evaluation of clinical data, permission for eventual use by the general public, and continuous subsequent monitoring of the drug (in the present case, the contraceptive agent) on one agency, which can hardly fulfill all these partially competing functions in an objective manner. As far as the prospects for the development of better birth-control agents are concerned, the Achilles heel seems to be the presently unassailable ultimate authority of government regulatory agencies to pass judgment on scientific matters. The more questionable the scientific fact is, the more questionable this single scientific authority becomes. In view of the extraordinary scientific complexity and the many unanswered scientific questions in the field of human reproductive physiology, which cannot await leisurely answers because of the enormity of the problem of population growth, the ultimate authority on such scientific matters (especially during the experimental preclinical and clinical phases) should rest on independent bodies of experts to whose scientific judgment the governmental regulatory agencies as well as the investigator are prepared to bow. Since the appointment of membership to such "final courts of scientific appeal" is such a delicate matter, my recommendation is that the national responsibility in the United States be delegated to the National Academy of Sciences, and that the international responsibility be delegated to the World Health Organization. In fact, the World Health Organization already has such groups (*3, 4*) consisting of experts from developed and developing countries. All that is needed is to bestow on them the necessary authority.

References and Notes

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2. C. Djerassi, *Science* **151**, 1055 (1966).
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5. The cost of the agents themselves is no longer a critical factor, since, in such large-scale government-sponsored projects, it has already reached the level of 10 cents per woman per month.
6. For the purposes of this article, the conventional foam tablets, jellies, and the like are not considered within the definition of "chemical contraceptive agents."
7. My association with this field has been through Syntex Corporation, a commercial organization of which I am a director and president of the research division, rather than in my capacity as professor of chemistry at Stanford University. This connection may raise some question, perhaps reasonably, as to the objectivity of my remarks. However, this has also given me a kind of practical experience that is not readily available to anyone who has not been directly involved in the commercial development of pharmaceuticals for wide public use. I would also add that my own strong feelings about the importance of finding practical solutions to the world population problem have been a primary incentive in my work and in my efforts to bring my views to public attention. Therefore, I hope that any criticism will be directed at the content, rather than the source, of this article.
8. See, for instance, J. J. Bonica and G. D. Allen, in *Drugs of Choice, 1966–1967*, W. Modell, Ed. (Mosby, St. Louis, 1966), pp. 199–232; "National Clearinghouse for Poison Control Center Bulletin," *U.S. Dep. Health, Educ. Welf. Annu. Rep.* (Government Printing Office, Washington, D.C., 1968).
9. K. E. Taylor and C. O. Miller, *FDA Pap.* (1968), p. 27.
10. E Diczfalusy, Karolinska Institute, Stockholm, personal communication.
11. E. I. Goldenthal, *FDA Pap.* (1968), p. 13.
12. In retrospect, it is interesting for me to recall a series of lectures that I presented in Sweden in September 1962 under the auspices of the Swedish Chemical Society, dealing with the development of steroidal oral contraceptives. Sweden had at that time not yet approved oral contraceptive steroids for domestic use, yet, as part of its impressive and intelligent foreign assistance program involving population control measures, it was already promoting with great vigor the use of such contraceptive agents in certain Asian countries. In my lectures I emphasized the moral and logical objections to such a position.
13. The medical community seems by no means to be unanimous on this question; see L. E. Moses, *J. Amer. Med. Ass.* **208**, 694 (1969) and references cited therein.
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Language Universals: A Research Frontier

Empirical limits of logically possible types provide a basic method for linguistic generalization.

Joseph H. Greenberg

The number of languages in the world may be estimated as between five and ten thousand. This vast linguistic diversity is but one facet of human sociocultural diversity in general. The term "universal" is well established in cultural anthropology and sociology to designate those properties of human cultures which are found in all groups; for example, tool-making and the existence of organized social institutions and belief systems. Lists of such panhuman cultural traits have been drawn up from time to time by cultural anthropologists. The following is a well-known example of such a list: speech, material traits, art, knowledge, religion, society, property, government, and war. Each item furnishes a component of a "universal culture pattern" as described by Clark Wissler in 1923 (*1*).

