A Dimensional Model of Multilinear Sociocultural Evolution

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Thurstone's latent-distance method was used to find the coordinates of fifty-five societies in a three-dimensional space that has level of sociocultural development as its principal axis. By assuming that the most probable evolutionary precursor of any society was of a type represented by the society at a lower level of development that showed the greatest similarity to it, societies were linked to form a branched evolutionary "tree." Its structure supported the postulate of multilinear sociocultural evolution and suggested its sequence and dynamics in three main lines of development up to the level of early civilization.

INTRODUCTION

DISCUSSION OF whether human culture has evolved along one or more than one main sequence has been complicated by ambiguities of terminology and has led to few, if any, satisfactory attempts to test the matter empirically. In one study (Gouldner and Peterson 1962) "multilinear" was used to designate a feature of their model that would have been more appropriately called "multidimensional" because the study was not directly relevant to "multilinearity" in the sense implied in the anthropological discussion of sociocultural evolution.

The construction of a Guttman scale of sociocultural traits has been put forward in some studies (Carneiro 1962, Carneiro and Tobias 1963, Freeman and Winch 1957, Goodenough 1963, Schwartz and Miller 1964, Udy 1958, Young and Fujimoto 1965, Young and Young 1962) as evidence for "unilinear" evolution, but for reasons discussed elsewhere (Bowden 1969) this is unacceptable. The most important reason for this conclusion is that the conventional standard procedure for Guttman scaling, which all of these studies have used, implies that if the data can be scaled at all, then only a unilinear scale can be constructed; traits that in a more refined version of the method might indicate the existence of parallel or branched scales (evolutionary sequences) are simply rejected as unscalable.

Although the usual form of Guttman scaling permits only a unilinear interpretation of cross-cultural data and therefore provides no test of the unilinear-multilinear question, the multidimensional model provided by principal-components analysis cannot deal with the specifically evolutionary aspect of the problem. The technique can, as shown by Schuessler and Driver (1956), Gouldner and Peterson (1962), and Bowden (1969), be used to identify conceptual dimensions that may be used to characterize societies quantitatively and hence to represent them as points in a multidimensional space; but the resulting model lacks the essential property of sequential development. Udy (1965) has argued that sequentiality is inherently not derivable from cross-cultural data (the invalidity of "dynamic inference from static data"), but the example of biological evolutionary theory shows that this is true only in a purist sense. Darwinian theory was based entirely on static data from the morphological study and comparison of living and fossil forms. The absence until fairly recently of directly observable instances of evolutionary development due to mutation necessitated the two assumptions that morphological similarity generally implies evolutionary relationship and that greater morphological complexity generally implies relative lateness in the evolutionary

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sequence because it tends to be correlated with a greater degree of adaptation to the environment. The overall success of biological evolutionary theory shows that such assumptions, despite the exceptions that inevitably are revealed as the methodology of the science advances, provide a useful substitute for types of data that in the early stages of building any theory are unavailable.

The model of sociocultural evolution described here is based on two similar assumptions. The first is that the major component of social change is the adaptive viability of sociocultural systems, a result of their subsistence pattern, technology, and institutional organization, as measured by an Index of Sociocultural Development (Bowden 1969). This assumption is supported by analysis of cross-cultural data (Gouldner and Peterson 1962, Bowden 1969). The other assumption is that the more similar two societies considered as representatives of sociocultural types are, the more likely they are to have an evolutionary link.

PRINCIPLES AND METHOD

In principle, the model does not refer to the evolution of individual societies, which is assumed to be subject to considerable random variation, that is, variability that one does not expect to be able to account for at present, but to the evolution of sociocultural types. In practice, samples of cross-cultural data suitable for the method used to develop the model are at present too small for both comprehensive typologies and evolutionary sequences to be extracted at the same time. Particular societies appear in the model, but they should be regarded as merely isolated, more-or-less-typical representatives of the type-sequences that would be found in samples perhaps twenty times larger in both societies and traits than the one used here and with traits ideally rated on more than the usual dichotomous basis found in collations of anthropological data.

