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Underlying and Superficial

Linguistic Structure[*]

The following remarks based on examples from English are a rather infor-mal discussion of some of the kinds of results and implications of linguistic research being done in the conceptual framework which has come to be called 'generative grammar.'[1]

A linguistic description of some natural language is designed to provide a specification of the knowledge which speakers of that language have which differentiates them from non-speakers. This knowledge is evidently enormous in extent and varied in nature. It includes, among other things, the ability to distinguish those noises which are sentences of the language (*well-formed* or *grammatical*) from those which are not; to recognize similarities between utterances and their parts; to recognize identities of various sorts from full rhyme on the phonological level to identity of meaning or paraphrase on the semantic level, etc. Since each speaker is a finite organism, this knowledge must be finite in character, i.e. learnable. Yet a moment's thought is sufficient to show that someone who has learned a natural language is in fact in posses-sion of full information about an infinite set of linguistic objects, namely the sentences. This follows because there is no longest sentence. Given any sen-tence we can always find a longer one by replacing some noun with a noun and following modifier, or by replacing some verbal phrase with a conjunc-

[1] For a partial bibliography of such work see the footnote references and other references listed at the end of this article. The following abbreviations are used throughout the article:
NP-Noun Phrase; S-Sentence; VP-Verb Phrase; *-non-sentence.

tion of two verbal phrases, etc. Of course, the finite and in fact rather small bound on human memory will prevent actual speech behavior from making use of more than a small finite subclass of all possible sentences. But this in no way affects the psychologically and linguistically fundamental fact that knowledge of a natural language provides a speaker in principle with knowledge of an infinite set of linguistic objects. Only this assumption, for example, makes it possible to explain why, as the limits on memory are weakened, as with the use of pencil and paper, speaker's abilities to use and understand sentences are extended to those of greater length. It is no accident that traditionally, for example, written German involves lengthy and complex constructions not normally found in the spoken language. The analogy with arithmetic is appropriate here. One who has learned the rules of arithmetic is clearly capable in principle of determining the result of multiplying any two of the infinite set of whole numbers. Yet obviously no one ever has or ever could compute more than a small finite number of such multiples.

In principle knowledge by a finite organism of an infinite set of linguistic facts is neither paradox nor contradiction, but results from the fact that there are kinds of finite entities which specify infinite sets of objects. In mathematics these are often referred to by the term 'recursive.' For example, consider the set of rules:

(1) $A \rightarrow X$

(2) $X \rightarrow X+X$

where the arrow is to be interpreted as the instruction to rewrite the left symbol as the righthand string of symbols. It is evident that continued application of these rules will specify an endless, unbounded, i.e. strictly infinite set of strings of the form X, XX, XXX, XXXX, etc. And a person who learned these two rules plus the finite set of instructions for applying them would, in a precise sense, have learned the infinite set of possible outputs.

It is in exactly this sense that we must postulate that a speaker has learned the infinite set of sentences of his language, by learning some finite set of rules which can enumerate, list, specify, or, as it is usually said, *generate* these sentences. Such a set of rules can be called a *grammar* or *syntax*.

A *language* in these terms is then just the set of strings of symbols (the 'X's in the above trivial example) enumerated by the grammar. We shall see below that this conception of language must be greatly enriched. When we have come to the point of seeing each sentence as a string of symbols of some type, it is natural to ask about the nature of these symbols in actual natural languages like English, Chinese, etc. It is traditional to think of these as *words*, i.e. roughly as minimum units of pronunciation, those elements which may be uttered independently. Modern linguistics has greatly emphasized, however, that words are themselves in fact composed of or are analyzable into syntactically

significant parts, usually referred to as *morphemes*. For example, it would be pointed out that the word:

(3) uninterrupted

is composed of at least three morphemes *un+interrupt+ed*, the first of which is also found in (4), the second of which is also found in (5), and the third which is also found in (6):

(4) unhappy

(5) interruptable

(6) destroyed

It thus follows that the syntactic structure of each sentence must be represented as a string of words with morpheme boundaries also indicated.

However, all linguists are in effect agreed that sentence structure is not exhausted by division into words and morphemes. Most crucially, the words and morphemes must be considered as grouped into significant sequences, in other words to be *parsed*, or *hierarchically bracketed*. Thus in the sentence:

(7) Harry liked the nice girl

most linguists would probably agree that the elements must be bracketed something like:

Harry	liked	the	nice	girl
	liked	the	nice	girl
	like	ed	the	nice	girl
			nice	girl

Such a bracketing indicates that the sentence is first made up of two basic parts, *Harry* and everything else; that everything else is made up of two primary parts *liked* and the remainder, etc. However, it would further be agreed that such bracketing representations are inadequate if not accompanied by an associated *labelling* of the segments obtained by the bracketing. It has become common to represent such labelled bracketings in the form of rooted trees like Diagram 1 but such are perfectly equivalent to (labelled) box diagrams like that above or labelled parenthesizations, or any other suitable diagrammatic equivalent.
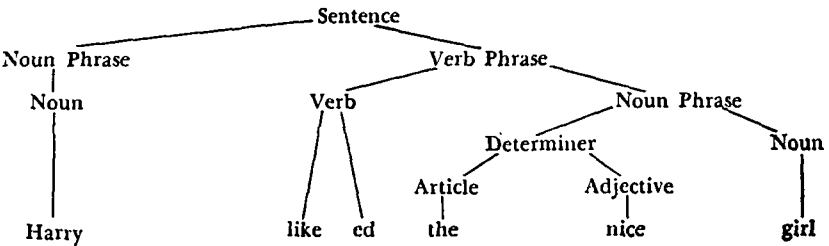
Such a labelled bracketing provides far more explanatory insight into the structure of a sentence than the mere bracketing alone. It accounts for similarities between various sequences, i.e. for example our knowledge that *Harry* and *the nice girl* are in some sense similar kinds of elements as against *liked*, or *the*. I shall refer to the kind of linguistic structure represented by labelled bracketings in any of their various forms as *phrase markers*. Such structures describe for each sentence (string of minimal syntactic symbols) what parts make it up, how these are grouped together into significant sequences, and what type of grouping each is.

