XXV. LINGUISTICS*

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RESEARCH OBJECTIVES

There have been two main traditions in the study of language in modern times. The first is the tradition of "universal" or "philosophical grammar," which flourished in the seventeenth and eighteenth centuries in intimate connection with philosophy and speculative psychology. The second is the tradition of modern linguistics, a nineteenth and twentieth century phenomenon that was also closely interwoven with the philosophy, psychology, and anthropology of its day. Philosophical grammar was concerned with general, universal principles of language structure; it attempted to ground these principles in a theory of mental processes, and to illustrate them with detailed study of particular languages. By modern standards, the work lacked care and attention to detail, and the conclusions that were reached, though often highly insightful, were deficient in empirical support and sharpness of formulation. In comparison, modern nineteenth and twentieth century linguistics has achieved a much higher standard of rigor, and has accumulated linguistic data of an incomparably greater scope and variety. It has been limited, however, by a much narrower interpretation of the purposes and goals of linguistic science. It has eschewed theory construction in favor of elaboration of methods of analysis, and it has not been concerned with linguistic universals — often, in fact, it has denied that there are, in any significant sense, genuine and deep universal principles that constrain the form and use of human language.

The work in linguistics at the Massachusetts Institute of Technology represents, in a sense, a synthesis of these two major traditions. In terms of its general goals and even many of its specific hypotheses, this work has a very classical flavor. But in the range

and reliability of evidence and precision of formulation, this work accepts and attempts to surpass the standards of modern structuralism.

For classical linguistics, a central property of human language is what we can call its "creative" aspect, that is, its unboundedness and freedom from stimulus control. Under ordinary circumstances, what a person says is not determined by the stimuli that impinge on him or by identifiable physiological states, to any significant degree. The unboundedness of normal language is evident from the fact that almost every linguistic utterance produced and understood is quite new, not similar in any physically defined sense to those that have been produced in the past experience of the language user, and not conforming to familiar or memorized patterns, in any meaningful sense of the notion "pattern." Nor are these utterances "generalizations" from past experience, in any sense of "generalization" known to psychology or philosophy. Nor can language use be described in terms of "habits" or "repertoires of responses." In recognizing these facts, philosophical grammar was entirely correct and to the point.

To account for this creative aspect of normal language use, we must attribute to the language user knowledge of a certain organized system of rules that establish a sound-meaning relation for an infinite class of sentences. This knowledge is, of course, quite unconscious, but it is nonetheless perfectly real. Thus it is quite likely that no one reading this report has ever seen, heard, or produced the sentence

(1)   What disturbed John was being disregarded by everyone.

Yet every reader will understand that the sentence may be roughly paraphrased by either (2) or (3):

(2)   Everyone was disregarding the thing that disturbed John.

(3)   The fact that everyone was disregarding him disturbed John.

Thus sentence (1) is ambiguous, its possible interpreations being (2) or (3). If the word "our" is inserted in (1), giving (4), the sentence is unambiguous.

(4)   What disturbed John was our being disregarded by everyone.

The interpretation of (4) can only be along the lines of (3), with "him" replaced by "us." Or, to choose an example from a totally different sphere of language, speakers of English would know that the plural of the word dap is daps, whereas that of linch is linches (with es rather than s), in spite of the fact that most of the speakers would neither know the meanings of these words nor have heard them before.

A speaker of English has knowledge of these facts and numerous others without having been exposed to these sentences or to any explicit "teaching." He has mastered a system of rules that determine both the phonetic form of sentences (1)-(4) and their various semantic interpretations. The first task of the linguist who is investigating the structure of English is to try to determine this system of rules, the system that is called the "generative grammar of English." This generative grammar has in some manner been internalized by every speaker of English; it determines the pairing of sound and meaning for an indefinitely large range of possible sentences. It is this internalized generative grammar that makes possible the normal, "creative" use of language.

