three logical representations that we have considered should be the logical form of (21), we need to examine other evidence. Relevant evidence comes from (24).

(24) Who did John read everything to?

Interestingly, (24) differs from (21) in that it is not ambiguous. ((24) only has the reading where the wh-operator has broad scope over the quantifier.) If (24) is assigned an LF parallell to (21)--one in which the VP has a nonbinary branching structure--then the following LF-structure can be derived for (24).[6]

(25) $[_{S'}who_2[_{S^3}\ everything_3\ [_{S^2}\ John\ [_{VP}read\ e_3\ to$
$e_2]]]]$
Path(2) = {VP, S^2, S^3, S'}
Path(3) = {VP, S^2, S^3 }

This LF-representation is perfectly grammatical: its paths fulfill the PCC. However, being well-formed, (25) allows the SP to apply to it with the consequence that, since the wh-operator governs the quantifier, (24) is predicted to be ambiguous. Obviously, such a consequence is undesirable. If, however, we assume that the VP must binary branch and that only major phrasal nodes are listed in a path-set, we can derive LF (26).

(26) $[_{S'}$who$_2[_S$ everything$_3[_S$ John $[_{V''}[_{V'}$read $e_3]$ to $e_2]]]]]$
Path(2) = {V'',S^2,S^3,S'}
Path(3) = {V'',S^2,S^3 }

(26), unfortunately, leads to the same conclusion that (25) does. That is, (26) is a grammatical LF-representation that predicts that (24) should have ambiguous scopal readings. But, if we assume that the VP must binary branch and that all phrasal nodes are specified within a path-set, we can derive the following LFs for (24).

(27a) $[_{S'}$who$_2[_{S}3$ everything$_3[_{S}2$ John $[_{V''}[_{V'}$read $e_3]$ to $e_3]]]]]$
Path(2) = { V'',S^2,S^3,S'}
Path(3) = {V',V'',S^2,S^3 }

(27b) $[_{S'}$who$_2[_S$John $[_{V''}2$ everything$_3[_{V''}1$ $[_{V'}$ read $e_3]$ to $e_2]]]]]]$
Path(2) = { V''1,V''2,S,S'}
Path(3) = {V', V''1,V"2 }

(27c) $[_{S'}$who$_2[_S$John $[_{V''}[_{V'}2$ everything$_3$ $[_{V'}1$ read $e_3]]$ to $e_3]]]$
Path(2) = { V'',S,S'}
Path(3) = {V'1,V'2 }

LFs (27a,b) are ungrammatical. The paths in these LF-structures violate the PCC because Path(2) intersects and overlaps with Path(3). So neither (27a) nor (27b) is a possible LF-structure for (24). (This an important result because if either of these LFs would be well-formed they would incorrectly predict that (24) should allow free scopal relations.) (27c), on the other hand, does not violate the PCC. The paths of (27c) do not intersect; therefore, they vacuously satisfy the PCC. This means that (27c) is a grammatical logical representation of (24). Further, because (27c) is a possible LF-structure for (24), the Scope Principle can apply to it. When we apply the SP to (27c), we discover that the wh-operator does not govern the quantifier (the intervening V''-node, as a boundary of a maximal projection, prohibits government). In accordance with the SP, the operators can only have configurationally defined scope--a correct prediction.

The PCC, then, forces us to analyze the structure of

VPs headed by verbs subcategorized for multiple arguments in terms of binary branching structures.

Further Consequences of the PCC

An interesting consequence of May's theory of Logical Form concerns the structural relationship between adjuncts and VPs. Cosider the scopal relations between the adjunct when and the quantifier everyone in (28).

(28) When did John see everyone

In (28), either operator can have broad scope. This is confirmed by the fact that (29a) and (29b) can be acceptable responses to (28).

(29a) John saw everyone yesterday.

(29b) John saw Mary a week ago; he saw Sarah yesterday; and he saw Bill earlier this morning.

To account for the ambiguity of (28), there must be an LF-representation of (28) that satisfies two conditions. First, since the wh-operator is in the COMP-node at LF, the quantifier must be able to escape the VP-node that dominates it to insure that the VP-node will not prevent the wh-operator from governing the quantifier (thereby preventing free scopal relations). Second, the PCC must be met. Satisfying the PCC, however, can be accomplished in two ways: either the operator paths do not intersect or they are properly embedded. The former case arises in LF (30).

(30) $[_{S'} when_3 [_{S^4} [_{S^3} everyone_2 [_{S^2} John [_{VP} kiss\ e_2]]] e_3]]$
Path(2) = $\{VP, S^2, S^3\}$
Path(3) = $\{S^4, S'\}$

In (30), the adjunct when is an adjunct of S^4, a node created at LF-structure (only this type of LF-representation will guarantee that the adjunct-path will not intersect with the quantifier-path). The adjunct, then, would be only an LF-argument--a possibility not compatible with current theories of predication.[7] The second case necessitates that the path of the adjunct-operator includes the path of the quantifier. That is, the path of when must include the VP-node that dominates the quantifier trace. The adjunct, therefore, must be a within the VP, not outside of it. Such conditions are captured in LF (31).

(31) $[_{S'}\text{when}_3\ [_{S^3}\ \text{everyone}_2[_{S^2}\ \text{John}\ [_{VP}\ \text{kiss}\ e_2\ e_3]]]]$
Path(2) = {VP, S^2, S^3 }
Path(3) = {VP, S^2, S^3, S'}

Notice that (31) is not only a well-formed logical representation for (28) because its paths properly embed but also a logical representation that predicts that the logical operators in (28) have free scopal relations.

To decide whether (30) or (31) (or both) is the correct representation for (28), we need to cosider further empirical data. Relevant data is provided in (32).

(32) Who saw what where

Assuming that the adjunct is an S-adjunct and assuming, as do May (1986) and Chomsky (1985), that wh-in-situ elements are moved into the COMP at the LF-level, we can derive LF (33) for (32).[8]

(33) $[_{S'}[_{NP}[\text{what}_2\ \text{where}_3]\text{who}_4][_{S^3}\ [_{S^2}\ e_4[_{VP}\text{see}\ e_2]]e_3]]$
Path(2) = {VP, S^2, S^3, S', NP}
Path(3) = { S^3, S', NP}
Path(4) = { S^2, S^3, S' }

In (33), Path(3) and Path(4) intersect but they do not embed. Consequently, this logical representation is an ill-formed LF- representation because it violates the PCC. If we assume that the adjunct is a constituent of the VP, rather than an adjunct to S, we derive LF (34) for (32).

