8 The Role of Grammar in the Use of Language

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> *We have seen that a model of sentence comprehension is, in effect, a device which associates token wave forms with messages. Very little is known about how such a device might operate, though I would guess that, if we started now and worked very hard, we might be able to build one in five hundred years or so.*
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> — J. A. Fodor (1975, p. 167)

I. THE TASK OF LINGUISTICS

Ultimately, the task of linguistics is to give an account of the ability of human beings to produce and to comprehend the expressions of a language in a manner that is appropriate to the contexts in which they are used.[1] As with most tasks of this magnitude, the most effective strategy for dealing with it is a "divide-and-conquer" one, in which the task is broken down into a number of subtasks and the accomplishments in each domain are then integrated into an overall account.[2] For example, we may divide the

[1]Throughout this paper I use the term "linguistics," rather than "psycholinguistics." No special significance should be attached to this wording. The ability in question is what Chomsky has called "the creative aspect of language use" (1966, pp. 17–18; 1972a, pp. 11–13).

[2]Specific arguments for adopting a divide-and-conquer strategy in dealing with the task of linguistics are given in the "Introduction" to Bever, Katz, and Langendoen (1976). See also Bever (1974).

task of linguistics into the study of the principles (or rules) that determine the structures of the expressions of human languages and of the principles (or rules) that determine the appropriate use of those expressions. The former study may be called the study of linguistic competence; the latter, the study of linguistic performance.[3] The study of linguistic competence and linguistic performance can be further divided into the study of those aspects that all languages of necessity have in common and of those aspects that are peculiar to individual languages. The study of those aspects of linguistic competence that all human languages of necessity have in common is now generally called the study of universal grammar,[4] and while there is no generally agreed upon term for the study of those aspects of linguistic performance that all languages of necessity have in common, the term "universal performance" suggests itself. We may suppose further that the properties of universal grammar and of universal performance are properties of mind, so that the "necessity" with which all languages have certain common properties is "biological necessity."[5] The further divisions of the study of linguistic competence (both universal and language-particular aspects) into the study of syntax, semantics, morphology, phonology, and phonetics is familiar and requires no further discussion here.[6] On the other hand, how the study of linguistic performance may be further articulated is perhaps less familiar, and some discussion of this matter is called for.

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[3]This use of the term "linguistic competence" follows that of Chomsky (1965). However, our use of the term "linguistic performance" differs from his, in that Chomsky includes in the study of linguistic performance such phenomena as hesitations, false starts, and slips of the tongue, that clearly have nothing to do with "appropriate use." By "linguistic performance" we have in mind a notion like that of "communicative competence."

[4]This term was commonly employed in this sense in seventeenth-century rationalist discussions of the nature of human language. It fell into disuse with the rise of empiricist views of language, and has only been recently revived. For discussion, see Chomsky (1966).

[5]Alternatively, we may suppose that the systems of universal grammar and/or of universal competence (and similarly the grammars and performance systems of individual languages) are abstract systems that happen to be representable in some form by human minds. Viewed in this way, the "necessity" with which all languages have certain common properties is essentially definitional in nature. The difference between these alternative views of the relation between language and mind are of considerable philosophical interest, but for the present at least have no consequences for the way in which linguistic investigations are carried out.

[6]This is not to say that there is total agreement that all these divisions of the study of linguistic competence are necessary. Indeed, the main theoretical issue separating "generative semantics" (Lakoff, 1971; Postal, 1972) from "interpretive semantics" (Chomsky, 1972b, Jackendoff, 1972; Katz, 1972) is whether syntax and semantics can clearly be isolated as separate aspects of grammatical study, while form-content analysis (discussed in this volume by Diver) makes do without syntax entirely.

II. DIVISIONS OF THE STUDY OF LINGUISTIC PERFORMANCE

As language users, we either produce or we comprehend linguistic expressions; thus we may broadly divide the study of linguistic performance into the study of production (further divided into the study of the production of speech, of manual signs, and of writing) and of comprehension (further divided into the study of the comprehension of speech, of manual signs, and of writing). Each of these processes not only takes place in time, but ordinarily takes place in no more time than is required to process linguistic expressions as physical events (for example, we ordinarily understand speech in no more time than it takes us to hear it). To account for the extraordinary efficiency of the human language processing mechanisms, we must assume that representations of the significance[7] of expressions are built up as those expressions are being received and produced. Furthermore, it would appear necessary to assume that separate, but integrated, processing subsystems operate simultaneously, in parallel, during the reception and production of linguistic expressions. Accordingly, each performance system is best analyzed as a set of interacting subsystems, much as the system of linguistic competence is.

