

Department of Linguistics and the Research Center in Computer and
Information Sciences at The Ohio State University, Columbus, Ohio

WORKING PAPERS IN LINGUISTICS

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Content:

- I. Introduction
- II. Lexical Analysis Research Project
- III. Mathematical Linguistics
- IV. Laboratory Activities

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I. Introduction

II. Lexical Analysis Research Project

1. Introduction
2. Activities connected with the project
3. Research completed in 1967
 - a. The Grammar of HITTING and BREAKING, Charles J. Fillmore
 - b. The English preposition WITH, P. Gregory Lee
 - c. Relative Clauses and Conjunctions, Sandra Annear
 - d. On Selection, Projection, Meaning, and Semantic Content, D. Terence Langendoen
 - e. Some Problems of Derivational Morphology, Sandra Annear and Dale Elliott

9
30
80
100
150

III. Mathematical Linguistics

1. Report, D. Terence Langendoen
 - a. The Accessibility of Deep Structures, D. Terence Langendoen
2. Report, J. T. Heringer, Jr.
 - a. Review of Haim Gaifman, "Dependency Systems and Phrase-Structure Systems," J. T. Heringer, Jr.

66
88
127

IV. Laboratory Activities

1. Report, Ilse Lehiste
 - a. Diphthongs vs. vowel sequences in Estonian, Ilse Lehiste

137

II. LEXICAL ANALYSIS RESEARCH PROJECT

1. Introduction

The research of The Ohio State University Lexicology Project is directed toward the general question of the treatment of lexical information in a transformational generative grammar. Workers on the project include Charles J. Fillmore, Sandra S. Annear, Dale E. Elliott, and P. Gregory Lee. D. Terence Langendoen and James T. Heringer, associated primarily with the Mathematical Linguistics Project under the same NSF contract, have closely cooperated with the work of the Lexicology Project, as have several members of the Ohio State University Linguistics staff--George Landon in particular--and a number of graduate students majoring or minoring in Linguistics.

The issues of generative lexicology are formulated differently depending on whether syntax is correctly viewed as generative, with semantics having a purely interpretive role, or whether semantic structures provide input to the syntactic component, syntax being interpretive.

If syntax is generative, the issues are these: Given grammatical descriptions of (deep structure) sentences above the level of words, what can be said about the lexical items that can occur in the various positions in these sentence types, what grammatical and semantic properties do these words contribute to the sentences, and what is the nature of the semantic theory which is capable of interpreting sentences given all of this information.

On the other hand, if syntax is interpretive, questions of lexicology concern the nature of semantic primitives, the apparatus for generating semantic deep structures (if it makes sense to speak of semantics as being generative), the nature of the lexical substitution rules which replace (possibly quite large) segments of the semantic deep structures by lexical items, constraints on the formal relations between deep structures and surface structures, as well as the general question of whether this approach eliminates all of the interpretive role of semantics, or only part.

Of the two approaches to lexical insertion--depending on the "location" of the ordered and context-sensitive processes--the latter seems to require a great deal of redundant information. It is necessary, in other words, to construct a complex symbol which registers all the relevant environmental information, and it is also necessary to identify this same information as properties of verbs which require insertion in each such environment. The same facts, in other words, are introduced twice, once in a purely automatic way. If this is the only difference between the two main approaches--and that is something we do not yet know--we shall probably choose the approach by which lexical insertion is itself a context-sensitive process.

Once inserted, a lexical item brings along with it, so to speak, certain inherent properties that are relevant to the operation of other grammatical rules, or to the insertion of other lexical items. Nouns classified as "mass" nouns, for example, do not tolerate a as an indefinite determiner, while a singular "non-mass" noun does. (Thus, a bottle is acceptable, but a milk is not.) The verb murder is used appropriately only when both subject and object nouns are capable of denoting human beings. Nouns like boy and uncle are marked as inherently "human," nouns like cat and petunia as inherently "non-human". (Thus, the boy murdered my uncle is acceptable, but the petunia murdered the cat is not.)

Other inherent lexical properties of words are the idiosyncratic properties, in particular those that relate to the applicability of syntactic rules. There is a rule in English which converts (the structures underlying) active transitive sentences into their passive counterparts. This rule can be stated most generally in terms of the placement of noun-phrases, modification of the verbal expression, etc. It happens, however, that some sentences which satisfy the conditions for the passive transformation in their categorial form, nevertheless cannot be made passive; and that the structures underlying certain other sentences must be expressed only as passive sentences. Constraints on the applicability

of the passive rule seem to be most clearly associated with the main verb. Hence, in some way it must be made explicit that verbs like have and resemble do not permit passivization, while some other verbs (in certain constructions) must be marked as appearing passively only. (Thus, while Martha resembles a horse and John has three dollars are acceptable, *a horse is resembled by Martha and *three dollars are had by John are not; on the other hand, while the Egyptians are said to have worshiped the cat is acceptable, its expected active counterpart *someone says the Egyptians to have worshiped the cat is not.) The theoretical issue that must be faced in dealing with these facts is whether these properties of lexical items should be stated in a way which makes explicit reference to specific rules (the rules they require, tolerate, or disallow), or whether the rules should themselves be formulated in such a way as not to work, or to work obligatorily, when the lexical environment is of one kind or another.

The alternative which allows lexical features to refer to specific rules requires the elaboration of a full theory of irregularity of the kind suggested by Lakoff.¹ Not to allow this

¹George Lakoff, "On the Nature of Syntactic Irregularity", Math. Linguistics and Automatic Translation, Computation Laboratory of Harvard University Report No. NSF-16, Dec., 1965.

is either to list exceptions with each rule (a procedure which is effectively the same as the former, but one which does not require-- or rather, which does not admit the need for--a theory of exceptions); or to assume that a careful statement of the conditions of application for each rule can be accomplished which will in fact have the correct results but which refers only to independently justified properties of words. This last alternative might be based on the assumption that the speakers of a language do not learn, with the rules that they learn, idiosyncratic facts about the words that govern them, nor do they learn, with the words that they learn, idiosyncratic facts about the rules that these govern. Speakers

of a language, under this view, learn general conditions on the application of rules, conditions which refer only to properties of lexical items that are justified and discoverable on independent grounds.

If this third position is taken as a philosophy of research, one may still list exceptions to rules, but such a list is to be viewed as evidence that the ~~full~~ full range of facts about the matter at hand is not yet known, and that a more careful analysis will permit a reduction in the list of exceptions; or that, just in case no further improvements are in fact possible, language is at least partly unsystematic after all. This position is illustrated by Chomsky's (factually incorrect) claim that the passive transformation can be limited to those verbs capable of taking manner adverbs.²

²Noam Chomsky, Aspects of the Theory of Syntax, M.I.T. Press, 1965, pp. 103-106.

Lexical information that is relevant to the semantic interpretation of sentences involves many issues. We may wish to be able to distinguish, for example, those aspects of the semantic structure of a word which represents what the word directly "asserts" (when used as a predicate) from those which specify the conditions of appropriateness for its use. We may further wish to discover principles for distinguishing between the "meaning" of a word and the properties of the real-world object which the word "names": we need to consider the difference, in short, between a dictionary and an encyclopedia. The formal nature of semantic "features" needs to be determined, in some way which makes it possible to escape the one-term predicate form implicit in some of the earlier work in semantic theory.

Concerning the difference between what a predicate asserts and what it presupposes, we might wish to separate out the component 'unmarried' as the asserted meaning of bachelor and state that the components 'male, adult, human' identify what is "presupposed" whenever the word is used appropriately. The sentence Harry is a

in reality a relational term with one of the variables unexpressed. (To say that A is unmarried is to say that there is no B such that A is married to B.) The analysis of ordinary language vocabulary requires, in fact, a rather rich and detailed description of the use of unexpressed variables: to illustrate this with concepts involving marriage, we may note that brother-in-law means male sibling of a spouse or male spouse of a sibling, where expressions of the type A is B's brother-in-law do not mention the intervening spouse or sibling; or adjectives like divorced or betrothed do not make explicit the (past or future) time or the other party to the marriage.

The nature of a semantic theory capable of interpreting sentences on the basis of the grammatical organization of its components and the lexical information associated with each of its words is a matter that must await the solution of some of these more essential problems. We know for sure that the treatment of semantic properties as one-term predicates, nurtured by the use of pluses and minuses in current notations for semantic features, is quite wrong. We know that the rule for projecting semantic characterizations of lexical items into the semantic reading of a sentence requires the elaboration of much more subtly arranged relationships among the parts of a sentence than those provided by the small number of definable syntactic relations formulatable within the current received version of transformational grammar. And we know furthermore that there are a great many semantic facts that cannot be related either to the properties of individual words (taken one at a time) or to well-understood syntactic constructions. These facts include the system of presuppositions of sentences that are most directly related to what appear to be properties of clauses, such as that of the "counterfactual" clause in a conditional sentence.

2. Activities Connected With the Project

The work of the project began with the part-time employment of Linguistics graduate student Sandra S. Annear in the winter quarter of 1967. Her research at that time was concerned with the

general role of the lexicon in a generative grammar. She was joined in the spring quarter by Dale E. Elliott, P. Gregory Lee, and James T. Heringer.* Charles J. Fillmore joined the project

*primarily associated with the Mathematical Linguistics project

on a full-time basis in the summer. During the ten weeks of the summer quarter, the members of the project and several other members of the staff and student body met every Wednesday and Thursday morning for reports and discussions on a large number of topics relating to semantic theory and lexicology. A partial list of the topics discussed, with the name of the reporter given in parentheses after each title, follows.

The general problem of lexicography in generative grammar
(Annear)

Meaning vs. entailment vs. presupposition (Fillmore)

Semantic vs. encyclopedic information, meaning vs. "use"
conditions (Lee)

Bendix's application of Weinreichian semantics to verbs
semantically related to 'have' (Fillmore)

Reichenbach's application of concepts from the calculus of
relations to natural language vocabulary (Heringer)

Bierwisch's treatment of spatial extent adjectives (John
Diskin)

Bach's treatment of nouns as predicates (Langendoen)

The conjunction source of relative clauses (Annear)

Semantic selection vs. semantic projection (Langendoen)

The possible relevance of general semantics to lexicography
(Elliott)

The Indiana University project on the classification of
verbs (Landon)

Componential analysis in the analysis of kinship systems
(Landon)

Syntactic irregularity and Lakoff's theory of exceptions
(Heringer)

be, with, and have in absolute constructions in English
(Lee)

Participants' papers completed at the time of this report follow.

Charles J. Fillmore

December 1967

3. Research Completed in 1967

The Grammar of HITTING and BREAKING*

Charles J. Fillmore

(To appear in Studies in English Transformational Grammar,
R. Jacobs and P. Rosenbaum, eds., Ginn-Blaisdell, 1968.)

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University.

theory of the nature of human language. What this means in practice is that the linguist keeps the connection with empirical linguistic theory in mind, at least, whereas the philosopher traditionally has not been expected to do so.

A grammatical description of a language is successful if it accounts for precisely the facility that an ideal speaker of a language has in producing and understanding the grammatical sentences in his language. The knowledge that the speaker brings to bear in exercising this ability may be separated into the general and the specific. One's general knowledge about a language is organized and displayed in its grammar; one's specific knowledge about the individual linguistic objects known as words or "lexemes" is collected and itemized in a dictionary or lexicon of the language. In this paper I shall attempt to determine at least some of the specific things that speakers of English know which account for their ability to use the words HIT and BREAK correctly. Put differently, the goal of this paper is to discover the information that needs to be registered, in one way or another, in the entries for these two words in a scientifically sound dictionary. It is in this sense an exercise in lexicological research.

The reader might at first be inclined to think that the task we have set for ourselves has already been completed--that anyone who wants to learn the lexical facts about HIT and BREAK can do so quite readily by looking the words up in a standard dictionary. It can be shown very easily, however, that there are indeed important facts about words which the makers of dictionaries do not generally bother to tell us. For example, if you look up the words SICK and ILL in a standard dictionary, you will be told that they are synonymous in one of their meanings, but what you will not be told is that although both of these adjectives can occur as predicates, only SICK can occur attributively. Notice examples (1) and (2).

(1) the children are { sick
ill }

(2) the { sick
*ill } children

Or if you look up the word GOOD, you will not find out from the dictionary something that every speaker of English knows, and that every foreign speaker of English needs to know, that GOOD is (apparently) the only adjective in English which can take, in negative and interrogative predicate sentences, the "quantifier" ANY. Notice examples (3) and (4).

(3) is it any { good } ?
 { *pink }

(4) they weren't any { good }
 { *tall }

An ordinary dictionary will not tell us everything that there is to know about HIT and BREAK; there is much we shall have to figure out for ourselves. One of the things that it will tell us, however, is that each of these words has several senses. We shall concern ourselves here only with what might be called their basic or non-transferred meanings. We shall consider their use in expressions about HITTING TREES and BREAKING STICKS, but we shall ignore their use in expressions about HITTING UPON GOOD IDEAS or BREAKING IN A NEW MAN, for example.

The first problem to take note of is that in a grammar which requires subjects in the deep structure¹ representation of

¹For a statement of the distinction between "deep" and "surface" representations of the structure of sentences, the reader is referred to Chomsky (1966), pp. 31-51, and Chomsky (1965).

every sentence, it is necessary to recognize three distinct verbs having the form BREAK and two distinct verbs having the form HIT, and that these distinctions are unaffected by the decision to restrict our attention to the basic meanings of these words.²

²Although it is certainly possible to rephrase the facts under examination in such a way that there is one verb BREAK with several distinct uses, it is important to realize that the formal complexity that concerns us here is in no way affected by this reformulation.

The three BREAK verbs may be referred to as BREAK-1, BREAK-2 and BREAK-3. BREAK-1, which is illustrated in sentence (5)

(5) the stick broke

is an intransitive verb which asserts of its subject the particular deformation or change of state we associate with the meaning of the verb.

BREAK-2 is seen in sentence (6)

(6) John broke the stick (with a rock)

It is used for asserting of an object the same change-of-state mentioned in connection with BREAK-1, but BREAK-2 asserts it of its direct object. In general, precisely those noun phrases which can occur as subjects of BREAK-1 can appear as objects of BREAK-2. BREAK-2 assigns an agentive or instigative role to its subject, which is typically animate. As shown in the parenthesized expansion of (6), BREAK-2 may co-occur with a phrase which identifies the instrument, i.e., the inanimate object immediately responsible for the action of breaking.

BREAK-3, seen in sentence (7)

(7) a rock broke the stick

differs from BREAK-2 in accepting inanimate subjects³ and in not

³There are good reasons for saying that an instrumental noun phrase (in the intended sense) is always underlyingly inanimate. A sentence like THE DOG BROKE THE STICK, when it is used to refer to what happened to the stick when we threw the dog at it, must then be interpreted as containing in its deep structure the noun phrase THE DOG'S BODY. The word BODY, then, being inanimate, is capable of fulfilling an instrumental function in the clause. There are languages in which the distinction between THE DOG as agent and experiencer and THE DOG (= THE DOG'S BODY) as physical object must be made overt. Mohawk, Paul Postal has informed me, is one such language.

permitting an instrument phrase in the same clause. In other words, a sentence like (8)

(8) *a rock broke the stick with a hammer

is unacceptable (where A ROCK is not intended metaphorically), because this verb interprets the role of its subject instrumentally, and a simplex clause presumably can only identify one

"instrument".⁴ BREAK-2 and BREAK-3 agree in the semantic

⁴A simplex clause identifies at most one noun phrase as having an instrumental role. This is not to deny that the noun phrase can be compound.

relation to the direct object.

There are three BREAK verbs, but there are only two verbs with the form HIT (in the meaning we have in mind); and these are HIT-1, seen in (9)

(9) John hit the tree (with a rock),

and HIT-2, seen in sentence (10)

(10) a rock hit the tree.

HIT-2 parallels BREAK-3 in assigning an instrumental role to its (inanimate) subject, and in not tolerating an instrumental WITH-phrase. That is, sentence (11)

(11) *a rock hit the tree with a stick

is unacceptable. And HIT-1 parallels BREAK-2 in assigning an agentive role to its (animate) subject and in accepting an instrumental phrase (as in the parenthesized expansion of (9)). The two verbs HIT agree in their semantic relation to the direct object.

Our two sets of verbs differ in that there is no intransitive verb HIT corresponding with BREAK-1, since there is no sentence of the form (12).

(12) *the tree hit

This division of BREAK into three verbs and HIT into two verbs is necessary if we wish to include in our descriptions of what we know about individual verbs constraints on the noun phrases that can occur in construction with them, the sentence types in which they can play a role, and the semantic relations which they express among the constituents of the clauses in which they are used.⁵ But clearly there is something wrong with

⁵The nature of these differences between our two verbs and the necessary complexity of their description in grammars which require underlying subjects for all sentences are discussed in detail in Hall (1965).

a grammatical model, or with an interpretation of a grammatical model,⁶ which requires there to be two HITs and three BREAKs.

⁶In this essay I have only considered interpretations of (5)-(10) that regard them as simplex sentences. A competing view, very convincingly presented in Lakoff (1967), would have them all be complex (involving successive embeddings) and would assign to them deep structures of an extremely abstract character. I know at the moment no empirical data that would be relevant to a choice between these two views, and it seems to me that neither the facts about HIT and BREAK nor the concluding message about the role of a semantic theory would be affected by a choice between them.

We shall reject this formulation, then, and propose a different description of the facts we have encountered. We shall assume that in some way certain noun phrases can be designated in the deep structure as having an agentive relation to the verbs they are in construction with, others designated as having an instrumental role. Let us label these noun phrases Agent and Instrument, and let us assume that a part of our specific knowledge about each verb in our language is a knowledge of the "kinds" of noun phrases (in the sense we are suggesting) that can occur in construction with it. We are forced to abandon the notions of deep structure subject and deep structure object, if we take this approach, and we must therefore accept a model of grammar in which the subjects and objects that we see in surface structures are introduced by rules.

Temporarily giving the noun phrase THE STICK in examples (5) to (8) the label "X", we may describe BREAK as a verb which requires an X and which permits either an Agent or an Instrument or both. Syntactic rules will specify that if there is only an X, the X noun phrase must be the subject. If there is an Agent, then the X appears as the direct object and the Agent as subject.⁷

⁷We ignore here the rules that result in "passive" sentences. A more detailed description of the operation of syntactic rules in a grammar of the type suggested here may be seen in Fillmore (1968).

only to the verbs HIT and BREAK. I have developed elsewhere⁸

⁸Fillmore (1968)

the outlines of a general grammatical theory which incorporates modifications of the type we have been discussing. These matters need not concern us here, but it should at least be pointed out that the observations we have made about BREAK and HIT are true of many other English verbs as well. Verbs which are semantically similar to BREAK and whose occurrence in clause types is accounted for by formula (13) are exemplified in (15); some English verbs sharing with HIT properties identified by formula (14) are given in (16).

(15) bend, fold, shatter, crack

(16) slap, strike, bump, stroke

Since (13) and (14) identify classes of verbs, it may be the case that certain properties of HIT and BREAK are associated in general with the verb classes to which they belong, other properties being more uniquely associated with the two words as individual lexical items.

In determining what these shared properties might be, we may first note that all of the verbs we chose to associate with BREAK assert that the object identified by the X elements understood as undergoing some kind of change of state. That is, the X element is understood as essentially different after the event symbolized by the verb has "happened" to it. But this does not seem to hold for the verbs classified by formula (14). For the purposes of this essay, we shall refer to verbs like BREAK and BEND as change of state verbs, and verbs like HIT and SLAP as surface contact verbs. The surface contact verbs assert the occurrence of some physical contact between two objects, but from the use of these verbs one cannot necessarily infer that the objects have undergone any essential change.⁹ The most

⁹Of course, the surface contact verbs can also be said to identify a "change-of-state" of some kind. In a purely abstract sense, a cheek which has once been slapped is different from the same cheek before the slapping event took place. The semantic structures of some words recognize properties of objects discoverable not in the objects themselves but in their "histories" (words like BASTARD or WIDOW), but such matters have no relevance to the distinction between the two kinds of verbs we are discussing here.

direct way of seeing this fact is by comparing our acceptance of sentence pairs like (17) and (18), in which verbs of these two kinds are contrasted.

(17) I hit the window with a hammer; it didn't faze
the window, but the hammer shattered

(18) *I broke the window with a hammer; it didn't faze
the window, but the hammer shattered.

There is, then, a semantic as well as a syntactic difference between our two classes of verbs. We can capture some of these facts by replacing our temporary symbol X by Place in formula (14), which we associated with the surface contact verbs. For the other X we may use (for want of a better word) the term Object. We can now reformulate (13) and (14) as (19) and (20) respectively, and associate part of the meaning of expressions containing our verbs with these newly introduced categories of noun phrases.

(19) (Agent)(Instrument) Object

(20) (Agent|Instrument) Place

The lexical entries for BREAK and HIT are assumed to contain references to formulas (19) and (20) respectively.

Change-of-state verbs, as we have said, are verbs which assert of an object a change in time from one "state" to another. An additional syntactic difference between the two verb classes is that stative adjectives can be derived from the change of state verbs, but not from the others. These adjectives describe the later of the two states referred to by their underlying verbs. A consequence of this fact is that sentences like those

in (21) are ambiguous in ways in which sentences like (22) are not.

- (21) the window was { broken
bent
shattered }
- (22) the window was { hit
struck
slapped }

The sentences of (21) may be understood either as passives or as descriptions of states while those of (22) can only be understood as passives.

One more syntactic difference between change of state verbs and surface-contact verbs can be seen when the Object or Place noun phrase is a possessed body-part noun. The sentences with surface-contact verbs have paraphrases in which the "possessor" appears as the direct object and the body part noun appears in a locative prepositional phrase.¹⁰ Notice (23) to (26).

¹⁰This fact, incidentally, tends to lend support to our choice of the category Place for the "direct objects" or surface contact verbs. Some surface-contact verbs, furthermore, permit either the Place or the Instrument to become the direct object (where there is an Agent to serve as subject), allowing paraphrases as

- (i) I hit the roof with the stick
(ii) I hit the stick on the roof

It should be noticed that when the Instrument noun phrase is made the direct object, the Place preposition shows up, and that when the Place noun phrase is made the direct object, the Instrument preposition shows up. This is because the rule for forming direct objects, like the rule for forming subjects, has the effect of deleting the preposition that would otherwise be associated with the category Agent, Place, Instrument, etc.

-
- (23) I { hit
slapped
struck } his leg

- (24) I { hit
slapped
struck } him on the leg
- (25) I { broke
bent
shattered } his leg
- (26) *I { broke
bent
shattered } him on the leg

If the sentences paired by (23) and (24) are correctly interpreted as paraphrases of each other, and if that means that they are identical in their deep structure, it follows that our investigation into the classes of verbs associated with HIT and BREAK requires an understanding of the precise ways in which English grammar deals with body-part nouns.¹¹

¹¹One suggestion on the way in which body-part nouns are to be treated in a grammar is found in the section entitled "The grammar of inalienable possession" in Fillmore (1968).

I suggested above that the categories Agent and Instrumental were to be used somehow to guarantee that the noun phrases that filled these positions in sentences would be animate and inanimate respectively. Perhaps a more satisfactory way of dealing with the same facts is to say that the categories Agent and Instrument impose a particular interpretation on the nouns that occur "under" them. The sentences we rejected above were sentences in which interpretations imposed on a noun are contradicted by facts that we know about the objects identified by the noun itself. In sentences (8) and (11), for example, we are forced to interpret THE ROCK agentively; but since a rock is not animate, and is therefore known to be incapable of initiating any action, we must either interpret the sentences as meaningless, or as fairy-tale sentences in which THE ROCK was personified (or perhaps the word we need is "animated"). It must remain an open question just what the best treatment of the distinction between normal

and semantically anomalous sentences is, but we can at least be clear about the facts. I shall suggest below that my first formulation is more adequate.¹²

¹²For a careful discussion of this difference (or rather, a similar difference), see D. T. Langendoen (1968).

Since we have assigned two different categories to the noun phrases we originally labeled X, we must now ask whether the nouns that occur in the X role with these two verbs must be different (or, alternatively, if nouns are to be interpreted in two different ways depending on whether they are identified as Places or as Objects).

Consider, in this regard, sentences (27) and (28).

(27) I broke the top of the table

(28) I hit the top of the table

In (27), the noun TOP must be referring to the top of a table as a more or less distinct object, while on (28), it can refer either to that or to a portion of the surface area of the table.

This distinction can probably be made clearer with a different kind of example. Suppose you didn't know what TWARGE meant, and you were told two things about some twarge:

(29) John hit the left side of the twarge

(30) John hit the top of the twarge

You might imagine, on hearing (29) and (30), that a twarge was some kind of solid object, and certainly nothing in the two sentences would contradict that assumption. But suppose you were then told two more things about this twarge:

(31) John broke the left side of the twarge

(32) John broke the top of the twarge

This time you would be forced to interpret SIDE and TOP, not as words designating portions of the surface area of the twarge, but as more-or-less separable parts of it. The ideas you could have about what a twarge looked like would be much more constrained after you heard (31) and (32) than before. It is clear,

in other words, that the X nouns that can occur with HIT must be partly different (or differently interpretable) from those which occur with BREAK.

The fact that in sentences (28) and (30) the noun TOP may be understood as referring either to an object or to a location suggests to me that one of the roles of the symbols Agent, Place, etc., is in the selection of nouns, and that they are not restricted in their effect to the imposition of an interpretation on nouns. To appear as an Object, a noun must identify something that can either be an object or a location.¹³

¹³The distinction could be made more forcefully if we would find nouns which can occur as Places but never as Objects. The word LAP might possibly be such a noun, but I am not sure. At least I am surer about the unacceptability of I BROKE HIS LAP than I am about that of I HIT HIS LAP.

The ways in which we can understand the nouns that occur with HIT are almost entirely accounted for by referring to the category Place, but those connected with the change-of-state verbs appear to involve idiosyncratic properties of individual verbs. In other words, the kinds of objects that TWARGE might refer to are quite different for the various verbs in (34), but not so for those in (33).

- (33) I { hit
slapped
struck
smote } the twarge
- (34) I { bent
folded
shattered
broke } the twarge.

Here for the first time our observations become lexically specific. We must now consider what there is to say about objects concerning which it is appropriate to use the word BREAK. We have seen already that the object must be in some sense "separable" or

discontinuous with other things, but that aspect of its meaning is perhaps best associated with the category Object.

A sentence like (35)

(35) I broke the dog

can be interpreted as referring to something which happened to a figurine in the shape of a dog, or perhaps to a frozen dog, but not to an ordinary dog. That is because BREAK requires of the entity named by its Object noun that it be "rigid" in some of its dimensions. One can BREAK a dog's bone, but not, ordinarily, a dog.

To show that we are here dealing with a property of the word BREAK, rather than with change-of-state verbs in general, we may compare BREAK and BEND. An object that can be BENT must be "rigid" to the extent that it offers resistance (one doesn't BEND a handkerchief, normally), but it must also be flexible. Then too, there are more constraints on the permitted shapes of objects that can be BENT than for objects that can be BROKEN; but here the best I can do is expect the reader to know what I mean.¹⁴

¹⁴Notice, too, that BEND differs from FOLD in respect to both kinds of properties, resistance and shape. The resistance required when one is correctly using the word BEND is not required for FOLD, and there are further constraints still on the shape of objects that can be FOLDED. One cannot, FOLD, for instance, a string.