The discovery of the generative grammar of English, and other languages, is, however, only the first task that faces the linguist. To the extent that such grammars have been developed and validated, the linguist can then turn to the question of how they are put to use, by the speaker or hearer, in normal conversation, in literature, in internal monologue, and so on. Furthermore, he can turn to the basic problem of classical linguistics: What are the universal principles that limit the form of such generative grammars? Clearly, there must be universal principles with a very narrow and limiting character. If this were not true, it would be impossible for the child, presented with scattered samples of a language for an extremely short period, to determine for himself the generative grammar of this language. But this is a task that normal humans accomplish with great facility. This indicates that they must approach the task forearmed with

highly specific advance knowledge (obviously, unconscious) of the possible form that a generative grammar must assume. To put it loosely, although the child cannot "know" in advance whether the language to which he is exposed is English, Chinese, and so on, he must "know" that it is a "human language" of a highly special sort, which can only vary in very restricted ways. The problem of "universal grammar," now, as in the seventeenth century, is to determine the principles that limit the variety of human language and make possible the acquisition of language. To the extent that such principles can be formulated and validated, we gain insight of an unparalleled kind into the innately determined character of human mental processes.

We feel that recent work, much of it carried out at M. I. T. , makes it possible to formulate a fairly precise theory of universal grammar in this sense, a theory which is, furthermore, reasonably well supported by substantial empirical evidence from a variety of languages. The major goal of our research, then, is to sharpen and deepen the theory of generative grammar, and to use it as a basis for the study of cognitive processes.

Since many of the problems of language lie in the area in which several disciplines overlap, an adequate and exhaustive treatment of language demands close cooperation of linguistics with other sciences. The inquiry into the structural principles of human language suggests a comparison of these principles with those of other sign systems, which, in turn, leads naturally to the elaboration of a general theory of signs, semiotics. Here linguistics touches upon problems that have been studied by philosophy. Other problems of interest to logicians — and also to mathematicians — are touched upon in the studies devoted to the formal features of a general theory of language. The study of language in its poetic function brings linguistics into contact with the theory and history of literature. The social function of language cannot be properly illuminated without the help of anthropologists and sociologists. The problems that are common to linguistics and the theory of communication, the psychology of language, the acoustics and physiology of speech, and the study of language disturbances are too well known to need further comment here. The exploration of these interdisciplinary problems, a major objective of this group, will be of benefit not only to linguistics; it is certain to provide workers in the other fields with stimulating insight and new methods of attack, as well as to suggest to them new problems for investigation and fruitful reformulations of questions that have been asked for a long time.

<div align="right">M. Halle, N. A. Chomsky</div>

A. PSYCHOLOGICAL REALITY OF THE LEXICALIST HYPOTHESIS

The relation among derived nominals, gerunds, and verbs has been investigated by examining the confusions among these classes. Subjects were presented with mixed lists of such items and required to pick the recurring items from subsequently presented similar lists.

In experiment I, subjects were presented with four pairs of lists. The first list of each pair (the inspection list) contained 50 words, each of which was either a verb (V), a derived nominal (DN), or a gerund (G); the category of each item was randomly selected. The second list (the response list) was made up of the same roots, but the choice of V, DN, or G was again made at random. Thus, there was approximately 1 chance in 3 that a particular item would be identical on the inspection and response lists. Subjects were given 30 sec to examine a list; response lists were presented immediately following the inspection lists. Results of this experiment were similar to those reported

below for experiments II and III, but the differences were not statistically significant.

In experiments II and III the procedure was similar to that for experiment I, except that each test word was presented in a sentence context. The lists were only 25 sentences long rather than 50 words long. The test item (G, DN, or V) was underlined in each sentence. Context sentences were kept as similar as the shift in class would permit. In experiment II inspection lists were viewed for 75 sec; the response list was presented immediately following the inspection list. In experiment III inspection lists were viewed by the subjects for 3 min; the presentation of the response list was delayed 15 min (subjects were required to perform an irrelevant distracting task during this interval).

In experiments II and III, DN's were identified as V's significantly more often than as G's; G's were identified as V's significantly more often than as DN's; in experiment III, V's were identified significantly more often as DN's than as G's. Put another way, DN and G were least likely to be confused with each other, and V and DN were most likely to be confused with each other, with the likelihood of V and G confusions somewhere intermediate.