Linguists are rather well agreed on the fact that each sentence of a natural language is correctly represented by at least one phrase marker of some kind. This agreement is, of course, accompanied by many disagreements of various types, both substantive and terminological, which need not concern us here. Since each speaker knows an unbounded set of sentences, and since it is agreed that each sentence has one phrase marker, it follows that each speaker must learn a finite set of rules which can enumerate not only strings of symbols (words or morphemes) but rather an infinite set of correct phrase markers. It follows then that a linguistic description of a language must contain just this finite set of rules. A crucial problem for linguistic theory is then the specification of the character or form of such rules, the way they associate phrase markers with an infinite output of strings of symbols, etc.[2]

UNDERLYING GRAMMATICAL STRUCTURE

However, in stopping at the point, in effect widely agreed upon, that the syntactic structure of a sentence is given by a *single* phrase marker, we will have seemed to embrace a position which we cannot in fact accept. There is overwhelming evidence showing that the syntactic structure of the sentences of natural languages is by no means adequately representable by single phrase markers, regardless of how elaborated. Although each sentence certainly has one phrase marker which provides a labelled bracketing of the actual string of morphemes and words which are directly related to its phonetic manifestation, this is only the most superficial aspect of syntactic structure. There is

[2] For a discussion of phrase markers, phrase marker assignment, rules which generate phrase markers, relation of phrase markers to generally held linguistic views cf. Noam Chomsky, "On the Notion 'Rule of Grammar'," *Structure of Language and its Mathematical Aspects,* ed. Roman Jakobson (Providence, R. I.: American Mathematical Society, 1961); Noam Chomsky, "A Transformational Approach to Syntax," *Third Texas Conference on Problems of Linguistic Analysis in English,* ed. A. A. Hill (Austin, Tex.: U. of Texas Press, 1962); Noam Chomsky, "The Logical Basis of Linguistic Theory," *Proceedings of IXth International Congress of Linguistics,* ed. H. Lunt (The Hague: Mouton and Co., to appear); and Paul Postal, *Constituent Structure,* a Supplement to International Journal of American Linguistics (1964).

a whole other domain of required structure which is crucial for describing both the formal syntactic properties of sentences and the way they are understood, i.e. their semantic properties.[3] The superficial phrase marker of each sentence is chiefly relevant only to the way sentences are pronounced. To determine what sentences mean, one must attend to the far more abstract underlying structure.

Consider the following English sentences:

(8)   drink the milk

(9)   go home

(10) don't bother me

These are normally referred to as *imperative sentences*. And in terms of their superficial phrase markers it is evident that they consist of an uninflected verb plus other elements of the Verb Phrase but no preceding 'subject' Noun Phrase of the kind found in declaratives like:

(11) he drank the milk

(12) I went home

(13) John didn't bother me

English also contains so called *reflexive pronouns* like the underlined 'objects' in such sentences as:

(14) the man cut *himself*

(15) John admired *himself* in the mirror

(16) you overestimate *yourself*

If one now inquires into the rules which govern the occurrence of this kind of reflexive form in English, one finds, among other things, that there are sentences of the form $NP_1 + Verb + reflexive\ pronoun + Y$ just in case one can also find sentences of the form $NP_2 + Verb + NP_1 + Y$. That is, those verbs which take reflexive pronoun 'objects' are just those which can elsewhere occur with 'objects' identical to the 'subjects' of the reflexive sentences.[4] Hence one finds: (14)–(16) and:

(17) John cut the man

(18) I admired John in the mirror

(19) she overestimates you

but we do not find:

(20) *Harry demands himself

(21) *you concede yourself

(22) *Mary completes herself

[3] This conclusion is in effect implied by the whole literature which argues that adequate grammatical description involves transformational rules.

[4] The grammatical descriptions in this paper are highly oversimplified in a number of ways irrelevant to the points they are designed to illustrate. For more detailed and extensive description of reflexives cf. Robert B. Lees and E. Klima, "Rules for English Pronominalization," *Language*, XXXIX (1963), 17-28.

and accordingly there are also no English sentences:

(23) *I demand Harry

(24) *John concedes you

(25) *you complete Mary

although one can find:

(26) I demand the answer

(27) John concedes the game

(28) you complete the task

These facts show that the rule for forming reflexives of the type being con-
sidered is in effect based on *a possible equivalence* of 'subject' and 'object'
Noun Phrase and suggests that reflexive sentences be described by rules which
in some sense 'derive' reflexive sentences from structures in which there are
equivalent 'subjects' and 'objects'. Hence (14)–(15) would be derived from
abstract structures something like the following schematically indicated
phrase markers:

(29)

(30)