There are, then, these more or less specific, and at least intuitively graspable, properties of objects named by nouns capable of appearing non-anomalously with the verb BREAK. One could make these observations seem more formal, of course, by writing "rigidity" with an initial capital letter and postulating it as a semantic feature of certain nouns, but I believe it would be quite misleading to do so. It seems very unlikely to me that anything is gained by treating these particular "selectional" properties of BREAK (and BEND, FOLD, etc.) in terms of semantic features that are assignable in any natural

way to other words. It is rather that the verb presupposes that the real world objects named by the nouns that occur with it have certain physical properties.

But we have still said nothing about what BREAK means. By comparing BREAK with BEND we can see that the former implies, while the latter does not, the appearance of some discontinuity in an external or internal surface of the object; but if there is more to say than that, it is something that can be said as well by dictionary makers as by linguists.

I am inclined to think that the systematic study of the semantic structure of these words ends pretty much with what we have already noted. To seek criterial differences between BREAK, SMASH, SMATTER, to say nothing of the attempt to discover what distinguish HIT, STRIKE, SLAP, SMITE, BUMP, etc., from each other, is to involve oneself in judgments that may vary widely from person to person and that may individually have nothing to do with other facts about the English language.

Our findings can be summarized by noting that some of the syntactic and semantic properties of our two words can be blamed on the fact that they are words of a particular type; that is, many of the facts we have encountered are instances of general facts about whole classes of words or about uses and interpretations of grammatical categories the existence of which is determinable independently of questions of lexicography.

Both of these verbs can be used transitively, with subjects that are understood agentively as well as with subjects that are understood instrumentally. But BREAK, unlike HIT, can also be used intransitively. BREAK is one of a class of verbs used to express a change of state in some object, and as such it provides, in the form of its past participle, a stative adjective which is capable of describing the object in its latter state.

One of the properties of HIT, namely the existence of certain kinds of paraphrases when it is used with body-part nouns, is apparently accounted for by referring to the ways in which body-part nouns are used as indicators of places rather than as indicators of objects. And constraints on the specific nouns that can occur in construction with these verbs are partly determined by the categories Agent, Instrument, Place and Object.

All of these phenomena are either ascribable to larger grammatical facts or to whole classes of verbs. They fall under what really amounts to our general knowledge of English, and are therefore to be treated only in the grammar. The only word-specific information that is related to the preceding observations is (a) that given in formulas (19) and (21), the information that indicates, for each of these verbs, the syntactic environments in which it is appropriate to use it, and (b) the information that BREAK semantically expresses a change of state.

Apart from the information about their general semantic character (as change-of-state verbs or not) and the needed indication of the environments into which they can be inserted, the only really specific lexical information that we have encountered is (a) the special ways in which speakers of English accept the Object nouns that occur with BREAK and interpret them, and (b) the specific meanings of the two words. The word BREAK can only be appropriately used of an object that is "rigid" in some of its dimensions, and it expresses the appearance of some discontinuity therein. (But why one can BREAK a thread, but not a cloth, is not easily covered by this statement.) The nouns that can occur with HIT apparently do not need to satisfy any requirements not associated with their categorization as Places, and what exactly is meant by HIT, in the sense of the kind of surface contact asserted by HIT in particular (as opposed to STRIKE, etc.), is extremely difficult to pin down.

Certain aspects of the meanings of the two words simply have not been satisfactorily described, and I would not be surprised to find out that they cannot be. Although the ways in

which words acquire meanings and change meanings, as well as the general ways in which human beings learn the meanings of words, will always be of professional concern to linguists as linguists, it may well be that certain aspects of the meanings of many of the specific words in a language are every bit as well "explained" by a handful of examples and an anecdote as by a theory.

Not every change-of-state verb can be used intransitively: consider SMASH and CUT in this respect. Not every verb having syntactic properties of the kind represented by formula (19) is a change-of-state verb: there is a large class of motion verbs syntactically like BREAK, including MOVE, TURN, ROTATE, SPIN, etc. Not every verb that is semantically a change-of-state verb and is syntactically transitive or intransitive in a way analogous to that represented by formula (19) takes an Object: some take animate nouns, such as WAKE (UP). Some change-of-state verbs are understood as affecting a place on an object rather than an object as a whole. CUT and BITE, for example, are of this type, and show paraphrase relations of the type seen in (25) and (26) with body-part nouns. And some change-of-state verbs have associated adjectives that are not identical in form with their past participles. AWAKE is the stative adjective for WAKE (UP), and that must have something to do with the fact that nobody knows what the past participle of WAKE is!

What these observations show is that many of the apparent regularities suggested by this study are slightly spurious, and what that means is that the lexical description of some of the other verbs we have mentioned will be somewhat more detailed than that of BREAK or HIT.

One of the conclusions that can be drawn from this study is that the data we have examined fail to support the distinction

between syntax (as providing a "level" of representation) and semantics. Modifications that are being devised in the theory of deep structure are tending more and more to provide concepts of the kind that can be used quite directly for expressing semantic assertions about linguistic expressions. The designation of noun phrases as Agents, Places, etc., that have been used in my approach, has a role in semantic interpretation, and such properties of verbs as the change-of-state feature we have associated with BREAK are semantic in a more obvious way.

The assignment of such semantic features has, however, clear syntactic consequences. Current developments within the theory of generative transformational grammar suggest that all purely syntactic concepts in grammar relate to the application of syntactic rules, not to the underlying representation of sentences.¹⁵

¹⁵I have in mind unpublished manuscripts by James D. McCawley, John R. Ross, George Lakoff and D. T. Langendoen.

Certain other matters that have been considered proper to semantics but distinct from syntax include formalizations of the notion of semantic anomaly through semantic projection rules of the type proposed by Katz and Fodor.¹⁶ These authors distinguish

¹⁶Katz and Fodor (1963).

between markers and distinguishers among the features that compose semantic characterizations of lexical items. The distinguishers are those features of the semantic description of a word which are idiosyncratic to that word. The markers are those features which enter into semantic generalizations, features in terms of which various semantic judgments on sentences--including judgments on semantic anomaly--can be formalized and made explicit.

Since a part of the description of certain words is a statement of their selectional restrictions--that is, a statement of the conditions that determine their meaningful use--it should be the case that all semantic anomalies should be describable by a single device. Our consideration of the conditions of appropriateness

for the use of words like BREAK, BEND and FOLD, however, suggest that selectional information can be as idiosyncratic as the kinds of properties that have been referred to as semantic distinguishers. The treatment of the selectional properties of verbs cannot be carried out in a non-ad-hoc way, it seems to me, by seeking features on nouns which do or do not violate restrictions associated with particular change-of-state verbs. In fact, it looks very much as if for a considerable portion of the vocabulary of a language, the conditions determining the appropriate use of a word involve statements about properties of real world objects rather than statements about the semantic features of words.

Some facts about language that have been hitherto treated in terms of a semantic interpretive component viewed as distinct from the syntactic component have been absorbed into the latter--that is, they have been shown to be explainable within a combined syntactic-semantic component. Other facts that have been treated by some as belonging to semantic theory proper are believed to be more correctly assigned to the study of the speakers' practical knowledge of their language. It seems to me that the explanatory scope of semantics as such, to the extent that semantic knowledge can be separated from knowledge of syntax (or syntax-semantics) and knowledge of the world, should be limited to a clarification of the conceptual interrelatedness of lexical items and the semantic judgments on sentences that can be directly accounted for in terms of this interrelatedness.

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The English Preposition WITH*

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TABLE OF CONTENTS

	<u>Page</u>
Introduction	31
1. Three classes of <u>have</u> sentences . .	31
2. Stative <u>have</u> sentences	39
3. Possessive <u>have</u> sentences	57
4. Absolute <u>be</u> sentences	61
5. Copula sentences as verb complements	70
6. The <u>do the same thing with</u> test .	76
References	79

Introduction

In this treatise I will demonstrate the existence of a transformation which prefixes with to subjects of English sentences. It will be shown that the with that occurs in four apparently dissimilar environments has this source. The four environments are: 1) reduced relative have sentences, e.g., The house with the white shutters was torn down, 2) absolute sentences, e.g., With the radio playing, you can't hear the canary, 3) complements to a certain class of "causative" verbs, e.g., John planted the field with oats, 4) the pro-form do the same thing with, e.g., Harry put his car in the garage, and Mary did the same thing with hers. My point requires a cursory analysis of each of these four constructions. The first three sections are devoted to delineating and analyzing the class of have sentences which as relative clauses can undergo reduction to relative clauses introduced by with.

Some of the arguments that follow were contained in a paper presented by the author to the Chicago Linguistics Society (Lee, 1966).

Terence Langendoen first interested me in the topic of have sentences in 1965 and has made several valuable suggestions since. Charles Fillmore has offered a number of very useful comments. I am especially grateful to Sandra Annear for the great amount of time she has spent criticizing my analysis and my examples.

This paper was completed under the aegis of the Lexical Analysis Research Project which is sponsored in part by the National Science Foundation through Grant GN-534 from the Office of Science Information Service to the Information Sciences Research Center, The Ohio State University.

1. Three classes of have sentences

This section is a necessary preliminary to subsequent arguments. It is important to distinguish what I shall call 'stative' have sentences from two other varieties--'causatives'

and 'pseudo-causatives'. To that end I list with examples some properties shared by one or two, but not all three of the classes of have sentences.

Examples of the three classes

Causative:

- (1) Henry had Mary jump off the cliff
- (2) My coach has me do push-ups every day
- (3) I have cherry doughnuts sent to the old lady occasionally

Pseudo-causative:

- (4) John intentionally had the stopper out of the bottle
- (5) Harry had Papa's package in Linda's mailbox
- (6) Bill has the door closed

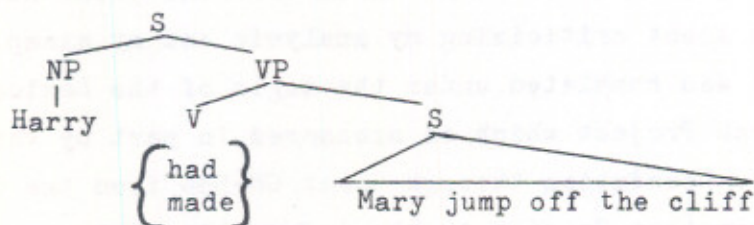
Stative:

- (7) The table has a book on it
- (8) This tree has a bird's nest in its top branch
- (9) John had dirt all over him

The causatives I assume are complex and have the same deep structure as sentences where make takes a sentence complement.

Causative:

- (10) Harry { had
made } Mary jump off the cliff



Causatives differ from the other two classes in taking the progressive. (Statives take the progressive in circumstances which will be noted in the next section.)

Causative:

- (11) Bill is having us visit him tomorrow
- (12) John was having Mary iron his shirt

Pseudo-causative:

(13) *John was intentionally having the stopper out
of the bottle

(14) *Bill is having John's car in Mary's garage

Stative:

(15) *My car is having a dent in its fender

(16) *The table is having a book on it

The embedded sentence in a causative must have an agent and, therefore, a non-stative verb or adjective.¹

¹'Agent' and 'stative' are traditional terms. However I rely on the arguments Lakoff (1966) makes for ascribing the feature stative/non-stative to English verbs and adjectives. Likewise I refer you to Fillmore (1967) for an account of what part cases, the agent case among others, play in English syntax. Fillmore (1967, p. 57) has noted that sentences with stative verbs lack agents.

Causative:

(17) Bill had the men break the piano into little pieces

(18) *Bill had the piano break into little pieces

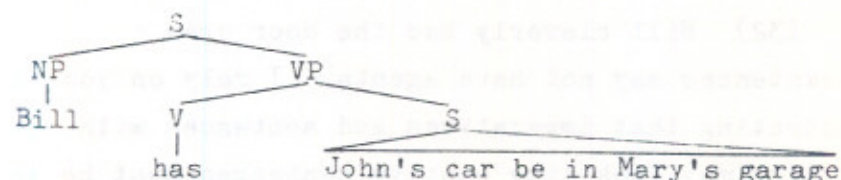
(19) Bill had the piano broken into little pieces
by the men

(20) *Bill had the piano broken into little pieces
by the sledgehammer

Pseudo-causatives may be viewed as having the same deep structure as causatives, except with a copula sentence as complement.

Pseudo-causative:

(21) Bill has John's car in Mary's garage



The copula of the complement of a pseudo-causative is always deleted. Unlike causatives, pseudo-causatives do not take

complements with agents. However, in case a copula sentence has an agent, it may occur as complement in a causative; in this case the copula is not deleted.

Causative:

(22) John had Mary be at his house by 8

Pseudo-causative:

(23) John had Mary in his house by 8

Unlike the copula, the be of the passive is deleted from the complement of a causative. Thus in the case of a complement which can be either a passive or a copula sentence, the have sentence can be causative or pseudo-causative; be is deleted in either case.

Causative or pseudo-causative:

(24) John had Mary's car painted

Causatives always have an agent as subject. Pseudo-causatives may have an agent. These two classes, then, form imperatives, take adverbs like intentionally, and in general have the properties of sentences with agents (except that pseudo-causatives cannot be progressive).

Causative:

(25) Have Mary jump off the cliff!

(26) Have John put the car in the garage!

(27) Bill intentionally had Mary jump off the cliff

(28) Bill cleverly had Harry store the beans

Pseudo-causative:

(29) Have the car in the garage by midnight!

(30) Have the chair in the hall when the movers get here!

(31) John intentionally had the bed on the roof

(32) Bill cleverly had the door open

Stative sentences may not have agents. I rely on your intuition in demonstrating that imperatives and sentences with agent-type adverbs which may look like stative sentences must be interpreted as pseudo-causatives. (Stative sentences with human subjects can generally also be interpreted as pseudo-causatives.)

Stative or pseudo-causative:

(33) Bill has his clothes dirty

(34) John has a cut on his arm

Pseudo-causative only:

(35) Have your clothes dirty!

(36) Have a cut on your arm!

(37) Bill cleverly has his clothes dirty

(38) John intentionally has a cut on his arm

When have is in the simple past tense, pseudo-causatives and statives take by time adverbs. Causative sentences do not.

The adverb can however occur as part of the embedded sentence inside a causative sentence.

Causative:

(39) *Simons had [Esther carve the turkey] by five o'clock

(40) *Charley had [Bill eat a cracker] by last week

The adverb must belong to the sentence complement in

(41) George had [Phyllis have the dishes washed by meal time].

Pseudo-causative:

(42) Bill had the picture on the wall by yesterday

(43) Harry had John's house built by last year

Stative:

(44) This chair had its leg already broken by last week

(45) The cage had a tiger in it by Thursday

The existence of a reflexive pronoun in the verb phrase of the complement sentence serves to distinguish pseudo-causatives from statives.

Pseudo-causative:

(46) John intentionally had mud covering { him
himself },
so that nobody would recognize him

(47) Have the greasepaint smeared all over { you
yourself }
by the time I get back!

Stative:

- (48) The church tower has a huge clock on { it
*itself }
- (49) That tire has a puncture in { it
*itself }

As relative clauses, stative have sentences can be reduced by taking out NP (repeated) Tense have and inserting with. NP (repeated) signifies the noun phrase in the relative clause that is identical with the noun phrase the relative clause modifies. Neither causatives nor pseudo-causatives can undergo this reduction.

Causative:

- (50) The man who has Mary steal chairs for him is in this very room
- (51) *The man with Mary steal chairs for him is in this very room

Pseudo-causatives:

- (52) The man who has George's belt in Mary's handbag is in this very room
- (53) *The man with George's belt in Mary's handbag is in this very room

Stative:

- (54) The man who has a scar on his left wrist is in this very room
- (55) The man with a scar on his left wrist is in this very room

Negated stative sentences may sometimes have be without instead of not have. The other two classes of have sentences do not turn up with this alternate type of negative.

Stative:

- (56) John doesn't have a mark on him
= (57) John is without a mark on him

There is a noun phrase contained in the verb phrase of every stative have sentence, that is identical with the subject of the have sentence. Causatives and pseudo-causatives may or

may not have such an identical noun phrase. Since this identical noun phrase is a repeated occurrence (the subject being its first occurrence), it is either deleted or pronominalized. It can be deleted just in case (!) it is genitive (that is, if it would come out after of or with 's'), and it occurs next to the noun it modifies. Even if the identical noun phrase is deleted, its presence in the underlying structure can be inferred from semantic evidence.

Stative:

(58) John has a cut on his arm

= (59) John has a cut on the arm

(60) This pot has a hole in the bottom of it

= (61) This pot has a hole in its bottom

= (62) This pot has a hole in the bottom

(63) *This pot has a hole in the bottom of the pan

Sentence (63) is unacceptable because a) it is a have sentence with an inanimate subject and so must be stative, b) a stative have sentence must have a noun phrase identical with its subject in its verb phrase, c) since neither this pot nor any pronoun that might represent it appears in the verb phrase, this pot must have been deleted, d) only a genitive noun phrase can be deleted, so the this pot that was deleted must have been genitive, e) the two noun phrases that of this pot could be associated with are in the bottom of the pan and of the pan, f) of this pot could only be a part of the noun phrase in the bottom of the pan if it were a part of of the pan, or if it were conjoined with of the pan, and g) pots do not ordinarily possess pans, nor do a pot and a pan ordinarily possess a common bottom.

Stative have sentences have paraphrases which lack have and the subject of have sentence, but which are obviously closely related to the have sentences in structure. I list some statives with copula sentence paraphrases. (Some of the copula sentences have undergone the rule that moves the auxiliary and be to the front and adds there.)

Stative

- (64) The table has a scratch on it
= (65) There is a scratch on the table
(66) The pot has a hole in the bottom of it
= (67) There is a hole in the bottom of the pot
(68) A locomotive has the cowcatcher on its front end
= (69) The cowcatcher is on the front end of a locomotive
(70) The refrigerator has its door broken
= (71) The door of the refrigerator is broken
(72) This jug of wine has a fly in it
= (73) There is a fly in this jug of wine
(74) I have a mar in the finish of the inside of the
top of my car's left front fender
= (75) My car has a mar in the finish of the inside
of the top of its left front fender
= (76) My car's left front fender has a mar in the
finish of the inside of its top
= (77) The top of my car's left front fender has a
mar in the finish of its inside
= (78) The inside of the top of my car's left front
fender has a mar in its finish
= (79) The finish of the inside of the top of my car's
left front fender has a mar in it
= (80) There is a mar in the finish of the inside of
the top of my car's left front fender

To conclude this section I remark that the superficial similarity of the three types of have sentences that I have talked about conceals some underlying diversity. When the diversity has been accounted for (this paper is preliminary to such an attempt), the similarity will remain to be explained.

The following chart summarizes the properties of causative, pseudo-causative, and stative have sentences.

Causatives

progressive
agent in
sentence complement

agent as
subject
imperative
agent-type
manner adverbs

Pseudo-causatives

reflexive in VP of
sentence complement
copula deleted from
sentence complement

past + by time X

Statives

be without replaces
not have or have no
with in relative
clause
identical NP in VP
related paraphrase

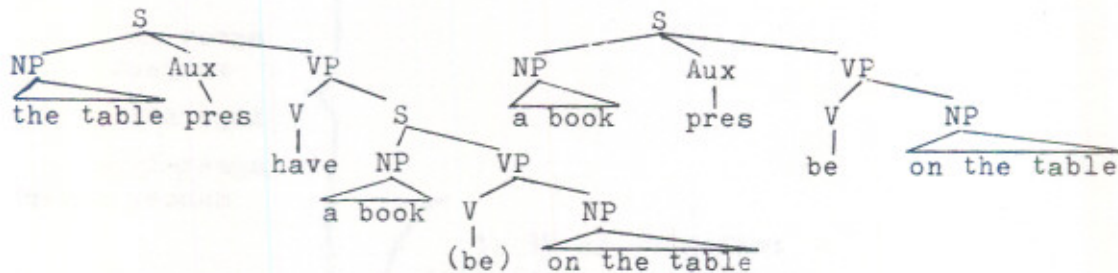
2. Stative have sentences

Now I will give my account for a few (but only a few) of the facts noted in the preceding section. It was noted that stative have sentences have paraphrases whose relation to the have sentences is formally rather simple. In the paraphrase the subject of have and have itself are not in evidence, except that a noun phrase identical to the subject of have, the noun phrase that must occur in the predicate of a have sentence, is present. The auxiliary of the have sentence occurs somewhere in the paraphrase, and after it occurs be (at least in the first examples to be considered). Otherwise the paraphrase is identical to the

have sentence. Assuming the same sort of structure for the stative have sentence as was assumed for pseudo-causatives, then, the following surface trees will illustrate the relationship.

(82) The table has a book on it

There is a book on the table
(before the there rule)



I suggest that a stative have sentence and its related paraphrase mean the same thing because they are both derived from the same deep structure. Two alternatives then present themselves; either the have sentence is closer to the deep structure, or the copula sentence is. If the former, then in the derivation of the copula sentence one will eliminate all the elements of the superordinate sentence that occurs in the derived structure of the have sentence save the sentence complement to have. If the copula sentence is closer to the deep structure, then a superordinate sentence whose subject is a copy of some noun phrase in the copula sentence will be added to the copula sentence to derive the have sentence.

I favor the second alternative, that the have sentence is secondary, and will address myself to the task of formulating a transformation which, when applied optionally to the phrase marker that directly underlies a copula sentence, results in a have sentence. But first I shall list some reasons why I think the second alternative more advisable than the first. This is especially necessary since structure-adding transformations like the one I propose have not often been adduced. In fact I have seen arguments that use the necessity for postulating such a transformation as a *reductio ad absurdum*.

If one chose to derive the copula sentence paraphrases by eliminating the superordinate structure of a have sentence, then all copula sentences would probably have to be derived in this fashion. (And, it will later appear, this applies to a larger class of sentences than just copula sentences.)

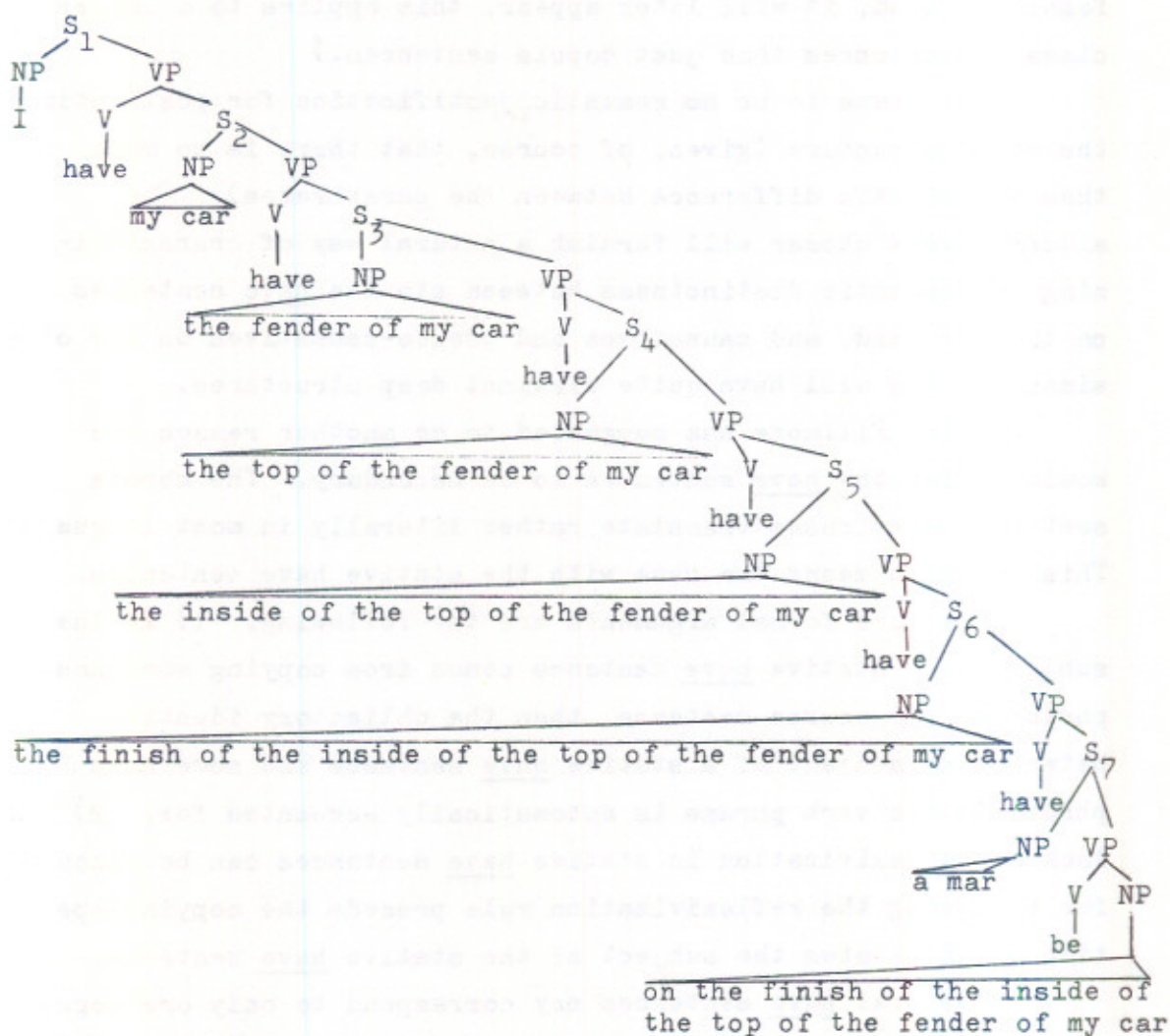
There seems to be no semantic justification for postulating the extra structure (given, of course, that there is no more than a stylistic difference between the paraphrases). The alternative I choose will furnish a natural way of characterizing the semantic distinctness between stative have sentences on the one hand, and causatives and pseudo-causatives on the other, since the two will have quite distinct deep structures.

Charles Fillmore has suggested to me another reason one would prefer the have sentences to be secondary. The copula sentence paraphrases translate rather literally in most languages. This is by no means the case with the stative have sentences.

Three more formal arguments are the following. 1) If the subject of a stative have sentence comes from copying some noun phrase of the source sentence, then the obligatory identity between the subject of a stative have sentence and some noun phrase in its verb phrase is automatically accounted for. 2) The lack of reflexivization in stative have sentences can be accounted for by having the reflexivization rule precede the copying operation which creates the subject of the stative have sentence.

3) Several have sentences may correspond to only one copula sentence paraphrase. (See, for example, sentences (74) to (80) in section 2.) Attempting to deal with this situation by deriving copula sentences from have sentences would lead to absurd results. Either one would have to give up the goal of deriving all the paraphrases from one deep structure (in other words, refusing to deal with the situation), or one would have to assume a deep structure containing one sentence for each paraphrase. That is, something like the following.

(83) There is a mar in the finish of the inside of the top of the fender of my car



Perhaps this is not unreasonable as a deep structure for this sentence, but it is absurd. Then, a rule must be formulated for eliminating the subject and verb of at least five of the sentences S₁, S₂, S₃, S₄, S₅, S₆. Such a rule would be without parallel.

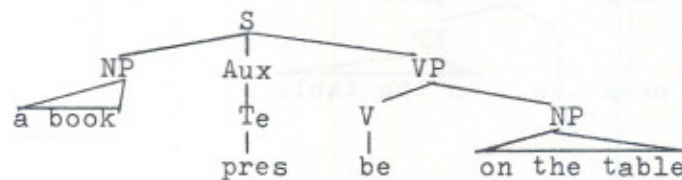
If the have sentences are secondary, one need allow only an optionality in the choice of which noun phrase is to be copied, and a much more economical solution is achieved.

