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The definitional model of language

The briefest and most usual way of defining the field of linguistics is to call it the "science of language," where "language" is intended to mean a natural language. This is not a sufficient definition, since there are other sciences of language such as the psychology of language, the sociology of language, and similar disciplines. How does linguistics differ from these other fields?

Linguistics can most readily be differentiated from other sciences of language by expanding its original definition to read: Linguistics is the science of language with language as its primary objective of cognition. Other sciences may also deal with language, but their interest in language is as a tool for studying the particular scientific field. In the psychology of language, for example, the major focus of interest is speech behavior as part of human behavior in general; language is considered to the extent to which it affects this primary concern. In the sociology of language, where such problems as class differences in speech or the effect of speech patterns on group identification are studied, interest is centered on social relations, to which language is used as an ancillary. In linguistics, on the other hand, language is studied for its own sake, and social and psychological or other factors are brought into the picture only in so far as they illuminate our insight into the workings of language.

In the older approaches to linguistics, much of which was commonly referred to as philology, the study of problems of language history and of the relationship among languages was of primary interest. The study of the history of individual words and expressions, well known under the name of etymology, was a part of this traditionally historical orientation.

Many linguists still pursue this historical interest; however, a second direction in linguistics has become increasingly significant: the study of language as a phenomenon without regard to its history. Perhaps the most appropriate label that can be applied to this branch of linguistics is "synchronic linguistics." The center of interest is structure—what language, or a particular language, is like, rather than how it came to be

that way. The question of what language is like can be answered by a reasonable theoretical discussion of the nature of natural human language; or, in the case of a particular language, it can be answered by an orderly description of that particular language. In a sense then, the two pursuits germane to synchronic linguists are linguistic theory and linguistic description. The two are interrelated in that the concepts of linguistic theory can be used as points of departure for the methodological devices of linguistic description.

It is obvious that for purposes of language-data processing historical linguistics is of little interest, since the goal is to deal with languages as they are. In this connection "models of language" are those in synchronic linguistics and not in historical linguistics.

The use of the term "model" in linguistics is fairly recent. For more than a generation descriptive linguists have been interested in a generalization of their procedures and results as applied to a variety of languages but have not always used the model terminology to refer to these generalizations. It used to be more common to talk of "theoretical frameworks" or "descriptive frameworks," but "model" can be applied with some justification to those earlier frameworks, since they often were thought out along lines similar to present approaches.

The attempt to use models in the social sciences may be brushed off by some as just another desire to attain the prestige of the physical sciences by copying some of their devices. While this is undoubtedly a common motivation on the American academic scene, it is not quite fair to leave it at that. On the contrary, it is eminently worthwhile to consider whether models in the strict mathematical sense or perhaps models in a looser metaphorical sense are not reasonable tools in the description and interpretation of social and human phenomena.

Some of the models currently vying for popularity in linguistics are intended to have definite mathematical properties; indeed, in modern American linguistics there has been a distinct shift away from an orientation toward behavioral psychology in the direction of a stronger orientation toward mathematics and symbolic logic. Much of this new orientation is characterized by extensive symbolization and mathematical and/or logical terminology. Thus, instead of using conventional terms such as *verb, noun,* and *adjective,* the tendency is to use symbols such as *x, y, z* or abbreviation-derived symbols such as *V, N, A.* Instead of writing

A subject followed by a predicate and an object constitutes a sentence.

this statement would be symbolized by something like

$S + P + O = sent$

Instead of saying

This noun constitutes a subject.

the symbolization may be

$$X \in S$$

Similarly, linguistic writings are replete with such terms as *correlation, transformation,* or *product,* used in the most varied senses. Frequently such symbols and technical terminology result in a certain brevity and an appearance of logicality, although on closer scrutiny, the actual content of a discussion is often not greatly different from previous linguistic discussions in which terminology more of a social-science or humanistic type was employed.

It is suggested here that the use of models, terms, and symbols is to an extent something of a fad in linguistics, just as it has become something of a fad in other social sciences. Once recognized, this matter can be viewed with detachment; we can consider the proper place of a model within the field of linguistics, and more important, we can also consider what kind of model, if any, is best suited for the purposes of descriptive linguistics.

According to colleagues in engineering and the physical sciences, one of the essential characteristics of a real mathematical model is that it allow for genuine and interesting predictive computations, often based on the application of real mathematical theorems. This is equally true of symbols and formulae in engineering and the physical sciences: some real mathematics is applicable to them. Unfortunately, none of the symbolizations or models in linguistics is mathematical in this rigorous sense. Thus, if the term "model" is to be used in linguistics, it will have to be in the looser nonmathematical sense.

THE USEFULNESS OF MODELS IN LINGUISTICS

Even though at present we are far from being able to formulate and prove interesting theorems about natural language, there still remain the two objectives of synchronic linguistics: the theoretical interpretation of the nature of language and the description of a particular language. The usefulness of a model can then be measured by the extent to which it contributes to these two objectives.

