

Cross cultural factors in phonological change

ALAN LOMAX

Cantometrics

New York

ABSTRACT

Analysis of the vowel/consonant patterns in a world sample of folk songs indicates that some speech sounds vary regularly with certain aspects of social structure. Consonant frequencies shift in relation to technological level: mid stops, fricatives and laterals increase in relative frequency along a scale of productive range. Alteration in the vowel map, on the other hand, seems to be related to cross-cultural differences in sex role. Thus changes in phonology, familiar to the linguist, may be symbolic of and explained by familiar societal phenomena. These suppositions are, it is true, based on the analysis of sung languages and remain to be confirmed for speech. However, the power of expressive style as a general diagnostic of the layout of culture implies that they will be so confirmed, since expressive patterns often turn out to be a sort of heightened and extra-redundant version of everyday behavior. Moreover, collections of recorded song performances provide a world-wide resource of 'unselfconscious' and culturally validated language data that is simply unavailable for other kinds of speech activity. (Phonology; variation; expressive (stylistic) function; song style; mode of production and sex role; cross-cultural sample.)

BACKGROUND

In an earlier study (1964) Lomax and Trager drew phonemic maps of the vowel sequences of standard folksongs from various areas of Europe and the United States. The object of this so-called Phonotactic study was to verify an observation of the first author that one of the dynamic formative elements in traditional song-lore was a preferential vowel grid – an ideal way of using the vocoid resources of the language – to which the folk verse of that culture is as closely conformed as possible. I chose the songs and, together with Edith Trager, transcribed the vowels as they occurred, syllable by syllable and line by line, in songs from fifty cultures. The vowel sequence in each line of poetry was traced in a distinctive color.

The overlap and repeat of patterned movement within limited sectors of the phonemic map provided a spectacular confirmation of the hypothesis. The favored vowel biases of a folk tradition were not only heavily underscored in the

patterns of vowel proportion in all the songs of each of the regions, but were doubly marked in the most frequent oscillations or axes between pairs of favored vowels. Moreover, the traditional lullabies of each area consisted almost entirely of the vowel axes most frequent in the most typical songs of their area. Soon we could recognize the regional source of a folk song by the shape of the diagram it made on the vowel map. There seemed, furthermore, to be a connection between the bias expressed in the differential frequencies of the vowels in one set of songs and the severity of sexual sanctions in that community. Front vowels appeared to be much more emphasized in songs from Mediterranean cultures, where the sexual code is generally strict, while back vowelizing was more frequent in Eastern and Middle European song texts, where sexual practices were less strait-laced. This finding called for further research.

American linguists were so focused on structural analysis that our data-oriented thesis on phonological symbolism had to go abroad to find a sympathetic publisher (*L'Homme*, Jan.–Apr., 1964). Meantime the author continued personal experiments in the phonotactics of American songs. He found that the favorite ballads of the Southern Appalachians, home of punishing Calvinist attitudes toward sex, were marked by extreme fronting of vowels. The vowel axis shifted toward the center in the ballads of the Northeast and Canada, where a more permissive sexual standard prevailed. Both these sets stood in strong contrast to Southern Black vowel style, which strongly emphasized back and low back vowels, perhaps a phonological witness of the comparatively permissive sexual standards prevalent in Black rural folk culture. I then ran the phonotactic patterns in the 'hit parade' of that day (1964) by miming the tongue and bucal cavity movements of the vowel sequences heard over the radio. I observed that back vowelizing still strongly marked the Black rock and roll hits, whereas front vowelizing was just as clearly favored by classical pop singers like Sinatra and Martin. Areas of acculturated style lay between these two extremes. I found I could spot two of the main trends of that day – Black singers trying out the favored WASP vowel terrain and White singers experimenting with Black patterns.