It will be noted that each of these items is a highly general rubric, such as might form the topic of a chapter in the ethnographic description of a particular people. To posit the existence of universals of this type involves the assertion of the basic comparability of all cultures. As minimal as such a claim may seem, it is in fact a basic achievement of the last century of anthropology to have demonstrated that all human groups, however simple their technology, possess coherently structured institutions which include functional equivalents of all the basic categories of the technologically most advanced societies. Indeed these results have still not fully penetrated popular consciousness. For example, in respect to language, it is still widely believed that the languages of the technologically simpler peoples are themselves simple and lack fully articulate sound systems and well-defined grammatical rules.

It is obvious that such a list as that of Wissler cited above lacks specificity in that it merely asserts, for example, that all peoples have speech and government without delimiting in any fash-

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ion the kinds of languages or governments that may be found in human groups. There has emerged in the last two decades within anthropology the so-called cross-cultural approach. This involves a systematic comparative study of particular human institutions in order to determine what more detailed universal statements may be made regarding human societies (*2*). In a manner quite parallel to that to be described here for linguistic studies, the cross-cultural approach has broadened the logical basis of the concept of cultural universal. It has not only admitted such statements as "all human societies have marriage institutions" but also allowed for relationships among variables in order to demonstrate, for example, that certain forms of marriage show a significant statistical relationship with other human institutions, that is, residence rules, kinship terminology, and inheritance.

Historical Background

The topic of language universals has gone through several stages. In what may be called traditional grammatical theory, languages were described by means of a set of categories of presumed universal validity. Among these were the parts of speech and the bipartite division of all sentences into a subject and predicate. The conviction of the universal applicability of such categories was based on the assumption of man's rationality and the concomitant view that language as the instrument of thought must conform to the normative requirements of coherent discourse. Thus the grammatical subject-predicate form of sentence was the linguistic counterpart of the necessary logical form of propositions.

The actual categories were ultimately derived from the Western Greco-Roman grammatical tradition. If, in fact, all languages have the same basic form, the historical accident that linguistics employs those which have developed within the Western cultural tradition will not cause any particular difficulty.

It gradually became apparent, however, that this was not the case. As languages, such as those of American Indian groups and those of Africa and Oceania, began to be the subject of serious study, the traditional categories were more and more viewed as straitjackets. They forced an analyst to impose categories often not functionally

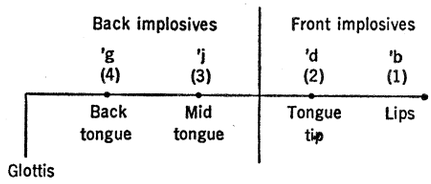

Fig. 1. The main types of implosive sounds.

relevant to the language being studied and to ignore others which were.

It was essentially because of these difficulties that various "structuralist" approaches developed in the last 50 years or so and came to dominate scientific linguistics. There were and are a number of schools of structuralism in Europe and the United States. Common to all, however, is the basic concept of "structure." Every language is an organized system which must be described in its own terms without the imposition of the observers' ethnocentrically derived categories. To a great degree and in ways which cannot be elaborated here, structuralism developed methodologies which enabled the linguist to describe each linguistic system in its own terms.

Structuralism, particularly in its American variants, tended to emphasize the differences rather than the uniformities of language (*3*). This was natural enough since the structural approach itself grew out of problems connected with the diversities of language. Except for a very few, almost commonplace observations, all that was common to languages seemed to be merely the consequence of the universal applicability of the methodological procedures themselves. For example, phonemic theory provided the method for discovering the basic sound units, "phonemes," of each language. Hence, every language had phonemes, but each language had its own particular set and little in the way of general principles was presumed to operate in regard to these individual systems.

Within the last decade, however, there has been a marked resurgence of interest in the study of language universals. One may point, in particular, to two developments. One was the conference on language universals held in 1961 under the sponsorship of the Committee on Linguistics and Psychology of the Social Science Research Council. This conference, whose results were published in book form (*4*), involved the participation of leading linguists, anthropologists, and psychologists. The second major development was the central place which the topic of universals has come to occupy in the theoretical framework of the generative transformational school of linguistics, now the dominant trend in American linguistics (*5*). These recent developments have been marked not only by a revival of interest and much substantive work but also by theoretic innovations.