I must admit, however, that I lack a definitive demonstration that the approach I choose is the only tenable one.

(96) I hadn't expected him to go yet.

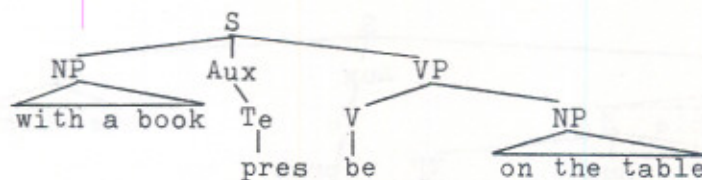
In section 4 it will be shown that a transformation that adds with at the beginning of sentences is desirable. It is convenient for me to assume the existence of this transformation in what follows. Whether the transformation 'with-addition' applies before or after FRONTING, it may add with at some point in the derivation of a stative have sentence. That is, either (97) → (98) → (99),

(97)



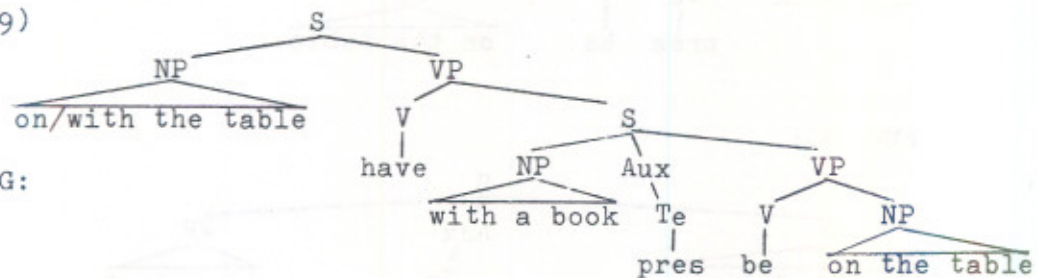
(98)

with-
addition:



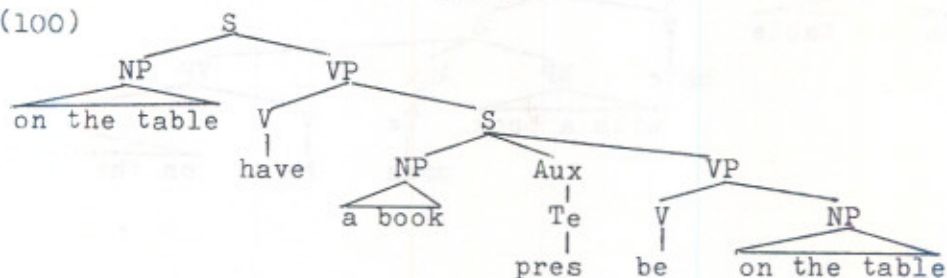
(99)

FRONTING:



or, if FRONTING applies before with-addition, (97) → (100) → (99).

(100)

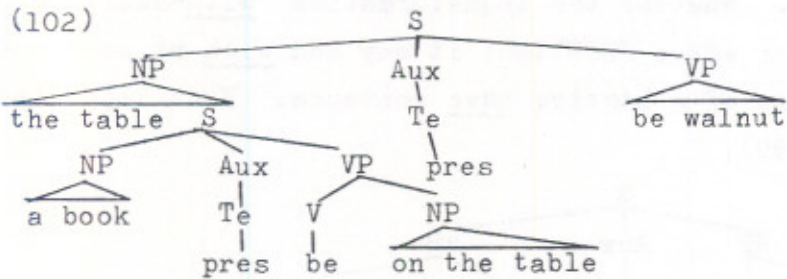


(99) eventually becomes (101).

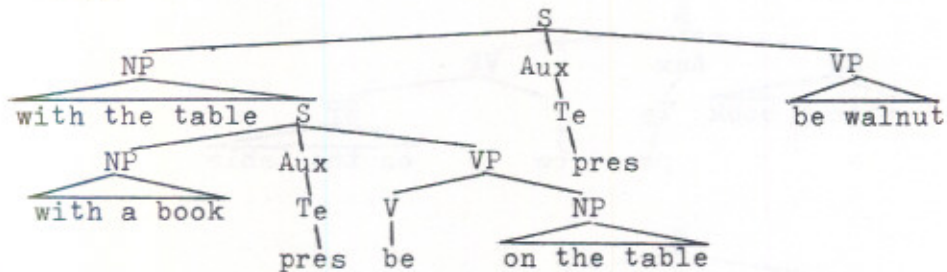
(101) The table has a book on it

It was noted in section 1 that stative have sentences as relative clauses may have a reduced form where with turns up. Now to account for this we need only add a rule for relative clause

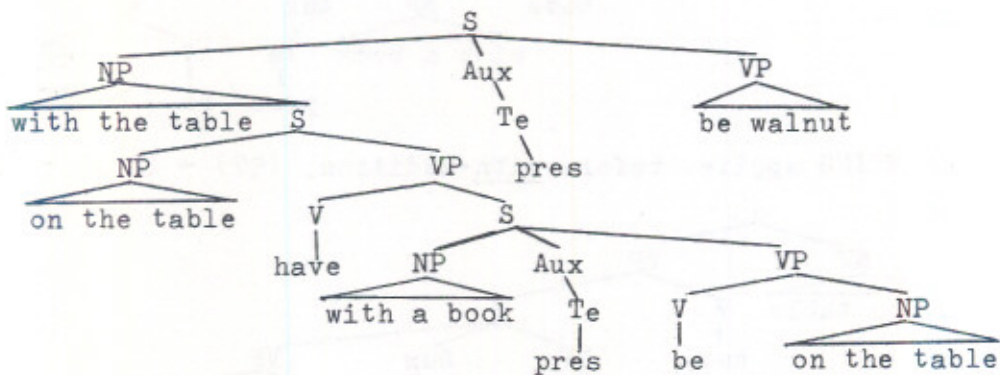
reduction NP (identical) have $\rightarrow \emptyset$ similar to the rule NP (identical) be $\rightarrow \emptyset$, which is needed in the derivation of sentences like The book on the table is brown. So the derivation of The table with a book on it is walnut goes something like (102).



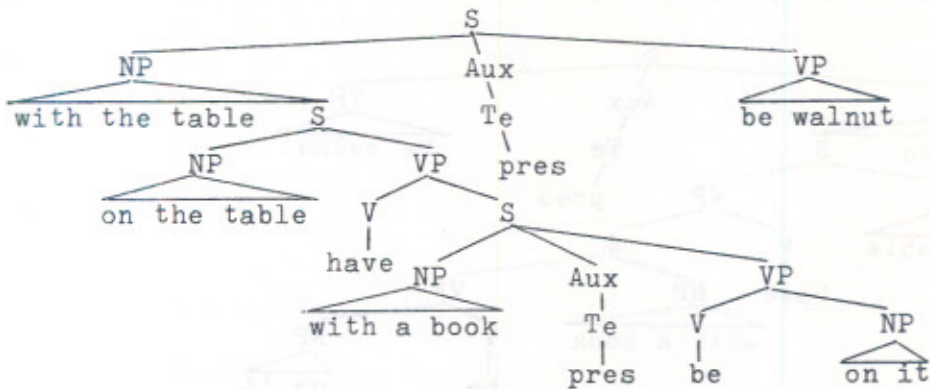
a) with-addition:



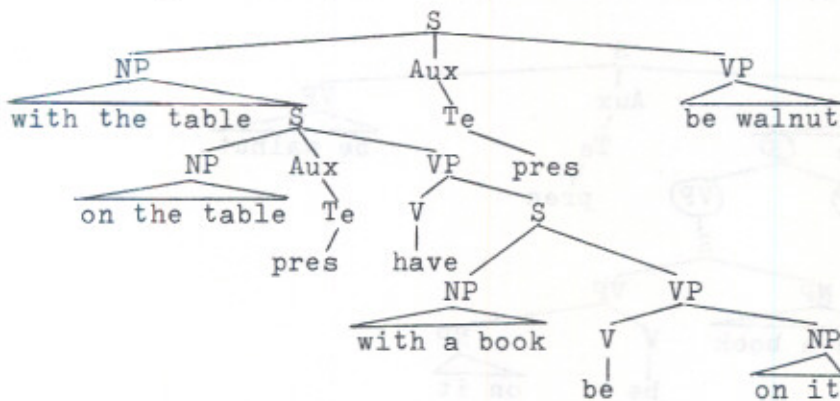
b) FRONTING:



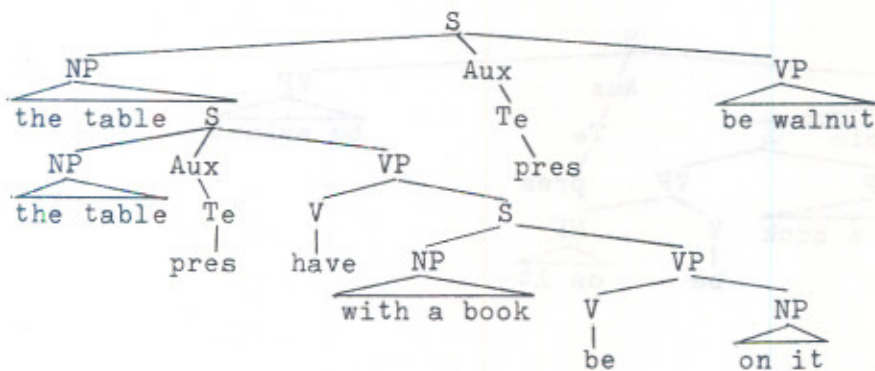
c) pronominalization:



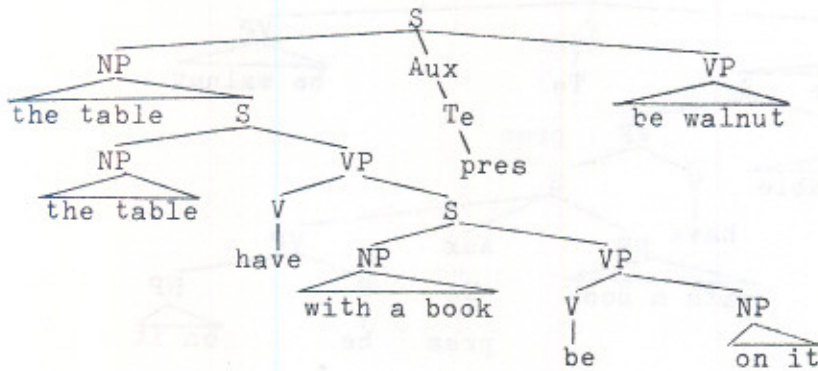
d) Auxiliary moved up into superordinate sentence:



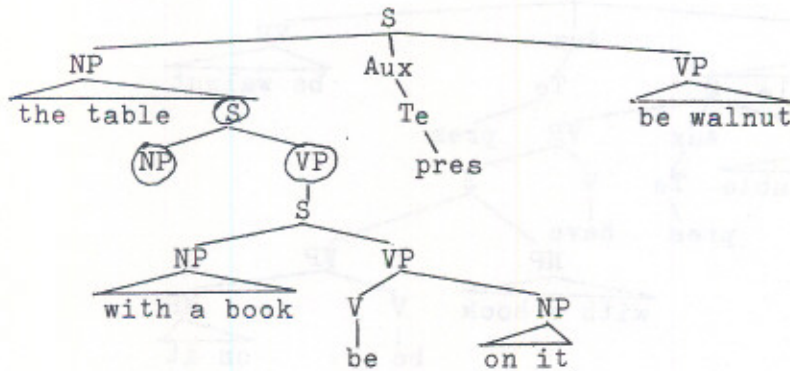
e) Preposition is deleted at beginning of finite sentence:



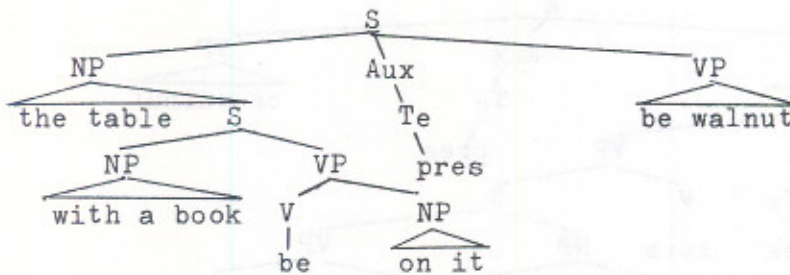
f) Auxiliary in relative clause that is identical to Auxiliary in main sentence is deleted:



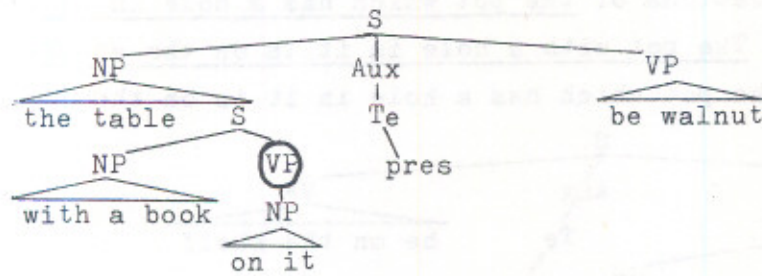
g) relative clause reduction:



The circled nodes are deleted (see Ross (1966)), giving



h) be-deletion (be is deleted when it is not preceded by Aux--sometimes):



(VP)-node is deleted, as before.

Lest we turn out something like The table which has with a book on it is walnut, we must delete with in case the relative clause reduction rule does not apply.

(103) have, with →
1 ∅

I will not go into the ordering (obviously crucial) or the exact formulation of the transformations I mention except as these matters directly concern my argument.

A further revision of FRONTING allows greater generality. Suppose that instead of adding have, FRONTING adds be. That is, revise FRONTING to read

(104) [NP Aux be X, NP, Y] →
 S S
 2 be 1 2 3

This obviates the necessity for having a special relative clause reduction rule for stative have sentences. The rule NP (identical) have → ∅ is no longer necessary, because the regular rule NP (identical) be → ∅ will do the job. In this fashion pseudo-causatives can be prevented from being reduced when they occur as relative clauses and their subjects are relativized. The previous formulation of FRONTING along with the other rules I posited would allow such a reduction.

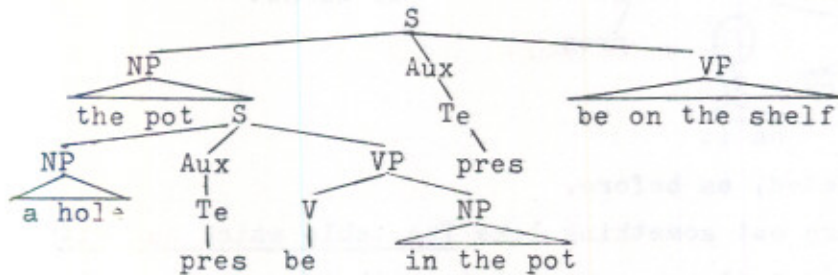
But now if FRONTING adds be instead of have, then be must at some point be changed to have in case be is not previously deleted. Then let (105) follow relative clause reduction.

(105) be, with →
 have ∅ 2

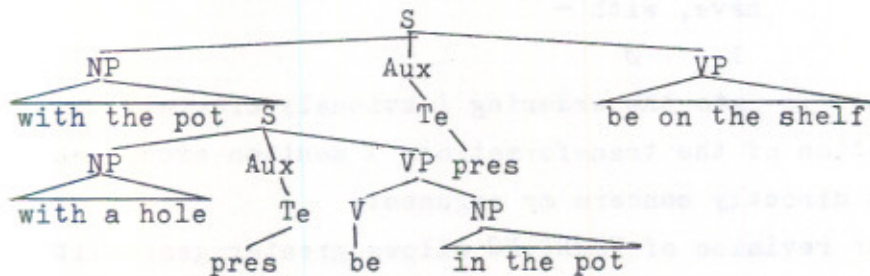
The rule that deletes with after have (103) must follow (105).

To exemplify the application of the revised rules, I outline the derivations of The pot which has a hole in it is on the shelf and The pot with a hole in it is on the shelf.

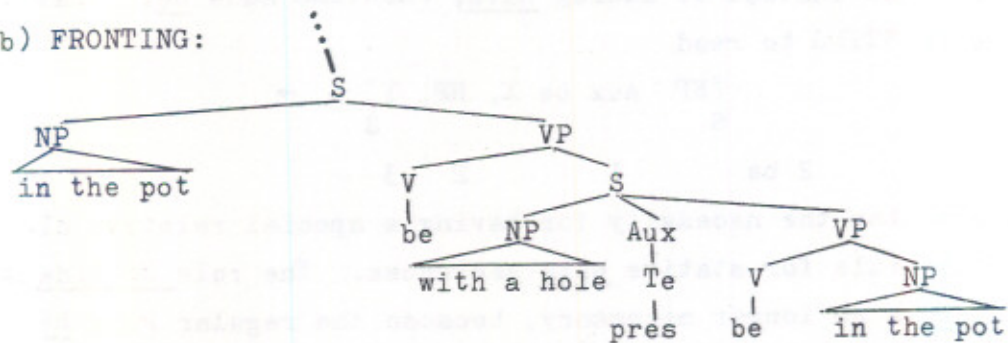
(106) The pot which has a hole in it is on the shelf



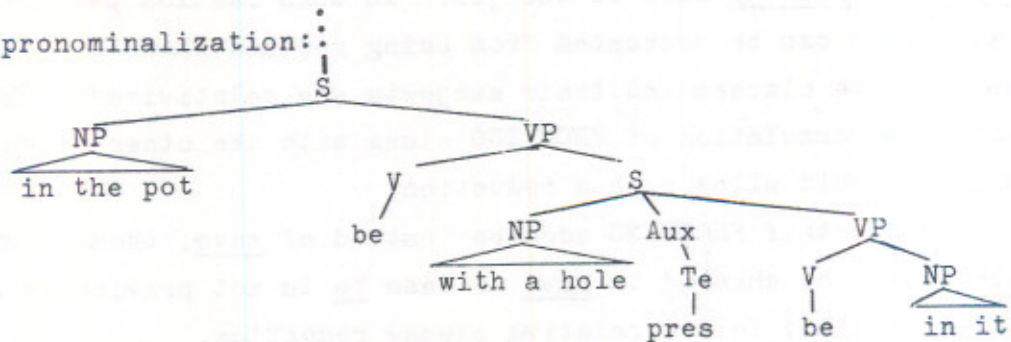
a) with-addition:



b) FRONTING:

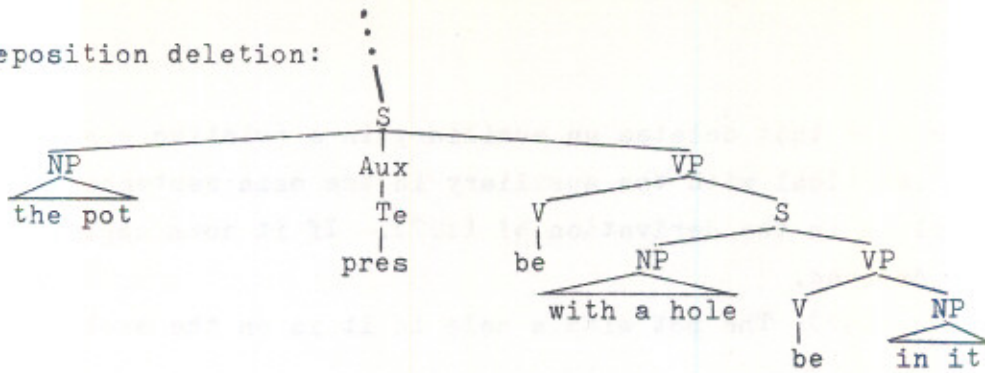


c) pronominalization:



d) Auxiliary is moved up:

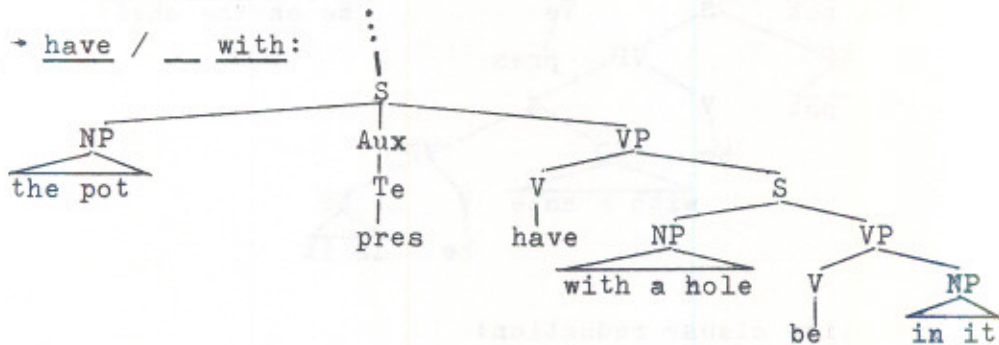
e) preposition deletion:



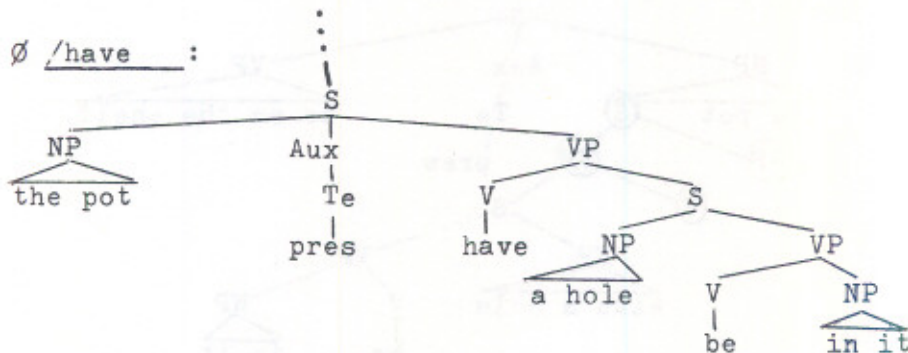
(f) delete identical Auxiliary:)

(g) relative clause reduction:)

h) be → have / with:

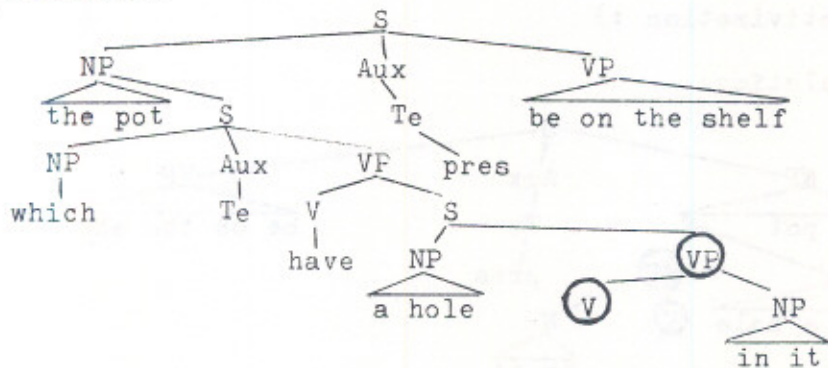


i) with → ∅ / have :



j) relativization:

k) be-deletion:

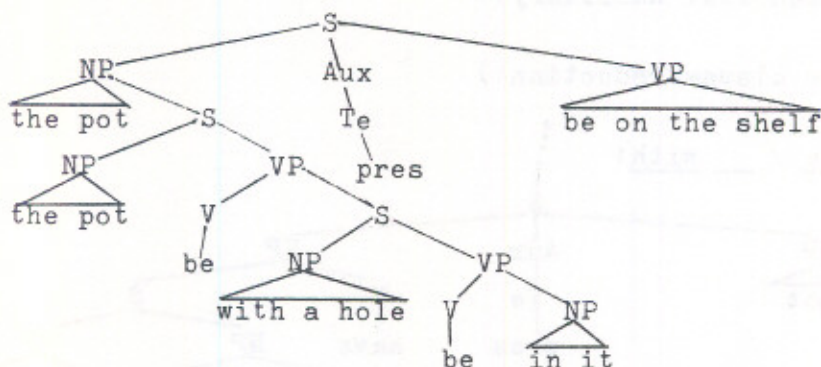


The rule that deletes an auxiliary in a relative clause if it is identical with the auxiliary in the main sentence was not applied in the derivation of (107). If it does apply, then (107) is derived.

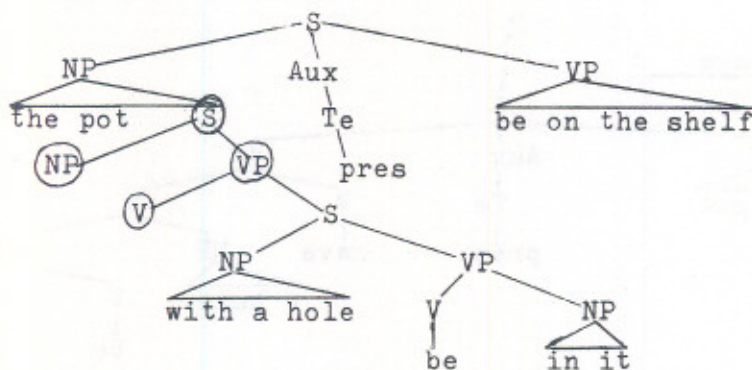
(107) The pot with a hole in it is on the shelf

...

f) delete identical Auxiliary:



g) relative clause reduction:

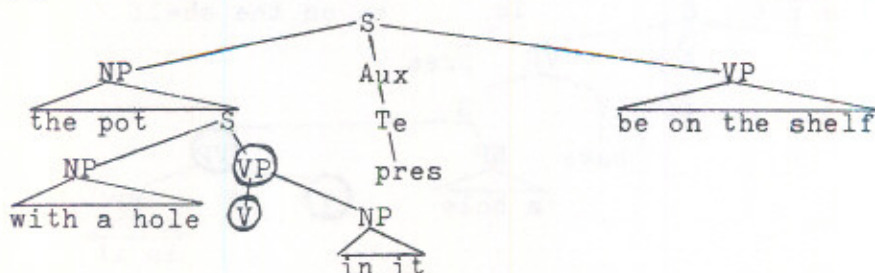


(h) be → have / ___ with :)

(i) with → ∅ / have ___ :)

(j) relativization :)

k) be-deletion:



I have two final notes on the have of stative have sentences originally being be. First, if this is so, then the occurrence of be without instead of not have is somewhat easier to deal with. Before be is changed to have, not with can be changed to without.

Second, changing be to have is optional in some infinitival complements.

- (108) I expect my pie to have ice cream on it
- = (109) I expect my pie to be with ice cream on it
- = (110) I expect ice cream on my pie

If have were not derived from be, these paraphrases could only be accounted for in a completely ad hoc way.

The last formulation of FRONTING was (111).

- (111) [NP Aux be X, NP, Y] →
 S S
 2 be 1 2 3

In this formulation it is implicitly claimed that the noun phrase that is preposed occurs after be, and that only copula sentences can undergo FRONTING. If FRONTING gives rise to all stative have sentences, then both of these claims must be given up. In sentence (112) the noun phrase that has been proposed was originally part of the subject.

- (112) The chair has its leg broken
 (= The leg of the chair is broken)
- (113) is derived from a sentence that does not contain be.
 (113) My coffee pot had twelve people try to break it by
 throwing it on the floor last night at the party
 (= Twelve people tried to break my coffee pot by
 throwing it on the floor last night at the party)

Removing the unnecessary restriction on FRONTING allows the following simpler formulation.

- (114) [X, NP, Y] →
 S S
 2 be 1 2 3

Earlier in this section I claimed that stative have sentences do not take the progressive because the copula sentences that they are derived from do not take the progressive. Now if a have

sentence is derived from some sentence in which the progressive does occur, one would expect that the stative have sentence would also contain the progressive. This is in fact the case. Note the following paraphrases.

