

DEEP AND SURFACE GRAMMAR

by

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Deep-Surface Grammar

0. Grammars and the Theory of Grammar

We take the province of linguistic theory to be defined by the following questions: What distinguishes natural languages from all other conceivable sets of objects? What do they have in common and in what ways can they possibly differ? To ask such questions is simply to ask for a precise characterization of what a natural language is (and, correspondingly, what it is not).

0.1 Adult Language Learning

When an adult learns a new language, he approaches it with certain preconceptions--exclusive of the idiosyncracies of his native language. He knows something of what to expect. He knows that the set of sentences in that language will differ markedly from the set of possible differential equations, the set of sequences of real numbers, the set of possible checker games, and an indefinitely large number of other sets. Although the sentences of the language will be unfamiliar to him, he can expect that they will be related to things that are quite familiar to him, namely, meanings. He knows in advance that he will be called upon to produce and recognize sequences of individual sounds that can be produced by the human vocal tract, and he will be expected to relate these sound sequences to meanings.

Before he starts, he knows that no matter what language he is involved with, he will be called upon to learn individual lexical items, that is, to pair isolated meanings with instructions as to how to pronounce the sequences of sounds that represent them. He can count on being able to form simple sentences from individual items by placing them one after another in some order. In fact, he begins with some notion of what a simple sentence is, and even more remarkable, he knows that he will be able in some sense to form complicated sentences from simple ones, though, of course, it will not be obvious to him how to do so. And he can be certain that the arbitrary natural language he has chosen to learn will have conjunction; it will have nouns; it will have ways of speaking about certain basic human activities; and it will have ways of stating assertions, asking questions, and ordering people to do things. These are but a few of the things that each of us knows about any given human language--simply by virtue of our being human and its being a language. We are asking exactly what this knowledge is.

0.2 Child Language Learning

Such knowledge is, of course, not confined to adults. A child raised in China will speak Chinese; one brought up in Finland will speak Finnish. Children seem to be able to learn any arbitrary natural language.

It seems unlikely that they would be able to do so if they did not have some innate ability to learn natural languages. To ask what this ability is seems to be equivalent to asking what all natural languages share.

Consider the remarkable feat that each normal child performs in learning his native language. Having been exposed to a small number of utterances, the child begins to compose his own new utterances. At a very early stage, these new utterances cannot be considered random babblings or attempts at repetition. Rather, it appears as if the child has constructed a theory of what a correct utterance is, and he attempts to use that theory to communicate intelligently. When his theory is incorrect and he utters ungrammatical sentences, his elders correct him and he occasionally revises his theory. In a very short time, by the time the child is three or four, he has composed a theory which is very nearly correct, and can speak his native language fluently. That is, from that time on, he can understand altogether new sentences of his language, which he has never heard before, and in response, he can utter appropriate grammatical sentences, almost all of which are entirely new to him and most of which, in all probability, have never been uttered before in the history of the human race.

Each of us possesses this remarkable ability, and each of us has performed such a feat of theory construction. We are asking what are the principles, which we evidently all share, on which we have based these theories. Clearly such principles must exist. There are an infinite number of formal systems to serve as possible theories of some subject matter or other, just as there is an infinite range of subject matter to theorize about. It can safely be assumed that a child, confronted by the strange continuous sound signals emanating from his parents, does not start from scratch choosing random subject matter to theorize about and looking at randomly chosen theories to see if they fit whatever subject matter he has chosen. If this were so, a child would be just as likely to come up with a theory of physical acoustics as with a theory of how natural languages work in general and how his native language works in particular. Certainly a theory of natural language is at least as abstract and sophisticated as a theory of acoustics; indeed, it is so sophisticated that scholars working over the centuries have not been able to specify exactly what a natural language can be. Yet somehow each child, regardless of intelligence, knows this and uses this knowledge to construct a grammar of his own language.

To ask what are the principles by which we have constructed the grammars of the natural languages we know seems to be equivalent to asking what a natural language is, or what characterizes the grammars of all possible natural languages.

0.3 Linguistic Theory

One can conceive of the problem in other ways, of course. Imagine an abstract automaton which could generate all possible grammars of all possible natural languages and only these. Think of it as a mechanical

procedure, which if followed will lead to the construction of all and only the possible grammars of possible natural languages. Such a mechanical procedure would be one way of characterizing what a natural language is. Of course, it need not be thought of as a mechanical procedure at all, but only as a set of conditions that all grammars of natural languages must meet. We will call such an automaton a "theory of grammar," a "theory of language," and a "linguistic theory." If grammars are considered as theories of particular natural languages, such automata may be considered as metatheories. We will refer to rules of such metatheories as "metarules" or "universal rules."

In practical terms a tentative metatheory constructed by linguists may fail in at least two ways. (1) It may fail to characterize an adequate grammar of some existing natural language. That is, it may in principle be unable to account for one or more phenomena in a single natural language. (2) It may characterize objects which could not be grammars of natural languages. For instance, our theory may allow for the expression of rules or combinations of rules which do not, and presumably, could not occur in any language. If inadequacy (1) arises, we must broaden our metatheory to include grammars which could describe the phenomena in question adequately, but not lose the ability to describe what it already can describe. If inadequacy (2) arises, we will have to constrain our metatheory to eliminate the objects which cannot be adequate grammars for some language, while not eliminating any which can.

Of course, in practice no linguist can ever be sure that he is working with an accurate, consistent and fully specified metatheory. Rather, in actual practice, linguists attempt to expand or limit the scope of such metatheories on the basis of empirical evidence. In this study, we will be doing both. First, we shall point out that current theories of grammar cannot handle many kinds of syntactic irregularities, and we will propose an expanded metatheory which will do so. We will argue this primarily on the basis of evidence from English. Secondly, we will observe that the expanded metatheory can be constrained in certain ways, apparently without sacrificing its ability to characterize real languages.

0.4 The Form of a Linguistic Theory

In recent years there has been a great deal of discussion of the goals of linguistic theory, or of what the automaton described in 0.3 should be capable of doing. We assume that the goals described in [Chomsky, 1965b, Chapter I] are reasonable ones and define an interesting area of study. Attempts at justifying these goals have also been made in the following works: [Chomsky, 1955-1957; 1962b; 1964; 1965 a and c] and [Postal, 1964 a and b]. By way of justifying our interests, we have nothing to add to what has already been said in these works.

However, since this study is meant as a contribution to the theory of language, that is, a proposal about what the automaton of 0.3 should

look like, perhaps we should reiterate and try to clarify those assumptions about linguistic theory that we will lean on most heavily.

In 0.3, we set ourselves the task of constructing an automaton which would in turn construct possible grammars of possible natural languages. We can view this task as having three closely related parts: (1) providing a universal vocabulary, the elements of which will be used to construct grammars; (2) defining the form of rules to be used in these grammars; (3) providing an organization of a possible grammar, that is, setting up components of a grammar which contain certain types of rules that use certain types of vocabulary elements, and stating the way in which these components may be related.

0.41. Vocabulary

A linguistic theory will have to contain a vocabulary of units from which grammars can be constructed. For instance, the units on the phonological level might be distinctive features such as those defined by Jakobson. On the syntactic level, they might be category symbols, such as S, NP, VP, N, V, etc., and syntactic features, such as [+ANIMATE] or [-ABSTRACT]. Many students of language have observed that all languages seem to have nouns and verbs, vowels and consonants, and to share other elements as well. Thus, it seems that some of these elements will function in the grammars of all natural languages. This is, of course, an empirical question, but our best guess right now is that there are many such units.

Other units seem to function in a wide variety of languages, but not in all. For instance, some languages have dual number but others do not. A large number of languages have articles, but by no means all. And so on. A major desideratum of a universal vocabulary is that all units should occur either in all languages, or in a wide variety of languages. A unit which appears in only one language, and plays a minor role in that language, will be a suspicious candidate for such a vocabulary.

Since any unit that occurs in the grammar of any natural language will have to appear in such a vocabulary, we might ask whether linguists have had to postulate units that seem to occur only in one particular language, and which cannot be explained away as wrong analyses. The answer is that they have in particular, in cases of irregularity. (For examples, see Section 2.11.) As we shall see later, these seem to be spurious units, since they serve only to indicate that isolated lexical items must or must not undergo some rule or some combination of rules. One of the results of this study will be to show that we can eliminate these units from the universal vocabulary. Instead, we shall revise our tentative linguistic theory so that, given the rules of a grammar, our theory will automatically define, in terms of that grammar, the set of features that can possibly function to distinguish irregularities in the language generated by it.

0.42 The Types of Rules

Since natural languages exhibit an enormously wide variety of phenomena, one might guess that an equally wide variety of kinds of rules would be necessary to describe these phenomena. But this is not the case. As it turns out, the types of rules actually needed to form grammars of natural languages are very few in number and are of a very restricted sort. One of the major problems of the linguistic theorist is to figure out exactly what kinds of rules are necessary and what kinds are not.

Perhaps the best way to consider the nature of the problem is to ask what kinds of rules we can rule out *a priori*, simply by employing our intuitions as to what a language can be like. Let us look at some logically possible rules, which we know in advance could not occur in a natural language, and which, indeed, have never been found to occur in any.

a. It is logically possible that in some natural language imperative sentences could be the mirror images of their corresponding declarative sentences (that is, declarative sentences spoken backwards).

b. It is logically possible that a natural language could exist in which the number of nouns in each sentence always had to be equal to the cube of the number of prepositions.

c. It is logically possible that a natural language could exist in which each sentence had to contain exactly a prime number of words.

d. It is logically possible that in some natural language the $5x$ th word has to be identical to the $5x+1$ th word, for all x .

No natural language like any of these has ever been found, and we know in advance that none ever will be found--simply because we know that natural languages do not work like that. Therefore, we know in advance that rules capable of generating languages with the above constraints can and must be ruled out of a theory of natural language.

As of now, we have a number of firm ideas as to the kinds of rules that actually do occur in grammars of natural languages. Constituent structure rules are quite well-motivated, as are a number of types of transformational rules: rules which add and delete constants (affixes, prepositions, individual phonological segments, etc.); rules which delete whole constituents under conditions of identity (though it is not altogether clear just what "identity" means); rules which change feature values in certain environments; rules which move constituents; etc. However, it is by no means clear at present just how such rules are to be defined, and just what restrictions can or must be placed on them. For instance, it is not at all clear what the metarules for derived constituent structure should be for many kinds of rules. In most transformational grammars that have been published so far, transformational

rules have had to be stated with a great many restrictive conditions. For example, some of the rules in (Lees, 1960) are obligatory if the proper analysis meets one condition, optional if it meets some other condition, and nonapplicable if certain words in a given list appear. So far, no adequate proposal has been made as to how conditions of this sort are to be restricted. In Chapter II, we shall present an argument to the effect that many of such conditions involving individual lexical items or classes of lexical items can be removed from the transformations and either built into individual lexical items in a highly restricted way or built into redundancy rules that operate on lexical items. We shall also see in Chapter II that the problem of defining an adequate mechanical procedure for applying rules is a non-trivial one (exclusive of the problem of derived constituent structure), and we shall point out some previously unnoticed areas of difficulty and make some proposals as to how to handle them.

Universals of Linguistic Form Some Methodological Remarks

By definition, the theory of grammar specifies that which is universal in grammar. The vocabulary of units of which grammars can be constructed is, for each proposed theory of grammar, a set of putative universals of linguistic substance. What these are is, of course, an empirical question. One might ask, for example, whether there exists a grammatical category Manner Adverbial, or whether the things which are called manner adverbials are really representatives of some other grammatical category. A theory of grammar which postulates the existence of such a category is a slightly different theory than one which does not. Similarly, in listing the types of rules that can occur in grammar and the constraints on their use, a theory is presenting a set of putative universals of linguistic form. Again, it is an empirical question as to what types of rules occur and what types are necessary. A theory of grammar which does not permit any transformational rules would be wrong since it could not define any grammars that could account adequately for the facts of language. And a theory which permitted rules that allowed one to form questions by saying declarative sentences backwards would be equally wrong since such processes do not occur in natural language. Each time one postulates a new type of grammatical process or proposes a new constraint on the way rules should operate, one puts forth a new putative universal of linguistic form.

Considering this, one ought to ask a methodological question: Can one at the present time study the grammar of a single language without also studying linguistic universals, that is, without studying the theory of grammar? The answer, I think, is no. Anyone who seriously undertakes the study of the grammar of a language learns very quickly that all of the theories of grammar that have so far been proposed are inadequate in various ways. This includes, of course, all of the present variations on the theory of transformational grammar. Though these are the best theories we have, they are still far from being equal to

the task. The study of language-particular facts requires us to continually enrich and refine the theory of grammar if we are to make sense of the facts; and this requires us to search for facts that are relevant to choices between conflicting versions of the theory of grammar. At the present time the study of the grammar of any language must go hand-in-hand with the study of the theory of grammar. In investigation of the grammar of even one language requires the postulation and testing of a considerable number of putative universals.

Of course it is possible to hold a rather different view as to how the study of linguistic universals should proceed. A common-sense view might be the following:

Go out and write grammars of all the languages you can find--or at least try a lot of different types of languages. When you get done, compare them and see what they have in common.

Such a view would be absurd. It assumes that we know what a grammar is. But we don't. In fact, the main object of the study is to find out what a grammar of a language can and cannot be. At present our knowledge is scattered and terribly scanty. One cannot just go out and write a grammar of English, finish it, and go on to Chinese, Navaho, Bantu, and Upper Chehalis. In fact, one cannot just go out and write a grammar of any language. English is the language which has probably been worked on the most. Transformational analysis of English has revealed a lot in the course of ten years. But the most striking thing that our research has shown is that our knowledge of English grammar is still minuscule. What is lacking is not data. English verbiage is hardly scarce. Nor is there any paucity of researchers or native speakers with keen intuitions. What we lack are insights into the nature of language which would enable us to make some sense out of all the data at our disposal. In a very real sense, the study of universals must lead the study of specifics. Without fruitful hypotheses about the form of grammar, the huge accumulation of facts at our disposal remains meaningless. Only with insights about grammar in general can language-specific data be brought into focus.

This is not to say that it is unprofitable to look at a wide range of linguistic data given our present knowledge of what grammar is like. Not at all. Only by looking with very great care at many diverse languages can we test competing theories of grammar. Unfortunately, almost all of the work of that sort that has been done so far has been limited to surface structure studies, which by their very nature can provide only information of a very restricted sort.

A case in point is the work of Greenberg (1963). Greenberg took a very superficial look at 30 languages. He considered only the surface structure of certain types of sentences in these languages. The questions he asked concerned the order of certain surface structure constituents and the presence or absence of well-known grammatical categories such

as gender, number, and case. These features of grammar, taken in isolation, represent an incredibly tiny aspect of the study of grammar. Of course, Greenberg could not have done anything more sophisticated along these lines since there do not exist thirty diverse languages that have been studied extensively beyond the level of surface structure. But considering the limited scope of his study, there was no reason why he should have come up with any interesting facts at all. *A priori*, there is no reason to believe that one aspect of surface structure should have anything discerning to do with some other aspect of surface structure. What is remarkable is that Greenberg did come up with some results, primarily, they were statistical correlations, presumably beyond the possibility of chance, among certain types of linear ordering of constituents in surface structure. For example,¹

If some or all adverbs follow the adjective they modify, then the language is one in which the qualifying adjective follows the noun and the verb precedes its nominal object as the dominant order. In expressions of volition and purpose, a subordinate verbal form always follows the main verb as the normal order, except in those languages in which the nominal object always precedes the verb.

Languages with dominant VSO order are always prepositional.
(VSO = verb-subject-object in simple sentences. Prepositional is opposed to postpositional. --- GPL)

These are interesting facts. But their interest does not lie in their ability to explain something about the nature of language. Instead, they themselves cry out to be explained. Why should the order of adjectives and their modifying adverbs have anything to do with verb-object and noun-adjective order? Why should relative order of verbs and objects have any bearing on the relative order of verbs and clauses of volition or purpose? Why should the appearance of prepositions as opposed to postpositions be related to the basic word order of the sentence? The facts become interesting only when one asks why they should be so. Certainly no present theory of transformational grammar (or any other theory of grammar) has any answer to these questions. In fact, the present theory of transformational grammar cannot even account for why languages can predominantly have either prepositions or postpositions, but not both. Present transformational theory allows rules that can move prepositions and postpositions around without regard to whether they wind up before or after noun phrases. Given such a theory one would expect there to be as many prepositions as there are postpositions in any given language. But this is not so. Present theories can account for virtually no correlations involving linear ordering in surface structure. To this extent present theories are inadequate. None of them can tell us what it is about the nature of language that accounts for these strange facts.

Besides being of inherent interest, Greenberg's work is also of interest for its virtuosity. Considering the impoverished theory of grammar that he was working in--phrase structure grammar--it is remarkable

that he was able to describe any universal facts at all that are of interest. But though Greenberg was able to describe these facts in terms of phrase structure grammar, he could not explain them within that theory. Indeed, there exists no known theory of grammar in terms of which they can be explained.

In any cross-linguistic study such as Greenberg's, one is limited in two ways. First, one is limited by the descriptive power of the linguistic theory that one is assuming. One cannot describe any facts that the theory in principle cannot handle. For example, using the descriptive devices of phrase structure grammar one cannot describe any facts about the transformational structure of a language. Unless one makes very rich and relatively correct hypotheses about the nature of language in general, one cannot hope to describe most of the facts about a language. They will be beyond study, a closed book. Secondly, in any serious cross-linguistic study, one is limited by the quality and extent of the descriptive work that has already been done on the languages in question. The kinds of facts that Greenberg considered happened to be accessible. Facts about the order of constituents in simple sentences can be come by without too much difficulty. But deeper facts are harder to get at in any language.

Very little of what we know about English can be described adequately at all. The difficulty is not that raw data is hard to find. We are overwhelmed by it; every word we speak or read is raw data. The difficulty is that we can't make sense of the data. Only by constructing rich hypotheses about the nature of language can we begin to make sense out of it.

The early literature on transformational grammar is full of examples that demonstrate this claim. Most of these dealt with the abstract hypotheses that there is a distinction between deep and surface structure, that there exist transformational rules, and that these rules are ordered in some way. Most of the arguments showed how very well-known and much-studied data could be explained on the basis of these hypotheses. We will reproduce one of the well-known arguments here, before going on to more sophisticated ones.

As any native speaker of English knows, the following reflexive sentences are based upon identity of reference between subject and object.

- (1) a. I kicked myself.
- b. You kicked yourself.
- c. Harry kicked himself.

Although there are sentences like (2),

- (2) Harry kicked Harry.

it is understood that two different people named "Harry" are involved. If the two occurrences of "Harry" are meant to refer to the same person,

For the examples that we are considering, it is sufficient to define linguistic identity as identity of both reference and lexical item. (We will show shortly that this definition must be made much stronger.) Given a notion of linguistic identity, we can now use it to define a rule which deletes something under conditions of identity. Only with such a rule could we derive the sentences of (1) from the structures underlying the sentences of (4). Notice the amount of theoretical (i.e., universal) apparatus needed to account simply for what we know intuitively about the sentences of (1): a distinction between deep and surface structure; a notion of referential identity; a notion of linguistic identity; a notion of a rule which may delete an item under identity and thus help effect a mapping from deep to surface structure.

Once we set up a reflexive transformation which can delete the objects in (4) under identity with their subjects and replace them by the appropriate reflexive pronouns to yield (1), then we can account for the non-occurrence of the following sentences.

- (7) *I kicked yourself.
- *you kicked myself.
- *Harry kicked themselves.
- *Mary kicked ourselves.

and so on . . .

We can also account very naturally for some facts that would seem strange if we had only a notion of surface structure and no notion of deep structure to work with. Look at the surface structure of simple transitive sentences of the form:

- (8) X kicked Y.

The distribution of items in position Y is skewed. X may be any animate noun and Y may be any physical object, including animate nouns of course--but excluding any animate noun that is linguistically identical to the subject. Y may also be a reflexive pronoun, but not any reflexive pronoun; only a reflexive pronoun with the same person, number, and gender as the subject may appear. Without a notion of deep structure, the construction in (8) seems odd: the distribution of objects is irregular. With a notion of deep structure, such constructions--simple transitive sentences--turn out not surprisingly to be completely regular in distribution. In the deep structure of (8), Y may be any physical object noun phrase. The reflexive transformation, appropriately defined, would then account for the skewed surface structure distribution in a natural way, reflecting the fact that reflexive pronouns have no independent status in grammar but always stand in place of a noun phrase which is linguistically identical to some other noun phrase in the sentence.

If we consider other phenomena involving the reflexive, say, the occurrence of reflexives in imperative sentences, we can see that even more abstract hypotheses about the nature of grammar than the ones

considered above are necessary to make sense of the data. One basic fact about imperative sentences that grammarians have long noted is that a second person subject is understood, although no overt subject occurs.

- (9) a. Leave the room.
- b. Go home.
- c. Sweep the floor.
- d. Clean up that mess.
- e. Buy me a quart of beer.

In (9) a second person subject, either singular or plural, is understood as the subject in each instance. A natural way to express this fact in terms of a transformational grammar is to have the subject present on the level of deep structure and to have it deleted by a transformational rule. Thus, we would need to permit transformational rules to delete designate items such as second person pronouns--another hypothesis about the nature of language. Such a hypothesis would allow us to describe what we know about the sentences in (9). But it would receive far greater confirmation from sentences like the following:

- (10) 1. a. Shoot me.
- b. *Shoot myself.
- 2. a. *Shoot you.
- b. Shoot yourself.
- 3. a. Shoot Harry.
- Shoot him.
- b. *Shoot himself.
- 4. a. Shoot us.
- b. *Shoot ourselves.
- 5. a. *Shoot you.
- b. Shoot yourselves.
- 6. a. Shoot Harry and Tom.
- Shoot them.
- b. *Shoot themselves.

In (10) "you" is understood as the subject of each sentence. Ordinary pronouns can occur as the object in these sentences only if they are first or third person; ordinary second person pronouns cannot occur as objects. For reflexive pronouns however, the situation is reversed. Only second person reflexives may occur as objects; first and third person reflexives may not occur. Moreover, if the second person singular reflexive occurs (10-2b), then the subject is understood as being singular. If the second person plural reflexive occurs as object, then the subject is understood as being plural (10-5b).

If we assume, as we did for (9), that the deep structures in (10) contain underlying second person subjects, which are deleted by a transformational rule, and if we assume as we did above that reflexives have no independent status, but are introduced transformationally in

place of objects which are identical to their subjects, then we can explain the distribution of pronouns in (10). The second person reflexives are formed by the reflexive transformation when the deep structure objects are in the second person. Since only second person subjects can occur in the deep structure of (10), the reflexive transformation could never apply when first and third person objects appear in those deep structures. Thus no first and third person reflexives can occur in the surface structures of these sentences.

In order to use this explanation, however, we must make a further hypothesis about the nature of language. We must assume that when the reflexive transformation applies in (10), the second person deep structure subjects are still present in the sentences--that is, that they have not yet been deleted by the imperative formation rule. We are assuming that these rules must apply in the order:

- (1) Reflexive transformation.
- (2) Imperative formation transformation.

Thus, we must make a further hypothesis, that the rules that relate deep structures to surface structures apply in some order. This notion of order has no temporal significance, of course, since rules of grammar do not tell us anything about the actual physical process of speech production, but only facts about our knowledge of our language. The order is an abstract one. The assumption that the rules apply in some abstract order is but one of the rich hypotheses about the universals of linguistic form that must be made before we can make sense out of such commonplace data as appears in (10).

In the next section we will consider other putative universals that must be postulated in order to approach the task of accounting for fundamental facts of grammar.

The Transformational Cycle

1. Passives, Reflexives, and It Replacement

The passive and the reflexive are mutually exclusive in English. Although we have such active sentences as:

- (1) a. Bill shot himself.
b. We washed ourselves.
c. Jane saw herself.

there are no corresponding passives.

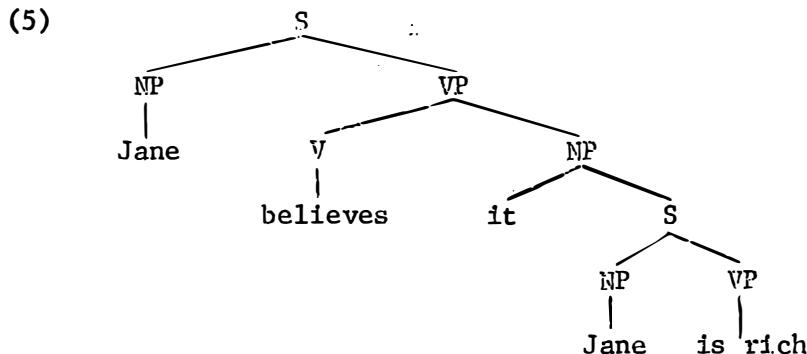
- (2) a. *Bill was shot by himself.
b. *We were washed by ourselves.
c. *Jane was seen by herself.

Paul Postal (1967) has pointed out that this seems to be true not only about English, but also about other languages where constructions similar to the passive exist. Postal reasons that this is not a language-particular fact, but a fact about grammar in general: whenever a transformation interchanges a subject and an object, the two items may not be identical. So the non-occurrence of (2) follows not from a rule of English, but rather from a universal constraint on what rules may do.