In 1964 a grant from the National Institute of Mental Health permitted me to enlist the help of a professional linguist, Dr Fred Peng, a graduate of the University of Buffalo. My aim was to confirm the importance of phonological grids to song-style cross-culturally and to test the relation of sexual sanctions to vowel frequencies. The study required a transcription framework that could be moved from language family to language family without distorting the data. Dr Peng, a former student of G. L. Trager, suggested that we work at the metalinguistic level, rating differential frequency of 'vocoids' and 'contoids' – vowel and consonant areas – rather than working at the 'emic' (too culture specific) or the 'etic' (too fine-grained) levels, since we intended to see whether the phonotactic patterns of song style varied cross-culturally in meaningful ways. In *The Field of*

Linguistics (1949) Trager had defined metalinguistics as the study of the 'relations between language and any of the other cultural systems'.

Our metalinguistic grid consisted of nine vocoids and eleven contoids. The vocoids were defined by three dimensions: (1) high, medium, and low; (2) front, central, and back; and (3) rounded and unrounded. Since rounding does not seem to affect research results, it will not enter into what follows.

The contoids were also defined in terms of three dimensions: (1) three kinds of articulators: front (lower lip), mid (tip and blade of tongue), back (back of tongue and throat); (2) three zones of articulation: 1. front (upper lip and upper teeth), 2. mid (alveolar ridge and hard palate); 3. back (soft palate, pharynx and glottis); (3) four kinds of articulations: 1. stops, 2. fricatives, 3. nasals, 4. laterals. Only the eleven most frequent combinations of these dimensions of contoids were counted and used in our comparative frame of reference.

1. fr fr stp (p, b) [referred to below as FFS]
2. fr fr fric (f, v) [FFF]
3. fr fr nas (m) [FFN]
4. mid fr fric (th) [MFF]
5. mid mid stp (t, d) [MMS]
6. mid mid fric (s, sh, ts, ch, z, zd) [MMF]
7. mid mid nas (n) [MMN]
8. mid mid lat (l, r) [MML]
9. ba ba stp (g) [BBS]
10. ba ba fric (h, k) [BBF]
11. ba ba nas (ng) [BBN]

In six months Dr Peng analyzed a sample of 300 songs, ten from each of thirty cultures, using this grid. The first step was to determine the vocoid and contoid frame characterizing the linguistic space in a given recorded song. In subsequent replays he estimated the relative percent of each phonological type in the total performance. He also noted the most frequent sound axes, the most prolonged sounds, and the beginning and ending sounds per song.

The sample, though small, was well distributed: Pacific – 5 cultures; North America – 5 cultures; South America – 2 cultures; Asia – 5 cultures; Africa – 7 cultures; Europe – 6 cultures; and Australia – 1 culture (Appendix, I). The variance between the ten songs from each culture was far less than the variance between the samples themselves. Thus the existence of strong patterns of vocoid and contoid preference to which song styles conformed was established cross-culturally. The nature and the cultural connections of these phonological profiles was partially set forth in a 1968 publication (Lomax 1968: 146ff.). The number of contoid distinctions used in song performance increases with cultural complexity. (2) Mid contoids notably increase in number in more complex economies whereas back contoids seem more frequent in simple economies, especially hunting cultures (Appendix, II).

LANGUAGE IN SOCIETY

This finding may be at least partially explained as follows. More distinctions can be more readily produced in the region of the alveolar ridge and the hard palate than in the other two main zones of articulation. The mid-zone not only allows the most free play to the tongue but it also affords it the most numerous and the most well-defined points of articulation. Since, therefore, this mid-zone is capable of producing more fine-grained distinctions than the other two, it is natural that its possibilities be more fully exploited in situations requiring the most distinctions. The social and economic systems of full agriculture are, comparatively speaking, more highly articulated than those found in slash-burn