- (115) Some men were painting those shacks
- = (116) Those shacks had some men painting them
- = (117) Those shacks were having some men paint them
- (118) A ship was being built in that bottle
- = (119) That bottle had a ship being built in it
- = (120) That bottle was having a ship built in it

It appears from these examples that the entire auxiliary need not be moved up into the have sentence proper; be + ing can be left behind. On the other hand, a modal or the perfect have + en must be moved up.

- (121) Those shacks might have some men paint them
- (122) *Those shacks had some men may paint them
- (123) Those shacks had had some men paint them
- (124) *Those shacks had some men have painted them

But the passive be + en must be left behind.

- (125) That bottle had a ship built in it
- (126) *That bottle was had a ship built in it

These facts suggest that the structural description for the transformation that, it was said before, moves the auxiliary up should in part read

- (127)

{	Tense	(Modal)	(Perfect)	}	
	Tense	(Modal)	(Perfect)		

 .

Before concluding this section with a list of restrictions that must probably be imposed on FRONTING, I give below a bunch of examples to illustrate what positions preposed noun phrases can occupy in the source sentence.

NP is part of subject:

- (128) The door of the cupboard was left open
- = (129) The cupboard had its door left open
- (130) One of the tubes in the amplifier burned out
- = (131) The amplifier had one of the tubes in it burn out

NP is object:

- (132) Right now five people are using this toilet
= (133) Right now this toilet has five people using it
(134) Two million people visited the World's Fair in
one week
= (135) The World's Fair had two million people visit it
in one week

NP is part of object:

- (136) Someone stole the front tire of my bike last week
= (137) My bike had someone steal its front tire last week

NP is locative in the VP:

- (140) 1000 cubic feet of air had been pumped into the
balloon before it burst
= (141) The balloon had had 1000 cubic feet of air pumped
into it before it burst

NP is indirect object

- (142) Five pounds of bonbons were sent (to) the janitor
by mistake
= (143) The janitor had five pounds of bonbons sent (to) him
by mistake (The mistake was not the janitor's.)

NP is in reduced sentence complement to the verb:

- (144) Many people have tried to ride that horse
= (145) That horse has had many people try to ride it

There are apparently strong restrictions on the application of FRONTING . The following are just some accidental observations; some readers may disagree with my judgments of acceptability.

- a) To be preposed, the noun phrase cannot be subject.
(146) The hat was on the rack
(147) *The hat had itself on the rack
(148) This sword has skewered twenty men

- (149) *This sword has had itself skewer twenty men
- (150) John was in Wyoming last summer
- (151) ?John had himself in Wyoming last summer
(if acceptable, must be pseudo-causative)

a possible exception:

- (152) I hear your city hall was renovated last year
- (153) ?I hear your city hall had itself renovated last year

b) The noun phrase, if it is animate, cannot be dominated by an animate noun phrase. (An animate noun phrase is one whose head is animate.)

- (154) John's wife is in labor
- ≠ (155) ?John has his wife in labor
- (156) There is some dirt on John's friend's jacket
- ≠ (157) John has some dirt on his friend's jacket²

²Mary Bremer pointed out this type of ungrammaticality.

c) A sentence whose main verb or adjective is stative is not subject to FRONTING.

- (158) I don't appreciate that kind of music
- (159) *That kind of music doesn't have me appreciate it
- (160) Bill knows that man
- (161) *That man has Bill know him
- (162) Judy loves those hatpins you sent her
- (163) *Those hatpins you sent Judy have her love them

However, animate objects of stative verbs can at least occasionally be preposed.

- (164) Mary believed me
- = (165) I had Mary believe me
- (166) Unfortunately, someone saw me as I stole out of the building
- = (167) Unfortunately, I had someone see me as I stole out of the building
- (168) Some people had suspected John of stealing money
- = (169) John had had some people suspect him of stealing money

The fact that the above have sentences are unambiguously stative makes it impossible to say that these verbs, which ordinarily lack agents, may take agents when their objects are animate. Recall that sentences with agents can be complements in causative have sentences. If the sentence Mary believed me contained an agent, one would expect to be able to form the causative have sentence I had Mary believe me. Yet this sentence admits only a stative interpretation.

This is puzzling, but it is no more puzzling than the fact that some stative verbs occur in the command imperative construction just when they have animate objects.

(170) Believe me!

(171) *Believe that theorem!

(172) Know thyself!

(173) *Know Sanskrit!

I have been unable to decide whether a noun phrase can be preposed if it is a part of neither the subject nor the verb phrase and whether a noun phrase can be moved across an intervening S-node.

My final version of FRONTING is

(174) [X, NP, Y] →
 S S

 2 be 1 2 3

where: X is not null

 if NP is animate, it is not dominated by an
 animate NP

 the main verb of S is non-stative

3. Possessive have sentences

It is not difficult to find have sentences which are clearly neither causatives nor pseudo-causatives, yet which do not exhibit all of the properties of stative have sentences listed in section 1. For example, have may be used in the sense of 'consume' or 'enjoy', in which case it takes an agent. But (175) and (176) have neither the structure of a causative nor that of a pseudo-causative.

(175) We had dinner early

(176) We were having dinner early

In this section I propose a tentative analysis of a class of exceptional have sentences which I call 'possessive', for want of a better name. These sentences can often be closely paraphrased by replacing have with possess. Some examples follow.

(177) He has a house to be proud of

(178) He possesses a house to be proud of

(179) This machine has no moving parts

(180) This machine possesses no moving parts

(181) Our library has a million books

(182) Our library possesses a million books

(183) Mary has red hair

Replacing have- by possess in the stative have sentences that have been previously considered produces unacceptable sentences.

(184) John has dirt all over him

(185) *John possesses dirt all over him

(186) The table has a book on it

(187) *The table possesses a book on it

Possessive have sentences as relative clauses may be reduced by removing NP (identical) be and inserting with. This is a property of stative have sentences not shared by causatives and pseudo-causatives.

(188) A machine that has no moving parts is unlikely to break down

= (189) A machine with no moving parts is unlikely to break down

(190) A library that has a million books is pretty big

= (191) A library with a million books is pretty big

However possessive have sentences do not have the other two properties of stative sentences upon which the analysis in section 2 was based. First, there are no related paraphrases of the sort that stative have sentences were found to possess.

(192) They have related paraphrases

(193) There are related paraphrases ?? them

This fact is not always obvious in the case of possessive have sentences with inanimate subjects. One might maintain that (194) was a paraphrase of (195).

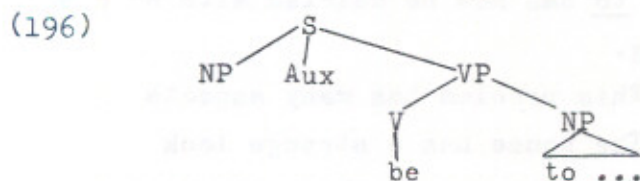
(194) Our library has a million books

(195) There are a million books in our library

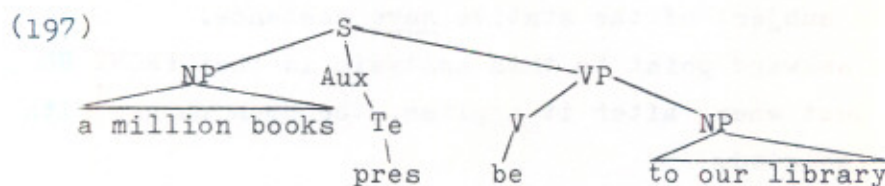
However these sentences do not mean the same thing. A library might keep some of its books in a warehouse, yet "have" them.

Second, it is apparent that there is no noun phrase in the predicate of a possessive have sentence that is identical (save for a preposition) with its subject.

The fact that when their subjects are relativized possessive have sentences have a reduced form in with indicates that they are, despite appearances, to be analyzed as stative have sentences. Otherwise, it seems to me, the analysis in section 2 must be incorrect. Therefore the problem is to provide likely source sentences which, after they undergo FRONTING, can be made to yield possessive have sentences. There is no getting around the fact that these sentences have no structurally related paraphrases, so in their derivations FRONTING must be obligatory. I propose source sentences of the following form.



FRONTING must apply to prepose the noun phrase introduced by to, and this noun phrase that is copied must then be deleted. Then Our library has a million books is from (197).



FRONTING is applied, to our library is deleted, and the other rules discussed in the last section are applied.³

³Terence Langendoen first suggested to me that possessive have sentences should be derived by deleting to and identical noun phrase.

Of the sources that could be postulated for possessive have sentences (given my assumptions), I choose the preceding because in special circumstances copula sentences of this form are acceptable without the deletion of to NP, and, in this case, the noun phrase with to can be deleted after FRONTING has applied with no change in meaning. The special circumstances are that the subject of the copula be a noun phrase whose head is one of a class of nouns including air, appearance, look, side, facet, and that the relation between the subject and predicate of the copula sentence be that of part to whole.

(198) There are many aspects to this problem

(199) There is a strange look to the house

(200) There is a white appearance to the water

The deep structures of these sentences may undergo FRONTING, in which case we get

(198) = (201) This problem has many aspects to it

(199) = (202) The house has a strange look to it

(200) = (203) The water has a white appearance to it

The noun phrase with to can now be deleted with no discernable effect on the meaning.

(201) = (204) This problem has many aspects

(202) = (205) The house has a strange look

(203) = (206) The water has a white appearance

So to does in fact occur introducing noun phrase complements of the copula, and, to explain the above paraphrases, there must be a rule to delete a noun phrase with to that is otherwise identical with the subject of the stative have sentence.

An awkward point to this analysis is that FRONTING is obligatory just when, after it applies, the noun phrase with to must be deleted.

In section 5 evidence will be presented that the source sentences I postulate for possessive have sentences do occur as non-finite complements to some verbs and have some connection with possessive have sentences.

4. Absolute be sentences

A be sentence is a sentence whose tense carrier is be (as opposed to a have sentence, which, for me, is a sentence whose main verb is have). The absolute be sentences that I shall talk about are subordinate to sentences whose main clauses follow the absolute be sentences. The absolute be sentences are tenseless, be-less, and are introduced by the preposition with. Some examples are given below along with what the absolute sentence might come out to be were it independent.

- (207) With the door wide open, the bugs can get in
(The door is wide open)
- (208) With so many dishes still in the sink, we'll have to wash them before we leave
(So many dishes are still in the sink)
- (209) With nobody picking the fruit, it's getting rotten
(Nobody is picking the fruit)
- (210) With Harry going to town early, he can pick up some things for dinner
(Harry is going to town early)
- (211) With Harry about to mow the lawn, we'd better put gas in the mower
(Harry is about to mow the lawn)
- (212) With their apartment building to be razed the following week, they felt they had to move
(Their apartment building was to be razed the following week)
- (213) With the trees all cut down by lumbermen, the birds are finding new homes
(The trees are all cut down by lumbermen)
- (214) With the hole enlarged by the men, the trapped miners could escape
(The hole was enlarged by the men)

The source of the be can be the copula, the progressive, be to or the passive.

My claim is, then, that absolute be sentences (the term assumes my conclusion) are from be sentences that lack tense and modal. It seems likely that the tense is deleted because of identity to that of the main, finite clause.

Note that the with that introduces these absolute constructions differs in two important respects from subordinate conjunctions like if, since, when, after. The first difference is the obvious fact that subordinate conjunctions introduce finite sentences that may contain modals. The absolute sentences can contain neither tense nor modal. The second difference is that, unlike subordinate conjunctions, with seems to have no lexical semantic content (if you see what I mean). With indicates only that the clause that contains it is subordinate. To support this rather impressionistic observation I note that, for me at least, the with can occasionally be omitted without altering meaning in the slightest.

(215) (With) One chair painted, he started on the next
Also, the with construction may be closely paraphrased by subordinate sentences that are finite. Compare sentence (214) with the following.

(216) After the hole was enlarged by the men, the trapped
miners could escape

(217) Since the hole was enlarged by the men, the trapped
miners could escape

(218) If the hole were enlarged by the men, the trapped
miners could escape

Sentence (214) can be understood in each of these ways. In the case of the absolute construction in (214), then, the relation between the subordinate and main clauses is not so closely specified as in the case of clauses introduced by subordinate conjunctions.

With is then a function word, and it is appropriate to introduce it by a non-lexical sort of transformation, a "spelling rule" (see Lakoff (1965)).

Since with introduces absolute sentences, I propose that it is attached to the initial noun phrase, i.e. the subject, of every sentence by (215).

(215) with addition [, NP →
1, with^2

If a sentence is made absolute by deleting its tense and be, this with remains. Otherwise it is deleted by (216).

(216) With deletion [[, with, X] Tense →
1 ∅ 3

It seems that absolute sentences introduced by with can only be derived from be sentences. Sentences like (217) are rather marginal.

(217) ??With trains go by every hour, how will you be able to sleep?

So the existence of with in the subjects of other than be sentences must be motivated by the examples given in section 2 of stative have sentences derived from non-be sentences.

Of course, absolute be sentences are only one variety of non-finite sentence, and the rules given so far predict that with will be present in all non-finite sentences, unless their tense marker is deleted after the with deletion transformation applies. That with does indeed occur in at least two other non-finite constructions will be shown in sections 5 and 6. First two difficult varieties of absolute be sentences must be dealt with.

Since the be that is deleted to form absolute be sentences may be the be of the progressive marker be + ing, we can derive absolute sentences where ing is attached to the first verbal element after the subject. But some absolute sentences with ing apparently cannot be derived this way, because they would have no grammatical source.

(218) With the guide knowing so many languages, we got along very well on our tour

(219) With Bill believing everything Mary says, you'll have a hard time convincing him she's a jerk

but (220) *The guide was knowing so many languages

(221) *Bill is believing everything Mary says

The progressive must not occur in the auxiliary of a stative verb (see Lakoff (1966)).

But this same problem crops up in deriving reduced relative clauses. If relative clauses are reduced by the rule

(222) NP (identical) be →
 ∅

then how are the following to be derived?

(223) A man who knows Sanskrit will go far
= (224) A man knowing Sanskrit will go far

Again we are faced with the problem of postulating an ungrammatical source sentence.

The fact that sentences (223) and (224) are paraphrases leads me to suggest the following solution. The progressive marker be + ing is deleted before stative verbs and the copula. The rule that accomplishes this follows the relative clause reduction transformation and the transformation that deletes the be in absolute be sentences. If either of these two latter transformations applies to delete the be of be + ing, the structural description for the rule that eliminates be + ing before a stative verb or the copula is no longer met, and the +ing remains.

I mention it as an interesting possibility that the presence or absence of be + ing before the copula may correspond to the distinction in languages like Portuguese between the forms of the copula that attribute accidental (estar) and inherent (ser) properties to their subjects.

Unfortunately the class of absolute sentences in ing is not yet exhausted. But before the next variety is examined, it is convenient to note the existence of reduced absolute sentences. As in the case of relative clauses and while clauses, NP (identical) be can be deleted from absolute sentences. As with time adverbial while clauses, the noun phrase deleted must be identical to the subject of the main clause.

(225) Wide open, the door will let in too many bugs
 (With the door wide open, ...)

- (226) Shielding your eyes, you can still see land
 (With you shielding your eyes, ...)
- (227) Being too stupid to turn the knob, John couldn't
 open the door
 (With John being too stupid to turn the knob, ...)
- (228) About to mow the lawn, Harry broke his ankle
 (With Harry about to mow the lawn, ...)
- (229) Cut down by the lumbermen, the trees were being
 trimmed and hauled away
 (With the trees cut down by the lumbermen, ...)

It is important to distinguish sentences like (226) and (227) from superficially similar reduced while clauses. A repeated tense and NP (identical) be can also be deleted from while clauses.

- (230) While I was going to town, I met an old man
 = (231) While going to town, I met an old man

Further, the while can be deleted.

- = (232) Going to town, I met an old man
 (233) can be understood either in the sense of (234) or (235).

- (233) Wearing her high heels, Mary seems very tall
 (234) With Mary wearing her high heels (today), she
 seems very tall
 (235) While Mary is wearing her high heels, she seems
 very tall

Stative have sentences, since they are at one point be sentences, may occur as absolute sentences. Be is deleted before it can be changed to have. Unfortunately such absolute sentences are at best awkward.

- (236) ?With the sink with so many dishes in it, we'll
 have to stay home to wash them

The absolute sentence in (236) is derived from the deep structure of So many dishes are in the sink by applying the transformations FRONTING and with addition. When one of the with's is for some reason eliminated, such constructions are more acceptable. The

second with will be deleted if the source copula sentence contains the progressive, since in this case the be of the progressive is deleted to form an absolute sentence, and the be added by FRONTING remains. The latter be is changed to have, and after have, with is deleted.

(237) With the sink having so many dishes in it, we'll
have to stay home to wash them

Below is an outline of the steps in the derivation of the absolute sentence in (237).

(238)		[so many dishes be +ing be in the sink]
in the sink	be	[so many dishes be +ing be in the sink]
with the sink	be	[with so many dishes be +ing be in the sink]	
with the sink	be	[with so many dishes be +ing be in it]	
with the sink be +ing	be	[with so many dishes	be in it]
with the sink +ing	be	[with so many dishes	be in it]
with the sink +ing have		[with so many dishes	be in it]
with the sink +ing have	[so many dishes	be in it]
with the sink +ing have	[so many dishes	in it]

On the other hand the first with is deleted along with the noun phrase that contains it if this noun phrase is identical to the subject of the main clause.

(239) With a horse to get to Paris, Henry could conquer
the world
(With Henry with a horse to get to Paris, ...)

Note that in (240) the presence of the perfect have + en in the absolute construction is demanded by the "sequence of tenses" rule.

(240) With a horse to get to Paris, Henry could have
conquered the world

compare

(241) If Henry had had a horse to get to Paris, he could
have conquered the world

We may suppose that the perfect in the absolute sentence is deleted along with the tense, since the perfect is also present in the main clause and is a repeated occurrence.

The assumption that FRONTING has applied in the derivation of sentences like (239) and (240) seems otiose. For example the absolute sentence in (242) could as well be derived from the structure underlying Wax is on the car as from that underlying The car has wax on it.

(242) With wax on it, the car looks like a million dollars
If the pronoun it in the absolute sentence were reflexive, this would constitute evidence that FRONTING had applied, since a pronoun is made reflexive only if its antecedent occurs in the same minimal sentence. However as was noted in section 2, reflexivization applies before FRONTING. So the crucial evidence is missing.

It should be noted that the underlying structures of while clauses may undergo FRONTING and undergo the same reduction as absolute sentences.

(243) While trees have leaves on them, they are difficult
to see through
= (244) With leaves on them, trees are difficult to see
through

The following are examples of the class of absolute sentences with ing that remains to be accounted for.

(245) With John having painted one chair yesterday, he
has one fewer to paint today
= (246) Having painted one chair yesterday, John has one
fewer to paint today

The reduction transformation has applied to sentence (246). By the foregoing analysis the absolute construction in (245) must be from (247).

(247) John be +ing Have +en paint one chair yesterday
Of course *John is having painted one chair yesterday is unacceptable, and the anomaly cannot this time be dismissed by supposing that be +ing is deleted if the sentence is not made absolute. This is so, since have + en comes before be + ing in the auxiliary, not after. The tentative solution that I propose is a slight extension of the analysis proposed by T. R. Hoffman (1966). In

(248) the perfect is from what Hoffman calls the "past tense

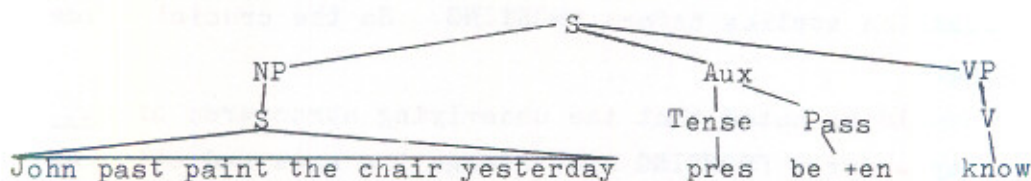
(248) John is known to have painted the chair yesterday replacement" transformation. The past tense must occur in the deep structure of (248), since yesterday can only occur with a past tense. Note that (249) is unacceptable.

(249) *John has painted the chair yesterday

(248) is a paraphrase of (250), and both sentences can be derived from the same structure, namely (251).

(250) It is known that John painted the chair yesterday

(251)



(251) has undergone the passive transformation. The embedded sentence in (251) can be made into a that clause or into an infinitive clause. In case it is made into a that clause it may be extraposed, giving sentence (250). If it is made into an infinitive clause its auxiliary and verb phrase, past paint the chair yesterday, winds up at the end of the superordinate sentence and its subject, John, becomes the derived subject of the main clause. This gives (252).

(252) John pres be + en know to past paint the chair
yesterday

The past tense marker cannot remain in this position, and is replaced by the perfect have + en. By familiar rules, this gives John is known to have painted the chair yesterday, which is the desired result.

Sentences (253) and (254) can be derived from one deep structure in a similar fashion. Here to does not appear, and the case must be deleted.⁴ In sentence (254) then, although

⁴On the deletion of so in similar circumstances, see Lakoff (1966b). Whether the abstract item to be deleted is best represented by so, the case, or true seems problematical.

(253) It must be the case that John painted the chair yesterday

(254) John must have painted the chair yesterday
must appears to be part of the auxiliary that goes with the verb phrase paint the chair yesterday, it is really from the auxiliary of a superordinate sentence. Similarly the progressive be +ing in (255), which underlies (256), is from a superordinate sentence.

(255) John be +ing have +en paint one chair yesterday

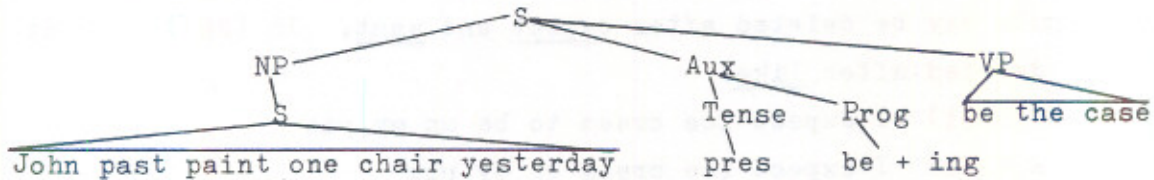
(256) With John having painted one chair yesterday, ...

As Hoffman notes, the have + en in such absolute sentences must be from the past tense replacement transformation. Note that (257) is a paraphrase of (256).

(257) (With) It being the case that John painted one chair yesterday, ...

Both (256) and (257) arise from the same structure, namely (258).

(258)

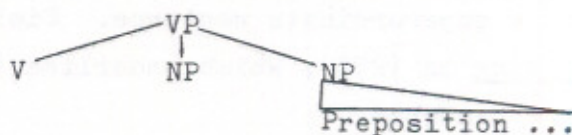


To derive (257) pres and the be of the progressive are deleted and the embedded sentence is made into a that clause and extraposed. To derive (256) the auxiliary and verb phrase of the embedded sentence are put after the verb phrase of the main clause, be the case is deleted, and past is changed to have + en.

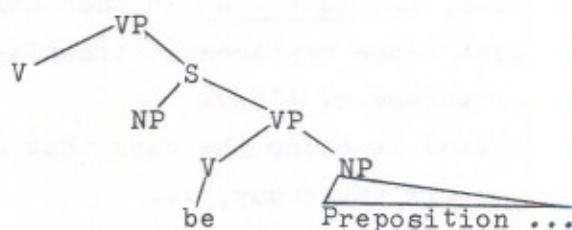
5. Copula sentences as verb complements.

My thesis in this section will be that certain verb phrases which have in the past been analyzed as having the structure (259) actually have the structure (260), or something essentially similar.

(259)



(260)



Note first that copula sentences certainly occur as complements to the verbs expect, want, like. Along with to the copula may be deleted after expect and want. In (265) it must be deleted after like.

(261) I expect ice cream to be on my pie

= (262) I expect ice cream on my pie

(263) He wants water to be in the pool when he gets back

= (264) He wants water in the pool when he gets back

(265) I like your lamp on John's table like that

Evidence that these complements are in fact sentences is provided by their ability to undergo FRONTING.

(266) I expect my pie to have ice cream on it

= (267) I expect my pie to be with ice cream on it

= (268) I expect my pie with ice cream on it

(269) He wants the pool to have water in it when he gets
back

= (270) He wants the pool to be with water in it when he
gets back

= (271) He wants the pool with water in it when he gets
back

(272) I like John's table with your lamp on it like that
Also, Lakoff's FLIP transformation can apply to (265) and (272)
to give (273) and (274) (see Lakoff (1965: A-15)).

(273) Your lamp on John's table like that pleases me
= (274) John's table with your lamp on it like that pleases
me

Probably no one would doubt that the complements in the above
examples constituted sentences. The important thing to note is
that the with that turns up in (268) and (271) is a trace of the
underlying sentences; its source is the rule that adds with at
the beginning of a sentence.

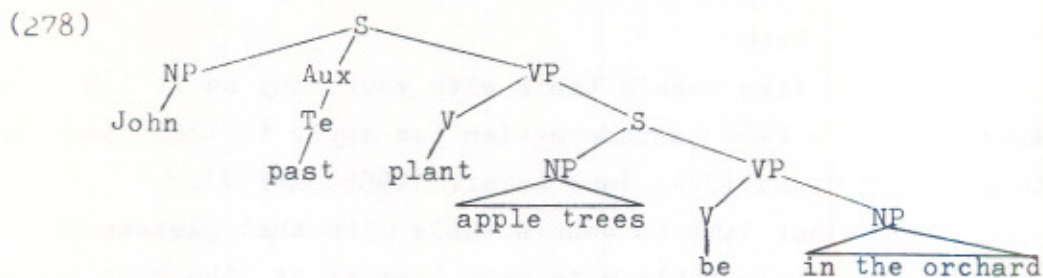
Now consider complements of verbs like plant.

(275) John planted apple trees in the orchard
The locative in the orchard is shown to be in the verb phrase by
the do so test developed by Lakoff and Ross (1966). The pro-
form do so replaces verb phrases.

(276) *Harry planted apple trees in the yard, and John
did so in the orchard

That apples and in the orchard in (275) constitute a syntactic
unit as well as both occurring in the verb phrase could probably
be demonstrated by a co-occurrence argument, although I shall
not attempt this. That is, there are mutual restrictions on
noun phrases in these positions that are independent of restric-
tions imposed by plant. (276) is odd just because apple trees
would be too big for a window box, not because one doesn't plant
things in window boxes.

(277) John planted apple trees in the window box
I shall claim that apple trees in the orchard is from a copula
sentence and that the deep structure of (275) is the following.



Since apple trees is the subject of a sentence, it will be changed to with apple trees by the with addition rule. The fact that with does not show up must be because plant is like have in deleting a following preposition.

But there is a switching rule that may apply to such complements which in the present case has the effect of reversing the order of apple trees and in the orchard. Now in the orchard is next to the verb, and it turns out that its preposition is deleted. So the rule that deletes the preposition must follow the switching rule. The with added to apple trees therefore remains, since after the switching rule with apple trees no longer directly follows the verb.

(279) John planted the orchard with apple trees
 Verbs that take copula sentences as complements and allow the order of elements in these complements to be reversed are quite common. I give some examples below.