Another constraint on the occurrence of reflexives in English is that the two noun phrases in question (the one to be reflexivized and the one to which it is identical) must be dominated by exactly the same S-nodes. We can get the sentences of (3) but not those of (4).

- (3) a. I think that John saw me.
 - b. I saw the man who knows me.
 - c. Jane believes that she is rich.
- (4) a. *I think that John saw myself.
 - b. *I saw the man who knows myself.
 - c. *Jane believes that herself is rich.

In the (c) sentences of (3) and (4), the deep structure would be that of (5).



The second occurrence of 'Jane' is contained in an S which does not also contain the first occurrence of 'Jane.' Since the two occurrences of 'Jane' are not dominated by exactly the same S-nodes, reflexivization cannot take place.

We have stated this generalization about the occurrence of reflexives in terms of deep structures, such as (5). But this is not quite correct. Consider (6).

- (6) Jane believes herself to be rich.

(6) has the deep structure of (5), but unlike (3c), which has the same deep structure, (6) may undergo reflexivization. Thus we see that the above generalization does not hold on the level of deep structure. However,

it can be revised so that it holds in terms of derived structure. The revised condition would be reflexivization applies in case the two noun phrases are dominated by exactly the same S-nodes at the point in the derivation where reflexivization applies. Reflexivization would not apply in (3c), since the derived structure would be essentially the same as the deep structure, with the second occurrence of "Jane" inside the S 'Jane is rich.' But in order for reflexivization to apply in (6), a rule must have applied previously which moves "Jane" out of the S 'Jane is rich,' so that both occurrences of "Jane" would be dominated only by the topmost S of the sentence. Note that such a rule would have to apply in case an infinitival complementizer ('for'-'to') is present but not in case a "that" complementizer is there. The movement of "Jane" out of the sentence "Jane is rich" would mean that in "Jane believes herself to be rich" the sequence "herself to be rich" would not be a single constituent. This seems correct on intuitive grounds.

But there is further reason to believe that there exists a process that moves the subject of a complement sentence out of that sentence in case there is an infinitival complementizer present. Look at (7).

(7) Jane believes Mary to be rich.

(7) is just like (6), except that the deep structure subject of the embedded sentence is 'Mary' instead of 'Jane.' If there is indeed a process which moves this subject out of the embedded sentence, then we would expect 'Mary' in (7) to be in the position of a surface structure direct object of 'believe.' If this process occurred before the passive transformation as well as before the reflexive transformation, then we would expect (7) to be subject to passivization. It is.

(8) Mary is believed by Jane to be rich.

Thus we have independent motivation for believing that the process which was described above to account for reflexivization in (6) actually exists.

Let us return to example (6). Before reflexivization takes place (6) would appear as (9).

(9) Jane believes Jane to be sick.

At the point in the derivation when the passive transformation is reached, the second occurrence of 'Jane' would be in the position of the direct object of 'believe.' According to Postal's non-identity constraint, (9) should not undergo passivization. Indeed, it does not. If it did, we would, with subsequent reflexivization, derive (10).

(10) *Jane was believed by herself to be sick."

The occurrence of (8) but not (10) indicates that the subject-movement process described above occurs before passivization.

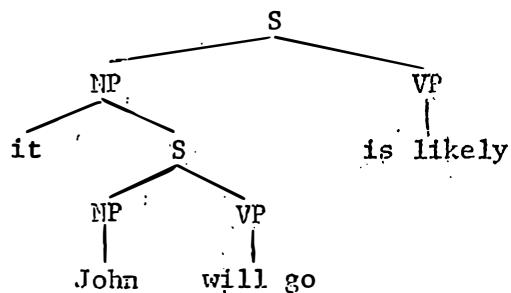
This shows that the version of this process postulated in Rosenbaum (1965) is incorrect. Rosenbaum attempted to account for cases like (8), but since he didn't notice cases like (10) he didn't attempt to deal with them. He tried to handle cases like (6) and (8) using rules that he had set up to handle other complement phenomena in English and he wound up arguing that the subject-movement process occurred after passivization. We will reproduce the essentials of his argument, since most of it is correct.

Consider cases like those in (11).

- (11) a. It is likely that John will go.
That John will go is likely.
- b. It bothers me that John smokes.
That John smokes bothers me.

Rosenbaum postulated that the deep structure of (11a) would be (12).

(12)



The complementizer "that" would be adjoined to the sentence "John will go." Then the following two rules would apply.

EXTRAPOSITION: (optional)

Structural description:

X	it	S	Y			
1	-	2	-	3	-	4

Structural Change:

Permute 3 and 4.

IT DELETION: (obligatory)

Structural description:

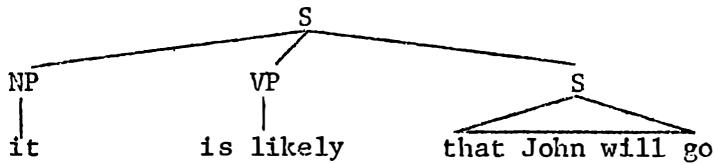
X	it	S	Y			
1	-	2	-	3	-	4

Structural Change:

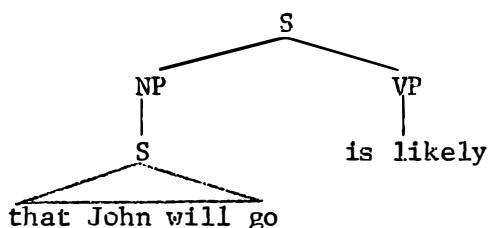
Delete 2.

EXTRAPOSITION would optionally apply to (12) to yield (13). If EXTRAPOSITION does not apply, IT DELETION will obligatorily apply to yield (14).

(13)



(14)



One might ask why Rosenbaum's choice of postulating the occurrence of "it" in the deep structure is superior to assuming that NP's like that of the subject in (12) contain only S, and that "it" is introduced transformationally in the proper environments. The reason is that it is virtually impossible to define what is meant by "the proper environments." In the sentence of (11) it may be possible, but if we consider other examples, some involving irregularities, we find that the difficulties accumulate rapidly.

(15) I dislike it for John to smoke.

If we assume Rosenbaum's treatment, we can look upon "dislike" as an exception which simply doesn't undergo IT DELETION. But if we assume that "it" is to be inserted, we are lost because it appears that no general rule of "it" insertion can be stated that would handle (15). Or take cases like (16).

- (16) a. I am aware of it that he came.
 b. I am aware that he came.

As we will point out in our discussion of exceptions below, "aware" can be looked upon as an exceptional lexical item in that it permits optional IT DELETION (with subsequent preposition deletion, which we will discuss shortly). But it is hard to see how any independently motivated rule of "it" insertion could yield (16).

Note that if we were concerned only with the examples of (11) we could give the rules in the opposite order with IT DELETION being optional and EXTRAPOSITION obligatory. But if we consider sentences like (17) we see that this is not possible.

(17) Everyone believes that Jane is rich.

(17) has two passives. The 'it' which is present in the deep structure shows up in (18a).

- (18) a. It is believed by everyone that Jane is rich.
- b. That Jane is rich is believed by everyone.

So, before the application of EXTRAPosition and IT DELETION, (17) must appear as (19).

(19) Everyone believes [NP it [S that Jane is rich S] NP]

Suppose IT DELETION came first and were optional. Suppose that it did not apply. EXTRAPosition would have no effect, since the that-clause is already at the end of the sentence. The result would be the non-sentence:

(20) *Everyone believes it that Jane is rich.

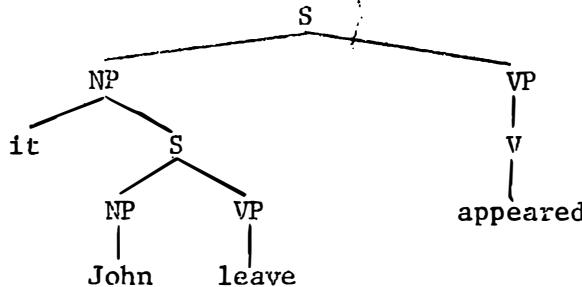
In order to derive (17) we would need an additional rule of "it" deletion which would then apply obligatorily. But to have two such rules would be to miss the generalization provided by a single obligatory rule of IT DELETION following an optional EXTRAPosition rule. Also note that the sentences of (18) give us evidence as to the relative order of PASSIVE and EXTRAPosition. In order to derive (18a), PASSIVE must precede EXTRAPosition.

Rosenbaum now turns his attention to pairs like the following:

- (21) 1.a. It is likely that John will go.
- b. John is likely to go.
- 2.a. It appeared that John left.
- b. John appeared to leave.

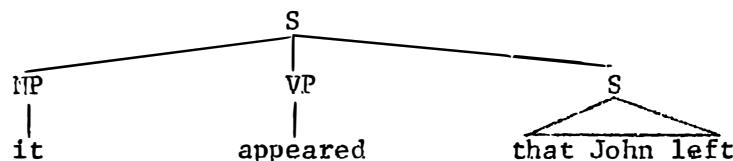
Note that the (a) and (b) sentences of (21) are synonymous. They contain the same lexical items (i.e., "likely," "John," "go"), so their synonymy must be due to grammatical construction, not to lexical synonyms. And they share cooccurrence restrictions--the subject of the that-clause in the (a) sentences corresponds to the subject of the main clause in the (b) sentences; the verb phrase of the that-clauses in (a) correspond to the infinitival phrases of (b). These facts suggest that the (a) and (b) sentences have the same deep structures. Irrelevant details aside, (21-2a) would have the deep structure of (22).

(22)

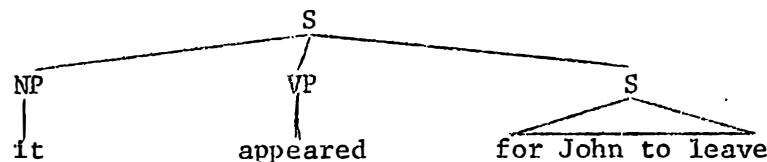


Rosenbaum hypothesized that "appear" could take a "that" or "for-to" complementizer. After EXTRAPosition we would get (23) and (24).

(23)



(24)

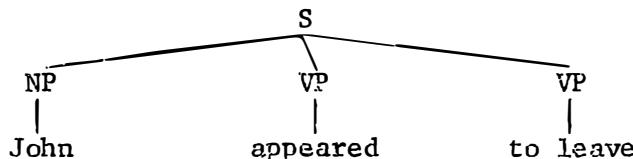


From sentences like (25) we know that it is possible for an S with a for-to complementizer to undergo EXTRAPosition.

- (25) It bothered me for John to smoke.
 It amused me for Harry to dance the rhumba.
 I disliked it very much for Max to rob banks.

Rosenbaum proposed that for certain classes of verbs and adjectives a rule applied to structures like (24) which substituted the subject of the embedded sentence ("John" in this case) for "it." A subsequent for-deletion rule would delete the "for." Such rules would map (24) into (26).

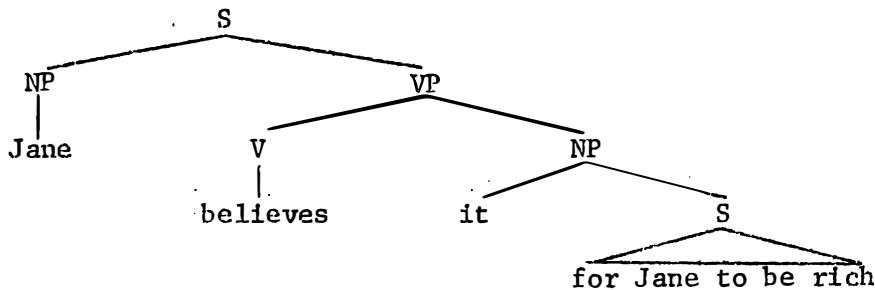
(26)



We will call the rule that substituted "John" for "it" IT REPLACEMENT.

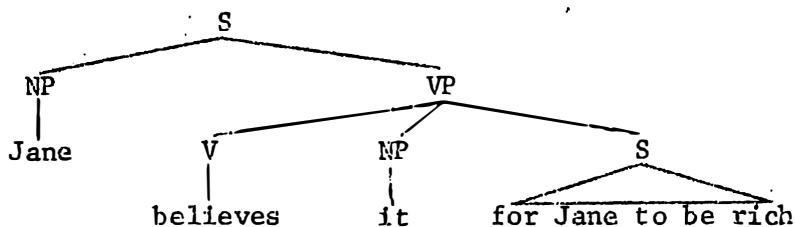
Noting that the process of IT REPLACEMENT had the effect of moving the subject of an embedded complement sentence into the main clause, Rosenbaum proposed that the rule be generalized to account for cases like (6) and (7) above. Given the deep structure of (5), a for-to complementizer would be added, yielding (27).

(27)



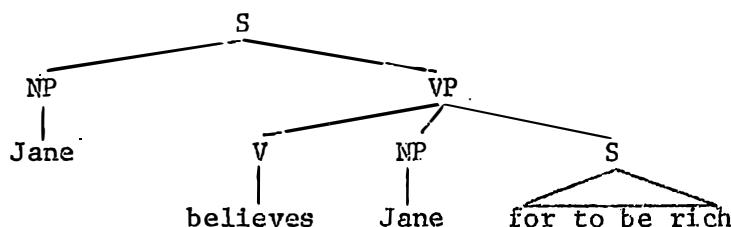
Rosenbaum proposes that EXTRAPosition apply 'vacuously' to (27), yielding a change in structure though not in linear order. Noting that the structural description of EXTRAPosition has a variable following S, he proposes that the structural description be interpreted as being met, even when the variable is null. He then claims that EXTRAPosition would map (27) into (28).

(28)



By IT REPLACEMENT, "Jane" would substitute for "it." The result would be (29).

(29)



"For" would be deleted by a subsequent for-deletion rule. Reflexivization could now apply to (29) to yield (6). (7) would be derived in the same way.

The critique of Rosenbaum's rules and the alternative analysis presented below has been worked out jointly by John Robert Ross and myself. For further discussion see Ross, 1966 and Lakoff and Ross, to appear.

For Rosenbaum's analysis to work, the rules would have to be ordered in the following way.

PASSIVE
EXTRAPOSITION
IT REPLACEMENT
IT DELETION
REFLEXIVE

Rosenbaum would derive the passive sentence (8) in the following way.
Start with:

Jane believes [NP it [S for Mary to be rich S] MP]

PASSIVE yields:

[NP it [S for Mary to be rich S] NP] is believed by Jane

EXTRAPOSITION yields:

[NP it NP] is believed by Jane [S for Mary to be rich S]

IT REPLACEMENT yields:

Mary is believed by Jane [S for to be rich S]

And after for-deletion, we get (8).

In Rosenbaum's derivation of this sentence, the passive transformation applies not to the noun phrase "Mary" but rather to "it for Mary to be rich." Now suppose that instead of "Mary," "Jane" appeared as the subject of the embedded sentence in the above derivation. At the point in the derivation when the passive transformation was reached, "Jane" would be the subject and "it for Jane to be rich" would be the object. The subject and object would not be identical and Postal's principle of non-identity in easiness could not apply. Thus we would have no way of stopping the derivation of the non-sentence "*Jane was believed by herself to be rich."

What is wrong is that Rosenbaum's version of IT REPLACEMENT depends upon the prior application of EXTRAPOSITION, and as (18a) shows, EXTRAPOSITION must follow PASSIVE. But, as we pointed out above, the mechanism for moving the subject out of an embedded complement sentence and into the main clause must precede PASSIVE so that Postal's principle can apply. This shows that Rosenbaum's version of IT REPLACEMENT is not the proper mechanism for accomplishing subject movement.

But there are other reasons as well for believing that Rosenbaum's version of IT REPLACEMENT is incorrect. As Rosenbaum has pointed out (personal communication), sentence (30) indicates that reflexivization must precede EXTRAPOSITION.

- (30) It suggests itself to me that Harry is a liar.

"Itself" must be derived from the noun phrase [_{NP} it [_S that Harry is a liar _S] _{NP}]. Since REFLEXIVIZATION requires that the two noun phrases involved be identical at the point in the derivation that the rule applies, the subject of (30) must also be "it that Harry is a liar." Hence EXTRAPOSITION cannot have taken place yet at the point in the derivation when REFLEXIVIZATION applies. So REFLEXIVIZATION is ordered before EXTRAPOSITION. But in order for REFLEXIVIZATION to yield "Jane believes herself to be rich," the subject movement process must apply before REFLEXIVIZATION. But Rosenbaum's subject movement process requires EXTRAPOSITION and then IT REPLACEMENT. Since subject movement must precede REFLEXIVIZATION and EXTRAPOSITION must follow it, Rosenbaum's version of subject movement must be incorrect.

There are still other indications that Rosenbaum's subject movement process is incorrect. In order to map (27) into (28) Rosenbaum must have EXTRAPosition apply 'vacuously,' changing the structure in the appropriate manner without changing the linear order of the morphemes. But vacuous extraposition, as Posenbaum describes it, is not a well-defined grammatical process. Rosenbaum would like this process to yield the structure of (28), where S is part of the verb phrase. The only way that this could be accomplished would be for Y in the EXTRAPosition rule (which equals the null element in this case) to be part of the verb phrase. Then by permuting S around an element of the verb phrase, we would get S to be part of the verb phrase. But there is no more reason to believe that the null element is part of the verb phrase than there is reason to believe that it is part of the noun phrase containing S or part of the topmost S but not the verb phrase. For this reason, vacuous extraposition is not well-defined.

Another difficulty is that, as Rosenbaum points out, EXTRAPosition cannot occur if the sentence to be extraposed has a possessive-ing complementizer. Thus, we do not get sentences like (31), although we do get (32).

- (31) *It amuses me John's swimming.
 *It surprised me John's leaving early.

(32) John's swimming amuses me.
 John's leaving early surprised me.

But Rosenbaum (personal communication) has also proposed (and I think he is correct) that 'begin' in sentences like (33) is an intransitive verb with a subject complementizer.

- (33) John began to run.
John began {swimming. }
running. }

"Begin" is intransitive in sentences like (34).

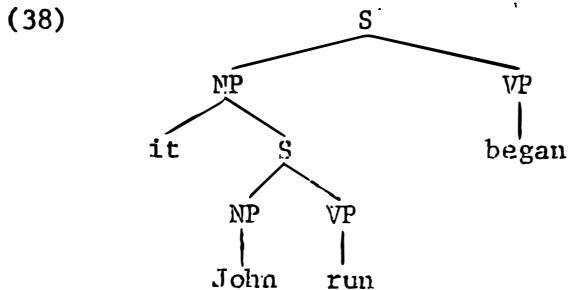
- (34) The concert began.
 The shooting began.
 The slaughter began.

And there are pairs like the following:

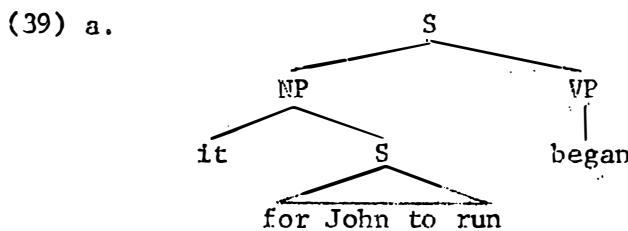
- (35) a. John's singing began.
 b. John began singing.
- (36) a. John's writing began.
 b. John began writing.
- (37) a. John's preaching began in 1964.
 b. John began preaching in 1964.

Each of these pairs is cognitively synonymous, that is, the (a) sentences can't be true without the corresponding (b) sentences also being true, and vice versa.

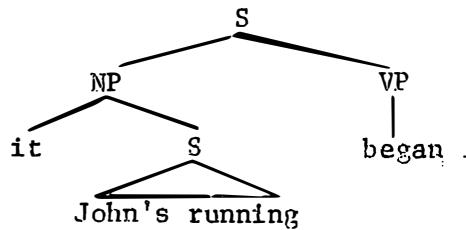
Rosenbaum proposes that the deep structure of (33) would be the following:



The subject complement of (38) could then take either a for-to or a possessive-ing complementizer. Thus Rosenbaum would get the following derivations:

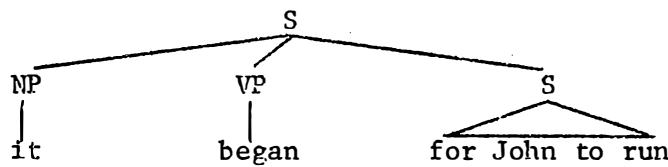


b.

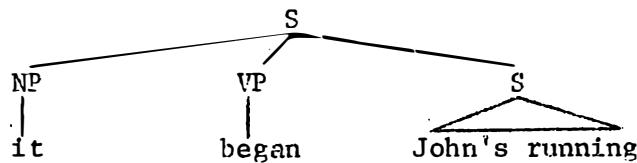


EXTRAPOSITION yields:

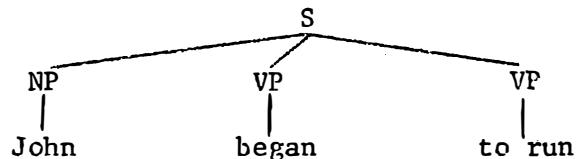
(40) a.



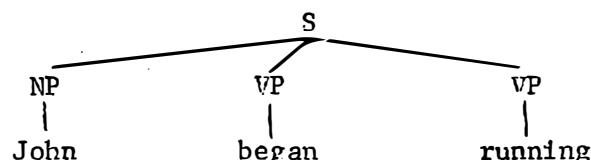
b.

IT REPLACEMENT (and subsequent for and possessive deletion) yields:

a.



b.

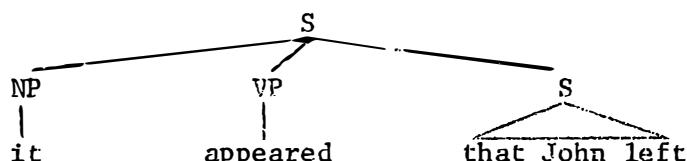


But such a derivation would require that EXTRAPOSITION be made to apply to sentences with possessive-ing complements, in order to get (40) b). As we pointed out above, EXTRAPOSITION never applies in such cases. If we were to permit this derivation, we would have to find some way to allow EXTRAPOSITION to apply in just these cases without having it apply generally in the case of other possessive-ing complements.

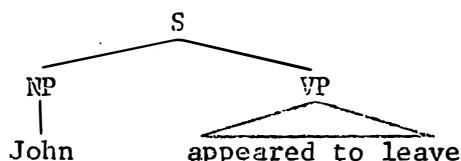
Another difficulty with attempting to derive sentences like (33) in this manner is that the derived constituent structure comes out wrong. EXTRAPOSITION from the subject requires that S wind up outside of the

main VP and dominated only by the topmost S, as in (40). This seems correct in cases like "It is likely that John will leave," "It appeared that John left," and "It is believed that Mary is rich." It seems intuitively correct that in such sentences the sequences "likely that John will leave," "appeared that John left," and "is believed that Mary is rich" are not single constituents. Rather they are sequences of constituents: VP S. In these cases the derived structure that results from EXTRAPosition from the subject yields the correct results, as for example, in (23). If the sentences of (33) are derived by this rule of EXTRAPosition, as in the above derivation, then EXTRAPosition will yield structures like (40) and IT REPLACEMENT will yield structures like (41). In (41) "to run" and "running" are not part of the same VP as "begin." This is incorrect. We know on intuitive grounds that "begin to run" and "begin running" are constituents. And we can show on syntactic grounds that they are verb phrases. As we will discuss in Chapter ____ below, the phrase "do so" substitutes for a verb phrase. So we can say "I caught a salmon and John did so too" with "do so" replacing "catch a salmon." But "do so" may not replace part of a verb phrase. So we cannot get "I caught a salmon and John do so a sardine." In the case of "begin" we can get "John began to run and Harry did so too" and "John began running and Harry did so too." If, however, "begin" were itself a verb phrase as in (41), then "do so" should be able to substitute for "begin" alone. This is not the case. We cannot get such sentences as "John began to run and Harry did so to swim" or "John began running and Harry did so swimming." Thus, "begin to run" and "begin running" must be verb phrases and the structure of (41) is incorrect. It follows that the normal rule of EXTRAPosition cannot apply in the derivation of such sentences. This is not only true in the case of "begin" but also in other cases of IT REPLACEMENT. Note that in sentences like "John is likely to leave go," "John appeared to leave," and "Mary is believed to be rich" the sequences "likely to leave," "appeared to leave," and "is believed to be rich" do seem intuitively to be constituents, unlike sequences like "appeared that John left" in "It appeared that John left." This would suggest that even though sentences like "It appeared that John left" and "John appeared to leave" have the same deep structure, they have quite different surface structures, like those below.

(42) a.



b.

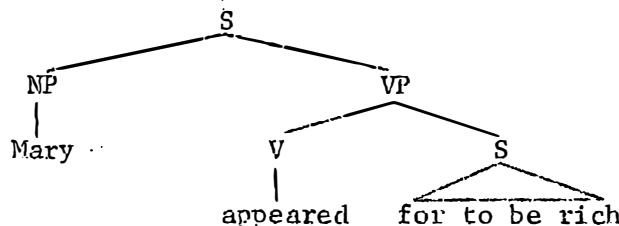


Thus sentences like (a) with no IT REPLACEMENT may be derived by ordinary EXTRAPOSITION, which must apply after the PASSIVE transformation. But EXTRAPOSITION may not apply in cases like (b), which are exactly the IT REPLACEMENT cases. As we showed above, these must be derived by some other process which applies before the PASSIVE transformation.