Because the significance of an expression is usually distinct from what that expression literally means (i.e., distinct from its semantic interpretation), the question arises whether semantic interpretations are computed in the course of obtaining representations of significance. Elementary theoretical considerations would lead one to conclude that they are, and though we lack systematic experimental evidence that would bear on this question, what experimental evidence we do have (Clark & Lucy, 1975) supports that contention. If the contention is correct, then we can divide the components of any performance system into those that are involved in the construction of what expressions mean and those that are involved in determining what they signify in context, given what they mean. The former components of a system of language use are like those of the system of linguistic competence in that they are involved in the construction of the representation of the sound-meaning relations of linguistic expressions.[8] We, therefore, refer to the former components of a performance system as a "performance

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[7]For this term, see Katz and Langendoen (1976, p. 10). The significance of expression is its meaning in the context of its use.

[8]It is clearly not necessary for a performance system, such as that of speech comprehension, to construct the entire grammatical representation of an expression in order for that expression to be appropriately used. However, we must assume that that system is in principle capable of constructing its entire representation.

grammar" and to the system of linguistic competence as the "competence grammar."

III. THE RELATION OF PERFORMANCE GRAMMARS TO COMPETENCE GRAMMAR

We come now to a problem that has greatly exercised linguists and psychologists alike over the past 15 years or so: what is the exact nature of the relation between the competence grammar of a language and the various performance grammars of that language? At one extreme is the possibility that for each language there is exactly one performance grammar and that it is identical to the competence grammar of that language. At the other extreme is the possibility that performance grammars construct representations of linguistic expressions by principles of their own, without recourse to the principles of competence grammar. Of these two extreme possibilities, the first appears more attractive on general simplicity grounds, and it is, therefore, not surprising that it was this possibility that was first seriously entertained by linguists following the advent of the theory of transformational-generative (TG) grammar. However, it is easy to see that the principles of TG grammar, whether those of Chomsky (1955) and (1957), Chomsky (1965), Chomsky (1972b) and (1975), or even those of Bresnan (1978), cannot possibly serve directly as the principles of performance grammars. First, it is manifest that performance grammars construct representations of linguistic expressions essentially from beginning to end (from left to right, assuming Indo-European writing conventions), whereas the principles of any TG grammar do not. Second, performance systems directly construct, as a first step, representations comparable to surface-structure representations given by TG grammars, whereas TG grammars do not directly construct such representations.[9]

Once it became abundantly clear that the principles of TG grammar cannot themselves serve as the principles of performance grammars, linguists who chose to maintain one form or another of TG grammar as a theory of linguistic competence found themselves compelled to move closer and closer to the second of the two extreme positions just described. At the same time, many other linguists chose simply to ignore the relation between competence and performance grammars entirely, to concentrate their attention solely on the development of performance grammars, and perhaps also to claim that the study of TG-based linguistic competence is

[9]For further discussion of the inappropriateness of TG grammars as mechanisms for the construction of structural descriptions in performance, see Fodor, Bever, and Garrett (1974, chaps. 5–6).

devoid of interest (Derwing, 1973). Finally, there has developed a movement to replace or to alter TG theory of linguistic competence in favor of a theory of competence grammar whose principles can be directly used by the various performance systems. Given our discussion so far, it is clear that the grammatical principles that such a theory must provide directly construct surface representations essentially from left to right, whatever else they may do (for example, construct semantic representations). The best-developed theory that meets both of these requirements is that of augmented transition networks (ATNs), formulated initially by Thorne, Bratley, and Dewar (1968), construed as a theory of linguistic competence by Woods (1970), and applied to problems of linguistic analysis by a number of researchers, notably Kaplan (1972) and Wanner and Maratsos (1978). As Woods observes, ATN theory is as capable as that of TG grammar of providing for grammars that generate all and only all of the expressions of a human language.[10] Therefore, in order to determine the adequacy of ATN grammatical theory, relative to the theory of TG grammar, as a theory of linguistic competence, one must assess their relative capacities for expressing true linguistic generalizations.

