CONCERNING THE NOTION "BASE COMPONENT OF A TRANSFORMATIONAL GRAMMAR"

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This paper originated as a term paper written during Anderson's first semester as a graduate student at M.I.T. (winter 1966-1967) and was circulated in duplicated form at that time. In it, Anderson tackles a problem that has largely been avoided by generative grammarians, namely that of specifying what the substance of the base rules of a transformational grammar is. He shows that the standard conception of base rules conflates two independent notions - definitions of syntactic categories (which Anderson takes to be largely universal) and language-particular rules of constituent order - and argues that when these notions are separated and each made precise, the mechanisms corresponding to the former render unnecessary the tree-pruning principles of Ross (1969a).

Anderson's proposals share with the structure-preserving principle of Emonds (1970) the characteristic that the effects of transformations are constrained by the "base rules". However, Emonds' proposals do not separate word-order rules from definitions of categories and impose no particular constraint on the content of base rules.

It should be kept in mind that Anderson's concern is with how to fit universal category definitions into a theory of grammar, not with justifying the particular definitions that he proposes. The definitions, in fact, are merely a restatement of the particular universal base rules that were

accepted by Ross and George Lakoff at the time this paper was written. One point of constituent structure that Anderson does try to justify is contested in Bresnan (1974), who argues convincingly that complementizers are "Chomsky-adjuncts" of the Ss that they go with.

The final argument in the paper, concerning examples (27)-(31), is incorrect as it stands, since the meaning of (27) corresponds not to (28), in which the main clauses are conjoined, but to a structure in which hate *has a conjoined complement* 'Δ arrest John and Δ arrest Bill'. *The multiple* fors *in (27) result from the "spreading" of a single occurrence of* for, *much the same way that a single occurrence of the past participle morpheme is spread over the conjuncts in* I have often eaten a pizza and been sick an hour later. *It may be possible to rescue this argument if one replaces* and *by* or *in (27) and takes the revised (27) as arising from (28) by a derivation involving the And-or conversion rule proposed in Horn (1972).*

In a recent study, McCawley (1968a) discussed the form that the base component of a grammar should take and evaluated the empirical consequences of each of several proposals in terms of the assertions made about language by each. He has proposed that the phrase structure rules of a transformational grammar be viewed as an (unordered) set of conditions for the well-formedness of underlying phrase markers, rather than as a set of ordered rules that construct such objects (with or without an intermediate representation as a class of equivalent derivations in a string rewriting system).

Recent research in generative grammar has led to a detailed examination of the possibility that some significantly large portion of the base component is not a part of the grammars of particular languages at all, but is rather provided by universal grammatical theory. The strongest hypothesis about the contribution of universal grammar to the base so far taken seriously is the assertion that the categorial component of the grammar consists of exactly the following unordered conditions, stated here in the notation proposed by McCawley:

(1) < S; S* >

< S; NP VP >

< NP; N(S) >

< NP; NP S >

< NP; NP* >

< VP; VP* >

< VP; V (NP) (S) >

(i.e., a node labeled S may directly dominate a sequence of nodes labeled S; a node labeled S may directly dominate a node labeled NP followed by a node labeled VP; etc.). It will be noted that the above rules are exceedingly simple in form, and if it can be shown that they constitute the (universal) base, the formal mechanism seems overly elaborate for the task it is called upon to perform in stating them. In fact, most of these rules appear to be little more than a statement of what it means for a constituent to be of type NP, VP, or S. Such an interpretation will be suggested here.

In the same paper, McCawley suggests a formalism for the expression of the structure of the linguistic objects called trees. A tree is said to consist of a finite set of objects called "nodes" (represented here by lower case letters x, y, z, etc.) and three relationships that relate the nodes to each other and to a finite set of elements called "labels" (represented by L_0, L_1, ...):

(2) $x\rho y$ 'x directly dominates y'

(3) $x\alpha L$ 'x bears the label L'

(4) $x\lambda y$ 'x is to the left of y'

In addition, the relation

(5) $x\rho^* y$ 'x ultimately dominates y'

can be said to hold between x and y if

(6) there exists a sequence of nodes $x_1, x_2, \ldots x_n$ such that $x\rho x_1$, $x_1\rho x_2$, ..., $x_{n-1}\rho x_n$, $x_n\rho y$.