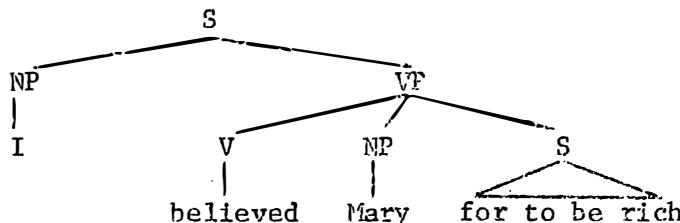
Although Rosenbaum's 1965 analysis of IT REPLACEMENT doesn't work for the reasons just given, there is a lot about it that is right. His account of underlying structures is basically correct. And he correctly noticed that the same process was going on in both the subject and object cases of IT REPLACEMENT. That is, both in cases like "Mary is likely to go" and "I believed Mary to be rich," "Mary" starts out as the subject of an embedded sentence and moves out of that sentence into the main clause--in fact, into the position formerly occupied by "it." His account of vacuous extraposition correctly expresses the fact that before the IT REPLACEMENT process, the embedded complement sentence is dominated by noun phrase (as in (27)) and after the process it is no longer dominated by noun phrase but only by the topmost verb phrase of the main clause. This is true not only in the case of object complements such as "I believed Mary to be rich" but also in the subject complement cases ("Mary is likely to go"). He also saw correctly that the process has two parts: (1) replacement of "it" by the subject of the embedded sentence and (2) a movement of the embedded sentence to the end of the main clause. We now see that in this movement, the embedded sentence must turn out to be dominated by the topmost VP of the main clause and not by the topmost S. And this process can take place in the case of for-to and possessive-ing complementizers, while EXTRAPOSITION can take place only with that and for-to complementizers.

Though we know that the embedded sentence, when moved, must wind up as part of the topmost verb phrase of the main clause, the exact derived constituent structure that must result is still a question. There are two possibilities. The first is that the S is moved inside of the topmost VP and added to the right of all the other constituents of VP. This would produce structures like (43).

(43) a.

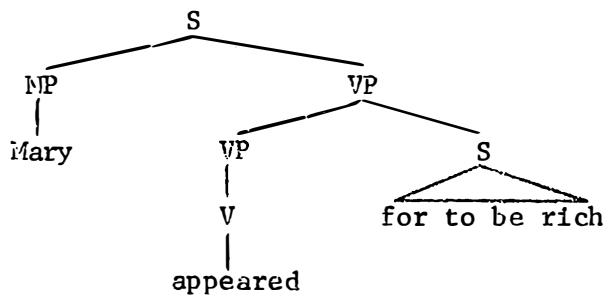


b.

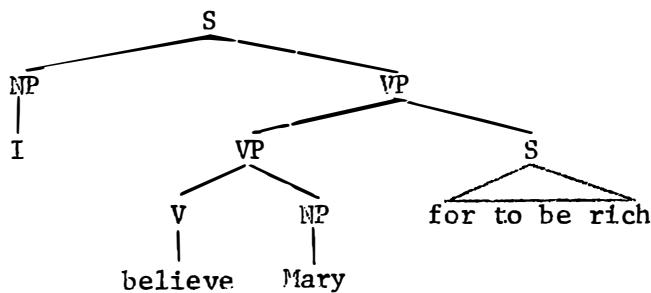


Such a process is called 'daughter-adjunction.' In these cases, we would say that S is adjoined as a daughter to VP. Note that in these cases, the VP node has gained a new constituent. But there is another possibility, namely, that the old VP node keeps its old constituents and that a new VP node is created to dominate the old VP and the S. Such a process would yield structures like (44).

(44) a.



b.

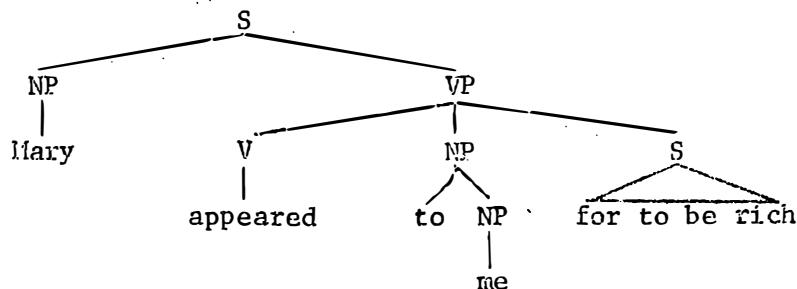


The elementary operation which yields structures like this is known as Chomsky-adjunction. Chomsky-adjunction tends to preserve constituent structure, whereas daughter-adjunction tends to break it down. So far as we can tell right now, Chomsky-adjunction seems to be a basic syntactic operation, while there are no clear cases now known where daughter-adjunction must apply. Thus, on systematic grounds, we might favor (44) to (43). But on empirical grounds, we have no present reason to favor one or the other. However, if we consider some other sentences, we can find very weak empirical grounds for favoring Chomsky-adjunction. Consider (45).

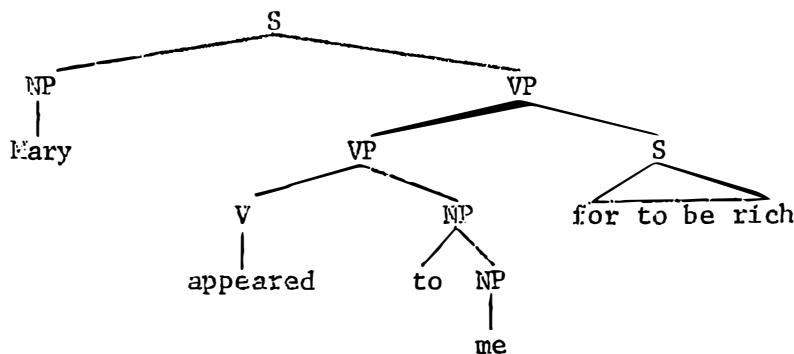
- (45) a. It appeared to me that Mary was rich.
 b. Mary appeared to me to be rich.

Before the IT REPLACEMENT process which yields (45 b), "appeared to me" is a VP. Does it remain a VP in the surface structure of (45 b)? Under daughter-adjunction, it would not; under Chomsky-adjunction it would. Thus we would get the structure of (46).

(46) a. Daughter-adjunction



b. Chomsky-adjunction



It seems to me that (46 b) is correct and (46 a) is not: that is, both "appeared to me" and "appeared to me to be sick" are constituents. But I depend only on weak intuition and not on any syntactic evidence for this judgement. For the time being we will assume that Chomsky-adjunction is correct in this case, though future evidence may show this to be wrong. The choice will have no bearing on what follows.

Let us now try to state the rule for our new process of IT REPLACEMENT. Part one of the process will substitute the subject NP of the complement sentence for "it." For this part we will need a structural description like:

(47)	X	it	$\left\{ \begin{array}{c} \text{for} \\ \text{possessive} \end{array} \right\}$	NP	VP	Y
	1	2	3	4	5	6

where: 3^4^5 is dominated by S
and
 $2^3^4^5$ is dominated by NP

The structural change will substitute 4 for 2 and delete 4. Part two of the rule will take the remainder of the embedded sentence, which appears as terms 3^4^5 of the SD (structural description) of (47), and

adjoin it to the topmost VP of the main clause. This part of the rule has two cases: the movement from subject position and the movement from object position.

(48) Movement from Subject Position
 Structural description:

NP	S	VP	
1	2	3	where 1^2 is dominated by NP

Structural change: Adjoin 2 to 3 and delete 2.

The movement from object position is somewhat more complicated, since the S that must be adjoined to VP starts out inside of VP.

(49) Movement from Object Position
 Structural description:

NP	X	NP	S	Y	
1	2	3	4	5	where: 3^4 is dominated by NP and $2^3^4^5$ is dominated by VP

Structural change: Adjoin 4 to $2^3^4^5$ and delete 4.

In (49) we adjoined S to the sequence of constituents that made up VP. This rule is to be interpreted as adjoining S to the node that dominates the sequence, in this case, VP. Such a rule would be well-formed only if a single node dominated the sequence.

Cases one and two of the movement rule, as they are now stated, do not capture the generalization that the embedded sentence is adjoined to the topmost VP of the main clause. To capture this generalization, (48) and (49) should be collapsed into a single rule. Within the present theory of transformational grammar this cannot be done: the formal apparatus is simply not available. Since we believe that the generalization is genuine, it seems to us that the present theory is at fault and should be changed so that the generalization can be stated. Moreover, (48) and (49) both should be collapsed with (47) since all are part of the same process. To handle this, we propose that the theory be expanded so that a rule may have not one, but two simultaneous structural descriptions and that the structural change may refer to both structural descriptions. We could then state the entire IT REPLACEMENT process in a single rule.

(50) IT REPLACEMENT
 Structural description:

A. NP VP
 1 2

B. I it {for possessive} NP VP I. where: $B3^B4^B5$ is dominated by S and $B2^B3^B4^B5$ is dominated by NP

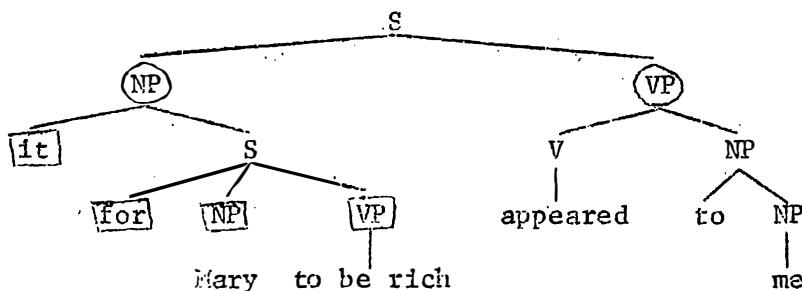
Structural change:

1. Substitute $B4$ for $B2$ and delete $B4$.
2. Adjoin $B3^B4^B5$ to $A2$ and delete $B3^B4^B5$.

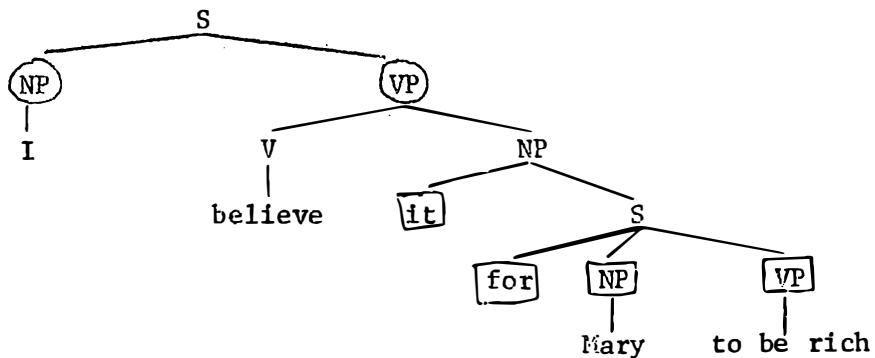
Part A of the structural description isolates the topmost NP and VP of the main clause. This must be done so that we can state the generalization that the embedded S is adjoined to the topmost VP, in this case, the term $A2$. Part B of the structural description is identical to the structural description of (47). This specifies the environment in which the substitution of NP for "it" takes place. The first part of the structural change is identical with the structural change of (47). Note that terms 3^4^5 of part B of the structural description are dominated by S and together comprise the embedded sentence which is to be adjoined to the VP of $A2$. The adjunction is stated in part 2 of the structural change, where the embedded S is referred to as the sequence of terms $B3 B4 B5$. We assume that such a sequence of terms may be adjoined only if they are dominated by a single node, in this case, S. We interpret the adjunction of such a sequence of nodes as the adjunction of the node dominating the sequence.

Let us consider some examples of how our new version of IT REPLACEMENT will work. IT REPLACEMENT will apply to the trees of (51). In (51) we have encircled the terms of part A of the structural description, and we have enclosed in rectangles terms 2, 3, 4 and 5 of part B of the structural description. Since terms 1 and 6 of part B are variables, we haven't bothered to indicate them.

(51) a.

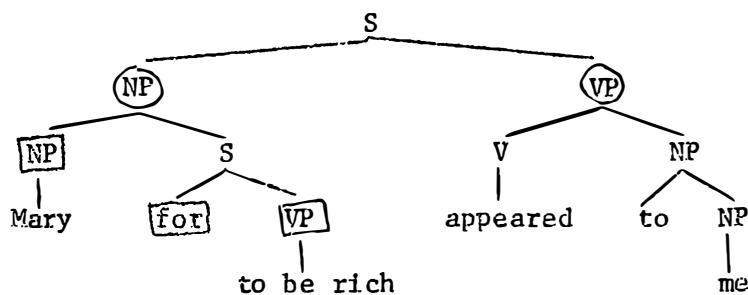


b.

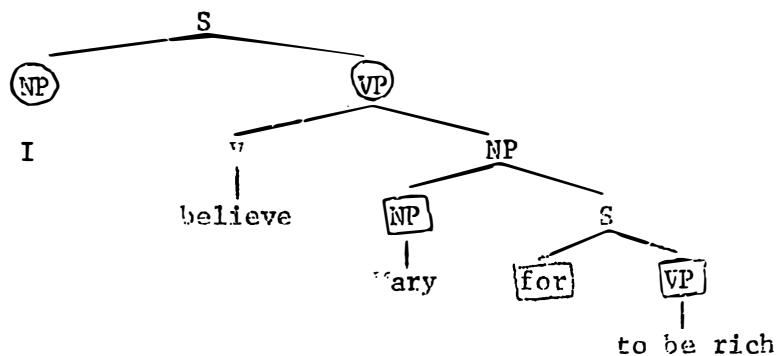


After part I of the structural change applies, we will get (52).

(52) a.

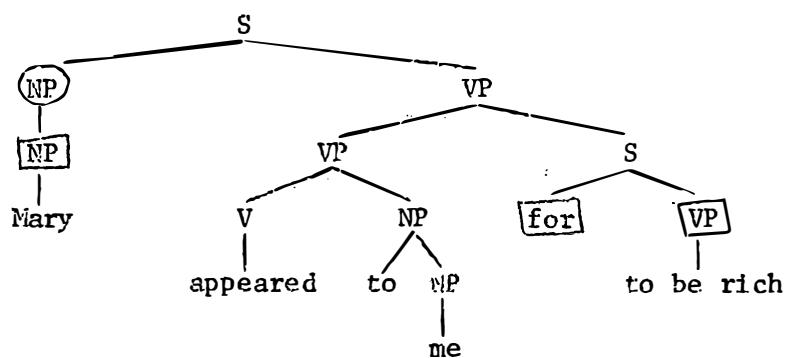


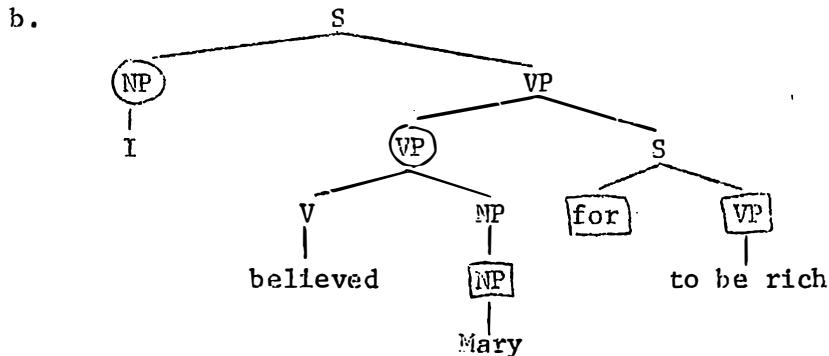
b.



At this point in the operation of the rule, term B4 is null as a result of the deletion in part 1 of the structural change. Part 2 of the structural change will now yield (53).

(53) a.





The two NP nodes immediately above the two occurrences of the NP "Mary" will delete by a convention of the theory of grammar that says: whenever a node A immediately dominates only another node A, the upper A is deleted. Since we assumed that Chomsky-adjunction applies in IT REPLACEMENT, the encircled VP node, which started as the topmost VP node, has been moved down a notch to make room for the VP node created by the adjunction. Had we used daughter-adjunction instead, (53 a and b) would have looked like (43 a and b) respectively.

The rules we have mentioned so far must be ordered in the following way:

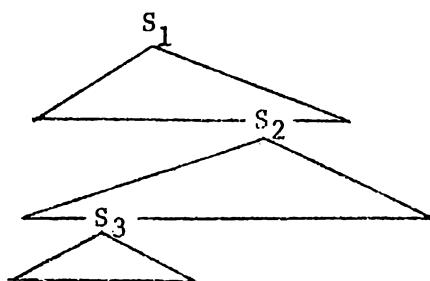
IT REPLACEMENT (new version)
 PASSIVE
 REFLEXIVE
 EXTRAPosition
 IT DELETION

Since PASSIVE and REFLEXIVE are mutually exclusive, we have no evidence as to whether they must be ordered with respect to one another.

2. The Cycle

Rules must apply not only in an abstract order, but in an even more complex fashion. Suppose some sentence S₂ is embedded inside sentence S₁. Fillmore (1963) showed that rules frequently had to apply to S₂ before they applied to S₁, but that none of the rules then known ever had to apply to S₁ before they applied to S₂. Coupled with the Postal-Katz (1964) hypothesis that there is a single level of phrase structure analysis--deep structure--on which semantic interpretation takes place, Fillmore's observation forms the basis for the definition of the transformational cycle: rules apply first to the most-deeply-embedded sentence, then to the next highest, and so on until all of the S's in the deep structure of a complex sentence have been processed. Suppose, for example, that we have a deep structure with three sentences embedded one inside the other.

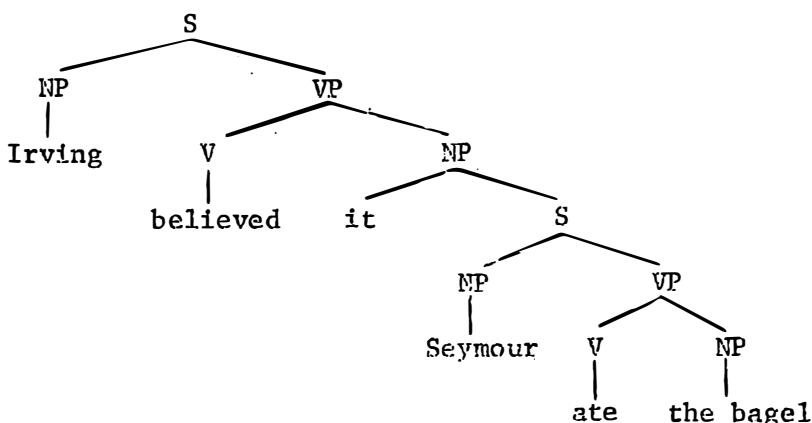
(54)



According to the principle of the transformational cycle, the transformational rules of a grammar would apply in their abstract order first to S_3 . After we finished applying rules to S_3 , we would move up to S_2 and again apply the transformational rules in their abstract order. Finally we would move up to S_1 and apply the ordered rules once more. Note that, as in the case of ordered rules, the process of cycling does not take place in real time. The cycle on S_3 precedes the cycle on S_2 in the same abstract sense that one rule precedes another. Cycling, like most concepts in the theory of grammar, is not meant to have any physical analog in actual speech production. It is meant only to be part of the definition of what we mean by "grammar." We will try to show in what follows that this extremely sophisticated hypothesis about the nature of language is necessary if we are to make sense of commonplace data.

Consider the following deep structure.

(55)



Since "believe" can take either a "that" or "for-to" complementizer, this underlying structure could yield either (56) or (57).

(56) Irving believed that Seymour ate the bagel.

(57) Irving believed Seymour to have eaten the bagel.

In the derivation of (57), "believe" takes a "for-to" complementizer and then IT REPLACEMENT applies, moving "Seymour" out of the embedded sentence into the object position of the main clause. Note that the

past tense on 'ate' in (55) has been replaced by have-en. This is normal in "for-to" complements. Since this process is incidental to our discussion, we will not consider it in detail.

Since 'Seymour' is in object position in (57), the passive transformation can apply to the structure underlying (57) to yield (58).

(58) Seymour was believed by Irving to have eaten the bagel.

This is natural, since, as we pointed out above, PASSIVE must follow IT REPLACEMENT. So far, we have assumed that the rules given in the last section apply to the entire structure of (55), rather than applying cyclically, first to the embedded sentence, then to the topmost sentence. Let us now consider the difficulties with this position that force us to adopt the principle of the transformational cycle.

Consider sentence (59).

(59) Irving believed that the bagel was eaten by Seymour.

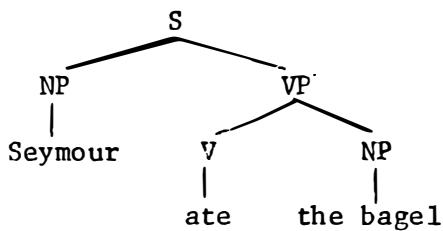
(59) has the same deep structure as (56), namely, that of (55). In (59) the passive transformation has applied to the embedded sentence. This shows that the passive can apply to either of the S's in (55). This is true not only in the case of the 'that' complementizer, but also in the case of 'for-to'. So we can get (60).

(60) Irving believed the bagel to have been eaten by Seymour.

In (60), as in (57), the subject of the embedded sentence, 'the bagel' is moved by IT REPLACEMENT to the direct object position in the main clause. But this means that PASSIVE must have applied first to the embedded sentence, moving 'the bagel' into subject position, as in (59). Only then may IT REPLACEMENT apply. But in the last section we showed that IT REPLACEMENT must precede PASSIVE. Here we find that PASSIVE must apply first, [sic] at least in the embedded sentence. One might be tempted to propose that there are two passive transformations, one applying before IT REPLACEMENT and another applying after it. But if this were so, it would be impossible to block the occurrence of (10), as we pointed out in the previous section. Moreover, such a move would, as we will point out below, lead to the conclusion that a grammar may be infinitely long.

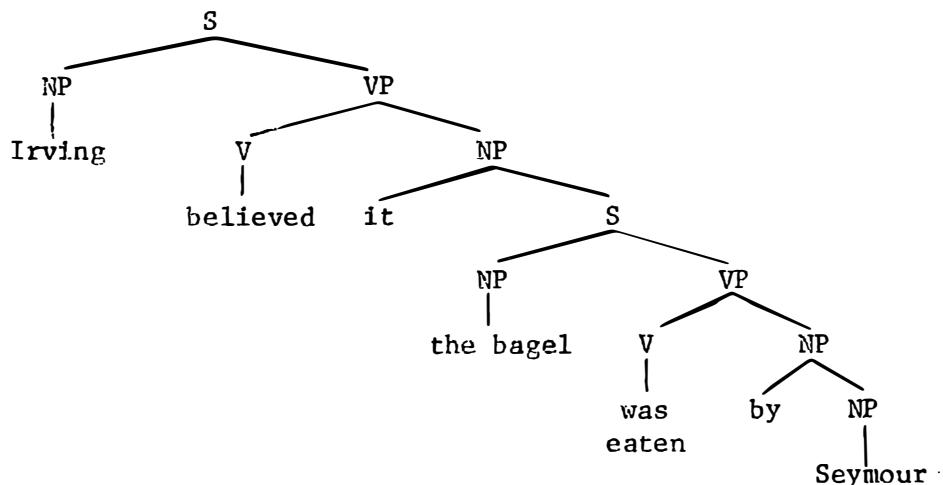
If, however, we assume the principle of the transformational cycle, none of these complications arise. We may keep just one passive transformation and we can have it follow IT REPLACEMENT, as is necessary. On the first application of the cycle to (55), only the embedded sentence will be considered. The rules will apply as though the upper S did not exist. That is, they will apply to the tree of (61).

(61)



IT REPLACEMENT will not occur on this cycle, since the environment for it will not be met. PASSIVE, which follows IT REPLACEMENT in the list of rules, will apply to yield "The bagel was eaten by Seymour." On the next cycle, the rules will apply to the next highest S, that is, to the tree of (62).

(62)



Now, after the insertion of the "for-to" complementizer, IT REPLACEMENT will apply to yield (60). Since PASSIVE follows IT REPLACEMENT, PASSIVE may now apply to the structure underlying (60) to yield (63).