My own interest in the subject was largely stimulated by the first of these developments. Continuing contact and collaboration with psychologists as a member of the Social Science Research Council Committee on Linguistics and Psychology served to focus my interest on the universal aspect of language. Both the neglect at that time of this topic in American linguistics and its key significance for psychology as well as other sciences dealing with man became apparent in our mutual discussions and activities leading, ultimately, to the 1961 conference on the topic. The approach outlined here, which is chiefly but not exclusively typological, derives largely from these initial interdisciplinary contacts and has continued along lines arising from this stimulus.

Language Diversity

It was not merely theoretical prepossessions which in the past discouraged research in language universals. As the panorama of the world's languages unfolded, nearly every familiar landmark seemed to disappear. Language differences run deep and are not to be lightly dismissed.

To understand something of the extent of interlinguistic diversity we may compare English with some other language, such as French. Even such a very limited comparison will suffice to refute many universal hypotheses. Thus the existence of nasal vowels in French but not in English and of interdental fricatives (the *th* sounds of *thin* and *this*) is sufficient to destroy the hypothesis of the universality of these two sets of sounds. Even where the phonetic similarity is great enough for the sounds of the two languages to be equated there will often be important phonetic differences. Thus, the *t* of French, which is dental and unaspirated, is not the same as English *t*, which is alveolar and has varying degrees of aspiration depending on complex rules. In grammar French has a system of grammatical gender in the noun without any real parallel in English, showing that

grammatical gender is not a universal. Even in vocabulary, outside of perhaps certain scientific and technical vocabularies, there is frequent disparity. Thus, corresponding to English "to know" are the common French equivalents, *connaître* and *savoir*.

Yet French and English are likely to be more similar than just any two languages chosen at random, since they are both Indo-European and their speakers have participated in a common Western European cultural tradition. We may expect the differences between English and unrelated languages with a long history of separate cultural development, such as Chinese or Navaho, to be far greater. In studying a language like French there will still be important common ground for the speaker of English that will appear so self-evident that it will generally not obtrude into his consciousness. Thus French nouns, like English, distinguish singular and plural. However, one does not have to seek far to find languages, such as Chinese, which have no grammatical distinction of number in the noun. One can express plurality when it is so desired, but Chinese nouns, unlike those of English and French, do not have two forms of the noun with compulsory choice of one or the other.

Typology

Let us consider further the example of nominal plurality just described. It would seem, on the face of it, that we cannot make any universal statement since some languages, like English, have a grammatical distinction between singular and plural and some, like Chinese, do not. Instead of asking, however, whether the distinction of singular and plural exists in all languages, the answer to which, as has been seen, will be negative, let us ask a different sort of question, one based on the concept of type. We may say that English and Russian, which distinguish singular and plural, belong to one type of language in regard to the category of number, while Chinese and Malay, which do not make the distinction, belong to a second and different type.

We may now consider the category of number more systematically from the typological point of view. We will inquire whether there are other types than the two exemplified by English and Chinese. Our first goal will be an exhaustive enumeration of types. Further investigation will disclose that the English and Chinese types are not the only ones. A fair number of languages in different parts of the world possess an additional category, the dual number. A well-known instance is Classical Greek, in which we have, for example, (in the nominative case) *ánthrōpos*, "a man" (singular), *anthrṓpō*, "two men" (dual), and *ánthrōpoi*, "more than two men" (plural).

Having enumerated the types which are to be found, our next step is to ask the following questions (*6*). What are the logically possible types of systems for the category of number in the substantive? If these are more numerous than those which are known actually to occur, can we state any general principles which govern this particular choice of the actual types from among the possible?