(34) $[_{S'}[_{NP}[\text{what}_2\ \text{where}_3]\text{who}_4][_S\ e_4\ [_{VP}\ \text{see}\ e_2\ e_3]]]$
Path(2) = {VP, S, S', NP}
Path(3) = {VP, S, S', NP}
Path(4) = { S, S' }

Since all the paths embed in (34), LF (34) satisfies the PCC and is, therefore, a well-formed logical representation if (32). The consequence of the above argument is that adjuncts, at least at the LF-level, are within the verb phrase.

Given that our previous arguments demonstrate that VPs have binary branching structures for the arguments of V, the question arises: what is the branching relationship between adjuncts and subcategorized arguments within the VPs? Sentences that immediately bear upon this question are:

(35a) When did Mary read a book to everyone?

(35b) When did Bill tell everyone about Mary's problem?

(35c) When did Mary send everyone's paycheck to him?

That the operators in (35) engage in free scopal relations--see (36) for an example of a broad scope reading assigned to the quantifier in (35b)--suggests that the adjunct is at least as deeply embedded in the VP as is the argument most proximate to the verb.

(36) Bill told Sally about Mary's problem yesterday; he told Tom about it today; and he told Jean about it just minutes ago.

This is the case because if the adjunct were not as deeply embedded as is the direct object in (35a), the paths for the quantifier and the wh-operator would overlap, as (37b) demonstrates.

(37a) $[_{S'}$ when$_2[_{S^3}$ everyone$_3[_{S^2}$ Bill $[_{V''}$ $[_{V'}$ tell e_2 $e_3]$ about Mary's problem]]]]
Path(2) = $\{V', V'', S^2, S^3, S'\}$
Path(3) = $\{V', V'', S^2, S^3\}$

(37b) $[_{S'}$ when$_2[_{S^3}$ everyone$_3[_{S^2}$ Bill $[_{V''}$ $[_{V'}$ tell $e_3]$ e_2 about Mary's problem]]]]
Path(2) = $\{V'', S^2, S^3, S'\}$
Path(3) = $\{V', V'', S^2, S^3\}$

Note that as represented the paths in (37a), which assume that the adjunct is as embedded as the direct object, satisfy the PCC. However, if the adjunct is higher in the VP-node than is the direct object, as in (37b), then Path(3) = $\{V'', S^2, S^3, S'\}$. In this case, the paths will intersect and not embed, in violation of the PCC. It follows therefore that adjuncts, which are constituents of VPs, must be as proximate to the verb as is the closest argument of the verb at LF-structure. The above condition on VP-structure produces two possible logical representations for verb phrases: one in which the adjunct and the closest argument are sisters and one in which the adjunct is a sister to the verb alone. These VP-structures are given in (38).

(38a) $[_{VP}$ $[_{V'}$ V adjunct] NP]

(38b) $[_{VP}$ $[_{V'}$ V adjunct NP]]

The LF-representations in (38) make very different predictions about multiple-wh constructions, so they can be tested for empirical adequacy. (38b) predicts that sentences formed by moving a wh-object and leaving the wh-adjunct in-situ at S-structure will be as grammatical as sentences formed by moving the wh-adjunct and leaving the wh-object in-situ because both types of sentences will have logical representations that meet the PCC. That is, the LF-representations derived from multiple-wh constructions based on (38b) are either (39a) or (39b), both of which are well-formed.

(39a) $[_{S'}[_{NP}[\text{wh-adjunct}_2]\text{wh-NP}_3][_{S}\ldots[_{VP}[_{V'}\ V\ e_3\ e_2]]]]$
Path(2) = {V',VP,S,S',NP}
Path(3) = {V',VP,S,S' }

(39b) $[_{S'}[_{NP}[\text{wh-NP}_3]\text{wh-adjunct}_2][_{S}\ldots[_{VP}[_{V'}\ V\ e_3\ e_2]]]]$
Path(2) = {V',VP,S,S'}
Path(3) = {V',VP,S,S',NP]

Since the paths in (39a) and (39b) intersect and embed, either type of multiple-wh construction under consideration is predicted to be well-formed.

LF (38a) makes different predictions about multiple-wh constructions than does (38b). It predicts that multiple-wh constructions with the wh-object in-situ should violate the PCC, but such constructions with the wh-adjunct in-situ should satisfy the PCC. This can be seen by examining the paths for the two constructions under consideration, as given in (40).

(40a) $[_{S'}[_{NP}[\text{wh-adjunct}_2]\text{wh-NP}_3][_{S}\ldots[_{VP}[_{V'}\ V\ e_2]\ e_3]]]$
Path(2) = {V',VP,S,S'NP}
Path(3) = { VP,S,S' }

(40b) $[_{S'}[_{NP}[\text{wh-NP}_3]\text{wh-adjunct}_2][_{S}\ldots[_{VP}[_{V'}\ V\ e_2]\ e_3]]]$
Path(2) = {V',VP,S,S' }
Path(3) = { VP,S,S',NP}

LF (40a) satisfies the PCC: its paths properly embed. LF (40b), on the other hand, has paths that intersect and overlap--a PCC violation. So, if the logical representation for multiple-wh constructions is as stated in (38a), then such constructions are predicted to be grammatical if the wh-adjunct is left in-situ at S-structure and to be ungrammatical if the wh-object is left in-situ at S-structure. The above predictions can be tested by the data presented in (41).

(41a) ?Why did John buy what

(41b) *What did John buy why

(41c) ?When did John buy what

(41d) *What did John buy when

Now if the VP-structure is as expressed in (38b), there should be no grammatical distinction between (41a) and (41b) nor between (41c) and (41d). The fact that there is a grammatical difference between these pairs suggests that (38b) does not represent the logical structure of VPs. On the other hand, if the VP-structure at LF is the structure expressed in (38a), then we should expect the construction with the wh-adjunct in-situ to be well-formed and the construction with the wh-object in-situ to be ill-formed. Interestingly, the data does not support this prediction either: the data is exactly opposite of what it is predicted to be.

A Re-analysis of Multiple-Wh Constructions

The above results force a re-examination of our earlier assumptions (after all, at least one of our assumptions must be incorrect or we would have one of our predictions supported by, rather than both of them contradicted by, the data). I will argue here that the questionable assumption is the assumption that wh-in-situ elements move into COMP at LF (note: I am only challenging this assumption for languages that permit wh-movement as S-structure). I will argue that wh-in-situ elements remain in-situ at LF where they function as dependent, lexical variables.