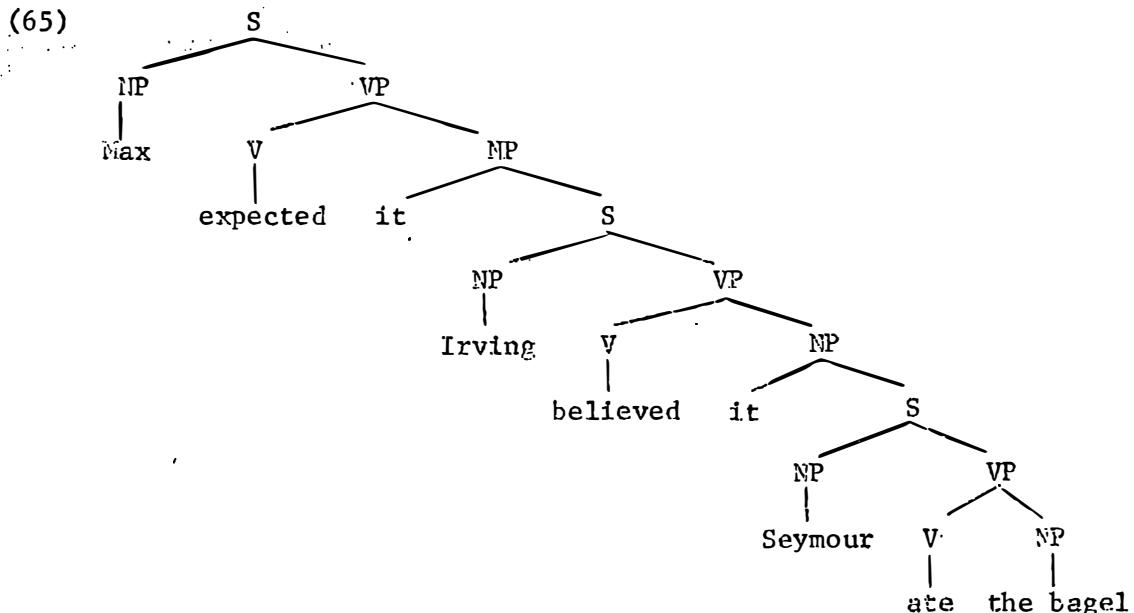
(63) The bagel was believed by Irving to have been eaten by Seymour...

In the derivation of (63) PASSIVE has applied twice, once on each cycle. Note that the NP 'the bagel' has moved from final position in the deep structure of (55) to initial position in (63). On the first cycle, PASSIVE moves it to first position in the embedded sentence. On the second cycle, IT REPLACEMENT moves it to direct object position in the topmost sentence. Later in that cycle, PASSIVE moves it to the beginning of the topmost sentence.

Thus we see that from the deep structure of (55) we can get four possible surface structure with a 'for-to' complementizer. The possibilities correspond to the possibilities for the application of the passive transformation.

- (64) a. Irving believed Seymour to have eaten the bagel.
 (No passive)
 b. Irving believed the bagel to have been eaten by Seymour.
 (Passive on cycle 1)
 c. Seymour was believed by Irving to have eaten the bagel.
 (Passive on cycle 2)
 d. The bagel was believed by Irving to have been eaten by
 Seymour. (Passive on cycle 1 and cycle 2)

Now suppose we embed (55) inside of the object complement of the verb "expect," as in (65).



On the first two cycles, all of the possibilities of (64) can be realized. On the third cycle, the one which applies to the topmost S, IT REPLACEMENT can apply, yielding (66 a - d), which correspond to (64 a - d).

- (66) a. Max expected Irving to believe Seymour to have eaten the bagel. (No passive)
 b. Max expected Irving to believe the bagel to have been eaten by Seymour. (Passive on cycle 1)
 c. Max expected Seymour to be believed by Irving to have eaten the bagel. (Passive on cycle 2)
 d. Max expected the bagel to be believed by Irving to have been eaten by Seymour. (Passive on cycle 1 and cycle 2)

But later in the third cycle the PASSIVE may apply to the structures underlying (66) to yield (67).

- (67) a. Irving was expected by Max to believe Seymour to have eaten the bagel. (Passive on cycle 3)
 b. Irving was expected by Max to believe the bagel to have been eaten by Seymour. (Passive on cycle 1 and cycle 3)
 c. Seymour was expected by Max to be believed by Irving to have eaten the bagel. (Passive on cycle 2 and cycle 3)
 d. The bagel was expected by Max to be believed by Irving to have been eaten by Seymour. (Passive on cycle 1, cycle 2, and cycle 3)

Thus the deep structure of (65) corresponds to eight surface structures. If we assume the principle of the transformational cycle, we can account for all of these by the application of two rules, IT REPLACEMENT and PASSIVE, applying in that order on successive cycles. If we do not assume the principle of the cyclical application of rules, then we run into trouble of two sorts. First we must assume that there exists a second passive transformation that applies before IT REPLACEMENT, which makes it impossible for us to account for the non-occurrence of (10). Moreover, the larger the sentence we consider the more extra rules we have to postulate. Thus in the derivation of (67d) the following rules must apply in the following order:

- (68) PASSIVE (to lowest S)
 IT REPLACEMENT (to second S)
 PASSIVE (to second S)
 IT REPLACEMENT (to highest S)
 PASSIVE (to highest S)

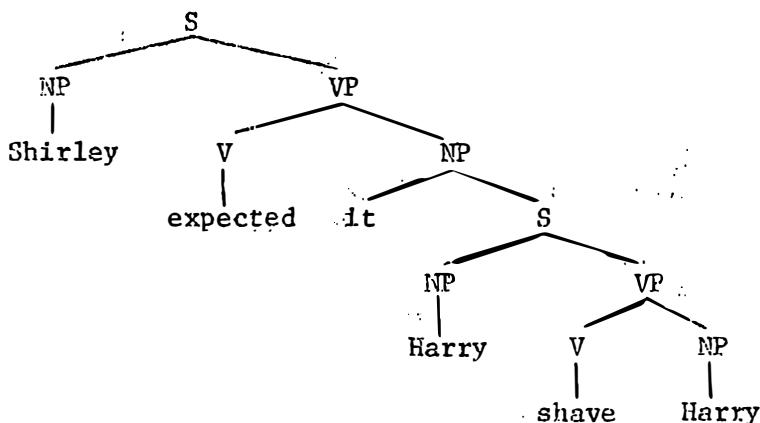
Without the cycle, we would have to hypothesize three passive transformations and two it-replacement transformations. But we can form deep structures like (65) which are arbitrarily large. For example, we could embed (65) into the object of [_S Harry believed [_{NP} it _S _{NP}] _S]. And so on, ad infinitum. The base component will define an infinite number of such deep structures, and for each of them there will be a sentence like (67d). Given any such deep structure with n occurrences of S, there will be a corresponding surface structure like (67d), in the derivation of which PASSIVE will have applied n times and IT REPLACEMENT n-1 times in a pattern like (68). Without the principle of the cycle, we would need n passive transformations and n-1 it-replacement transformations--2n-1 rules--to account for a sentence containing n occurrences of S in the deep structure. Since n is unbounded, the number of rules in English would have to be infinite if the cyclical application of rules were disallowed. With the principle of the cycle, only two rules are necessary. The cyclical principle will permit these rules to apply over and over again, as many times as there are occurrences of S in the deep structure. This principle is necessary if grammars are to be kept finite in size and if the correct generalizations are to be stated.

We have shown that PASSIVE and IT REPLACEMENT must apply cyclically. We can now show that REFLEXIVE must also apply cyclically. From sentences like "Jane believes herself to be rich" we saw that REFLEXIVE must follow IT REPLACEMENT. Now look at (69).

(69) Harry was expected by Shirley to shave himself.

"Himself" is derived from "Harry" by reflexivization. In order for reflexivization to apply, both occurrences of "Harry" must be dominated by the same S's at the time when the rule is reached. (69) has the deep structure of (70).

(70)



Reflexivization must apply before the occurrence of "Harry" that is the subject of the embedded S is moved out of that S by IT REPLACEMENT. Since REFLEXIVE must be ordered after IT REPLACEMENT, which is in the cycle, reflexivization could not occur precyclically, before the cycle began to operate. Therefore, reflexivization could only have applied on the cycle prior to the cycle on which IT REPLACEMENT applies, namely, the cycle that applies to the embedded S in (70). On the second cycle, the one that applies to the topmost S of (70), IT REPLACEMENT occurs, and then PASSIVE can apply to yield (69). Suppose the subject of the main clause of (70) were "Harry" instead of "Shirley." After reflexivization on the first cycle to yield "Harry shaved himself," IT REPLACEMENT could apply on the second cycle and then reflexivization could take place again to yield (71).

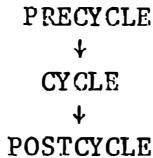
(71) Harry expected himself to shave himself.

So we see that REFLEXIVE must also be a rule that applies cyclically.

3. Precyclical Rules

In Chomsky's formulation of the transformational cycle (Aspects, 134-135), it is assumed that all transformations operate cyclically. But there are certain other logical possibilities for the organization of the transformational component. Given that some rules must apply cyclically, it is possible that there may exist other rules that apply to the entire deep phrase marker before the application of any cyclical rules. It is also possible that there may exist rules that apply only

after all of the cyclical rules have applied. If both of these logical possibilities actually do occur, the organization of the transformational component would be as follows:



Precyclical and postcyclical rules apply to the entire phrase marker, not simply to a subpart of the phrase marker, as cyclical rules do (until the cycle reaches the topmost S).

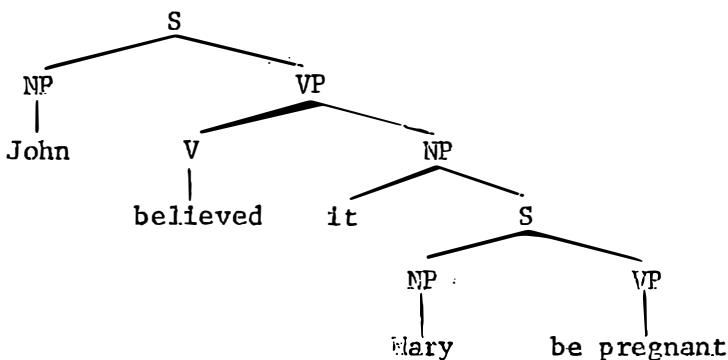
There is another logical possibility, which has been brought up by Chomsky (M.I.T. class lectures, 1966). Chomsky pointed out that postcyclical rules may be viewed as rules that apply on the last cycle, and only on that cycle, after all of the cyclical rules have applied. Rather than being in a separate postcyclical component of the grammar, these rules would appear at the end of the cycle and would be marked in some way so that they would apply only when the highest S of the tree has been reached. Such a proposal would be equivalent to the above proposal that there is a separate component of postcyclical rules. Chomsky then pointed out that another possibility existed, namely, that rules marked for applying only on the final cycle might be interspersed with cyclical rules. That is, final-cycle rules might be ordered before cyclical rules, though they would not apply on any cycle but the last. At the time, Chomsky had no evidence for choosing between the postcycle and final-cycle proposals. We will present evidence in what follows that there exist precyclical rules and that the final-cycle proposal is correct.

Sentences like (72) provide evidence for the existence of at least one precyclical rule in English.

- (72) Mary was believed by John to be pregnant, but Harry didn't believe it.

The "it" in (72) is understood as standing for the noun phrase: [_{NP} it [_S Mary be pregnant _S] _{NP}]. That is, it is understood in (72) that what Harry didn't believe was that Mary was pregnant. Therefore, the S [_S Mary be pregnant _S], must appear on the right-hand side of the deep structure of (72) and must be deleted at some point in the derivation of that sentence. By the principle of recoverability of deletion (see Chomsky, Aspects, 144-145), we know that such an S can be deleted only if it is identical to another S somewhere in the sentence. Such an S does occur in the deep structure of the left-hand side of (72), which is:

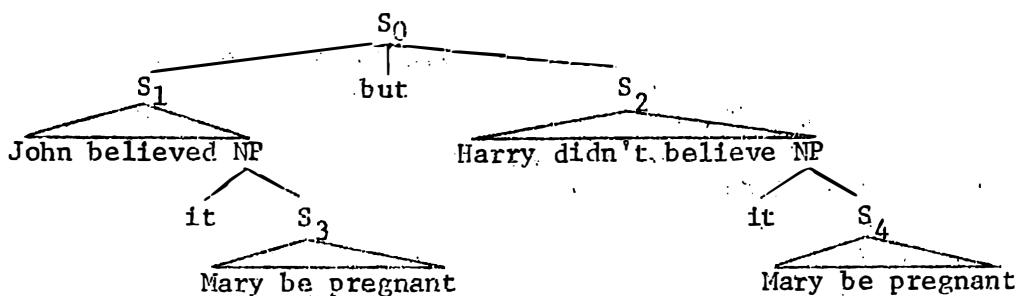
(73)



We can now show that the rule which deletes the S "Mary be pregnant" which is on the right-hand side of the deep structure of (72) must be precyclical.

The deep structure of (72) is that of (74) (with irrelevant details omitted).

(74)



S_1 and S_2 are disjoint. The cycle must apply to S_1 and S_2 independently before it applies to S_0 . That is, on the S_1 cycle, the contents of S_2 cannot be considered, and on the S_2 cycle, the contents of S_1 cannot be considered. Only on the S_0 cycle can the contents of both S_1 and S_2 be considered.

Let us now look at what happens on the S_1 cycle. As we showed in the previous section, IT REPLACEMENT and PASSIVE are both cyclical rules. Both will apply on the S_1 cycle. IT REPLACEMENT will substitute "Mary" for "it" and PASSIVE will move "Mary" to the front of the sentence, yielding "Mary was believed by John to be pregnant." At this point, S_3 no longer exists as a single entity. "Mary" is now at the front of the derived structure of S_1 and "be pregnant" is at the end of it. Thus before the cycle on S_0 is reached, S_3 is broken up into two widely separated parts.

If the rule which deletes S_4 under identity with S_3 were cyclical, then it would have to apply on the S_0 cycle, since that cycle is the only one which considers both S_1 and S_2 . In order for the rule to operate, it would have to state that S_4 is identical to S_3 . But on the

S_0 cycle, S_3 (as it appears in (74)) no longer exists; it has already been split up on the S_1 cycle. Thus, the rule deleting S_4 under identity with S_3 cannot operate on the S_0 cycle--nor on any other cycle. The only time when it could possibly operate is before the operation of any cyclical rules--at a point in the derivation when S_4 is still identical to S_3 . This rule must apply precyclically. Thus we know that there exists at least one precyclical rule of English. This means that we must expand the theory of grammar to allow for the existence of precyclical rules.

4. Final-cycle Rules

The difference in function between restrictive and non-restrictive relative clauses is well-known. As their names suggest, restrictive clauses limit the scope of the noun phrases they are associated with, while non-restrictive clauses do not.

- (75) a. Drug manufacturers who are rich are thieves.
- b. Drug manufacturers, who are rich, are thieves.

In (a), "who are rich" is a restrictive clause; in (b), it is non-restrictive. In (a) we are not talking about all drug manufacturers, only about the rich ones. But in (b) we are discussing all drug manufacturers and are making the additional assertion that they are all rich. Note that in (a) we are not asserting that all drug manufacturers are rich.

These types of clauses differ in grammatical properties as well as in semantic function. Only in restrictive clauses may "that" be used as a relative pronoun.

- (76) a. Cats that scratch are nasty.
- b. *Cats, that scratch, are nasty.

And only non-restrictive clauses may modify proper nouns.

- (77) a. *Sandy Koufax who has a good curve ball won 25 games.
- b. Sandy Koufax, who has a good curve ball, won 25 games.

In order to account for the difference in semantic function between the two types of clauses, we must assume that they come from different deep structure sources. Restrictive clauses, since they limit noun phrases, must be closely related to them in deep structure. Peters and I (Lakoff and Peters, to appear) have argued that they are introduced by a phrase structure rule of the form: $NP \rightarrow NP\ S$. Others have argued that they are introduced as part of a Determiner constituent inside of the NP . Non-restrictive clauses, on the other hand, serve no limiting function and so there is no reason to believe that they are associated with noun phrases in deep structure. In fact, since

non-restrictive clauses simply make an additional assertion, there is good reason to believe that they are derived from conjoined sentences in the deep structure.

If this is so, then it should be the case that a sentence containing a non-restrictive clause should be synonymous with the corresponding sentence conjunction. As (77) shows, this is true. The (a) and (b) sentences of (77) are synonymous.

- (77) a. Even John, who is a friend of mine, left early.
- b. Even John left early and he is a friend of mine.

Moreover, non-restrictive relative clauses may be paraphrased by appositive clauses that are clearly derived from conjoined sentences.

- (78) Even John, and he is a friend of mine, left early.

(78) is synonymous to both sentences in (77). Cases like (78) show that there must exist a rule that takes a sentence from a conjoined structure (like that underlying (77b) and adjoins it to a noun phrase (such as "John" in (78)). This is just the kind of rule that we would need if we were to form non-restrictive relative clauses from conjoined sentences. In fact, we would claim that appositive clauses as in (78) are intermediate steps in the derivation of non-restrictive relative clauses as in (77a). Informally, the steps in the derivation would be:

- (79) a. Even John left early and he is a friend of mine.
- b. Even John, and he is a friend of mine, left early.
- c. Even John, who is a friend of mine, left early.

If we derive non-restrictive relative clauses in this way, we can not only account for the fact that they function semantically like conjoined sentences, but we can account for an otherwise inexplicable grammatical fact as well. Noun phrases having "no" or "any" as articles may take restrictive relative clauses, but not non-restrictive ones.

- (80) 1. a. No student who was a friend of mine left early.
- b. *No student, who was a friend of mine, left early.
- 2. a. Any girl who can lift 500 pounds can beat up Harry.
- b. *Any girl, who can lift 500 pounds, can beat up Harry.

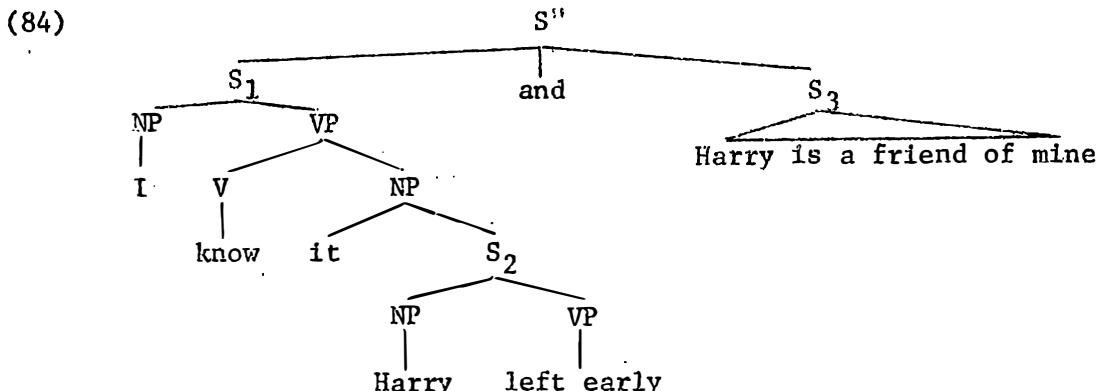
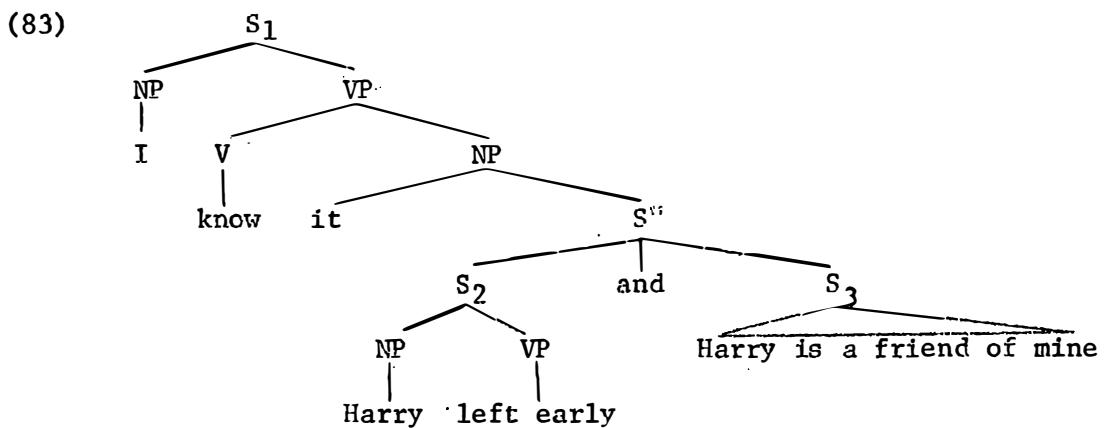
If we derive non-restrictive relative clauses from conjoined sentences, then the non-occurrence of the (b) sentences of (80) will follow from the non-occurrence of (81).

- (81) 1. *No student left early and he was a friend of mine.
- 2. *Any girl can beat up Harry and she can lift 500 pounds.

A basic fact about non-restrictive relative clauses is that they can occur on any noun phrase of the appropriate sort, no matter how deeply embedded.

- (82) 1. I know that Harry, who is a friend of mine, left early.
 2. Bill said that Jack believes that Max knows that Irving found out that Harry, who is a friend of mine, left early.
 3. Mary wanted to try to persuade Harry, who is a friend of mine, to leave early.
 4. Bill knew a salesman who knew a farmer who knew that Harry, who is a friend of mine, left early.

Suppose that the rule which forms nonrestrictive and appositive clauses applied cyclically. If this were so, then each of the sentences of (82) would be structurally ambiguous. The reason for this is that each of them has more than one S in its deep structure and the conjoined sentence, which is the source of the appositive clause, may be conjoined to any of the deep structure S's. For example, (82-1) could have either (83) or (84) as its deep structure.

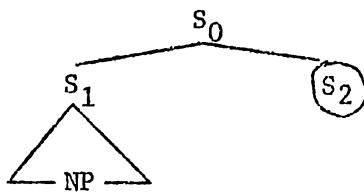


If the appositive formation rule applies cyclically, then both (83) and (84) will be sources for (82-1). In the derivation from (83), the rule will apply on the S''-cycle to yield "Harry, who is a friend of mine, left early." After the S1-cycle, we would get (82-1). In the derivation from (84), the rule would not apply until the S'-cycle,

after which (82-1) would result. It is clear that the number of possible ambiguities of this sort would be equal to the number of S's in the deep structure of the sentence. Thus, to claim that the rule applies cyclically would be to claim that there exist sentences containing appositive clauses in which each clause may be derived in an indefinitely large number of ways; this follows from the fact that there exist sentences with indefinitely many S's in their deep structure. Of course, there is no evidence that any of this structural ambiguity actually exists. In fact, each of the sentences of (84) seem unambiguous in this sense.

One might attempt to get around the problem of structural ambiguities in various ways. One of them is the next-highest-S proposal. According to this proposal, the appositive formation rule would be restricted so that it could apply only if the following conditions hold.

(85)



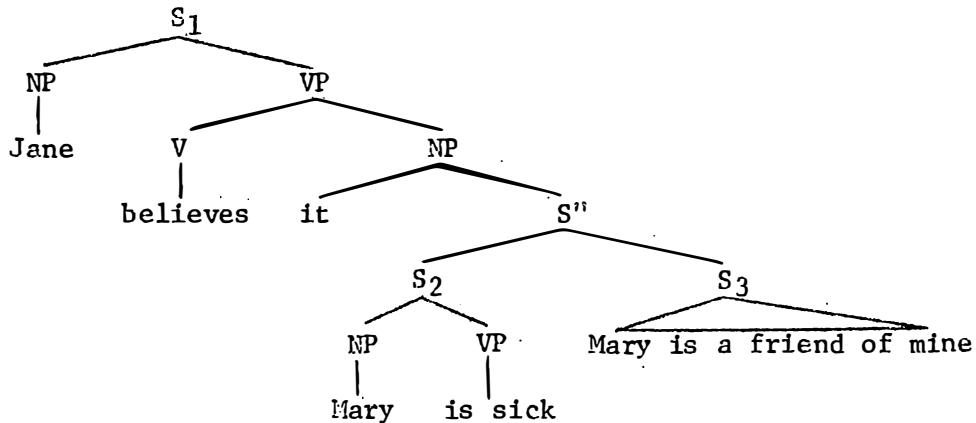
In (85), S₂ is the sentence to be made into an appositive clause. It is to be adjoined to NP. The condition is that S₀ and S₁ be the only S's to dominate NP. For example, this condition would allow the appositive formation rule to apply to (83), but not to (84). That is, to impose this condition would be to make the claim that (83) and not (84) is the correct deep structure for (82-1). In cases like (82-1), this condition would allow only one of the conjoined S's that might be encountered in the course of a derivation to be adjoined to a given NP--and it would claim that the S chosen was the correct S.

It is easy to show that the next-highest-S proposal does not do what it was invented to do. It fails to get rid of infinite structural ambiguity in appositive clauses. Consider (86).