It is, as a matter of fact, not at all difficult to conceive of possible systems for the category of number which are not empirically exemplified in any natural language. Indeed there are an infinite number of such systems. Let us imagine a language in which there are two grammatical categories, *A* and *B*. The first, *A*, is used whenever we talk about a collection with an odd number of objects, and the second, *B*, whenever we refer to a set with an even number. No such natural language exists, of course. The arithmetic of odd and even which underlies such a hypothetical grammatical system is, of course, just a special case of modular arithmetic, that with modulus two. Since we can obviously construct a system of categories with any natural number whatever as the modulus, there are an infinite number of such systems. There are also an infinite number of other ways that such systems could be generated. For example, given any infinite sequence whatever among the natural numbers, one grammatical category might apply whenever we referred to a set which contained a number of objects which was a member of the sequence and the other whenever we did not.

In light of the infinity of possibilities it becomes rather more impressive that natural languages, while they do not all have the same system, are confined to one of only three such systems.

The next question is the following. Are these three systems a mere random selection among the infinity of possible systems, or can they be delimited in some systematic fashion?

Let us put in correspondence with each grammatical category the set of cardinal numbers of the sets of objects to which the grammatical category applies. The three empirically found systems can be enumerated:

I. (1, 2, 3 . . .); for example, Chinese

II. (1) (2, 3, 4 . . .); for example, English

III. (1) (2) (3, 4, 5 . . .); for example, Classical Greek

As we have seen, a system of grammatical numbers corresponds to a particular kind of partition of the positive integers. Formally, a partition P of the positive integers corresponds to a system of grammatical numbers only if it satisfies the following two axioms:

Axiom I. Every partition contains n sets (where $n = 1, 2, 3$)

Axiom II. Every partition contains the set consisting of the integers $\geqq n$, where n is the number of sets

Each of the three systems enumerated above satisfies these axioms, and no other system does.

Another example in which the number of types is finite and can thus be enumerated and examined separately is the following.

There is a set of consonant sounds, called implosives, found in a fairly large number of languages in Africa, Southeast Asia, and in a number of American Indian languages. In the formation of such sounds the air chamber between the glottis and some supraglottal position in the speech tract, for example, the lips, is increased in volume by lowering the glottis, thus rarefying it. When the supraglottal closure is released the air will momentarily rush in since the rarefication of the air in the chamber behind the supraglottal closure has decreased its pressure in relation to the air in front of this closure (*7*).

Implosives may be classified according to the place of supraglottal closure. There are four main points of closure which are involved. These are shown schematically in Fig. 1 in relation to the glottal point of closure.

The main division lies between points (3) and (2). Implosives produced at points (1) and (2) may be called front implosives and those at (3) and (4) back implosives. We can now enumerate the logically possible types of languages with regard to implosive sounds by referring to the presence or absence of (i) front implosives and (ii) back implosives. Since there are two properties, each of which may be present or absent independently of the other, there are four possibilities.

1) Front and back implosives may

both be present. An example is Angas, a language of Nigeria with implosives at positions 1, 2, 3, and 4.

2) A front implosive is present but back ones are absent. An example is Zulu in South Africa which has only one implosive, at position 1.

3) Front implosives are absent but at least one back implosive is present. No such language is known.

4) Both front and back implosives are absent. The vast majority of the world's languages which, like English, have no implosives, belong to this type.

We see once more that a logically possible type, namely, that which has back but not front implosives, is not found. This result, like our previous one regarding the category of number, seems to be a negative one. Indeed, we might describe the overall purpose of linguistic science in its generalizing aspect to be the delimitation of the concept "humanly possible language" among the infinity of abstract possibilities.

However, all such statements as the foregoing about the nonexistence of certain types are logically equivalent to positive statements with the limitation that they are implicational, that is, conditional in form. The equivalent of the statement that there are no languages which have back implosives but no front implosives is the implicational proposition that the presence of back implosives implies the presence of front implosives (*8*).

Such implicational statements turn out to be very numerous in all aspects of language, far more numerous than "absolute" universals of the type "all languages have vowels." There seems very good reason to admit such statements as universals. Their logical scope is universal since the reference set is that of all languages. Thus the foregoing statement regarding implosives could be logically paraphrased as follows. For all x, if x is a language, then if it has at least one back implosive it always has at least one front implosive. Scientific generalizations always hold only under certain stated conditions and, in fact, universal implications have often been proposed as the typical logical form for scientific laws.