In terms of these relations, trees must meet the following conditions:

(7) a. $(\exists x_0)(\forall x: x \neq x_0)(\sim (x\rho x_0) \cdot (x_0\rho^* x))$

(i.e., the tree is 'rooted' and 'connected')

b. $(\forall x_1, x_2, y)(x_1\rho y \cdot x_2\rho y \rightarrow x_1 = x_2)$

(i.e., the tree has no 'loops')

c. $(\forall x)(\exists L)(x\alpha L \cdot (\forall L')(x\alpha L' \rightarrow L = L'))$

(i.e., every node has exactly one label)

I should like to propose that certain of the nodes in any tree are labeled with the basic lexical categories, N(oun), V(erb), and C(onjunction). Assuming that every syntactic tree will have nodes labeled N, V, or C, the following conditions may also be imposed on trees:

(8) $(\forall x)(x\alpha N \vee x\alpha V \vee x\alpha C \Leftrightarrow \sim(\exists y)(x\rho y))$

thus, all nonlexical nodes must be nonterminal, i.e., must branch (possibly unarily), and no lexical nodes may do so.

Given a tree of the above form, we may say that labels can be associated with nodes not already labeled N, V, or C by assigning the labels NP, VP, S according to the following implicational definitions:

(9) a. $((x\rho y)\cdot(y\alpha N)) \rightarrow x\alpha NP$

b. $((x\rho y)\cdot(y\alpha V)) \rightarrow x\alpha VP$

c. $((x\rho y)\cdot(x\rho z)\cdot(y\alpha NP)\cdot(z\alpha VP) \rightarrow x\alpha S$

d. $(\forall L)((\forall x)(y\rho x \rightarrow ((x\alpha L)\vee(x\alpha C))) \rightarrow y\alpha L)$

Note that (9a-c) are simply definitions of what it means to be a NP, VP, or S, while (9d) is the assertion that a node that dominates only nodes of one type (and possibly a conjunction) is of the same type. A set of nodes meeting conditions (7) and (8) are labeled in accordance with conditions (9a-d) will be said to be a "constituent structure tree" and will be subject to the following condition of redundant node deletion:

(10) $((x\rho y)\cdot(x\alpha L)\cdot(y\alpha L)\cdot \sim(\exists z)((x\rho z)\cdot(z \neq y))) \rightarrow (x = y)$

This principle asserts that it is unnecessary to label a constituent more than once: if a node exhaustively dominates another node of the same category, it is to be set equal to it, which is equivalent to deleting the "upper" of the two.

In order to specify exactly the class of all trees that would be considered well formed by the rules of the universal base given in (1), which will be called "underlying constituent structure trees", it is necessary to require that the members of this class meet the following additional conditions:

(11) a. if x_0 is the root of tree T, $x_0\alpha S$

b. $((x\rho y \cdot ((y\alpha N)\vee(y\alpha V))) \rightarrow \sim(\exists z)((x\rho z) \cdot (z \neq y) \cdot ((z\alpha N)\vee(z\alpha V)))$

c. $((x\rho y) \cdot (y\alpha V)) \rightarrow \sim (\exists z)((x\rho z) \cdot (z\alpha VP))$

d. $((x\rho y) \cdot (y\alpha N)) \rightarrow \sim (\exists z)((x\rho z) \cdot ((z\alpha NP) v (z\alpha VP)))$

e. $((x\rho y) \cdot (y\alpha VP)) \rightarrow \sim (\exists z)((x\rho z) \cdot (z\alpha S))$

f. $((x\rho y) \cdot (y\alpha C)) \rightarrow \sim (\exists L)((x\alpha L) \cdot (\forall z)((x\rho z) \rightarrow ((z\alpha L) v (z = y)) \cdot (\exists z_1, z_2 \neq y)((x\rho z_1) \cdot (x\rho z_2)))$

g. $(\forall x, y, z, L)((x\rho y) \cdot (x\rho z) \cdot (y\alpha L) \cdot (z\alpha L)) \rightarrow (x\alpha L) \cdot (\forall w)((x\rho w) \rightarrow ((w\alpha L) v (w\alpha C)))$

The intent of (11a) is to insure that underlying structures underlie sentences; that of (11b) to assure that a node dominates at most one lexical item in deep structure; that of (11c,d) to assure that NP and VP cannot dominate other instances of these categories except for conjoined structures and the NP direct object of a VP; (11e) asserts that a sentence may not dominate an S as well as its expansion into NP and VP; (11f) insures that a conjoined structure contains exactly one conjunction and at least two other nodes with the same label ($\neq$C); while (11g) states that the only conditions under which a node may dominate two nodes of the same type is in case of conjunction.

