On the Correlation of Stops and Fricatives in a Phonological System

ABSTRACT

Bundles of distinctive features (phonemes) are classified as more or less strongly marked, depending on their commonness in the languages of the world. In the voice correlation, /g ɣ/ are marked, /b v/ unmarked in the voiced series. In the voiceless series, /p f/ are marked, /k x/ unmarked. Among the dental fricatives, /θ ð/ are more strongly marked than /s z/. The existence of /p g/ implies redundancy of /f ɣ/ and inversely.

CONTENTS

1. Hierarchic Relation of Markedness between Phonemic Units

1.1 During the last decade in linguistic theory interest in the traditional problem of the marking of linguistic categories has increased in connection with the elaboration of problems of linguistic typology and linguistic universals.

The concept of the presence of marked (feature-bearing, "merkmaltragend") and unmarked (lacking a feature, "merkmallos") categories in a language system arose in the Prague School, in the works of N. Trubetzkoy and R. Jakobson.[1] As is well known, in Trubetzkoy's Principles of Phonology (1939) the concept of the marking of phonological oppositions, connected with the problem of neutralization and the archiphoneme, already plays an essential role.

However, in the subsequent period of intensive development in descriptive linguistics, some withdrawal from working out problems of marking, due to taxonomic restrictions, is to be observed. Only in recent years has particular attention been given to the traditional problems of the marking of linguistic categories and the ascertainment of the hierarchical correlations of elements in a system.

In this respect the recent works of R. Jakobson played a decisive part; in them the traditional problem of marking undergoes substantial development and reformulation, being treated as a universal hierarchical relation between linguistic categories.

1.2 The problem of the marking of linguistic categories holds a special place in the linguistics of universals, in J. Greenberg's theory.

The relation of marking is connected by Greenberg with the frequency indices of linguistic units. The unmarked member of the relation, which is functionally more normal and widespread, has a greater frequency of occurrence in a text compared to the marked member, which is a more complex and textually more restricted unit. In positions of internally conditioned neutralization the unmarked member of a phonological opposition appears.

[1] On the terms 'marked' and 'unmarked' as correlates of the RUSSIAN terms 'priznakovyj' and 'bespriznakovyj' see Jakobson 1971c.

Linked with these characteristics of the unmarked member of a phonological opposition are its capacity for wider distribution compared to the corresponding marked member, the appearance of the unmarked member in a greater number of phonological environments, and its wider subphonemic variability.[2]

Thus, for example, on material from a large number of languages with various sorts of systems, we can determine that unglottalized consonants have a substantially greater frequency of occurrence than the corresponding glottalized consonants, which are opposed to the unglottalized consonants as the marked members of an opposition to the unmarked members. The feature of glottalization is, in the present case, the marked feature. Aspiration is also a marked feature, opposing the aspirated phonemes to the unaspirated phonemes as the marked members of the opposition to the unmarked members, which are characterized by a greater relative frequency of occurrence.

On the basis of the statistical data we can maintain that glottalization is a stronger feature of marking than aspiration, and the normal hierarchy of increasing markedness of a phoneme is represented in the sequence: unaspirated -- aspirated -- glottalized (Greenberg 1966a: 17ff).

In a system of vowels the nasal vowels are opposed to the oral vowels, which have a greater frequency of occurrence (unmarked) as opposed to the former (marked). The same ratio holds for the long vowels (marked members) in opposition to the short vowels (unmarked members of the opposition).

In general we can maintain that the number of phonemes of a marked category never exceeds the number of phonemes of the unmarked category (cf. the situation noted by C. Ferguson, that the number of nasal vowels can never exceed the number of nonnasal vowels; Ferguson 1963). We can formulate this as an implicational statement: the presence in a language of a marked category presupposes the existence in it of the corresponding unmarked category (cf. the assertion that in all languages with nasal vowels there are also oral vowels, where the marked feature appears as the implicans and the unmarked feature as the implicatum).[3]

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[2] See Greenberg 1966a. The factor of frequency of occurrence as a characteristic of the marking relation has been previously mentioned by Trubetzkoy and Jakobson; see Jakobson 1941: 366ff.

[3] Greenberg 1966a, 1966b. Concerning implicational rules in phonology see Jakobson 1939. See also Jakobson 1963 and 1971.

1.3 The distribution of empty slots (gaps) in a paradigmatic system is also connected with the statistical characteristics of the marked members of oppositions, which are distinguished by a narrower textual frequency compared to the unmarked members. The empty slots (gaps) appear in place of marked members of oppositions, as cells, as it were, which would be filled by marked members of a relation; these marked members have a frequency of zero (see Hockett 1955:142ff.).

In the series of glottalized consonants (marked),[4] as opposed to the unglottalized consonants (unmarked), the labial glottalized phoneme /p'/ is distinguished by the least frequency of occurrence in a text; in a number of languages in which a series of glottalized stops is represented, /p'/ is absent, creating an empty slot (gap) in the system (e.g. in a number of CAUCASIAN languages, in many African and AMERINDIAN languages, etc.). In the present case the empty slot reflects a general linguistic regularity: the greatest marking is that of the glottalized labial phoneme /p'/, the frequency of which drops to zero in a number of systems (Greenberg 1970).

Analogous correlations in the system may be established for the series of pharyngealized stops as well. The pharyngealized stops ṗ ṭ ḳ are opposed to non-pharyngealized (pure) stops as the marked members of an opposition to the unmarked. Incidentally, the labial member represents the weakest link in the pharyngealized series, forming in many languages with pharyngealized stops a gap in the system (cf. e.g. the system of SEMITIC languages with the emphatic consonants ṭ and q, the labial *ṗ being absent). It is worth noting in this connection that in the opinion of some scholars the SEMITIC emphatic (pharyngealized) consonants derive from corresponding glottalized counterparts (see Cantineau 1952, Martinet 1953).

The proposal that the marking relation is of a conditioned character, determined by the context, the environment in which the given feature appears, acquires special significance in Greenberg's theory. Thus, for example, the feature of voicing is a marked feature in nonresonant consonants (i.e. in the environment of the features making up these phonemes), while in the resonants it is an unmarked feature. In the case of the resonants the marked feature is [-voiced], i.e. voicelessness (Greenberg 1966a:24).

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[4] On 'series' (séries) and 'groups' (ordres) in a paradigmatic system, see Martinet 1955:69ff.

1.4 The principle of the conditioned nature of the marking relation advanced by Greenberg becomes one of the fundamental principles in working out problems of marking in the theory of transformational-generative grammar (Chomsky and Halle 1968: 402ff., Postal 1968). A certain distinctive feature [F] does not assume the value [mF] (i.e. marked) or [uF] (i.e. unmarked) invariably, independently of the conditions of the given feature's functioning, but in accordance with the character of the environment, the context in which it appears in a 'vertical' (simultaneous) and/or 'horizontal' (linear) sequence.[5] Therefore each of the values + and − of a certain feature [F] can be specified as m or u, depending on the environment. Thus, for instance, in an example of the conditioned character of the marking relation cited by Greenberg, the feature 'voicing' with the value +, i.e. [+voiced], is defined as [mF] (i.e. 'marked') in the nonresonant consonants, while in the resonants the feature [+voiced] is an unmarked feature [uF] (in the case of the resonants the feature of voicing with the value −, i.e. 'voicelessness,' is 'marked;' cf. the presence of voiceless resonant phonemes in a number of language systems). Analogously, the feature of labialization (flatness) [+F] is the marked feature [mF] for front vowels, but the same feature of labialization (flatness) [+F] is unmarked [uF] for back vowels. (See Cairns 1969:865, Postal 1968:80ff.)