Perhaps more important than these general considerations is the fact that the inclusion of implicational along with absolute generalizations about language is fruitful in linguistically relevant results. Linguistic universals, including the implicational ones, tend to form coherent groups instead of being isolated statements. The basis of this cohesiveness is that a whole set of them will point to the same hierarchy among linguistic features; that is, they will provide evidence of a panhuman system of preferences.

The relation between implications and a preferential hierarchy rests on the following consideration. The implied is more fundamental than that which implies it since the former may be present without the latter but the latter can exist only in the presence of the former. Thus front implosives are preferred or are more fundamental in human speech because they are implied by back implosives which cannot occur without them. But the relation is asymmetrical since the front implosive, the preferred type, can occur without the back implosive being present.

The example just discussed is, as presented up to now, an isolated one. In the next section we shall consider the possibility of broader principles; that is, higher level principles which are common to whole sets of universals, each of which points to some one hierarchical relation.

Phonological Hierarchies and Marked Features

As a further example of a hierarchical relation in phonology, we will consider the feature of nasality in vowels. In the production of nasal vowels the back extremity of the soft palate (the velic) is not raised, so that the entrance to the nasal cavity is not cut off. As a result air escapes both from the mouth and the nose. In the nonnasal vowel, also called the oral vowel, the velic is raised so that the entrance to the nasal cavity is closed and the air escapes from the mouth only.

There are a whole series of universals all of which point to the preferred status of oral over nasal vowels. Among these are the following. The presence of nasal vowels in a language always implies the presence of oral vowels but not necessarily vice versa. That is, a language may have oral vowels without nasal vowels, but it can never have nasal without oral vowels. A second statement is that the number of nasal vowel phonemes is never larger than the number of oral vowel phonemes. They may be equal in number. A large group of languages, including French, have fewer nasal than oral vowel phonemes. No language has been found, however, in which the number of nasal vowels is larger than the number of oral vowels. A third regularity which leads to the same hierarchy is that the frequency of nasal vowels in text is always less than that of oral vowels.

The fact that a number of separate statements of universal scope all suggest the same relationship between oral and nasal vowels, namely, that the former are more basic than the latter, obviously increases the reliability of this conclusion. Moreover, there are other such "clusters" of universals, each one serving to establish with a high degree of probability some particular hierarchical relationship among classes of sounds.

Given a whole series of such results we can ask if still higher levels of generalization are possible. Are there any properties which distinguish favored articulations as a group from their alternatives? There do, as a matter of fact, appear to be several principles at work. There is room here to discuss only one of these principles, but it is one which accounts for a considerable number of clusters of phonological universals as well as having some application, when appropriately broadened, to the grammatical aspect of language as well. This is the principle that of two sounds that one is favored which is the less complex. The nature of this complexity can be stated in quite precise terms. The more complex sound involves an additional articulatory feature and, correspondingly, an additional acoustic feature which is not present in the less complex sound. This additional feature is often called a "mark" and hence the more complex, less favored alternative is called marked and the less complex, more favored alternative the unmarked (*9*). Thus the nasal vowels, as has been seen, are less favored than the oral vowel. They are more complex; they involve an additional resonance chamber, the nasal, besides the oral chamber which functions alone in the oral vowels (*10*). Again, nonglottalized consonants are favored against glottalized. The latter are like the former except that the glottis is closed simultaneously with the consonantal closure while, with the nonglottalized, this closure is absent. The general principle involved is evidently of broad application and allows us to deduce many specific universals that can then be subject to empirical test.

It may be noted that the approach outlined here avoids the circularity for which earlier formulations, such as those of Zipf (*11*), were attacked. Such

theories stated that there was a general human preference for "easier" sounds but when the question was raised regarding which sounds were easier the operational definition appeared to be "those which are favored." In the present instance, panhuman preferences were investigated by formulating universals based on the occurrence or nonoccurrence of certain types, by text frequency and other evidence, none of which referred to the physical or acoustic nature of the sounds. Afterward, a common physical and acoustic property of the favored alternatives was noted employing evidence independent of that used to establish the universals.

Marked Features in Grammar

The more basic fact underlying the concept of marked and unmarked, and of other principles that might have been cited, is that of hierarchy. Such hierarchical relations are just as basic in grammatical and semantic aspects of language as in phonology. A principle quite analogous to that of marking in phonology is also operative in grammar and semantics and goes by the same name (*12*).