- (280) John stocked fish in the stream
- (281) John stocked the stream with fish
- (282) John hung curtains in the kitchen
- (283) John hung the kitchen with curtains
- (284) John heaped ridicule on Bill
- (285) John heaped Bill with ridicule
- (286) John spread the butter on the bread
- (287) John spread the bread with butter
- (288) John inspires confidence in me
- (289) John inspires me with confidence
- (290) They conferred honors on John
- (291) They conferred John with honors

However I do not claim that the members of each of these pairs of sentences are exact paraphrases. John planted the orchard with apple trees means that the orchard wound up with no other kinds of trees, while John planted apple trees in the orchard does not imply this. A similar observation applies to (292).

(292) John spread the box with papers

In addition this can be understood either as John spread papers on the box or as John spread papers in the box.

I suggest that the proper analysis is one along the lines of that proposed in section 3. Prepositions are not freely deleted after the verb; only to and with (and possibly other "function prepositions") can be deleted. Then the sentences with with have underlying structures where the preposition after be is to.

Some peculiar semi-paraphrases obtained with verbs like hang can be given an explanation similar to the above if it is assumed that these verbs may lack underlying subjects, and that their underlying objects become superficial subjects.

(293) Cobwebs hung in the kitchen

(294) The kitchen hung with cobwebs

(295) Fish teem in the sea

(296) The sea teems with fish

(297) Bees swarm in the garden

(298) The garden swarms with bees⁵

⁵The existence of such pairs of sentences was pointed out to me by James Heringer.

A further rule is necessary to delete with in the complements of verbs that allow unreversed copula sentences with to noun phrases. After the verbs in the sentences that follow, this rule is optional.

(299) John assigned a task to Bill

= (300) John assigned Bill with a task

= (301) John assigned Bill a task

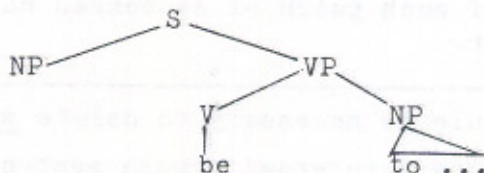
- (302) John supplies them with money
- = (303) John supplied money to them
- = (304) John supplied them money
- (305) John furnishes books to libraries
- = (306) John furnishes libraries with books
- = (307) John furnishes libraries books
- (308) John presented a ring to Bill
- = (309) John presented Bill with a ring
- = (310) John presented Bill a ring
- (311) John provided cash to Bill
- = (312) John provided Bill with cash
- = (313) John provided Bill cash
- (314) John left a fortune to his nephew
- = (315) John left his nephew with a fortune
- = (316) John left his nephew a fortune
- (317) John left Bill with nothing to do
- = (318) John left Bill nothing to do

But after another class of verbs, the rule is obligatory.

- (319) John gave a typewriter to Bill
- = (320) John gave Bill ~~with~~ a typewriter
- (321) John sent a letter to Bill
- = (322) John sent Bill ~~with~~ a letter
- (323) John handed a gun to Bill
- = (324) John handed Bill ~~with~~ a gun

The two classes of verbs exemplified in (299) to (324) are of course two kinds of indirect object verbs. They take complements of the form (325).

(325)



It was proposed in section 3 that sentences of this form underlie possessive have sentences, so what I am now claiming is that these classes of indirect object verbs take complements which, were they independent, would come out to be possessive have sentences. This position is supported by the fact that an

indirect object sentence of the above type implies the acceptability of some possessive have sentence with the original indirect object as subject and the original direct object as object. The unacceptability of (326) implies the unacceptability of (327).

(326) *Bill has truth

(327) *John gave Bill truth

The acceptability of (328) implies the acceptability of a sentence like (329) given an appropriate choice of subject for the indirect object verb.

(328) The house had a funny appearance

(329) The purple light gave the house a funny appearance

It may be that the rule which reverses the positions of the noun phrases in a copula sentence complement is FRONTING. Evidence against this is the fact that the noun phrase with to sometimes appears after FRONTING has applied to an independent sentence. When however the indirect object is moved next to the verb, it is never echoed by to plus pronoun.

(330) The house had a funny appearance to it

(331) *The purple light gave the house a funny appearance to it.

6. The do the same thing with test.

In this section I present some preliminary results of a syntactic "test" modeled on the do so test for verb phrase constituency (see Lakoff and Ross (1966)). These results support what was said in section 5 about certain verb complements.

Some verb phrases can be replaced by do the same thing with plus the direct object of the verb, if they are duplicated (aside from their objects) earlier in the sentence.

(332) Bill planted the pear trees in the orchard, and
John did the same thing with the apple trees

(333) Bill spread the jam on the drapes, and John did the
same thing with the butter

(334) Bill put the chair on the porch, and John did the
same thing with the lamp

In the last section it was seen that with is sometimes a trace of an underlying sentence. The with that occurs after do the same thing in the above sentences likewise shows that the verb phrases replaced by do the same thing with plus object contain sentence complements. The source of this with is, again, the with addition rule.

The verb phrases that I previously analyzed as containing sentence complements can all be replaced by do the same thing with plus object if the verb of the verb phrase is non-stative. On the other hand verb phrases without sentence complements cannot be so replaced.

(335) *Bill built the table, and John did the same thing
with the chair

(336) *Bill killed a man, and John did the same thing
with a woman

(337) *Bill drank some beer, and John did the same thing
with some wine

(338) *Bill broke the stick, and John did the same thing
with the branch

but (339) Bill broke the stick in(to) pieces, and John did
the same thing with the branch

There are some exceptions to the observation that do the same thing with plus object replaces verb and sentence complement. I list three classes of exceptional verbs with suggestions about how to make them fall into line.

Apparent exceptions:

a) throw away, spend, lose

(340) Bill threw his old shoes away, and John did the same thing with his

(341) Bill spent his money, and John did the same thing with his

(342) Bill loses his gloves, and John does the same thing with his

In (340) his old shoes away is from a sentence with be (or perhaps go) deleted. The complements of spend in (341) and lose in (342) are his money away and his gloves away. Spend and lose delete away.

b) paint, butter, fertilize, dye, store

(343) Bill painted his house, and John did the same thing with his

(344) Bill buttered his bread, and John did the same thing with his

(345) Bill fertilized his lawn, and John did the same thing with his

(346) Bill dyed his hair, and John did the same thing with his

(347) Bill stored his winter clothes, and John did the same thing with his

Sentences (343) to (346) contain the verb phrases put paint on his house, put butter on his bread, put fertilizer on his lawn, put dye on his hair. paint on his house, etc. are from sentences with be deleted. When put takes such a sentence complement, the subject of the complement may replace put, in which case the former noun is realized as a verb. Sentence (347) has the verb phrase put his clothes in storage. In this case it is the locative complement of be that replaces put.

c) heat, boil, bake

(348) Bill heated his sandwich, and John did the same
thing with his

(349) Bill boiled his socks, and John did the same thing
with his

(350) Bill baked the potatoes, and John did the same
thing with the ham

The verb phrases are really cause his sandwich to heat, cause his socks to boil, cause the ham to bake. Heat, boil, bake may replace cause. This analysis of causative verbs is in essential respects similar to the analysis given in Lakoff (1965).

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Relative Clauses and Conjunctions*

Sandra Annear

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1. Introduction

In this paper, I will argue for, and show the consequences of, deriving relative clause sentences from conjunctions. Because my analysis will be of English, it will be necessary first to consider anaphora and the definite determiner in English, which play a central role in relative clause formation.

2. Anaphora and the Definite Determiner

It has been recognized for some time that account must be taken, for syntactic reasons, of co-referentiality of two NP's. A well-known example is the obligatory reflexivization of the second NP in:

(1) Herman saw himself

as opposed to the non-reflexivization in:

(2) Herman saw Herman

depending on whether the two nouns "have the same reference." Other examples include the choice of the pronouns it and one, as in:

(3) Anne saw a reindeer and Karen saw it too

(4) Anne saw a reindeer and Karen saw one too

In (3), the use of it implies co-referentiality, while in (4), one is neutral in this respect.

Nouns, then, must be marked, or indexed, for co-referentiality. It is not clear just what relationship this co-referentiality of nouns has with real-world referents, since it is obvious, for example, that the question of the existence of centaurs does not affect the fact that the observations made about sentences (3) and (4) are applicable to (5) and (6) as well:

(5) Anne saw a centaur and Karen saw it too

(6) Anne saw a centaur and Karen saw one too

I prefer to leave the question as an open one, and rather vaguely consider two identically indexed nouns to be "the same" for grammatical purposes.

A change in the form of the second of two co-referential

NP's is what is referred to as anaphora.¹ Pronominalization to

¹Reflexivization may be thought of as an additional step in this process.

it (or he, she, or they) is an example; since these pronouns do not occur except anaphorically, we may view sentences containing them as semi-sentences. An anaphoric pronoun may be derived if there is a previous sentence in which a prior occurrence of the NP can be found,² even though the previous sentence may be

²With respect to pronouns, this is not a new observation. See, for example, C. J. Fillmore, "On the Syntax of Preverbs," unpublished ditto, 1966.

deleted by the speaker if, for example, it contains information which the hearer has access to from some other source.

I would like to suggest that all NP's containing the definite determiner must be explained in exactly the same way. That is, I suggest that the definite determiner is the anaphoric determiner, and that "first occurrences" of NP's contain only indefinite determiners.³ Thus, under the same conditions of co-referen-

³This relationship has also been noticed by a number of linguists. See especially LeRoy Baker, "Definiteness and Indefiniteness in English," University of Illinois master's thesis, 1966, and references cited therein.

tiality,

(7) Anne saw a reindeer_a and Karen saw a reindeer_a

(where subscript "a" represents identical indexing) can become either:

(8) Anne saw a reindeer and Karen saw it too

or:

(9) Anne saw a reindeer and Karen saw the reindeer too

In an earlier treatment of this topic,⁴ I concluded that a

⁴Sandra S. Annear, "English and Mandarin Chinese: Definite and

definite determiner could be used by a speaker if he believed that his hearer had some prior knowledge about the referent. The hearer could have obtained this knowledge by convention, as in:

(10) The moon is full tonight ,

by means of a restrictive relative clause:

(11) The man who spoke to me is my uncle ,

by means of the physical environment, which could account for a sentence like:

(12) The street needs repairing ,

or by some previously expressed sentence, as could be postulated for:

(13) The man came to see you .

I now propose, since this simple observation cannot in any sense be construed as a linguistic explanation of the definite determiner, that it be modified in such a way that the "previous knowledge" which is a necessary prerequisite for the use of the definite determiner be represented as part of the underlying structure of definite determiner sentences, namely as the first conjunct of a conjunction. This first conjunct may remain unexpressed; if so, the result is a semi-sentence. This is precisely the difference between:

(9) Anne saw a reindeer and Karen saw the reindeer too and any of the sentences (10) through (13); (10) through (13) are semi-sentences, sentence (9) is not. That is, the notion of "previous knowledge", which I postulated in my earlier treatment to account for the appearance of the in sentences like (10) through (13), might be shown, upon further investigation, to be representable by some previous sentence in the underlying structure.

It seems clear that this is the best way to analyze a semi-sentence like (13); it is similar to the other instances of

anaphora which I have discussed. It is not so clear that the previous knowledge presupposed by the in (10) through (12) can or should be represented in this way. At this time, I can only present some of my reasons for suggesting that they should be.

In particular, a sentence like:

(10) The moon is full tonight

may not seem to need an explanation in terms of any preceding sentence, since that preceding sentence hardly ever appears and the referent, by convention, is immediately understood by any speaker of the language. However, there does not seem to be any way of drawing a boundary between such "conventional" uses of the and other occurrences. The only difference between (10) and (12), for example:

(12) The street needs repairing

is that in (10) the context is simply wider and the number of speakers who share the "convention" happens to be much larger. "Intermediate" between these two would be a sentence like:

(14) The dog wants to go out

in which the context might be a household and the number of speakers sharing the convention might be the people living in it. Of course, this is not proof that either (10) or (12) must be explained in the way I have suggested, but it is an indication that an explanation for one of them may also turn out to be an explanation for the other.

Another type of alleged exception to the "previous sentence" hypothesis is exemplified by a sentence like (11):

(11) The man who spoke to me is my uncle

since the relative clause, it has been claimed, provides the "previous mention."⁵ Again, it seems to me that the reason we

⁵See Beverly Robbins, "Relative Clause Adjuncts of a Noun," University of Pennsylvania, TDAP #47, 1963.

believe this to be true is simply that the chances are greater

that the hearer has some previous knowledge about the referent in the relative clause sentence than in a non-relative-clause sentence, since there are, in the universe of things which the NP could be referring to, likely to be more men than men-who-spoke-to-me. However, it is quite clear that it would not be appropriate for me to say (11) if my hearer did not already know, prior to (11)'s being uttered, that a man spoke to me. In other words, the relative clause does not explain an accompanying definite determiner; a linguistic correlate to some kind of "previous knowledge" must be posited for relative clause sentences exactly as for simple sentences.

In addition, if the relative clause were considered to constitute the previous sentence necessary for the appearance of the definite determiner, the occurrence of the indefinite determiner with a relative clause, unreplaced by the definite, would be mysterious, as in:

(15) A man who spoke to me was wearing an orange tie

My proposal is, then, that the definite determiner is anaphoric in just the same way as are the true pronouns and like them must be described as occurring in the second part of a conjunction. "After" these anaphoric replacements, the first clause may be deleted, leaving an anaphoric semi-sentence, depending on the speaker's assessment of the extent of the hearer's knowledge.

It should be emphasized here that given any simple surface sentence containing an anaphoric pronoun or an anaphoric determiner, it may not be possible for the hearer to reconstruct the initial sentence by virtue of which the anaphoric change took place. This point will be taken up again after an analysis of relative clause sentences has been presented.

3. Relative Clauses and Conjunctions

Putting aside for the time being the proposed treatment of the definite determiner, I now wish to present evidence to demonstrate that the deep structure of a relative clause sentence is in fact a conjunction.

1. Paraphrasability

The fact that every relative clause sentence has a conjunction paraphrase constitutes sufficient grounds for postulating identical deep structures for these two sentence types. So:

(16) I met a lady downtown today and she spoke to me
in Mundari

is identical to:

(17) A lady that I met downtown today spoke to me
in Mundari⁶

⁶The order in which the conjuncts in this and the following examples appear is not relevant to the present discussion, though it will be seen that this order plays a crucial role in my argument.

2. Co-occurrence restrictions

A whole set of problems faced in generating acceptable relative clause sentences is exactly matched in generating acceptable conjunctions. The rules needed to prevent, or mark as deviant, a sentence like:

(18) The singer who is old is young

will also be needed for a sentence like:

(19) The singer is old and he is young

Similarly, whatever makes (20) acceptable also works for (21):

(20) The singer who is old off-stage is young under
lights

(21) The singer is old off-stage and young under lights

While this is not evidence for underlying relatedness, since it is conceivable that one set of rules could be developed which would prevent such similar deviancies in both of these sentence types, a far simpler and apparently more natural solution would be to state such restrictions at the deep structure level before the two different sentence types have been generated.

3. Indexing

The indexing of NP's for co-referentiality without which relative clauses cannot be formed is also necessary in conjunctions in order for the anaphora rules to introduce pronouns and definite determiners.

There is also other evidence for this relationship, which will be presented in the form of consequences of the analysis I have chosen.

So far I have only given reasons for suspecting that relative clause sentences and conjunctions have the same deep structure. That conjunctions are basic, with relative clause sentences derived from them, is indicated by the fact that while all relative clause sentences have conjunction paraphrases, the reverse is of course not true, since conjunctions need not have identical NP's; a different source for those which do not have identical NP's would have to be found were relative clause sentences considered to be basic. This would be equivalent to claiming that the following two sentences are underlyingly quite different:

(22) A boy gave me a hamster and a girl gave me a rabbit

(23) A boy gave me a hamster and he gave me a rabbit too

since only the latter can be related to a relative clause sentence. Clearly these are not desirable consequences.

Before proceeding with an analysis of relative clause sentences derived from conjunctions and adducing some of the more desirable consequences, the distinction between restrictive and appositive relative clauses must be made explicit.

Restrictive

(24) I used a knife which Seymour gave me

(25) I used the knife which Seymour gave me

Appositive

(26) I just saw a janitor, who gave me this key

(27) I just saw the janitor, who gave me this key

There are many differences between these two types of relative clause sentences. Relevant to the preceding discussion of definite determiners, however, is the recognition that the two definite determiner sentences, (25) and (27), are quite different with respect to the "previous knowledge" involved. In order for (25) to be used appropriately, the speaker must believe that the hearer knows that Seymour gave me a knife, while for (27), as for any simple sentence containing the, the speaker assumes only that the hearer knows what janitor is being referred to. This fact will be made structurally explicit below.

Now, I have claimed that relative clause sentences should be thought of as being derived from conjunctions. Let us consider the conjunction paraphrases of these two relative clause sentence types, restrictive and appositive.

(24) I used a knife which Seymour gave me

(25) I used the knife which Seymour gave me

As a first approximation, to be modified shortly in light of the proposals concerning the definite determiner, both of these restrictive relative clause sentences seem to be paraphrasable by:

(28) Seymour gave me a knife and I used it

where the second sentence of the conjunction has become the superordinate sentence and the first sentence of the conjunction the embedded sentence. That this must be the case may be further illustrated by sentences such as:

(29) A nut that I met at the LSA meeting in December
wrote me a letter last week

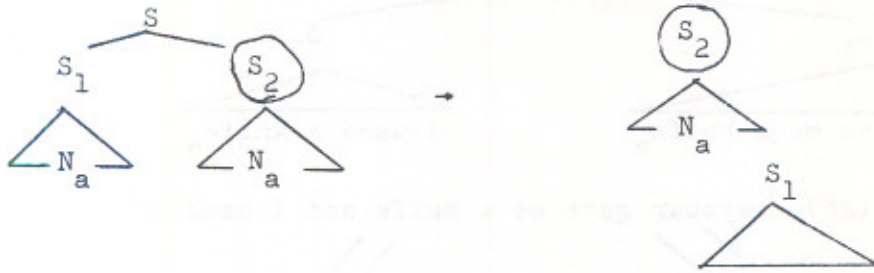
whose paraphrase is not:

(30) A nut wrote me a letter last week and I met
him at the LSA meeting in December

but rather:

(31) I met a nut at the LSA meeting in December and
he wrote me a letter last week

Restrictive relative clauses, then, are related to conjunctions in the following way:

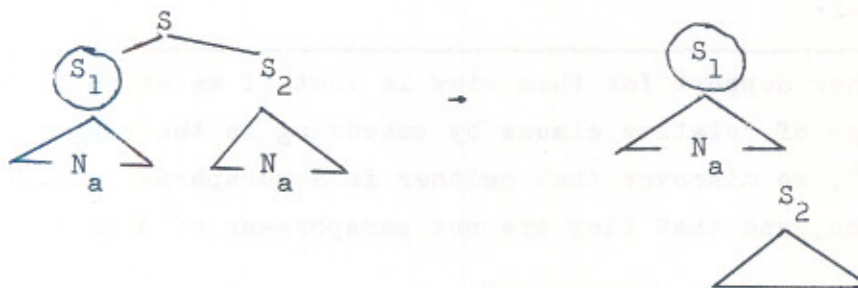


The paraphrase of an appositive relative clause, however, like:

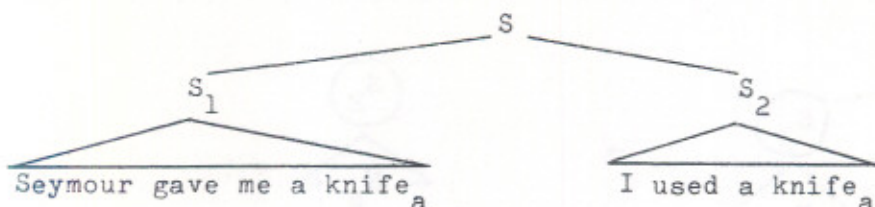
(26) I just saw a janitor, who gave me this key is very clearly:

(32) I just saw a janitor and he gave me this key but not:

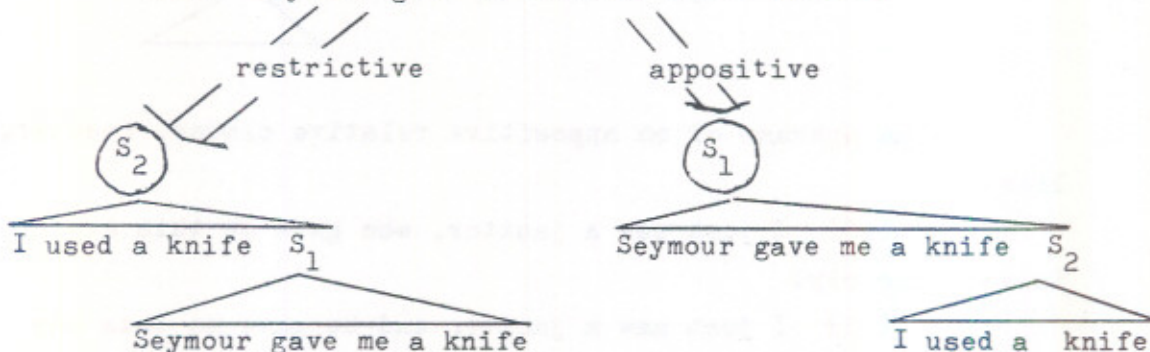
(33) A janitor gave me this key and I just saw him
 In fact, in informal conversation (32) would be more natural than (26). I claim, then, that the derivation of appositive relative clause sentences can be schematically represented like this:



Aside from the arguments presented above, there is additional evidence for the view that embedding of S_1 into S_2 creates restrictive relative clauses, while embedding of S_2 into S_1 creates appositive relative clauses: a given conjunction with identically indexed nouns in each conjunct should be convertible into either a restrictive or an appositive relative clause sentence depending on which embedding rule is applied, and these two relative clause sentences should be paraphrases; in fact this is the case.



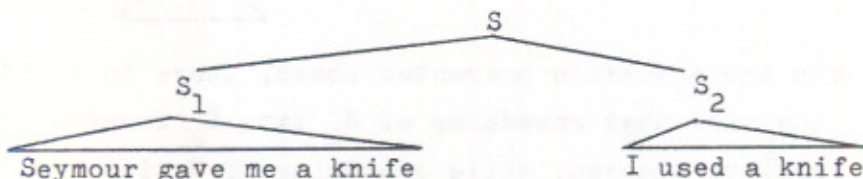
(28) Seymour gave me a knife and I used it



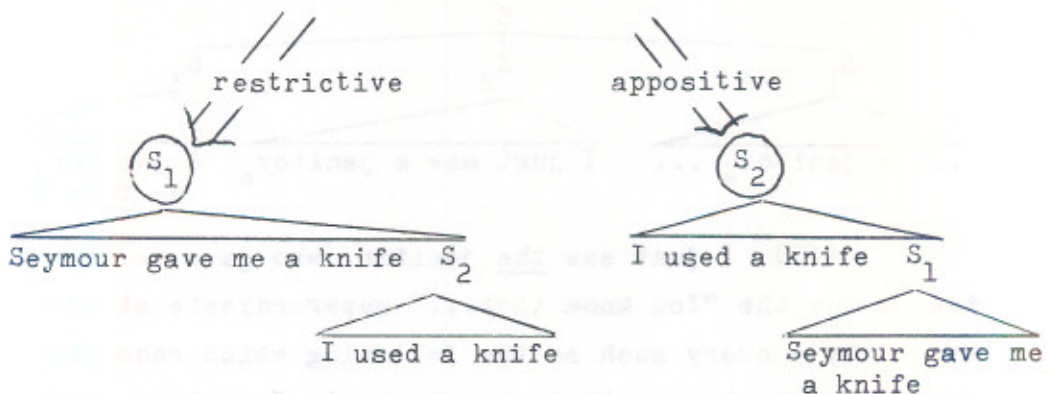
I used a knife which Seymour gave me = Seymour gave me a knife, which I used?

⁷I am purposefully avoiding indicating the structural differences between these two types of embedding. Such a difference must exist, although I do not know precisely what it is, because appositive and restrictive relative clause sentences are "intoned" differently.

Further support for this view is that if we attempt to derive either type of relative clause by embedding in the "opposite direction", we discover that neither is a paraphrase of the original conjunction, and that they are not paraphrases of each other:



(28) Seymour gave me a knife and I used it



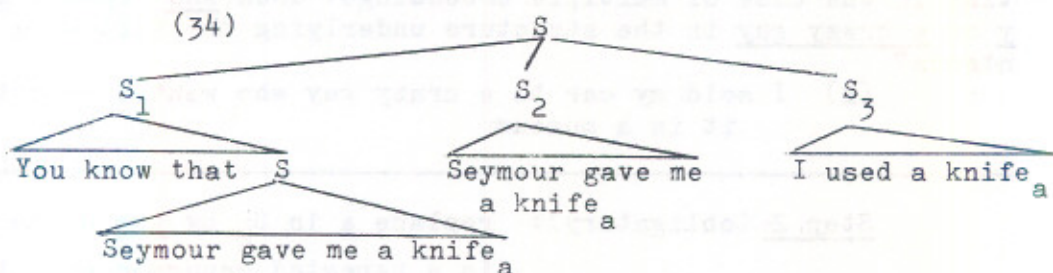
Seymour gave me a knife which I used \neq I used a knife, which Seymour gave me

I have shown the difference between restrictive and appositive relative clauses. What remains to be accounted for is the appearance of the in sentences like (25) and (27).

(25) I used the knife that Seymour gave me

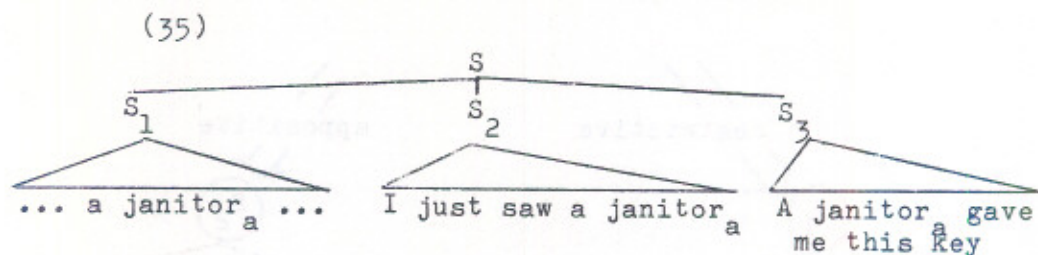
(27) I just saw the janitor, who gave me this key

Recalling that the previous knowledge necessary for the replacement of an indefinite determiner by a definite one may be represented by a preceding sentence in the deep structure, the obvious next step is to consider sentences (25) and (27) to be derived, not from two-conjunct conjunctions like their indefinite determiner counterparts, but from conjunctions with three conjuncts. In the structure underlying (25), I claim that the first two conjuncts are identical, except that the first is actually complex and contains the superordinate sentence "You know that...":



(25) I used the knife which Seymour gave me

In the structure underlying (27), on the other hand, the first conjunct, as in the underlying structure of any simple sentence containing the, is indeterminate:



(27) I just saw the janitor, who gave me this key
 Evidence for the "You know that..." superordinate structure is provided by a query such as the following which requests confirmation from the hearer that the speaker's "previous knowledge" assumptions are justified:

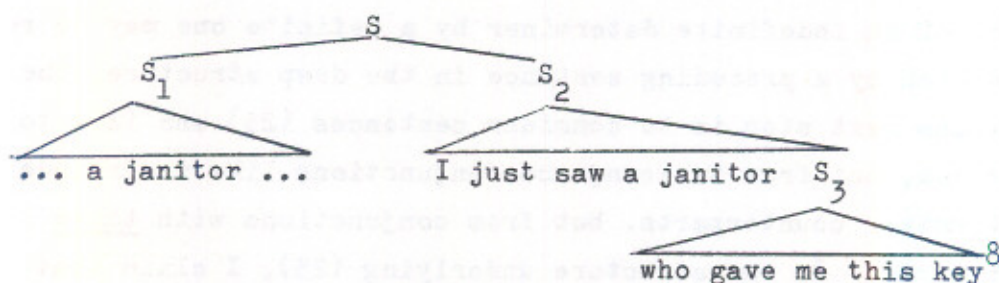
(36) You know the knife Seymour gave me?

which does not appear with simple sentence occurrences of the:

(37)? You know the knife?