In other words, because of the conditioned character of the marking relation, a one-to-one correspondence can not be established between the values m, u and +, − of a certain feature, as was the case in the traditional interpretation of the marking relation, which assumed the presence of a certain feature in the 'marked' member of an opposition (feature-bearing, i.e. a feature with the value +) and its absence in the 'unmarked' member (lacking a feature, i.e. a feature with the value −). It is here that a difference of principle is to be observed between the present conception of the marking relation and its conception in the Prague Linguistic School. (See Chomsky and Halle 1968:404ff., also Shapiro 1972.)

2. Marking Conventions in the System of Occlusive Phonemes

2.1 Basing her work on Greenberg's conception of the marking relation, and taking into account the statistical characteristics of phonemes and the distribution of empty slots in a system,

[5] On 'vertical' and 'horizontal' sequences of features, constituting the 'environment' of a given feature, see Gamkrelidze 1968.

I. Melikishvili establishes a number of regularities pertaining to the correlations of nonresonant consonants in a paradigmatic system, and determines for them a rather general and universal hierarchical dependence with respect to marking. (See Melikishvili 1970, 1972.)

In particular, the following hierarchical correlations between phonemic units of various series and groups (points of articulation) are established.

In systems with an opposition of stops on the feature voicing/voicelessness the voiced labial phoneme /b/ is functionally a stronger unit than the voiced velar stop /g/. This correlation is determined on the basis of the greater relative textual frequency of the phoneme /b/ compared to the velar /g/ in various language systems with an opposition of stops on the feature voicing/voicelessness. In other words, the feature of labiality, in the condition of simultaneous combination with the feature of voicing, is unmarked, as opposed to the feature of velarity, which is a marked feature in combination with voicing.

In the voiceless stops (both simple and glottalized), on the other hand, the velar stop /k/ (and correspondingly /k^h/ and /k'/), which is the unmarked member of the opposition, has a greater functional load than the labial stop /p/ (and correspondingly /p^h/ and /p'/), which is the marked, functionally weaker member. In the labial group the frequency of the voiced phoneme is greater than the frequency of the voiceless one, while in the velar group the frequency of the voiceless phoneme is greater than the frequency of the voiced one.

Thus, velarity combined with voicelessness and labiality combined with voicing form the optimal combinations /k/ and /b/, but uniting voicelessness with labiality and voicing with velarity creates the functionally weak units /p/ and /g/.

Gaps (empty slots) in paradigmatic systems are distributed in accordance with the established functional correlations of feature marking. Systems with gaps in the class of plosives, opposed on the feature voicing/voicelessness, have basically the following forms (Fig. 1):[6]

[6] The LIFU language is occasionally cited to illustrate a gap in the system in place of the labial /b/, which at first sight contradicts the established regularity concerning the unmarked nature of the

(a)			(b)			(c)		
	b	–		b	p		b	–
	d	t		d	t		d	t
	g	k		–	k		–	k

Figure 1

2.2 The dental group is opposed to the labial and velar groups as that group which has the greatest general frequency of occurrence; it is thereby characterized as unmarked with respect to the two other groups. However, the possibility of such systems as (2), with gaps in place of the voiced stops of both the velar and dental groups,[7] shows the greater marking of the voiced dental stop in comparison to the voiced labial, and its lesser marking compared to the velar (Fig. 2).

b	p	p'
–	t	t'
–	k	k'

Figure 2

From the standpoint of combinations with the feature voicing/voicelessness, the features for point of articulation form a definite

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(ftnt. 6 cont.)
labial member in the series of voiced phonemes as opposed to the velar member (cf. Martinet 1955:103). The alleged gap in the place of the phoneme /b/ is assumed from the fact that /b/ occurs in LIFU words borrowed from EUROPEAN and neighboring MELANESIAN or POLYNESIAN languages, whereas the phonemes /d/ and /g/, as well as the voiceless /ptk/ occur in the native forms of LIFU (cf. Lenormand 1952). However, such an assumption of a gap of /b/ in diachrony may not reflect the real state of affairs, for the series of voiced stops in LIFU must have originated from phonemes of a different nature; the series in question may be traceable to the unvoiced series with a regular absence of the labial member that appeared later during the transition of unvoiced series to the corresponding voiced. (In this connection it would be interesting to investigate the correspondences of the voiced stops /d g/ in LIFU to consonants of related MELANESIAN languages.)

[7]A system of this sort is represented, for example, in the AMERINDIAN languages: in SIRIONÓ see Priest 1968, in TZOTZIL and ALAKALUF see Milewski 1967:13, 41, in AMUZGO see Longacre 1965:46, in QUECHUA, TZELTAL, HUASTECO and in other languages of the MAYAN group see Jackson 1972:109ff.

hierarchical series. Voicing is best combined with labiality, and voicelessness with velarity, while dentality occupies an intermediate position. We can represent this correlation in the following figure (with arrows indicating the direction of increase of the functional load of the feature; Fig. 3) (Melikishvili 1972 : 23):

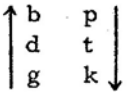

Figure 3

2.3 In the class of voiceless stops the degree of marking is increased by the addition of the secondary features of aspiration and glottalization; furthermore, the feature of glottalization is a more marked feature than the feature of aspiration, so that the hierarchical sequence on the feature of marking in the class of voiceless stops has the following form: voiceless simple -- aspirated -- glottalized.

Thus, the glottalized labial /p'/ is the marked member of the opposition with respect to the aspirated /p^h/, while the aspirated /p^h/ is marked with respect to the simple voiceless phoneme /p/.

Gaps in paradigmatic systems appear in accordance with these correlations. The following systems, with empty slots in the groups of voiceless stops, are possible (Fig. 4):

(a)				(b)			
	b	p^h	–		b	–	–
	d	t^h	t'		d	t^h	t'
	g	k^h	k'		g	k^h	k'

Figure 4

But less probable are systems of the type (c), i.e. systems with glottalized labial /p'/ and a gap in place of the aspirated /p^h/[8] (Fig. 4a):

(c)			
	b	–	p'
	d	t^h	t'
	g	k^h	k'

Figure 4a

[8] The system of a dialect of BORANA belongs to such an extremely rare type (cf. Andrzejewski 1957:354-74). See also Sasse 1973:2ff.

2.4 The same sorts of correlations between different series in the class of voiceless stops can also be ascertained in systems without an opposition of stops on the feature voicing/voicelessness. The gaps in such systems are distributed in accordance with the degree of marking of the members of the labial group (Fig. 5).

(a)			(b)				(c)				(d)			
p	-		p	-	-		p	-	p'		-	-	p'	
t	t'		t	t^h	t'		t	t^h	t'		t	t^h	t'	
k	k'		k	k^h	k'		k	k^h	k'		k	k^h	k'	

Figure 5

There are systems of types Fig. 5 (a)[9] and (b),[10] but less probable are systems of type Fig. 5 (c). Even less probable are Fig. 5 (d) systems with glottalized labial /p'/ and gaps in place of the aspirated and/or simple voiceless labial phonemes. The glottalized labial phoneme is functionally a weaker member than the voiceless aspirate, the latter being weaker than the simple voiceless phoneme.

But united with the feature of velarity the feature of glottalization can also create a functionally stronger unit than aspiration can. In many systems the glottalized velar phoneme /k'/ has a greater relative frequency of occurrence than the corresponding aspirated or simple voiceless velar /k/; it is thereby the unmarked member of the opposition with respect to the unglottalized voiceless velar phoneme.[11]

2.5 The regularities established for the velar group of stops can be extended a fortiori to the postvelar (uvular) group. The weakest element (most marked member), in functional terms, in the group of voiced phonemes is the postvelar (uvular) phoneme /G/, which creates a gap in a number of systems in which there is a phonemic postvelar (uvular) group. The postvelar phoneme

[9] Cf., for example, the TONKAWA language (Hoijer 1933-38).