MEAN PERCENTS

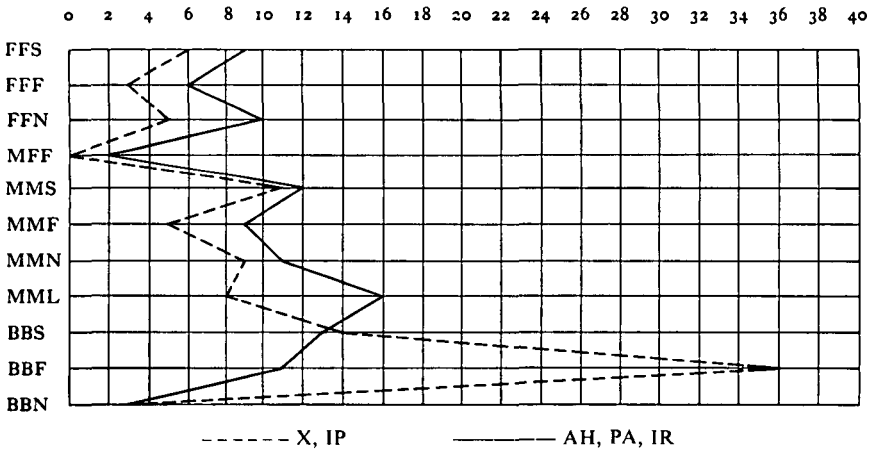


FIGURE 1

gardening or hunting cultures. Since both the labor force and cadres of management are more specialized, more orders of explanation and description are required to define any given act of cooperation in advanced than in simple economies. It is natural, therefore, to find this contrast reflected in differing habits of articulation. Comparison of the modal contoid profiles above (Figure 1) makes this point clear. The dashed line displays the modal use of contoids by all the gatherers, hunters, fishers (X) and incipient agriculturalists (IP) in the sample; the solid line traces the profile of farmers with animal husbandry (AH), intensive plow agriculture (PA), and irrigation agriculture (IR). The dashed profile indicates a less balanced use of the articulatory resources with a strong preference for back articulation. The agricultural profile exhibits more emphasis on mid or palatal articulation. (FFS, etc. indicate the eleven combinations of contoid dimensions discussed above.)

This discovery parallels many others that have emerged in stylistic research. For instance, the Cantometric study of song style shows that the amount of new

text, the percent of precisely enunciated syllables, the number of types of accompanying instruments and the number of small intervals (minor seconds) all increase along with socio-technical development (see pages 130–8, *op. cit.*; see Appendix, III). A separate study of dance found more fine-grained discriminations in the dance movements of complex rather than simple producers (pages 240–7, *op. cit.*, see Appendix, IV). Summatively, multi-factor analysis indicates that in song, dance and culture there is always a large and powerful factor which reflects the level of discrimination and articulation present in a given system.

In another place I have shown that these control factors from the three systems vary together cross-culturally (Lomax: 1972). This parallel variance taken along with the present finding points to the existence of a factor that shapes the whole of culture and provides a key to cultural evolution. The input of this so-called *control factor* steadily rises in productive, managerial and expressive communication systems as communities increase in size and stability. Extensive work with cross-cultural factor analysis produced only one other factor that varied in a similarly orderly way across the whole range of human culture. This integrative factor has to do with the organization of teams – especially the role of the sexes and the solidarity of group activity. Since language is key to so much of human achievement, it is essential to test for the operation of these two generalized socio-communication factors in this field.

NEW FINDINGS

In the 1968 publication on this subject the expected connection between vocoids and sex role was not proved out. However, more thorough computer exploitation of the data has now discovered this relationship. After testing many combinations of back, mid and front vocoids we have found two areas which appear to have a strong positive relation to the degree of control exercised by males upon the sexual and economic norms of culture. High and low front vowels (iy and ih and ae) are significantly more common in the songs of cultures marked by masculine dominance. (Note: This statistical relationship, like all others in this paper, is to be found in the Appendix.)