Let us consider how the structure (35) becomes the appositive relative clause sentence (27):

Step 1 (optional): embed S_3 into S_2

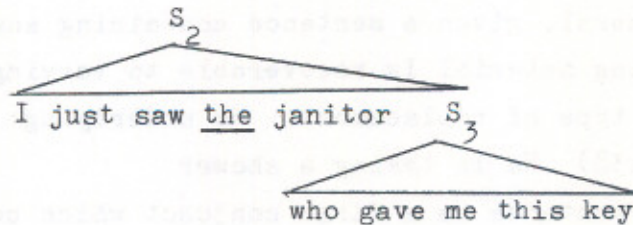


⁸I am also ignoring the problem of at what stage the relative pronoun replaces the identical noun; the question becomes interesting in the case of multiple embeddings: does who replace a guy or a crazy guy in the structure underlying the following sentence?

(i) I sold my car to a crazy guy who wanted to put it in a museum

Step 2 (obligatory): replace a in S_2 by the since it is a repeated occurrence of the NP in S_1

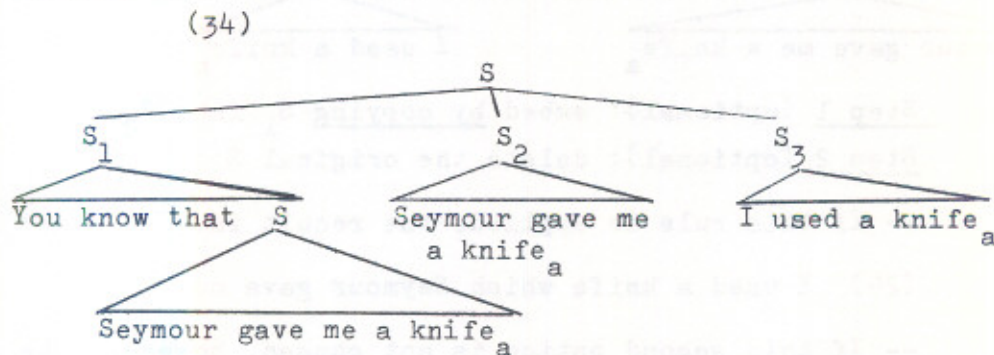
Step 3 (optional): delete S_1



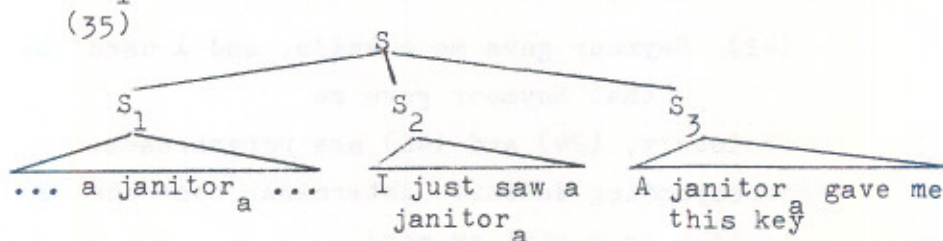
It may now be seen that I have given the structural correlate to the difference, mentioned on page 88, between restrictive and appositive relative clauses with the in terms of what the hearer knows. What I said was that (25) was inappropriate unless the hearer knew that Seymour gave me a knife:

(25) I used the knife which Seymour gave me
while (27) is inappropriate only if the hearer does not know what janitor is being discussed:

(27) I just saw the janitor, who gave me this key
The deep structures which I have given for these two sentences reflect this fact. Underlying (25) is:



where no other sentence but S_1 could represent what the hearer knows. The S_1 underlying (27), however, is not recoverable:



Any sentence containing a janitor_a would be acceptable as the first conjunct, which corresponds to my earlier suggestion that there is an indeterminate number of sentences which could represent what the hearer knows to justify the use of the.

In general, given a sentence containing anaphoric elements, the preceding material is recoverable to varying degrees depending on the type of replacement. So underlying:

(38) He is taking a shower

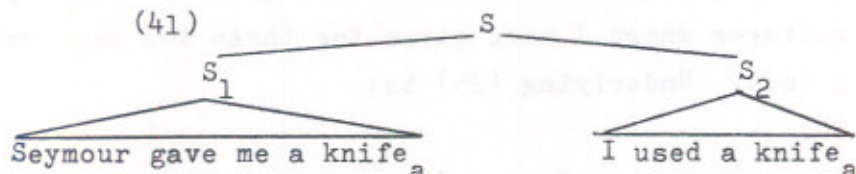
may be any sentence as a first conjunct which contains a masculine noun. Underlying:

(39) Bill doesn't like his mother either

must be a first conjunct of the shape:

(40) Bill doesn't like X

Now we will abandon for the time being the appositive relative clauses and examine in more detail the derivation of restrictive relative clauses, taking first the derivation of the indefinite determiner sentence from its two-conjunct underlying structure:



Step 1 (optional): embed by copying S_1 into S_2

Step 2 (optional): delete the original S_1

-- If this rule is applied, the result is:

(24) I used a knife which Seymour gave me

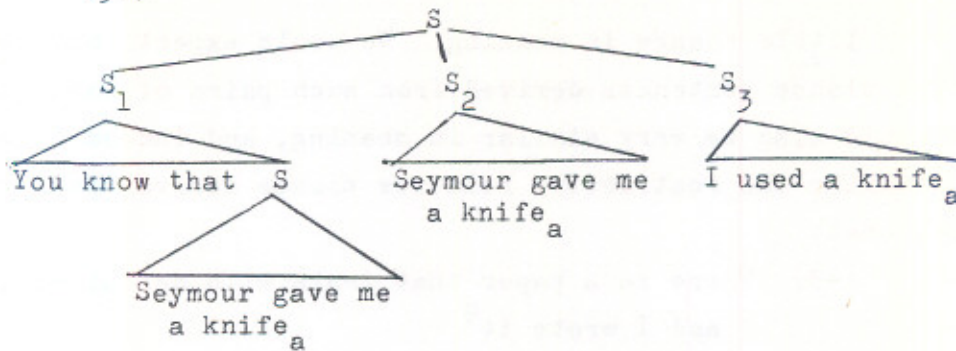
-- If this second option is not chosen, however, the a in S_2 must be changed to the since it is a repeated occurrence, and the result is:

(42) Seymour gave me a knife, and I used the knife
that Seymour gave me

Obviously, (24) and (42) are paraphrases.

The corresponding definite determiner sentence (25) is derived from (34) in a similar way:

(34)



(25) I used the knife which Seymour gave me

Step 1 (optional): embed S_2 into S_3 by copying

Step 2 (obligatory): delete the original S_2 since it is a repetition of S_1

Step 3 (obligatory): change a in S_3 to the because this NP is a repeated occurrence of the one in S_1

Step 4 (obligatory): delete S_1

The slight meaning difference which may be perceived, then, between:

(24) I used a knife which Seymour gave me

and

(25) I used the knife which Seymour gave me

is represented by their respective structures, (41) and (34), which are identical except for the S_1 , the "previous knowledge", in (34). This S_1 corresponds to my claim that the the in a relative clause sentence must be related to a previous sentence just as much as any other occurrence of the must be, and cannot be thought of as being directly related to, or derived from, its relative clause.

4. Some Consequences

Additional support for this view of deriving relative clause sentences may now be presented in terms of the mechanism which I have outlined.

1. Commutative conjunctions

The conjuncts of some conjunctions may be reversed in order

with very little change in meaning. We would expect that the relative clause sentences derived from such pairs of conjunctions would also be very similar in meaning, and indeed this is true. Taking the restrictive relative clause derivations, we can see that:

- (43) There is a paper that deals with definiteness
and I wrote it⁹

⁹An indefinite NP as the subject of a stative verb, at least in my dialect, must undergo the There is transformation, which may create such a pseudo-relative clause as the one in (43).

is similar to:

- (44) I wrote a paper and it deals with definiteness

We are not surprised, therefore, that:

- (45) (from (43)) I wrote a paper that deals with
definiteness

is similar to:

- (46) (from (44)) A paper that I wrote deals with
definiteness

Some conjunctions, however, upon reversal of the conjuncts, involve a significant meaning change; examples include instances of conjuncts which express a certain sequence of events:

- (47) I planted the seed and it grew

- (48) The seed grew and I planted it

Note that not only are (47) and (48) semantically different, but that (48) seems to be interpretable only if the I is stressed.

The derived relative clause sentences are:

- (49) (from (47)) The seed that I planted grew

- (50) (from (48)) I planted the seed that grew

(50), just like (48), seems difficult to interpret unless the emphasis is on the fact that I did the planting.

2. Questions and imperatives

It might appear that my statement that relative clause sentences all have conjunction paraphrases was a bit hasty, since it is well-known that questions and imperatives do not conjoin,

yet both are found in relative clause sentences:

(51) Did you see the coke that I put in the refrigerator?

(52) Get the coke that I put in the refrigerator

Consideration, however, of the following relative clause sentences which do not occur:

(53) *I put a coke in the refrigerator which did you see?

(54) *I put a coke in the refrigerator that (you?) get

leads to the conclusion that we do in fact have conjunctions with questions and imperatives, but only as second conjuncts, with the and deleted. The sources for (51) and (52) above would be conjunctions of this perfectly normal type:

(55) I put a coke in the refrigerator ~~and~~ did you see it?

(56) I put a coke in the refrigerator ~~and~~ get it

Notice that without the "left-to-right" embedding which I have proposed, it would be difficult to know what the underlying structures for (51) and (52) would be, since the following conjunctions, if they exist at all, are not paraphrases of (51) and (52) respectively:

(57) ?Did you see a coke ~~and~~ I put it in the refrigerator?

(58) ?Get a coke ~~and~~ I put it in the refrigerator

3. The in the sense of the only

I shall now attempt to account for the fact that some occurrences of the plus a relative clause seem to be interpretable as meaning the only. For example, the phrase:

(59) the symphony that O'Brien wrote

implies that he only wrote one symphony, while

(60) a symphony that O'Brien wrote

is neutral with respect to the total number of symphonies he wrote.

Before addressing ourselves directly to this problem, it should be pointed out that (59) need not be interpreted as the only symphony O'Brien wrote. For example, under normal stress, (59) might occur in a discussion in which O'Brien's 4th Symphony had recently been mentioned; (59) would then be directing the hearer's attention back to this previously mentioned symphony. With the following stress pattern:

(59) a) the symphony that O'Brien wrote ,
(59) might occur in a discussion of one symphony of each of several composers, where no reference is made to other symphonies which they may have written. Stressed like this:

(59) b) the symphony that O'Brien wrote
this phrase might be found in a discussion of several of O'Brien's compositions: a symphony, a concerto, an opera, and a sonata.

These various interpretations suggest either that (59) is ambiguous and may come from more than one underlying structure, one of these structures containing the sentence

(61) O'Brien wrote one symphony ,
or that (59) is unambiguous and that the various interpretations must be explained in some other way. For two reasons I tend to reject the former hypothesis. First, the differences among the various interpretations of a relative clause phrase such as (59) seem to be matters of context, not directly expressible by regular underlying syntactic differences. Second, (59), which normally seems to take a "the only" interpretation, does not appear to differ in kind, but only in degree, from all other relative clauses, and this difference, too, seems to be a matter of context.

To examine the second point more carefully, it will be necessary to show one further "condition" on the appropriate use of the with relative clauses. Not only must the hearer know what is asserted by the sentence underlying the relative clause, but this sentence must be unambiguous in its reference. This may be demonstrated by considering any relative clause phrase, such as:

(62) the knife that Seymour gave me

Underlying this relative clause, I have claimed, is the sentence:

(63) Seymour gave me a knife

Notice that if, in fact, Seymour gave me three knives, however, it becomes obvious that the the in (62) is inappropriate, not because the hearer does not know that (63) is the case, but because (63) is not unambiguous in its reference. Note that

this cannot be taken to mean that one of the conditions for the use of the is that the hearer be able to identify the referent. This condition fails in two directions, by being neither necessary nor sufficient. The the in (62), for example, may be quite justified if the hearer had never seen the knife that Seymour gave me, or even if he had no idea what kind of a knife it was or what it looked like. On the other hand, in a situation in which:

(64) Here's a cookie for you

might be uttered, the hearer would be very likely to be able to identify the referent, since it might be right in front of him, yet that ability in itself would not justify the use of the. In other words, all the hearer needs to know is that the sentence which underlies a relative clause is unique in its reference.

Exactly the same can be said, I think, of (59).

(59) the symphony that O'Brien wrote

Independent of conversations like the ones suggested above which might affect the interpretation of a relative clause phrase, the sentence underlying (59),

(65) O'Brien wrote a symphony ,

must simply be unambiguous in its reference for the to have been used correctly. If there are no clues from the discussion to make (65) unambiguous, then the hearer, knowing the conditions for the use of the, concludes that there must be only one symphony which could be the referent for (65).

On Selection, Projection, Meaning, and Semantic Content*

D. Terence Langendoen

*Sponsored in part by the National Science Foundation through Grant GN-534 from the Office of Science Information Service to the Information Sciences Research Center, The Ohio State University.

1. Introduction

Bertrand Russell has suggested that the state of our knowledge about nature is like our knowledge about a language of which we know only the grammar and the syntax, but not the meanings of its words. Given a statement in that language, we would not know the possible meanings of such a statement, nor the meanings of the unknown words which would make it true (1919, p. 55). As he says, we know much more about the form of nature than about its matter. But his remarks need not be taken only as an analogy--they apply directly to our present understanding of language. Our knowledge about the syntactic form of language, though far from complete, and lacking at present a compelling explanatory theory to organize it (see Langendoen (1967 b)) for an effort to begin to remedy the latter situation), is formidable. Not so our knowledge concerning the semantic properties of language. The reason for this is that knowledge of the semantic properties of sentences and discourses is not systematically obtainable; for reasons which, unfortunately, are only rather sketchily supplied in the final two sections of this paper, systematic understanding of the meaning of lexical items can be obtained (and then only for some of them), but beyond that it is in general inappropriate to speak of meaning at all. In this paper, we thus return to the Saussurean conception of words as belonging to langue, but sentences and discourses as belonging to parole--not because we lack the theoretical apparatus to deal with sentences and discourses syntactically, but because we lack the necessary apparatus for dealing with them semantically in any systematic fashion.

In addition, we support the loyal opposition to generative grammar who have tried to maintain over the past ten years that the ability of humans to determine the interpretation of so-called deviant sentences under particular contextual conditions is a part of linguistic data. Linguistics must come to grips with the problem of explaining this ability and of showing how it works in particular cases; it must not be dismissed as lying outside

the domain of linguistic competence. I must admit, however, that at present I have no serious proposals to make concerning this matter.

The first two sections following this one prepare the ground somewhat for the material presented in the final two, but their primary function is to effect what I think are some terminological and conceptual clarifications and improvements in semantics. These clarifications are independent of the more controversial aspects of this paper.

2. Selection and projection the same

Recent work in generative grammar has made it possible for us to consider as one and the same phenomenon what had formerly been treated as two separate matters: grammatical selection and semantic projection. The bases for the identification of selection and projection are (1) the further identification of deep structures with semantic structures, and (2) the essentially predicate-argument form of semantic deep structures. Typically, selection has been described as the process by which a verb, adjective, or predicate noun can occur with a subject or object noun phrase without anomaly. This can now be stated more simply (and accurately) as the process by which a predicate occurs with an argument without anomaly. Projection, on the other hand, has been characterized as the process by which higher-level constituents receive semantic interpretation on the basis of the semantic interpretations of their parts. This process can now be stated as the means by which predicates impose semantic characteristics on their arguments. Thus in the sentences:

- (1) The child drank the water.
- (2) The child drank the stuff.
- (3) The child drank the spoon.

we say that the predicate drink selects the argument the water, but not (without anomaly) the spoon; and that it imposes on, or projects onto, the argument the stuff the information that it is liquid.

But there is no point in separating and separately naming the processes so described. In (1), we could as well say that drink projects onto the argument the water the information that it is liquid, but that this information is redundant, since the water inherently designates a liquid. Similarly in (3), drink may be said to project onto the spoon that it is liquid, which is incompatible with the inherent specification of that argument as not being liquid. Thus, sentences such as (3) which contain a semantic incompatibility may be called internally incompatible, a term to be preferred to the neutral term anomalous as it also conveys the idea of how it is that such sentences are in fact semantically anomalous. Such sentences, moreover, are not to be considered ungrammatical; this for a variety of reasons, one of them being that internally incompatible sentences may not be obviously so, their anomaly becoming apparent only upon semantic "computation," as in the sentence:

- (4) I am eleven years older than my father's brother's son's only cousin.

Another reason is that a sentence may stop being internally incompatible as soon as another sense of one of its lexical items becomes acquired. Thus a person for whom screwdriver refers only to an instrument for turning screws would find a sentence such as the following internally incompatible:

- (5) The child drank a screwdriver.

but not as soon as he acquires for screwdriver reference to a particular mixed drink. In general, an internal incompatibility may be said to be resolved if there is some interpretation of the arguments in the sentence which, no matter how seemingly preposterous, eliminate the incompatibility. These usually involve, but not necessarily a special context or a "possible world;" in fact knowing the context means that no resolution of incompatibility has to take place. The incompatibility is really a fiction of the detached linguist-observer.

It should be clear from considerations such as the foregoing that the semantic content of predicates--verbs, adjectives, and

predicate nouns--is projective. That which is projected by a predicate noun onto its subject noun phrase is, moreover, exactly as that which we are accustomed to thinking of as the characteristics of its referents. Thus the characteristics of the referents of woman are precisely the same as those which are projected onto the argument this in the sentence:

(6) This is a woman.

and the characteristics of the referents of wife are also that which are projected onto the argument that person in the sentence:

(7) That person is the wife of the mayor.

But this is no accident since, as Bach (1968) has shown, a surface structure noun which is not a predicate noun occurs in deep structure as a predicate noun, and is transformationally substituted for the variable which is its argument. Thus the sentence:

(8) I first met my wife in Boston.

is interpreted the same way and has the same deep structure as:

(9) I first met the one who is my wife in Boston.

while the sentence:

(10) Our chauffeur retired six months ago.

has the same deep structure as:

(11) The one who was our chauffeur retired six months ago.

3. The semantic content of sentences and of discourses.

Restricting our attention for the time being to simple declarative sentences, we assert that the semantic content of a sentence consists of what the predicates contained in it project onto the arguments contained in it. In terms of the notion projection as originally proposed by Katz and Fodor (1963), the semantic content of a sentence is a composite of the contents of its constituent noun phrases. In case the main predicate is a one-place predicate, (i.e., is intransitive) matters appear relatively straightforward; in a sentence such as:

(12) The woman died.

the argument the woman simply received the specification of having died (much more than this, of course, is involved in the meaning of (12); in particular, attention must be paid to the tense of the verb, the original predicate status of woman, the definite article, and the inchoative character of die (i.e., its relationship to the semantic properties of dead), and the declarative form of the sentence itself). In case the main predicate is a two-place one (i.e., is transitive), then we require in addition means of describing the relationship established by the predicate between its two arguments; for example, the relationship established by swallow between the whale and Jonah in the sentence:

(13) The whale swallowed Jonah.

The means that we suggest is the following: describe the two-place predicate as separately ascribing the relationship to each of its arguments. In (13), then, we would say that the argument the whale receives the specification SWALLOWED JONAH and Jonah, SWALLOWED BY THE WHALE. The reason for separately ascribing the relationship to each argument is that each one, whenever it occurs in a discourse following sentence (13), is understood to be so specified. Thus (14), while not internally incompatible in and of itself, expresses an incompatibility when taken together in a discourse with (13):

(14) However, Jonah managed to escape being swallowed.

The reason is that (14) ascribes to Jonah the specification NOT SWALLOWED, which is incompatible with its specification from (13). Similarly, it is possible to construct a sentence ascribing to the whale a specification which is incompatible to the one ascribed to it by (13).

In general, we may say that the specifications received by arguments are not limited to those which it receives in any particular sentences, but that these specifications pile up throughout a discourse. Thus, we may generalize our characterization of semantic content to the discourse; the semantic content of a discourse consists of the specifications projected onto the arguments contained in it.

The specifications ascribed to particular arguments, moreover, may carry over from discourse to discourse, the resulting conglomeration being what we may call our knowledge or beliefs about the world, which may in turn be widely shared. Accordingly, such sentences as the following, in the context of such shared knowledge and belief, express incompatibilities:

(15) Lyndon Johnson was defeated in the U.S.
presidential election of 1965.

(16) Paris is the capital of Sweden.

Notice, in particular, that (16) is doubly incompatible; it is incompatible with what we know (or believe) about both Paris and Sweden. Of course, knowledge about the world need not come from prior verbal experience, but rather from prior sense experience in general. Thus one may have never had occasion to talk about or hear about the color ink used to print the New York Times, but one's experience with having seen that paper will doubtless lead one to perceive an incompatibility in a sentence such as:

(17) The headlines of the New York Times are printed
in blue ink.

It is quite possible that what I am getting at here is what the British linguists Malinowski, Firth, Halliday, and others have had in mind by the context theory of meaning--this despite the disparaging things I have to say about their version of that theory in Langendoen (1967)--except I would not grant that what I have been talking about in this section is meaning at all, but rather semantic specifications of particular arguments with, n.b., particular reference. On this distinction, see especially the recent work of John Lyons (1964, 1966) on semantic theory--his terms are meaning and having meaning.

4. The meaning of lexical items.

We are accustomed to thinking of the meaning of a lexical item as consisting of a distillation of the semantic contents of tokens of that item used without incompatibility in sentences. This distillation is, in standard dictionaries, expressed as a

definition of that item, the definition itself being either a sentence or a linguistic expression readily convertible, without addition of semantic content, into a sentence. This accustomed way of thinking about meaning strikes me as fundamentally sound. One consequence of this, not often noted, is that meaning is not a property of sentences of parole at all--such sentences cannot even be said to have meaning (pace Lyons), but only, to repeat the rather vague term used in the preceding section, semantic content. Sentences only take on meaning upon conscious reflection, as for example when the applicability of a section of a legal document such as the First Amendment of the U.S. Constitution to a particular situation is determined. But at this point such sentences become part of langage, and are no longer part of parole.

The experience of lexicographers, moreover, is that meanings for lexical items are extraordinarily difficult to pin down, even if dialect differences are overlooked (we may view the task of a lexicographer, at the risk of sounding prescriptive, as dealing with the meaning of an item in a standard language); one can almost never be sure that some element has been overlooked, or conversely that some superfluous material has been included. Alternative ways of defining items are almost always possible, and considerations of simplicity or elegance are often of no help in choosing among alternatives, and may be downright misleading. Nevertheless, one has the feeling that the lexicographer's job is well-defined. In fact, it may well be the very fact that lexical items have meanings that makes it sometimes difficult to put some particular semantic content into words--those that come to mind possess shades of meaning which do not contribute to or even subtly contradict the intended semantic content. Conversely it is possible to speak meaningfully but without conveying semantic content. Empty talk is possible precisely because lexical items carry meaning and can be strung together such that the impression of semantic content is conveyed, but not any actual content.

5. Meaning and semantic content further contrasted.

It is well-known that the meanings of many kinship predicates, for example uncle, involve the existence of parties other than those which comprise its arguments. Thus for x to be the uncle of y it must be the case that x is either a brother or the husband of a sister of one of x's parents. Yet it is unlikely that one has in mind these intermediate parties when one uses terms in sentences, for example:

(18) Bill's uncle is in the Peace Corps.

Indeed it is most likely that children acquire the ability to use such terms appropriately long before they learn their definitions. Even adults can be caught off-guard and not immediately perceive any internal incompatibility in such sentences as (4) or even the following:

(19) My grandfather was childless, the poor man.

This suggests that the semantic content of sentences containing such predicates does not involve the intermediate parties referred to in the definition of those predicates; moreover that the semantic content of sentences is comprehended by children long before characterizations of the meanings of lexical items arise in their minds. It goes without saying that the meaning of particular items may change for people over time, or may become completely forgotten.

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Some Problems of Derivational Morphology*

Sandra Annear and Dale Elliott

*Sponsored in part by the National Science Foundation through Grant GN-534 from the Office of Science Information Service to the Information Sciences Research Center, The Ohio State University.

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The ability of a fluent speaker of English includes his mastery of derivationally related forms. What he knows about derivational morphology must be part of the grammar of English, but it is not clear just how the various aspects of this knowledge should be accounted for.

It is clear that the things we know about our language must either be regularities of structure, such as how questions are formed, which are accounted for by rules in the grammar, either universal or language-particular, or they must be idiosyncratic facts, such as what the plural of child is, which are represented as information accompanying an item in the lexicon.

In the case of our ability to use derivationally related forms, not only is the formal account of what we know sometimes difficult to arrive at, but it is not altogether obvious just what it is that we know.

The following is an attempt to demonstrate that this is the case.

Some affixes are, generally and intuitively speaking, productive, e.g., -able as in washable, which is so productive that we can make up new forms like doable. However, there are certain (classes of?) forms for which the addition of -able is not possible, e.g., verbs which take resultative objects like build. This affix cannot be applied to two-word verbs, or to verb + preposition combinations: *pickable up, *pick upable, *talkable to, *talk toable. However, listenable does appear, although listen requires to: *He listened the singer, She's a very listenable singer. We can imagine the creation of a word *talkable, as in

*He's very talkable

meaning, He's easy to talk to, though it does not actually appear. Listenable may have resulted in this way, from an attempt to put -able on a verb + preposition combination. This seems to be a

fairly clear-cut example of a syntactic rule which allows the derivation of a sentence like

This coat is washable
from the structure underlying

One can wash this coat.

We simply do not know yet exactly what the environments are for the application of this rule.

The speaker is capable of recognizing the structure of derived words, as ungentlemanliness. By assigning two different structures, we can represent the ambiguity of a word like untieable. Also, the speaker can recognize the structure in, and in this way understand the meaning of, complex words which do not seem to conform to the usual derivational processes, such as unthinkable and perishable, to say nothing of listenable, thus disallowing the possibility of listing such words as monomorphemic in the lexicon. The other alternative, though, for deriving these forms is by means of the general rule by which -able is added to certain verbs, but this rule obviously does not apply generally to intransitive or two-word verbs like perish or think (about). But, how are we to predict their semantic interpretation, since it cannot come from the usual rules, and how exactly are we to represent the fact that they should not exist at all?

This question has implications beyond the scope of derivational morphology alone. Consider, for example, the usual treatment of irregular plurals in a transformational grammar, accomplished by using the notion of rule-ordering. The rule ox + Plural → oxen is given, along with other such rules, before the rule for the formation of regular plurals. Thus, we know that the plural of ox is oxen. But how do we represent the intuition that the plural of ox OUGHT TO BE oxes? The received conception of ordered rules is one in which earlier rules take no account of later rules. The rules for plurals in English are composed of a group of irregular rules followed by a single general rule.