Also in principle, the model is probabilistic in that it is assumed that a society *may* have evolved from any sociocultural type at a lower level of development but that the greater the similarity between the two, the greater the probability of an evolutionary link. However, without very extensive historical data, which is almost totally lacking at present, the actual probabilities cannot be computed from the indices of intersocietal similarity used in the method.

The dimensional framework of the model is based on Thurstone's latent-distance method of analyzing measures of similarity between entities such as persons or societies, described by Torgerson (1958). The principle is that societies are regarded as being in a multidimensional Euclidean space, their distance apart being a function of their overall similarity. Two societies with all traits identical would be zero distance apart; that is, they would be at the same point in the space.

In Thurstone's method, similarity and distance are treated as distinct concepts represented by measures that are inversely related, but this appears to be an unnecessary complication. In the present application of the method an index of *dis*similarity is employed and is treated as conceptually identical with distance between societies. For want of an established measure of similarity or dissimilarity based on information-theory statistics, one was constructed from the product-moment correlation coefficient by means of the formula

$$d = -\log(\tfrac{1}{2}(1 + r))/\log \tfrac{1}{2}.$$

This gives zero dissimiliarity when $r = +1$, infinite dissimilarity when $r = -1$, and unity when $r = 0$. This measure is not entirely satisfactory, because the correlation coefficient measures covariation rather than similarity and therefore may be high even though one society has uniformly higher ratings on all its traits. But this is not important except where all the traits are highly loaded on a single factor, which is not the case in the heterogeneous sample that should be used to ensure a multidimensional solution. This index also raises problems when any value of

$r = -1$ occurs in a sample; but this again should arise extremely rarely in any sample that has sufficient traits for the method to be applicable.

Although *n*-dimensional coordinates for societies may be obtained directly by a principal-components analysis of the matrix of correlations between all pairs of societies, Thurstone's method yields a different solution that is preferable for the present purpose because it allows a plausible geometrical interpretation, whereas direct principal-components analysis does not. Given an index of dissimilarity that has the algebraic properties of distance, conversion of the matrix of intersocietal distances into a matrix of vector products and its analysis, as specified in Thurstone's method, yields *n*-dimensional coordinates from which the original distances can be reconstituted by the ordinary algebra of Euclidean space. No such heuristic geometrical interpretation can be given to the factor loadings obtained by a direct principal-components analysis, which are merely numbers that, multiplied and added in a particular way, yield the numbers one started with, namely the correlation coefficients, which themselves have no heuristic meaning beyond their significance as statistical parameters.

The data used for the present analysis were derived from Simmons's monograph (1945) and are described elsewhere (Bowden 1969). Briefly, the data consisted of four-point ratings on fifty-eight cultural traits for fifty-five societies, ranging from

TABLE 1. INDICES OF SOCIOCULTURAL DEVELOPMENT (I.S.D.) AND CULTURAL ACCUMULATION (I.C.A.) AND SCORES ON FIRST AXIS OF LATENT-DISTANCE MODEL (L.D.A.)

