B.   LINGUISTIC ANALOGUES OF THE FREE-VARIABLE

During the past year I have continued my work on the analysis and definition of those entities of a natural language system which function as structural-constants. The method of analysis, as well as the description of the grammatical category of structural-constants, is set forth in the introduction to my paper,   "On the Semantic Interpretation of Linguistic Entities That Function Structurally," which was presented in September 1961 at the First International Conference on Mechanical Translation of Languages, held in Teddington, England.

I have concentrated mainly upon the analysis of those structural-constants that function as the analogue of the free-variable in logical and mathematical systems. These are words such as 'any', 'either', 'whichever', 'ever', and 'whether'.   No grammatical category comprising these words and others that function in similar ways has yet been recognized by traditional grammarians,   so that there is no generally accepted grammatical name by which they can be called.   In traditional grammar they are called variously 'determiners', 'pronouns', 'connective pronouns', and even 'adjectives'.   Of these, I prefer the term 'determiner', since the words that correspond to free-variables are closely related to other structural-constants, such as 'the',   'a', 'all', 'some', and 'many', some of which have been given the grammatical name 'determiner'.   However, it is always risky to use in a different way a grammatical term that has an accepted

meaning, so that, for the time being, I cannot refer to them other than as 'those lin-
guistic entities that behave as free-variables'.

In the Teddington paper, a detailed analysis of the free-variables 'any' and 'either',
occurring within the structural environment of a conditional, 'if—, then—', is made. One
of the main purposes of the paper was to show that, although the definition of the lin-
guistic free-variable remains constant, its semantical significance, as an occurrence
in a sentence, changes, the change being dependent, in large part, upon the structural
properties of the containing sentence. For example, a sentence of a given sentence-
type containing an occurrence of the word 'any' must be paraphrased by a sentence con-
taining the universal-quantifier, structural-constant 'all', in order for the sentence
and its paraphrase to be semantically equivalent, whereas a sentence of a different type
which contains an occurrence of 'any' must be paraphrased by a sentence containing an
existential-quantifier, the structural-constant 'some'. The rules of replacement for
these cases were established in the Teddington paper. Since not all of the natural lan-
guages possess the device of a free-variable, and, even in those languages that do,
there does not exist a one-to-one correspondence between the terms in English and the
terms in these other languages (e. g. , French, German, Scandinavian, Russian), one
cannot translate the correct meaning of a given sentence containing a free-variable
belonging to one system into a sentence belonging to another language system without
taking into account the total structure of the sentence in question. To put this result
quite strongly, certainly no word-by-word translation would suffice unless the two sen-
tences were absolutely isomorphic. To be sure, translation involving two sentences,
from different language systems, whose structural differences are not very great in
that they can be made isomorphic by minor ad hoc rules can be effected by a word-by-
word translation; hence the partial success of word-by-word translations from certain
Western European languages into English, in which many of the sentence-types of the
input language are structurally very similar to their translations in English. Sentences
containing free-variables, however, are known to be very difficult to translate, not
because they are ambiguous, which they are not, but because the meaning of the sentence
is affected by the complexity of structure.

Since the Teddington paper was written, the analysis of these words, and other
related free-variable words, such as 'ever' and 'whichever', has been extended to cover
their occurrences in structural environments that are different from the conditional
'if—, then—', e.g., '—, unless—', '—, lest—', 'only if—, —', '—or—', 'even if—, —'.
Recent analysis has shown that these different connectives affected the meaning of sen-
tences containing occurrences of free-variables in such ways as to alter the replace-
ment rules for binding the free-variable. Thus, replacement rules for each and every
sentence-type have to be established in order to translate the meaning of the free-
variable. (I regard the problem of paraphrasing among semantically equisignificant