In order to illustrate this principle in grammar, we return to the category of number in the noun which was the topic of earlier discussion. In English, which has the singular-plural distinction, the formal expression of the two is quite different. The plural for the vast majority of nouns is symbolized by a suffix *-s* (*13*). The singular, on the contrary, has no overt expression. In fact, we might say that the plural is formed from the singular by the addition of an *-s* suffix, and it is often so stated in traditional grammars. It seems not too farfetched to consider this *-s* as analogous to the additional phonetic mark of the more complex category in phonetics. This would suggest that the plural is in some fashion more complex than the singular.

There are a number of indications that this is a reasonable assumption, so that we can consider the singular as unmarked in relation to the plural as the marked category. First, the marking of the plural is not an idiosyncratic feature which is confined to English. There are many other languages in which the singular has no overt mark while the plural does. It is also true that many languages have overt singular and plural indicators. However, there seems to be no language which marks the singular alone and not the plural. Once more then we have an implicational universal. The existence of an overt marker for the singular implies its existence for the plural. A second important consideration is that once more we have clusters of universals indicating the same hierarchy and some of the principles involved are similar to those found in phonology. As in phonology, the unmarked category has greater text frequency than the marked. A number of frequency studies show that the plural is less frequent than the singular, usually about 20 percent, compared to 80 percent for the singular. A further characteristic is that called neutralization. When number interacts with other categories, such as gender, the number of distinctions in the plural or marked member is never greater than in the singular or unmarked category and is frequently fewer. Thus, in German the three genders, masculine, feminine, and neuter, are distinguished in the singular but this distinction is neutralized in the plural. These are but a few of the characteristic relationships which are found to hold for all languages in regard to the distinction of singular and plural. Some of these are analogous to the marked-unmarked relationship in phonology and some are not (*14*). The third major consideration is that, as might be expected, the singular-plural relationship is not the only one to show these characteristics. For example, whenever there is grammatical expression of comparison in the adjective, the comparative and superlative are marked as against the positive. Such relationships also hold in certain semantic domains and, once again, can be couched in terms of linguistic universals. For example, in systems of kin designation the affinal (in-law) terms are marked as compared to the consanguineal terms.

Diachrony and Synchrony

The discussion thus far has been on a synchronic plane and is thus seriously incomplete (*15*). It may be pointed out that the study of universals promises to be an important factor in integrating the results of the two basic branches of scientific linguistics: the synchronic, which studies phenomena in terms of state abstracted from change; and the diachronic, which investigates the principles of linguistic change. The formulation of synchronic universals by specifying possible types of languages at the same time sets bounds on change, since change can be only from one possible type to another possible type of language. On the other hand every given synchronic state is the resultant of diachronic forces.

The concept of type discussed here provides one possible approach to the study of these interrelationships. It was noted earlier in this paper that there are a series of synchronic universals which point to a hierarchical relation between nasal and oral vowels in which oral vowels are the more fundamental class. We shall be concerned here with two specific synchronic universals in this area, the greater text frequency of oral vowels and the fact that no language is known to have more nasal than oral vowel phonemes.

The appropriate synchronic typology will evidently be one in which languages are classified by two criteria: the presence or absence of nasal vowels and the presence or absence of oral vowels. There will then be four logically possible typological classes of languages: (i) oral and nasal vowels both present; (ii) oral vowels present but nasal vowels absent; (iii) nasal vowels present but oral vowels absent; and (iv) oral and nasal vowels both absent. Of the four classes just defined, as far as present knowledge goes, classes (iii) and (iv) are empty but (i) and (ii) exist and are exemplified by French and English, respectively.

We can ask, regarding any given set of typological classes generated by synchronic criteria, what potential diachronic relations exist for every pair of nonempty typological classes. In the present instance we can ask how a language of type (i) can become a language of type (ii) (loss of nasal vowels), or how a language of type (ii) can become a language of type (i) (acquisition of nasal vowels). We shall be concerned here only with the second question.