The Purpose of Theoretical Models For the theoretical interpretation of language, a model should be capable of accounting for the two apparently contradictory conclusions that have emerged as basic insights from the experience of the profession. One is that all the languages of the world are similar to each other, in that they all are languages. The other is that all the languages of the world are dissimilar to each other, in that they all are different languages. Any theoretical framework or model must account for both the similarity and the dissimilarity in such a way that they become logically compatible. A theoretically useful model, therefore, must be specific enough to stipulate all the necessary properties of natural

human language; it also must be general enough to accommodate the variety of different individual features of particular languages that have been uncovered by the efforts of linguistic analysis over the past few generations.

The Definitional Model The general properties stipulated by the model should be defined in such a way that they can serve as suitable points of departure for the study of any language. Each of the concepts used in the model, in other words, should reflect one of these general properties of natural languages and should allow the development from it of analytic procedures specifically suitable for the investigation of the detailed conditions prevalent in a particular language. A theoretical framework which in such a commonsensical way stipulates the properties of the object of cognition as derived from observational experience is thus more of a definition or set of definitions in the classical sense than a model in the modern logical mathematical sense. This is why it is called here a "definitional model."

This definitional model of language should include a genus and a differentia specifica. The genus portion of the model must set forth those properties which natural language shares with other comparable objects and on the basis of which it can be included in a larger class of phenomena. The differentia specifica portion of the model must then set forth those properties which make natural language a particular species of this larger genus of phenomena and differentiate it from other related objects within the same class.

The latter aspects of the definitional model are particularly important in the present context, since the term "language" is so frequently used nowadays to designate objects other than natural languages. This use of the term has undoubtedly been a contributing factor, though perhaps not the major factor, in the common tendency to investigate simple systems that are not natural languages, in order to generalize the results of these investigations to apply to natural language as well. The presumed advantage of such an approach is that a particular linguistic problem can be simplified by dealing with it under a set of conditions which are arbitrarily simplified by the investigation. Such a simplification very often allows the derivation of logically neat and sometimes even mathematically manipulable solutions. The only question is: What problem has been solved by such solutions? Was it a real problem of natural-language-data processing, or was it a problem rendered fictitious by the simplification?

The above is not intended as a rejection of the technique of simplification for purposes of problem solving. It is intended as a necessary caution that results should be not only neat—that is, simple and rigorous—but also relevant to the real problem. Thus, any simplification of a genuine natural-language problem should be based on a recognition of

the essential structural properties of a natural language. The simplification should be such that none of these properties is lost in the process. The simplified problem should adequately represent the real situation, in order for its solution to remain applicable to the original more complex problem or at least allow an extension of its applicability to it.

It is for this reason that a statement of the presumable properties of a natural language has great operational significance, even before one becomes involved in the actual development of linguistic analytic procedures from such a statement.

The point of the above discussion is that in a definitional model *all* the necessary properties of the object of cognition should be stipulated in order to ensure its applicability. In addition, it is equally important that *only* the necessary properties be stated and no additional ones, in order not to distort the reality of the phenomenon by forcing it to conform to a model which is too specific.

The classic example of such a model, which by its specificity destroys the reality of the phenomenon, is the traditional Latin model of grammar. Until the advent of the descriptive interest in linguistics early in the century, most grammars of the well-known languages followed the medieval tradition of being patterned after Latin, and new grammars of previously undescribed languages, prepared mostly by such dedicated amateurs as missionaries and travelers, likewise followed the Latin model. That is, all languages were described as if they had some of the characteristic features of classical Latin (such as six cases, six tenses, three moods, etc.), or they were described in terms of those features of Latin that were present and those that were absent. Traditional grammars for such languages as Russian, which indeed has a case system, or for Italian, which after all is historically very closely related to Latin, turned out to be fairly adequate for most practical purposes. But for a language such as English, which very definitely has a structure rather different from classical Latin, the traditional grammar patterned on Latin is patently unusable for most scientific and practical purposes.

Some of the models proposed by modern investigators differ from the traditional Latin model merely by proposing another set of extremely specific characteristics to be shared by all languages; that is, instead of forcing any given language into the old Latin mold, they now force the variety of human languages into a different equally detailed, and therefore equally distorting, bed of Procrustes. In their attempts at a modern analysis, some linguists have recently succeeded in making English, for instance, look not like Latin, but like Turkish, or in making Russian look like an American Indian language. In summary then, it is necessary to proceed with caution in proposing a model to be sure that it will be at the same time general enough not to prejudge the results, and yet specific enough not to be trivial.

In order to arrive at such a reasonable model, the most appropriate approach seems to be to draw on both the commonsensical and analytic insights of the profession and of gifted amateur investigators. There is a fairly consistent body of experience to draw on, from which there have emerged some observations on the basic attributes of natural languages. From these observations a number of general conclusions can be drawn which, when appropriately formalized in terms of a commonsensical rather than a formal logic, may be presented in the form of a general theory or model of language.

Because such a model is essentially rooted in common sense and experience rather than an extraneous logical system, it lends itself to the formulation of analytic suggestions which are not contradictory to analytic practice. Whether the procedures that can be developed to implement these suggestions are "real" procedures in a very strict logical sense is not as important as whether they allow a verified and controlled acquisition of knowledge about a particular language. Fundamentally, linguistic procedures can do no more, but definitely should do no less, than formalize at each stage of the analysis the intuitive insights of the trained investigator about the nature of his data. Highly significant is the step-by-step formalization of individual small intuitions which by their very smallness and separateness become tractable, where a more extensive body of intuition might lend itself to empirical verification with much more difficulty.