[10] Cf., for example, NAVAHO (Sapir and Hoijer 1967, also Hoijer 1966) and HUPA (Woodward 1964). The unmarked series of voiceless stops, in contrast to the marked aspirated and glottalized series, is represented with the LATIN symbols for voiced b, d, g in the descriptions cited above.

[11] Melikishvili 1972: 17; see also Greenberg 1970.

/G/ is at the same time the marked member with respect to the velar /g/; there are no systems with a voiced postvelar stop /G/ and a gap in the velar group in place of the voiced /g/.

The systems of stops in a number of CAUCASIAN languages are a typical example of paradigmatic systems of this sort, with a gap in place of the voiced postvelar stop /G/ (see Deeters 1963: 19ff.). Compare, for example, the system of the SVAN and OLD GEORGIAN languages (Fig. 6):

b	p^h	p'
d	t^h	t'
g	k^h	k'
–	q^h	q'

Figure 6

In the group of voiceless postvelar stops the glottalized velar stop /q'/ is the functionally strongest member; its frequency is greater than that of the corresponding aspirated phoneme /q^h/ (cf. the functional load of the glottalized velar phoneme /k'/). The loss, in a number of cases (e.g. in MODERN GEORGIAN), of the marked unglottalized member of the opposition, and the appearance of a gap in the paradigmatic system in its place, must be explained by such a correlation between unglottalized and glottalized postvelar phonemes.

3. An Interpretation of the Relationship of Markedness

3.1 The concept of markedness, which arose in phonology as a characteristic of the presence of a feature in a certain member of an opposition in contrast to its absence, assumed that the members of an opposition were whole phonemic units in privative opposition to one another (Trubetzkoy 1939: 82ff.). The transference of the oppositional function of marking from phonemes to separate distinctive features of phonemes, and the recognition of the contextually conditioned nature of the marking relation extended its sphere of application and changed the original conception of this hierarchical relation as an opposition between feature-bearing and non-feature-bearing units.

3.2 In its present-day conception the marking relation must be interpreted as the 'normalness,' the 'naturalness' of a certain unit of a system, present in all or in a majority of language systems,

in contrast to a phonetically less normal and natural, and therefore less widespread unit, which has definite restrictions in the system.[12] The degree of 'normalness' and 'naturalness' of the units of a system under consideration also determines the hierarchical relation of marking between them. The phonetically more normal, natural, and widespread (functionally strong) elements of a system are characterized as 'unmarked,' in contrast to the 'marked' elements, which are the less normal and widespread (functionally weaker) elements in the system.[13]

Naturally the statistical characteristics of the oppositional members of the marking relation are also linked with such an interpretation of the function of marking. We should expect that the more normal and natural member of the relation (the unmarked unit) will have a greater frequency of occurrence than the less normal and natural member of the relation (the marked unit).

The calculation of indices of frequency, the counting of textual frequencies of phonemes in determinining the marked or unmarked character of correlated phonemic units, is founded in principle on such an assumption.

However, the logically relevant link is not that between the degree of marking of the phonemic units and their relative textual frequency, but rather the link between their marking and their frequency in the system, the extent to which they are encountered in the lexicon, which gives a basis for determining the functional load and thereby the degree of marking of the given phonemic units.

The textual frequency of phonemic units purports to be only an indirect reflection of the frequency of their occurrence in the system (lexicon) to which the degree of markedness of the given units seems to be directly related. However, inasmuch as a single-

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[12] On the concept of 'naturalness' in a system, cf. Fromkin 1970, also Postal 1968:53ff.

[13] Under such an interpretation the investigation of the marking relation between oppositional phonemic units leads to defining the basic, primary phonological oppositions and determining the minimal phonemic inventory of a language, complicated by later secondary phonological features, i.e., the problems investigated by Jakobson on the basis of a study of child language and aphasia; see Jakobson 1941.

valued correspondence can be empirically established between the textual frequency of phonemic units and their frequency in vocabulary (the frequency ratio 'more-less' within the opposed pairs in the text coincides with their correlation in the system) the count of the textual frequencies of phonemes may serve as a kind of heuristic procedure for determining their relative frequencies in the system (lexicon), which give a logical basis for determining the degree of marking of a phoneme in relation to the other phonemic units of the system. [14]

3.3 But with respect to which elements of the phonological system is the hierarchical dependence of marking determined; which units function in phonology as the oppositional members of the marking relation; separate distinctive features, or entire bundles, simultaneous combinations of these features? (See McCawley 1968:556.)

It is assumed that the condition of marking affects not phonemic units as a whole, but separate distinctive features of phonemes, which constitute a hierarchical relation of marking in the environment of other features. It is further emphasized that a definite marking value is not assigned to a concrete distinctive feature invariably, independent of the conditions of its functioning in simultaneous combination with other distinctive features, but conditionally, contextually, depending on the character of the other distinctive features which the given feature is combined with in a phoneme or phonemic sequence. One and the same feature can take the value of either a marked or an unmarked member depending on the concrete environment of distinctive features making up the content of the phoneme.

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[14] In this sense the category of marking on the level of phonology is distinct in principle from the marking relation in grammar (semantics), which is manifested in the textual frequency of the corresponding units; the parallelism (isomorphism) in the character of the marking relation on different linguistic levels (in phonology, grammar, semantics) is thereby, as it were, broken. This parallelism was brought to light by Jakobson (1931), and analyzed in detail by Greenberg, who also notes the difference between these categories on different linguistic levels (Greenberg 1970:56ff.). The distinction can also extend to the factors underlying the marking relation in phonology and grammar (semantics). On the phonological level the marking relation is a function of psycho-physical factors governing the combinability of distinctive features (see below).

Indeed, the marked feature of labialization (flatness) in nonlow front vowels, i.e. in the environment of the features [+syllabic, -nonsyllabic, -low, -grave],[15] automatically determines the value of all these features to be 'markedness,' i.e. the feature [+syllabic] in combination with the features [-nonsyllabic, +labialized, -low, -grave] will be characterized as 'marked;' the feature [-grave] in the environment of the features [+syllabic, -nonsyllabic, +labialized, -low] will be defined as 'marked,' and so on for each feature of the given environment.

Perfectly analogous to this, the nonmarkedness of the feature of labialization (flatness) in nonlow back vowels, i.e. in the environment of the features [+syllabic, -nonsyllabic, -low, +grave], automatically determines the value of all these features to be 'nonmarkedness,' i.e. the feature [+syllabic] in combination with the features [-nonsyllabic, +labialized, -low, +grave] will be defined as 'unmarked,' the feature [+grave] in the environment of the features [+syllabic, -nonsyllabic, +labialized, -low] will be defined as 'unmarked,' and so on for each feature of the given environment.

3.4 The monovalence of all the distinctive features of a certain bundle, of a certain combination of features, with respect to marking must be interpreted to mean that the category of markedness affects not the separate distinctive feature appearing in a certain simultaneous environment of features, but is rather a function of the entire given group of features as a whole, affects the whole given bundle of features. It is not the separate distinctive

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[15] The system of distinctive features used in the present investigation is somewhat different from the traditional system proposed by Jakobson and his colleagues (see Jakobson, Fant, and Halle 1962), and modified by Chomsky and Halle (1968:293ff.). In particular, in place of the features [± vocalic] and [±consonantal], which are tautological regarding the definition of vocalic and consonantal phonemes, it seems expedient to introduce the features [±syllabic] and [±nonsyllabic], which give the specific character of sound segments in accordance with their ability to form syllabic peaks, i.e. to appear as a syllable-forming (central)~nonsyllabic-forming (marginal) element in a sequence of sounds. Accordingly, the vowels will be characterized by the features [+syllabic, -nonsyllabic], the consonants by the features [-syllabic, +nonsyllabic], and the sonorant phonemes (resonants/sonants), which appear as syllable-forming or nonsyllable-forming elements depending on the environment, will be defined as [+syllabic, +nonsyllabic] (cf. Lehmann 1952, Chomsky and Halle 1968:354).

feature that is marked or unmarked, but the entire aggregate of features as a whole.