The methodology required for the answering of such questions involves a kind of generalization of the historical-comparative method in the usual sense. We are to compare the results of specific studies of different language groups in which, in historically independent instances, languages which previously had only oral vowels acquired nasal vowels in the course of time. Such generalized historical investigations may be said to be concerned with process. In the present instance we are asking about the process by which languages acquire nasal vowels. Such theories may be called theories of relative rather than absolute origin, because they indi-

cate the manner in which nasal vowels have arisen again and again at different times and places. Such theories may be considered a type of diachronic universal since they are of universal scope in regard to language, and since they refer to sequences of events which are of potential occurrence in languages of any chronological period or linguistic stock.

A comparison of different instances of the historical process of the acquisition of nasal vowels shows the following typical sequence of events (*16*). An oral vowel becomes nondistinctively nasalized when preceded by or followed by a nasal consonant, or both, usually, though not necessarily, in the same syllable. If the consonant is then lost, the contrast between nasality and orality in vowels becomes distinctive. This final stage is most frequently reached if the original nasal is syllabic final rather than syllabic initial and hence follows the vowel in the same syllable. We may symbolize this sequence of events as follows: $VN > \tilde{V}N > \tilde{V}$ where V stands for vowel, N for nasal consonant, and the tilde symbolizes nasalization.

Apparently there are no instances in which the set of vowel phonemes in nasal consonantal environments is greater than in nonnasal environments. Hence at the time that they arise they should not be more numerous than the oral vowels. The diachronic factors at work will tend to lessen the number of distinct nasal vowels as compared to oral vowels through the merging of nasal vowels with each other (*17*). More strongly put, we hypothesize the following implicational diachronic universal. The merger of a particular set of nasal vowels always precedes that of the corresponding oral vowels, if the latter indeed occurs at all. There is thus a mechanism for decreasing the number of nasal vowels as compared to the number of oral vowels. To summarize, the synchronic universal that the number of nasal vowels is never greater than the number of oral vowels is deduced from two diachronic universals, the relative origin theory of nasal vowels and the preferential merger of nasal vowels, and one synchronic universal regarding the smaller or at most equal number of distinct vowels in a consonantal nasal environment as compared to the number of vowels in other environments.

Similar consideration will serve to explain the synchronic facts concerning the greater text frequency of oral vowels as compared to nasalized vowels. That the total frequency of vowels in nasal environments should be smaller than that in all other environments is highly plausible and indeed supported by empirical evidence. We must also assume that fluctuations over time due to obsolescence, new coinage, borrowing, analogy, and other processes exercise a basically random effect on this frequency relation once it is established.

We may apply this theory to Latin and French. In Classical Latin, which is ancestral to French, the proportion of vowels followed by nasals in the same syllable is 14.7 percent, while the proportion of those not followed by nasals is 85.3 percent. The relative frequency of nasal and oral vowels in French is 16.3 and 83.7 percent, respectively (*18*).

The foregoing example is meant to illustrate one of a number of possible methods by means of which the study of universals, approached through the concept of type, opens up broad perspectives for fruitful interaction between the synchronic structural and the diachronic historical approaches to language.