THE GENUS AND DIFFERENTIA SPECIFICA OF THE DEFINITIONAL MODEL

The Genus As stated above, the definitional model, like all classical definitions, consists of a genus and a differentia specifica. The genus portion of the definitional model reads: Language is a system of signs. This is a statement upon which investigators of language have agreed since classical antiquity. Note that this definition of language—after the Swiss linguist Ferdinand de Saussure, who is considered by many the founder of modern synchronic linguistics—is less detailed than some of those found in recent textbooks of linguistics. A number of these definitions speak of language not merely as a system of signs but as a system of vocal symbols. The qualification *vocal* is purposely omitted, since the material manifestation of the system through the medium of sound is not one of its essential structural properties; one of the fundamental insights of data processing has been that systems can easily be transposed from one medium to another by means of machines, provided their structural properties are known. In regard to natural language, it seems reasonable to require that its definition should not be limited to spoken language alone, but should include all its isomorphic or not so isomorphic representations in other media such as writing or, for that matter, computer

code. A further qualification often found in textbook definitions of language is that it is a system "by means of which the members of a human community interact." This qualification seems redundant, since the term *sign,* or *symbol,* seems to imply to most observers the presence of human interactors. Similarly, the qualification *arbitrary,* which is often added before *sign* or *symbol,* is redundant, since signs or symbols, unless they are iconic in Charles Peirce's terms, are arrived at by convention and hence are arbitrary in the sense that their physical shape is not necessarily related to their meaning.

Language is a *system* of signs in the sense that it consists of a set of discrete entities which are in some meaningful way related to each other. These relations are in the experience of linguistic analysts mostly nonstatistical in nature, since the pattern of occurrence of the discrete entities making up a natural language is largely nonrandom. The concept of discreteness in the linguistic consideration of language is discussed later in "Syntax in Machine Translation." It is necessary here to stress the property of relatedness in terms of which language is considered a system. This implies that a language must be described by the relations of the elements that comprise the system rather than by a mere listing of those elements.

The elements which make up the system of a language are thus signs of a particular kind. To make this definition meaningful we must say something about the nature of signs. The classical definition of the sign is that it is "something that stands for something else." It is possible to rephrase this definition in terms of modern psychology to read: A sign is a potential stimulus object the response to which is governed, not by its physical properties, but by a convention pertaining thereto.

The term *potential* is used here in the redefinition of *sign* because many linguists consider language an abstract system that allows for concrete manifestations in the process of speech or writing. Hence the elements of language are *potential* objects, in that they are capable of concrete manifestation in a particular process. Signs are termed potential *stimulus* objects because an element of the abstract system in each of its concrete manifestations has as its function to serve as stimulus for a response by a qualified hearer, reader, or other receiver. The response, if any, to such a stimulus is, as stated above, not directly related to the physical properties of the stimulus object; this is the significant criterion which makes it noniconic in Peirce's sense. Consider the following illustration of the difference between a stimulus object that does not constitute a sign and one that does.

Assume that you are driving down a highway somewhere and that you suddenly notice a fallen tree sprawling across the road. Presumably your response to this visual stimulus will be to stop your car and to do whatever else you may consider proper under the circumstances. It is reason-

able to assume that your response was in some way directly related to the physical properties of the stimulus object; such a stimulus object is thus not the manifestation of a sign.

Imagine now the same situation again, but instead of noticing a tree sprawling across the road you just see a small red flare placed in the middle of your lane. Chances are you would again bring your car to a stop; it is reasonable to assume, however, that your response here was not governed by the physical properties of this latter stimulus object, but by your awareness of the convention embodied in the traffic code. This, of course, was an instance of the manifestation of a sign.

In addition to the defining property discussed above, signs which form part of a system have an additional property first stated by the Austrian psychologist Karl Bühler in his book on the theory of language.[1] This property is called by him "the principle of abstractive relevance." It can be stated as follows: Not all of the physical characteristics of a sign are relevant to its communicative function, but only certain abstracted ones. Thus, in the above example it is only the red color of the flare which is relevant to signal danger, not its size or its design. Nor is the shade of red a necessary detail of the signal, so long as it is clearly recognizable as red.

An elaboration of abstractive relevance, which we may call the "principle of contrastive differentiation," reads: The abstractively relevant characteristics of each sign in a system are differentiated by contrast with the other signs of the system. In the well-known system of traffic lights, for example, the redness of the red light is recognized as red by contrast with the amber and green. The principle of contrastive differentiation leads to the further corollary that the permissible range of variation of an abstractively relevant characteristic of a sign depends on the number of signs with which it is in contrast. The redness of a red light which is opposed to both amber and green has a smaller range of variation than the redness of a red light which is opposed to green only.

Some further significant attributes of signs, as discussed by Karl Bühler, are worth pointing out here. The characteristics considered above are those that signs have by virtue of forming part of a system; they can therefore be called system-derived. Each manifestation of a sign, however, takes place in a particular environment. The environment may consist in part of other signs of the same system, in which case it can be called a *context.* It may further consist of the set of circumstances in which the sign is used, in which case it can be called the *situation.* It can be observed that in each instance of use, a sign with its system-derived characteristics is placed into its environment—that is, its possible context and situation—and is modified by that environment. The additional charac-

[1] Karl Bühler, *Sprachtheorie,* Jena, 1934.

teristics thus derived can be called environmentally derived and further specified as contextually derived or situationally derived. The latter distinction is of some significance in language-data processing, and is discussed further in "A Linguist's View of Language-data Processing."