Accordingly, instead of designating the marking values of separate distinctive features [mF] and [uF] we should introduce the designation of the marking of an entire aggregate, an entire bundle of distinctive features, i.e. (Fig. 7):

$$m\begin{bmatrix}\alpha F_1\\ \alpha F_2\\ \alpha F_3\\ \vdots\\ \alpha F_k\end{bmatrix} \text{ and } u\begin{bmatrix}\alpha F_1\\ \alpha F_2\\ \alpha F_3\\ \vdots\\ \alpha F_l\end{bmatrix}, \text{ where } \alpha = + \text{ or } -$$

Figure 7

Specifically, the correlations of labial and velar stops examined above must not be interpreted as the markedness of velarity in the condition of simultaneous combination with voicing, in opposition to the nonmarkedness of the feature of labialization, or as the markedness of labialization in the condition of simultaneous combination with voicelessness, but as the markedness of the simultaneous combination of features [voiced, stop (interrupted), velar] in contrast to the unmarked combination of features [voiced, stop (interrupted), labial], and as the markedness of the simultaneous combination of features [voiceless, stop (interrupted), labial], in contrast to the unmarked combination of features [voiceless, stop (interrupted), velar].[16] Thereby the marking relation is transferred

[16] These combinations of features, when united with other distinctive features, make up the complete bundles of features that characterize the corresponding marked and unmarked labial and velar occlusive phonemes /g b k p/:

$$m\begin{bmatrix}\text{-syllabic}\\ \text{+nonsyllabic}\\ \text{+interrupted}\\ \text{+voiced}\\ \text{velar}\end{bmatrix} \sim u\begin{bmatrix}\text{-syllabic}\\ \text{+nonsyllabic}\\ \text{+interrupted}\\ \text{+voiced}\\ \text{labial}\end{bmatrix} \quad m\begin{bmatrix}\text{-syllabic}\\ \text{+nonsyllabic}\\ \text{+interrupted}\\ \text{-voiced}\\ \text{labial}\end{bmatrix} \sim u\begin{bmatrix}\text{-syllabic}\\ \text{+nonsyllabic}\\ \text{+interrupted}\\ \text{-voiced}\\ \text{velar}\end{bmatrix}$$

/g/ ~ /b/ /p/ ~ /k/

Consequently, m → u, where [velar] → [labial] in the presence of the feature [+voiced]; u → m, where [velar] → [labial] in the presence of the feature [-voiced]. The features 'velar' and 'labial' can be represented in terms of binary acoustic features as the feature combinations [compact, grave] and [diffuse, grave] respectively.

from the separate distinctive feature to the simultaneous combination of features, to the whole bundle of distinctive features making up the content of the phoneme.

It is easy to see that such a conception of the marking relation, in which hierarchical dependency is not attributed to separate distinctive features but to combinations of features as a whole, comes close to its traditional conception in the Trubetzkoy-Jakobson theory, in which markedness/nonmarkedness is determined for whole phonemic units viewed as bundles of distinctive features. However, interpreting the marking relation as the presence or absence of a certain feature in a phoneme remains different in principle from interpreting it as a hierarchical relation determining the degree of normalness, naturalness, and frequency of occurrence of concrete combinations of distinctive features.[17]

3.5 In such a conception marking must be viewed as the capacity of certain distinctive features for uniting into simultaneous bundles, for combining with one another on the axis of simultaneity and forming various phonemic units. The different capacities of features for combining with each other into simultaneous combinations, into 'vertical' sequences, also creates various types of combinations of features in the system, characterized by different degrees of marking; that is, there are combinations of features which are normal, natural, have a high frequency of occurrence in the system (unmarked), and there are the less normal, less natural combinations of features, which have a lower frequency of occurrence (marked). Both whole phonemic bundles, and subphonemic combinations making up only a certain part of the phonemic unit, can be combinations of distinctive features of the sort that a marking relation is established with respect to.

Depending on the different capacities of distinctive features for combining with one another in a simultaneous bundle, it is possible to provide a complete gradational scale of the marking of simultaneous ('vertical') combinations of features. The opposite extreme

[17] Therefore the marking relation can be extended to all kinds of phonological oppositions, affecting not only privative oppositions, but also gradual and equipollent oppositions (following Trubetzkoy's logical classification). Thereby the terms 'marked' and 'unmarked' diverge from their original etymological meanings 'merkmaltragend' and 'merkmallos,' assuming the new meanings of 'nonnormal' and 'normal' feature combinations.

values on this sort of marking scale are: (a) the obligatory combinability of distinctive features on the axis of simultaneity, i. e. maximally unmarked combinations (for example, combinations of features such as [+syllabic, -nonsyllabic], [-syllabic, +nonsyllabic] or [stop, dental], etc., which are represented in any phonological system, being component parts of the phonemes which enter into the minimal phonemic inventory of a language); and (b) incombinability, mutual incompatibility of features which potentially form maximally marked combinations (for example, the features [glottalized] and [voiced] or the features [nasalized] and [fricative], which cannot combine together into simultaneous bundles.

All the possible simultaneous combinations of distinctive features, with their various degrees of marking, are distributed between these extreme values of marking, with greater or lesser approximation to the extreme values, reflecting the various capacities of the distinctive features for combining with one another in simultaneous bundles.

3.6 Such a marking scale for combinations of distinctive features should, in principle, have a sufficiently high degree of universality, insofar as it reflects a property common in human language: the capacity of certain phonetic, acoustico-articulatory properties for combining more or less freely with one another to form synchronous articulatory complexes. Certain phonetic features, because of their acoustico-articulatory properties, combine with one another on the axis of simultaneity more easily than others.

Marked bundles of features, in contrast to unmarked bundles, reflect the limited capacity of certain features for entering into simultaneous combinations with one another, their lesser inclination toward mutual combinability. Therefore such bundles are less normal, less natural combinations of features, distributed closer to the maximal marking value on the scale of markedness. [18]

[18]Underlying these sorts of restrictions imposed on the mutual combinability of certain phonetic features are the particular properties of the human articulatory apparatus, on the one hand, and the perceptual possibilities of vocal communication, on the other.

Taking into account these psycho-physical characteristics of speech, we can determine which combinations of phonetic features are most optimal in the acoustico-articulatory and perceptual respects (which would correspond to unmarked combinations on the

It is natural to expect that such bundles (and accordingly the phonemes they represent) will have a lesser degree of realization in languages than bundles of features which, because of their acoustic and articulatory properties, combine with one another easily, representing natural, normal combinations of features. The first group of feature bundles (and accordingly the phonemes they represent) constitutes functionally weak units in the system, which have both a lower frequency of occurrence and distributional restrictions, and, in a number of systems, are completely absent, creating empty slots (gaps) in the paradigm; the second group of bundles, the more normal and natural, and, in this sense, the 'unmarked' group, constitutes the functionally strong units of the system, which have a greater distributional freedom and a higher frequency of occurrence -- some of them, in fact, with a frequency of occurrence equal to one (the maximally unmarked combinations of features). Thus, for example, the features [+syllabic, -nonsyllabic, +labialized, -low, +grave] combine with one another into a simultaneous bundle, creating the unmarked group of labialized back vowels, more easily than the features [+syllabic, -nonsyllabic, +labialized, -low, -grave], which characterize the marked group of nonlow labialized front vowels. On the other hand, the features [+syllabic, -nonsyllabic, -labialized, -low, +grave] are less inclined to combine together to create the group of nonlabialized back vowel phonemes, than the features [+syllabic, -nonsyllabic,

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(ftnt. 18 cont.)
phonological level) and which combinations are nonoptimal in these respects, whose production and perception require great effort (the phonologically marked combinations) (see Greenberg 1966a, Greenberg and Jenkins 1964:177, Postal 1968:170ff.). Thus, for example, we can explain the very high marking of 'nasalized fricatives' by the incompatibility of the features 'nasality' and 'friction' in a single articulatory complex, by the physical impossibility of producing a sharp nasalized fricative, since, when the soft palate is lowered to open the nasal resonator, the pressure in the oral cavity behind the constriction proves to be insufficient to produce turbulence. In the same way, the incombinability of the features 'voicing' and 'glottalization' is explained by the particular articulatory properties of glottalized and voiced sounds. A glottalized consonant is articulated with a compression or a complete closure of the glottis, while voicing presupposes an articulation of the sound under the conditions of an open glottis and an accompanying vibration of the vocal cords (see Chomsky and Halle 1948:300ff., Cairns 1969:868ff.).