Front vowels are the product of a forward positioning of the tongue and a narrowing and constriction of vocal apertures. Cantometric analysis of 4000 songs shows that narrow and constricted use of voice as well as nasalizing – another kind of vocal constriction – are most frequent in societies where punitive sanctions, enforced by males, restrict the pre-marital sexual life of females. Wide, free, and non-congested vocalizing, on the contrary, was found to be typical of cultures where the premarital sex life of women was free of such male control and where women play an equal or predominant part in the main food-producing activity. The only reliable indicators of masculine dominance available for a large

sample of cultures are these two, dealing with sex sanctions and division of labor. This study indicates that many other manifestations of the effect of masculine dominance will be found in other cultural fields.

For example, positive results came from a test for the relation of front vowels to male dominance in the main food-producing activity of culture. Here the Lomax–Arensberg nested hierarchy of productive range was used: (1) X for gatherers and hunters; (2) IP for incipient agriculturalists; (3) AH for gardeners and others with animal husbandry; (4) PA for intensive plough agriculture; (5) IR for irrigation with large permanent works. Each of the thirty cultures was assigned to one of these productive categories and then a further Murdock coding permitted us to define the culture's principle food-getting activity as dominated by women, shared by women or dominated by men.

When the differential of the vowels in the 300 songs from the thirty cultures was plotted against male dominance of the economy, the following relationships emerged:

- (1) High front and high central vowels were nearly twice as likely to occur where males dominated (Appendix, V).
- (2) High front vowels were nearly twice as likely to occur with male dominance (see Appendix, VI).

The resultant hypothesis would then predict that high front vowels (*iy*, *ih*) would increase as males came to dominate the productive system and would decrease in relative frequency as economies became more complementary. This hypothesis throws light on the finding in a recent cross-cultural study of phonological symbolism (Miron: 1961) that high front vowels were rated as pleasant, where back vowels were rated as unpleasant. The important point here is that the subjects tested were students from Japan and the U.S.A., both cultures in which males are clearly in control of the means of production – as they have generally been in industry and other advanced systems. But why should the members of technologically developed cultures have a strong preference for words employing the vocoids *iy* and *ih*? Perhaps it is because the high front sounds, the product of extreme bucal closure, are the closest of all vocoids to full stops or contoids. We shall show in what follows that contoids in song are proportionately more frequent in more complex technologies, where more discriminators are wanted. Thus, the rise of complex economies may stimulate the use of high front vocoids because, like the contoids, they could be used as discriminators. This interpretation coincides with one of the few ideas about verbal symbolism to gain general credence – that *iy* and *ih* somehow signify 'little' or 'small' because they so often occur in diminutives and terms for small measures, in a word, because the high front vowels imply fine-grained discriminations.

The explanation may, however, lie in another direction or have another level. Front vowels are often described by linguists as being more tense than mid and

especially back vowels. Societies notable for male dominance may be comparatively 'up tight'. There is vocal evidence for this. Front vowels seem to be significantly more frequent in the songs of societies where males control the sexual life of women. Specifically, the cluster of the front vocoids (iy, ih, ey, eh, ae) are half again as common in societies where female premarital sexual intercourse is either sanctioned or ruled out by early marriage (Appendix, VII). On the other hand the cluster of the back vocoids (u, o, aw) plus low mid (ah) were more frequent in the songs of cultures where the sexual norms affecting women were permissive (Appendix, VIII). The locus of these correlations, however, appears to be in two specific vocoid areas – low front (ae) and low central (ah). Low front was almost twice as common in the songs of cultures governed by severe sexual codes (Appendix, IX) and low central was half again as frequent in songs of permissive cultures (Appendix, X). It is tempting to surmise that this opposition between (ae) and (ah) represents a primal communication factor that shapes all vocalizing. (Ah) is the vowel produced by a two-level constriction of the vocal apparatus. The tongue is forward and the glottis is constricted and tense. (Ae) is also a central and frequent element in the cry of an angry and frustrated baby. Contrariwise, the low central vocoid (ah) is the sound of satisfaction and contentment par excellence, since it is the product of a vocal position very close to that of swallowing, where the vocal apparatus is wide open and relaxed. Thus a factor symbolizing the basic contrast between satisfaction and frustration, capable of affecting the whole vowel grid, is introduced into comparative phonology.