But there is no way at present to distinguish this situation from that in a language in which there is no such thing as a regular plural. That is to say, given a set of rules such as the plural rule for ox, there is no way to express the fact that they are followed by a regular rule, which should apply to the words in this set.

There is further the question of our ability to recognize the structure of words with learned affixes, such as -ology, etc., and of words such as loquacious and loquacity, where the "stem" does not exist. We cannot list these last two, for example, separately in the lexicon, since this would not indicate the obvious relationship between them, but the verb *loq, "to speak frequently," is scarcely as credible a back-formation as, say, *agress. (Such non-occurring base forms are discussed by George Lakoff in On the nature of syntactic irregularity, Computation Laboratory, Harvard University, Report No. NSF-16, Cambridge, 1965.)

In most cases where there is more than one affix with the same meaning, as dishonest but unhappy, a given word will take only one: *unhonest, *dishappy. But in unmeasurable and immeasurable, we find two different forms of the negative affix on the same word, giving two semantically distinct forms.

The size of a virus is unmeasurable without an electron microscope.

The mind boggles at the contemplation of the immeasurable depths of interstellar space.

How can we represent the derivation of these words formally? It is at least initially plausible to say that they both have the deep structure NEG + measurable, but what we have is two different "shades" of not measurable. Furthermore, we have such sets as unassembled, disassembled; displace, misplace; unmoral, amoral, immoral.

The general problem of acceptable vs. unacceptable back- and "front-" formations should be considered. Why is *agress

believable from aggressive, aggressor, etc., but not *ten, from tenacious and tenacity, as in the triple rape, rapacious, rapacity? Why do *wetten and *hotten, in the pattern of moisten, sound better than *stickyen and *thinnen on the same pattern? Since these are intuitions we have about forms never heard before, they must be based on certain rules. But what rules? Does this constitute evidence for considering the addition of the -en causative suffix to be a rule, even though no common feature has so far been found which could characterize as a class the forms with which it is found?

Nominalizations may perhaps be said to be inherently abstract, but certain of them are "concretizable," while others are not. Resignation is commonly used in both ways, whereas agitation and knowledge can only be abstract.

My resignation took only a few minutes.

My secretary typed my resignation for me.

*This is my knowledge of flying ants. (said of a piece of paper on which you have written all you know of flying ants.)

The word proliferation, on the third hand, while commonly used only as abstract, can be imagined as a concrete noun.

?Look at that proliferation of flying ants.

But,

*Look at that agitation of people.

If nominalizations are formed by the operation of certain regular syntactic rules, (and there is abundant evidence for considering that they are), then how can this arbitrary information be associated with the newly created form?

A similar problem is encountered in the case of a derived form which has a meaning which could not be predicted from the meanings of the stem and the affix. E.g., neither ignorant nor the phrase ignorant of have meanings that could be gleaned by simply knowing that they are adjective forms of the verb ignore; considerate is not an attribute of one who considers.

There are cases in which we do not even have the evidence of new formations which seem intuitively correct to determine whether or not there are rules operating. Consider our knowledge of which words take an -ist agentive suffix. Cyclist and typist seem to be examples of phonological exceptions to the rule which adds -er to verbs. But -ist seems to be the unmarked agentive suffix for players of musical instruments: flutist, pianist, with trumpeter as an exception. If questioned as to what to call someone who plays a sackbutt, however, at least the authors find themselves with no intuitions on the preferability of either sackbutter or sackbutlist. Then is the addition of -ist to the names of musical instruments an example of a rule?

These paradoxes illustrate cases in which neither lexical lists or syntactic rules, which are the only two available means, provide a satisfactory account of certain aspects of a fluent speaker's ability to use his language. The important consideration in arriving at a solution to this problem is an account of how we arrive at the knowledge that we exhibit of these forms and the relationships among them. It is obvious that the forms of the grammar must be constrained by learning-theoretical considerations. Otherwise, we would have no grounds for objecting to any conceivable rule mechanism, including mirror-image sentences and the like.

All of this indicates that the solutions made available by the present form of the grammar are not sufficient.

III. MATHEMATICAL LINGUISTICS

Mathematical linguistics involves the application of various mathematical ideas and methods to the problems of clarifying the fundamental properties of natural languages and of providing a satisfactory notation for representing linguistic structures. It also involves research in pure mathematics-- those areas of mathematics which have turned out to have linguistic applicability, but which themselves are in need of further work, for example the theory of context-free languages. At the present time, there is a great deal more work being done on mathematics within the discipline of mathematical linguistics than on linguistics. I see my task as dealing with the problem of the fundamental properties of languages, so that it will become clearer just what mathematical tools are appropriate for the study of language. One clarification I think has already been obtained, namely that formal logic is perhaps the single most important tool (for the study of semantics), not the theory of context-free languages, the area which has of late received the most attention from mathematical linguists.

The work on mathematical linguistics has been closely correlated with research reported in the previous section. D. T. Langendoen worked under the project full time in the spring quarter of 1967; J. T. Heringer, Jr., part time during the spring and summer quarters of 1967.

I have been primarily concerned with two problems in the foundations of linguistics: (1) the nature of the representation of semantic structure and (2) explanation in syntax.

Concerning (1), I have developed some arguments to show that there are fundamentally two basic aspects of semantic structure: meaning and semantic content. In a preliminary work-paper "On selection, projection, meaning, and semantic content" (see p. 100), I maintained that the semantic content of a

sentence is the aggregate of what is predicted of the individual noun phrases (arguments) which appear in that sentence. The same characterization can be made of the semantic content of discourses. Meaning is fundamentally a property of lexical items, and is arrived at by processes which are not generally well understood from exposure to the lexical items in linguistic contexts. In that paper I also held that, properly speaking, there is no such thing as the meaning of a sentence or a discourse, but it has since been pointed out to me that it is a perfectly straightforward matter to define those concepts. I am presently working on a paper, hopefully publishable, which will enlarge upon and clarify these ideas.

Concerning (2), I have shown in a paper "The accessibility of deep (semantic) structure" (see p. 118; to appear in P. Rosenbaum and R. Jacobs, eds., Studies in English Transformational Grammar, Ginn-Blaisdell, 1968) that it is possible to explain the existence and obligatory or optional character of some transformational rules of English on the grounds that their application (or occasionally non-application) is necessary that the underlying semantic structure be perceived by a perceptual apparatus such as the human brain without external memory aids. I have reason to believe that the ideas sketched in this paper can also be enlarged upon and made to fit into a general theory of linguistics.

The work of J. T. Heringer has consisted mainly of critical reading and reviewing of papers related to mathematical linguistics. One of these reviews is presented as part of this report (p. 128).

D. T. Langendoen
December 1967

The Accessibility of Deep (Semantic) Structures*

D. Terence Langendoen

(To appear in Studies in English Transformational Grammar,
R. Jacobs and P. Rosenbaum, eds., Ginn-Blaisdell, 1968).

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University.

Given the conception of language which asserts that for each sentence in a language there is a deep semantic representation and a surface syntactic representation of it, the question is raised: why is there a surface syntactic representation at all; or to put it slightly differently, why are there grammatical rules to convert deep structures into surface structures; or again, why are there transformations?

The fact that transformations exist is a fact that demands explanation, for an "ideal" language would be one which provided direct phonological realizations of its semantic structures. Such an explanation should be based, moreover, on considerations which are independent of such internal linguistic considerations as that a child could not acquire his native language from primary linguistic data unless he assumed the existence of transformations. And such an explanation most certainly should not be in terms of simplicity considerations alone; these are appealed to only in the absence of more powerful modes of explanation from outside. In this paper, we shall show that a partial explanation for the existence of transformations on the basis of considerations of the function of language as an instrument of communication--the communication of that which is given in deep structure representations--can be given.

Chomsky has pointed out in a number of places that the relative unacceptability of particular sentences is due to the internal complexity of their surface syntactic structures; thus a sentence such as (1) with three degrees of self-embedding, although completely and fully grammatical, is quite unacceptable:

- (1) The rumor that the report which the advisory committee submitted was suppressed is true is preposterous.

To distinguish cases of sentence unacceptability arising from internal complexity from other cases, let us say that sentences

such as (1) have deep structures which are relatively inaccessible. We will also say that their surface syntactic structures do not provide ready access to their deep structures.

Now consider the sentences:

- (2) The rumor that it is true that the report which the advisory committee submitted was suppressed is preposterous.
- (3) The rumor is preposterous that it is true that the report which the advisory committee submitted was suppressed.
- (4) The rumor that it is true that the report was suppressed which the advisory committee submitted is preposterous.
- (5) The rumor is preposterous that it is true that the report was suppressed which the advisory committee submitted.

Sentences (2)-(5) all have the same deep structure as (1), yet their surface structures provide relatively greater access to that deep structure than does (1). The reason for this is that various extra-position transformations have been applied to obtain the surface structures of (2)-(5), reducing their degree of self-embedding. In (2), the that-clause subject of the adjective true has been extraposed to the end of the clause containing it, leaving behind the pronoun it as the surface subject of it. In (3), moreover, the that-clause complement of the noun rumor has been extraposed to the end of the main clause. This rule has also been applied in (5). In (4), the relative clause modifying the noun report has been extraposed to the end of the clause containing it. This rule has also been applied in (5). The results are that the degree of self-embedding has been reduced to two in sentence (2), to one in sentences (3)-(4), and to zero in sentence (5). Thus, sentences (2)-(5) provide more ready access to the deep structure common to (1)-(5) than does (1), (5) more so than (2)-(4), and (3)-(4) more so than (2). Now, if the effect of the various extraposition transformations is to render

certain deep structures more accessible than they would be if those transformations were not applied, then we can say that the existence of these transformations is motivated (explained) on the grounds that they facilitate communication of certain deep structures.

Similarly the optional or obligatory character of certain transformations under particular conditions can be explained. For example, it is known that the extraposition of that-clause subjects of intransitive verbs such as seem is obligatory, while the extraposition of that-clause subjects of transitive verbs such as prove is optional. The reason for this is that the application of the extraposition transformation to that-clause subjects of intransitive verbs never decreases accessibility, while the extraposition of that-clause subjects of transitive verbs may. To see this, consider the sentences:

(6) That Tom's told everyone that he's staying proves that it's true that he's thinking that it would be a good idea for him to show that he likes it here.

(7) It proves that it's true that Tom's thinking that it would be a good idea for him to show that he likes it here that he's told everyone that he's staying.

Sentences (6) and (7) have identical deep structures, however the surface structure of (7), obtained by application of the extraposition transformation to its subject that-clause, provides less ready access to its deep structure than does (6). Therefore, the extraposition transformation must be free not to apply to such that-clauses (that is, its application in such circumstances must be optional), so that the most accessible surface structures of particular deep structures will be grammatical.

A similar situation presents itself with regard to the so-called particle-movement transformation in English whose application can be detected in such sentences as:

(8) A sudden gust of wind knocked him down.

(9) A sudden gust of wind knocked the old man down.

In case the object of the verb is a personal pronoun, the particle movement transformation is obligatory, but if it is not, then the transformation is optional. Thus (10) is ungrammatical while (11) is not:

(10) *A sudden gust of wind knocked down him.

(11) A sudden gust of wind knocked down the old man.

In Ross (1966), it was suggested that the transformation be considered inapplicable in case the object noun phrase is complex; that is, contains a subordinate clause. Thus (12) was considered grammatical, but not (13):

(12) A sudden gust of wind knocked down the man who
I saw get out of a car a few minutes ago.

(13) A sudden gust of wind knocked the man who I saw
get out of a car a few minutes ago down.

However, rather than consider (13), and sentences like it, ungrammatical, it would be more in accordance with fluent English speakers' intuitions of grammaticality to consider them fully grammatical, but relatively less acceptable than their counterparts in which the particle movement transformation has not applied. Such sentences are also less accessible than their counterparts, as the following examples dramatically illustrate:

(14) The assailant knocked the man who put the
rebellion which caused the banks to close down
down down.

(15) The assailant knocked down the man who put down
the rebellion which caused the banks to close
down.

Consequently, the particle movement transformation must be optional (at least when the object noun phrase is not a personal pronoun) so that the surface structures which provide greatest access to deep structures such as that which underlies (14)-(15) will be grammatical.

From these examples, it should be clear that a genuinely explanatory theory for the existence of transformations, their effects on the structure of sentences, and the conditions under which they are optional or obligatory can be worked out, at least in part, along the lines suggested here. We do not assert that for every well-formed deep structure there is a surface structure which provides ready access to it--one can imagine, at least, an English sentence so complex that the various extra-position transformations would reduce its deep structure complexity only to reintroduce it elsewhere--but simply that transformations are designed to apply so as to increase accessibility and that their application is suspendable in those situations in which such application would in fact decrease accessibility.

In the examples considered so far, degree of inaccessibility had to do with degree of self-embedding in surface structures. There are, however, other reasons why a surface structure will not provide ready access to the deep structures underlying it. Consider the fact that the relative pronoun may be deleted except when it stands for the subject of its relative clause:

- (16) The class which/that I will teach next semester will meet in the evening.
- (17) The class I will teach next semester will meet in the evening.
- (18) The class which/that regularly meets in the seminar room has been moved downstairs.
- (19) *The class regularly meets in the seminar room has been moved downstairs.

If (19) is imagined as a possible surface structure for the deep structure expressed by (18), in which the relative pronoun deletion transformation has not been applied, it will be seen that it does not provide access to that deep structure, since indication of the subordinate status of the relative clause has been destroyed. The same is not true of sentence (17), since the subordinate status of the relative clause in it is still indicated by the presence of the subject and verb of that clause.

Thus the inapplicability of the relative pronoun deletion transformation in case the pronoun stands for the subject of its relative clause results in the ungrammaticality of surface structures which fail to provide access to their corresponding deep structures. And, although accessibility theory cannot provide a direct explanation for the existence of the relative pronoun deletion transformation in the first place, there may be an explanation in terms of the desire for parsimony (this is by no means an entirely unserious proposal).

We can account, on similar grounds, for the fact that when the relative pronoun stands for the subject of a subordinate clause inside the relative clause, the subordinating conjunction that introducing that subordinate clause must be deleted. Thus the following sentence is grammatical:

- (20) The committee which I understand investigated
the accident has not yet made its report public.

but not:

- (21) *The committee which I understand that investi-
gated the accident has not yet made its report
public.

The subordinating conjunction may, however, be retained in case the relative pronoun stands for some other noun phrase in the subordinate clause. Thus both of the following sentences are grammatical.

- (22) The accident which I understand the committee
investigated was the worst in the state's
history.

- (23) The accident which I understand that the
committee investigated was the worst in the
state's history.

The ungrammaticality of (21) stems presumably from the fact that the retention of that would lead to a false parsing of the sentence, in which that is taken to be the subject of the subordinate clause. This means, of course, that (21) fails to provide access to the deep structure underlying it and sentence

(20); the obligatory deletion of the subordinating conjunction may then be understood as a means of rendering certain surface structures which do not provide ready access to their deep structures ungrammatical.

From the foregoing considerations, we see that accessibility and grammaticality are partially independent, partially dependent notions. From our consideration of the various extraposition transformations and the particle movement transformation, we saw that certain surface structures which fail to provide ready access to their deep structures need not be ungrammatical; there need only be grammatical surface structures which do provide more ready access to them. On the other hand, we saw from our consideration of the relative pronoun and subordinating conjunction deletion transformations, that certain other surface structures which happen to fail to provide ready access to their deep structures also turn out to be ungrammatical.

Given the conception of deep structures as semantic structures, it is apparent that for any well-formed deep structure, there must be at least one grammatical surface syntactic realization of it. The conception of the transformational component as a filter, to weed out unwanted deep structures, cannot in the present theory be seriously maintained. This position has some interesting consequences. For example, it is known that there are no grammatical surface structures in which the semantic content of the following sentences can be expressed as single non-compound sentences:

(24) *The landlord is upset about the window which
I saw the boy who broke it.

(25) *The committee which I wonder whether it investigated the accident has not yet made its
report public.

These facts would appear to contradict the thesis just maintained, since although the semantic content of (24) and (25) is straightforward (hence there must be deep structures which underlie them), there are apparently no grammatical surface structures

by which they may be expressed. But in fact there are, namely the compound sentences:

(26) I saw the boy who broke the window and the landlord is quite upset about it.

(27) I wonder whether the committee investigated the accident; it has not yet made its report public.

The fact that relative clauses arise from deep structure conjunctions has recently been established by Annear (1967); these observations suggest that the ungrammaticality of sentences containing relative clauses in which the relative pronoun has been drawn from a relative clause or a subordinate clause introduced by a subordinating conjunction other than that is due to the fact that such sentences provide relatively less access than do their coordinate sentence counterparts. Example (24), in turn, is more nearly grammatical, and provides greater access to its deep structure, than the following, in which the final pronoun it has been deleted:

(28) *The landlord is quite upset about the window which I saw the boy who broke.

Examples like (24), which often turn up in the speech of English speakers, are usually thought of as making the best of a bad job--a speaker having found himself relativizing out of a relative clause retains a pronoun in place of the noun phrase so relativized, thus providing himself and his audience with a trace of the deep structure, and thus rendering that deep structure more accessible than it otherwise might have been.

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Review of Haim Gaifman, "Dependency Systems and Phrase-Structure
Systems," Information and Control 8 (1965), pp. 304-337.*

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This article is concerned with the comparative strong and weak generative capacities of dependency grammars (dgs) and phrase-structure grammars (psgs), the latter being equivalent to Chomsky's context-free psgs. It is shown in the article that psgs and dgs are equal in weak generative capacity; they define the same set of strings. Since the structures assigned by these two types of grammars differ significantly, it is necessary to introduce notions of strong equivalence between grammars of the two types, based on structure assignment, before the strong generative capacities of the grammars can be compared. Different concepts of strong equivalence between dgs and psgs are defined in the article, and it is shown that in terms of these concepts, psgs have more strong generative capacity than dgs, in that for every dg there is a "naturally corresponding" psg, but not vice versa. The concept of degree of a psg is defined and used to characterize that property of psgs which causes them to have more power than dgs.

To show the analogies between dependency trees (d-trees) and phrase-structure trees (pss), Gaifman gives a descriptive definition of the former which he shows to be equivalent to the constructive definition used in RAND publications. Both definitions use the following formulation of a dg (or dependency system, in Gaifman's terminology). A dg consists of three sets: 1) a set of rules which gives for each category those categories which may derive directly from it with their relative positions, symbolized $X(Y_1, Y_2, \dots, Y_k, *Y_{k+1}, \dots, Y_n)$, where k may equal zero or n and n may equal zero (meaning X may stand alone, without dependents; 2) a set of rules which give for each category the list of words belonging to it, the lists not necessarily being mutually exclusive; 3) a list of categories which may govern sentences. To define dependency trees, it is necessary to characterize the dependency relation associated with the dg, a two place relation. PdQ means P depends directly on Q ; $Pd Q$ means there is a sequence of dependencies relating P and Q , where P and Q are occurrences of categories.

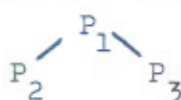
Gaifman defines d as follows: 1) d^* is irreflexive; 2) d is many-one; 3) d^* does not introduce discontinuities with respect to sentence word order; 4) d is interconnective; 5) d is specified by the first list of rules given above. In particular, if for no P does PdQ hold, then X_j (*) must be a rule of the first list, where X_j is the category which Q is an occurrence of; 6) if for no Q does PdQ hold, then the category of P is listed in the third list above; 7) the occurrences related by d are occurrences of categories assigned to the words of the sentence by the rules of the second list above. Any set of occurrences related by d is a d -tree. By theorem 1.1 of the article, this definition is equivalent to the recursive definition of d given in RAND publications.

To characterize phrase-structure trees (phrase structures or pss, in the article) Gaifman introduces the notion of ramification, based on one meaning of the term parenthetical expression (pe) as Hayes uses it. For Gaifman, a pe in a string of words is a string of successive occurrences, i.e., a substring, taking position into account. A ramification over a string α is a set Γ of pes in α satisfying the following: 1) α belongs to Γ . 2) If two pes are in Γ and they are not equal then they are either disjoint or one is a proper substring of the other. 3) There is no pe in Γ which is partially decomposable into other pes in Γ ; either it is unanalyzable or decomposable as a whole.

A ps over a string of words is then defined as a set of ordered pairs $\langle \Pi, X \rangle$ in which all the Π 's form a ramification over the string and the X 's are categories. Since a psg is three sets: 1) a set of rules for expanding categories, 2) a set of rules associating words with some categories, 3) a set of initial categories, a ps may be assigned to a psg if the following hold: 1) Given a pe associated with a category in the ps, the decomposition of the pe must be associated with categories linked to the former category by a rule in the psg of type 1 above. 2) If a pe associated with a category is unanalyzable

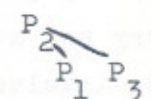
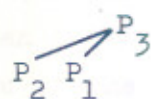
then the word in the pe must be of that category by a rule in the psg of type 2 above. 3) The category assigned to the whole string is in the third set above.

We now have two sorts of structure on strings of words, that defined by dependency relations and that defined by ramification. One way of comparing the structures is to examine the ramification induced by a d-tree, defined thusly: since every occurrence P in a d-tree, together with all occurrences depending directly or indirectly on it form a pe of the string, we may let this pe, $\Pi(P)$, be a member of the induced ramification Γ' . If we add no more pes the set Γ' will fulfil conditions 1 and 2 for ramifications given above, by properties 3) and 6) of the d-relation. However, to get complete decomposition of pes, we must add to Γ' as pes all the single occurrences P which govern some other occurrence. As an example, consider the d-tree

 . We have $(P_1) = P_2 P_1 P_3$, $(P_2) = P_2$, $(P_3) = P_3$ and

the set consisting of these pes can be described by:

$$\frac{((*) * (*))}{\frac{\Pi(P_2) \quad \Pi(P_3)}{\Pi(P_1)}}$$

But note $\Pi(P_1)$ is not completely decomposed. To obtain a ramification, we must add P_1 as a pe, deriving $((*)(*)(*))$. It is obvious that the induced ramification does not reflect all the structure of the d-tree, for  and 

would induce the same ramification as given above.

To get a ps from the induced ramification, Gaifman associates a category with each pe in that ramification. First, with every $\Pi(P)$ is associated the category assigned to P in the d-tree. Second, if P governs other occurrences, P itself will be a pe distinct from $\Pi(P)$. These pes must be assigned different categories or recursion will be introduced into the psg associated with the ps which is not present in the dg. Gaifman does this by associating the category X^W

(X restricted to a single word) to P if X is associated with
(P) \neq P.

Gaifman now induces a psg from a dg by finding a grammar giving all the pss induced by all the d-trees given by a dg. Actually the algorithm derives the psg directly from the rules of the dg in an obvious manner. Gaifman claims that, because of distinguishing between X's and X^w's, "although the induced ramification did not express fully the d-relation, the induced ps does." Namely, given an induced ps, the d-tree can be effectively reconstructed by algorithm. What he does not point out, however, is that the reconstruction involves analysis of the supposedly unitary symbol X^w as a complex symbol in order to identify it with the symbol X. Thus, the reconstruction algorithm uses information extraneous to the psg and involves a strictly local transformation.

To compare psgs and dgs, Gaifman defines a psg and a dg to be equivalent if they have exactly the same ramifications (if the ramifications of all the pss are the same as the induced ramifications of all the d-trees). Gaifman notes this is a qualified sort of equivalence, since induced ramifications do not preserve all the structure of the d-trees. For every dg there is an equivalent psg, the induced psg defined above, expressing, in a certain sense, the full detail of the dg. However, for some psgs there are no equivalent dgs.

A necessary and sufficient condition for a psg to be equivalent to some dg involves the notion of degree of a psg. A category X in a psg is of degree zero, "deg (X) = 0," if only single words are of category X. Deg (X) = n if deg (X) is not less than n and for every rule of the form $X \rightarrow Z_1 \dots Z_k$ there is a Z_i , $1 \leq i \leq k$, such that deg (Z_i) is less than or equal to n-1. Deg (X) = ∞ if for no n deg (X) = n. The degree of a psg is the maximum of the degrees of the categories in the psg. Intuitively, if deg (X) = n, this means that starting from a node of category X in any tree of the psg, it is impossible to travel downwards through more than n nodes before

reaching a single word, and, at the same time, the psg must be capable of generating at least one tree where there are n nodes between X and the closest single word lower down in the tree. Gaifman formalizes this in several lemmas. Since degree is actually a property of ramifications (one aspect of tree structure), two equivalent psgs must have the same degree in order to have the same ramifications. It is fairly obvious that if a psg is equivalent to some dg then it must be of degree 0 or 1, for the induced ramifications of d-trees never display any nodes which would have degree greater than one in the induced psg. This implication holds in the other direction also, a result that follows from the main theorem of the paper.

Since equivalence erases some d-tree information, it may be argued, according to Gaifman, that it is not significant that dgs are equivalent to a special class of psgs (those with degree 0 or 1). To counter this, he compares the two grammar types by the notion of correspondence, originally introduced by Hayes, based on the concept of subtrees and complete subtrees in d-trees. A subtree is any set of occurrences connected by the d-relation. A complete subtree is the $\overline{\Pi}(P)$ we defined before; an occurrence P with all those occurrences depending directly or indirectly on it. Hayes has the following definition of a ramification corresponding to a d-tree. Every complete subtree is a pe of the ramification (as with Gaifman's induced ramification) and every pe is a subtree. In other words, to construct the corresponding ramification, we begin with the pes defined by the complete subtrees of the d-tree and add to these pes pes which are subtrees until the set of pes constitutes a ramification. In general, there will be more than one ramification corresponding to a d-tree. Gaifman makes the obvious extension of the notion of correspondence to the relation between d-trees and pss by calling them corresponding if the corresponding d-tree ramification is the same as the ps ramification. If all the pss of a psg correspond respectively to all the d-trees of a dg, the psg and the dg correspond.

The major theorem of the article is this: "A psg corresponds to some dg if it is of finite degree. Moreover, if this condition is fulfilled, then given the psg a dg can be constructed effectively having the following property: Given any d-tree of the dg a unique [italics Gaifman's] ps of the psg which corresponds to it can be constructed effectively and vice versa. (Thus the dg expresses fully the psg and all the passages from one to the other can be done in an automatic way by a computer.)" Unfortunately, the theorem as stated is wrong, for, given a d-tree, in general there will not be a unique corresponding ps, and, given a ps, there will not be a unique corresponding d-tree. Thus there is no algorithm for passage back and forth between dgs and psgs of finite degree.

The first part of the proof of the major theorem shows that if a psg corresponds to some dg then it is of finite degree. This is done by showing that rule length in the corresponding dg must increase as the degree of the psg increases. Since rules must be of finite length, if a psg is of infinite degree, it does not correspond to any dg.

The second part of the proof presents an algorithm to construct for any psg of finite degree a corresponding dg fulfilling the requirements of the theorem. It is this algorithm that fails. Space limitations prohibit presenting the algorithm here. However the dg constructed with the given algorithm will generate several d-trees for a given ps whenever the psg has a rule containing more than one category on the right-hand-side which is of smaller degree than the category on the left-hand-side, and this rule was employed in generating the ps. This contradicts the theorem.

As a concrete example, consider the psg $S \rightarrow NP VP$, $NP \rightarrow Det N VP \rightarrow V NP$. Both NP and VP are of degree 1, S is of degree 2. To form a dg from this psg, the decision must be made as to whether the subject noun or the verb is to dominate the sentence and as to whether the determiner of the noun is to dominate the

noun phrase. Whatever information is relevant to these decisions, i.e., government relations, is not given in the psg. How to make these decisions is not discussed in the algorithm presentation.