References and Notes

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2. The basic materials used for such cross-cultural studies are those of the Human Relations Area Files at Yale University. An example of the use of these methods is J. Whiting and I. Child, *Child Training and Personality: A Cross-Cultural Study* (Yale Univ. Press, New Haven, Conn., 1953).
3. In Europe, members of the Prague School in particular maintained an interest in the universal features of language but without a concerted attack on the problem which has been characteristic of recent developments. For an account of the Prague School see J. Vachek, *The Linguistic School of Prague* (Indiana Univ. Press, Bloomington, 1966).
4. *Universals of Language*, J. Greenberg, Ed. (M.I.T. Press, Cambridge, Mass., ed. 1, 1963; revised ed. 2, 1966).
5. For a discussion of universals from the transformationalist point of view, see particularly *Universals in Linguistic Theory*, E. Bach and R. T. Harms, Eds. (Holt, Rinehart & Winston, New York, 1968). This book resulted from the Texas Conference on Universals held in 1967.
6. This statement holds for the overwhelming majority of languages. The following qualifications should, however, be made. In Kiowa, an American Indian language, a large class of nouns distinguishes dual from nondual (one and three or more). Some languages have a paucal versus unlimited plural distinction in which the paucal is used for a small set defined in terms of a continuous sequence. For example, Classical Arabic has one set of plural formations which applies at least theoretically in referring to from three to ten objects (there is also a dual). However, it seems to be used typically with cardinal numbers. Russian has a different inflected form of the noun for two to four objects but only when there is a numeral. If we qualify the statement in the text to exclude constructions with numerals, it will hold without substantial exceptions.
7. This is a simplified account. For more detail, see P. Ladefoged, *A Phonetic Study of West African Languages* (Cambridge Univ. Press, Cambridge, ed. 2, 1964).
8. For the case of two variables, the logical tautology $\sim (\sim p \cdot q) = q \rightarrow p$ provides a conversion formula from a negative statement to a positive implication. This may be paraphrased. If there is nothing which is q and p then anything which is q is also p. For one variable the positive statement is an unrestricted, that is, nonimplicational, universal: $\sim (\sim p) = p$. For example, if there is no type of language without vowels, then all languages have vowels.
9. The theory of marked features occurs already in the work of the Prague School. The classic exposition in phonology is N. Trubetskoy, *Grundzuege der Phonologie* (Travaux du Cercle Linguistique de Prague, No. 7, Prague, 1939).
10. It might be thought that the nonnasal articulation is more complex from the articulatory point of view in that it involves an upward movement of the velic cutting off egress of air through the nasal cavity. However, it appears that articulatory speech movement should be considered a departure not from the position of the speech organs in nonspeech situations but in terms of a "position of phonation." Present evidence is that in preparation for phonation the nasal passage is automatically cut off by the raising of the velic, and hence it is the lowering of the velic for nasalization which is a departure from the "neutral" rest adjustment of the speech organs. On the neutral position, see N. Chomsky and M. Halle, *The Sound Pattern of English* (Harper & Row, New York, 1968), p. 300.
11. G. K. Zipf, *Human Behavior and the Principle of Least Effort* (Addison-Wesley Press, Cambridge, Mass., 1949).
12. The concept of marking outside of phonology was first employed by R. Jakobson in "Zur Struktur des russischen Verbums," in *Festschrift Mathesius* (Cercle Linguistique de Prague, Prague, 1932), pp. 74–84.
13. Orthographic *-s* and *-es* correspond to three phonemes or phoneme sequences in spoken English /s/, /z/, and /əz/, but the choice is predictable from the last sound of the singular.
14. See J. H. Greenberg, *Language Universals, with Special Reference to Feature Hierarchies* (Mouton, The Hague, 1966) for a detailed treatment.
15. For a fuller discussion of the interrelationship of diachronic and synchronic factors in relation to universals, see J. H. Greenberg, "Some Methods of Dynamic Comparison in Linguistics," in *Substance and Structure of Language*, J. Puhvel, Ed. (Univ. of California Press, Berkeley, 1969).
16. It should be noted that the statements here regarding the origin of nasal vowels are subject to the reserve expressed in C. A. Ferguson, "Assumptions about nasals: A sample study in phonological universals," in *Universals of Language*, J. H. Greenberg, Ed. (M.I.T. Press, Cambridge, Mass., 1963), regarding the possible origin of a nasal vowel in Iroquoian by spontaneous nasalization.
17. The greater tendency for nasal vowels to merge with each other than the corresponding oral vowels has a basis in their greater acoustic similarity. Nasal vowels have additional nasal formants whereas oral vowels have no such additional acoustic property. Further, the nasalized vowels have alternated first and second formants as compared with the corresponding oral vowels, thus reducing the basis for acoustic distinctness of vowels of differing quality (for example, *a* versus *i*) in comparison with oral vowels.
18. The figures for French are taken from A. Valdman, "Les bases statistiques de l'antériorité articulatoire du Français," in *Le Français Moderne* **27**, 102 (1959), based on a sample of 12,144 vowels. Those for Latin derive from a personal count of the first 1000 vowels of Cicero's *Letters to Atticus*, Book III, Letters 1, 3, 5, 7, and 9.