(31)
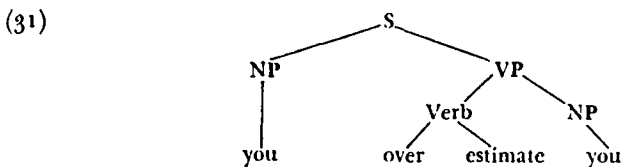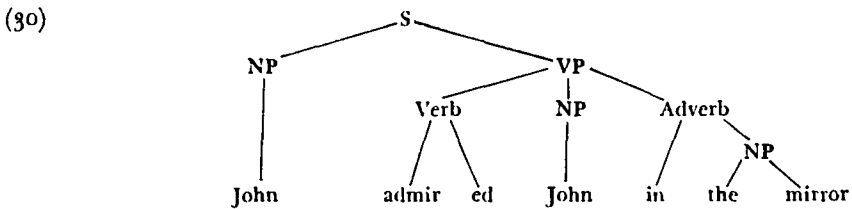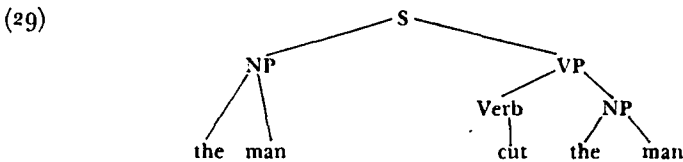
Notice that the rules which associate 'subjects' and 'objects' with verbs, these
rules being part of the set which enumerate phrase markers like (29)–(31),
will be *simpler* if they are allowed to produce such structures as (29)–(31) than
if not, since, as we have seen, all the possible 'subjects' and 'objects' of (29)–
(31) must be allowed with their respective verbs in any event. Hence to pre-

vent derivation of structures like (29)–(31) and their analogues would require *adding* special restrictions to the grammar prohibiting identical 'subjects' and 'objects' with a single verb.

But now if structures like (29)–(31) are enumerated they provide a simple means for describing correctly reflexive sentences if one simply adds the rule that the second Noun Phrase in a structure $NP_1 + Verb + NP_2 + X$ is replaced by the appropriate reflexive pronoun when $NP_1 = NP_2$. This correctly derives just those reflexive strings which meet the equivalence condition stated before and permits retention of the non-complicated verb-'object' and 'subject'-verb selection rules by eliminating the need for special restrictions to prevent the enumeration of the analogues of (29)–(31). This follows because this new reflexive rule converts (29)–(31) and all similar phrase markers into the superficial phrase markers which must represent the occurring reflexive sentences like (14)–(16) and these must be described anyway.

But this analysis of reflexives provides an immediate explanation of why an English speaker *understands* reflexive sentences to refer to 'objects' identical to their 'subjects,' *if* we insist that the understanding of a sentence refers to abstract structures like (29)–(31) rather than to the superficial phrase markers of actual sentences like (14)–(16) in which the 'subject'-'object' equivalences cannot possibly be marked.[5]

This very natural and explanatorily powerful description of reflexive sentences requires, however, a radical shift in one's notion of grammatical structure. It requires that the grammatical structure of a sentence be taken to consist, not of a *single phrase marker*, but at least of a *set of phrase markers*, these being related by the kind of rules illustrated by our description of the reflexive. This leads to a picture of syntax in which there is a basic division into two components, one containing rules which derive very abstract *underlying phrase markers* like those represented by (29)–(31); the other containing rules like the reflexive above. These latter rules apply to whole phrase markers and derive new phrase markers. The last such phrase marker derived by the final rule of this second component is called a *final derived phrase marker* and represents the superficial labelled bracketing of the actual string of words of the sentence. Rules which derive phrase markers from phrase markers have been called *transformations*. The rules which enumerate underlying phrase markers are simpler in character. It was assumed at first that these were roughly variants of rules like (1) and (2) above, i.e. rules which operated exclusively on strings of symbols by replacing single symbols by certain distinct strings of

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[5] The claim that the semantic interpretation or meaning of a sentence is determined by the *underlying* structure assigned it by the syntax is argued extensively in Jerrold Katz and P. M. Postal, *An Integrated Theory of Linguistic Descriptions* (Cambridge, Mass.: M.I.T. Press, to appear).

other symbols. These were called *phrase structure* or *constituent structure* rules. Such phrase structure rules as the following have been proposed:

(32)   Sentence $\rightarrow$ NP+VP

(33)   NP $\rightarrow$ Determiner+Noun

It has become increasingly apparent, however, that underlying phrase markers cannot in fact be correctly described exclusively with rules of this type. It appears that such rules must be supplemented by more powerful devices to help account for so-called 'selectional restrictions' such as the fact that certain verbs occur only with animate 'subjects' and inanimate 'objects,' others with inanimate 'subjects' and animate 'objects,' others with animate 'subjects' and animate 'objects,' etc. It appears that the sub-component of syntactic rules which enumerates underlying phrase markers is itself divided into two elements, one containing phrase structure rules and the other containing a *lexicon* or *dictionary* of highly structured morpheme entries which are inserted into the structures enumerated by the phrase structure rules. Although quite new and too complicated to say more about here, research into this area of syntactic structure promises to yield great insights into many areas of traditional interest, including characterizations of such notions as *word, inflection, derivation, Noun,* and *Verb,* as well as resolving the original difficulties with selectional restrictions.[6]

We can provide more motivation for an extension of the notion of grammatical structure to include a whole set of phrase markers for each sentence, including most crucially abstract underlying phrase markers, by returning to imperative sentences which superficially have no 'subjects.' These may also contain reflexives:

(34)   wash yourself

(35)   don't kill yourself

However, there is a crucial restriction on the reflexive pronouns which can occur in imperative sentences, namely only *yourself* is permitted. Hence there are no sentences like:

(36)   *wash himself

(37)   *wash themselves

(38)   *don't kill myself

(39)   *don't kill herself

But we recall the fact that reflexives are based on an equivalence of 'subject' and 'object.' This means that if we are to embed imperative reflexives into the simple description of reflexives given earlier, imperatives must be derived from underlying phrase markers which contain *you* 'subjects.'