These results suggest that both verbs and derived nominals and verbs and gerunds are more closely related to each other than are derived nominals and gerunds. In experiment III, the results suggest further that verbs and derived nominals are more closely related than are verbs and gerunds. Thus we might represent the relationships as

Verb   (1)   Derived Nominal

(2)   (3)

Gerund
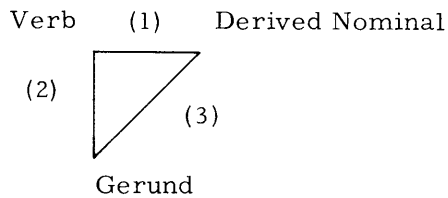
where distances represent relative degree of relatedness. At present, these results must be advanced with some caution. A variety of experimental factors that might prove relevant are being explored.

Unless the difference between (2) and (3) is explained nonsyntactically, these results seem to best fit a psychological model based on the lexicalist hypothesis (see Chomsky[1]). Verbs and derived nominals would be assumed to be closely related because they stem directly from the same lexical entry, while gerunds would be expected to be related to verbs and not to derived nominals, because of the involvement of the former in the transformational derivation of the gerund.

D. Caplan

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B. STRUCTURE IN SENTENCE MEMORY

Some words from a sentence prompt recall of that sentence better than others.[1] It appears that the grammatical relation of the prompt to the rest of the sentence determines its effectiveness as a prompt, and this hypothesis is supported by the observation that an increase in the number of relations involving the prompt word increases its effectiveness as an aid to recall.[2] These findings support the view that one remembers a sentence in a linguistically coded form.

While this is both experimentally and intuitively supported for long-term memory, there is no obvious reason to suppose that the same should be true of immediate memory, which is sometimes thought to be simply a transduction of the input signal. Nonetheless, similar behavioral consequences of grammatical relations are observed. For example, the latency with which one provides the next word, given some word from a previously presented sentence, is less when the same words are grammatically related than when they are not related.[3]

When two words are presented for recognition (in order to overcome the requirement of surface structure contiguity imposed by the next word task), a noun and verb in subject relation, in either matrix or embedded sentence are recognized more quickly than pairs of the same nouns and verbs which are not so related.[4] Thus, in sentences like

The scouts the Indians saw killed a buffalo

the probes Indians saw and scouts killed are recognized faster than scouts saw and Indians killed. Furthermore, probes containing scouts tend to be more quickly recognized than those containing Indians.

Among other things, the object relation of scouts and saw, and/or the matrix rather than embedded stature of scouts, might account for facilitation of probes containing it. Other research has shown that the order in which the words appear in a probe (noun-verb or verb-noun) causes changes in recognition latency, depending on the relation of the words in the sentence that is being tested.[5] Thus, given either active or passive versions of sentences like

The hostess delighted the foreigner
The foreigner was delighted by the hostess

hostess delighted is recognized faster than delighted hostess. On the other hand, delighted foreigner was recognized faster in the active version and foreigner delighted, in the passive version. The results suggest that an underlying subject relation facilitates recognition, even at the expense of surface structure order, but that an underlying object relation is of no effect.

An experiment was conducted to determine whether subject and object relations are

facilitative in embedded and matrix sentences. Probes of every subject relation and every object relation in the surface structure of the sentences below were recognized faster when stated in noun-verb and verb-noun order, respectively.

1. The fool that the idiot advised advised the lunatic.
2. The fool that advised the idiot advised the lunatic.
3. The fool advised the idiot that advised the lunatic.
4. The fool advised the idiot that the lunatic advised.

Object relations were recognized slower in embedded sentences than in matrix sentences, while subject relations were recognized equally quickly in both. The increase of latency when object relations were probed in reverse order (noun-verb) was not so great as that for subject relations.

If underlying (only) relations have similar effects, then there should be no preferred order for probes containing head nouns of relative clauses in which the relation of the head noun to the embedded verb differs from that to the matrix verb (1 and 3, above). The hypothesis was supported when the subject noun was relativized (1), but disconfirmed when the object noun was relativized (3). For some speakers, the last case is ambiguous: the relative clause either modifies the object noun or has been post-posed from the subject noun-phrase. The results are consistent with this view, but it has no other support within this experiment.