If wh-in-situ elements do indeed move at LF, then we would predict that the wh-operator moved at S-structure and the wh-operator moved at LF in multiple-wh constructions would engage in free scopal relations, in accordance with the Scope Principle. We can see that this is predicted by examining the LF of (42)--which is stated in (43).

(42) Which man was kissing which woman

(43) $[_{S'}[_{NP}$[which $woman_2$]which $man_3][_S\ e_3\ [_{VP}$ kiss $e_2]]]$

LF (43) shows that under the assumption that wh-in-situ elements move at LF the wh-operators govern one another; therefore they should have free scopal relations.

Now let us consider possible responses to (42) in order to check how free the scopal relations in it really are. Note the answers given to (42) in (44).

(44a) John was kissing Mary; Bill was kissing Sue; but Tom was kissing no woman.

(44b) ?*John was kissing Mary; Bill was kissing Sue; but no man was kissing Sarah.

We can see that (44b), as a response to (42), is much worse than (44a) is. This difference is unexpected if (43) is the LF of (42). After all, LF (43) predicts that the order and the way in which the wh-arguments are instantiated should not affect grammaticality--a prediction not compatible with the evidence given in (44).

An LF-representation for (42), such as (45), that keeps the unmoved wh-elements in-situ at LF makes different predictions about grammatical responses to (42) than (43) does.

(45) $[_{S'}$which $man_2[_S$ e_2 $[_{VP}$ kiss which $woman_3]]$

In (45), Wh_2 and Wh_3 are not both independent operators that can freely choose their referents. Rather, only Wh_2 is an operator; so only Wh_2 can freely pick a referent or a non-referent (for example, <u>no man</u>). Wh_3, on the other hand, is a dependent variable--a variable licensed for a referent if and only if it is bound to a wh-operator that has chosen a referent (as opposed to choosing a non-referent). (Note that the assumption that wh-in situ expressions are variables dependent on a wh-operator will explain why the absence of a wh-operator in sentences such as "I love who" are uninterpretable on the non-echoic reading.) LF (45) then predicts that if Wh_2 selects a referent then Wh_3 can freely choose a referent or a non-referent; but if Wh_2 does not select a referent, then Wh_3 cannot choose a referent independently. So (45) predicts the following grammaticality judgments about responses to (42).

(46a) No man was kissing any woman

(46b) *No man was kissing Mary

(46c) John was kissing Mary

(46d) John was not kissing any woman

(46e) Every man wasn't kissing any woman

(46f) *No man was kissing every woman

The fact that the judgments predicted by (45) accord with accepted intuitions about responses to (42), while (43) has no way of differentiating the various responses cited in (46), suggests that (45)--a logical representation that leaves wh-elements in-situ at LF--has more empirical validity than does (43).

A second argument in support of my wh-in-situ analysis involves scopal relations between conjoined wh-phrases and other logical operators. Consider (47).

(47) Which man and which woman was some child dancing with

Example (47) is two-ways ambiguous, having the readings given in (48).

(48a) For some child x, which man y and which woman z are such that x was dancing with x and y

(48b) For which man y is there some child x_1 and for which woman z is there some child x_2 such that x_1 loves y and x_2 loves z.

The scopal ambiguity of (47), as captured in (48), follows from May's theory of scope assignment. In May's theory, (47) has LF (49).

(49) [$_{S'}$which man and which woman$_2$ [$_S$some child$_3$[$_S$e$_3$ was dancing with e$_2$]]

Since the conjoined wh-operators govern the quantifier, free scopal relations arise between the logical operators. (Note: the reading of (47) given in (48b) follows from a principle of operator distribution developed in Barwise and Cooper (1981). They demonstrate that connected operators that have wide scope over another operator distribute. This can be represented formally: $(O_1 @ O_2)O_3 = O_1O_3 @ O_2\ O_3$. Hence in (49), the wide scope reading for the conjoined wh-operators (i.e., (Which man and which woman) (some child)) is equivalent to the reading given in (48b): ((which man)(some child) and (which woman)(some child).) Now if wh-in-situ element move at LF, then we would expect (50) to have the same scopal ambiguities as does (47).

(50) Which child loves which man and which woman

Notice that LF (51)--the LF for (50) in the move-wh at LF analysis--has the same government relation between the conjoined wh-operators and Wh_3 as (49) has between the conjoined wh-operators and the quantifier.

(51) $[_S[_{NP}$[which man and which $child_2$] which $child_3][_S$ e_3 loves e_2]]

Since (49) and (51) have the same government relations between operators, we would predict that they should have the same range of readings. (50), however, does not have all the scopal possibilities of (47). It lacks (52), the equivalent of (48b).

(52) Which man y for which child x_1 and which woman z for which child x_2 are such that x_1 loves y and x_2 loves z

The move-wh at LF analysis, then, overgenerates scopal possibilities and, therefore, needs to be questioned.

A better analysis of (50) is one that assumes that wh-in-situ elements do not move at LF. This analysis would give LF-representation (53) to (50).

(53) $[_{S'}$which $child_2$ $[_S e_2$ $[_{VP}$loves which man and which woman]]]

LF (53) does not permit ambiguous scopal relations because it has but one operator--this necessarily prohibits a multiplicity of scopal configurations. The only reading that (53) allows then is the reading in which the wh-operator first selects its referent and subsequently the wh-variable makes a referent choice. So possible answers to (50) consists of a set of order pairs <which child, which man and which woman>, where the value of the first member of the ordered pair determines the value of the second member of the pair. But such answers, as predicted by (53), are the only answers to (50) that are well-formed. Although the wh-in-situ at LF analysis does account for scopal data (especially (47) and (50)) that resist the move-wh at LF analysis, there does appear to be some evidence in support of the latter analysis. In particular, sentences such as (54) seem to have scopal relations determined by a rule that moves wh-elements at LF.

(54) Who took everyone to which restaurant

The fact that the wh-operators both have scope over the quantifier is explained by (55), an LF-representation formed by the general move-Wh rule.

(55) $[_{S'}[_{NP}[\text{which restaurant}_2]\text{who}_3][_S\ e_3\ [_{VP}\ \text{everyone}_4\ [\text{take}\ e_4\ \text{to}\ e_2]]]]$

Since there is a VP-boundary between the quantifier and the wh-operators, the Scope Principle correctly permits only configurationally defined scope.