As support for this, consider so called 'tag' questions like:

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[6] For a discussion of the topics of this paragraph cf. Noam Chomsky, *A Fragment of English Syntax* (to appear).

(40) Mary will come, won't she

(41) John can run, can't he

(42) I have won, haven't I

It is evident that the part of such questions which follows the intonation break (represented by the comma) involves a repetition of the Auxiliary[7] and 'subject' of the first pre-comma part, with the proviso that the order must be changed, the negative added, and the 'subject' pronominalized.[8] But there are tag sentences in which the first part is *imperative* in form:

(43) eat the meat, will you

(44) go home, won't you

And there is a constraint here that the pronoun form after the commas can only be *you*. Hence we find no English sentences like:

(45) *eat the meat, will $\left\{ \begin{array}{l} \text{she} \\ \text{he} \\ \text{they} \end{array} \right\}$

(46) *go home, will $\left\{ \begin{array}{l} \text{I} \\ \text{we} \end{array} \right\}$

But this can be readily explained in terms of the fact that the second Noun Phrase is a repeated pronominalized form of the 'subject' Noun Phrase before the comma, if it is assumed that imperatives have in their underlying phrase markers a *you* 'subject' Noun Phrase in front of the verb. We see then that the evidence of reflexives and tag sentences converges on the conclusion that the underlying structure of imperatives contains a second person 'subject.' But now this can immediately provide an explanation of the fact that every English speaker understands an imperative to refer to the second person if, as before, we assume that the structures relevant to understanding are the underlying phrase markers.

Here as before we must posit a transformational rule which will derive the superficial structure of imperatives from the underlying phrase markers. Notice that the Auxiliary repetition of tag questions shows that the underlying phrase markers of imperatives must contain the modal *will* (*will + contracted not = won't*) since this is the form found in imperative tags and in fact is the only permitted Auxiliary form:

(47) *eat the meat, did he

(48) *eat the meat, can he

But this provides an explanation of why we understand that imperative sentences refer to the future. The transformational rule which derives the super-

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[7] That is, the constituent which in underlying phrase markers represents such elements as the Tense morphemes, as well as *will, may, be, can, have,* etc.

[8] When the initial element is itself negative, then the part after the comma must be non-negative.

ficial forms of imperative sentences will delete the *will* (and preceding tense morpheme) and optionally delete the 'subject'. Optionally only because we find imperatives with explicit *you*:

(49)   you eat your meat

(50)   you go home (or I'll tell your mother)

These also have a *non* imperative declarative semantic interpretation but this need not concern us here.

We have suggested that in order to provide an account of both the formal properties of sentences and the way in which they are understood it is necessary to extend the notion of grammatical structure in such a way that each sentence is represented by a whole set of phrase markers, including crucially quite abstract underlying ones. This conclusion is greatly strengthened if we consider so-called grammatical relations like *subject-verb*, or *verb-object*.[9] To understand a sentence it is obviously quite crucial to know which parts bear which relations to which other parts. For example, despite the fact that the following sentences contain identical elements we understand them differently:

(51)   Mary loves John

(52)   John loves Mary

In (51) we understand that it is Mary who does the loving and John who receives the affection; in (52) conversely. The fact that these differences are associated with a distinct order of elements might suggest that the various relations involved can be precisely characterized in terms of *order*. We can say that in a phrase marker the first Noun Phrase bears the *subject* relation to the Verb, the Noun Phrase following the Verb bears the *object* relation to this element, etc. However, attractive as this proposal is, it obviously fails for *superficial* phrase markers because of the enormous number of cases like:

(53)   John was loved by Mary

(54)   Mary was loved by John

(55)   John is anxious to please Mary

(56)   John is easy for Mary to please

In (53) the relations between *John* and *Mary* and the Verb are the same as in (51), while in (54) they are the same as in (52). Yet the order of constituents in (53) is like that in (52) and the order in (54) is like that in (51). Similarly in (55) we recognize that *John* is the 'subject' of *please* while in (56) it is the 'object' of this Verb. Yet its relative order is the same. In short we see that in the actual superficial forms of sentences the crucial grammatical relations are not associated with any unique configurations of constituents.