Consider again the example of the traffic lights to illustrate the relation between system-derived and situationally derived characteristics; to illustrate contextually derived characteristics, a more complex system would have to be cited. The system-derived meaning of the lights, as everyone knows, is "stop," "caution," "go." In the normal situational environment of an intersection, this meaning is translated into appropriate responses by drivers. In the situation of a driver's vision test, where a replica of the traffic lights may be used, the system-derived meanings of "stop," "caution," and "go" are retained, but situationally derived elements of meaning modify the response in terms appropriate to the different conditions.

The general characteristics of signs disclosed above can be summarized as follows: Signs have both form and meaning (that is, they constitute stimuli—form—to which conventional responses are expected—meaning) ; when they form systems, their abstractively relevant characteristics are differentiated by opposition; when signs are used, their system-derived characteristics are modified by environmentally derived characteristics. Since natural language is here considered a system of signs, all these properties of signs must also apply to the elements of natural language.

From the association of form and meaning follow the linguistic equivalence principle and relevance criterion.

The linguistic equivalence principle differentiates between what is same and what is not same in linguistics as follows: Same is what is structurally equivalent, and not necessarily what is substantively identical. Variant spellings of the same word—to choose a simple example from written language—have different forms but the same meaning; they are substantively not identical, but structurally equivalent. Conversely, homonyms are substantively identical, but structurally not equivalent. Thus, sameness and difference can be established only if form and meaning are considered together. A consequence of the linguistic equivalence principle is the linguistic relevance criterion: That which affects structural equivalence is relevant; that which does not affect structural equivalence, although it may affect substantive identity, is not relevant.

In linguistic analysis, the intent of the description is to determine the elements of a natural language and their relations to each other. Let us consider how, from the general properties of signs as stated above, some of the basic techniques of the linguistic analysis of hitherto undescribed languages can be derived.

The source of information about an unknown or little-known language is a native speaker of the same, called an informant by linguists. The techniques employed in obtaining information from an informant are

summarized under the heading of informant work or, if such work is conducted in the territory of the language to be investigated, field work.

One of the corollaries of the relation between the form and the meaning of the sign is that there exists a certain degree of covariance between these two properties. This covariance can be utilized in informant work to elicit linguistic responses in a systematic way, in a manner comparable to a psychological experiment in which controlled stimuli are presented and responses are observed for their systematicity. Most psychologists refer to such controlled stimuli as the independent variable and to the observed responses as the dependent variable. In informant work, the covariance of form and meaning is exploited by utilizing one of the two variables as the independent variable and observing the other as the dependent variable. In most instances, bilingual informants are used for this purpose. One mode of exploiting the covariance of form and meaning is to control the meaning of the informant's responses and observe their form. This is done, in effect, by presenting the informant with short examples in English, for example, and asking him for the equivalent in his native language. By making sure that the English examples are in some way systematically similar to each other, the investigator may observe whether comparable systematic similarities emerge in the informant's answers. This allows the investigator to obtain an initial inventory of elements in the language under investigation, since it may be assumed that the systematic differences in the informant's answers which vary with the systematic differences in the English questions are related as forms and meanings of signs.

It is evident that the principle of contrastive differentiation similarly enters into the initial procedure of linguistic analysis: Forms are elicited not singly but in sets, and elements are separated from each other by a constant comparison of the forms within a set in order to observe the similarities and differences by means of which these elements may turn out to be in opposition to each other within the system. It can also be seen that this elementary technique of linguistics consists in observing the manifestations of the signs in a language in order to infer from them the abstract system which is the ultimate objective of study.

The relation between system-derived and environmentally derived characteristics is taken into account in informant work by attempting to eliminate so far as possible situationally derived characteristics through the creation of the artificial environment of the "informant session," which is the linguistic analog of laboratory conditions. Contextually derived characteristics are minimized in the beginning of informant work by using short stretches of speech.

The Differentia Specifica This second portion of the definition of language reads: Language is a system of signs, structured in terms of three sets of levels.

Most descriptive linguists call the various structural aspects of language "levels"; in their theoretical presentations they like to say that in a language there are *x* levels of analysis, or that linguistic analysis should be conducted on *x* levels; linguists also often debate whether or not in the analysis or in the description it is legitimate to "mix" levels, and so on.

A level can best be defined as a set of structural relations pertaining to a particular qualitative aspect or property of language. Since a natural language can be assumed to have more than one pertinent structural property, it is not unreasonable to talk of several levels, each level dealing with one of these.

The reason three *sets* of levels are postulated here rather than simply a specified *number* of levels is that language can be considered as having not merely a number of properties in this respect, but three sets of properties, each in terms of a particular defining criterion. One of these dimensions is concerned with the types of linguistic units that can be posited, the second with their varying degree of complexity, and the third with the nature of the relations between the units.

The first set of levels, which we can call *levels of structuring,* is defined in terms of the nature of the elements of natural language that can be singled out by linguistic analysis: units which themselves constitute signs—that is, have both form and meaning—as opposed to units that merely serve to differentiate signs without themselves being signs—that is, sign components.