ATN theory is criticized on these grounds by Dresher and Hornstein (1976), who contend that proponents of ATN theory have ignored the basic questions of grammatical-theory evaluation. However, they are able to sustain this contention only by failing to consider those discussions of ATN theory, in particular Woods (1970), in which those questions are raised. Woods claims, in fact, that ATN theory does provide a notation in which true generalizations about linguistic structure are indicated by the brevity of the statement of the principles that express them, just as in TG theory. Whether this claim can be sustained under close scrutiny, of course, remains to be seen, but it certainly cannot be dismissed out of hand. It is ultimately an empirical question, yet to be decided, whether a theory of grammar, such as ATN theory, in which first surface-structure representations are built up left to right, is to be preferred as a theory of linguistic competence, to a theory, such as that of TG grammar, in which linguistic representations are constructed in some other way.

More important, however, than the question of the adequacy of ATN theory of grammar is the correctness of the claim that the grammar of competence also serves as the grammar of the various performance systems. By definition, the expressions constructed by the competence grammar of a given language are the grammatical expressions of that language. On the other hand, the expressions constructed by a performance grammar of a given language are the acceptable expressions of that

[10]Like the theories of TG grammar, ATN theory provides for grammars that are capable of generating every recursively enumerable set; hence of generating every human language.

language. To hold that the competence and performance grammars of a language are the same is to hold that the set of grammatical expressions of a language is identical to the set of acceptable expressions of that language. Now we know that under ordinary conditions, those sets appear to have quite distinct membership: there appear to be grammatical expressions that are unacceptable and acceptable expressions that appear to be ungrammatical (Chomsky, 1965, pp. 12–14; Langendoen & Bever, 1973; Bever, Carroll, & Hurtig, 1976). Thus, the question arises whether under ideal conditions, the acceptable and grammatical expressions of a language converge. Unfortunately, the answer to this question is unknown, though there are fairly good grounds for conjecturing that it is negative (for discussion, see Langendoen, 1977). Hence, we may properly be skeptical about the contention that the performance principles by which linguistic expressions are constructed are to be identified with the principles of competence grammar.

But if this is the case, then the second of the two extreme positions concerning the relation of competence to performance grammars remains a viable option. We can continue to maintain some version of a TG theory of linguistic competence and at the same time to feel free to develop theories of performance grammars as we see fit. Such theories would still bear a significant relation to the theory of competence grammar, in that the performance principles would be formulated as a function in large part of the principles of competence grammar. For example, those principles would presumably make systematic and extensive use of the constructs of competence grammar — the various grammatical (phonetic, phonological, morphological, syntactic, and semantic) categories and relations, etc. However, to make this position at all attractive, it is necessary to go into some detail as to how it might work.

IV. TOWARD AUTONOMOUS PERFORMANCE GRAMMARS

In Section II, it was argued that any given performance system constructs representations of linguistic expressions by means of a set of interacting subsystems operating in parallel. It may be maintained further that the function of the first subsystem (or group of subsystems) of the speech comprehension mechanism that is activated by the perception of linguistic input is to construct a surface representation of the perceived input expression (i.e., to "parse" that expression). Following Fodor, Bever, and Garrett (1974), we may assume that once this subsystem completes the job for some portion of the input material, it sends its analysis off to a second subsystem, which continues the linguistic analysis; meanwhile, the comput-

ing space available to the first subsystem is cleared, to make room for computations on the next portion of the input material.

On this view, one of the major problems faced by the first subsystem is how to divide up the input material into units that are large enough so that a significantly useful amount of analysis can be carried out, and yet not so large as to exhaust the relatively small amount of computation space available to it. Ideally also, the units should be as independent from one another as possible, to minimize the number and kinds of relations that subsequent processing subsystems would have to establish among them, in order for the entire input to be comprehended. Reasoning of this sort leads us to expect that the first subsystem will attempt to analyze the input material into units, or "chunks," that correspond to major constituents in the surface-structure representation it is trying to construct, and as far as possible into units that do not appear to have elements missing from them that they ordinarily have. The results of experiments carried out by Carroll (1976) suggest that, indeed, chunking is carried out in this fashion.[11]