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[9] For a fuller discussion of grammatical relations and their characterization in precise linguistic terms cf. Chomsky, "Logical Basis of Linguistic Theory," and *Fragment of English Syntax,* and Katz and Postal, *loc. cit.*

It seems, however, that in underlying phrase markers this is the case. That is, in underlying phrase markers grammatical relations are uniquely and uniformly definable in terms of constituents and their order. Hence the underlying structures of (52) and (54) are quite similar to those of (51) and (52) respectively and the actual order to elements in (53) and (54) is derived by the so-called *passive transformation*[10] which, among other things, inverts 'subject', and 'object' Noun Phrases. This solution is formally motivated *inter alia* by the fact that for a fixed Verb type those Noun Phrase elements which can occur in the initial position of passive sentences are just those which can occur in the 'object' position of declaratives. Hence one finds:

(57)   John admires Harry

(58)   John admires truth

but not:

(59)   *truth admires John

and similarly:

(60)   Harry is admired by John

(61)   truth is admired by John

but not:

(62)   *John is admired by truth

and:

(63)   John demands a raise

(64)   John believes Harry

but not:

(65)   *John demands Harry

(66)   *John believes love

and similarly:

(67)   a raise is demanded by John

(68)   Harry is believed by John

but not:

(69)   *Harry is demanded by John

(70)   *love is believed by John

If passive sentences are not derived from underlying structures in which the 'subject' and 'object' elements are in the same order as in active sentences, all these selectional facts must be stated twice. Thus again we find formal motivation for abstract underlying phrase markers which contain structures of just the type needed to explain the way the occurring sentences are understood.

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[10] For a description of this rule cf. Noam Chomsky, *Syntactic Structures* (The Hague: Mouton and Co., 1957) and Chomsky, "Transformational Approach to Syntax." For a slightly revised and more up to date description cf. Katz and Postal, *op. cit.* and Chomsky, *Fragment of English Syntax.*

Consider finally (55) and (56). These sentences are in a sense fundamentally different from any considered before because their underlying structure must be taken to include a *pair* of underlying phrase markers which are combined to produce the occurring sentences. The transformations which perform such combining operations have been called *generalized transformations.*[11] Sentences like (55) in which the initial Noun Phrase (NP) is understood as the 'subject' of the verb in the infinitive phrase must be derived from a pair of structures of roughly the form $NP_1+is+Adjective+Complement, NP_1+Verb +NP_2$. That is, the two phrase markers which are combined must have identical 'subject' Noun Phrases. This restriction is necessary to account for the fact that those verbs which can occur in the infinitives of sentences like (55) are just those which can take as 'subject' the initial Noun Phrase. Hence one does not find:

(71)   *truth is anxious to see Mary
(72)   *love is anxious to marry Mary
because there is no:
(73)   *truth sees Mary
(74)   *love marries Mary

etc. But these formal reasons force us to derive sentences like (55) from underlying structures in which *John* is the 'subject' of the verb *please* in terms of the uniform configurational account of grammatical relations roughly sketched earlier.

In (56) the situation is analogous although reversed. Here the sentences must be derived from a pair of underlying structures with the forms:

$NP_1+is+Adjective+Complement, NP_2+Verb+NP_1$

In this case the equivalence of Noun Phrases is between the 'object' Noun Phrase of the second underlying phrase marker and the 'subject' of the predicative type phrase marker. This is necessary because those verbs which can occur in the *for* phrases of sentences like (56) are just those which can occur with the sentence initial Noun Phrase as 'object.' Hence one does not find:

(75)   *truth is easy for Mary to please
(76)   *meat is easy for Mary to prove
because one cannot find:
(77)   *Mary pleases truth
(78)   *Mary proves meat

But this means that one is forced by these formal facts to derive sentences like

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[11] It now seems likely that combinations of phrase markers are in fact performed by a single generalized transformation which is part of the component which generates underlying phrase markers rather than the component which contains simple transformations like the reflexive, passive, etc. Cf. Katz and Postal, *op. cit.* and Chomsky, *Fragment of English Syntax.*

(56) from underlying structures in which *John* is indeed the 'object' (by the uniform characterization given above) of *please*. So that again the independently motivated underlying structures provide a correct account of the way sentences are understood with respect to grammatical relations.

<div align="center">LINGUISTIC SUMMARY</div>

We have briefly considered a few of the enormous number of cases which support the view that the grammatical structure of sentences can only be adequately represented by structural descriptions which include highly abstract underlying phrase markers. We see then that a linguistic description must minimally include rules to generate the correct set of underlying phrase markers, rules to combine underlying phrase markers in the case of sentences which are complex [like (55) and (56)], and finally rules to derive the correct superficial phrase markers of sentences from their abstract structures. A full account of the nature of all such rules has yet to be given, although tremendous progress has been made in recent years and the outlines of correct solutions appear to be relatively clear. The crucial point is that any adequate theory of grammar must provide an account of such rules for only in this way can such a theory provide the theoretical apparatus which individual linguistic descriptions must draw on in order to explain the finite mechanism a speaker has learned which yields his knowledge of the underlying and superficial structures of the endless class of well formed utterances.