Also, a procedure is given for deriving the corresponding d-tree from a ps. This procedure also fails, for it uses information irrelevant to the operation of the dg and which was derived in obtaining the dg from a psg. As an example, one of the dgs corresponding to the psg given above is $S(NP * NP)$, $NP(\text{Det } *)$, $\text{Det } (*)$, where words formerly of category V are now of category S, and words formerly of category N are now of category NP. The first rule yields several possible sets of corresponding psg rules: $S \rightarrow NP X_1 NP$, $X_1 \rightarrow V$ or $S \rightarrow NP X_1$, $X_1 \rightarrow V NP$ (this is the original) or $S \rightarrow X_1 NP$, $X_1 \rightarrow NP V$. Gaifman circumvents this difficulty and chooses a unique corresponding set of rules by using subscripts on categories indicating at what level they appeared in the original pss. Thus, instead of $S(NP * NP)$, he has $S(NP_1 * NP_2)$, which signals that the subject NP must be introduced before the object NP in the corresponding psg. But this means the unique corresponding psg must be given before it may be algorithmically derived, certainly an unreasonable prerequisite.

It is my own view that the notion of dominance in d-trees and that of level of structure in psgs are incomparable. Gaifman's concept of correspondence fails just as equivalence did in this respect. However, the former concept allows interesting comparison between dgs and psgs. Starting from the following six rule psg $S \rightarrow NP VP$, $NP \rightarrow N (S)$, $NP \rightarrow NP + NP$, $VP \rightarrow V NP (S)$, and using Gaifman's algorithm, one derives a corresponding dg with 119 rules producing non-unique corresponding d-trees. If the verb is taken to dominate the sentence, the dg with unicity has 39 rules. If the noun (or +, with conjoined NPs) dominates, the dg with unicity has 51 rules. If redundant categories and rules are removed (Gaifman's algorithm introduces redundant categories, which are avoidable with a simple change in the algorithm),

the dg without unicity has 40 rules, the V-dominant dg has 14 rules, and the N-dominant dg has 20 rules. The multiplicity of rules results from the necessity for dependency theory to view the NP in $NP \rightarrow N(S)$ and the NP in $NP \rightarrow NP + NP$ as two distinct categories, one resulting in an occurrence of N and one resulting in an occurrence of + in the related d-trees.

The article concludes with an outline of a proof of the theorem that psgs and dgs are equal in weak generative capacity. The proof is based on the fact that every set of sentences definable by a psg is definable by a psg of finite degree. This, together with the major theorem, provides the desired result.

In conclusion, it should be noted that the results of the article have no linguistic relevance. Since we know that psgs fail to characterize natural language in part because of insufficient strong generative capacity, we might think that now the same argument could be used against dgs, and with even more force. However, consider psgs of infinite degree. They are characterized by their containing rules, or sequences of rules, which yield $X \xrightarrow{*} XX: X \xrightarrow{*} XXX$, or any other finite number of XXs. Rules of this form are not used in grammars characterizing natural languages. A rule schema of the form $S \rightarrow (S)^*$ subsumes these rules, but, through inclusion of r.h.s.'s which are arbitrarily long, transcends the strong generative capacity of psgs. Actually, then, the degree of a psg is irrelevant to its inability to characterize natural language; restricting ourselves to use of psgs of finite degree, either empirically or logically (by using dgs) neither helps nor hinders this inability.

IV. LABORATORY ACTIVITIES

In the period covered by this report, the work in the laboratory has been mainly developmental. Gaberell Drachman of the Department of Linguistics has been engaged in exploratory studies concerning the use of continuous palatography in phonological research. He was assisted in the winter quarter of 1967 by Knut Fintoft from the University of Oslo. Small projects in acoustic phonetics have been carried on simultaneously, one of which was completed in July, 1967, by Ilse Lehiste (see p. 138; the paper was presented at the VI International Congress of Phonetic Sciences in Prague in September, and will be published in the Proceedings of the Congress). The department is currently in the process of outlining a more extensive research project in phonology, details of which are not yet ready for publication.

Ilse Lehiste
December 1967

Diphthongs Versus Vowel Sequences in Estonian*

Ilse Lehiste

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This paper deals with the problem of distinguishing between diphthongs and vowel sequences containing a word boundary. The language in which the phenomenon has been studied is Estonian. The paper is based on acoustic analysis of 500 short sentences produced by one informant (the author). It is to be understood that generalizations drawn from this limited material serve only to set up working hypotheses which will be tested by analysis of a larger corpus of utterances, produced by several additional speakers.

There are nine vowels and a large number of diphthongs in the language. Of the nine vowels, /a e i u/ may occur in stressed as well as unstressed position in any syllable; they may also occur as first or second element of a diphthong. The following combinations of these four vowels were studied: the diphthongs /iu/, /ei/, /ea/, /eu/, /ai/, /ae/, /au/, and /ui/, and the vowel sequences /i/ + /u/, /e/ + /i/, /e/ + /a/, /e/ + /u/, /a/ + /i/, /a/ + /e/, /a/ + /u/, and /u/ + /i/. It was hypothesized that in a diphthong, V_1 would be similar in phonetic quality to a stressed short vowel, and V_2 to an unstressed vowel occurring in the second syllable of a disyllabic word. It was further assumed that the diphthongal sequence would differ from a sequence of the same vowels containing a word boundary in the relative stress of the components: in the diphthong, V_1 would be stressed, V_2 unstressed, whereas in the sequence containing a boundary, V_1 would be unstressed and V_2 stressed.

Broad-band spectrograms were made of all utterances. The sentences were also processed through an intensity meter and pitch meter (produced by B. Frøkjær-Jensen, Engineering Firm of Electronic Instruments, Copenhagen) and displayed on a four-channel Mingograph (Mingograph No. 42--EM/122, Elema-Schönander, Stockholm). The results of the study are summarized in a series of acoustical vowel diagrams which were constructed on the basis

of averages calculated from measurements made of broad-band spectrograms. Corresponding tables are likewise presented.

The first figure shows $F_1 - F_2$ positions of the stressed short vowels /i e a u/ and positions of the same vowels forming the first element of a diphthong. The positions of stressed long and overlong vowels have likewise been plotted on the diagram. The figure shows that the phonetic values of stressed short vowels are remarkably similar to the first components of diphthongs. Both differ markedly from long and overlong vowels, which are phonetically close to each other.

Figure 2 compares the second components of diphthongs with target positions of stressed monophthongs. In the case of /i/ and /u/, the second components of overlong diphthongs are phonetically similar to long vowels; but with /a/ and especially with /e/, no such statement can be made. The second components of long diphthongs are in each case distinctly different from stressed monophthongs.

Figure 3 compares V_2 of diphthongs with unstressed vowels in the second syllable of disyllabic words. The results are contradictory: for /u/, unstressed vowels are similar in phonetic quality to V_2 of long diphthongs, but for /e/, /a/, and /i/, the unstressed vowels are more similar to V_2 of overlong diphthongs.

It seems that the second hypothesis cannot be verified on the basis of this material: the phonetic quality of the second component of diphthongs is not identical with the phonetic quality of unstressed vowels. Neither is it identical with that of stressed vowels, except for /i/ and /u/, where V_2 of overlong diphthongs was similar in quality to long and overlong monophthongal /i/ and /u/.

The clues provided by duration were considered next. The duration of the two segments was measured, assuming a boundary in the middle of the transition from the first to the second component. The two components of a diphthong were found to be almost equal in duration both in long and in overlong diphthongs:

the lengthening of an overlong diphthong was apparently accomplished by a proportional lengthening of both components. The average durations of V_1 and V_2 of a long diphthong were 9.4 and 7.0 csec; in an overlong diphthong, the values were 13.2 and 13.9 csec. The average durations of vowels in a sequence containing a word boundary were 8.6 and 8.3 csec. Duration thus distinguishes a V + V sequence from overlong diphthongs, but not from long diphthongs. The contribution of intensity to the difference between diphthongs and vowel sequences containing a word boundary came next under consideration. Only qualitative observations are available, since the test material was not suitable for a quantitative treatment of the data. Limitations of space make it impossible to present more than a single example. Figure 4 contains an oscillogram, a fundamental frequency curve, and an intensity curve of the two utterances Ilmad on kuivad ("The days are dry") and Selleks kulus terve eluiga ("It took a whole lifetime"). The comparison is between the long diphthong /ui/ in kuivad and the /u/ + /i/ sequence in eluiga, which contains a word boundary between /u/ and /i/. The intensity curve shows an additional peak during the second component of the /u/ + /i/ sequence eluiga. Such separate peaks were frequently found in V + V sequences; they did not occur in diphthongs.

In summary, a complex set of distinctions was found between diphthongs and V + V sequences. The difference between long diphthongs and V + V sequences was partly due to the difference in phonetic quality between the second component of diphthongs and between stressed vowels. The difference between V + V sequences and overlong diphthongs was primarily durational. Intensity differences provided an additional clue that seemed to be relatively independent of vowel quality. An unexpected result was the discovery that the overlength of long diphthongs is distributed evenly over both components of the diphthong. This finding supports the assumption that the domain of overlength is the whole syllable rather than one of the segments of the diphthong.

Table I. Comparison of stressed monophthongs with the first component of diphthongs.

Vowel	Number of occurrences	Average Duration in csec	Formant frequencies in cycles per second		
			F ₁	F ₂	F ₃
Short /i/	15	8.6	395	2495	3115
Long /i/	4	14.7	350	2540	3200
Overlong /i/	12	19.4	325	2560	3320
/i/ as V ₁ *	2/3	11.5/14.0	380	2475	3035
Short /e/	13	9.6	585	2130	2940
Long /e/	7	12.1	470	2205	2885
Overlong /e/	12	18.3	460	2350	2985
/e/ as V ₁	11/16	8.4/12.9	580	2190	2975
Short /a/	21	11.4	925	1600	2695
Long /a/	8	15.9	950	1495	2720
Overlong /a/	23	22.1	975	1445	2765
/a/ as V ₁	25/18	10.2/13.9	955	1605	2705
Short /u/	10	9.7	420	1060	2780
Long /u/	14	17.2	395	750	2855
Overlong /u/	26	21.0	385	770	2845
/u/ as V ₁	5/4	6.8/11.3	410	1000	2730

*The formant positions for the first component of a diphthong are averages for both long and overlong diphthongs. The number of each type and the durations are given separately; the first number refers to the first segment of long diphthongs, the second to the first segment of overlong diphthongs.

Table II. Second components of diphthongs.

Vowel	Second component of long diphthongs					Second component of overlong diphthongs				
	N	Dur.	F ₁	F ₂	F ₃	N	Dur.	F ₁	F ₂	F ₃
/i/	28	6.4	415	2310	3055	19	12.2	365	2560	3215
/e/	2	6.0	740	1865	2800	8	13.4	655	2060	2875
/a/	2	8.0	800	1815	2775	7	13.4	950	1620	2700
/u/	11	7.5	480	1030	2725	7	16.0	415	785	2845

Table III. Unstressed vowels in the second syllable of disyllabic words.

Vowel	Quantity of preceding syllable	Number of occurrences	Duration in csec	Formant positions in cycles per second		
				F ₁	F ₂	F ₃
/i/	Short	21	10.9	355	2520	3120
	Long	14	9.2	365	2470	3120
	Overlong	29	9.9	370	2465	3115
	Average:			365	2485	3120
/e/	Short	21	9.6	625	2030	2890
	Long	21	8.1	595	1980	2845
	Overlong	35	9.4	615	2005	2885
	Average:			610	2005	2875
/a/	Short	33	12.3	900	1530	2685
	Long	60	9.6	825	1615	2720
	Overlong	51	9.5	880	1625	2775
	Average:			870	1590	2725
/u/	Short	14	11.9	445	975	2810
	Long	9	9.7	505	1110	2815
	Overlong	21	8.9	470	1125	2735
	Average:			475	1070	2785

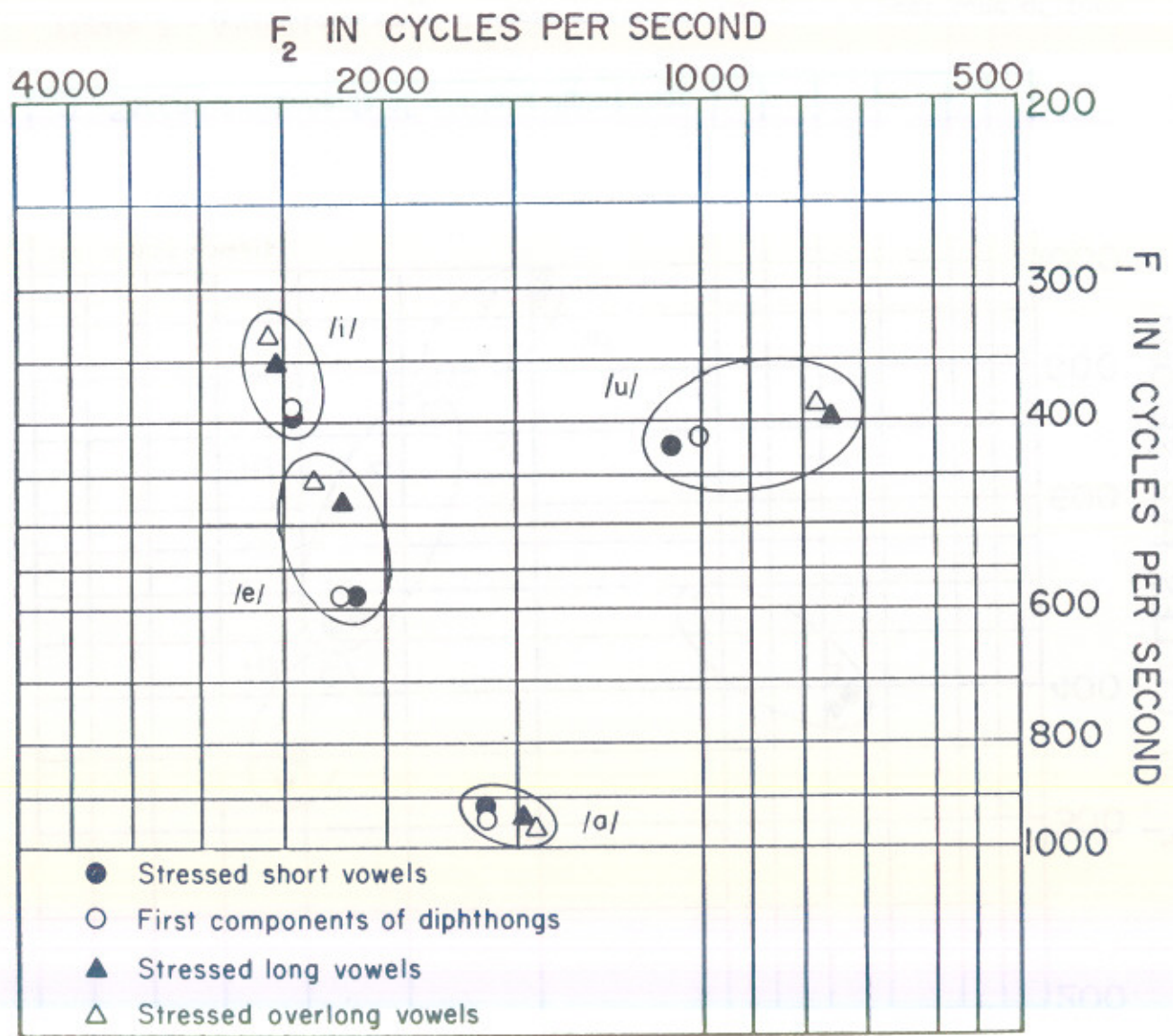


Figure 1 - Acoustical vowel diagram representing F₁ - F₂ positions of the stressed vowels /i e a u/ occurring in three quantities as monophthongs and as first components of diphthongs.

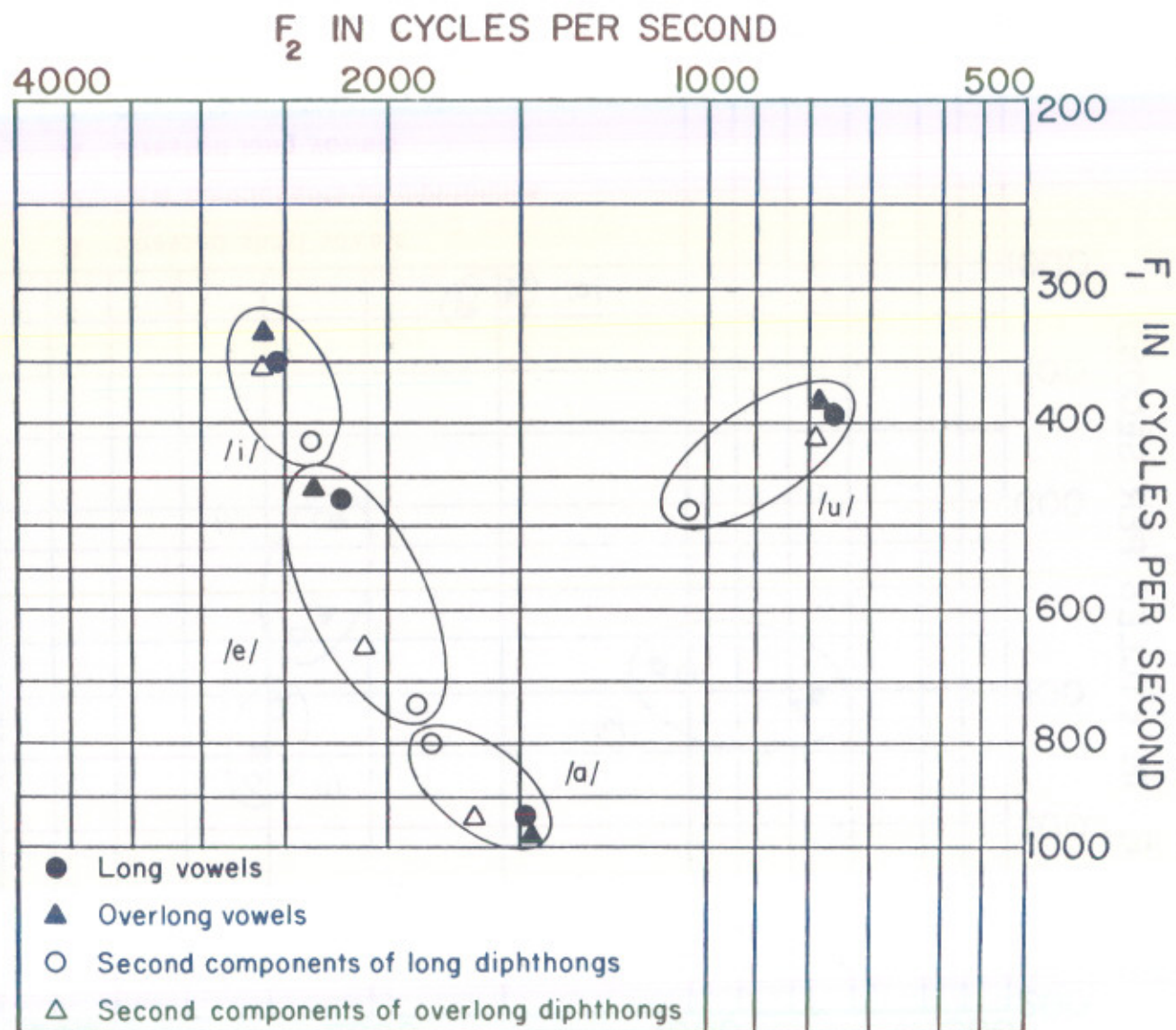


Figure 2 - Acoustical vowel diagram representing $F_1 - F_2$ positions of long and overlong /i e a u/ compared with the same vowels occurring as second components of long and overlong diphthongs.

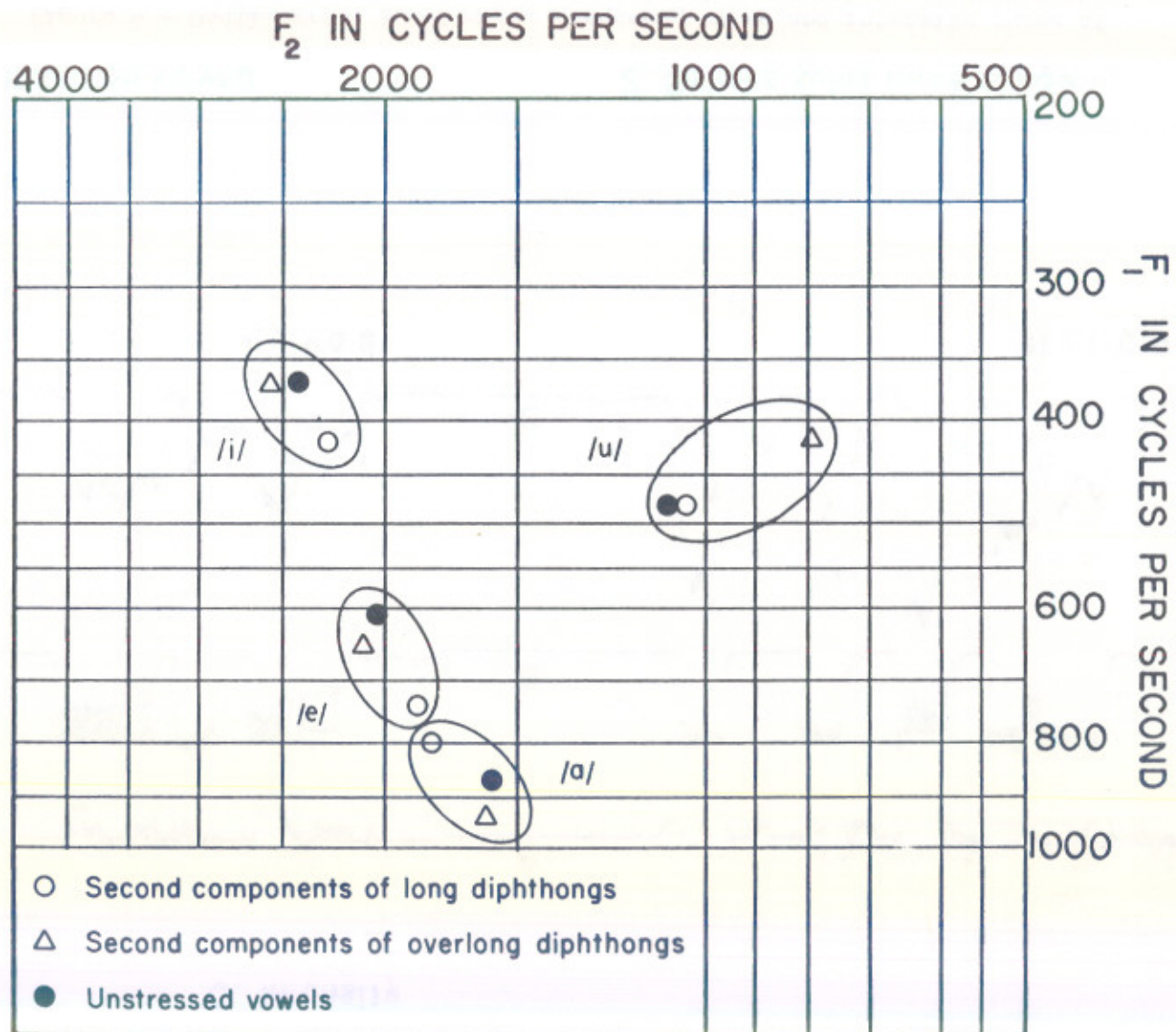
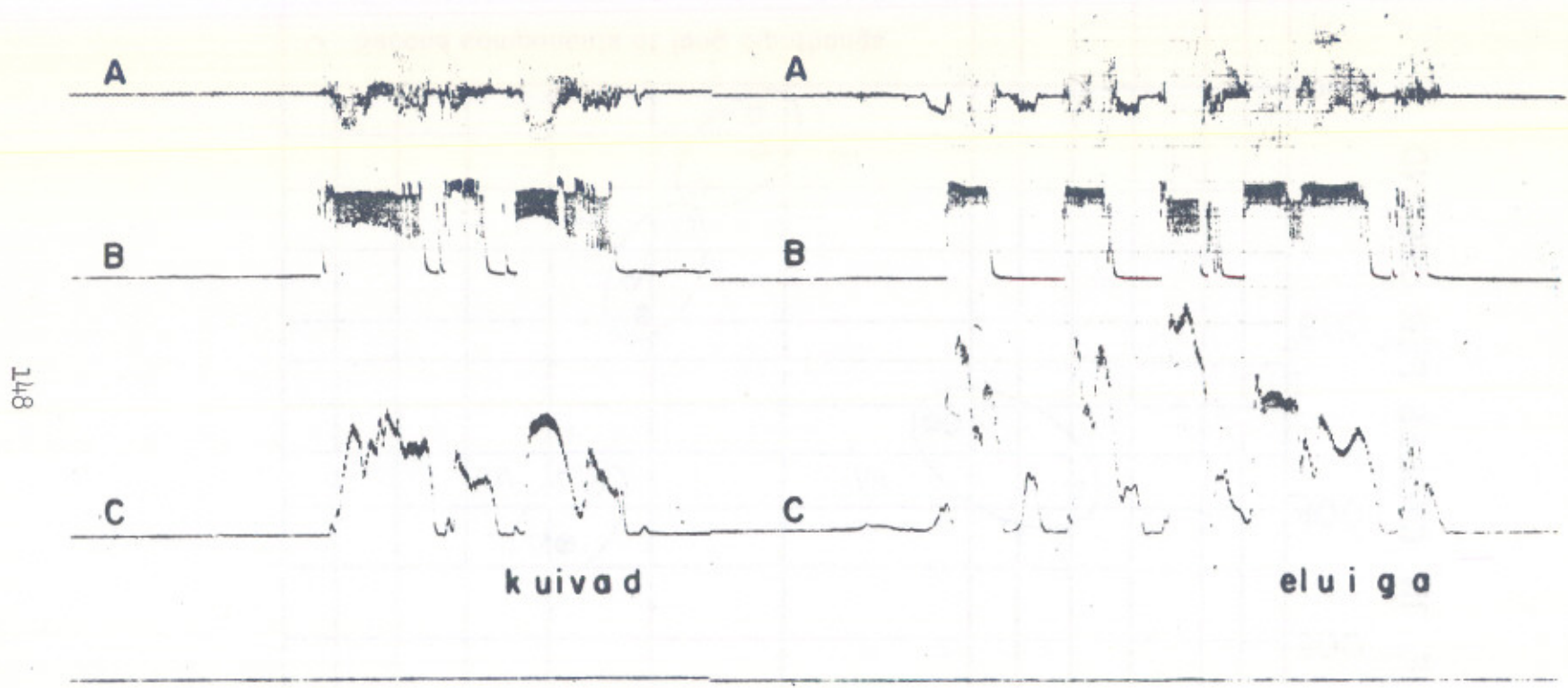


Figure 3 - Acoustical vowel diagram representing $F_1 - F_2$ positions of /i e a u/ occurring as second components of long and overlong diphthongs and as unstressed vowels in the second syllable of disyllabic words.

- A. Oscillogram
- B. Fundamental frequency
- C. Intensity



1. Ilmad on kuivad

2. Selleks kulus terve eluiga

Figure 4 - Oscillogram, fundamental frequency curve and intensity curve of two utterances, one containing the long diphthong /ui/, and the other the sequence /u/ + /i/.