Society	*I.S.D.*	*I.C.A.*	*L.D.A.*	*Society*	*I.S.D.*	*I.C.A.*	*L.D.A.*
Aztecs	1.73	302	0.25	Kwakiutl	0.90	57	−0.24
Norsemen	1.60	223*	0.35	Haida	1.00		−0.14
Vai	1.56		0.27	Pomo	0.95		−0.39
Ashanti	1.73	198	0.34	Hottentot	0.99	44†	0.00
Berber	1.51		0.30	Kazak	1.14		0.20
Bakongo	1.70		0.42	Rwala	1.09	79	0.18
Munda	1.69		0.44	Banks Isd	1.06		−0.04
Shilluk	1.44		0.33	Kiwai	0.96	36	−0.22
Bontoc Igorot	1.52	60	0.21	Ainu	0.94		−0.12
Xosa	1.73		0.50	Navaho	1.09		0.04
Hebrew	1.67		0.50	Yakut	1.05		0.05
Araucanian	1.35		0.20	Mafulu	0.89		−0.10
Chippewa	1.60	10	−0.01	Lengua	0.64	9	−0.52
Sema Naga	1.41		0.29	Dieri	0.57		−0.29
Lango	1.29	50	0.23	Veddas	0.53	7	−0.44
Palaung	1.56		0.28	Todas	0.88	36	0.06
Iban	1.45		0.10	Semang	0.51	3	−0.40
Akamba	1.65		0.40	Witoto	0.67		−0.30
Albanians	1.54		0.33	Mongols	0.80		0.06
Mangbetu	1.36		0.14	Yukaghir	0.52	31	−0.37
Creek	1.31	77	0.01	Seri	0.68		−0.36
Iroquois	1.22	64	−0.21	Andamanese	0.35	10	−0.62
Maori	1.16	92	0.16	Chukchi	0.55		−0.17
Trobriand	1.22		0.06	Bushmen	0.44	5	−0.45
Chin	1.31		0.24	Yahgans	0.25	5	−0.46
Arawak	1.24		−0.08	Tasmanians	0.19	0	−0.43
Samoans	1.14		−0.12	Polar Eskimo	0.28		−0.46
Omaha	1.19	45	−0.05				

* Vikings.
† Nama Hottentot.

the Andamanese and Tasmanians to the Bakongo, Ashanti, and Munda in level of development. The product-moment correlations between all pairs of societies were calculated and converted into dissimilarity coefficients (distances), as defined above. The matrix of distances-squared was converted to vector products and analyzed into its principal components, according to Thurstone's method described by Torgerson, by means of a computer program for the IBM 7090. Only three components, all orthogonal, were extracted, in order to facilitate graphical representation, and they were rotated orthogonally in order to maximize the correlation between societies' coordinates on the principal axis and their scores on the Index of Sociocultural Development previously constructed (Bowden 1969). The rotation required was twenty degrees. The relationship between the two sets of values was linear, and the correlations were 0.9078 and 0.9654 respectively before and after rotation. The two sets of values and some societies' scores on Carneiro's Index of Cultural Accumulation are listed in the paper previously cited (Bowden 1969) and in Table 1 of this paper.

Once the position of each society in a three-dimensional space defined by intersocietal similarity was found, the correlation of each society with every other society was examined to determine each society's most probable type-precursor at a lower level of development, that is, the society with the highest correlation with the given society and a lower value on the principal axis. Linking each society to its most probable type-precursor resulted in a "tree" that could branch only upwards and in which each society (except the lowest) was joined to a single society below it. In interpreting the resulting evolutionary diagram, it is necessary to consider the general pattern, discounting short branches and sudden variations in direction, which are likely to result