We have been speaking essentially only of syntactic structure. It is obvious that a full linguistic description must contain other aspects. First, it must contain a *phonological component* whose rules specify the phonetic character of each structure generated by the syntactic rules. It appears that the phonological component operates exclusively on the *final derived phrase markers* of the syntax and associates a phonetic representation with each. The phonetic rules must also, quite crucially, characterize the notion of 'phonetically possible morpheme.' That is, it is these rules which will state that in English, although neither *ftorts* or *geyk* is an actual morpheme, the latter but not the former is a possible morpheme, and might be introduced tomorrow as the name of a new soap, or a new concept. Much progress has also been made recently in our knowledge of the form and character of phonological rules but this will not concern us further.[12]

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[12] For descriptions of the phonological component cf. Morris Halle, *The Sound Pattern of Russian* (The Hague: Mouton and Co., 1954); Morris Halle, "Phonology in a Generative Grammar," *Word*, XVIII (1962) 54-73; Noam Chomsky, "Explanatory Models in Linguistics," *Logic, Methodology, and the Philosophy of Science*, ed. E. Nagel, P. Suppes, A. Tarski (Stanford, Calif.: Stanford Univ. Press, 1961); Chomsky, "Logical Basis of Linguistic Theory;" and Noam Chomsky and G. A. Miller, "Introduction to the Formal Analysis of Natural Lan-

Most important, however, is the fact that a full linguistic description must contain a *semantic component* whose task is to assign each sentence a *meaning*. We have shown that the syntactic structure relevant to this task is present in underlying but not superficial grammatical structure. But nothing has been said precisely about how semantic interpretations are assigned to the structures which the syntactic rules generate. Obviously, however, a full linguistic description must specify this information, since it is evident that speakers know the meanings of the sentences of their language as well as their grammatical structure and pronunciation features.

Although fundamental insights into this question have recently been achieved, this topic is too complex and too new for extended treatment here.[13] The problem for a semantic description is to specify how the speaker who learns the meanings of a finite number of *lexical items,* morphemes, multi-morpheme idioms, plus the rules which characterize the grammatical structure of the sentences which contain these lexical items, determines the meanings of sentences. This can be formulated as a purely formal problem of specifying rules which operate on the grammatical structure (the underlying phrase markers) and the meanings of lexical items, if the notion *meaning of a lexical item* can be formally characterized. This can be done by postulating abstract atomic elements, *semantic markers,* which represent the conceptual content of lexical items. For example, we can postulate a semantic marker (male) which will be associated with the lexical items, *man, boy, father,* or *uncle,* to represent part of the conceptual similarity between these (as opposed for example, to *car, truth, mother, girl*). Besides a dictionary which associates sequences of such semantic markers *(readings)* with lexical items, the semantic component of a lingustic description will also contain a set of *projection rules* which will combine the readings of lexical items in order to obtain derived semantic characterizations for higher order constituents, on up to the constituent Sentence itself. These rules will operate on the readings of lexical items plus the grammatical relations which hold between these items, these relations being indicated in the underlying phrase markers in the manner suggested earlier.

The output of the semantic component will be a formal semantic characterization of each constituent of each sentence. These characterizations will provide an explanation of such semantic properties as *ambiguity, paraphrase,*

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guages," *Handbook of Mathematical Psychology: Volume II,* ed. R. Luce, J. Bush and E. Galanter (New York: Wiley, 1963).

[13] For descriptions of the semantic component cf. Jerrold Katz and J. Fodor, "The Structure of a Semantic Theory," *Language* XXXIX (1963), 170-211; Jerrold Katz, "Analyticity and Contradiction in Natural Languages," *The Structure of Language: Readings in the Philosophy of Language,* ed. J. Katz and J. Fodor (New Jersey: Prentice Hall, forthcoming); Katz and Postal, *op. cit.*

synonymy, or *anomaly*.[14] It should be emphasized that this kind of semantic theory leaves its primary descriptive objects, the semantic markers, uninterpreted. That is, it does not specify the relation of these elements to the nonlinguistic world. (This means that such notions as *reference*, and *truth*, are not characterized.) This task is left as a fundamental (and fantastically difficult) psychological problem independent of the problem of formulating linguistic descriptions and the theory underlying them. Interpretation of the system of markers is seen as part of the fundamental problems of concept formation, categorization of experience, etc.

It appears then that the linguistic knowledge whose possession characterizes a speaker of a language has the form of an abstract linguistic object containing three major components of rules. The basic element is a generative syntactic component whose rules generate highly complex structures including a set of phrase markers for each derived string of words. There are then two subsidiary *interpretive* components. The phonological component provides each sentence with a phonetic interpretation and accounts for the speaker's knowledge of the facts of pronunciation. The semantic component provides each sentence with a semantic interpretation in the form of a set of readings and accounts for the speaker's knowledge of the facts of meaning.

It seems that the two interpretative components are each based on a fixed, universal vocabulary of primitive conceptual elements with universally specified relations to the non-linguistic world. In the case of the phonological component, this vocabulary consists of the set of phonetic features with which sentences are described (Voicing, Stress, and Nasality). That is, there is a fixed universal phonetic alphabet which provides all the relevant phonetic information about each sentence. In the case of the semantic component, the vocabulary consists of the set of semantic markers, about which, however, much less is known. The universality of the set of semantic markers is plausible but much work on a wide variety of languages will be needed before it can be verified to anything like the extent to which the universality of the phonetic features has been confirmed. In claiming that the atomic elements of both interpretive components are universal, one is saying that the child who learns a language based on them need not learn these elements or their relations to the non-linguistic world. That is, for example, someone who learns English need not learn what the semantic marker (Male) denotes or what properties of vocal utterances the phonetic feature (Nasal) refers to. He only need determine *if* these elements play a role in English sentences,

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[14] These properties are respectively illustrated by:
a. I observed the ball
b. John is a farmer; John is someone who farms
c. not living; dead
d. John married a potato pancake

and if so, how, that is, what rules describe them, what other elements they are related to, etc.