–labialized, –low, –grave], which characterize the nonlabialized front vowels.[19]

Analogously, the features [–syllabic, +nonsyllabic, +voiced, stop, velar] (for the marked voiced velar stop /g/) combine together with greater difficulty than the features [–syllabic, +nonsyllabic, +voiced, stop, labial] (for the unmarked phoneme /b/). The combination of features [–syllabic, +nonsyllabic, +voiced, stop, dental] holds an intermediate position in this respect.

The features [–syllabic, +nonsyllabic, –voiced, stop, velar] (the unmarked phoneme /k/) combine together more easily than the features [–syllabic, +nonsyllabic, –voiced, stop, labial] (the marked phoneme /p/).[20] Combining these features in a simultaneous articulatory complex becomes yet more complicated when

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[19]This general tendency, i.e. the absence of labialization in the nonlow front vowels, and, on the other hand, the presence of labialization in the nonlow back vowels, is explained by the particular perceptual properties of vowel sounds. The combinations of greatest contrast, and in this sense the optimal combinations for the perception of the vowels, are created by uniting the tonality features 'peripherality' (gravity) and flatness, with identical values. i.e. [+grave, +flat] (the labialized back vowels) or [–grave, –flat] (the nonlabialized front vowels) (see Cairns 1969:879ff.). It is noteworthy that nonlabialized back vowels and labialized front vowels are characterized as 'abnormal' in the phonetic literature, i.e. as less natural compared to labialized back vowels and nonlabialized front vowels (see Pike 1961:9).

[20]These characteristics of the occlusive phonemes should be explained by their acoustico-articulatory properties. The most compact consonants (velars and postvelars), located at a point of articulation close to the glottis, do not combine easily with an accompanying vibration of the vocal cords as different from the most diffuse consonants (the labials), located at the point of articulation farthest from the glottis. The dental occlusives, which are articulated farther from the glottis compared to the velars, but closer compared to the labials, occupy an intermediate position.

On the other hand, inertness of the vocal cords (voicelessness) is the most optimal state for the articulation of the most compact consonants (the velars) and the least favorable property for the articulation of the most diffuse consonants (the labials).

one adds to this combination the feature of aspiration or (to a greater degree yet) the feature of glottalization, which respectively form the marked phoneme /p^{h}/ or the marked phoneme /p'/, the latter distinguished among the stops for the greatest degree of marking (see above).

Thus, certain distinctive features combine together in simultaneous bundles more easily than other features, whose combinations on the axis of simultaneity create articulatorily and perceptually more complex (and therefore less optimal) formations, with a limited distribution in the system.

3.7 Since in the class of sibilant (strident) spirants and affricates (phonemes of the types s – š, z – ž, c – č, ʒ – ǯ) the voiceless (unmarked) phonemes are opposed to the corresponding voiced (marked) phonemes (the frequency of voiceless phonemes, as a rule, exceeds that of the voiced ones; gaps in a system are usually observed in place of the voiced sibilant spirant and affricate phonemes), whereas in the class of stops, along with the numerous systems which reflect the correlation of voiceless and voiced as an opposition of unmarked phonemes to marked phonemes, there are also systems with the reverse correlation (i.e. the voiced stops are unmarked, the voiceless stops marked; the CAUCASIAN languages in particular, and also an INDO-EUROPEAN language of the CAUCASIAN region -- OSSETIAN -- belong to the class of such systems; Melikishvili 1972:9ff.), we can maintain that in the general case the feature 'voicing' is more inclined to combine in a simultaneous bundle with the feature of 'occlusion' ('interruptedness') than with the feature of 'affrication' or 'friction' ('continuantness') united to the feature 'stridency.'[21]

3.8 One of the fundamental problems of contemporary typological phonology is to set up these kinds of universal models of the combinabilities of distinctive features into simultaneous bundles, into vertical sequences, along with determining their oppositional function of marking in a system. This permits us to ascertain the universally valid hierarchical dependence between correlated

[21] Apparently the momentary opening of the articulatory organs (abrupt offset) characteristic of the stops creates more favorable conditions for an accompanying laryngeal articulation (vibration of the vocal cords) than the sort of opening of an occlusion or incomplete closure of the organs that create the complex obstacles with a powerful air turbulence that are characteristic of the articulation of the sharp fricatives and affricates.

units of a phonological system and to distinguish the basic nucleus of phonemic oppositions, the deep phonological structures themselves, which constitute the foundation of the phonological system of human language, invariant with respect to both concrete phonemic systems in synchrony and the possible transformations of these systems in diachrony.

4. Markedness in the Class of Fricative Phonemes and the Interrelationship of Occlusives and Fricatives

4.1 In this sense the question of the correlations of occlusive and fricative phonemes in a phonological system is of particular interest.

Labial /w/v -- f/ and velar fricatives /γ -- x/ opposed on the feature of voicing/voicelessness are correlated with one another in a relation of marking analogous to that of the corresponding occlusive phonemes.

In the labial group the unmarked member of the opposition is the voiced fricative phoneme /w-v/[22] in contrast to the marked voiceless member /f/,[23] while in the velar group the voiceless fricative /x/ functions as the unmarked unit in contrast to the marked voiced fricative /γ/, i.e. f → w/v and γ → x (where the arrow points from the marked member of the opposition to the unmarked member).

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[22]The bilabial spirant [w], [β], and the labiodental spirant [v] both represent the voiced labial fricative phoneme. In many systems these phonetic segments appear as variants of a single voiced labial fricative phoneme; in others they can be opposed to one another as independent phonemic units. When this happens, the voiced labial fricative /w/, together with the palatal fricative /y/, usually belongs to the class of resonant phonemes, the so-called 'semivowels.' Thanks to its dual acoustico-articulatory features the voiced labial fricative phoneme /w/ is correlated with both the class of sonorants and the class of non-resonant consonants, thereby forming a bilateral dependency (see Pulgram 1959). In the present case we are interested in the correlations of the labial fricative /w/ with the remaining fricative phonemes of the labial and velar groups.

[23]The voiceless labial fricative phoneme /f/ is usually realized in a language as the labio-dental spirant [f] or the bilabial [ɸ].

In the series of voiced phonemes the labial fricative /w-v/ is opposed to the velar fricative /ɣ/ as the unmarked member of the opposition to the marked: ɣ → w/v; in the series of voiceless fricatives the velar fricative /x/ is the unmarked member of the opposition, in contrast to the marked member, the labial fricative /f/: f → x.

The hierarchical dependence of marking among the members of the articulatory groups and series of fricative phonemes can be represented in combined form in a rectangle of dependences, with arrows pointing from the marked member of the opposition to the unmarked member (Fig. 8):

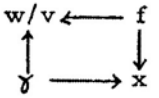

Figure 8

4.2 Such universally valid correlations of marking between fricative phonemes of the labial and velar groups are determined on the basis of the statistical characteristics of these phonemes in various language systems and the distribution of the empty slots (gaps) in a paradigmatic system.