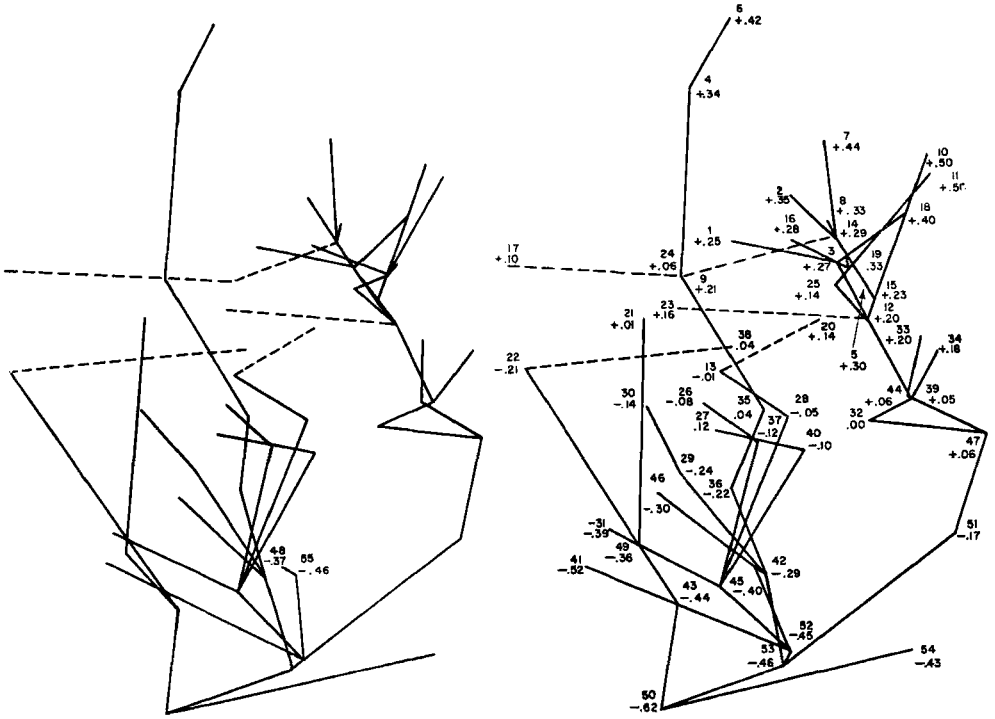

FIGURE 1. Stereoprojections of three-dimensional sociocultural evolution model. I.D.A. values (see Table 1) are shown below the numbers of the societies.

from chance features of the random sample.

Two-dimensional projections of the tree diagram were prepared, but it was difficult to get a clear picture of the three-dimensional form of the sequences. To avoid this difficulty, stereoscopic diagrams were constructed by computing and plotting two slightly separated frontal viewpoints. These are shown in Figure 1. One can achieve stereoscopic fusion with the unaided eyes from a distance of about one foot, but an optical viewer such as those used for aerial cartography provides a more stable and solid image; even then, however, some minutes of concentrated attention to the different parts of the diagram is necessary, and not all parts can be perceived three-dimensionally at the same time. If the front parts are fixated with both eyes, the rear parts will appear doubled, and vice versa. Nevertheless, the stereoscopic view is more informative than a set of three two-dimensional projections, and it seems worthwhile to introduce stereoscopy into the social sciences.

RESULTS: INTERPRETATION OF THE EVOLUTIONARY DIAGRAM

With only five exceptions, the highest correlation of any society with a society below it was about 0.5 or greater, ranging up to 0.78. Tasmanians, number 54, correlated 0.4873 with the only lower society, the Andamanese Islanders. The five exceptions had highest correlations of 0.40 to 0.44 and the corresponding "evolutionary links" are shown dotted in Figure 1. The apparent downward trend of the link between societies 14 and 9 is due to perspective; in fact it is almost horizontal, receding into the plane of the diagram. These five links corresponding to the lowest correlations are at variance with the overall pattern; that is, they cut sharply across the otherwise distinct evolutionary main sequences. The ensuing discussion will therefore largely ignore these five deviant cases, and it will be assumed that the sample was too limited or the error-variance of the trait-ratings too great for the true evolutionary type-precursors of these five societies to be identified. For the record, the five in question were: (9) Bontoc Igorot; (17) Iban; (20) Mangbetu; (23) Maori; (38) Navaho.

The pattern formed by the remaining fifty societies is distinctly nonunilinear and falls into two main sequences at the right and center of the diagram and a less well developed sequence on the left. Since the left-right axis is that identified as *sex dominance* by Bowden (1969) while the one perpendicular to the plane of the diagram is monogamy-polygyny, these three main sequences will be designated the male-dominant, the equidominant and the female-dominant. One empirical result of the study is that only a small proportion of societies, 10 percent in the present sample, lie on a female-dominant sequence. An important secondary result, however, seems to be that at the lower levels of development there are numerous branchings from the equidominant sequence, all of which tend to turn toward female dominance either immediately or after a further stage of development. These branchings, at about -0.45 to -0.35 on the vertical axis, are so numerous that a characteristic phase of diversification of sociocultural types is postulated to occur at this level of development. Examination of the detailed pattern of traits of societies in this sequence indicates clearly that this phase of diversification corresponds to the acquisition of agriculture in the equidominant sequence; that is, agriculture is absent or only weakly developed in societies from which branchings stem and is generally dominant or well developed in the next societies up each branch. One exception is the branch from (42) Dieri to (29) Kwakiutl to (30) Haida, in which fishing as a dominant subsistence form develops instead of agriculture. It seems to be a fairly general rule in the equidominant sequence that fishing is both prior to and coexistent with agriculture, which precedes the use of grain for food. The use of metal is absent in the equidominant sequence until the uppermost levels of devel-