It is unquestionable that the form of the rules in each of the components is a linguistic universal, to be characterized in general linguistic theory. It is also quite likely, I believe, that some of the content of the various components is universal. That is, there are very probably universal rules, and many of the elements which occur in linguistic rules may be universally specified. In particular, there is much hope that the goal of traditional universal grammar, namely, the cross-linguistic characterization of notions like *Noun, Verb, Adjective*, and *Modifier*, can be given in general linguistic theory by limiting the specification to highly abstract underlying phrase markers rather than by attempting to give it in terms of superficial phrase markers wherein all previous attempts have failed.[15]

<center>IMPLICATIONS</center>

In the above sections we have given a quite informal discussion of some of the properties which must be attributed to adequate linguistic descriptions and the theory of language which underlies them. Unfortunately, there has been much confusion about the nature of the subject matter or domain which a linguistic description describes, and the relation between the output of such generative devices and actual speech behavior. This then requires brief discussion.

It must be emphasized that in no sense is a linguistic description an account of actual 'verbal behavior.' Even the grosser aspects of the descriptions of sentences provided by a linguistic description, the phonetic outputs of the phonological component, cannot be identified with real utterances of speakers. Any real utterance will, for example, contain features which provide information about the speaker's age, sex, health, emotional state, etc. And these features have obviously nothing to do with the *language* which the linguistic description characterizes. It is just these 'nonlinguistic' features which differentiate different speakers of the same language and different 'verbal performances' by the same speaker. But it is of course impossible to observe any actual utterances which do not contain such features. It is thus necessary to posit a relation of *representation* which holds between real utterances and the output of linguistic descriptions. The output for any sentence S_1 must be assumed to specify a set of phonetic conditions which any utterance must meet if it is to be an *instance* of S_1.

However, the relation between actual speech behavior and the output of linguistic descriptions is by no means exhaustively described in the above way.

[15] For discussion of these matters cf. Chomsky, *Fragment of English Syntax*.

It is evident that actual verbal performances contain an enormous number of utterances which do not in the strict sense represent any sentences at all. These are nonetheless perfectly adequate for communication and often more appropriate to the occasion than utterances which do represent full sentences. For example, in answer to questions such as (79)–(81):

(79) where is the car
(80) is John inside
(81) who did it

one can hear such answers as: *inside, yes, Bill*. It is evident that these utterances are understandable because in the context of the previous question they are understood as *versions* of the full sentences:

(82) the car is inside
(83) yes John is inside
(84) Bill did it

It is only the full sentences that should be generated by the linguistic description proper which must draw the line between full sentences and fragments which can represent full sentences in particular environments. Part of the differentia of these two classes of utterances, utterances which directly represent full sentences, and those which do not but are still understandable, is that the former have a *fixed* finite set of semantic interpretations independently of all context, and their interpretation in any one context is simply a selection from among this fixed set. For fragments, however, occurrence in isolation permits no interpretation at all. And their interpretation in context is directly determined by, and does not involve an elimination of fixed interpretations inappropriate to, the context. Thus the fragments given above can as well be answers to (85)–(87) as to (79)–(81):

(85) where did you leave your coat
(86) can Hitler really be dead
(87) who was clawed by the tiger

And in these cases the fragments must be understood as versions of:

(88) I left my coat inside
(89) yes Hitler really can be dead
(90) Bill was clawed by the tiger

In short we see that sentence fragments of the type being discussed have no finitely fixed number of interpretations at all and in this way are radically distinct from utterances which directly represent full sentences. The utterances *inside, yes, Bill* have an infinite number of possible interpretations and can hence not be described *as such* by a finite linguistic description. To account for the understanding of fragments and many other kinds of utterances, suitable for communication in various contexts but distinct from full sentences, it is then evident that linguistic theory must provide a means for ex-

tending the description of full sentences to a class of *semi-sentences*. We can say little about this here besides noting that (1) it would be surprising if the apparatus for extension to semi-sentences was not an inherent property of human beings, hence cross-linguistic, and (2) it is obviously impossible to carry out research on the topic of semi-sentences independently of extensive knowledge of the properties of full sentences. And it is just this knowledge which the study of linguistic descriptions in the narrow sense is designed to yield. We conclude then that a linguistic description does not describe actual speech behavior but rather an indefinite class of highly structured (in three distinct though interrelated ways, syntactic, semantic, phonological) abstract objects, *sentences,* which define the *language* which in various ways under-lies all speech behavior. A linguistic description is, in other words, a partial account of linguistic *competence.* To extend the characterization of this to an account of linguistic *performance* then requires a number of studies of various types of the way in which this underlying knowledge of linguistic rules is put to use.

The distinction between *competence* and *performance* or *language* and *speech* is quite crucial for understanding at least three goals related to lin-guistic descriptions proper, goals whose pursuit is crucial if a full account of the domain of language study is to be given. First, there is the task of con-structing a *model of speech recognition,* that is, a model of the way speakers use their linguistic knowledge (language) to understand noises that they hear.[16] In terms of the above outline of linguistic structure, this task is the task of determining what sentence the noise represents and then determining the underlying structure of that sentence in order to determine its possible range of semantic interpretations.