The class of underlying constituent structure trees will be seen to be exactly the class of trees generated by the base rules (1), except for order. I propose that the definition given above of this class replace the categorial subcomponent of the base of the grammar altogether. In this conception of a grammar, the base would consist of a lexicon with appropriate insertion rules for the attachment of lexical items to the terminal nodes of underlying constituent structure trees in accordance with the selectional and sub-categorizing features peculiar to the individual lexical items, together with a set of language-particular rules whose function is to establish the ordering relation $x\lambda y$ among the nodes of the tree. In what follows, I will assume that trees are subject to the following conditions:

(12) a. For every pair of nodes x and y, with $y \neq x$, either $x\rho^* y$ or $y\rho^* x$ or $x\lambda y$ or $y\lambda x$.

b. If $w\rho^* x$ and $w\rho^* z$ and $x\lambda y$ and $y\lambda z$, then $w\rho^* y$.

c. λ is a partial ordering of the nodes of the tree.

(12a) asserts that distinct nodes that do not stand in a domination relation must stand in a left-to-right ordering relation; (12b) asserts that there is no "discontinuous-constituent structure", in which a node fails to dominate something that is between nodes that it dominates. It can be shown from (12) that

(13) If $x\rho^*w$ and $y\rho^*z$ and $x\lambda y$, then $w\lambda z$.

The following would be a set of ordering rules for English:

(14) Let $x\rho y$ and $x\rho z$ and $y \neq z$. Then:

a. $(x\alpha S) \cdot (y\alpha NP) \cdot (z\alpha VP) \rightarrow y\lambda z$

b. $(x\alpha NP) \cdot ((y\alpha N) \vee (y\alpha NP)) \cdot (z\alpha S) \rightarrow y\lambda z$

c. $(x\alpha VP) \cdot (y\alpha V) \cdot ((z\alpha NP) \vee (z\alpha S)) \rightarrow y\lambda z$

d. $(x\alpha VP) \cdot (y\alpha NP) \cdot (z\alpha S) \rightarrow y\lambda z$

e. $(\forall L)((x\alpha L) \cdot (y\alpha C) \cdot (z\alpha L) \rightarrow y\lambda z)$

The class of underlying constituent structure trees with lexical items inserted by the lexicon of language L and an ordering induced on their nodes by the base ordering rule of L will be called the class of "deep structures" of L.

In such a conception of the "base component" of a grammar, there thus exists a distinct level of representation on which the structure of each sentence is represented in unordered form. In class lectures in the summer of 1966, Chomsky criticized Šaumjan for asserting that a grammar must contain such a level of representation. In Chomsky's conception of a transformational grammar, such a level would indeed be unmotivated, since the constituent structure rules are language particular and operate on ordered, concatenated strings of symbols. Even in McCawley's base components, no natural division exists between unordered and ordered structures. But if the categorial component of the grammar is indeed provided by universal grammatical theory (up to order), such a level is indeed motivated, since it represents exactly the extent of structure as given universally. Indeed, if the order of constituents is given by language-particular rules, it seems impossible to avoid such a level of representation.

The principal advantages of the formalization given above for the contribution of universal grammar to the "base component" lie in the natural account it gives of the factors of structure that remain constant during the course of a derivation. Thus, the operation of the transformational component will considerably alter the deep structures before

they become surface structures, mostly in the line of simplifying structure. It is well known that surface structures violate many of the constraints on deep structures, yet it seems natural that certain principles should remain invariant. In particular, it seems that the criteria that determine the label attaching to a constituent (of higher than lexical degree) should be maintained insofar as possible; thus, we do not wish to permit surface structures wherein a node that dominates only a verb is said to be a noun phrase. etc. The natural way to capture this fact is to require that all intermediate stages of a derivation be constituent structure trees. That is to say, if during the course of a derivation, a node ceases to meet the criteria given above in (9a-d) for being a node with the label it has at that point, its label is to be changed so as to be in accord with some one of these criteria. If it meets none of the conditions (9a-d), it is unclear what status it should have (subject to a qualification to be discussed below); one might wish to assert that it retains its old label, or that it becomes altogether unlabeled. Such empirical evidence as exists seems to support the former. In addition, it should be noted that in accord with principle 10, any node that becomes redundant during the course of a derivation is "deleted".