It seems pertinent to remark that both the vocoid indicators – (iy, ih) for male productive dominance and (ae) for male enforced sexual sanctions can be considered manifestations of the same cultural phenomenon – male dominance. The second phonotactic hypothesis then states that the level of high front plus low front vowels present in the verbal stream of a culture is an indicator of the degree of dominance by males over females in social relations. Conversely, a low score for these vocoids indicates the presence of a strongly complementary relationship between males and females. If these hypotheses prove correct, shift in vocoid pattern could then be explained as the symbolic effect of changes in sex roles; sex roles vary with major shifts in productive systems (Lomax 1968).

The contoid data affords even more striking evidence of the influence of socio-technological advance on phonology. For example, the proportion of contoids to vocoids seems usually to be higher in complex than in simple economies. Dr. Peng rated this proportion on a five-point scale: (1) vocoids dominate; (2) more vocoids; (3) about 50/50; (4) more contoids; (5) contoids dominate. This scale is positively correlated to the scale of increasing productive range (see above). Most extractors (X) and incipient producers (IP) score 2 on the v/c scale since vocoids seem far to outweigh contoids in their songs. Most of the producers who know animal husbandry (AH) fall under column 2, but with scores in column 3 as well,

indicating an increasing use of contoids. The group of complex producers scored largely under column 3 where contoids are 50 per cent of the sung stream (Appendix, XI).

The relation of contoid frequency to productive range has been further confirmed and refined, by using the scores from the 300 songs studied. More complex producers generally employ at least nine contoids per song performance, whereas simpler producers use eight or less (Appendix, XII). This phenomenon seems to be due to an increase in the number of types of mid contoids habitually sung by complex producers. For example, the proportion of frequent mid stops and nasals is half again greater in the songs of complex than of simpler producers, and the proportional high frequency of mid fricatives and laterals is even higher (Appendix, XIII and XIV).

The relationship of back contoids to productive range is exactly the opposite, being twice as common among simpler economies than among those who practice full agriculture. Here the effect of back back fricatives (the 'h' type) is striking, since there are only seven out of 105 songs from full agricultural economies in which they occur in any important frequency (Appendix, XV and XVI). Thus, if the style patterns in singing are to be trusted, the importance of back consonants falls off steadily along the productive scale as the frequency of alveolar discriminators steadily rises along the same scale. This third phonotactic hypothesis ties the development of phonology directly to the evolution of productivity.

The overwhelming importance of back fricatives in the songs of simply organized societies led to the finding that there is a relationship between type of fricative and socio-economic level. Mid front fricatives ('th' contoid type) occur less than 5 per cent in societies of low and mid socio-economic complexity, but are found in 36 per cent of the songs of complex communities. Front fricatives (the 'f' type) and mid fricatives ('s, z, sh' contoid type) occur with increasing frequency along the scale of socio-economic complexity. They are present at some frequency in all or nearly all the singing of the evolved economies (Appendix, XVI). Type of fricative alone may then be a useful indicator of socio-economic development, the position of the tongue in shaping fricatives being the index.

Since the first and second phonotactic hypotheses link the vocoid grid to the degree of male dominance, which is ultimately based on male control of food production, it looks as if the growth of phonologies can be directly linked to the evolution of productive systems and masculine control. In another place (Lomax 1972) I have argued that the evolution of cultures is not a simple linear affair, that is, a function of the steady increase in the number of differential controls of the natural, social, and communicational surrounds. There seems to be no doubt that there is such a progressive factor running through human history: the recent work of Caneiro, Ribiera, and many others amply confirm this. The role of mid contoids is merely one more bit of confirming evidence. But as the food-produc-

ing base of society shifted from gathering to hunting to gardening then to specialized pastoralism and agriculture, the sexual composition of the main productive team varied as well. This shift in productive dominance seems to affect the vocoid grid in fundamental ways. Thus phonological development seems to be subject to the same pair of linked but independent variables which shape the evolution of other cultural systems.