The success that the move-wh analysis has in explaining the scopal relations of (54), however, does not carry over to other types of multiple operator structures. Consider (56), which under May's analysis has LF (57).

(56) Which book did everyone read to which boy and which girl

(57) $[_{S'}[_{NP}[\text{which boy and which girl}]\ _2\text{which book}_3][_S\text{everyone}_4[_S\ e_4\ \text{read}\ e_3\ \text{to}\ e_2]]]$

Given that the operators in (57) govern one another, (57) in accordance with the SP permits free scopal relations between the operators. May's analysis, then, predicts that all the sentences in (58) could be well-formed responses to (56).

(58a) Everyone read the Bible to John and Mary

(58b) Peter read the Bible to John and Mary; and Sarah read the Koran to Jean and Harry

(58c) ?*Peter read the Bible to John and Mary; and Sarah read it to Jean and Harry.

(58d) *Peter read the Bible to John and Mary; and Sarah read the Koran to them

Two of the above responses--(58a), where the the wh-elements have broad scope over the quantifier, and (58b), where the quantifier has broad scope over the wh-elements--are well formed. The other two responses, where the quantifier has narrow scope with respect to one wh-element and broad scope with respect to the other wh-element, are less well-formed and perhaps even ill-formed. Since the data in (58) contradict the predictions made by LF (57), a logical representation that employs the general move-wh rule, there is reason to suspect that wh-movement at LF is not a permissable rule.

Unlike May's move-wh analysis of logical form, an analysis that assumes that wh-in-situ elements remain in-situ at LF can account for the scopal relations of both (54) and (56). If wh-in-situ elements are lexicalized LF-variables that are value-dependent upon the value selected by a wh-operator and are not independent operators, then (54) will have LF (59).

(59) $[_{S'}$who$_2$ $[_{S}$e$_2$ $[_{VP}$everyone$_3$$[_{VP}$ [take e$_3$] to which restaurant]]]]

Notice that since the wh-in-situ element is not an operator, it does not directly participate in scopal relations. Rather, as a dependent variable, its scope is a function of the scope of the wh-operator upon which it is value-dependent. Consequently, the fact that the wh-operator in (59) has broad scope over the quantifier necessitates that the in-situ variable also has scope over the quantifier (hence, this analysis correctly predicts the scopal relations in (54)). This analysis naturally extends to account for the scopal relations in (56). That is, because the in-situ wh-elements have their value attached to the wh-operator in LF (60), they must indirectly have the same scopal relations with respect to the quantifier as does the wh-operator.

(60) $[_{S'}$which book$_2$ $[_{S}$everyone$_3$$[_{S}$ e$_3$ $[_{VP}$[read e$_2$] to which boy and which girl]]]]

In (60), then, the only scopal relations possible are the relations between the quantifier and <u>which book</u>, and these relations are free because the wh-operator governs the quantifier. Further, the in-situ wh-elements, which are variables that do not overtly participate in scopal relations, have their values set by the wh-operator. By having their values set by the wh-operator, the in-situ wh-elements indirectly absorb the scopal relations of the wh-operator. Therefore, the wh-elements all either have broad scope or narrow scope with respect to the quantifier, but they cannot have mixed scope, as in (58c,d). The possible scopal relations in (54) and in (56), then, accord with the predictions this analysis makes about scope.

Disallowing the general move-wh rule complicates my analysis of VP-structure. After all, I have appealed to multiple-wh structures to motivate the assumption that VP-adjunctions are VP-internal and to argue that such adjuncts are in fact more proximate to the verb at LF than the subcategorized arguments of the verb are. Without move-wh as a general rule, multiple-wh constructions can no longer be enlisted as evidence to show what VP-structures the PCC mandates. In what follows, I will introduce new evidence to support my claims that (i) VP-adjuncts are VP-internal and (ii) these adjuncts are sister-related to V at LF.

VP-structure Revisited

There two types of data that support the claim that VP-adjuncts are VP-internal: binding data and VP-deletion data. Some evidence in support of the above claim comes from the binding relations involving R(eferential)-expressions. In the Government and Binding framework, Binding Principle C states that an R-expression must be A-free.[9] This means that an R-expression cannot be coindexed with any element that c-commands it from an A-position. Principle C, then, predicts the binding in (61).

(61a) John broke (only) the piano$_i$ when he dropped it$_i$

(61b) His$_i$ mother loves (only) John$_i$

(61c) *He$_i$ loves (only) John's mother

Binding between the piano and it in (61a) is well-formed, in part, because Principle C is satisfied. That is, since the c-command domain of the pronoun lies within the adjunct-clause, the pronoun does not c-command the R-expression John; so John is A-free. The binding relations specified in (61b) are also well-formed because the pronoun, which has its c-command domain restricted to the NP of which it is a constituent, does not c-command John, thereby preserving Principle C. Opposed to the binding relations illustrated in (61a,b), the binding relations in (61c) are ungrammatical. The pronoun in this sentence has as its c-command domain the entire S; consequently, John is coindexed with and c-commanded by an element in an A-position--an obvious violation of Principle C.

If we apply Principle C to sentences with VP-adjuncts, we can discover something about the structural relationship between adjuncts and verb phrases. Consider the sentences in (62).

(62a) *It amazed her$_i$ that (only) Mary$_i$ was elected

(62b) *John broke it$_i$ when he dropped (only) the piano$_i$

(62c) *John annoyed her$_i$ by talking to (only) Mary$_i$

(62d) *Mary gave it_i to John before she read (only) the $book_i$

The binding relations expressed in (62) are all ungrammatical. They are so, it can be argued, because they all violate Principle C. The Principle C violation in (62a) is obvious. Given that the VP-structure of (62a) is (63), with both the pronoun and the embedded S within the VP, it follows that since the R-expression Mary is inside the c-command domain of a pronoun that is both in an A-position and coindexed with the R-expression, the R-expression is not A-free.

(63) $[_{VP}$...her_i that $Mary_i$...]

A similar explanation can be advanced for the binding violations in (62b-d) under the assumption that the adjunct lies within the VP. That is, if the structure of the matrix verb phrase is as stated in (64), then the pronoun, which occupies an A-position, will c-command and be coindexed with an R-expresion, in violation of Principle C.

(64) $[_{VP}$...it_i when he dropped the $piano_i$]

If, on the other hand, it is assumed that the adjuncts in (62b-d) are not VP-internal, then the R-expression in the adjunct will not be in the c-command domain of the pronoun--as shown in (65)--and the binding relations expressed in these sentences should be grammatical.