It is clear then that even immediate memory is linguistically coded. In all cases examined here surface and underlying structure are congruent, since the aforementioned head nouns provide equivocal results. Therefore, no decision can be reached about whether the encoded form is adequately described by surface structure or depends on some deeper analysis.

E. C. T. Walker

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C. ACQUISITION OF CONDITIONED RULES

Children's appreciation of the consequences of certain linguistic constraints has been investigated by using imitation, paraphrase, and judgments of preference. Children from 49 to 57 months old were studied; each child was interviewed at least 6 times at intervals of approximately 2 weeks. The linguistic constraints examined were the following.

A. Putatively global constraints

    1. Complex NP constraint (cf. Ross[1]).

    2. Crossover condition (cf. Postal[2]).

B. Phrase structure constraints

    1. Strict subcategorization rules.

    2. Selectional restrictions.

    3. Volitionality in verb-verb restrictions (cf. Fischer and Marshall[3]).

C. Conditions on transformations and surface structures

    1. Pronoun-object condition

    2. Unspecified object deletion

    3. Pronoun deletion in relative clauses

    4. Equi-NP deletion

Sentences were presented in pairs. In one sentence a rule applied (or not applied, if a condition would be violated by its application) correctly; in the other sentence, the rule was misapplied. The child repeated each sentence, and was asked to choose which sounded better and to give reasons for his choice. Occasionally he was asked to paraphrase an ungrammatical sentence in order to determine how the sentence was being interpreted.

All children proved to be sensitive to the complex NP constraint and insensitive to the crossover condition. All children were able to talk about what was wrong with a 'semantic' violation better than a 'syntactic' one. They did, however, correct some syntactic violations spontaneously in repetition, notably Equi-NP deletion, object pronoun deletion in relative clauses, and, with older children, subject-verb agreement. Older children (and the same children as they became older) did better on phrase structure constraints than younger children.

The pronoun-object condition was followed with particle movement, but consistently violated (in terms of adult grammar) with indirect object placement. When an unspecified object was incorrectly deleted, the resulting sentence was often interpreted as a

passive. In relative clauses in which the <u>subject</u> pronoun was not deleted, the sentence became incomprehensible. If the <u>object</u> pronoun was not deleted, the sentence was understood as if the pronoun had been deleted. This result obtained also in the case of Equi-NP deletion.

Of all rules considered, subject-verb agreement showed the most variation, both in order of acquisition of that rule relative to other rules and in how the rule was acquired. It seems that agreement came first with irregular verbs and later with regular ones. When children finally have acquired the rule, it is the verb that agrees with the subject; but before the rule is fully acquired, there is variation among children even in this respect. This was the only transformational rule that we witnessed being acquired by any of the children during the two and one-half months that we observed them (cf. Fischer[4]).

<div align="right">Susan D. Fischer</div>

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

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D. DISCRIMINATION AMONG PHONES BY INFANTS

An attempt was made to teach infants (3 1/2-4 1/2 months old) to discriminate among syllables beginning with 3 English phones. Two of these phones were perceptually identical, but acoustically distinct ([p] followed by two different vowels). The third was perceptually and acoustically distinct ([g] followed by a third vowel). Infants in one group were reinforced for responding to a set composed of the perceptually identical (for adults) phones; e.g., reinforced for [pi] and [pa] and not reinforced for [gu]. Infants in a second group were reinforced for responding to a set composed of perceptually distinct phones; e.g., reinforced for [pi] and [gu] and not reinforced for [pa]. That the first group succeeded in discriminating while the second group failed indicates that the discrimination was a function of the perceptual identity of the phones in the reinforced set. For, if the infants had depended on the acoustic distinctions among the phones to discriminate, we should expect the second group to have succeeded as well as the first. That perceptual constancy can be found at such an early preverbal age suggests that this constancy depends on innately determined phonological identities.

<div align="right">J. A. Fodor, M. F. Garrett, Diana B. Shapero</div>

E. TOWARD A THEORY OF SENTENCE INTERPRETATION

1. Introduction

The problem of sentence interpretation is essentially (i) to characterize the kinds of information hearers must extract from the sentences of a discourse if they are to understand it; (ii) to formulate explicit hypotheses about how a hearer could compute such information, given the available input data; and (iii) to determine which of perhaps many functionally equivalent hypotheses correspond to the strategies actually employed by users of a language.