Multi-factor analysis of the data supplied by Dr Peng's ratings supply important confirming evidence for the preceding statements. There appear to be nine factors all told:

- (1) *Contoid, Discriminatory*
 Total number of consonant types
 Mid stops (t, d)
 Frontal stops and nasals (b, p, m)
 back back nasal (ng)
 Absence of back fricatives (h)
- (2) *Low Vocoid, Sexual*
 Low central vocoid (ah)
 Absence of low front vocoids (ae)
- (3) *Narrowing, Male Dominance*
 High front vocoids (iy, ih, . . .)
 Mid fricatives (s, sh, ts, ch, z, dz, . . .)
 Frontal fricatives (f, v, . . .)
- (4) *Mid Front Vocoids, Liquids, High Back Vocoids*
 Mid front vocoids (ay, eh)
 Absence of mid lateral contoids (r, l)
 Absence of high back vocoids (u)
- (5) *Low Back Vocoids and Mid Nasal Contoids*
 Low back vocoids (aw)
 Mid nasal contoids (n)
- (6) *Mid Back Vocoids (o) – unique*
- (7) *Mid Central Vocoid (uh) – unique*
- (8) *Back Stop Contoids (g, k) – unique*
- (9) *Miscellaneous Factor*
 Mid front fricative (th, . . .)
 High central vocoid
 Total number of vocoids
 V/C proportion

The first three of these nine phonotactic factors seem clearly tied to important aspects of socio-economic structure. Factor One brings together all but one of the correlations that link highly articulated vocalizing to complex productive systems, adding frontal stops and nasals as a secondary source of discriminators.

Factor Two again affirms the opposition of low central to low front as a scaled indicator of the severity of the system governing sex relations. Factor Three, by tying the mid and frontal fricatives to the high front vocoids, indicates that extreme narrowing, whether in contoids or vocoids, can be viewed as one vocalizing function – perhaps symbolic of a strongly masculine bias in culture. Factor Four may be tied to narrowing because the mid front vocoid type is its center. Factors Five and Six, because they deal with lax vocoids may also be tied to sexual permissiveness. There are as yet no explanatory hypotheses for the other three factors, although Seven and Eight, at least, seem to have a sharp enunciatory focus and delimit a related cluster of sounds. The fact that there are only a few unattached factors is perhaps encouraging news for the field of sociolinguistics. It may be that only a small number of additional hypotheses will be necessary to clarify the basic links between phonology and culture, cross-culturally. With such a reduction of the basic research steps in comparative phonology, an early resolution of fundamental questions might be hastened. Already an explanatory framework for main developments in phonology seems to be at hand.

If this experiment has been successful, it is because it has been carried out at the level of language style rather than at the fine-grained levels of linguistic structure where linguists normally operate. Here, at the level that Trager termed 'metalinguistic', one operates with aspects of speech which can be validly compared cross-culturally. These can be examined for their relationships with other cultural factors that can in their turn be compared cross-culturally. More and more it appears that the prime function of culture and communication is to establish and sustain human communities by reinforcing coidentification and providing platforms of shared systems that insure the success of person-to-person interaction and cooperation. In studying the relation between communication and culture performance, style is more pertinent than content unless content, as well, is analyzed for its gross and contrastive features, as in Peacock's notable studies of Javanese drama. The 'how' of a communication system may be linked to the generalized structure of a culture. Such pairs may be compared to others. Studies of vocabularies, phonemic systems and grammars relate to the customs of particular cultures and will become most useful to the comparativist when viewed as adumbrations of the larger style patterns of which they are local manifestations.