opment, but a legal code is present from quite an early stage.

In these respects the equidominant sequence stands in marked contrast to the male-dominant sequence, which is characterized by herding as the dominant subsistence form until the acquisition of agriculture at a relatively high level of development. Herding, which evolves out of a hunting-and-collecting precursor, commences at a slightly lower level of development in the male-dominant sequence than does agriculture in the equidominant sequence; it arises from an early phase of diversification at about −0.55. The use of metals also begins at a lower level here than in the equidominant sequence, but the development of legal codes comes at a slightly higher level. A minor phase of branching and diversification and a trend toward equidominance occur at the stage where a legal code and the use of metals first appear in the male-dominant sequence. The major phase of diversification, however, which is associated with a further trend toward equidominance, occurs at about +0.15 to +0.30. This, like the corresponding phase in the equidominant sequence, is characterized by the appearance of numerous societies in which agriculture is the dominant subsistence form. Unlike the equidominant sequence, where fishing tends to be codominant with or subsidiary to agriculture, herding is coexistent with agriculture in the male-dominant sequence. Despite the preponderance of male-dominant societies in the upper half of the diagram, it is one branch of the equidominant sequence that leads to the highest level of development, the Ashanti and Bakongo.

Changes parallel to the monogamy-polygyny axis tend to be oppositely correlated with those in the sex-dominance dimension for the equidominant and the male-dominant sequences. In the equidominant sequence the branch that leads to the highest level shows a large-scale movement toward extreme polygyny accompanied by a slight tendency toward female dominance. A second set of branches, arising from a type-precursor represented by (45) Semang, maintains a neutral position on the monogamy-polygyny dimension and oscillates but tends toward female-dominance on the sex-dominance dimension. In the male-dominant sequence, on the other hand, at first a slight trend toward polygyny accompanies a movement toward extreme male dominance, and then both trends reverse. These variations account for the existence of sex-dominance and monogamy-polygyny as distinct dimensions because if movements in the two dimensions were always correlated in the same sense, they would, by any principal-components method, become a single dimension. The results suggest that polygyny takes essentially different forms and fulfills different adaptive functions in the equidominant and male-dominant sequences. In the latter, which comprise herding societies that later acquire a grain-utilizing agriculture, at the lower levels the polygynous female group appears simply to reflect the physical dominance of the males, the protectors of the group's herds or flocks. With the development of metallurgy in such societies and, closely associated with it, the development of legal codes, it may be that some degree of intrasocietal and intersocietal contract replaces physical force as the means of maintaining the group and its means of subsistence against human disruptive agents simply because the destructive efficiency of metal weapons must be controlled. Such a postulated reduction in the importance of physical force for group maintenance could well be reflected in a decline of male dominance and hence of harem-type polygyny. But when grain foods are introduced into the pastoralist, male dominant sequence, a great range of variations on the sex dominance and monogamy-polygyny dimensions erupts. Although all the societies at this stage in that sequence combine agriculture with herding, an examination of the traits of individual societies suggests that the greater the reliance on agriculture, the greater the incidence of polygyny in the society, though it is a hybrid type of polygyny that lacks

both the female dominance of polygyny in the agricultural equidominant sequence and the extreme male dominance of primitive herding polygyny. It probably represents a compromise between the polygynous workgroup that appears to be an especially effective response to the requirements of primitive agriculture and the harem type of polygyny associated with the male dominance of primitive herding societies.

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