The requirement that intermediate stages of a derivation be constituent structure trees in the sense of (9) and (10) captures correctly the generalizations that one would like to make about the structures of such trees. The requirements of (11) are peculiar to underlying trees; the restrictions on surface structures seem to be that they be constituent structure trees derivable by a permissible sequence of transformations from a well-formed deep structure. But this latter requirement also contributes to the imposition of a requirement on the possible results of applying a transformation; the output of every transformation must be a constituent structure tree (possibly with some changes in labels in accord with the above requirement), and at least the last such tree (the surface structure) should contain no constituents that cannot validly be given any label. These constraints on intermediate trees in a derivation and on the possible consequences of applying transformations have not been discussed previously, though their desirability seems apparent.

Notions similar to those suggested above in their syntactic consequences have been proposed by Ross, partially as a result of work on the rule of conjunction reduction in English. In particular, he has proposed a rule of "tree pruning", whereby nonbranching S nodes (or in one formulation, S nodes that cease to dominate both NP and VP) are to be deleted, and a rule of

"node relabeling", whereby a node that comes to dominate a conjunction of nodes of the same type is relabeled as being of that type also. This last is seen to be almost directly equivalent to condition (9d) above; a demonstration that the proposal embodied in this paper explains the facts accounted for by the rule of tree pruning will be given below. But these two rules by themselves do not suffice to handle all problems that have arisen in connection with node labels. In conjunction reduction in particular, nodes are continually appearing with embarrassingly counterintuitive labels that must be corrected by additional ad hoc conditions or hand-waving rules. In principle, any collection of such ad hoc conditions, even including the rule of tree pruning, must fail, whether they correctly describe the data or not. Such conditions merely state the problem in formal terms; the level of explanatory adequacy can only be reached by an account of these phenomena that shows why just these conditions should hold and not some arbitrary set of others. For example, there is no reason why the rule of tree pruning should apply exactly to S nodes, and not also to, let us say, NP nodes that are directly dominated by conjoined nodes. Also, why should exactly those nodes that cease to branch delete, rather than, let us say, those that come to dominate a number of nodes that is a term of the Fibonnacci series greater than the eighth? Since these rules are general metaconditions given by the theory of grammar, there appear to be no restraints on the sort of conditions that may apply. It is the thesis of this paper that an account of these facts in terms of more general facts about the composition of trees, facts that it is necessary to state in any event to properly define the concept of "well-formed deep structure", comes much closer to explaining them.

Let us now examine some of the data presented in support of the principle of tree pruning and show that the relevant phenomena follow from the principles adduced above. In his paper on this principle, Ross (1969a) suggests that (15d) is ungrammatical because at the point at which the rule of extraposition from NP applies, the modifying phrase *from India* is no longer dominated by S and is hence not subject to this rule.

(15) a. *A jug which was from India got broken.*

b. *A jug got broken which was from India.*

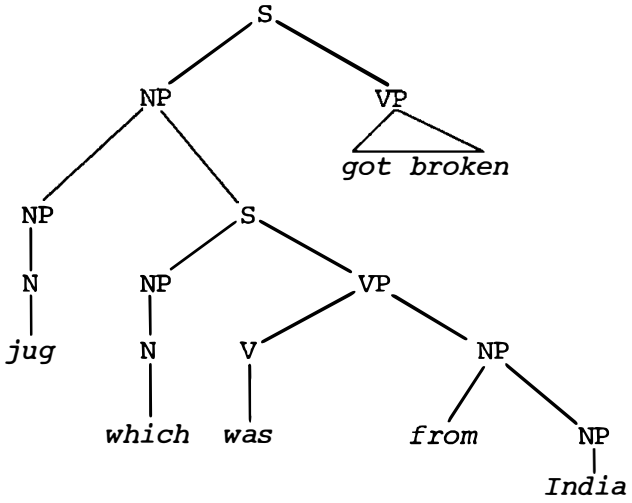
c. *A jug from India got broken.*

d. **A jug got broken from India.*

Assuming that the structure given in (16) underlies all four of these sentences and that the rule of relative clause

reduction then applies (optionally) to this structure giving (17) as the structure underlying (15c,d), we can see that the circled node in (17) no longer meets condition (9c) for being an S; furthermore it now does meet condition (9d), and hence must be relabeled NP. At this point, the principle of redundant node deletion (10) applies, giving the structure in (18).