CROSS CULTURAL FACTORS IN PHONOLOGICAL CHANGE

APPENDIX

I.

Pacific

Hanunoo
Manus
Usiai
Maori
Tikopia

Africa

Dogon
Kung
Bahima
Bulu
Ekonda
Toma
U.S. Negro

North America

Navaho
Taos
Cree
Flathead
Carrier

Europe

Basque
Kentucky Mts.
Nova Scotia
Andalucia
Castile

South America

Jivaro
Seri

Australia

N. Australia

Asia

Ainu
Temiar
Lapps
Tuareg
Kurds

II.

(A) Correlation between contoid complexity and productive range Median vs. X/IP/AH/PA

$$x \text{ sq.}/3df = 12.32 \text{ } p < 0.01$$

(p. 146, *op. cit.*)

(B) Correlation between dependency on hunting and number of contoids used Splits: 0-10 per cent hunting/20-50 per cent hunting vs. 10+ contoids/

$$7,8,9 \text{ } x \text{ sp.}/ldf = 6.96 \text{ } p < 0.01$$

(p. 149, *op. cit.*)

III.

Correlation between narrow intervals and productive range

Splits: Median vs. all others/IR

$$x \text{ sq.}/ldf = 15.24 \text{ } p < 0.001$$

(p. 136, *op. cit.*)

IV.

Correlation between effort complexity in dance and productive range

Split: Median vs. X IP/AH/PA/IR

$x \text{ sq./1df} = 19.84 \text{ } p < 0.001$

(p. 246, *op. cit.*)

The relation of the sexual division of labor in the main food-producing activity of a culture to its patterned use of vocoids in song. The split is between cultures in which women do 50 per cent or more of such work and cultures in which males do more.

V.

High front and central vocoids.

$x \text{ sq./1df} \dots 22.11 \text{ } p < 0.001 \geq 20$

	females \geq	males $>$
≥ 20	39	109
≤ 15	87	79

number
of
songs

The proportion of songs with a high ratio of high front and central vocoids changes from 31 per cent in complementary economies to 58 per cent in male dominated economies, an 87 per cent deviation increase.

VI.

High front vocoids

$x \text{ sq./1df} \dots 36.50 \text{ } p < 0.001 \geq 15$

	females \geq	males $>$
≥ 15	57	148
≤ 10	69	40

The same proportion relative to the frequency of high front vowels, changes from 45 per cent to 79 per cent as between complementary and male dominated economies, a 76 per cent deviation increase.

Sex sanctions and front vowels: The hypothesis is that severe sanctions and restrictions produce tensions, symbolized in very frequent use of high front vowels, whereas more permissive sexual codes do not induce such tension. The restrictive codes include: (1) insistence on virginity up to marriage; (2) premarital sex relations precluded by very early marriage; (3) premarital sex prohibited, though not severely punished. The permissive codes include: (1) trial marriage; (2) cases of no restrictions or prohibitions; (3) allowed with sanctions only upon pregnancy.

VII.

Front vocoids

$x \text{ sq./1df} \dots 15.90 \text{ } p < 0.001 \geq 45$

	permissive	restrictive
≥ 45	51	95
≤ 40	71	47

CROSS CULTURAL FACTORS IN PHONOLOGICAL CHANGE

This correlation deals with the proportion of songs with 45 per cent or more front vocoids to songs with about 40 per cent or fewer front vocoids. It rises from 42 per cent in permissive cultures to 67 per cent in restrictive cultures, a 60 per cent deviation increase.

VIII.

Back + low and mid central vocoids – virtually all the lax vocoids.

		permissive	restrictive
≥ 55		83	63
≤ 50		39	79

The split here is between songs with 55 per cent or more of lax vocoids and songs with 50 per cent or fewer lax vocoids. This ratio drops from 68 per cent in permissive cultures to 44 per cent in restrictive cultures, a 35 per cent deviation decrease.