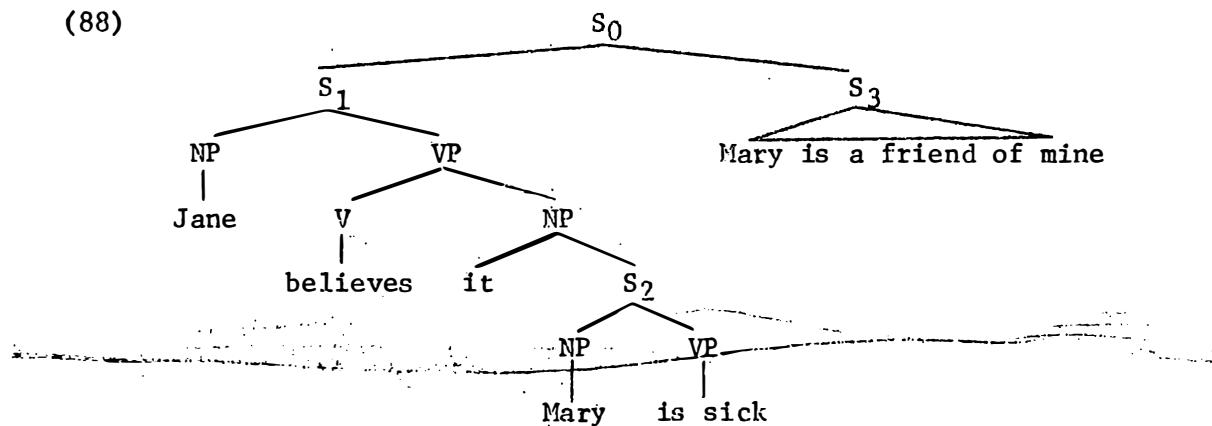
(86) Jane believes Mary, who is a friend of mine, to be sick.

Even with the next-highest-S condition, (86) would be structurally ambiguous if the appositive formation rule were permitted to apply cyclically. Both (87) and (88) would yield (86).

(87)



(88)



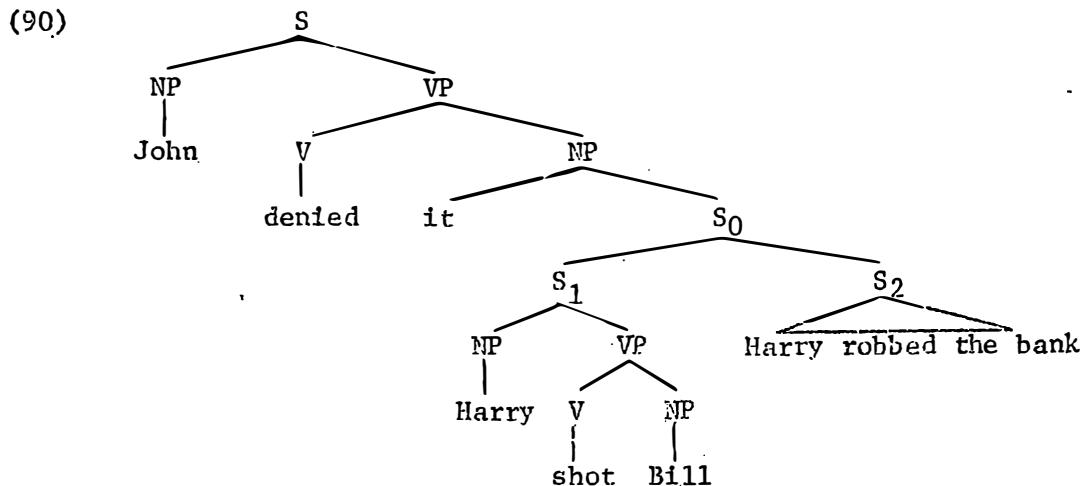
In the derivation from (87), appositive formation would apply on the S_1 -cycle, yielding "Mary, who is a friend of mine, is sick." This would follow the next-highest-S condition. In the derivation from (88), IT REPLACEMENT would apply on the S_1 -cycle, moving "Mary" out of S_2 and yielding "Jane believes Mary for to be sick." Now, on the S_0 -cycle "Mary" is dominated by S_1 and S_0 and no other S. Thus, the next-highest-S condition will be met and appositive formation will apply. So, even with the next-highest-S condition, (86) will be structurally ambiguous. This sort of situation will arise whenever IT REPLACEMENT occurs.

As we showed above, there exist sentences in which IT REPLACEMENT and PASSIVE may occur in succession an indefinitely large number of times, each on a different cycle. Even with the next-highest-S condition, an appositive clause can be formed on each such cycle. Hence this condition does not avoid infinite structural ambiguity.

But even without considering the structural ambiguity problem, we can show that appositive clause formation cannot apply cyclically. Consider the sentence:

(89) John denied that Harry, who robbed the bank, shot Bill.

Given the deep structure of (90), which will be generated by any adequate grammar of English, the appositive formation rule cannot be kept from applying to (90) to yield (89). In fact, given the next-highest-S condition it would be the only way of deriving (89).

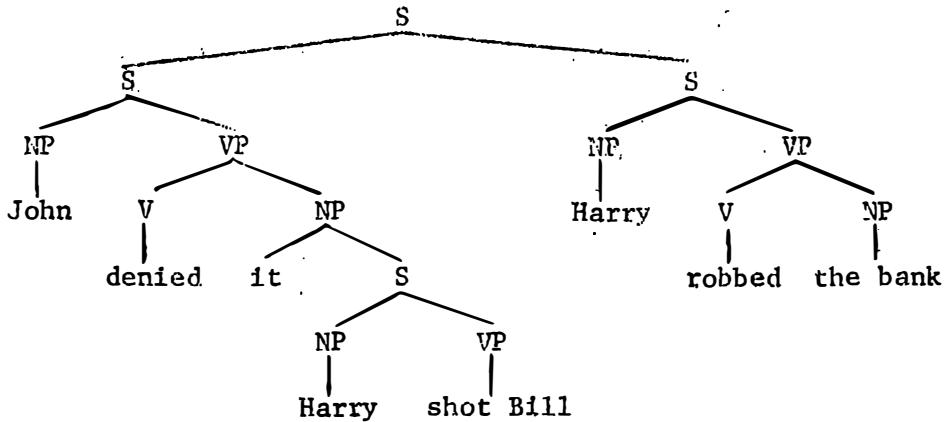


If the appositive formation rule is cyclical, then there will be no way of stopping it from applying to (90) on the S_0 -cycle to yield "Harry, who robbed the bank, shot Bill." Yet such a result would be completely incorrect, since it would embody the claim that (91), which we know has (90) as its deep structure, would have the same deep structure as (89).

(91) John denied that Harry shot Bill and robbed the bank.

To claim that (89) and (91) are both derived from (90) would be to claim that they are synonymous. They clearly are not. (91) denies the conjunction "Harry shot Bill and Harry robbed the bank." This is exactly the correct interpretation of the deep structure of (90). But (89) denies only that Harry shot Bill. It does not deny, in fact it asserts, that Harry robbed the bank. Thus (89) could not possibly have (90) as its deep structure. Consequently, the appositive clause formation rule could not possibly apply to (90) to yield (89), and since it would have to apply in that way if the rule were cyclical, it follows that the rule is not cyclical. The correct deep structure of (89) is (92), in which it is denied that Harry shot Bill and asserted that Harry robbed the bank.

(92)



Appositive formation must apply to (92) to yield (89).

This example shows not only that the appositive formation rule is not cyclical, but also that the conjoined sentence that is the source of the appositive clause must be conjoined at the topmost S and may not occur embedded. This accounts for the fact that appositive clauses always embody an assertion. This is not always the case with restrictive relative clauses. Thus (93) does not embody the assertion of (94).

(93) I gave Sheila all the unicorns that I found.

(94) I found some unicorns.

Note that if we derive appositive clauses from conjunctions at the topmost S, there will be only one source for appositive clause and the problem of infinite structural ambiguity disappears.

Example (89) led us to the conclusion that appositive clauses cannot come from embedded conjunctions and must therefore come from conjunctions at the topmost S. But we can demonstrate this in a much more straightforward manner. Suppose appositive clauses come from conjoined sentences. Let us then take two identical sentences and form a conjunction.

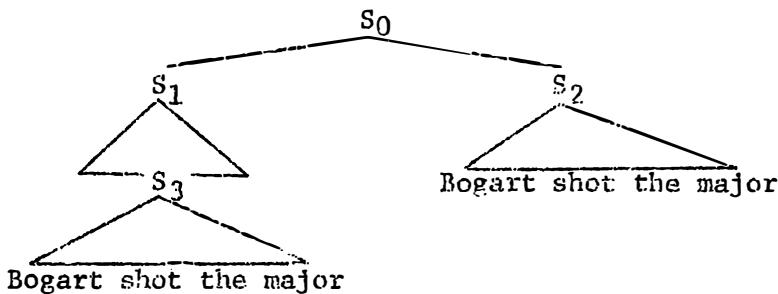
(95) Bogart shot the major and Bogart shot the major.

For me, sentences like (95) are ungrammatical. Some people find them grammatical, but admit that they are strange because they are redundant. There is no question that they are redundant. Since (95) contains a conjunction at the topmost S, we should be able to form a corresponding sentence containing a nonrestrictive relative clause. This sentence should also be redundant--and ungrammatical for those who find (95) ungrammatical.

(96) Bogart, who shot the major, shot the major.

(96) is indeed redundant--and, for me at least, ungrammatical. Now suppose we were to form another sentence in which (96) is embedded in the surface structure. If we are correct in claiming that the source of a nonrestrictive relative clause is a conjunction at the topmost S, then such a sentence should not be redundant since it would have a deep structure like (97).

(97)

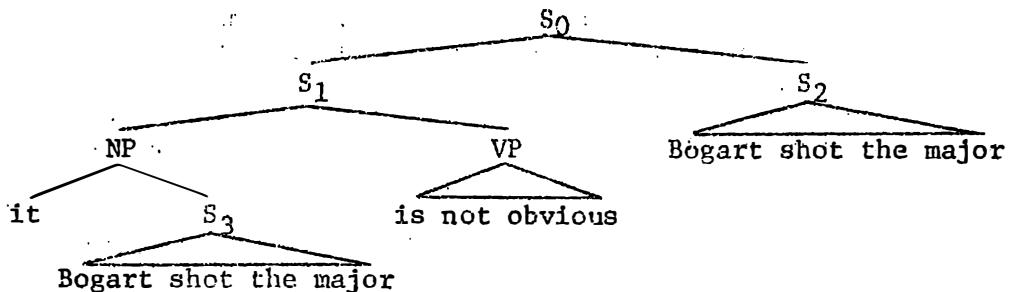


We would not expect redundancy, since S_1 and S_2 , the conjoined sentences, are not identical. If we are wrong in our claim, that is, if nonrestrictive relative clauses can come from embedded sentence conjunctions, then we would expect a sentence containing (96) embedded in its surface structure to be redundant, just as (96) is. (98) is a crucial case, since it contains (96) embedded in its surface structure.

(98) It is not obvious that Bogart, who shot the major, shot the major.

(98) is not redundant and is fully grammatical. This follows from our claim, since we would derive (98) from (99), which is of the same form as (97). S_1 is not identical to S_2 .

(99)



This example not only shows that we are correct in asserting that if a nonrestrictive relative clause comes from a conjunction, it comes from one at the topmost S, but it also provides extra evidence in favor of the proposal that such clauses come from conjoined sentences. It is only by means of the properties of conjunctions containing identical sentences that we can account for the redundancy of (96) and the nonredundancy of (98).

So far we have shown that nonrestrictive relative clauses must be derived from sentences conjoined at the topmost S, which means that they cannot be formed by any cyclical rule. Three possibilities remain: (1) they are formed precyclically; (2) they are formed postcyclically, that is, after the application of all cyclical rules; (3) they are formed on the final cycle, by a rule which must precede some cyclical rule, but which cannot apply cyclically. We will show that (1) and (2) are false, which will entail that (3) is correct. We will begin by showing that (2) is false. We can do this by demonstrating that there exists a cyclical rule that must apply after the formation of non-restrictive relative clauses.

Ross (1967) has shown that pronominalization must be cyclical. We will give only a short summary of his argument. As is well-known, pronominalization may apply either left-to-right or right-to-left.

- (100) a. That John had cancer bothered him.
 b. That he had cancer bothered John.

In (100), "he" refers to "John" and would be derived from an underlying occurrence of "John" by pronominalization. Under certain conditions, which Ross has specified but which do not concern us here, pronominalization cannot apply from right-to-left, as it does in (100b). (101b) is an example of this.

- (101) a. John learned that he had cancer.
 b. *He learned that John had cancer.

In (101b), "he" cannot refer to "John". That is, pronominalization can map "John learned that John had cancer" into (101a), but not (101b). The crucial example which shows that pronominalization must be cyclical is (102), which is minimally different from (100).

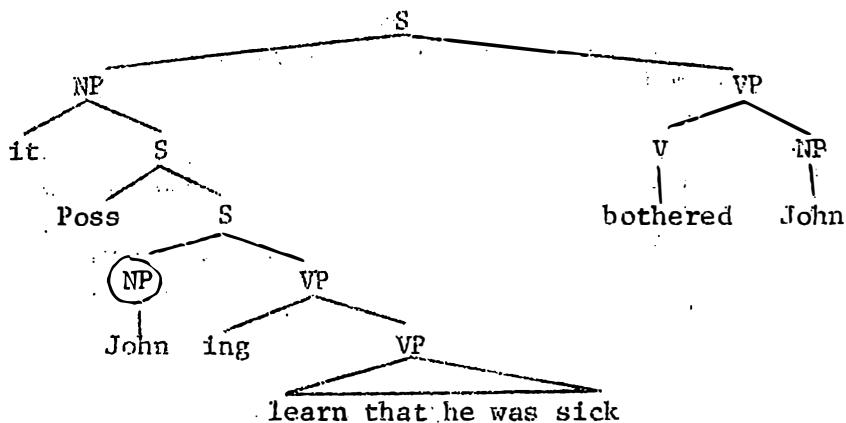
- (102) a. *Learning that John had cancer bothered him.
 b. Learning that he had cancer bothered John.

"He" can refer to "John" in (102b), but not in (102a). Thus (102) is quite different from (100), even though the only surface difference is the appearance of "learning" at the beginning of the sentences. But the difference in pronominalization between (100) and (102) cannot be accounted for simply by the presence of a noun at the front of (102). In (103) we have "the fact" in place of "learning," but pronominalization in (103) is just like that in (100).

- (103) a. The fact that John had cancer bothered him.
 b. The fact that he had cancer bothered John.

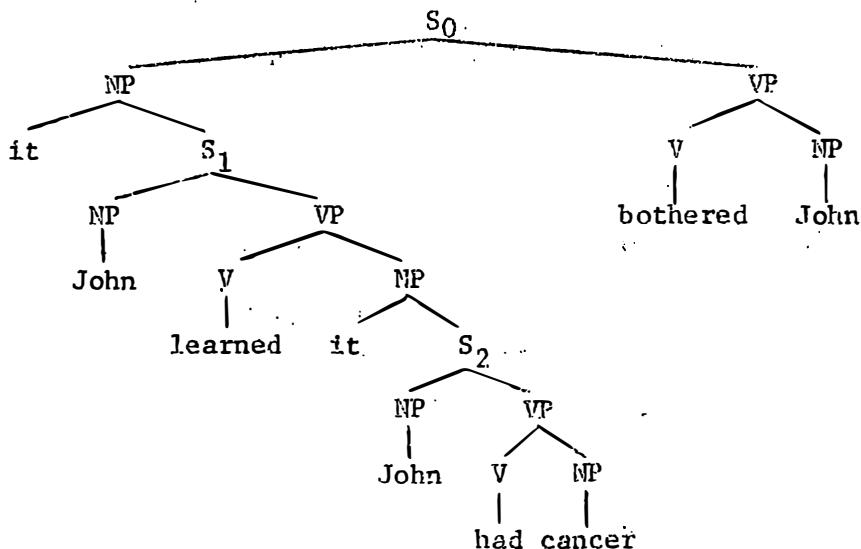
Ross points out that (102) differs from (103) in that in (102) "learning" has had its subject deleted. In (102) "learning that he was sick" must be derived from "John's learning that he was sick." At one point in its derivation, (102) must have the structure of (104).

(104)



The encircled occurrence of "John" will be deleted under identity with the occurrence of "John" that is the object of "bother." The rule which does this is quite general and also yields such sentences as "Killing butterflies amuses Bertram" and "Dating girls scares Harvey." The deep structure underlying the intermediate structure of (104) is (105).

(105)



Now suppose that pronominalization is cyclical. It will then apply on the S_1 -cycle. Now the situation at this point will be exactly as in (101). Pronominalization can operate left-to-right to yield "John learned that he had cancer," but it cannot work from right-to-left and so cannot yield "He learned that John had cancer." Now, on the S_0 -cycle, the rule deleting the occurrence of "John" that is the subject of "learn" will apply. The result will be (102b). (102a) could not possibly be produced, since the occurrence of "John" that is the subject of "had cancer" must be pronominalized on the S_1 -cycle, as (101) shows. Thus we can account for the facts of (102) in a natural way if we assume that

pronominalization is cyclical. But we could not account for these facts if we assumed that pronominalization applied on the last cycle, either after all cyclical rules or before some of them.

Suppose it applies on the last cycle after all the cyclical rules. One of those rules is EQUI-NP-DELETION, the rule which deletes the encircled NP of (104). (For a demonstration that this rule is cyclical, see § below). If pronominalization applied only on the last cycle following EQUI-NP-DELETION and other cyclical rules, then we could not possibly account for the difference between (102) and (103), since their derived structures would be identical at the time pronominalization took place. One might try to argue that since "the fact" has an article and "learning" does not, there would be enough structural difference between them so that the pronominalization rule could be fixed up to take such a difference into account. Not only would this drastically cut down on the generality of the pronominalization rule, but it wouldn't even work, as (106) shows.

- (106) a. *The knowledge that John had cancer bothered him.
- b. The knowledge that he had cancer bothered John.

"The knowledge that he had cancer" would have exactly the same derived structure as "the fact that he had cancer." Yet "the knowledge" works like "learning" not like "the fact." The reason for this is that "the knowledge that he had cancer" in (106) must be derived from "John knew that he had cancer." We can account for (106) in the same way as we accounted for (102).

We have shown so far that if pronominalization applied only on the last cycle, it could not follow EQUI-NP-DELETION. Suppose that pronominalization applied only on the last cycle and could precede EQUI-NP-DELETION, which is a cyclical rule. Then pronominalization would be a final-cycle rule and we would have proved our case, namely, that such rules exist. But we can show that pronominalization cannot precede EQUI-NP-DELETION. In § below, we will show that EQUI-NP-DELETION must precede IT REPLACEMENT. As we have shown above, IT REPLACEMENT must precede PASSIVE, which must precede EXTRAPosition. Ross (1967) has shown that EXTRAPosition must precede PRONOMINALIZATION. Ross' argument is based on examples like the following:

- (107) a. That Mary is tall bothers her.
- b. *It bothers her that Mary is tall.

In (107a) "her" can refer to "Mary." This is not so in (107b). If PRONOMINALIZATION preceded EXTRAPosition, it would be impossible to account for the distinction between (107a) and (107b). Since PRONOMINALIZATION must follow EXTRAPosition, it must also follow PASSIVE, IT REPLACEMENT, and EQUI-NP-DELETION.

We have now shown that if PRONOMINALIZATION applies only on the last cycle, it can neither follow nor precede EQUI-NP-DELETION, which,

of course, means that it cannot apply only on the last cycle. There are only two other possibilities: it is cyclical or precyclical. It is easy to show that PRONOMINALIZATION cannot be precyclical. In fact, the sentences of (107) show this clearly. EXTRAPosition cannot be precyclical, since it must follow PASSIVE, which is cyclical. If PRONOMINALIZATION were precyclical it would precede EXTRAPosition. (107) shows that PRONOMINALIZATION must follow EXTRAPosition and therefore it cannot be precyclical. An even clearer case that shows that PRONOMINALIZATION must follow some cyclical rule is (103).

- (108) a. John hates his father.
- b. *His father is hated by John.

In (108a) "his" can refer to "John." In (108b), this is not the case, (108) shows that PRONOMINALIZATION must follow PASSIVE. Such clear cases show that PRONOMINALIZATION cannot be precyclical. The only remaining possibility is that it is cyclical.

We are now in a position to show that appositive formation cannot be postcyclical. We can show that if it applies only on the last cycle, it must precede some cyclical rule, namely, PRONOMINALIZATION. We know that a nonrestrictive relative clause must be derived from a sentence conjoined to the main clause at the topmost S, but we do have no evidence as yet as to whether it must precede or follow the main clause. Therefore, we must consider three cases:

- (a) precedes main clause
- (b) follows main clause
- (c) either precedes or follows main clause

In each case we will show that PRONOMINALIZATION could not precede APPPOSITIVE FORMATION.

(a) Suppose a nonrestrictive relative clause comes from a preceding S. Then (109a) would underlie (109c). If PRONOMINALIZATION preceded APPPOSITIVE FORMATION, then (109c) would have to be derived from the intermediate stage of (109b). But this is impossible since (109b) cannot be derived by PRONOMINALIZATION. "Him" cannot refer to "Bill" in (109b), but it can in (109c).

- (109) a. Mary can't stand Bill and Bill gave Mary a diamond ring.
- b. *She can't stand him and Bill gave Mary a diamond ring.
- c. Bill gave Mary, who can't stand him, a diamond ring.

(b) Now suppose that the nonrestrictive relative clause is derived from a following S. Thus, (110c) would be derived from the structure underlying (110a).

- (110) a. John knows that ice cream is bad for John and John likes ice cream.
- b. *John knows that it is bad for him and he likes ice cream.
- c. John, who likes ice cream, knows that it is bad for him.

If PRONOMINALIZATION preceded APPOSITIVE FORMATION, (110b) would have to be an intermediate stage in the derivation of (110c). But PRONOMINALIZATION cannot yield (110b) though it can yield (110c). In (110b) "it" cannot refer to 'ice cream,' but in (110c) it can.

(c) Suppose that nonrestrictive relative clauses could be derived from either preceding or following sentences. This possibility must be considered, since one might claim that (109c) is really derived from a following S and (110c) from a preceding S, and that somehow the derivations of (109) and (110) could be blocked. Under such a proposal, (111) could be derived from the structure underlying either (112a) or (113a).

- (111) We, who fixed Sheila up with him, claim that she had a good time with Tom.
- (112) a. We fixed Sheila up with Tom and we claim that Sheila had a good time with Tom.
b. *We fixed Sheila up with him and we claim that she had a good time with Tom.
- (113) a. We claimed that Sheila had a good time with Tom and we fixed Sheila up with Tom.
b. *We claim that she had a good time with Tom and we fixed Sheila up with him.

Suppose PRONOMINALIZATION preceded APPOSITIVE FORMATION. If (111) were derived from (112a), (112b) would have to be an intermediate stage. This is impossible, since "him" refers to "Tom" in (111) but not in (112b). Similarly, if (111) were derived from (113a), (113b) would have to be an intermediate stage. This too is impossible, since "she" can refer to "Sheila" in (111), but not in (113b).

Under any of the above assumptions, PRONOMINALIZATION cannot precede APPOSITIVE FORMATION. Thus APPOSITIVE FORMATION must precede at least one cyclical rule and so cannot be postcyclical. So far we have shown that APPOSITIVE FORMATION can be neither cyclical nor postcyclical. There are only two other possibilities, that it is a final-cycle rule or that it is precyclical. We will now present evidence that it cannot be precyclical.

(114) is the crucial example needed to demonstrate that APPOSITIVE FORMATION cannot be precyclical.

(114) John and Mary, who are alike, know the answer.

In order to show the significance of (114), we must first consider a number of facts, among them the properties of the words "alike" and "know." As we will discuss in great detail in § below, words like "alike" cannot occur with singular unjoined subjects.

(115) *John is alike.

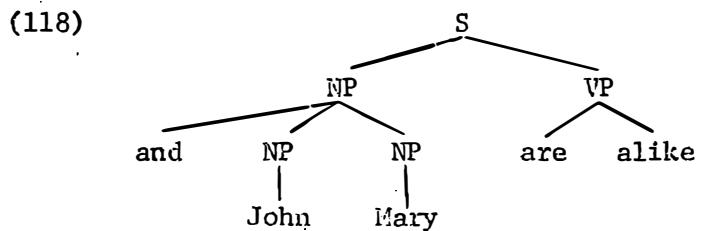
But "alike" may occur with conjoined subjects.

(116) John and Mary are alike.

As we will show in § , the conjoined subjects of "alike" must be conjoined in the deep structure and cannot arise from the reduction of a sentence conjunction. That is, (116) cannot be a reduced form of (117).

(117) *John is alike and Mary is alike.

Rather, the deep structure of (116) must be (118).



We will refer to a deep structure conjunction of noun phrases like the one in (118) as an NP*. "Alike" must have an NP* subject (or a plural subject) in the deep structure. "Leave," on the other hand, may, but need not, have an NP* subject. Thus, (119) is ambiguous.

(119) John and Mary left.

It could be a reduced form of (120).

(120) John left and Mary left.

In this case, the meaning is that John's and Mary's actions are independent and not necessarily related. In this sense, (121) is a paraphrase of (120).

(121) Both John and Mary left.

(121) is unambiguous, since sentences with "both" are derived only from sentence conjunction. On the other hand, (119) could be derived from a deep structure containing "John and Mary" as an NP* subject of "leave." In this case, the meaning would be the same as that of (122).

(122) John and Mary left together.

"Together" can occur only with NP* conjunctions and never with sentence conjunctions. Note the impossibility of (123).

(123) *Eoth John and Mary left together.

(123) is impossible because "John and Mary" cannot be derived from both a sentence conjunction and an NP* conjunction.

"Know," unlike "leave" and "alike" may not have an NP* subject.

(124) John and Mary know the answer.