(16)



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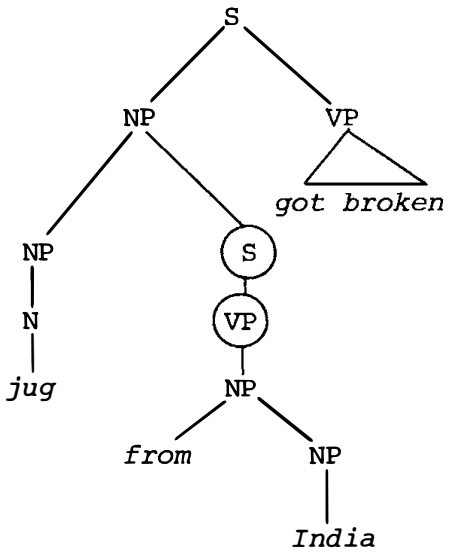

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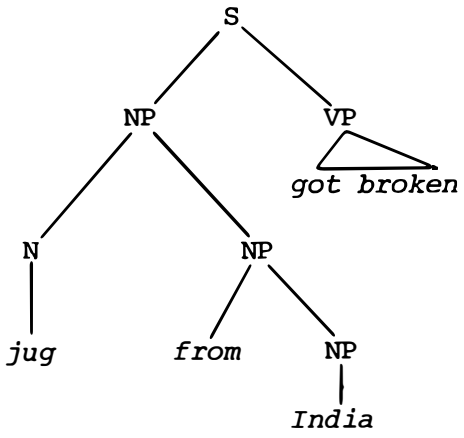


Note that the deletion of the circled node S is only part of the process; first, the circled node VP must become an NP, then be deleted, then the S becomes an NP and is deleted in turn. This is clearly necessary, since whatever it may be in deep structure, *from India* is nothing but a prepositional phrase adjunct of a noun in surface structure. It is counter-intuitive to claim that it is also a VP, as Ross does in his paper. In any event, the structure in (18) does not contain an embedded S and hence is not subject to the rule of extra-position.

Most of the cases discussed by Ross in his paper and the chapter of his thesis on this topic are of similar character, and it can be seen that they follow from conditions (9a-d). When a node labeled S ceases to dominate both NP and VP and comes to dominate only one of these, it will be seen that condition (9d) will require its being relabeled NP or VP as appropriate, at which point redundancy will have set in and it will go altogether. Thus, the tree-pruning metarule is seen to follow in most cases from other facts. Several more interesting cases are provided by embedded sentences with nonlexical grammatical formatives; it will be seen that they will require a modification of the theory as stated so far.

Consider the structure underlying the sentences in (19), which is given (approximately) in (20).

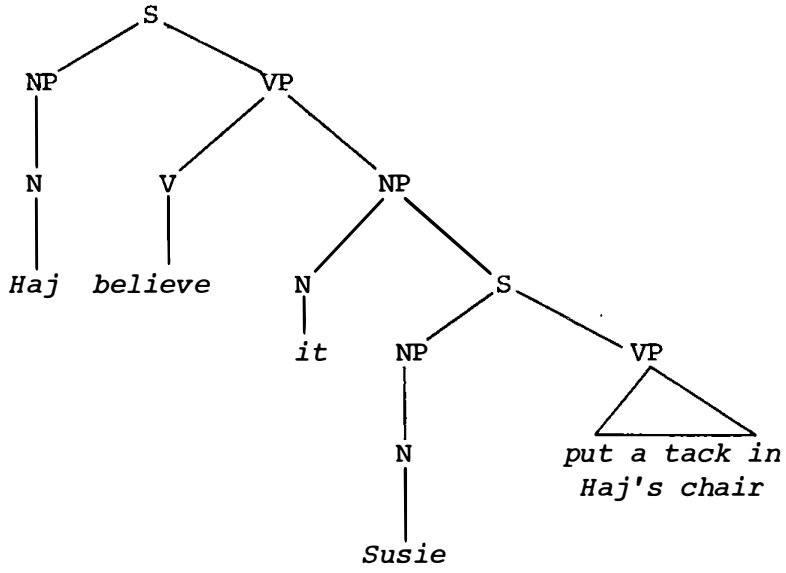
(19) a. *Haj believed Susie to have put a tack in his chair.*

b. *Susie was believed by Haj to have put a tack in his chair.*

c. *For Susie to have put a tack in his chair was believed by Haj.*

d. **Haj believed Susie to have put a tack in his own chair.*

(20)