IX.

Low front vocoids

		permissive	restrictive
≥ 5		49	91
0		73	51

The same proportion rises from about half to almost twice (40 per cent to 64 per cent) as many in the case of low front vocoids along, a 60 per cent deviation increase.

X.

Low central vocoids

		permissive	restrictive
≥ 20		74	54
≤ 15		48	88

Most of the above shift of proportion is due to the effect of low central vocoids (61 per cent – > 38 per cent, a 38 per cent deviation decrease). The relationships are about the same.

XI.

Proportion of Contoids to Vocoids

		X, IP	AH	PA, IR
≥ 50 contoids		28	28	69
< 50 contoids		114	68	31

The proportion rises from 20 to 30 to 69 per cent, a 250 per cent deviation.

XII.

Number of Contoid Types

	Low	Mid	High
9-11	15	33	71
7-8	44	45	22
1-6	53	44	2

x sq./4df...96.5 p<0.001

The split is between songs with 7+ contoid types and those with 6 or fewer. The 7+ type rises from 40 per cent more frequent in cultures of low or mid socio-technical complexity to +100 per cent in complex cultures. The box to the right shows that there is steady increase between the three levels of societal complexity.

XIII.

Mid stops and nasals

	Low, Mid	High
≥ 20	146	96
≤ 15	88	9

x sq./1df...17.6 p<0.001

This correlation deals with the proportion of songs with at least 20 per cent mid stops and nasals to songs with 15 per cent or less in relation to complexity. The proportion rises from 62 per cent in less complex cultures to 91 per cent in highly complex cultures.

XIV.

Mid fricatives and laterals

	Low	Mid	High
≥ 30	21	22	54
20-25	26	39	47
≤ 15	65	61	4

	Low	Mid	High
≥ 20	47	61	101
≤ 15	65	61	4

	Low, Mid	High
< 20	108	101
≤ 15	126	4

x sq./4df...83.67 p<0.001 x sq./1df...79.7 p<0.001

The proportion of mid fricatives and laterals increases from 46 per cent to 96 per cent in songs of the most complex societies.

XV.

Back contoids

	Low	Mid	High
≥ 40	50	53	2
25-35	38	40	37
< 20	24	29	66

	Low, Mid	High
≥ 25	181	39
≤ 20	53	66

x sq./4df...75.10 p<0.001 x sq./1df...50.9 p<0.001

CROSS CULTURAL FACTORS IN PHONOLOGICAL CHANGE

XVI.

Uvular (back back fricatives)

$\chi^2 / 1df = 70.8 \quad p < 0.001 \quad \geq 5$
 0

	Low, Mid	High
≥ 5	129	7
0	105	98

The proportion of at least 5 per cent of uvular contoids is 55 per cent in societies of less than high complexity, whereas the proportion of zero cases is 7 per cent.

XVII.

Mean per cent of any amount

Low Mid High
 (1-3) (4-6) (7-9)

Fricatives become steadily more fronted along a scale of increasing socio-economic complexity.

MFF	0	0	36
FFF	20	40	80
MMF	49	60	100

XVIII.

Correlation between narrow voice and regulations of female premarital sex

Median vs. permissive/restrictive

$\chi^2 / 1df = 23.27 \quad p < 0.001$

(p. 195, *op. cit.*)

The frequency of narrow voices varies almost linearly with the level of sexual restrictiveness.

REFERENCES

- Lomax, A. (1968). *Folk song style and culture*. Washington, D.C.: American Association for the Advancement of Science.
 — (1972). The evolutionary taxonomy of culture. *Science* 177. 228-39.
 Lomax, A. & Trager, E. C. (1964). Phonotactique du chant populaire. *L'Homme*. 1-55.
 Trager, G. L. *The field of linguistics* (Studies in linguistics, occasional papers, 1.) Norman, Oklahoma: Battenburg.