(65) $[_S$...$[_{VP}$...it_i]$[_{S'}$when he dropped the $piano_i$]]

So the ill-formedness of the binding relations in (62) follows only if it is assumed that the adjuncts lie within the VP.

Another binding argument in support of the VP-internal analysis of adjuncts concerns quantifier-pronoun binding. May argues that the binding relations in (66) follow from the PCC.

(66a) $Everyone_i$ loves his_i mother

(66b) *His_i mother loves $everyone_i$

May assigns the sentences in (66) LF-representations (67a,b), respectively.

(67a) $[_{S^3}$ $everyone_i$$[_{S^2}$ e_i $[_{VP}$loves his_i mother]]]
Path(e_i) = { S^2,S^3}

Path(his_i) = {VP,S^2,S^3}

(67b) [$_{S}$3 everyone$_i$ [$_{S}$2 [$_{NP}$ his$_i$ mother] [$_{VP}$ loves e$_i$]]]
Path(e_i) = {VP, S^2,S^3}
Path(his_i) = { NP,S^2,S^3}

LF (67a) is grammatical in May's analysis because the paths intersect and embed; and LF (67b) is ungrammatical because the paths intersect and overlap. The above analysis can apply to (68).

(68) Mary greeted every man$_i$ when he$_i$ first arrived

If we attempt to explain the well-formed binding relations stipulated in (68) by assuming a logical representation in which the adjunct lies outside the VP, we will posit the following LF.

(69) [$_{S}$3 everyone$_i$ [$_{S}$2 Mary [$_{VP}$greeted e$_i$] [$_{S*}$he$_i$...]]]
Path(e_i) = { VP,S^2,S^3}
Path(he_i) = {S*, S^2,S^3}

If, however, we assume that the adjunct is VP-internal, we will posit LF (70).

(70) [$_{S}$3 everyone$_i$ [$_{S}$2 Mary [$_{VP}$ greeted e$_i$ [$_{S*}$ he$_i$...]]]]
Path(e_i) = { VP,S^2,S^3}
Path(he_i) = {S*,VP,S^2,S^3]

Of the two possible LFs, only one--(70)--is well-formed. That is, (69) is an ungrammatical representation because its paths violate the PCC, and (70) is a grammatical representation because its paths satisfy the PCC. Therefore, binding relations in (68) are correctly captured only if it assumed that the adjunct is VP-internal at the level of Logical Form.

The second type of data that supports the claim that adjuncts are VP-internal involves data from VP-deletion. Since VP-deletion is considered a good test of VP-constituency, we can employ such deletion data to determine whether an adjunct does indeed lie within a verb phrase. The relation between VP-structure and VP-deletion can be observed in (71).

(71a) John saw Mary and so did Sue e

(71b) John kissed Mary yesterday but he didn't e today

Current analyses of VP-deletion data would argue that what is missing/deleted in the sentences in (71) are those constituents that comprise the verb phrase. So in (71a), the empty element e must have as its antecedent the VP of the first conjunct (giving the reading for the second conjunct that 'Sue [saw Mary]'). And in (71b), the fact that <u>today</u> can be appended to the second conjunct suggests that <u>yesterday</u> is not part of the first VP (or else the reading of the second conjunct would be: 'he didn't [kiss Mary yesterday] today').

That the deleted elements in VP-deletion sentences consist only of VP-constituents allows us to use such sentences to test whether or not adjuncts are VP-internal. To this end, consider (72).

(72) John kicked the dog because he hated it and so did Bill e

Interestingly, what the second conjunct in (72) can mean is that 'Bill kicked the dog because he hated it'; what it cannot mean is simply that 'Bill kicked the dog.' (72) suggests that the empty element e includes within it the because-adjunct. Hence, the adjunct is VP-internal. This preliminary conclusion can be tested further.

(73a) John didn't kiss Mary because he loved her but Bill did e

(73b) *John didn't kiss Mary because he loved her but Bill did e because he was told to

The sentences in (73) confirm our earlier conclusion. (73a), like (72), demands a reading in which the adjunct is included in e, thus re-inforcing the conclusion that adjuncts are VP-internal. And (73b) provides similar re-inforcement. That is, if we assume that the adjunct is outside the VP in (73b), then we will not be able to explain the ungrammaticality of the sentence (because the second conjunct could have the grammatical reading 'Bill did [$_{VP}$ kiss Mary] because he was told to'). However, if the adjunct is VP-internal, then the ungrammaticality of (73b) follows from the Projection Principle, which will disallow (74)--the reading of (73b) in which the adjunct lies within the VP--for the same reason that it probibits (76): for having too many arguments.

(74) *Bill did [$_{VP}$ [kiss Mary because he loved her] because he was told to]

(75) *John kissed Mary the sofa

VP-deletion data like binding data, then supports the assumption that adjuncts are VP-internal.

Granting that adjuncts are VP-internal leads to the question: what structural relations are there between the adjunct and the other constituents of a verb phrase. I will argue here that adjuncts form part of the predicate, being adjoined to (i.e., modifying) the verb before the subcategorized arguments of the verb are adjoined to it. Since my claim that adjuncts have a closer logical relationship with the verb than do the arguments of the verb is extremely controversial, I will offer several (four) arguments for it.[10]

The first argument in support of the above claim is provided by Williams' (1977) VP Rule. This rule allows all the constituents of V' (V and its sisters) to be deleted. The examples in (76) show the effect ot the VP Rule.

(76a) Who sent a flower to whom
John did to Mary

(76b) Who sent Mary what
*John did a flower

Example (76a) demonstrates that if the complete V'-constituency (send a flower, in this case) is deleted, the remaining structure can function as a well-formed response to the given question. And (76b) demonstrates that if only part of V' is deleted (see Wilkins and Culicover (1984) for arguments that both NPs are sisters of the verb), then the remaining structure is ungrammatical. So all the constituents of V' must be deleted to form a grammatical structure. The VP Rule then provides a test for V'-constituency. Consequently, by applying the VP Rule to sentences with VP-adjuncts, we can determine whether or not an adjunct forms a constituent with a verb. Consider (77).

(77a) Who kissed whom after the election results were announced
John did Mary.

(77b) Who was celebrating with whom because the Astros won
John was with Mary

(77) reveals two facts about VP-structure. First, since the verb and the adjunct can undergo the VP Rule together in (75), we can tentatively conclude that they form a V' constituent. Second, that the VP-object can remain behind without leaving an ungrammatical structure suggests that the object is not part of the V'-constituent in (77). To be concluded from (77), then, is that the VP has structure (78) at LF.