In the derivation of all these sentences, the first significant rule to apply will be complementizer introduction on the higher cycle (if there are cycles). This will adjoin the element *for* to the lowest S and the element *to* to the VP of that S. The type of adjunction to be employed is an unsettled question; Ross and Lakoff have proposed that these complementizers by introduced by Chomsky-adjunction, but have cited as evidence for this claim only the possibility of defining the notion of subordinate clause in German so as to include structures of the type where a nonconjoined S directly dominates another S. So far as I can see, this notion is inadequate to classify even all German clauses correctly; relative clauses, for example, do not seem to fit this definition. Further, the extra S node created by this operation appears to do no work in the grammar. Because it is created within the cycle, no cycle ever takes place within it, which is contrary to the intuitive motivation for the principle of the cycle that has so far been advanced. It seems counterintuitive to claim that the major constituent break in an embedded clause such as *that people take Fichte seriously* in (21) should come after the *that*:

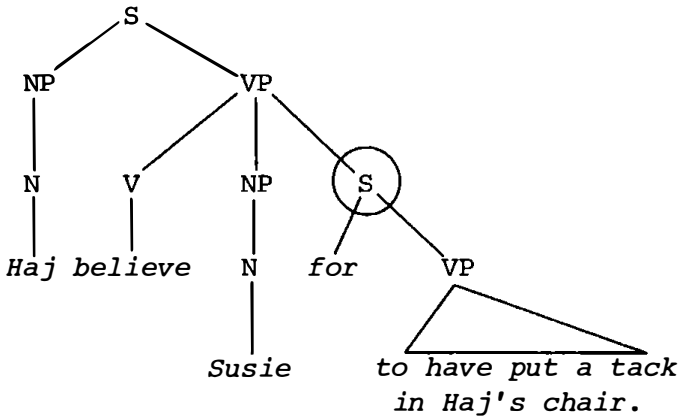
(21) *In a world like ours, it is frighteningly possible that people take Fichte seriously.*

If the extra S node does no real work, and furthermore must

be gotten rid of in every case, it seems more likely that it should never have been there. I shall assume henceforth that the complementizer is adjoined as daughter to the S (or as sister to its NP and VP).

At any rate, after the complementizer has been inserted in (20), Passivization may occur, giving the sentence (19c). Previously, on the same cycle, the rule of *It*-replacement may optionally have applied, giving the structure (22) underlying (20a,b,*d).

(22)



If Passivization takes place now, we get (19b); if it does not, we get (19a) or (19d). Note that if Passivization had occurred on the inner cycle, *It*-replacement could still have occurred, giving one of:

(23) a. *Haj believed his chair to have had a tack put in it by Susie.*

b. *Haj's chair was believed by him to have had a tack put in it by Susie.*

c. *Haj believed a tack to have been put in his chair by Susie.*

d. *A tack was believed by Haj to have been put in his chair by Susie.*

In all such cases where *It*-replacement has occurred, what is the status of the circled node S after the rule applies? Clearly, it is necessary to retain it as an S, for otherwise Reflexivization might apply, giving the ungrammatical (19d). But why should such a constituent be a sentence?