Consider a simple example from written English. The form *misleader* as used in a recent political speech, can be said to consist of three formal constituents, each with its own meaning: *mis-, -lead-,* and the final *-er.* These three constituents each have a form and a meaning—the meaning of the final constituent *-er* can be rendered by some such paraphrase as "one who performs the action indicated by the preceding constituent." They are thus by our previous definition manifestations of signs. Linguists call such elementary linguistic signs *morphemes.* Note in this connection that morphemes are not the same as words, since in our example the written English word *misleader* was analyzed into the manifestation of three consecutive morphemes. Note also that morphemes are not the same as syllables, since division into syllables is based on considerations of pronunciation and spelling without necessary regard to features of meaning. One possible division into syllables of *misleader* would thus be *mis-lea-der,* which is not like the above division into *mis-, -lead-,* and *-er.*

The form *-lead-* in the above example can be said to consist of three differentiative components: the letter *l,* which serves to differentiate it from forms such as *read;* the letter combination *ea,* which differentiates it from forms such as *lad* and *loud;* and the letter *d,* which differentiates it from forms such as *leak.* Note that the letter combination *ea* in *-lead-* is deliberately retained as a single component, instead of the form *-lead-*

being broken up into four letters. This is done because the sequence *ea* indeed functions here as a single differentiative element in the English spelling system, as opposed to the same sequence of letters in a form such as *reactivate,* where each of the two letters has its own separate differentiative function. The above letters and letter combinations into which the example is divided are thus, by our definition, manifestations of linguistic sign components. Linguists call the elementary sign components of written language *graphemes.* Note that a particular grapheme may be manifested by a single letter, or by a letter combination, or indeed by no letters at all—as in a nonalphabetic writing system such as the Chinese, where the individual symbols are not usually considered letters.

Until recently, linguists have been primarily interested in the description of spoken rather than written language. While they have applied the term *morpheme* to include the signs of both spoken and written languages—and differentiated between spoken and written morphemes when necessary—they have consistently used the term *phoneme* to refer to the sign components of spoken language, and reserved the term *grapheme* for the discussion of written language only. The distinction between phonemes and graphemes is justified, not only by the different substantive manifestations of each, but also—and primarily—by the observation that the phonemic structure of spoken language and the graphemic structure of written language are not necessarily in a one-to-one correspondence. English is a well-known example: English speakers are well aware of the fact that theirs is not what is popularly called "a phonetic language"—that is, a language such as Spanish or Finnish, for which the written graphemes are more or less reasonable equivalents of the spoken phonemes of the preferred pronunciation.

Phonemes are related to the speech sounds of phonetics in a similar way as graphemes are related to letters: Phonemes are manifested by a wide range of sounds sharing the same differentiative function, just as graphemes may be represented by single letters or by letter combinations. The phonetic range of a phoneme may be illustrated by the standard English example used by linguists: The two English forms *pit and spit* are both said to contain the phoneme */p/.*[2] The phonetic shapes of the pertinent sound types contained in the two forms differ: in *pit,* the */p/* is pronounced with a relatively forceful release of the air as the lips are opened, accompanied by an extra puff of air called aspiration; in *spit* the release is less abrupt and the aspiration is absent. In spite of these differences, the aspirated sound [p^h] of *pit* and the unaspirated sound [*p*] of *spit* are both included in the range of the same phoneme, because the

[2]In line with linguistic usage, letters representing phonemes are enclosed in slants, letters representing sound types are enclosed in square brackets.

presence or absence of aspiration depends on the surrounding phonetic substance: no aspiration when an [*s*] precedes, aspiration when no [*s*] precedes and a strongly stressed vowel follows. Hence this difference has no differentiating function, and only the common attributes of the two sound types (that is, absence of vocal-cord noise, lip closure followed by instantaneous release) are carriers of the function of the phoneme */p/* to which they both belong. By virtue of these attributes the phoneme */p/* is contrasted with other phonemes in the language, such as */b/*, which is marked by the presence of vocal-cord noise, or /*f*/, which is marked by friction between lower lip and upper teeth.

Finally, consider a classic example of the difference between spoken and written morphemes. The third-person-singular ending of English verbs, although it takes more than one phonetic or written shape, is considered by linguists a single morpheme with several variant forms. In written English, there are two possible spellings of this morpheme: *-s*, as in *he gives*, *-es* as in *he wishes.* In spoken English, on the other hand, there are three possible pronunciations which differ in their phonemic composition: /*-z*/ as in *he gives*, /*-s*/ as in *he cuts*, and /*iz*/ as in *he wishes.* The same morpheme has two variant forms, called allomorphs, in written English, but three allomorphs in spoken English. There is no necessary one-to-one correspondence between spoken and written morphemes, any more than there is between phonemes and graphemes. Written language thus has to be described in terms of graphemes and morphemes, spoken language in terms of phonemes and morphemes. Since graphemes are the written analogs of phonemes, we can for our present purposes subsume graphemic under phonemic and simply speak of *two levels of structuring*—the phonemic and the morphemic. Anything said about phonemes will then apply analogously to graphemes as well.