(78) $[_{VP}\ [_{V'}$ V adjunct]NP-argument]

A second argument for structural representations like (78) involves binding data. Binding relations in (79) test VP-constituent structure.

(79a) Who did Mary give several $books_i$ to after she had read $them_i$

(79b) What movie would Mary take no man_i to before she was properly introduced to him_i

(79c) What does Mary talk to every man_i about just before she fires him_i

Assuming that adjuncts lie outside V' and recalling earlier arguments that in structures like (79) the quantifier must adjoin to V' (where V' now is defined as [V NP]), we posit LF (80) for (79).

(80) $\ldots[_{VP}\ [_{V'2}\ Q_i\ [_{V'1}\ V\ e_i]]\ldots[_{S*}\ldots pronoun_i\ldots]]$
Path(e_i) = {V',V'}
Path($pronoun_i$) = undefined
where Q_i is a quantifier and S* is the adjunct-clause

Since there is no path from $pronoun_i$ to $Quantifier_i$, Path(pronoun) is undefined; hence the pronoun is not properly bound. The examples in (79) then should be as ungrammatical as the example in (81a), where the undefined path from his_i to the quantifier in (81b) makes the LF (81b) ungrammatical.

(81a) *Which movie did his_i mother take $everyone_i$ to

(81b) $[_{S'}$which $movie_2$ $[_S$ his_i mother $[_{VP}\ [_{V'}$ $everyone_i$ $[_{V'}$ take $e_i]]$ to $e_2]]]$
Path(which) = { VP,S,S'}
Path(e_i) = {V' }
Path(his_i)= undefined

The fact that the sentences in (79) are grammatical under the stipulated binding relations, while the one in (81a) is not, suggests that Path(pronoun) in the LF for (79) cannot be undefined. To express a well-defined path Path(pronoun) for (79), we must assume that the adjunct lies within V'--this will allow the pronoun to form a path with the quantifier that it is coindexed with. From the above assumption, we can derive two well-formed logical representations for the sentences in (79).

(82a) ...$[_{VP}$ $[_{V'2}$ Q_i $[_{V'1}$ V e_i $[_{S*}$...$pronoun_i$...]...]]]
Path(e_i) = { V',V'}
Path($pronoun_i$) = {S*,V',V'}

(82b) ...$[_{VP}$ $[_{V''2}$ Q_i $[_{V''1}$ $[_{V'}$ V $[_{S*}$...$pronoun_i$...]]
e_i]]]
Path(e_i) = { V',V",V"}
Path($pronoun_i$) = {S*,V',V",V"}

Notice that both logical representations stated in (82) are grammatical: they both satisfy the PCC.

At this point in our argument, we have facilitated two possible logical structures for adjuncts: one where the adjunct is the sole sister of the verb (82b) and one where the adjunct shares V-sisterhood with the most proximate argument of the verb (82a). There are two types of evidence that can help decide between the variant logical representations. The first type of evidence comes from data generated by the VP Rule. As previously discussed, VP Deletion shows that (82a), an LF-representation in which a verb , its NP-object, and an adjunct are sister within a V'-constituent, is ill-formed and that an LF-representation, which has binary sisterhood as expressed in (82b), is well-formed. The second type of evidence comes from sentences that have multiple adjuncts. If (82a) is the correct representation, then all adjuncts must be sisters with the verb, with the most proximate argument of the verb, and with one another. If (82b), on the other hand, is the correct representation, then adjuncts need not be sisters with the NP-argument nor with one another; in fact, if VP-structure is binary in nature, it would be expected that adjucts would have a structure like: $[_{VP}$ $[_{V''}$ $[_{V'}$ V $Adjunct_1$] $Adjunct_2$] NP-object]]]. With these predictions in mind, let us consider (83) and some Gapping data associated with it, as illustrated in (84).

(83) John left after Mary returned because he was angry.

(84a) and Bill e because he was sad

(84b) *and Bill e after Jean returned

Assuming the constituent structure [$_{V'}$ V Adjunct$_1$ Adjunct$_2$], we cannot explain why it is possible to gap only part of a constituent, as in (84a), nor why one ajunct can gap while the other one cannot, as in (84b). However, we can explain the differences in (84) by positing a structure where the adjuncts are not sisters and where the sisters are ordered as verbal modifiers. Such a structure, stated in (85), permits the gapping of the after-adjunct but not the because-adjunct because only the after-adjunct forms a constituent with the verb.

(85) [$_{V''}$ [$_{V'}$ V [after...]] [because...]]

There is a third argument in support of LF (78)--an argument drawn from the evidence presented in (86).

(86a) What did John read to Mary; and Bill, to Sue

(86b) Who did John read a poem to; and Bill, a novel to

Notice the different types of interpretations that are assigned to (86a) and (86b). In (86a), the wh-operator does not bind the wh-variable in the deleted constituent of the second conjunct. This is obvious from the responses that can be given to (86a).

(87a) The Bible.

(87b) John read the Bible to Mary and Bill read the Koran to Sue

(87b) demonstrates that the wh-operator can be instantiated differently for each conjunct in (86a); therefore, the operator does not bind both the wh-trace in the first conjunct and the variable in the gapped constituent of the second conjunct (V' is the gapped constituent and it consists of [V [$_{NP}$ e]], where is an empty argument of the verb--hence a variable). In (86b), on the other hand, the wh-operator does bind its trace in the first and the variable in the second conjunct. That such is indeed the case can be seen in responses to (88), where a response is acceptable only if the same value is given to the wh-trace in the first conjunct and the variable in the second conjunct.

(88a) Betty

(88b) ?*John read a poem to Betty and Bill read a novel to Sue

Before considering explanations for the interpretative differences between (86a) and (86b), let us observe some of the properties of the sentences in (86). First, notice that there are two empty elements in each sentence: a gapped verb and an empty NP--a fact that will be very important to an explanation of (86a). Second, note that since the variable in the second conjunct of the sentences is assigned an interpretation, it must be in the c-command domain of some operator (or else it would not be properly bound). Third, example (89) demonstrates that if there is not a variable in the second conjunct, the construction will not be grammatical.

(89a) *Who did Mary read a poem to and Sarah a novel to Jean

(89b) *What did Mary read to John and Sarah a poem to Mike

Fourth, from (90), we can observe that only a wh-operator can license the variable in the second conjunct.