In general, the issue here is the status of nodes that dominate nonlexical formatives such as complementizers and prepositions. Apparently, any rule that introduces a terminal

element directly provides by its operation a new well-formedness criterion in addition to those given in (9). For example, one might say that the rule introducing *for*, Poss, *that*, etc. simultaneously provides the definition (24) because they are introduced under S:

(24) $(x\rho y) \cdot (x\rho w) \cdot (x\rho z) \cdot (y\varepsilon\{$*for*, Poss, *that*$)$
$\cdot (w\alpha\text{NP}) \cdot (z\alpha\text{VP}) \rightarrow x\alpha\text{S}$

The situation is more complex than this, however. Other rules in English segmentalize certain features of NP so as to create prepositional phrases, and these rules also introduce some of the same formatives as are introduced by Complementizer placement. Thus, these rules will necessitate additional conditions, such as

(25) $(x\rho y) \cdot (x\rho z) \cdot (y\varepsilon\{$*for*, *to*, *by*, *of*, Poss, ...$)$
$\cdot (z\alpha\text{NP}) \rightarrow x\alpha\text{NP}$

But now it would appear that for the cases of *for* and Poss, at any rate, the simplest rule providing for their introduction as complementizers is no longer part of a schema such as (24), but is rather a rule such as (26).

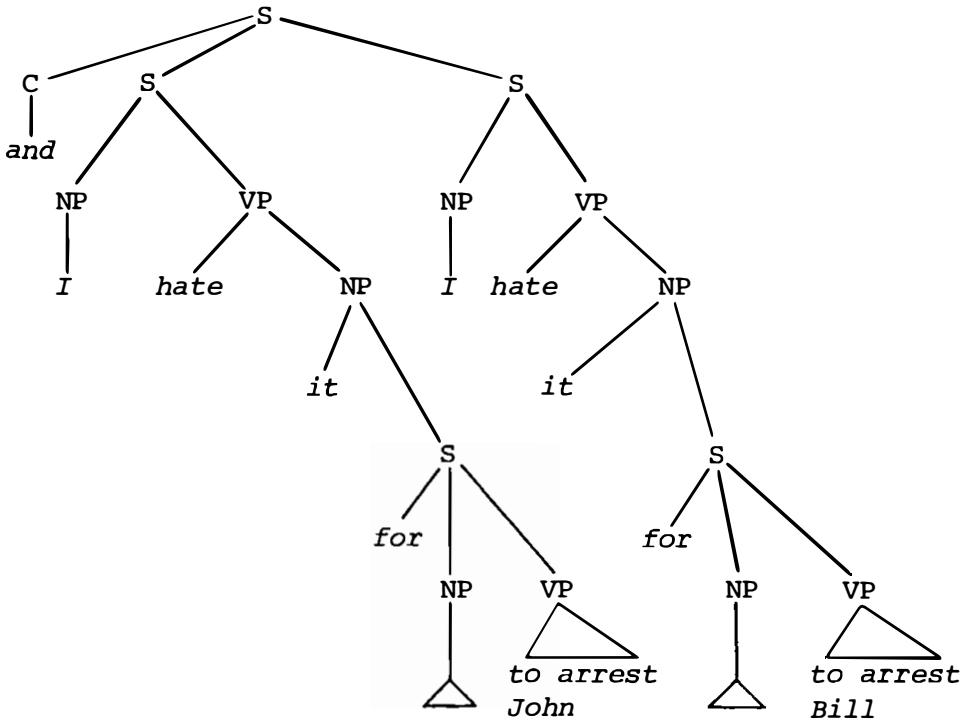
(26) $(x\rho y) \cdot (x\rho z) \cdot (y\varepsilon\{$*for*, Poss$\}) \cdot (z\alpha\text{VP}) \rightarrow x\alpha\text{S}$

This is precisely the rule needed to retain the circled node S in (22). The lack of a similar simplified rule for *that* could be adduced as a explanation of the fact that *It*-replacement does not apply to embedded sentences with *that* complementizers, since this would create an undefined configuration. Equi-NP deletion, another rule that creates a structure in which an S node dominates a complementizer and a VP only, similarly does not apply to embedded sentences with *that* complementizers; the relationship between the restrictions on these two rules is an otherwise gratuitous fact without the concept discussed above to unite them in terms of their production of ill-formed trees.

The interactions of the various conditions introduced by rules which introduce terminal elements directly produce several interesting cases in conjunction reduction. Thus, consider the deep structure underlying (27), which is given after Complementizer placement in (28).