The research reported here is concerned with fragments of points (i) and (ii). While the goal of a theory of sentence interpretation is a full account of (iii), it is clear that progress in that direction presumes the explicit functional analyses indicated in (i) and (ii) taken over a wide range of sentence types.

2. Syntactic Analysis

It is fair to suppose that a minimum requirement on the interpretation of an utterance is an analysis of it into its main and subordinate sentences or clauses. We are exploring the validity of the hypothesis that the first NP is the main sentence subject and the last verb "paired" with it is the main V; while other clauses, relatives or complements, are overtly marked and generally maintain their integrity in surface structure with the exception that certain NP's of those clauses may not be specified. Just as the main NP and V must be determined and paired, so must each subject NP and V of the various embedding types exemplified in (1)-(7) below. In order to accomplish this the missing NP's must be identified.

(1) The professor that the students believed was arrested died.
(2) The boy students believed the professor expected died.
(3) The boy the students believed the professor expected to live died.
(4) The girl that Bill wanted to leave is lovely.
(5) The workers that appeared tired.
(6) The workers that appeared tired quit.
(7) The dog the rat bit died.

Analysis proceeds on a left-to-right basis, storing NP's in a last in-first out buffer, NP dummy markers being inserted at relatives and infinitives where an NP must be recovered and identified. Whenever a verb is encountered, the last-in NP which is not a dummy is taken as its subject, and that NP or the dummy that went in after it is removed from the buffer. All verbs are tentatively assumed to have object NP's that follow them, with the provision that only an NP dummy, identified by its predecessor in the buffer, can be inserted to replace a missing object; as in an object relative (7).

When the first NP put in the buffer is paired, its verb is considered the main verb, e. g., tired in (5) or died in (7); unless another unpaired verb turns up, e. g., quit in (6) or died in (1). Such V-V contiguities as appeared tired, believed was arrested, bit died, etc., require important decisions in the clausal recognition process: Does the first V dominate the second as a complement fragment, e. g., tired in (6), or is the second in fact a higher V, e. g., tired in (5)? In spoken English, juncture and intonation provide important cues; without these a decision cannot be finalized until the next word, if any, is processed. Thus at tired in (6), juncture and sentence intonation aside, the workers would be assigned to it as subject. Given quit, however, tired is no longer the last verb to be paired, and barring conjunction, must be subordinate to appeared as a complement fragment. Notice, however, that the workers is the subject NP for tired in either case, (5) or (6). In general, when one has decided that a particular NP-V are the main subject and verb and another V is encountered, that NP-V combination must be reassigned as a complement sentence to the prior verb.

3. Semantic Representation

Given an analysis of an utterance into its clausal structure, the burden of semantic interpretation falls on the semantic representation of the words in those clauses. It should be noted that the information contributed by syntactic and semantic analyses is not independent (cf. Limber[1]). While the syntactic analysis described briefly above was intended to operate for the most part on so-called function words and inflections, such information is neither necessary nor sufficient for the interpretation of many sentences in context.

If the semantic representation of a word is viewed as the contribution which that word makes to the interpretation of its sentences, it appears that such representations are not solely carriers of semantic material, but in some cases also act like functions or sub-routines operating on context, discourse, and/or intra-sentence parameters whose output is an inference relevant to the interpretation. The a sentences below suggest inferences that might be drawn in conversation from the b sentences. These have been discussed by Limber.[2,3]

> (8) a According to state law, this water is warm enough to swim in.
> b This water is warm enough to swim in.
>
> (9) a Bob is fast at solving two-move chess problems.
> b Bob is fast.
>
> (10) a This knife is good for picking teeth.
> b This knife is good.
>
> (11) a Chess is easy to learn.
> b Chess is easy.

(12) a Quincy is tall for a basketball player.

     b Quincy is tall.

(13) a Merrill suggested that we buy a goose for the secretary.

     b Merrill suggested a goose for the secretary.

<div align="right">J. Limber</div>

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