The important difference between phonemics—the description of the phonemic level—and morphemics—the description of the morphemic level—thus lies in the different nature of the units that are dealt with. This difference can be restated in terms of the covariance of form and meaning discussed above.

Since phonemes and phonemic units in general are not themselves signs but merely serve to differentiate signs, their participation in the form-meaning covariance is of a different nature from that of morphemes and morphemic units in general. (The question of units in general is discussed further below.)

In case of morphemes, there is a specific covariance of form and meaning, in the sense that the form of a particular morpheme varies with the meaning of that morpheme (with some disturbances brought about by homonymy or homography). This means that wherever morpheme *A* is replaced by morpheme *B*, form *A* is replaced by form *B* and meaning *A* is replaced by meaning *B.* Note that in each instance of the use of form *B*

in replacement of form *A* we also have a use of meaning *B* in replacement of meaning *A*.

For phonemes, the nature of the covariance is not specific, if indeed one can speak of covariance at all. When in a sample of speech—that is, an utterance—one phoneme is replaced by another, there is a concomitant change of meaning, but the change of meaning is not directly related to the particular phonemes being exchanged for each other. In one sample, the replacement of phoneme *A* by phoneme *B* will bring about the replacement of meaning *X* by meaning *Y*, but in another sample, the replacement of the same phoneme *A* by the same phoneme *B* will bring about the replacement of meaning *Z* by meaning *W*.

Thus, whenever in English the morphemic form *I* is replaced by the morphemic form *you*, there is a corresponding change of meaning—always the same change of meaning: the meaning *first person* or *speaker* is replaced by the meaning *second person* or *person or persons spoken to* in all instances in which the replacement of forms has taken place. On the other hand, whenever the phonemic form */p/* is replaced by the phonemic form */b/*, there is a replacement of meaning, but the particular meanings which are replaced by each other vary from case to case: when the */p/* in *pall* is replaced by */b/*, the resultant form is *ball*, when the */p/* in */pit/* is replaced by */b/*, the resultant form is *bit*. Although the phonemic forms that have been replaced by each other are the same, the meanings that have been replaced by each other are not the same.

This difference in the covariance relation has an extremely significant consequence for the procedures of linguistic analysis, The technique stated above, in which meaning is used as the independent variable in order to observe form as the dependent variable, is applicable to morphemic analysis only—that is, to the analysis which has as its aim the description of morphemes. We can elicit related sets of examples in the language under investigation by asking appropriate English questions, and can expect to be successful in using these sets to arrive at an initial inventory of morphemic forms. In translation of the English examples *I am going there, you are going there, he is going there*, we can obtain the forms *ikoola, kekoola, ekoola*. in the Micronesian language of the island of Ponape. Comparing these forms, we can make the assumption that *i-*, *ke-*, *e-*, and *-koola* each represent a separate morpheme, with the respective meanings *I, you, he*, and go *there*. The three forms *i-*, *ke-*, and *e-* can be suspected to belong to one morphemic set, and the form *-koola* to another, in terms of the known similarities in the English forms of which they are translations.

In phonemic analysis, it is not possible to obtain phonemically related sets of forms by simple elicitation. No set of English examples can be found, the translations of which can be expected to exhibit systematic phonemic similarities. The Russian translations of *pit* and *bit*, which in

English are phonemically similar, are not particularly similar to each other: they are *yama* and *kusok*, respectively. The only thing that the phonemic investigator can control in the beginning of the analysis is the length of his examples; by asking for the translation of short English examples, he may expect to elicit forms that are short enough so that he can follow them and record them. He then has to make up his own sets of phonemically related forms by classifying his data according to the suspected phonemes which they seem to have in common and those by which they seem to differ.

The second set of levels has to do with the relative order of complexity of a linguistic unit. This set of levels is based on the assumption that the elements of language, both phonemes and morphemes, do not merely form sequential chains, but are integrated into units of a higher order of complexity which function as wholes and are characterized by certain over-all qualities that transcend the characteristics of the mere sum of their components. Units of this higher order may be called *fused units.* This, as can be seen, is an extension to linguistics of the well-known Gestalt principle of perception psychology.

Consider the following English examples to illustrate the concept of the fused unit. Linguists agree that a form such as *houses* represents two morphemes—a stem morpheme *house-* and a suffix morpheme *-s.* They would further agree that this example illustrates what may be called a *diagnostic context* for the analysis of the occurrence pattern, or *distribution,* of English morphemes. Stretches which are found to precede this suffix morpheme *-s* and to follow some equally clearly specified boundary—that is, which occur in the diagnostic context *-s*—can be said to constitute a distributional class in English morphemics, namely, the class of *noun stems.* On further examination of English data, it becomes apparent that the above diagnostic context can be occupied not only by single morphemes, but by small chains of morphemes, as in the forms *environ-ment-s, real-iz-ation-s,* and the like. Thus chains of morphemes occupying the diagnostic context_____-s are permissible replacements of single morphemes, such as *house-* in the initially cited example. Although these chains consist of more than one morpheme each, they nonetheless have a common replacement characteristic which belongs to the entire chain rather than to its individual components. They are thus fused units in the sense in which the term is used above.