Exactly how the first subsystem parses each chunking unit must remain, for the moment, a matter of conjecture.[12] We may, however, presume that the subsystem is constructed as a finite-state transducer that assigns surface structures to input strings up to some fixed finite degree of recursion.[13] Accordingly, the inability of performance systems, under ordinary conditions, to parse multiply center-embedded expressions is simply a consequence of the finite-state character of the first subsystem of those systems.[14] Similarly, the inability of performance systems, under ordinary conditions, to parse multiply right- and left-branching structures that have not been "readjusted" as coordinate-like structures follows from the finite-state character of the first subsystem (Langendoen, 1975).

From this picture of the organization of performance grammars, it follows that the same principles (or principles that have the same function) must belong to separate subsystems. For example, the first subsystem of the system of English speech comprehension must be able to assign the subject–predicate relation to the major constituents of expressions like 1, whereas some subsequent subsystem must do so for expressions like 2.

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[11]We assume, following Toppino (1974) and Kemper, Catlin, and Bowers (1977), that the results of Bever, Lackner, and Kirk (1969) can be reinterpreted in a way that eliminates the role of deep structure in chunking.

[12]Kimball (1974) presents interesting suggestions as to the nature of the universal-performance principles of surface-structure parsing.

[13]In Langendoen (1975) an algorithm for constructing a finite-state transducer that parses the expressions generated by an arbitrary context-free grammar up to some fixed finite degree of recursion is presented. This algorithm generalizes the one originally presented by Chomsky (1959).

[14]As pointed out at the end of Section III, it is unknown whether the other subsystems can overcome the limitations of the first subsystem under ideal conditions.

1. Doris went to Delaware.
2. The only sister of the best friend of my boss's nephew might want to try to get everyone in the office to go to Delaware.

In 1, the subject and predicate expressions are both contained within the same chunking unit (the sentence as a whole), so that the relation between them can be assigned by the principles of the first subsystem. In 2, on the other hand, the subject and predicate expressions each constitute separate chunking units, so that the operation of relating them as subject and predicate cannot be carried out by the first subsystem. But because 2 is fully comprehensible to normal English speakers under ordinary conditions, some other subsystem must be able to relate its subject and predicate appropriately. This observation, that different subsystems of a performance system appear to be able to carry out the same grammatical functions, provides us with another reason for distinguishing sharply between competence and performance grammars. It is a goal of competence-grammar description to achieve a redundancy-free statement of the principles that are needed to generate the structural descriptions of the expressions of a given language, whereas an adequate account of performance grammars will apparently have to be highly redundant.[15]

V. FROM SURFACE PARSING TO SEMANTIC INTERPRETATION IN PERFORMANCE GRAMMARS

The construction of a surface parsing for a linguistic expression is a major step in the determination of its semantic representation in performance. We may assume that while the surface parsing of an expression is being built up by the first subsystem, other subsystems are operating to determine the semantic representations of the lexical items and constituents that appear in it. The semantic relations that hold among the various constituents of the expression must then be determined as a function of the syntactic relations that hold among them by virtue of the surface parsing. In some cases, the syntactic relations that are relevant to semantic interpretation can be directly read off of the surface parsing, whereas in other cases they must be reconstructed by indirect procedures. Examples 3 and 4 illustrate these two possibilities.

3. Some people who are pretty angry are roaming the corridors.
4. Some people are roaming the corridors who are pretty angry.

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[15]See Schane's contribution to this volume for further discussion of the goals of the theory of linguistic competence. Besides the redundancy built into the grammars of each performance system, there is presumably considerable duplication of grammatical principles across the various systems also.