Systems with labial and velar fricatives opposed on the feature voicing/voicelessness have fundamentally the following forms (Fig. 9):

(a)		(b)		(c)		(d)	
w-v	f	w-v	–	w-v	f	w-v	–
ɣ	x	ɣ	x	–	x	–	x

Figure 9

The systems in Fig. 8 (b)–(d), with gaps in place of the marked members in the labial and velar groups (i.e. [w/v –] and [– x] are extremely widespread types, attested in numerous languages of the most various structures (see Pierce 1957: 36ff.), while systems with the reverse correlation of fricatives in the labial group (i.e. [– f]) are not encountered at all, and in the velar group (i.e. [ɣ –]) they are a rare exception.[24]

[24] Cf. the isolated cases of language systems with the velar fricative /ɣ/ that lack its voiceless correlate /x/ (e.g. TIBETAN, Rerikh 1961; BAMBARA, Toporova 1966; LOMA, Hockett 1955: 113).

The statistical characteristics of the voiced and voiceless fricatives in the labial and velar groups are also distributed in accordance with these correlations (see Table 1). In languages with very different systems, the relative frequency of the voiced fricative /w-v/, as a rule, exceeds that of the corresponding voiceless fricative /f/ in the labial series, while in the velar series the voiceless fricative /x/ statistically predominates over the corresponding voiced fricative /ɣ/. At the same time $P_{(w-v)} > P_{(ɣ)}$ and $P_{(x)} > P_{(f)}$, i.e. in the voiced series of fricatives the labial phoneme is statistically predominant over the labial.[25] At the same time the unmarked member of the opposition generally has a greater distributional freedom than the corresponding marked member.

In terms of implicational rules these correlations can be formulated in the following statements: the presence of the voiceless labial fricative phoneme /f/ in a system presupposes the simultaneous presence of the voiced labial fricative phoneme /w-v/: f → w/v; and the presence of the voiced velar fricative phoneme /ɣ/ in a system presupposes the simultaneous presence of the voiceless velar fricative /x/: ɣ → x.

4.3 On the level of the combinabilities of distinctive features, we can characterize the correlations of fricative phonemes examined above as follows: the combination of features [−syllabic, +nonsyllabic, −voiced, fricative, velar] is unmarked in contrast to the marked combinations [−syllabic, +nonsyllabic, −voiced, fricative, labial] and [−syllabic, +nonsyllabic, +voiced, fricative, velar].

Consequently, the features [−voiced, fricative, labial] do not combine together as well as the features [−voiced, fricative, velar], while replacing the feature 'voicelessness' with the feature 'voicing,' i.e. [−voiced] → [+voiced], the reverse correlation arises: the features [+voiced, fricative, labial] combine together in a simultaneous bundle more readily than the features [+voiced, fricative, velar]. Thereby a complete correspondence is established with respect to marking in the subclasses of occlusive and fricative

[25] Language systems with deviations from such statistical correlations of fricative phonemes are extremely rare. Among such systems are in particular, GERMAN: /v/ = 3.88, /f/ = 3.94, /x/ = 5.32; SPANISH: /w/ = 2.18, /f/ = 0.90, /x/ = 0.64; and SAMOAN: /v/ = 1.4, /f/ = 3.68 (see Delattre 1965:93ff., Schnitzer 1967:58-72, Sigurd 1968:1ff.).

phonemes.[26] The functionally strong (unmarked) members in a vertical correlation (i.e. in the series, cf. the phonemes /w-v/ and /x/ respectively in the oppositional pairs [w/v --ɣ] and [f—x]) prove to be the functionally strong (unmarked) units in a horizontal correlation too (i.e. in the groups, cf. the phonemes /w-v/ and /x/ respectively in the oppositional pairs [w/v —f] and [ɣ— x]) (Fig. 10):

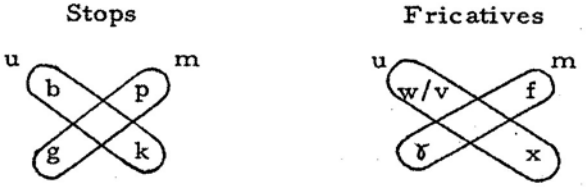

Figure 10

4.4 The correlations between the subclasses of stop and (nonsibilant) fricative phonemes in a paradigmatic system are not limited solely to the identical direction of marking in the oppositional members of the labial and velar groups.

More important in this respect is the connection between these subclasses of nonresonant consonantal phonemes that is manifested in the functional dependence of the fricatives on the corresponding stops, in the conditioning of the functioning of the fricative subclass by the subclass of stop phonemes.[27]

In particular, an analysis of the gaps (empty slots) in the paradigmatic system among the occlusive and fricative phonemes permits

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[26] Apparently the same rules of combinability for the sonority features compact/diffuse and the feature of laryngeal articulation hold for the fricatives as well as for the occlusives. The articulation of the most compact fricatives is combined less easily with vibrations of the vocal cords than the articulation of the less diffuse fricatives, while the inert state of the vocal cords, which causes the voicelessness of a consonant, is an optimal condition for the articulation of the compact fricatives and a less suitable condition for the articulation of the diffuse fricatives.

[27] On the general dependence of the fricative phonemes on the stops, in the sense of the priority of the stops in a phonological system, which precedes the appearance of the fricatives when the child acquires the language, see Jakobson 1941: 320.

us to assume a definite interconnection between the absence of the functionally weak, marked members in the subsystem of stops (i.e. the absence of the voiceless labial stop[28] or the voiced velar stop) and the presence, the functioning in the system of the corresponding fricative phonemes (i.e. of the voiceless labial phoneme /f/ or the voiced velar phoneme /ɣ/ respectively). Namely, the absence of the voiceless stop /p/ from the labial group presupposes the presence of the corresponding voiceless fricative /f/ in the system; and the absence of the voiced stop /g/ from the velar group presupposes the presence of the corresponding voiced fricative /ɣ/ in the system: i.e. p̄ → f and ḡ → ɣ.

Thus, if the marked combination of features [−syllabic, +nonsyllabic, −voiced, stop, labial] has a frequency of zero in a system (i.e. if there is a gap in place of the voiceless labial stop phoneme(s) in a paradigmatic system in which the labial group of stops is generally represented),[29] then the marked combination of features

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[28] Under the "absence of the voiceless labial stop" is understood here not a gap in place of one of the voiceless labial phonemes while the other voiceless labial members are present (e.g. the glottalized phoneme is absent from the labial group while the voiceless aspirate remains, cf. system 4.a above, languages of the type of the DAGHESTANIAN languages, cf. Gudava 1964, or the glottalized and aspirated phonemes are absent while the simple voiceless labial remains, cf. system 5.b above, languages of the type of NAVAHO); instead, the voiceless stops are completely absent in the labial group, i.e. systems of types 1.a, 1.c, and 4.b, with gaps in place of all the voiceless members of the labial group, are intended.

[29] The labial and velar groups of occlusives are represented in the phonological systems of an overwhelming majority of the languages of the world. Consonantal systems with a missing labial or velar group are a rare exception. For example, the absence of the velar group of occlusives is observed in some SLOVENIAN dialects (see Trubetzkoy 1939: 142). A system with a missing labial group of occlusives is encountered in a number of AMERINDIAN languages belonging to the IROQUOIAN group and the NADENE family. The latter includes TLINGIT, which lacks a labial group of stops and nasals (see Milewski 1967: 20, Pinnow 1966: 42). However, as has been observed by Jakobson (1941: 357ff.), the absence of a labial group of occlusives is possibly a secondary phenomenon, explained by ritual mutilation of the lips, also observed in a number of Central African tribes.