These examples represent a relatively low order of fused unit, which can be called morpheme cluster. In a language such as English (and for that matter, in languages very unlike English as well) there are many more orders of fused units of increasing complexity. The examples were chosen from the morphemic level of structuring; fused units of different orders of complexity can also be ascertained on the phonemic level of structuring, the best-known instance of which is the syllable, which in

many languages has over-all characteristics that are not simply a result of the sum of the properties of the phonemes composing it.

It is not unreasonable to posit a separate "level" for each order of fused units encountered in a language, be it on the phonemic or the morphemic level of structuring. It is furthermore reasonable to assume that in any given language there will be more than one of these levels, but not reasonable to assume any particular given number of these levels. These may be called *levels of integration.*

The assumption about the over-all properties characterizing the fused unit as a whole allows for a significant corollary with important consequences for linguistic analysis—namely, there is no necessary relation between the internal structure and the external functioning of a given linguistic unit. This allows us to formalize the common observation by linguists that units of the most varied internal structure in a given language often may have the same modes of external functioning, and conversely, units of the same internal structure may have different modes of external functioning. In the first instance, such units can be called functionally equivalent; in the second instance, such units can be called identically constituted.

A classic example of functionally equivalent units in English with the most varied internal structure is the use of entire clauses as modifiers such as in the expressions *a come-hither look* or *with a don't-come-near-me expression on her face.* It seems apparent that the external functioning of these modifying constructions cannot be meaningfully related to their internal structure, but must be explicated through the assumption that internal structure and external functioning are separately statable and partially independent properties.

Conversely, English nominal constructions of the type *John Henry* or *Jackie Anderson* are found not only in such examples as

John Henry is a good friend of mine.

where they can be said to function as subjects, but also in utterances such as

Don't you Jackie Anderson me.

where they can be said to function as predicates. These constructions illustrate how units that are identically constituted may differ in their external functioning.

In linguistic analysis the assumption of fused units implies that, in addition to ascertaining elements such as phonemes and morphemes in a given language, their integration into units of a higher order of complexity has to be described. This assumption also allows the application of a single unifying operation to an entire chain of elements, since it then will be based on the presumable over-all characteristics of this chain which

is assumed to constitute a fused unit. The corollaries regarding the separateness of internal structure and external functioning, leading to the properties of functional equivalence and identical constitution, permit the analyst to ignore internal structure while investigating external functioning, and vice versa. This is particularly significant in that it allows the analyst to ignore certain conditions of detail without violating the consistency of the analysis; it is perfectly possible to describe a set of units in a given language as to their external functioning and ignore the question of their internal structure, without thereby invalidating the statements pertaining to their functions. In many cases, the details of internal structure of infrequently recurring units are obscure, and no conspicuous analytic advantage would be gained by delaying the procedure in order to ascertain them; the description of the structure of the language as a whole can well proceed without the inclusion of these details. This is particularly true of the many instances in which grammatical elements, such as the stem portions of nouns or verbs, seem to consist of more than one morpheme, but where for a number of reasons the detailed description of this morphemic composition is not readily accomplished. It is then more efficient to describe these potential units as to their external functioning only, and to ignore their internal structure in order not to impede the progress of the analysis. The classical example of such units are the many English forms of Latin origin, such as *receive, detect,* and the like (which recur quite infrequently by comparison with such elements as the suffix *-s),* in which the original Latin morphemes seem to persist in English, but the rigorous application of linguistic procedures does not yield clear-cut morpheme boundaries.

The third set of levels deals with the manner in which the units of a natural language—both elementary units and fused units—are organized.

Any sign system by definition contains more than one sign; hence, in each instance in which the system is used, a selection has to be made from among the signs available within the system. This principle of selection applies to natural language as well; in each instance of the use of language, one or several of the many available linguistic units have to be selected. In many sign systems, selection is the only organizing principle present; most ordinary road signs are a good example of this. The function of each individual road sign is usually independent of the presence of any possible preceding or following signs along the same road; only the selection of the particular given sign matters in each instance of use.

In the case of language, however, the function of each of a sequence of linguistics units may be closely related to, or even governed by, the presence of other units within the sequence. That is, in addition to the selection of the units in each instance of use, the sequential arrangement of units is relevant. The classical examples are the two English sequences *dog bites man* and *man bites dog,* in which the same units have been

selected but the arrangements are different, and these two sequences constitute different messages because of these differences in arrangement.

In natural language, therefore, both the selection and the arrangement of the units are relevant organizing principles. We may refer to selection and arrangement as the two *levels of organization* of natural language, by which natural language differs from systems with a single level of organization (selection only) such as the system of road signs.

Some linguists refer to the level of selection and arrangement as the *paradigmatic* and *syntagmatic* levels respectively. Going back to the discussion of diagnostic contexts above, the distributional class allowed in a particular diagnostic context can be called a paradigmatic class, since in each particular instance of speech (or writing) one member of the class is selected to occupy the given context. The relation between the paradigmatic class and its diagnostic context can be called a syntagmatic relation, since the sequential position of the components of the context with regard to the blank into which the class fits, is one of the diagnostic criteria. That is, the diagnostic context *You* _____ *Mary* is different in diagnostic value from the context *Mary* _____ *you,* since the former allows occupancy by forms such as *love, see,* whereas the latter allows occupancy by forms such as *loves, sees.*

Consequently, the description of a language can not be limited to a listing of the paradigmatic classes and their members, to the extent permitted by the size of the class. It must also contain a statement of the syntagmatic relations in terms of which these classes are defined, and by virtue of which individual members can be assigned to these classes.