In both 3 and 4, the expression *who are pretty angry* is understood as bearing the syntactic relation of "modifier of" to the expression *some people.* This relation can be read directly off of the surface parsing of 3, because the two expressions form a single constituent *some people who are pretty angry,* in which *who are pretty angry* is syntactically subordinate to *some people.* In the surface parsing of 4, on the other hand, the two expressions do not directly bear any syntactic relation at all. That the expression *who are pretty angry* is a modifier of the expression *some people* in 4 must be reconstructed in performance by a procedure that recognizes (1) that *who are pretty angry* is an expression of the type that can only be construed as a modifier, (2) that the expression *some people* is the only available expression that can plausibly serve as the modified constituent, and (3) that the grammar of English permits the relation to hold in cases like 4.[16]

Formally, the way that a TG competence grammar establishes that *some people* and *who are pretty angry* are syntactically related as modified and modifier in 4 is by deriving that expression from an underlying structure in which the relation holds directly (that is, a structure very much like the surface parsing of 3), by application of a syntactic transformation that destroys that structure, and creates a new structure in which the relation no longer holds. Thus, the task of a performance grammar, when presented with the surface parsing of 4, is to recognize that it is a legitimate output of that transformation. How the performance grammar accomplishes this task need not concern us; it suffices to note that a performance grammar, in processing 4, must carry out certain operations that it does not have to carry out in processing 3.

For convenience, let us call a surface parsing, like that of 3, which provides an adequate basis for computing its semantic interpretation, "canonical." All others we may call "noncanonical."[17] From the foregoing discussion, we have seen that performance systems must carry out certain operations in the processing of expressions that have noncanonical parsings that they do not have to carry out in the processing of those that have canonical ones. Thus we may conclude that, ceteris paribus, expressions that have noncanonical parsings are more difficult to process than those

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[16]Proviso 3 is necessary to distinguish expression 4 from expressions like **The people are roaming the corridors who are pretty angry,* in which the relation does not hold, even though the counterparts to provisos 1 and 2 are satisfied.

[17]The terms "canonical" and "noncanonical" can also be applied to strings, but not without some difficulty. Some strings are canonical in two different ways (have two different canonical parsings associated with them), for example, *I asked for a reason.* Others may be associated with both a canonical and a noncanonical parsing, for example, *What agency has that spy under surveillance?* Finally, others may be noncanonical in two different ways, for example, *For what reason did you ask?*

that have canonical ones.[18] Because an expression that has a noncanonical parsing has a syntactic derivation in which one or more transformations have applied that alter or destroy syntactic relations, it follows that there is a relation between the complexity of a syntactic derivation of an expression, measured in terms of the number of transformations that have applied, and its processing complexity. However, that relation is not a direct (much less a linear) one: not all transformations have an effect on syntactic relations, the degree to which syntactic relations are altered by a transformation may vary, and other factors may intervene to obscure the relation.[19]

The problem of determining the exact nature of the relation between derivational and processing complexity is further complicated by the fact that there is not complete agreement as to which transformations alter syntactic relations (or if so, in what way), and hence which surface parsings are canonical and which are not. Thus, while it is generally agreed that the *wh-* movement transformation that applies in the derivation of certain interrogative expressions in English alters syntactic relations (except when it affects the subject of the main clause), there is no general agreement as to whether passive expressions in English are derived by means of a transformation that alters syntactic relations.[20] Until such disagreements can be resolved, we can give no systematic interpretation to the results of experimental investigations into the processing complexity of expressions of different syntactic types.

VI. CONCLUSIONS

To the question "What is the role of grammar in the use of language?" we may reply with another question: "What grammar, competence grammar or performance grammar?" The role of performance grammar is a direct one: It is used to construct the semantic interpretations (and, ultimately,

[18]The "ceteris paribus" provision is crucial here. Thus, while example 3 is canonical and 4 is noncanonical, 4 may nevertheless turn out to be easier to process than 3 because its degree of center embedding is less than that of 3.

[19]See footnote 18. Jacques Mehler informs me that something very much like this more restricted version of the "derivational theory of complexity" was in fact entertained by certain researchers in the early 1960s. If so, it was nevertheless quickly supplanted in everyone's minds by the more general theory. When the falsity of that theory was dramatically revealed several years later, the whole field of psycholinguistics was thrown into a disarray from which it has not yet fully recovered.

[20]The traditional view, established by Chomsky (1955, 1957) is that they are. An interesting recent restatement of the traditional view is given by Fiengo (1977). For the alternative view, see Bresnan (1978).

significance) of the linguistic expressions that are used. The role of competence grammar is an indirect one: It provides the vocabulary for the construction of performance grammars, and it presumably interacts with performance grammars in ways that we have not considered here. We have also not considered the ways in which universal grammar and universal performance may be related. Surely the principles that children use in the acquisition of a language and of the systems by which they use that language must be intimately related.

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