[−syllabic, +nonsyllabic, +voiced, fricative, labial] has a frequency exceeding zero (i.e. the voiceless labial fricative phoneme /f/ is present in the system). If the marked combination of features [−syllabic, +nonsyllabic, +voiced, stop, velar] has a frequency of zero in a system (i.e. if there is a gap in place of the voiced velar stop in a paradigmatic system in which the velar group of stops is generally represented), then the marked combination of features [−syllabic, +nonsyllabic, +voiced, fricative, velar] has a frequency exceeding zero (i.e. the voiced velar fricative phoneme /ɣ/ is present in the system).[30]

But the presence of the voiceless labial /f/ in a system implies, as was noted above, the presence of the corresponding unmarked voiced /w-v/, and the presence of the voiced velar fricative /ɣ/ in a system implies the presence of the corresponding unmarked voiceless phoneme /x/. Consequently, if the functionally weak, marked members in the labial and velar groups of the subsystem of stops are absent, thereby creating empty slots in the paradigmatic system, these gaps would be filled, as it were, by the corresponding fricative phonemes, i.e. by the fricative phonemes of the velar and labial groups. Thus, the fricative phonemes /f/ and /ɣ/ (and the implied or unmarked members, /w - v/ and /x/ respectively) are a substitute for the corresponding marked stops /p/ and /g/, compensating, as it were, for their absence and thereby establishing a 'balance' in a paradigmatic system with an opposition of phonemes on the feature voicing / voicelessness.

4.5 Paradigmatic systems with gaps in place of the marked stops 'filled in' by the corresponding fricative phonemes have fundamentally the following forms (Fig. 11):

(a)		(b)		(c)		(d)		
b	p	w/v	f	w/v	f	w/v	f	
d	t	b	–	b	–	b	–	–
–	k	d	t	d	t	d	t	t'
ɣ	x	g	k	–	k	g	k	k'
				ɣ	x			

Figure 11

[30] In other words, in occlusive phonemes characterized by a frequency of zero in the system, replacing the feature [stop] with the feature [fricative] ([stop] → [fricative] or [+interrupted] → [-interrupted]) converts these bundles of features into combinations with a frequency exceeding zero.

DUTCH, BELORUSSIAN, UKRAINIAN, CZECH, SLOVAK, the SOUTHERN GREAT RUSSIAN dialects (Bernshtejn 1961:292ff.),[31] KET (Kreinovič 1968:453ff.),[32] CHUAN (Moskaljev 1971), and TUVIN (Iskhakov and Pal'mbakh 1961: 50ff.) are examples of language systems of type (a); YORUBA (Toporova 1966: 219ff.), BERBER (Zavadskij 1967), BORA (Matteson 1972:31ff.), EGYPTIAN ARABIC, YEMENI ARABIC, CENTRAL ASIAN dialects of ARABIC (Sharbatov 1966, Tsereteli 1956:XII-XIII), ETHIOPIC (GEEZ) are examples of the system of type (b); system (c) is represented in VIETNAMESE (Gordina and Bystrov 1970:192ff.) and CLASSICAL ARABIC; and system (d) is characteristic of HAUSA (where the implosives /'b/ and /'d/ are also present) (Jushmanov 1937:7ff.).

4.6 We can assume that the tendency toward such a 'balance' in a paradigmatic system is evoked by a general tendency to symmetrically fill[33] the three basic articulatory regions, the labial, dental, and velar (pre-/postvelar) regions, with sounds of consonantal articulation, stops or fricatives.[34]

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[31] In some of these languages the phoneme /γ/ is realized as a voiceless pharyngeal spirant. Naturally, in such languages the pharyngeals do not constitute a special phonemic group (cf. Kučera 1962).

[32] An analogous correlation is also observed in KET with respect to the postvelar (uvular) group, where the missing voiced occlusive phoneme is replaced in the system by the corresponding fricative phoneme.

[33] On symmetry in a paradigmatic system, cf. Hockett 1955:140ff.

[34] Consonants articulated in these regions make up the three basic articulatory groups represented in almost all the languages of the world: the labial, dental (apical), and velar (dorsal) groups (the consonants p, t, and k are included in the minimal phonemic inventory of language, cf. Milewski 1967:15ff., Chomsky and Halle 1968:414). Consonantal sounds produced at these points of articulation can be regarded as 'the most natural,' in the sense that their appearance results in the most simple and natural manner from the activity of the mobile parts in the oral cavity (see Trubetzkoy 1939).

The 'velar region' covers the prevelar point of articulation as well as the postvelar (uvular) point and the velar region in the strict sense. In a number of language systems the nonvocoid sounds produced at these points of articulation are phonologically opposed units; in other systems these same sounds are subphonemic variants of a single consonantal phoneme which covers an undifferentiated velar region and can thus be characterized as 'velar' or 'guttural' (dorsal),

The absence of a functionally weak occlusive member of a system (a voiceless labial or voiced velar stop) is compensated by the presence of the corresponding fricative member, which fills the gap in articulation corresponding to the voiceless or voiced element in the labial or velar articulatory region.

We can assert that, if one ignores the feature occlusion/friction (interrupted/noninterrupted), each 'pigeonhole' of the voiced and voiceless series of the labial, dental and velar groups is filled with a corresponding phoneme, and that in a paradigmatic system with an opposition of nonresonant consonantal phonemes on the feature voicing/voicelessness there are no gaps (empty slots).[35]

(ftnt. 34 cont.)
and acoustically as 'compact and grave (peripheral)' (see Jakobson, Fant, and Halle 1962:173ff. in the RUSSIAN edition, Trubetzkoy 1939).

35 This sort of dependency between a marked occlusive and a corresponding fricative phoneme is not observed in a number of language systems, which constitute by their nature an exception to the established rule. Thus, for example, in the paradigmatic systems of some AMERINDIAN languages with a gap in place of the voiced velar occlusive /g/, the corresponding substitute, in the form of the fricative /ɣ/, is not found (cf. the system of ITONAMA, Liccardi and Grimes 1968:6-7; QUILEUTE, Andrade 1933-38:151ff. It is characteristic that in the majority of languages cited the class of fricatives is extremely restricted.).

Some SOUTHEAST ASIAN languages also constitute an exception in this respect, in particular THAI, KHMER and LAOTIAN (cf. Glazova 1970:283-303).

From an analysis of the exceptions with respect to the interdependency of occlusive and fricative phonemes we can conclude that these exceptions chiefly concern the velar group of stops and fricatives. Systems with similar exceptions with respect to the labial group are extremely rare and limited to a small number of AMERINDIAN languages (cf. Wheeler 1972:93ff.). This property of the labial group, which distinguishes it from the velar group, is very likely one of the manifestations of the priority of the labial group (along with the dental group) in comparison to the velar group (cf. Jakobson 1941). From this standpoint a defective group of velar occlusives without the corresponding substitutes in the form of fricative phonemes is, in a number of language systems, a reflection of an original linguistic state, with the basic oppositions of consonants restricted to the labial and dental regions. These systems can be thought of as being in the process of filling the gaps in the velar group with the missing members in the form of the voiced occlusive or the corresponding fricative phonemes (cf. the appearance of the consonants /g/ and /ɣ/ in some THAI dialects; see Moskaljev 1970:260ff.).

4.7 When the marked stops /p/ and /g/ are present in a system, i.e. the frequency of the combinations of features [-syllabic, +nonsyllabic, -voiced, stop, labial] and [-syllabic, +nonsyllabic, -voiced, stop, velar] exceeds zero, the presence of their substitutes in the system, in the form of the corresponding fricative phonemes /f/ and /ɣ/, is facultative. In the system such fricative phonemes represent redundant consonantal elements of the labial and velar groups(labial and velar points of articulation).