The Czech linguist V. Mathesius in the late thirties considered the two levels of organization of language significant enough to propose a basic division of linguistics into onomatology and syntax, representing the two levels of selection and arrangement respectively. While this distinction has not gained currency in the profession, it represents an interesting attempt to render more specific the very useful traditional distinction between dictionary and grammar which, for most practical purposes, corresponds closely enough to the two levels of selection and arrangement.

The most productive techniques of linguistic analysis are related to this distinction between the levels of selection and arrangement, as well as to the differentiation of external functioning and internal structure as discussed earlier. Two of these techniques are cited briefly below.

One is the very well-known technique of substitution, which, if properly specified, is extremely useful in linguistic analysis. It consists of investigating what units are interchangeable in the same diagnostic context. This investigation can be conducted either through informant work, by presenting the informant with an appropriate series of questions, or through an extensive analysis of a large body of text in which minimally different stretches are compared to each other. The substitution technique

results in the definition of a paradigmatic class, as discussed above. Examples of such paradigmatic classes would be the class of noun stems or the class of verb stems in a language such as English.

Another technique based on these two sets of levels is that of dropping. It consists of testing whether the omission of one portion of a given sequence leaves a viable residue—that is, one which is acceptable as an utterance in the language under investigation. The dropping technique is used to ascertain a syntagmatic relation of dependence: *A* is dependent on *B,* whenever *B* is the necessary condition for the occurrence of *A.* In the dropping test, the omission of *A* will leave a viable residue; the omission of *B* will not. In the English sequence

The houses were built last year.

the omission of the article *the* leaves a viable residue

Houses were built last year.

On the other hand, the omission of *houses* does not: *The were built last* year is not an acceptable English utterance. The results of the dropping test yield a clue (but, of course, only one clue) to the syntagmatic relation between *the* and *houses:* it will be more reasonable to assume that *the* depends on *houses* for its occurrence, than to assume the converse. Needless to say, additional tests will be necessary to validate this astsumption.

Let us now summarize the discussion so far and restate the definition of language in its complete form: Language is a system of signs, the structure of which is specified in terms of three sets of levels—namely, two levels of structuring, two levels of organization, and more than one level of integration.

The above definition can now be applied to any given system of signs in order to ascertain whether or not it is a language in the sense of being the linguist's proper object of cognition—that is, a natural language. If the system under consideration—whether it is called a language or not—exhibits all the properties specified above, it can be considered a natural language (or a complete isomorph of one, which for data-processing purposes ought to be the same); if the system lacks any of these properties, it is not a natural language.

Thus, when logicians talk about a simplified language as defined, for instance, by the vocabulary *a, b, c,* and the syntax +, —, =, it is not a language in our sense, since, although it does have the two levels of organization, it lacks both the required two levels of structuring and the levels of integration. Similarly, the language of the bees as described by von Frisch is not a linguist's language, since it, too, is limited to the two levels of organization and lacks the other two sets of levels *(cf.* Sebeok's discussion in "The Informational Model of Language"). On the other

hand, written English, for instance—although it is far from being a complete isomorph of spoken English—is as much of a natural language as any of the spoken dialects, since it exhibits all the structural properties set forth in the definitional model of language, although, of course, their substantive manifestation is graphic rather than phonetic. By defining natural language in terms of its structural and relational rather than any substantive characteristics, the definition becomes applicable to written as well as spoken language. This means that although descriptive linguists have heretofore concentrated the bulk of their efforts on the analysis of spoken languages, the techniques of descriptive linguistics are equally applicable to written languages.

In conclusion, consider the point of view which this definitional model suggests for linguistics and language-data processing.

Since language is viewed as consisting of a system of units of different defining characteristics and orders of complexity which are linked to each other—and defined—by the relations into which they enter, the basic objective of descriptive linguistics becomes one of defining these units and of stating these relations. In terms of concrete analytic practice, defining the units means being able to ascertain their boundaries: The definition of a linguistic unit should be such that given a particular analytic input (either a sample of speech or a set of units of a lower order obtained by a previous procedure) and this definition only, the application of this definition should yield unequivocally the boundaries of the units so defined.

The definitional model of language discussed here thus requires that in analytic practice, units and relations beyond a certain minimal order of complexity be appropriately defined rather than accepted as primary assumptions. This means, in effect, a requirement that the primitive terms of linguistic analysis be pushed back as far as possible, so that only terms of maximum generality are permitted as primitives. Specifically, this means that only such general terms as *phoneme, morpheme,* fused *unit, dependence relation,* or *substitutability relation* are allowed as axiomatic; more particular terms such as *stem, verb, noun,* or *phrase* should not be allowed as primitive terms, but should be defined in terms of the relation of the real primitive terms to each other and to the analytic input. In so doing, this definitional model allows a somewhat greater control over the investigator's intuition than would a less demanding point of view. Although many of these more special terms of the analysis may appear to be intuitively obvious, by being forced to give their proper definition, the analyst is compelled to verify his intuition at each step. This allows him to ascertain whether, in terms of the data before him, his intuition was or was not in error on some point. When confronted with the strict requirements of data processing on a computer, he will then be able to rely more securely on his results.