(124) is unambiguous with respect to the source of the conjunction.
"John and Mary." (124) must be derived from the sentence conjunction
of (125).

(125) John knows the answer and Mary knows the answer.

Note that (124) is synonymous to (126).

(126) Both John and Mary know the answer.

(127) is impossible, since "know" cannot take an NP* subject.

(127) *John and Mary knew the answer together.

So far we have established the following:

(a) "Alike" must have an NP* subject (or a plural subject) in the deep structure.

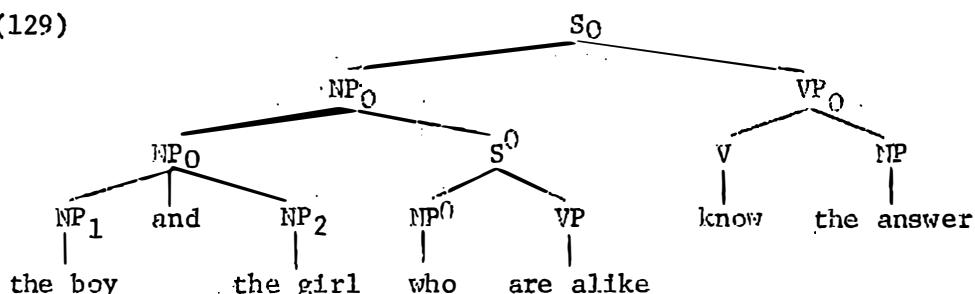
(b) Know may not have an NP* subject in the deep structure.

Now, before we can show the relevance of (114), we must consider a similar example that contains a restrictive, rather than a nonrestrictive, relative clause.

(128) The boy and the girl who are alike know the answer.

The surface structure of (128) is (129).

(129)

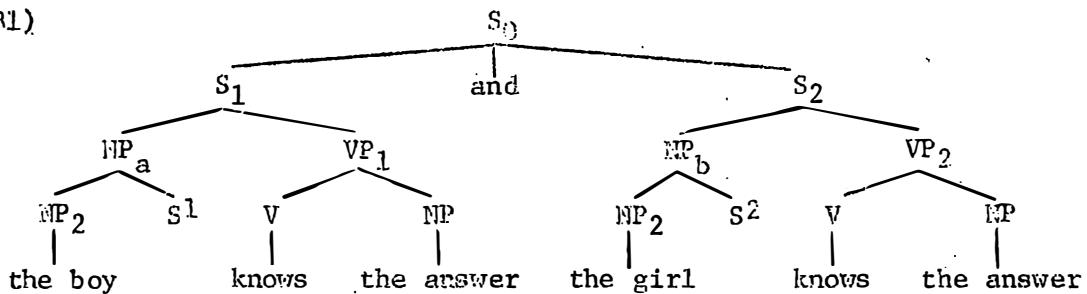


Since 'know' cannot take an NP* subject in the deep structure, we know that the NP-conjunction, NP_0 , must be derived from sentence conjunction. (130) shows this clearly, since 'both' may occur only with conjoined phrases derived from sentence conjunction.

(130) The boy and the girl who are alike both know the answer.

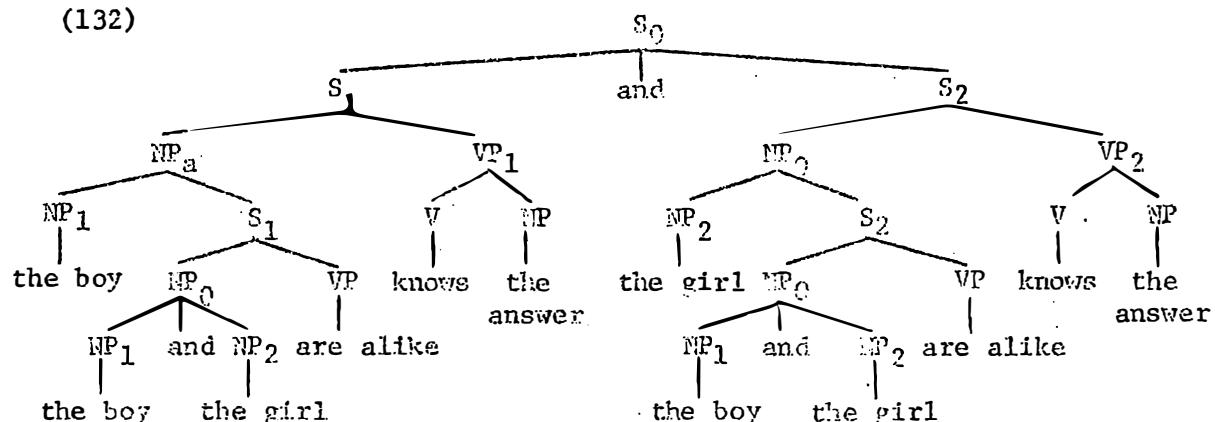
Thus the deep structure underlying (129) must be something like (131).

(131)



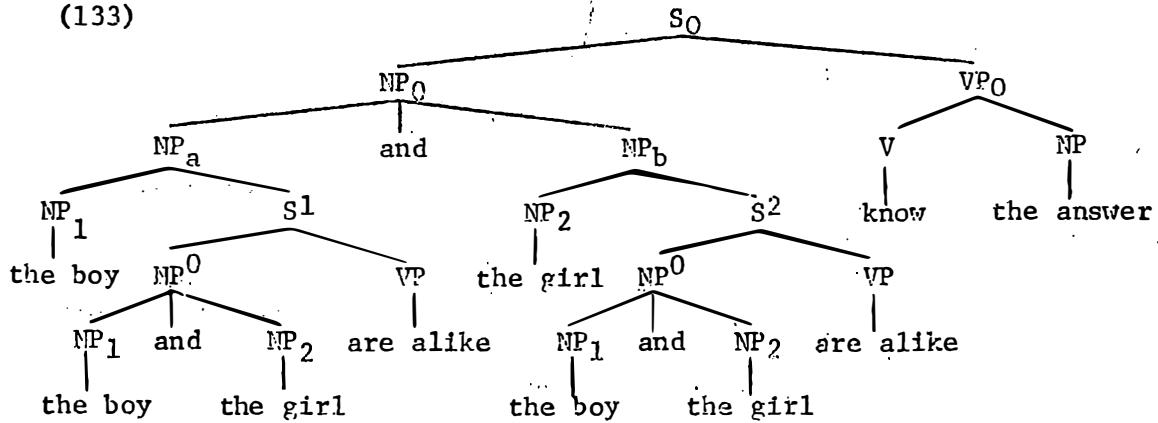
In (131), 'the boy' and 'the girl' occur in separate S 's, as they must if 'know' is to be kept from having an NP* subject. S^1 and S^2 are restrictive relative clauses on NP_1 and NP_2 . They must appear in this position in the deep structure so that after the application of conjunction reduction they will reduce to S^0 , the restrictive relative clause of (129). Let us ask what are S^1 and S^2 . It is clear that S^1 cannot be "the boy is alike" and S^2 cannot be "the girl is alike," since neither exists. The only possibility is that $S^1 = S^2 = S^0 =$ "the boy and the girl are alike." Thus the deep structure underlying (129) must be (132).

(132)



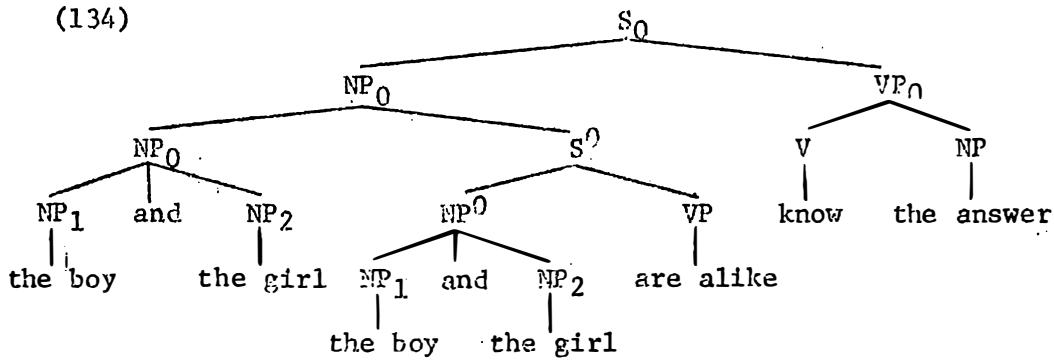
By conjunction reduction (See Lakoff and Ross, to appear), (132) is reduced to (133), since $VP_1 = VP_2$.

(133)



Since $S^1 = S^2$, conjunction reduction may apply again, yielding (134).

(134)



Now, since $NP^0 = NP_0$, relativization may apply and NP^0 becomes 'who.' Since NP_0 comes into existence only after the second application of conjunction reduction, relativization could not have applied before this point in the derivation.

Now let us return to (114), namely, 'John and Mary, who are alike, know the answer.' We will use (114) to show that APPPOSITIVE FORMATION cannot be precyclical. To demonstrate this we will assume that it is precyclical and show that such an assumption leads to a contradiction. We will also need to use the fact that conjunction reduction cannot be precyclical. This is clearly true, since conjunction reduction must follow the application of such cyclical rules as PASSIVE.

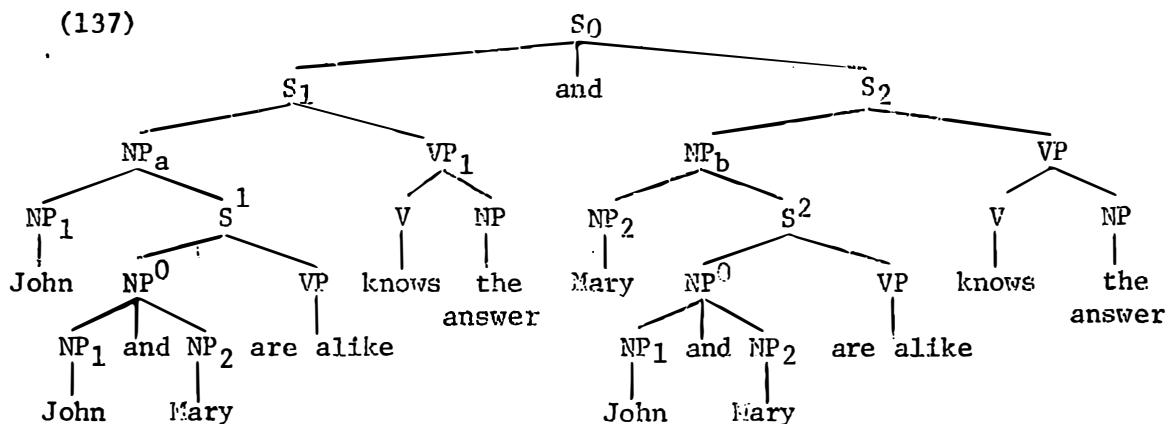
(135) John was kicked by Sally and punched by Jane.

(135) must be derived by conjunction reduction from (136).

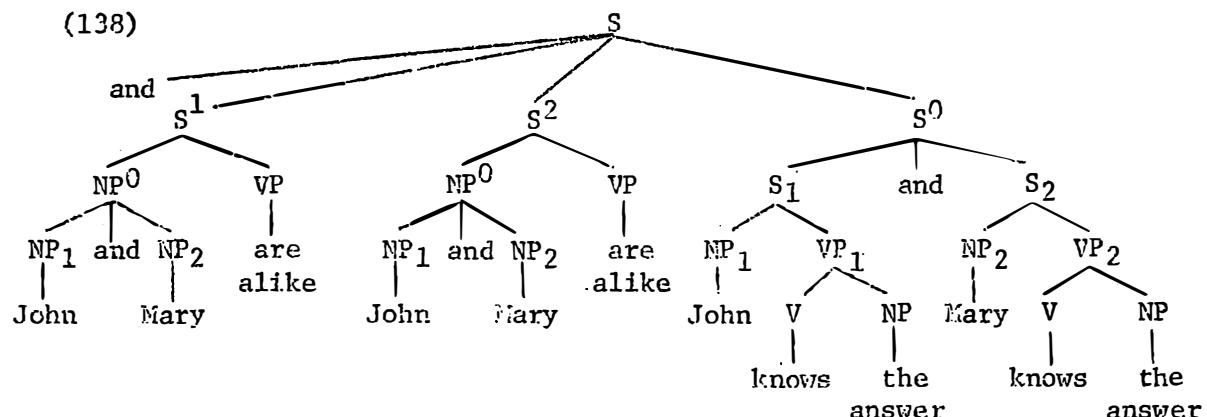
(136) John was kicked by Sally and John was punched by Jane.

Since PASSIVE must apply in each of the conjuncts of (136) before conjunction reduction could apply to yield (135), conjunction reduction must be capable of applying after PASSIVE, which is a cyclical rule. If conjunction reduction were precyclical this would not be possible.

Suppose APPOSITIVE FORMATION is precyclical. Since conjunction reduction is not precyclical, APPOSITIVE FORMATION must always precede conjunction reduction. Since "know" cannot take an underlying NP* subject, we know that "John and Mary" in (114) must have been derived from a sentence conjunction by the application of conjunction reduction. Thus, there will exist in the derivation of (114) a stage following APPOSITIVE FORMATION but preceding conjunction reduction, which is represented in (137).



In (137), S^1 must equal S^2 , so that the later application of conjunction reduction can yield (114). In (137), S^1 and S^2 are nonrestrictive relative clauses and so they must have been derived by AFPOSITIVE FORMATION from sentences conjoined at the topmost S in the deep structure. Thus the deep structure underlying (137) must be (138).



Note that $S^1 = S^2$. Thus the assumption that APPOSITIVE FORMATION is precyclical, leads to the conclusion that the topmost S in the deep structure underlying (114) must immediately dominate two identical sentences. But, as we pointed out above and will discuss further in § below, no deep structure conjunction can have two identical conjuncts. Thus we do not get (139).

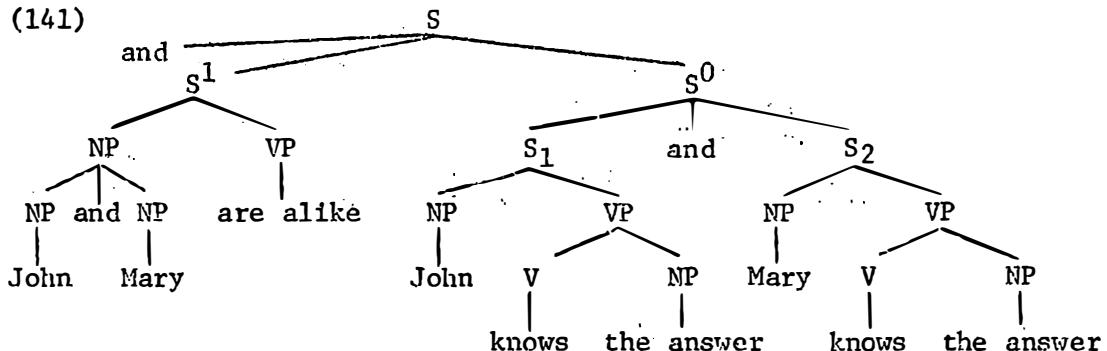
(139) *John and Mary are alike and John and Mary are alike.

Nor do we get the reduced version of (140).

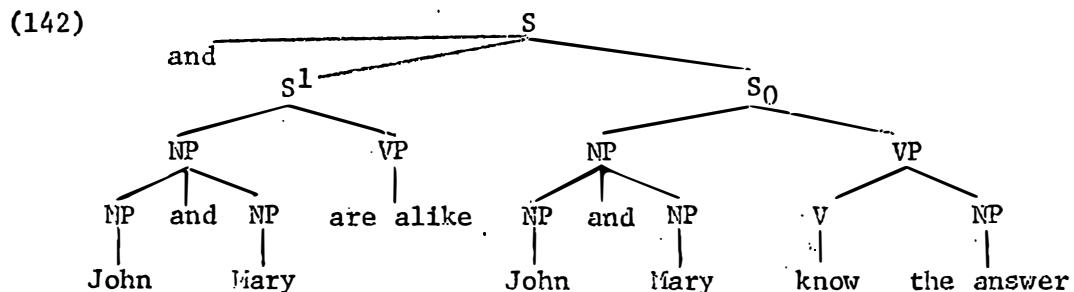
(140) *John and Mary are alike and alike.

Thus the assumption that APPOSITIVE FORMATION is precyclical has led to the false conclusion that two identical conjuncts can appear in a conjunction. Therefore, APPOSITIVE FORMATION cannot be precyclical.

Note that the above difficulty does not arise if conjunction reduction can apply before APPOSITIVE FORMATION. The real deep structure of (114) is (141).



If conjunction reduction can apply first to S_0 , we would get (142).



Now APPOSITIVE FORMATION can apply and subsequent relativization will yield (114).

In the above sections we have shown:

1. APPOSITIVE FORMATION cannot be cyclical.
2. APPOSITIVE FORMATION cannot apply only on the last cycle following every cyclical rule (that is, APPOSITIVE FORMATION cannot be postcyclical).
3. APPOSITIVE FORMATION cannot be precyclical.

The only remaining possibility is that APPOSITIVE FORMATION applies on the last cycle before some cyclical rule; that is, APPOSITIVE FORMATION is a final-cycle rule. By showing the existence of one such rule, we have shown that the concept of final-cycle rules must be defined in any adequate theory of grammar.

In postulating precyclical, cyclical, and final-cycle rules, we have incorporated into the theory of grammar some extremely abstract universals of linguistic form. Without hypothesizing such universals, we could not make any sense out of the data of the last three sections.

DEEP STRUCTURE IDENTITY

As we noted in our discussion of reflexivization above, the theory of grammar must contain an adequate definition of the concept "linguistically significant identity," since there exist many transformational rules (among them, REFLEXIVIZATION) which delete items when they are identical to other items. Examples like (143) and (144) show that identity of lexical items is not a sufficient definition.

(143) John shaved John.

(144) John shaved himself.

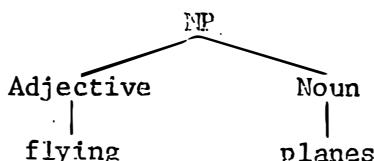
REFLEXIVIZATION will transform (143) into (144) if and only if both occurrences of "John" refer to the same person. Identity of reference is needed as well as identity of lexical items. But this is still not enough. Consider the following sentences.

(145) Flying planes are dangerous.

(146) Flying planes is fun.

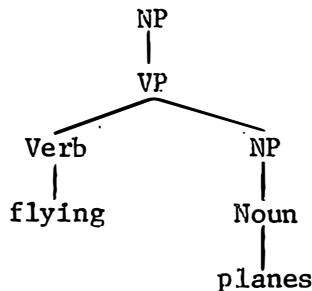
"Flying planes" in (145) is derived from "planes which are flying," and would have a derived structure something like (147).

(147)



In (146) "flying planes" is derived from the underlying sentence "someone flies planes," and would have a derived structure like (148).

(148)



Now suppose that we are referring to the same planes in (145) and (146). Then the sequence of words "flying planes" in (145) and (146) will have identical lexical items and identical reference, even though their grammatical structure will be different. Robert Lees noticed in the late 1950's that if identity of lexical item and reference were sufficient to define linguistic identity, then the subject of (146) should, by some transformational rule, be able to delete under identity with the subject of (145). For example, if (146) were a relative clause modifying the subject of (145), we should be able to derive (149).

(149) *Flying planes, which is fun, are dangerous.

As Lees noted, the fact that (149) is ungrammatical shows that grammatical structure must play a role in the definition of linguistic identity. He concluded that linguistic identity must be defined in terms of identity of derived grammatical structure as well as identity of lexical item and reference.

In the spring of 1966, it was noticed by John R. Ross and myself that this definition of linguistic identity was inadequate. Our conclusion depended crucially on the fact that sentences with different deep structures could have the same surface structure. Examples like those in (149) have been known for some time.

- (149) a. The shooting of the hunters disturbed the man.
 b. The children are ready to eat.
 c. The boy likes Mary more than Sue.
 d. The man doesn't beat his wife because he likes her.

Each of these cases has a single surface structure, but has two meanings corresponding to different deep structures.

- (149a): M₁: The hunters shoot someone.
 M₂: Someone shoots the hunters.

"The hunters" may be either the subject or object of "shoot."

- (149b): M₁: The children are ready to eat something.
 M₂: The children are ready to be eaten.

In M₁ "the children" is the subject of "eat;" in M₂ "the children" is the object of "eat."

- (149c): M₁: The boy likes Mary more than the boy likes Sue.
 M₂: The boy likes Mary more than Sue likes Mary.
- (149d): M₁: It is because he likes her that the man doesn't beat his wife.
 M₂: It is not because he likes her that the man beats his wife.

In M₁, "beat" is negated; in M₂ "because" is negated.

Given the sentences of (149), we can form relative clauses, each of which has a single surface structure corresponding to two deep structures.

- (150) NP_a: the man who was disturbed by the shooting of the hunters
 NP_b: the children who were ready to eat
 NP_c: the boy who likes Mary more than Sue
 NP_d: the man who doesn't beat his wife because he likes her

The relative clauses on the noun phrases of (150) correspond to the sentences of (149).

Given the noun phrases of (150), we can form sentences that have these noun phrases as both subject and object.

- (151) a. NP_a killed NP_a.
 b. NP_b washed NP_b.
 c. NP_c shaved NP_c.
 d. NP_d hated NP_d.

Written out in full, the sentences of (151) would be:

- (152) a. The man who was disturbed by the shooting of the hunters killed the man who was disturbed by the shooting of the hunters.
 b. The children who were ready to eat washed the children who were ready to eat.
 c. The boy who likes Mary more than Sue shaved the boy who likes Mary more than Sue.
 d. The man who doesn't beat his wife because he likes her hates the man who doesn't beat his wife because he likes her.

Assume that the subjects and objects of (152) are identical in each case. Then REFLEXIVIZATION will convert (152) into (153).

- (153) a. The man who was disturbed by the shooting of the hunters killed himself.
 b. The children who were ready to eat washed themselves.
 c. The boy who likes Mary more than Sue shaved himself.
 d. The man who doesn't beat his wife because he likes her hates himself.

In the formation of the sentences of (153) REFLEXIVIZATION has applied, deleting the objects of (152) under 'identity' with the subjects. Let us now return to the question of what 'identity' means. Suppose that linguistically significant identity were defined as follows:

1. Identity of lexical items.
2. Identity of reference.
3. Identity of derived grammatical structure.

If we look at two occurrences of any of the noun phrases in (150), we see that they contain the same lexical items and have the same derived grammatical structure. Let us also assume that the lexical items have the same reference. That is, if we take two occurrences of "the man who was disturbed by the shooting of the hunters," we can assume that we are talking about the same man and the same hunters in both cases. This is just what happens in (152a), which has the form:

- (154) NP_a killed NP_a.

Thus, the two occurrences of NP_a in (152a) meet all of the above criteria for identity. Note that this is true even if the two occurrences of NP_a have different meanings. Suppose the subject of (154) has Meaning 1 ("hunters" is the subject of "shoot") and the object of (154) has Meaning 2 ("hunters" is the object of "shoot"). By the above definition of identity, the subject of (154) will be 'identical' to the object of (154), even if their meanings differ in this way. Since each occurrence of NP_a can have two meanings, (154), with two such occurrences, should be able to have four meanings, depending on the combinations of meanings in subject and object.

(155)	NP _a	killed	NP _a
Combination 1:	M ₁		M ₁
Combination 2:	M ₂		M ₂
Combination 3:	N ₁		M ₂
Combination 4:	M ₂		M ₁

With any of the above four combinations of meanings, the subject of (154) will be considered identical to the object according to the above definition of identity. This means that REFLEXIVIZATION should be able to apply in all of the four cases of (155), to yield sentence of the form (156).

- (156) NP_a killed himself.

Since sentences of the form of (156) would be derived from any one of the combinations of (155), such sentences should be four-ways ambiguous. Thus, according to such a definition of identity, (157) (equals (153a)) should be four-ways ambiguous.

- (157) The man who was disturbed by the shooting of the hunters killed himself.

The same should be true of the other sentences in (153).

But this is not the case. (157) is two-ways ambiguous, not four-ways ambiguous. Combinations 1 and 2 of (155) occur; combinations 3 and 4 do not occur. If "the hunters" is understood as the subject of "shoot" in the subject of (157), then it can only be understood that way in the object. Similarly, if "the hunters" is understood as the object of "shoot" in the subject of (157), then it is understood that way in the object. The other possibilities do not occur. The same is true of the other examples in (153). REFLEXIVIZATION can occur only if the meanings are the same in both subject and object.

Let us consider another example.

- (158) John objected to the shooting of the hunters and so did Bill.

(158) would have to be derived from the structure underlying (159).

- (159) John objected to the shooting of the hunters and Bill objected to the shooting of the hunters.

In the formation of (158) the verb phrase "object to the shooting of the hunters" on the right side of (159) is deleted under identity with the same verb phrase on the left of (159). Since "the shooting of the hunters" may have two meanings depending on the deep structure source, (159) may contain four combinations of those two meanings.

- (160) Let S be "the shooting of the hunters"

John objected to S and Bill objected to S.