(90) *John read a novel to someone and Bill, a poem to

With the forementioned properties in mind, an explanation for the interpretative differences between (86a) and (86b) can be given along the following lines. First, to explain the fact that the wh-operator binds the variable in the second conjunct in (86b), assume that the logical representation of (86b) has the variable within the c-command domain of the wh-operator. This condition is satisfied by structures such as (91) (we are ignoring the fact that (86b) is a gapping structure because the verb-gap is irrelevant to the binding of the variable).

(91) $[_{S'}\ wh_i\ [_S\ [_S \ldots e_i \ldots]$ and $[_S \ldots t_i \ldots]]]$
where e_i is the wh-trace and t_i is a variable in VP of the second conjunct.

From LF (91), it is possible to account for the fact that both empty elements are assigned the same interpretation in (86b) because they both are bound to the same operator. Second, to explain the binding in (86a), assume that the gapped constituent includes both the NP-variable and the verb. The object-variable would then be part of an empty constituent, as in (92).

(92) $[_{S'}$ wh_i $[_S$ $[_S...[_{V'}$ read $e_i...]$ and $[_S...[_{V'}$ e_V $t_i]...]]]$

(Note: I articulate the deleted elements in the gapped constituent in (92) rather than just the constituent itself--$[_{V'}e]$--because structures that are like (86) but do not have a variable present in the second conjunct are ill-formed: the examples in (89) show the necessity of having an NP- variable present in the second conjunct in order to have a grammatical structure.) Now although the variable in the gapped constituent is bound by the wh-operator, it cannot take its interpretation directly from the operator because the gapped element, of which the variable is a constituent, has to be bound to and take its interpretation from some antecedent, the V'-constituent in the first conjunct. Therefore, the gapped constituent in (92) must take as its antecedent $[_{V'}$ read e]. The interpretation given to V' in the second conjunct, then, has a variable in it that is not directly bound (again, the variable is bound in (92)--this explains the grammaticality of (86a)-- but it is not constrained in the interpretation it takes within the gapped V'-constituent). Consequently, the variable can be interpreted independent of its bound counterpart in the first conjunct.

Crucial to the concerns of this paper is not the claim that the variable in the second conjunct of (92) is a parameterized variable (an interesting claim in its own right) but the claim that the differences in the interpretations of (86a) and (86b) depend on the fact that the variable in the second conjunct is part of the gapped constituent. This latter claim, therefore, is one that needs further verification. Support for the claim under consideration comes from (93) and (94).

(93) ?Which book was John reading to Mary and Bill reading to Sue

Now if the free interpretation of the variable in (86a) is independent of the relationship between the gapped verb and the variable, then we would expect that in sentences like (93) (sentences without gapped verbs) the range of interpretation for the variable would be the same as it is in (86a). However, the variable in the second conjunct of (93) is interpreted like the varible in (86b), not like (86a). That is, in non-gapped sentences, the variable is directly bound to the wh-operator. We are forced to conclude then that the interpretation of the variable in (86a) is dependent upon its relationship with the verb. Further, the claim that it is V'-gapping that is responsible for the interpretative differences in (86) can be tested by examples in which the V'-argument is not adjacent to the gapped verb; hence the argument cannot be said to be gapped with the verb. Such an example is provided in (94).

(94) ??Who did John talk to about Mary's problems and Jean to about Bill's problems

Notice that (94) is interpreted like (86b), not like (86a)--this can be seen in (95).

(95a) Sarah

(96a) ?*John talked to Benny about Mary' problems and Jean talked to Alice about Bill's problems

From (95), we see that only the response where the wh-operator binds both its trace and the variable is well-formed. So when the V'-argument is not adjacent to the verb and, therefore, not gapped with it, as in (94), the variable cannot have a parameterized interpretation.

Let us now assume that it is V'-gapping that explains the existence of the parameterized variable in sentences like (86). This assumption permits us to determine whether or not an adjunct is adjacent to the verb within the V'-constituent. Consider (96).

(96a) Why did John kiss Mary; and Bill, Sue

(96b) When did Mary kiss John; and Sue, Bill

(96c) Where did John meet Mary; and Bill, Sue

The sentences in (96) permit the same range of interpretations for their variables as (86a) does, with the variable in the second conjunct free to take a value different from the adjunct-trace in the first conjunct. This value differentiation is made obvious in responses to (96).

(97) John kissed Mary because he loved her and Bill kissed Sue because he was told to

Example (97) shows that the adjunct-variable is "free" to instantiate differently than the adjunct-trace. Given that V'-gapping is responsible for the readings in which the variable in the second conjunct takes parameterized values, we can conclude that the adjunct in (96) is a constituent of

V', more particularly an adjacent sister of V.

My fourth, and final, argument for LF-representations in which adjuncts are the most proximate arguments of a verb is taken from the data given in (98).

(98a) Why did John meet Mary before Bill did e Jean

(98b) Where did John meet Mary after Bill did e Jean

What needs to be explained in (98) is why the empty element in (98b) can include, within its interpretation, the wh-adjunct, while (98a) cannot do so with its wh-adjunct. It is possible to see these different interpretations more clearly when we recast (98) as (99).

(99a) *Why did John meet Mary before Bill met Jean for that reason

(99b) Where did John meet Mary before Bill met Jean there

Notice that in (99a) the wh-adjunct position cannot be filled in the adjunct-clause, but in (99b) the wh-adjunct can be filled in the adjunct-clause.

An explanation of the contrasts in (98) and (99) follows from a condition on the deletion of arguments in adjuncts. This condition can be extracted from the evidence in (100).

(100a) The book that Mary read to John before Bill did to Jean

(100b) ??The woman that Mary talked to about Tom's problem before Jean did to about Bill's problem

The examples in (100) demonstrate that, in adjuncts with deleted verbs, an argument of the verb can be deleted only if the if it is an adjacent sister of the verb. Given the above condition on deletion within an adjunct, we could hypothesize that the ungrammaticality of (99a) and the inability to assign a wh-adjunct reading to the VP within the adjunct-clause arises because the wh-adjuncts are not sisters of the verb. If we accept the above assumptions, we will posit the following logical representations for the VPs in (99).

(101a) $[_{VP}$ $[_{V''}$ $[_{V'}$ V before-adjunct] why-adjunct]]

(101b) $[_{VP}\ [_{V''}\ [_{V'}$ V where-adjunct] before-adjunct]]

Although the LFs in (101) are the LFs for the matrix VPs in (99), they are also the LFs for the VPs in the adjunct-clause. To see this, note that the before-clause cannot take a before-clause of its own--which is naturally explained if a before-clause is already present in adjunct-clause.