sentences as a problem of translation.)   For example,   'unless' and 'lest' have been shown to affect 'any' in opposite ways.   Part of the explanation of the change in meaning is that the scope of the quantifier in the semantically equivalent paraphrase is affected by different connectives.   The connective 'unless',   for example,   has been shown to represent the way in which the English language not only tells us that the two clauses are related as a conditional,   but adds the information that the event described by the clause governed by 'unless' is the necessary condition of the event of the second clause.   If 'any' occurs in the clause governed by 'unless',   it must be paraphrased by the universal-quantifier 'all'.   Thus the scope of the free-variable extends only over the 'unless'-clause.   'Even if is a connective that serves a different,   although related,   function; it,   too,   relates the two clauses as conditional but adds the information that the clause governed by 'even if is not the sufficient condition of the second clause.   The element of surprise or unexpectedness which frequently accompanies the use of 'even if' is a consequence of the fact that one usually uses 'even if in those cases when the event described by the 'even if -clause would ordinarily be regarded as the sufficient condition of the second.   In any case, the above-given definition of 'not sufficient condition' would be its canonical one, since all of the uses of 'even if' satisfy this definition in their basic, or core, meaning. The importance of this analysis of the meaning of these connectives is that it shows that the English language has structural devices to distinguish between necessary and sufficient conditionals, whereas the formal logic systems lack the symbolic means of expressing this distinction.   This is not to criticize the logical systems,   since it is not necessary,   for their purposes, to make such a distinction because the specific interpretations of the logical symbols are made in advance of the application of the system. However, it is important to realize that (a) the use of logical systems as analogues of natural language systems cannot be pushed too far,   since natural language systems are much more expressive,   and (b) no one logical system,   for example, the predicate calculus,   can serve as a model for a natural language system.   In order to use a logical system as a technique of analysis, one has to add, to the logical system under consideration, logical constants that do not appear as primitives in the logical system but correspond to structural-constants in the natural language under investigation.   (See the Teddington paper   for examples of adding restricted quantifiers to the predicate calculus.)

    Another important result of the recent analysis is the realization that there are restrictives upon the use of linguistic free-variables when certain ordering relations determine the time ordering of the happening of two events.   A time-order preposition like 'after',   which is a predicate-constant because it is a term that is denotative in that its referent is a physical relation, can be incompatible with free-variables. It is important here to realize that this incompatibility is a basic logical one, that the definition of a free-variable, although it is not defined with reference to any physical object or

relation (as is 'before') and represents rather an operation of activities of the sign-user, conflicts with the logical properties of time ordering.

In a sentence of the type 'Before John drank any milk, he went to town', the free-variable 'any', which means in this instance 'an arbitrary amount', can occur. However, if one replaces the ordering relation 'before' by 'after', a word belonging to the same category, one obtains the grammatically incorrect 'After John drank any milk, he went to town'.   The grammatical incorrectness of this sentence cannot be explained upon syntactic grounds.   This is a semantical incompatibility, whose explanation, of necessity, must make use of the definition of the incompatible words.

In this case, the employment of a free-variable in the phrase 'After John drank any milk' permits an arbitrary amount of milk to be drunk.   However, an arbitrary amount means that the amount can be arbitrarily large as well as small, since no restriction has been placed on the amount.   If the amount can be arbitrarily large, the time it takes to drink it can be arbitrarily long: in fact, it can increase to infinity.   Event A, which, like all events, has duration and direction from past to future, thus has no obligatory right-hand bound or termi-nal point.   If event A has no terminal point, it cannot be ordered as happening before B.

Since the tenses contain implicit time-order relations, it is to be expected that there will be found further restrictions upon the occurrences of free-variables in more complicated structural environments in which the tense features have been taken into account.   The method of analysis which I have developed and am still refining, however, is one in which the analysis proceeds systematically: the investigator first analyzes a feature within a simple environment and then gradually adds more and more complications.   The analysis of the free-variable, thus far, has been confined to relatively simple structural environments in which the connectives are the major feature of the sentence-types and an explicitly expressed time-order relation occurs.   The connectives, as well as the tenses,   contain implicit time-order relations; the conditional in its more common meaning contains an implicit time order because the cause precedes the effect and a purpose precedes the resulting activity.   The inner structure of the tense system is still being worked upon, and part of my program for the next year is to investigate the behavior of the free-variable with respect to the implicit time structure of the tense and the mood.

<div align="right">Elinor K. Charney</div>

<div align="center">References</div>

1.   Elinor K. Charney, On the Semantical Interpretation of Linguistic Entities That Function Structurally, paper presented at the First International Conference on Mechanical Translation of Languages and Applied Language   Analysis, National Physical Laboratory, Teddington, England, September 5-8, 1961.