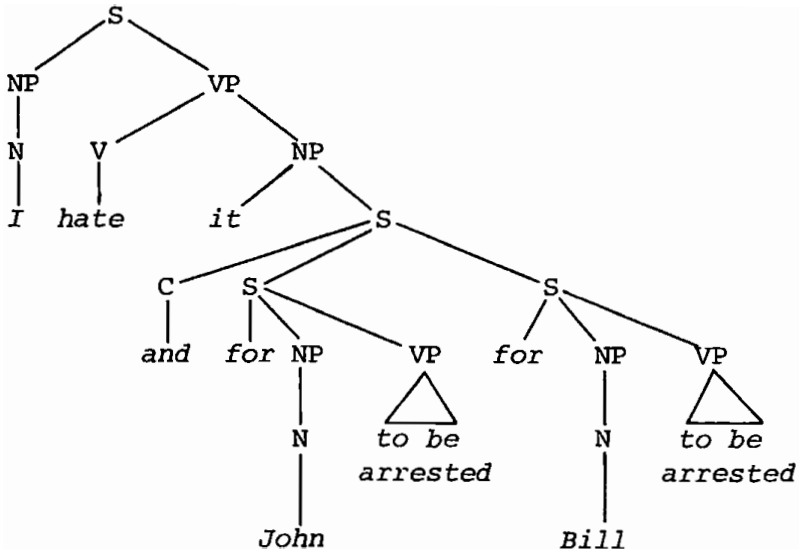
(27) *I would hate for John and for Bill to be arrested.*

(28)



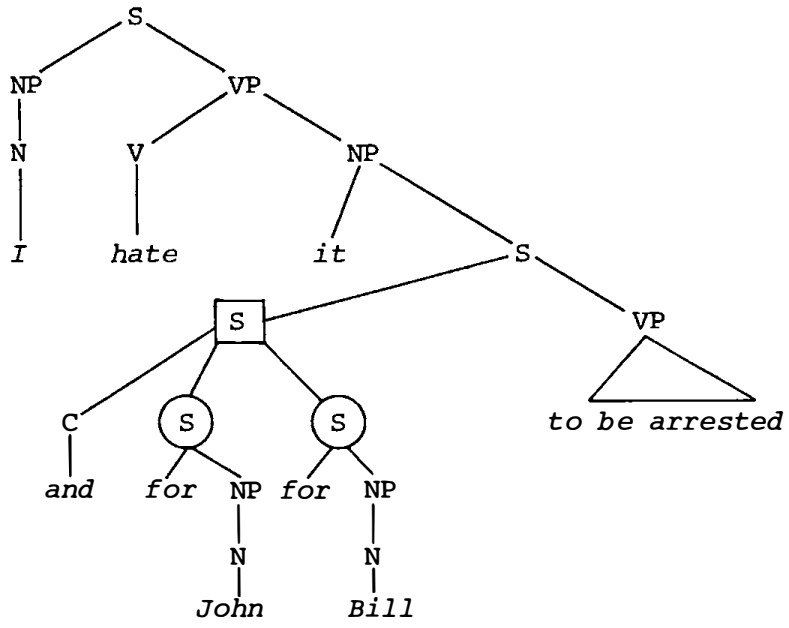
After Passivization has applied to both conjuncts and Conjunction reduction has applied to the whole conjoined structure, the result is as in (29)

(29)



When Conjunction reduction has raised the elements VP in the embedded sentences, the structure will be as in (30):

(30)



But note that now condition (25) applies, relabeling the circled S nodes as NP, at which point (9d) requires that the boxed S node also become NP, yielding the correct derived structure. The fact that such a rule as (25) exists for *for* and for Poss by virtue of independently motivated parts of the grammar (preposition introduction rules) also helps to explain why (31a-b) are much more acceptable that (31c).

(31) a. *I dislike it for John and for Bill to tell lies.*

b. *I dislike John's and Bill's telling lies.*

c. **I dislike it that John and that Bill tell lies.*

Since no such rule as (25) exists to define the configuration *that*+NP, it is not well formed.

There remain many problems concerning node labeling that I have not gone into here and that I do not claim to have solved. I do believe, however, that some such approach as that outlined here will form a necessary part of any attempt to account for node labeling in an explanatorily adequate manner. In particular, I suspect the all-or-nothing approach to the permissability of a derived constituent structure's

bearing a given label will have to be abandoned in terms of the notion that some configurations are more highly marked than others, in the sense in which that word is used in current phonological theory. Some account of the markedness of syntactic constructions must play a part in any adequate theory of language; it seems to me that the considerations discussed above must be part of such an account.