There are 'redundant' systems in which both the marked stops and their substitutes, in the form of marked fricative phonemes of the labial and/or velar groups, are present.[36] In such systems with the 'redundant' pairs [p — f] and [g —ɣ] one of the members of these pairs (and only one) can become lost in the process of diachronic phonemic transformation. However, at least one of the members of these pairs must be present in the system, because of the tendency to symmetrically fill the three basic articulatory regions with consonantal phonemes of the voiced and voiceless categories.[37]

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[36] In particular, many IRANIAN and TURKIC languages, with completely filled groups of both the occlusive and fricative phonemes, are typical examples of such 'redundant' systems. The reconstructed COMMON SEMITIC phonological system, with a voiced velar stop /*g/ alongside a velar group of fricatives /*ɣ, *x/, is also 'redundant' (cf. Moscati 1959:25ff.).

[37] The development of the COMMON SEMITIC phonemes /*g/ and /*ɣ/ in the historical SEMITIC languages can serve as an example of a diachronic process of this sort. The fricative phoneme /*ɣ/, which gave the laryngeal phoneme /ʾ/ as a reflex in EAST SEMITIC (AKKADIAN), merged with the pharyngeal /ʕ/ in HEBREW, SYRIAN, and ETHIOPIAN, thereby conditioning the preservation of the voiced velar occlusive phoneme /g/ in these languages. In contrast to this, the change of COMMON SEMITIC velar /*g/ to the affricate /ǯ/ in CLASSICAL SOUTH SEMITIC (ARABIC) contributes to the preservation of the velar fricative /ɣ/ in this language, compensating, as it were, for the absence of the voiced occlusive in the velar group.

In its turn the COMMON SEMITIC /*p/ changes to the labial fricative phoneme /f/ in ARABIC and ETHIOPIAN; as a result there appears a gap in the series of voiceless stops, which is filled by the fricative phoneme that had appeared. An analogous development with respect to the voiced velar stop /g/, forming a gap in the system of stops when it changes into its substitute, the corresponding

The complete or partial absence of fricative phonemes in various paradigmatic systems, whose labial and velar groups are filled with 'primary' elements in the form of occlusive phonemes, is also explained by this sort of dependence of the labial and velar fricatives on the functioning of the corresponding voiced and voiceless stops in the system.[38]

4.8. The weak functional role of the interdental fricatives [ð---θ] in the paradigmatic system is explained by an analogous dependence. Since the dental group of stops [d ---t] is distinguished for the greatest frequency of occurrence, being the most stable of the groups of stops (see Manczak 1959, Guiraud 1959: 100 ff.), the group of mellow fricatives corresponding to it is functionally the weakest among the fricative groups. As a consequence of the fact that there are no systems missing the dental group of stops (see Trubetzkoy 1939, Jakobson 1944), the (inter)dental group of fricatives [ð---θ], their substitutes, is always facultative, redundant

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(ftnt. 37 cont.)
fricative phoneme, can be observed in the example of transformations in many phonological systems (cf. the development of the phoneme /g/ in BELORUSSIAN, UKRAINIAN, CZECH, SLOVAK, the SOUTHERN GREAT RUSSIAN dialects, etc.).

On the other hand, the development in some RUSSIAN dialects of the spirant /f/, which is replaced with the unmarked sequence [xv] (cf. xvunt and xunt 'pound,' grax 'count,' torx 'peat'), or the merger of the velar fricative phoneme /x/ with the labial /f/ in EARLY MODERN ENGLISH can serve as typical examples of the transformation of a 'redundant' fricative phoneme (see Panov 1966: 115, Pilch 1964:136). The latter case is a rarer phenomenon in language, the merger of an unmarked phonemic unit with a marked one. The change of a marked phonemic unit in a system into an unmarked one, i.e. its merger with the latter, as a result of which an empty slot could appear in the system, is more normal and natural (cf. Postal 1968:170).

[38] Thus, for example, the labial and velar fricatives are completely absent in a majority of AUSTRALIAN languages (see Capell 1967:85ff.). In some systems the labial group of fricatives is absent and the velar group present (cf., for example, YAKUT, Ubrjatova 1966:403ff.; BAKAIRI, Wheatley 1967:81) or, on the other hand, the velar group of fricatives is absent and the labial group is present (ENGLISH, FRENCH, ALBANIAN, INDIAN languages, etc.).

in the system. This should also explain the restricted distribution of the (inter)dental spirants in the languages of the world, compared to that of the labial and velar fricatives.

4.9 Thus, the (nonsibilant) fricative phonemes of the labial, dental, and velar groups, i.e. [w/v---f], [ð---θ], and [ɣ---x] respectively, are correlated with the occlusive phonemes of the corresponding groups (the labials [b---p], the dentals [d---t], and the velars [g---k]) as their substitutes, filling the gaps in the paradigmatic system when the functionally weak members in the class of stops are absent. Thereby the occlusive and the nonsibilant fricative phonemes constitute a definite interdependent subsystem, opposed to the subsystem of the sibilant spirants and the affricates and to the subsystem of the resonant consonants within the general paradigmatic system of a language.

A definite hierarchical order among the various types of phonological oppositions is revealed in this interdependence, testifying to the existence of a certain strict stratification of phonological values in a linguistic system, the basic features of which were revealed earlier by Jakobson (see Jakobson 1939); we must assume that diachronic phonemic changes in a system, seeming at first glance to be processes uncoordinated and unconnected with one another, can be comprehended as interdependent, mutually conditioned transformations, governed by such a hierarchy of phonological values.

APPENDIX: Relative Frequencies of Fricatives[1]

Languages:	Phonemes:			
	/w-v/	/f/	/x/	/ɣ/
ABKHAZ	1.3	0.3	1.77	0.16
ADYGHE	0.45	0.1	2.89	1.41
AZERBAIJANI	1.66	0.13	0.94	0.69
ARABIC[2]	2.38	1.23	0.26	0.09
ARABIC (Central Asian)	0.99	0.95	0.64	0.54
GILYAN[3]	0.38	0.26	1.31	0.29
OSSETIAN	2.05	1.72	3.53	0.2
PERSIAN	1.74	0.6	1.63	0.28
TAJIK	1.69	1.07	1.46	0.26
UDIN[4]	0.45	0.1	2.82	1.41
AKHVAKH[5]	4.74	—	1.9	0.31
GEORGIAN	4.17	—	2.65	0.79
SVAN[6]	3.5	—	4.89	0.98
MUNJAN[7]	1.67	0.63	0.95	—
POLISH	5.96	0.25	1.44	—
RUSSIAN[8]	2.75	0.29	0.68	—
ASSYRIAN[9]	2.57	—	4.58	—
PIRO[10]	1.42	—	0.39	—
ALBANIAN[11]	0.83	0.49	—	—
ENGLISH[12]	1.88	1.3	—	—
HUNGARIAN[13]	2.06	0.12	—	—
TURKISH	1.34	0.55	—	—
FRENCH	2.15	1.11	—	—
HINDI[14]	1.78	0.18	—	—
SWEDISH[15]	2.6	1.8		

[1] The relative frequencies of fricatives (in percentages) in a text 10,000 to 30,000 phonemes long (depending on the language) are given in the table. The calculations of the textual frequencies of the fricatives is based on the assumption of the uniformity of random samples relative to the statistical distribution of phonemes in increasing or decreasing frequency (cf. Segal, 1972:169ff.).

[2] Tsereteli 1956:51-60.

[3] Rastorgueva 1971:268-73.

[4] Dzhejranashvili 1971:139-72.

[5] Magomedbekova 1967:151-55.

[6] Shanidze 1939:13-17.

[7] Grjunberg 1972:74-82.

[8] Cf. Kučera and Monroe 1968:33.

[9] Tsereteli 1965:14-26.

[10] Cf. Matteson 1963.

[11] Cf. Shirokov 1964:53ff.

[12] Cf. also Sigurd 1968.

[13] Cf. Vértes 1953:125ff.

[14] Konsovskij 1968:167-81.

[15] Sigurd 1968.

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