Combination 1:	M_1	M_1
Combination 2:	M_2	M_2
Combination 3:	M_2	M_1
Combination 4:	M_1	M_2

If the above definition of identity were correct, then (158) should be derived from any of the four combination of (160) and so should be four-ways ambiguous. But the fact is that (158) is only two-ways ambiguous, with meanings corresponding to combinations 1 and 2, not to combinations 3 and 4. "The shooting of the hunters" must have the same meaning on the left and the right side of (158).

What these examples show is that the definition of identity given above is inadequate. Not only must derived grammatical structure be taken account of, but deep grammatical structure must be considered also. (Note that if the deep structures are the same, the meanings will be the same.) On the basis of these examples, it appears that the correct definition of linguistically significant identity will involve all of the following:

1. Identity of lexical items.
2. Identity of reference.
3. Identity of derived structure.
4. Identity of deep structure.

Universal grammar, as it has been construed so far in transformational theory, can take no account of conditions like 4. The reason is that transformations have so far been defined only in terms of derived structures. They do not have the power to 'look back' to what occurred in previous steps of a derivation, e.g., in deep structure. Since such a view of transformations is inadequate, the question arises how can we redefine transformations to enable the theory of universal grammar to account for the observed facts without enriching the theory so much that it will be able to define grammatical operations which can never occur in natural language. It is clear that we must redefine transformations so that they can look back to a previous point in the derivation. But it would be incorrect to allow them to look back to any previous point in the derivation at all. Transformations must be able to refer back to deep structure, but not to, say, the point in the derivation after five transformations (or some other arbitrary number) have applied. Identity at the level of deep structure is linguistically significant. Identity after the application of some arbitrary number of transformations is not linguistically significant. Therefore, we must revise the definition of transformations so that they can look back only to deep structure and not to any arbitrary point in the derivation. Moreover, not every aspect of deep structure is linguistically significant as far as transformations are concerned. Thus, it is not linguistically significant whether the number of nodes that occurs in a given deep structure is a prime number or whether the word "aardvark" occurs in a deep structure. What is linguistically significant is whether certain subtrees are identical in deep structure--identical in constituent structure, lexical items and the references of their lexical items. Moreover, it is not the identity of just any deep structure subtrees that can be required by a transformation. Two deep structure subtrees can be checked for identity only in the case that a given transformational rule states that the derived structure corresponding to one deep structure subtree must be deleted under 'identity' with the derived structure corresponding to the other deep structure subtrees. Note that in order to define this notion of deep structure identity adequately we must also define adequately what it means for a deep structure subtree to 'correspond' to a derived structure subtree. As we shall see, it is not at all obvious how this can be done.

Our problem is this. how can we define the operation of 'deletion of one constituent under identity with another' so that such transformations will apply to derived structures and, in addition, have the power to check whether the two constituents involved were identical in deep structure? In the spring of 1966, Ross and I constructed the following solution. We observed that in defining identity of reference, the theory of grammar then current assumed that the reference indices (integers) assigned to lexical items had to be carried along from the deep structure to the derived structures, so that later transformations could use them in checking identity of derived structure. We proposed that the assignment of indices be extended from individual lexical items to each node in the deep structure of a sentence. The assignment of indices would be carried out by an algorithm with the following constraints:

- (I) Starting with the indices on the lexical items at the bottom of the tree, indices would be assigned to each node of the tree from the bottom up.
- (II) The index assigned to a node N would be uniquely determined by the nodes immediately dominated by N and by the indices assigned to those nodes.
- (III) Two nodes would receive the same index if and only if the subtrees dominated by those nodes were identical in structure and the corresponding nodes in the two subtrees had the same indices.

We assume that the indices assigned to the deep structure by such an algorithm would be carried along throughout the derivation. In applying a transformation that deleted one constituent under identity with another, we would check for identity of derived constituent structure just as we did above and check for deep structure identity by seeing whether the two constituents had the same index. They would have the same index if and only if they were identical in deep structure. By incorporating such a use of indices into the theory of grammar, we could define the notion of deep structure identity adequately to handle the cases given above.

In defining deep structure identity by such an indexing device, we have greatly enriched the theory of grammar and at the same time made strong claims about the nature of universal grammar. It is important to see exactly how this device changes the theory of grammar--to see exactly what it can and cannot do. That is, it is important to understand the linguistic significance of this formal device, what empirical consequences it has.

By adding the notion of deep structure identity as formalized by the indexing device, we have changed the theory of grammar so that it makes stronger claims than it did before. The addition of this device has reduced the power of transformations to relate deep structures to surface structures. We can think of the relational power of a transformation as being defined by the set of pairs of the form

(input tree, output tree)

such that the transformation has mapped the input tree into the output tree. For a given transformation, the greater the number of such pairs, the greater the relational power of that transformation. Let us consider a rule which deletes one constituent under 'identity' with another.

The relational power of the rule will depend on what is meant by 'identity.'

Definition I: Identity is defined in terms of derived structure identity (i.e., without our indexing device).

Definition II: Identity is defined in terms of derived structure identity and deep structure identity as defined by our indexing device.

It is clear that a given rule will apply to more cases under definition I than under definition II. For example, in (155) and (160), the rules in question will apply to derived structures representing all four combinations of deep structures if we assume definition I. Under definition II, however, those rules will apply only in the case of derived structures representing combinations 1 and 2. Although the addition of our complicated indexing procedure has enriched the theory of grammar, it has reduced the relational power of transformations.

At the same time, this device allows transformations to do something they could not do in previous theories of grammar: to look back to some aspect of some prior step in a derivation (i.e. identity at the level of deep structure). It is important to note however that this device does not allow transformations to have the choice of either considering deep structure identity or not. That is, this device does not allow for the existence of transformations which utilize derived structure identity, but not deep structure identity. The incorporation of this device into the theory of grammar embodies the claim that identity of derived and deep structure is the only kind of linguistically significant identity. Any definition of identity embodies strong claims about universal grammar. Such claims are empirical. They may be wrong. They are not mere notational questions, but embody real assertions. As we have already seen, the definition of identity in terms of derived structure is false.

When notations embody real claims about the nature of language they are anything but artifacts. Notations are of interest only to the extent that they embody real claims about what language is like. Thus, it would be of no interest to find another notation equivalent to the indexing procedure outlined above if that notation embodied exactly the same definition of identity. It would be of no interest because it would make no new claims. If such a notation were to embody a different definition of linguistically significant identity, then the question would arise as to which was correct, and we would look for empirical evidence to decide between the two. The only reason for setting up such notational devices as our indexing procedure is so that we can make our claims precise. Only if they are precise, can they be tested.

Exactly what claims does our indexing procedure make? Since indexes are determined only at the level of deep structure, they can indicate only deep structure facts and not facts about any other point in the derivation. Since rules which delete under identity can only check identity of indices, our indexing procedure allows for the checking of deep structure identity, but not for the checking of any other fact about deep structure. This embodies the claim that the only question about deep structure relevant to the operation of transformations is that of identity. Moreover, indexing gives us a natural way of defining the notion 'identity between deep structure subtrees that correspond to certain derived structure subtrees.' The tricky word here is 'correspond.' Without a device like indexing, the only way we could check for deep structure identity would be to trace the history of the relevant nodes back through each step of the derivation until we reached the level of deep structure. This would mean that in order to find out whether a given transformational rule could apply, one would have to check through the entire derivation of the sentence up to that point. However, if we assign an index to each node at the level of deep structure and then carry the indices along through the derivation, then in checking to see whether the rule applies we need only check to see whether the relevant indices are identical. Again, this embodies the claim that aside from deep structure identity, no information about the prior stages of a derivation is needed in order to tell whether or not some transformational rule applies.

We ought to point out some of the claims that our indexing procedure does not make. Suppose someone were to raise the following objection. "Your indexing procedure can't be right, since no one could possibly remember all of those numbers (the indices) when he is in the process of uttering a sentence." Such an objection would reveal a basic misunderstanding of what a generative grammar is and of the claims that are being made for its psychological relevance. It would involve a misunderstanding of the distinction between linguistic competence and the actual performance of a speech act. (See Chomsky, Aspects, Chapter I). A generative grammar embodies an account of what a speaker knows about his language. It is a system of rules defined in some precise way that accurately describes the structure of each sentence of his language. Empirical studies of what generative grammars are like have shown that they are very complex objects, that any adequate system of rules for a natural language must itself have a very complex structure. So far, the only precise way that has been conceived of to describe this structure adequately has been a formalism involving the notion of a 'transformational derivation.' This is a historical accident. No other kind of formalism that will come close to describing the facts of language happens to be known at present. Thus we are forced into the mould of thinking of a generative grammar as a kind of machine or complicated algorithm that describes the structure of a sentence step by step, by a kind of process. First the deep structure of a sentence is formed, then the precyclical transformational rules apply, then the cyclical rules apply in order from the most deeply embedded sentence

upward, then the final-cycle rules apply. When we are done, we have described the structure of, or "generated," a single sentence. Each step in the process is part of the grammar's description of the structure of the sentence. This 'process' is completely abstract. It does not occur in real time. In fact, it does not "occur" at all. When we speak of a "derivation" of a sentence, we are doing no more than speaking in the only precise terms now available of what a speaker knows about the structure of that sentence.

When we claim that a grammar is "correct" to some extent, we are making a claim about its psychological relevance. We are claiming that the descriptions of sentence structure that the grammar provides is in some way an accurate reflection of what a speaker knows about his language. Because of the paucity of available formalisms, we are forced to use an artifact to describe the structure that a grammar claims that a sentence has. We use the artifact of saying that the grammar 'goes through the process' of a transformational derivation. We are not claiming that the speaker of a language ever goes through such a 'process,' either in uttering or perceiving actual sentences. We are only maintaining that the sentence structure which the abstract process of derivation describes is in some poorly understood sense an accurate portrayal of what the speaker knows about the sentence.

When we say that a transformational derivation of a sentence represents what a speaker knows about that sentence, we mean the following: each step of a derivation of a sentence is related by a one-to-one correspondence to the speaker's linguistic knowledge about the structure of that sentence. We have no idea how linguistic knowledge is represented physically in the brain. So there is no reason whatever to believe that knowledge of sentence structure involves any 'process' of derivation in the mind. It may well be the case that knowledge of sentence structure is represented in the mind in some 'static' way, which is in a one-to-one correspondence with what we picture as a derivation. In such a static representation all of the steps of a transformational derivation would be available at once.

In maintaining that the concepts of linguistic theory are psychologically real and that grammars and derivations have representations in the mind, we are not claiming that any of these is represented directly in the mind in terms of the formal artifacts and notations that we are forced by historical accident into using. We are not maintaining that the mind goes through the operation of a transformational cycle or that some nerve ends are marked NP. We claim only that these concepts are somehow represented in the mind.

Our indexing process is a clear example of an artifact of notation being used to make a very abstract claim of psychological import. Our claim is not that the process of indexing as we have described it goes on in the mind, nor do we claim that indices as such are represented in the mind. The indexing process is only a formal way of expressing the principle of deep structure identity.

Suppose we consider as a description of sentence structure the sequence of the trees that one would derive by going through the steps of a transformational derivation. We can think of a transformation not as a process but as a formal statement that relates the ith tree to the i+1th tree. Under this interpretation we can think of a transformation which deletes one constituent under identity with another as a formal statement that relates a tree containing two identical constituents to the corresponding tree with one of those constituents absent. The principle of deep structure identity would state that the possibility of such formal statements would always depend not only on whether the two constituents were identical in the ith tree, but also on whether the corresponding constituents were identical in the first tree of the sequence (the deep structure). The principle would also state that no tree other than the ith tree and the first tree could ever be relevant to this question and that the only thing about the first tree that is relevant is the question of whether the two constituents are identical. The indexing procedure is nothing more than a notational device for stating this.

In some senses, indexing is an awkward notational device. For instance, if one were to try to program a computer to mimic a transformational derivation, it would be a burden on the computer's memory to keep track of all the indices. But this is irrelevant to linguistic theory. Suppose one could devise a less awkward notational convention, which made exactly the same claims about the nature of linguistically significant identity, but which was less of a burden on a computer's memory. This too would be irrelevant to linguistic theory. The only relevance of a notational device is the claims that it makes about the nature of language.

So far we have shown that the definition of linguistically significant identity cannot be adequately stated in terms of derived constituent structure alone. We have hypothesized that identity of both deep and derived structure are required, we have set up a formalism (the indexing process) that defines this precisely, and we have shown that this hypothesis will account for crucial examples like (153) and (158). Having defined deep structure identity precisely, we are now in a position to show that it too is incorrect and that the correct definition of linguistically significant identity is far more abstract than anything that we have considered up till now. A crucial example that reveals the inadequacy of deep structure identity is (161).

(161) The children are ready to eat and so are the chickens.

(161) is derived from the structure underlying (162).

(162) The children are ready to eat and the chickens are ready to eat.

(162) consists of a conjunction of sentences (163) and (164).

(163) The children are ready to eat.

(164) The chickens are ready to eat.

Both (163) and (164) are ambiguous in that "ready to eat" can mean either:

- M_1 : ready to eat something
- M_2 : ready to be eaten

In (162) there are four possible combinations of meanings.

(165) The children are ready to eat and the chickens are ready to eat.

Combination 1:	M_1	M_1
Combination 2:	M_2	M_2
Combination 3:	M_2	M_1
Combination 4:	M_1	M_2

But (161), like (153) and (158), is not four ways ambiguous, but only two ways ambiguous. (161) can only mean that both the children and the chickens are ready to eat something or that both the children and the chickens are ready to be eaten. That is, (161) may only have the meanings given by combinations 1 and 2 of (165).

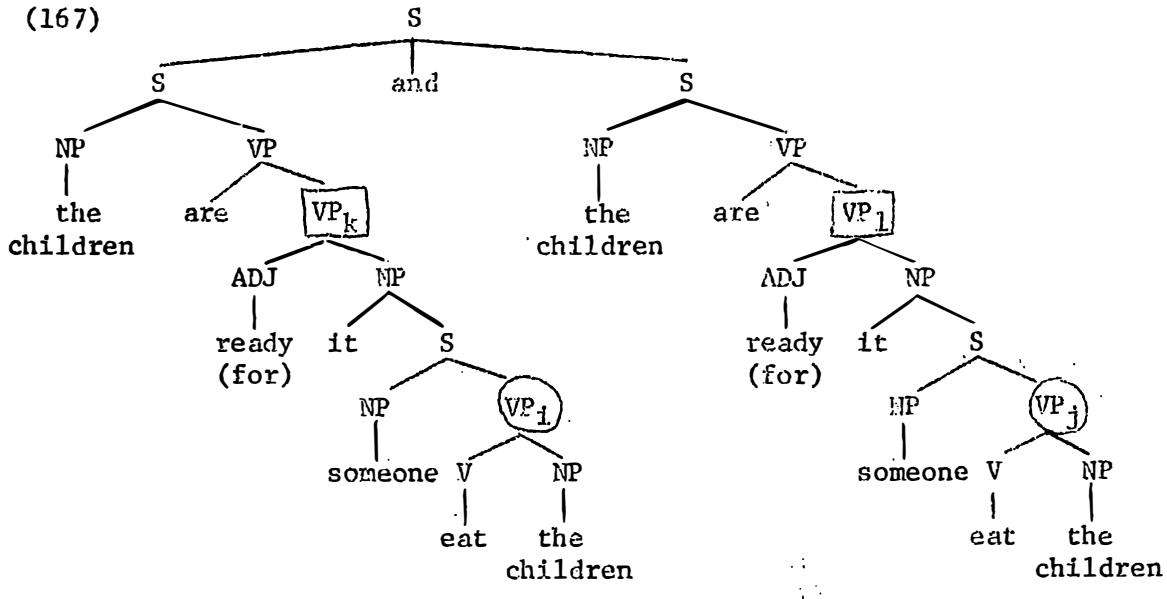
Superficially, (161) seems to be a case exactly parallel to (153) and (158). It seems to prove no more than that deep structure identity is required in the derivation of (161) from (162). But if we look closely at the principle of deep structure identity we will see that it is too strong in this case. With such a principle we cannot derive (161) with the meaning that both the children and the chickens are ready to be eaten. In this meaning "children" and "chickens" are both understood as objects of "eat." Thus the deep structure of (161) with this meaning will contain the two verb phrases of (166).

(166)



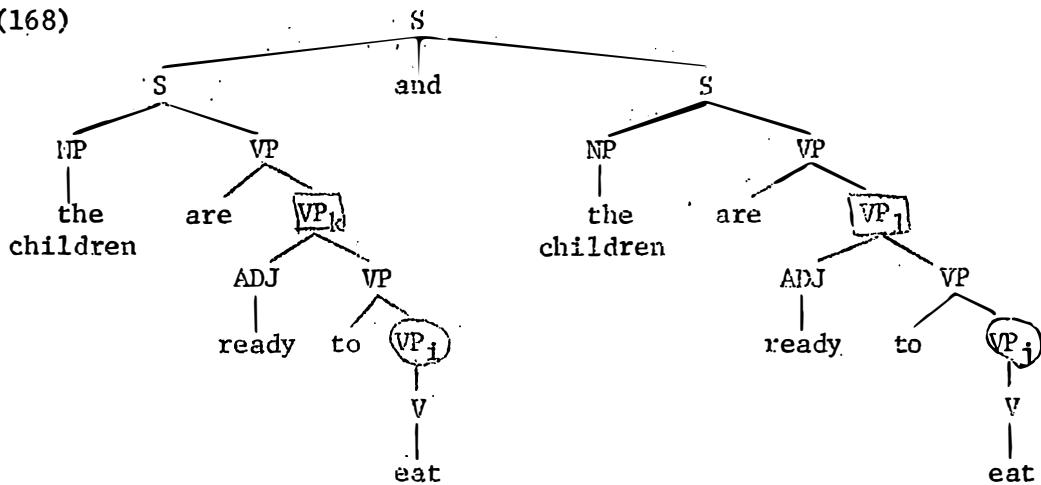
Since these verb phrases are not identical, their VP nodes will receive different indices, i and j, as in (166). The same is true of the verb phrase nodes which dominate "ready" on both sides of the deep structure of (161), as is shown in (167).

(167)



The encircled VP nodes are those shown in (166). They have different indices since they are not identical. The VP nodes in the squares dominate "ready." They are not identical, since one contains "children" and the other contains "chickens." Thus they must also receive different indices, k and 1. In both cases the VP's differ only in that one contains "children" where the other contains "chickens." In the course of the derivation, these occurrences of "children" and "chickens" are deleted, yielding the derived structure of (168).

(168)



To yield (161) the VP "ready to eat" on the right in (168) would have to delete under identity with the corresponding VP on the left. But, according to our principle of deep structure identity, this could not happen. Since the VP's were not identical in deep structure, they have

different indices and so deletion cannot apply. This shows that the principle as we stated it is too strong. Since (161) can be derived from the deep structure of (167) through the intermediate stage of (168), we must find a new principle which will permit deletion to take place in this instance, while forbidding it in the cases discussed above, (155) and (160). Any such new principle must involve deep structure in some way, but not involve identity of deep structure.

In our discussion of (155) and (160) we observed that deletion could take place only if the constituents involved were identical in meaning. We assumed that this meant that they had to be identical in deep structure. But we did not have to make this assumption. We could have assumed just what we observed--that they had to be identical in meaning. We could have formalized this in a rather straightforward way. In terms of the semantic theory of Fodor, Katz and Postal, semantic interpretation starts with the lexical items at the bottom of a deep structure tree and proceeds upwards. Starting with the meanings of the lexical items, semantic readings are assigned at each node of the tree by a principle of composition such that the meaning of a given node will be determined by the meanings of its daughters. Since this semantic theory (which is presently the only one in existence) assigns semantic readings to nodes, we could carry along the semantic readings at each node throughout the derivation. We could then attempt to define identity of derived constituent structure and identity of semantic reading.

Such a definition of identity would be subject to the same pitfalls as the principle of deep structure identity. In the case of (161), semantic readings would function much like indices. In (166) for example, the verb phrase nodes will be assigned different readings since they contain noun phrases with different meanings. Let us say that the verb phrase nodes in (166) are assigned the semantic readings i and j. Similarly, in (167), the verb phrase nodes in the squares will be assigned different readings, since they too contain noun phrases with different meanings ("children" versus "chickens"). Say that they are assigned semantic readings k and l. In (168), the VP in the square on the right will differ in semantic reading from the corresponding VP on the left. Under the suggested definition of linguistically significant identity, deletion will fail to take place. But as we pointed out above, deletion should take place in this case. Hence, the definition of identity in terms of identity of semantic readings and derived constituent structure must also be incorrect.

In seeking out a new definition of linguistically significant identity, we ought to ask just why the principle of deep structure identity failed in the case of (161). Under a correct definition of identity, the VP's in the squares in (168) should be considered identical. Under the principle of deep structure identity, they were not considered identical since one contained "children" in its deep structure where the other contained "chickens." But note that the occurrences of "children" and "chickens" that led to this do not appear in the derived structure

of (168). This suggests that items that do not appear in the derived structure are completely irrelevant to the question of linguistically significant identity.

RULES THAT APPLY AT ANY POINT IN THE DERIVATION

Above, we pointed out that there exist rules that can apply precyclically. We assumed at that time that such rules can apply only precyclically. We will now present some evidence that appears to show that the precyclical application of such rules is only a special case of a more general phenomenon: certain rules seem to be able to apply at any point in the derivation at which their structural index can be met, whether precyclically or cyclically.

The cases that lead us to hypothesize such a mode of rule application involve 'precyclical' S-deletion. We showed above that sentences like "Mary was believed by John to be pregnant, but I didn't believe it" had to be derived by the precyclical application of a rule that deleted the S "Mary be pregnant" following the 'it.' Since the S was deleted, IT-DELETION could not apply and so the "it" remained. The S-deletion rule would be stated essentially as follows:

(168) SD: X - S - Y - IT - S - Z
 1 2 3 4 5 6

where NP dominates 4^5 and $2 = 5$

SC: Delete 5

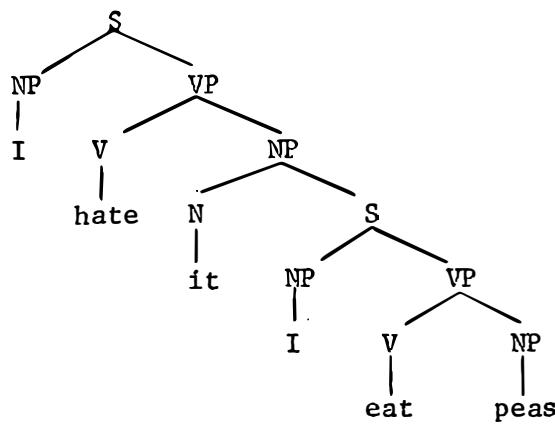
Difficulties arise in cases where S-deletion interacts with the rule of equi-NP-deletion. EQUI-NP-DELETION is the rule that operates to distinguish sentences like (169) from those like (170).

(169) I hate for John to eat peas.

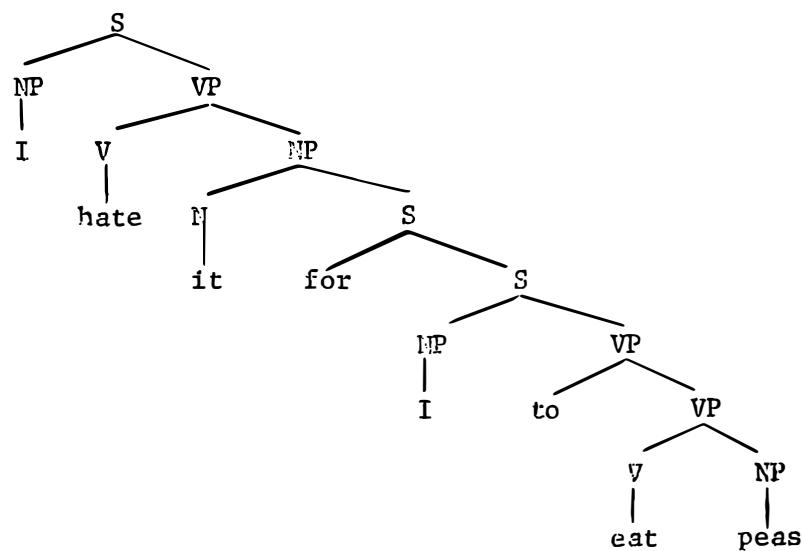
(170) I hate to eat peas.

In (169) "John" is understood as the subject of "eat." In (170), "I" is understood as the subject of "eat." But "I" does not appear as the surface structure subject of "eat" in (170). Since it must appear as the deep structure subject of "eat," it must have been deleted. EQUI-NP-DELETION is the rule that accomplishes the deletion. Basically, it deletes the subject of an embedded complement sentence when it is identical to the subject of the main clause. Given the deep structure of (171), COMPLEMENTIZER PLACEMENT will yield (172), and EQUI-NP-DELETION will yield (173).