When the above tasks have been carried out successfully, the context of the utterance must be applied in some way to pick the interpretation which was 'intended.' Almost nothing can be seriously said at the moment about this problem of contextual *disambiguation* of utterances beyond the obvious point that the problem cannot be seriously posed without understanding of the nature of language or linguistic structure. It appears that every piece of pos-sible human knowledge about the world is relevant to the disambiguation of some sentence and thus to its understanding in context.[17] This has rather obvious implications of two sorts. On the one hand it shows that theoretically there can be no *general* theory of the way contexts serve to permit choice of one of several possible interpretations for some sentence, and on the other,

[16] For a discussion of models of speech recognition and speech production cf. Noam Chom-sky and G. A. Miller, "Finitary Models of Language Users," *Handbook of Mathematical Psychology: Volume II,* ed. R. Luce, J. Bush, and E. Galanter (New York: Wiley, 1963) and Katz and Postal, *op. cit.*

[17] This is argued in Katz and Fodor, "The Structure of a Semantic Theory."

it shows that practical attempts to utilize linguistic research for the mechanical replacement of human performers (as in so-called 'machine translation') are doomed to failure.

A third goal which is involved in a full linguistic account is the problem of formulating a *model for the speaker*. This must involve specification of how a desired *message* is given as input to the linguistic description to yield as output a phonetic representation which is the input to the speaker's speech apparatus, the output of this being the actual utterances.[18] It appears that the inputs to the linguistic description must be taken to be *semantic objects*, i.e. *readings* in the sense of our earlier brief discussion. But just as linguistic theory as such does not specify the relation of semantic markers to the non-linguistic world, so also it cannot deal with the relations between a speaker's experiences, verbal or otherwise, and the utterances he produces. That is, it cannot deal with the fantastically complicated question of the *causation* of verbal behavior, although this is a task which modern psychology has too prematurely tried to deal with. Too prematurely, because *it is* obviously impossible to even *formulate* the problem of causation prior to an understanding of the character of speech behavior. And this, as we have seen, requires prior knowledge of the abstract *language* which underlies such behavior. Hence study of the causation of verbal behavior is two steps removed from reasonable possibility if attempted independently of the kind of studies discussed earlier.[19]

It should be obvious at this point that a linguistic description as such which *generates* sentences, i.e. highly abstract triples of syntactic, semantic, and phonological properties, is neither a model of the speaker or of the hearer although it is often confused with these. *Generation* is not *production* or *recognition*. A linguistic description simply characterizes the objects which a model of recognition must recover from verbal noise and which a model of production must encode into such noise. The study of linguistic descriptions per se is hence logically prior to the study of questions of recognition, contextual determination, production, and causation since it defines the objects

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[18] It is because this output is determined by other factors besides the phonetic representations which are the most superficial aspects of linguistic structure generated by the linguistic description that the latter can not be said to generate any actual utterances. That is, given a fixed phonetic or pronunciation code as input to the speech apparatus, the output is also determined by such factors as the presence or absence of food in the oral cavity, the speaker's age, sex, state of health (cleft palate or not, etc.), degree of wakefulness or intoxication, etc. Facts like these are sufficient in themselves to demonstrate the futility of any view of language which cannot go beyond the gross observations of utterances to the abstract structures which underlie them, i.e., the futility of any view of language which identifies the significant linguistic objects with what can be obtained from tape recorders.

[19] For a fuller discussion of these points cf. Noam Chomsky, "Review of *Verbal Behavior* by B. F. Skinner," *Language* XXXV (1959), 26-58.

in terms of which the problems with which these latter studies deal must be formulated.

Finally, the kind of conclusions reached above have obvious and important implications for any study of the problem of language learning. If, as we have argued, the structure of the sentences of natural languages involves an extremely complex and highly abstract set of entities related to actual utterances only by an extensive set of highly structured rules, it follows that the problem of language learning must be phrased in quite specific terms. That is, it is necessary to study the question of how an organism, equipped with a quite complex and *highly specific* characterization of the possible nature of a natural language, determines from various kinds of linguistic data, heard sentences, contexts, corrections, the particular manifestation of this abstract theory used in the community into which he was born. Again the primary constraint on the study of language learning is the logically prior knowledge of the character of the linguistic system which must be learned. And the more specific and detailed this knowledge can be made, that is, the more closely one can describe the general theory of linguistic descriptions which amounts to a hypothesis about the innate genetic knowledge which the human child brings to language learning, the greater is the possibility of being able to formulate the techniques or strategies which the child uses to apply this inherent knowledge of possible linguistic structure to induce the details of a particular language from his linguistic experience. From what was said earlier about the abstract character of linguistic structure, underlying phrase markers, and the like, it is clear that enough is already known about the nature of language to show that views of language learning which restrict attention to the gross phonetic properties of utterances, either by adherence to psychological theories which do not countenance concepts more abstract and specific than 'stimulus,' 'generalization,' 'chaining,' 'response,' etc., or linguistic theories which do not countenance more than the kind of linguistic structure representable by final derived phrase markers, cannot teach us very much about the fantastic feat by which a child with almost no direct instruction learns that enormously extensive and complicated system which is a natural language, a system which has thus far defied the efforts of the best students to describe it in anything like a complete or adequate way.

I hope that the too brief and inadequate remarks of this final section will nonetheless have shown that the study of any aspect of language or linguistic behavior cannot hope to progress beyond superficialities if it is not based on firm knowledge of the character of the highly complex, abstract, finitely specifiable though infinite linguistic system which underlies all observable linguistic performances. In short, I hope to have shown that the results of gen-

erative linguistics are not an obscure oddity, of interest only to the specialist in linguistics, but rather provide the kind of knowledge which is prerequisite to the understanding of the domains of the entire range of language studies.

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