(102) *Where did John meet Mary before Bill did Jean before it rained

So the adjunct-clause VPs in (98), under the interpretations given in (99), have the same structure as do the matrix clauses: the structure expressed in (101). Given that the adjunct-clauses in (98) have the VP-structures stated in (101), we can explain the differences in interpretation between (98a) and (98b). In particular, since the wh-adjunct is not a sister with the verb in (101a), it cannot be deleted with the verb; therefore (98a) cannot have the why-adjunct present in the verb phrase of the adjunct-clause, explaining why (98a) lacks an interpretation that permits the why-adjunct to be part of adjunct-clause VP. Conversely, the deletion of the verb and its wh-adjunct is acceptable in (98b) because these two elements form a constituent. As a consequence, the verb phrase in the adjunct-clause of (98b) can be interpreted as including the wh-adjunct.

Additional support for the conclusions just derived can be found in multiple-wh constructions. The following sentences give the relevant evidence.

(103a) ?Who ate where when

(103b) ?*Who ate when where

(103c) ?Who ate when why

(103d) *Who ate why when

The fact that the ordering of the wh-elements in (103) is crucial to the well-formedness of the sentences suggests that these wh-elements cannot have equivalent logical relations with the verb. That is, (103a,b) show that structures are grammatical if <u>where</u> is more proximate to the verb than <u>when</u> is, but ungrammatical if <u>when</u> is more proximate than <u>where</u>. Similar results obtain for <u>where</u> and <u>why</u> in (103c,d). Importantly, the above relations are exactly those predicted by (101).

The arguments that I have put forth in this section converge to the same point: VPs binary branch in such a way that their verbs accept arguments one at a time, beginning with all the adjuncts and ending with the NP-arguments. On some intuitive level, this conclusion seems correct. After all, in (104), the NP-object Mary seems more like the argument of the extended predicate see after Bill left, as represented in (104), than an argument of see.

(104a) John saw Mary after Bill left
(104b) (see after Bill left) (John, Mary)

Further Considerations

In this paper, I have argued that VP-structures binary branch and that VP-adjuncts are the most proximate arguments of V at LF. These conclusions raise some interesting questions about the relationship between the levels of representation posited in GB and some of the principles of grammar hypothesized in GB (in particular Case Theory, Th-Criterion, and the Projection Principle). For one, what needs to be explained is why VP-adjuncts are discontinuous with the verb at S-structure when they are continuous with the verb at LF. Now there seems to be an answer to this question. The reason for this S-structure discontinuity follows in a straightforward way from Case Theory within the GB-framework. According to Case Theory, structural case is assigned at S-structure. Further, Case is only assigned under conditions of adjacency. For case assignment of the direct object within a VP, the above conditions require the object to be adjacent to its case assigner (the verb) at S-structure. It is, therefore, the case that the verb and its "logical" sister (the adjunct) cannot be sisters at S-structure or else the assignment of structural Case of the object will be prohibited.

Although we can suggest an answer to problem that my analysis raises for Case Theory, there are some questions that arise that cannot be resolved so easily. These questions have to do with the D-structure position of VP-adjuncts. Are the adjuncts D-structure sisters of the verb? If so, doesn't that configuration interfere with th-marking? (Relatedly, can X'-elements, as well as X^0-elements, th-mark complements--as N' may do with its arguments when N^0 is modified by an adjective?) If not, what is the mechanism through which an adjunct comes to be the "logical" sister of a verb? Such questions, although very interesting, are however beyond the scope of this paper and must await empirical investigation.

NOTES

1 The Empty Category Principle (ECP) states that:

(i) An empty category must be properly governed.

There several definitions of proper government (see Aoun and Sportiche (1982) and Chomsky (1982, 1986). May's definition of proper government, although never stated, seems to be a notion built upon local antecedent government, where an empty category cannot be separated from its antecedent by another possible binder.

2 An A'-operator is informally defined as an operator that has moved to a non-argument position.

3 Chomsky (1986) argues that there is a binary relationship between an X^0 category and its complement and between an X^1 category and its specifier. However, he allows the internal structure of the complement and of the specifier to be nonbinary. My analysis argues that all constituent structure is binary.

4 Another LF-representation is possible for (21).

(i) [which novel$_2$[John [$_{VP}$ everyone$_3$ [$_{VP}$ read e$_3$ to e$_2$]]]

However, since LF (i) cannot predict the ambiguity of (21) because the VP-node prohibits free scopal relations, I do not consider it as an LF for (21).

5 The assumption that it is possible to adjunct element to non-maximal categories is a controversial assumption. Chomsky (1986: 6) claims that elements only adjunct to maximal categories. On the other hand, Fiengo and Higginbotham (1981) argue that adjunction to interrmediate categories is possible.

6 LF (i) can also be derived for (24).

(i) [who$_2$ [John [$_{VP}$ every book$_3$ [$_{VP}$ read e$_3$ to e$_2$]]]]

This logical representation both satisfies the PCC and predicts the correct scopal relations for (24). I do not discuss (i) because (i) is irrelevant to the issue under consideration: that May's theory overgenerates logical representations for (24). I am attempting to develop a theory of logical form that permits all and only the correct logical representations for a sentence.

7 The assumption that the adjunct could be an argument only at LF violates the Projection Principle, which states that all arguments are represented at each syntactic level (D-structure, S-structure, and LF).

8 May (1985) and Chomsky (1986) assume that wh-in-situ elements are adjoined to COMP at LF. May refines this assumption by claiming that only one operator can be adjoined per projection. For (33), this means that the wh-in-situ elements do not adjoin to COMP, which already has the wh-element that has moved at S-structure adjoined, but to the wh-element already in COMP. I will follow May's assumption in all the logical representations that I give for multiple-wh constructions.

9 I am using the Binding Principles developed in Chomsky (1981, 1982). Principles of the Theory of Binding

A. An anaphor is bound in its governing category
B. A pronominal is free in its governing category
C. An R-expression is free

The terms "bound" and "free" are defined as A-bound and A-free respectively; that is, bound means bound by an element in an A-position and free means not bound by an element in an A-position.

10 The claim that VP-adjuncts are more proximate to the verb than V-arguments are is controversial because it goes against the prevalent assumption in GB that such adjuncts are outside the VP. See Chomsky (1986) for arguments in support of the current GB-assumption about adjuncts.

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