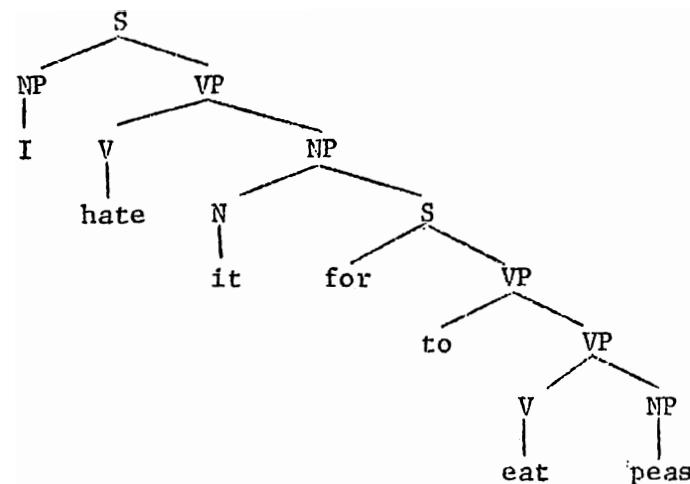
(171)



(172)



(173)

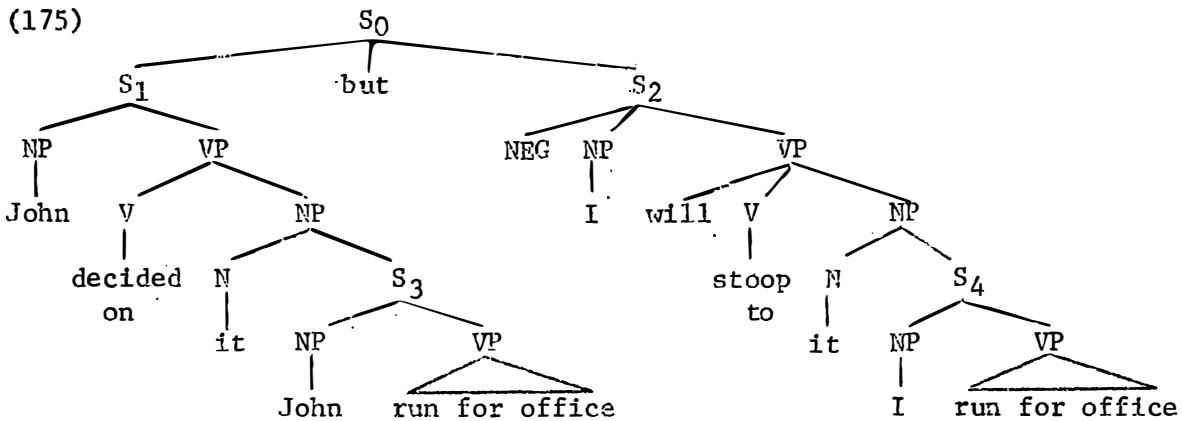


By late rules, "it" and the "for" will delete to give (170). Note that the S remains over "for to eat peas" until the 'for' deletes.

S-deletion and EQUI-NP-DELETION interact in the following sentences.

(174) John decided to run for office, but I will not stoop to it.

The S that has been deleted after the "it" is "I run for office." Note that "stoop" requires that the subject of the embedded sentence be identical to the subject of the main clause (that is, the subject of 'stoop'). Thus "I" is the only NP that could possibly appear as the subject of "run for office" in the deleted sentence. But now note that on the left side of (174) "John" is understood as the subject of "run for office." This means that the deep structure of (174) must be (175).



In the derivation of (174) S_4 must be deleted under identity with S_3 . Since S_3 and S_4 have different deep structure subjects, they are not identical in deep structure. As long as those subjects are still there, S-deletion cannot take place. However, the subjects of both S_3 and S_4 will delete by EQUI-NP-DELETION. At that point, S_3 will be identical to S_4 . S-deletion may take place only after that point in the derivation. That is, the rules may apply only in the order:

- (1) EQUI-NP-DELETION
- (2) S-deletion

Above, we hypothesized that S-deletion applies precyclically and only precyclically. It has also been assumed (see Rosenbaum, 1965) that EQUI-NP-DELETION is a cyclical rule. It is clear that these two assumptions are not compatible. Since precyclical rules must apply before any cyclical rules, it is impossible that S-deletion could apply after EQUI-NP-DELETION. Either one of these assumptions must be wrong, or else there is more than one rule of S-deletion. That is, there may be a precyclical rule of S-deletion that applies to the cases above and

another rule of S-deletion that applies cyclically in cases like (174). We will consider each of these possibilities in turn.

Previous studies of EQUI-NP-DELETION have been done in the context of a theory of grammar in which all rules were assumed to be cyclical. That theory of grammar did not have the concepts of precyclical and final-cycle rules. Now that we have admitted such concepts into our theory of grammar, we must ask whether EQUI-NP-DELETION really is a cyclical rule, as had been assumed, or whether it could be either a precyclical or a final cycle rule. In what follows we shall show:

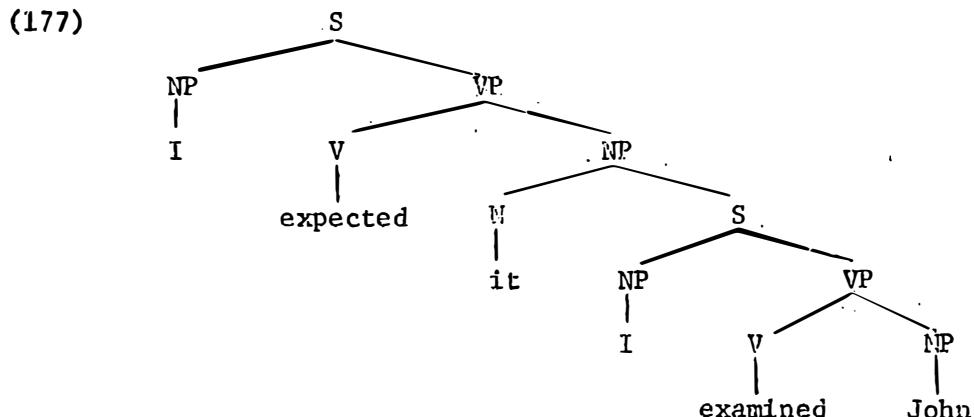
- (a) EQUI-NP-DELETION cannot apply precyclically;
- (b) EQUI-NP-DELETION must apply after some cyclical rule has applied;
- (c) EQUI-NP-DELETION cannot be a final cycle rule.

Taken together, these facts show that EQUI-NP-DELETION is indeed a cyclical rule.

- (a) Consider (176).

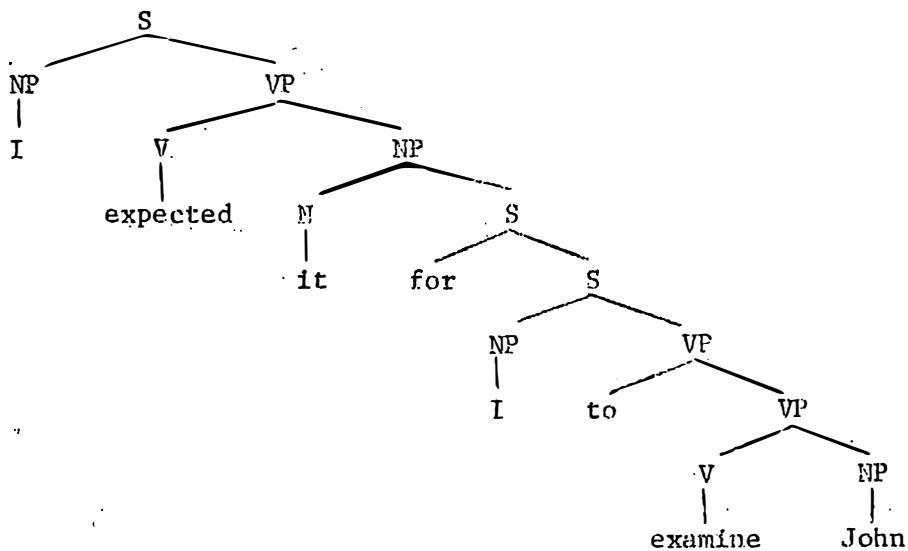
(176) I expected John to be examined by me, not by Harry.

The left-hand side of (176) would have the deep structure of (177).



Suppose that EQUI-NP-DELETION could apply precyclically. Since EQUI-NP-DELETION can apply only when a FOR-TO or POSS-ING complementizer is present, this could occur only if complementizer placement also applied precyclically. Let us assume that this is also the case. After complementizer placement, (177) would appear as (178).

(178)



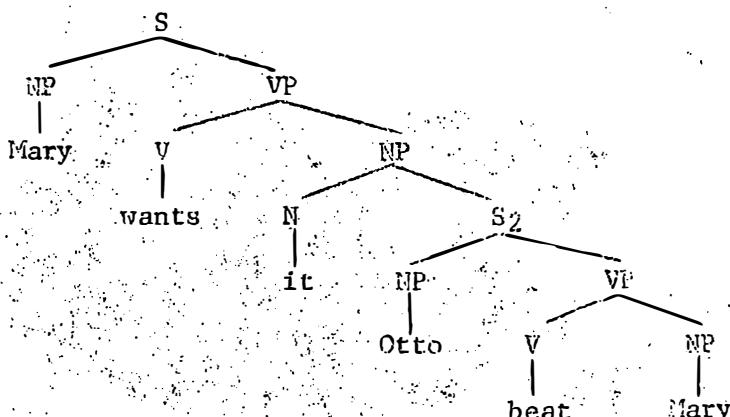
EQUI-NP-DELETION is an obligatory rule. If it applied precyclically, it would apply to (178), deleting the embedded occurrence of "I" obligatorily. But if this were so, we could never derive the left side of (176), since the occurrence of "me" in (176) must come from the embedded "I" of (178). If "I" were deleted precyclically by EQUI-NP-DELETION, it could never show up in (176). The fact that it does show up there means that EQUI-NP-DELETION could not have operated precyclically. This means that EQUI-NP-DELETION cannot apply precyclically at all.

(b) In an above section, we showed that PASSIVE is a cyclical rule. We will now show that EQUI-NP-DELETION must apply at some point in the derivation after PASSIVE has applied. Consider (179).

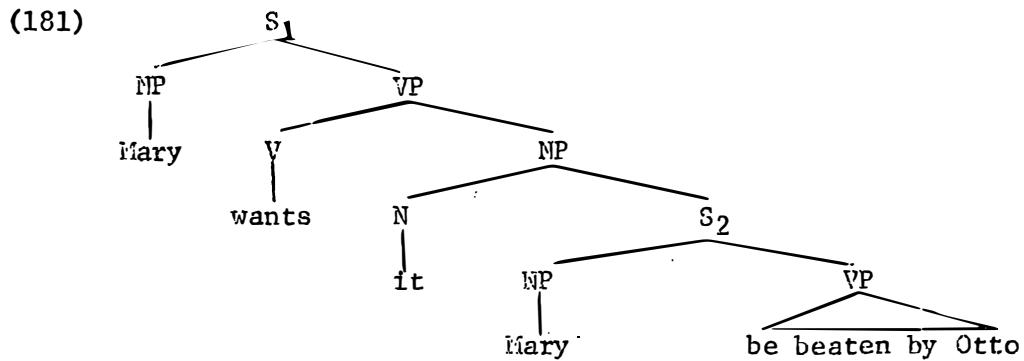
(179) Mary wants to be beaten by Otto.

(179) has the deep structure of (180).

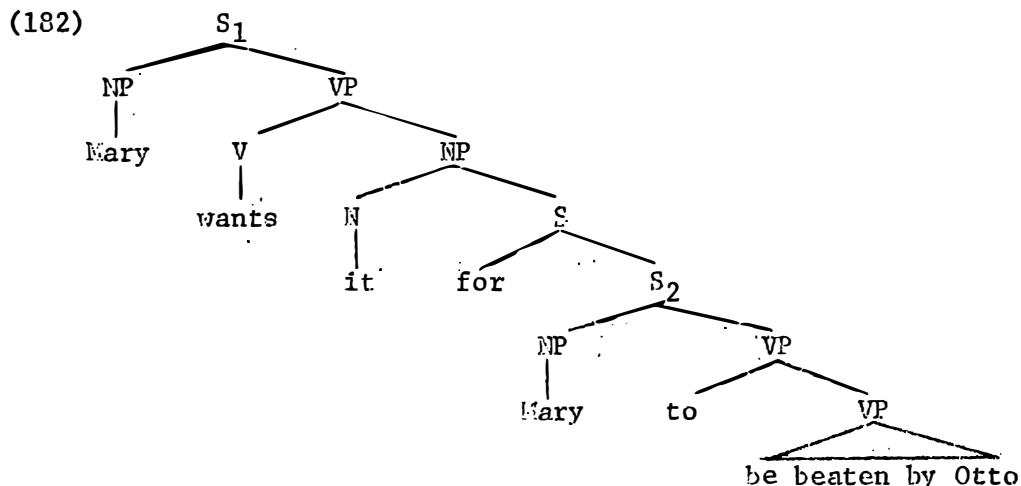
(180)



Note that PASSIVE must apply to S_2 before EQUI-NP-DELETION can apply. Applying PASSIVE to S_2 , we would get (181).

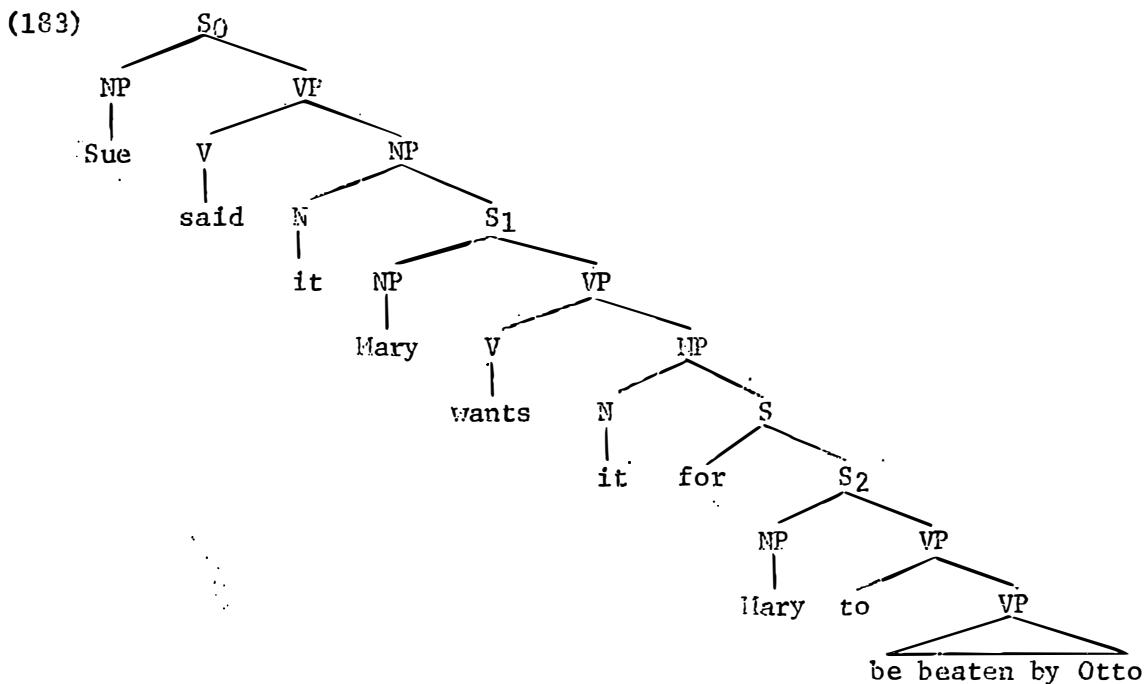


After complementizer placement, we would get (182).

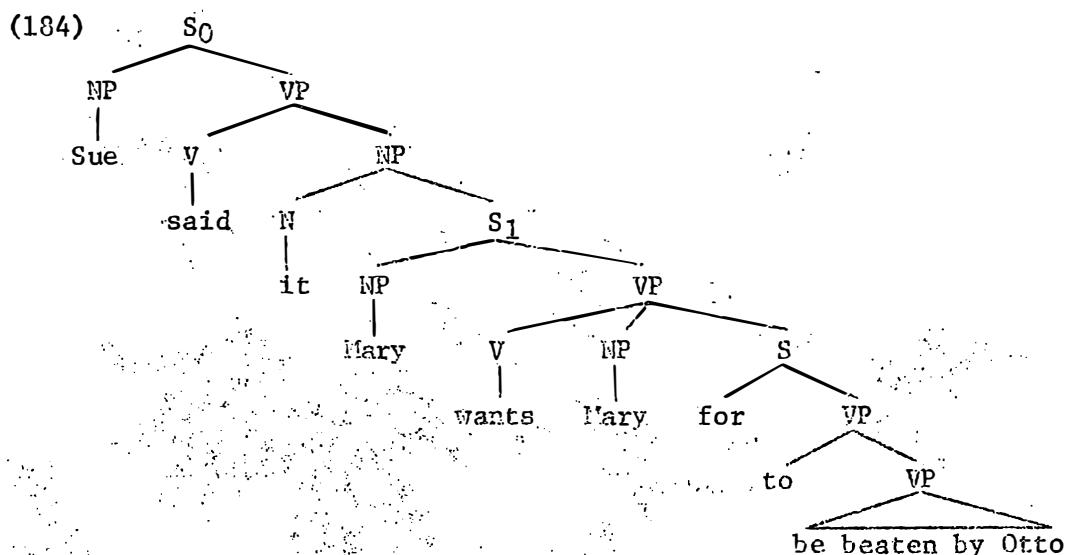


On the S_1 -cycle, EQUI-NP-DELETION will be able to apply to delete the embedded occurrence of "Mary." The fact that EQUI-NP-DELETION must apply at a point in the derivation after PASSIVE shows that it must be either a cyclical or a final-cycle rule.

(c) Above, we showed that IT REPLACEMENT is a cyclical rule. We will now show that this entails that EQUI-NP-DELETION cannot be a final-cycle rule. Suppose that (182) is further embedded as shown in (183).



Now suppose that EQUI-NP-DELETION is a final cycle rule. Then it can apply only on the S_0 -cycle, and not on the S_1 -cycle. If EQUI-NP-DELETION does not apply to S_1 on the S_1 -cycle, then S_1 will meet the structural description of IT REPLACEMENT on the S_1 -cycle, since IT REPLACEMENT is a cyclical rule. Since IT REPLACEMENT is an obligatory rule, it will have to apply on the S_1 -cycle. If it applies, it will yield the structure of (184).



But EQUI-NP-DELETION will not apply to this structure since the second occurrence of Mary is no longer the subject of a complement sentence. This means that if EQUI-NP-DELETION is a final-cycle rule, then we cannot derive the sentence "Sue said that Mary wants to be beaten by Otto" from the structure of (183), which seems to be the correct structure. The only way we can derive that sentence is to have EQUI-NP-DELETION apply in the cycle before IT REPLACEMENT. That is, EQUI-NP-DELETION must apply to S_1 in (183), preventing the change from (183) to (184). This means that EQUI-NP-DELETION cannot be a final-cycle rule.

Let us now return to the question of how (174) can be derived from the deep structure of (175). As we pointed out above, S-deletion can apply to delete S_4 in (175) only after EQUI-NP-DELETION has applied. But EQUI-NP-DELETION must apply cyclically and cannot apply precyclically. This means that S-deletion must apply after some cyclical rule. But we know that S-deletion must also apply precyclically. This means either that there are two rules of S-deletion, one precyclical and one cyclical, or that a single rule of S-deletion may apply both cyclically and precyclically. Essentially the issue is whether there is one rule or two, that is, whether the rule of S-deletion states the proper generalization in both cases. There is also a theoretical issue here. In the theory of grammar as it has been conceived so far, there is no such thing as a rule that can apply both precyclically and cyclically. Do we change the theory of grammar to admit a new type of rule application or do we keep the theory of grammar constant and add another rule to the grammar of English? This question, the matter of whether one should change the theory of grammar in this case, is a false issue. The real issue is an empirical one: whether a single rule of S-deletion captures the correct linguistic generalization. After all, the theory of grammar must be designed so that correct generalizations are captured. The substantive question is this: what empirical evidence is there that the S-deletion rules are the same or that they are different? As yet, there is no conclusive evidence one way or the other.

Let us consider the two alternatives in closer detail. Let us assume first that there is a single rule of S-deletion. We will introduce at this point the concept of an "unordered rule"--a rule that applies at any point in the derivation when it becomes possible for it to apply; that is, one which is not ordered with respect to the other rules of the grammar. Let us assume that the rule of S-deletion is stated as in (185) and is an unordered rule.

(185) S-DELETION

SD: X - S - Y - it - S - Z
 1 2 3 4 5 6

where: 2 = 5 and NP>4+5

SC: Delete 5

In the case of (74), S-deletion can apply precyclically. Since unordered rules apply whenever it is possible for them to do so, (185) will apply to (74) precyclically. In the case of (175), on the other hand, (185) cannot apply precyclically, since S_4 is not equal to S_3 at that point in the derivation. After the cycles on S_1 and S_2 in (175), S_4 will be equal to S_3 . Then, as soon as the S_0 -cycle is reached, (185) can apply, yielding (174).

Now let us assume that there are two different rules operating in these cases. The first is the S-deletion rule of (185), which applies only precyclically. The second is a VP-deletion rule, which applies only cyclically.

(186) VP-DELETION

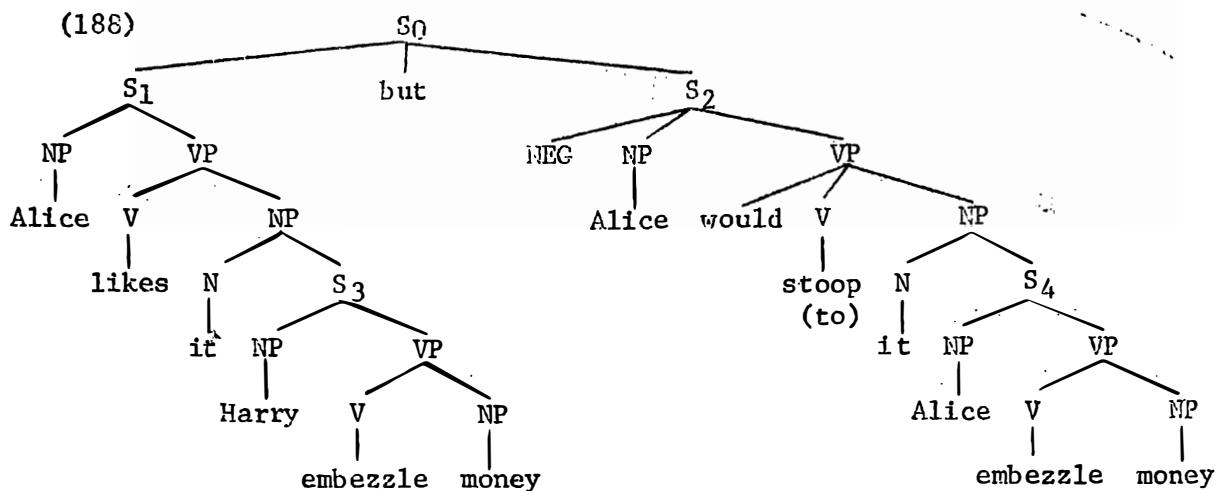
SD:	X - VP - Y - it - {POSS}	FOR }	
	1 2 3 4 5 6 7		where: $S > 5 + 6$ $NP > 4 + 5 + 6$ and 2 = 6
SC:	Delete 6 Delete 5		

Note that the terms deleted, 5 and 6, happen to constitute an S, which is the term deleted in (185). To claim that (186) exists as a separate rule from (185) is to claim that this is an accident. We doubt that it is accidental that an S is deleted in both cases, and believe that the single-rule solution is correct; but we cannot prove this. If (186) does exist, then it and not (185) will apply on the S_0 -cycle of (175) to yield (174).

To point up the empirical nature of the question of whether the one-rule or two-rule solution is correct, we will consider the limited evidence that is available on the matter. This evidence appears to favor the two-rule solution, but as we shall see, the matter is far from clear. Consider (187).

(187) Alice likes it for Harry to embezzle money, but she would not stoop to it.

(187) has the underlying structure of (188).



Note that "Harry" the subject of S_3 is not identical to the subject of S_1 , "Alice," and therefore cannot be deleted. Because of this S_3 can never become completely identical, in the absolute sense, to S_4 .

FOOTNOTES TO CHAPTER I

1. Greenberg, 1963, p. 111.
2. See Postal, 1964, for a more detailed version of this argument.
3. See Chomsky, 1965, note 18 to Chapter 2.
4. See Klima and Lees,
5. In class lectures at M.I.T., spring, 1965.
6. This form of the extraposition rule is only approximate. Actually it must be restricted to apply only in the case of that and for-to complementizers.
7. The critique of Rosenbaum's rules and the alternative analysis presented below has been worked out jointly by John Robert Ross and myself. For further discussion, see Ross, 1967, and Lakoff and Ross, to appear.
8. In all fairness, we should note that a number of the facts which show that Rosenbaum's analysis is incorrect were not known at the time his work was written.
9. Examples (48) and (49) are not meant as possible independent rules. They are meant only as illustrations of the two processes which must be captured by a correct rule of IT REPLACEMENT. As formulated above, (48) and (49) could apply to relative clause structures. In (50), where the process is made precise, this defect is corrected.
10. See Chomsky, 1965, pp. 134-5.
11. This was pointed out to me by John Robert Ross.
12. See Lakoff and Ross, to appear.