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Universal Patterns in Cultural Evolution: An Empirical Analysis Using Guttman Scaling

ABSTRACT We test for universal patterns in cultural evolution by Guttman scaling on two different worldwide samples of archaeological traditions and on well-known archaeological sequences. The evidence is generally consistent with universal evolutionary sequences. We also present evidence for some punctuated evolutionary events. [Keywords: cultural evolution, cross-cultural research, scaling, anthropological theory]

WHILE IT IS WIDELY ACCEPTED THAT CULTURES have generally become more complex over time, it is not widely accepted that societies generally develop traits in ordered evolutionary sequences. Building on the comparative ethnographic work of Linton Freeman (1957) and Robert Carneiro (1962), we test here for universal evolutionary sequences, primarily using Guttman scales on data from two worldwide samples of archaeological traditions.

GUTTMAN SCALING

Carniero (1962) suggested that Guttman scaling held great potential for the study of cultural evolution, as it was developed to identify unidimensional processes. This is accomplished in Guttman scaling by identifying a clear hierarchy among a group of scale items. At the top of the scale are traits that, when present, tell one that other traits below should also be present (Guttman 1950). There are obvious evolutionary implications if one finds that traits form a Guttman scale—"the order in which the traits are arranged, from bottom to top, is the order in which the societies have evolved them" (Carneiro 1970:837).

We agree that Guttman scaling is particularly useful for identifying patterns of cultural evolution because the hierarchy inherent in a Guttman scale suggests an evolutionary order. To date, however, only a handful of such scales have been proposed (e.g., Bowden 1969; Carniero 1962, 1970; Carneiro and Tobias 1963; McNett 1970; Naroll 1956), and only one general Guttman scale of cultural evolution has been put forward—Freeman's "Folk–Urban Continuum" Scale (Freeman 1957; see also Freeman and Winch 1957). The Freeman scale, which emerged from his examination of 52 ethnographically described cultures, suggests that 11 traits develop as cultures evolve from "folk" to "urban" (see the order shown in Table 1, column A).

Freeman was limited in the sample of ethnographic cases he was able to use and was only able to examine cases from the "ethnographic present." Because this scale is one that is intended to model an evolutionary process, testing it in a single time period may not be satisfactory. After all, such a scale may fit the "ethnographic present" but may not fit a sample derived from the entire range of human history. For this reason we attempted to replicate Freeman's scale using a random sample of 20 cases, varying both temporally and geographically, that we selected from the electronic Human Relations Area Files (eHRAF) Collection of Archaeology.

The eHRAF Collection of Archaeology provides indexed and searchable primary documents on cases selected by random sampling and geographical time series from the *Outline of Archaeological Traditions* (Peregrine 2001a). The *Outline of Archaeological Traditions* is a catalogue of all known archaeological traditions covering the entire globe and the entire prehistory of humankind and, thus, is a comprehensive sampling universe of prehistoric societies. While relatively small, our 20-case sample—chosen as it was from a comprehensive sampling universe by random sampling—should reflect the entire range of variation among prehistoric human societies and, thus, should mitigate any bias found among societies in the "ethnographic present." If Freeman's Guttman scale applies to all human societies at all times in human history, then we should be able to reproduce it using only these 20 cases.

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TABLE 1. Three Guttman scales of cultural evolution. Lower numbered items presumably evolve before higher-numbered items. Column A is the scale developed by Freeman (1957), column B is our version of the Freeman scale, shortened to apply to archaeological cases, column C is the scale we developed from Murdock and Provost 1973 and is also applicable to archaeological cases.

A: Freeman Scale	B: Revised Freeman Scale	C: 15-Item Murdock-Provost Scale
1. Trade with other societies	1. Intersocietal trade	1. Ceramic production
2. Subsistence economy based primarily on agriculture or pastoralism	2. Subsistence economy based on food production	2. Presence of domesticates
3. Social stratification or slavery	3. Social stratification or slavery	3. Sedentarism
4. Full-time governmental specialists	4. Full-time government specialists	4. Inegalitarian (status or wealth differences)
5. Full-time religious or magical specialists	5. Full-time craft specialists	5. Density > 1 person/mi^2
6. Secondary tools	6. Political state of 10,000 in population	6. Reliance on food production
7. Full-time craft specialists	7. Towns exceeding 1,000 in population	7. Villages > 100 persons
8. A standard medium of exchange	8. Writing	8. Metal production
9. A state of at least 10,000 in population		9. Social classes present
10. Towns exceeding 1,000 in population		10. Towns > 400 persons
11. Complex, unambiguous, written language		11. State (3+ levels of hierarchy)
		12. Density > 25 persons/mi^2
		13. Wheeled transport
		14. Writing of any kind
		15. Money of any kind

A basic problem we encountered in applying Freeman's scale to prehistoric cases was that some of the traits are not easily measurable from the archaeological record.[1] Two that proved especially difficult were the presence of secondary tools and the presence of full-time religious specialists. In both cases, the level of inference would be quite high, and we decided that rather than incorporate them and introduce error, we should drop those items. In addition, none of the sample cases had money, so we were unable to use that variable in our scale. Scaling the remaining eight items replicated Freeman's results (as shown in Table 1, column B) and resulted in a near-perfect scale with

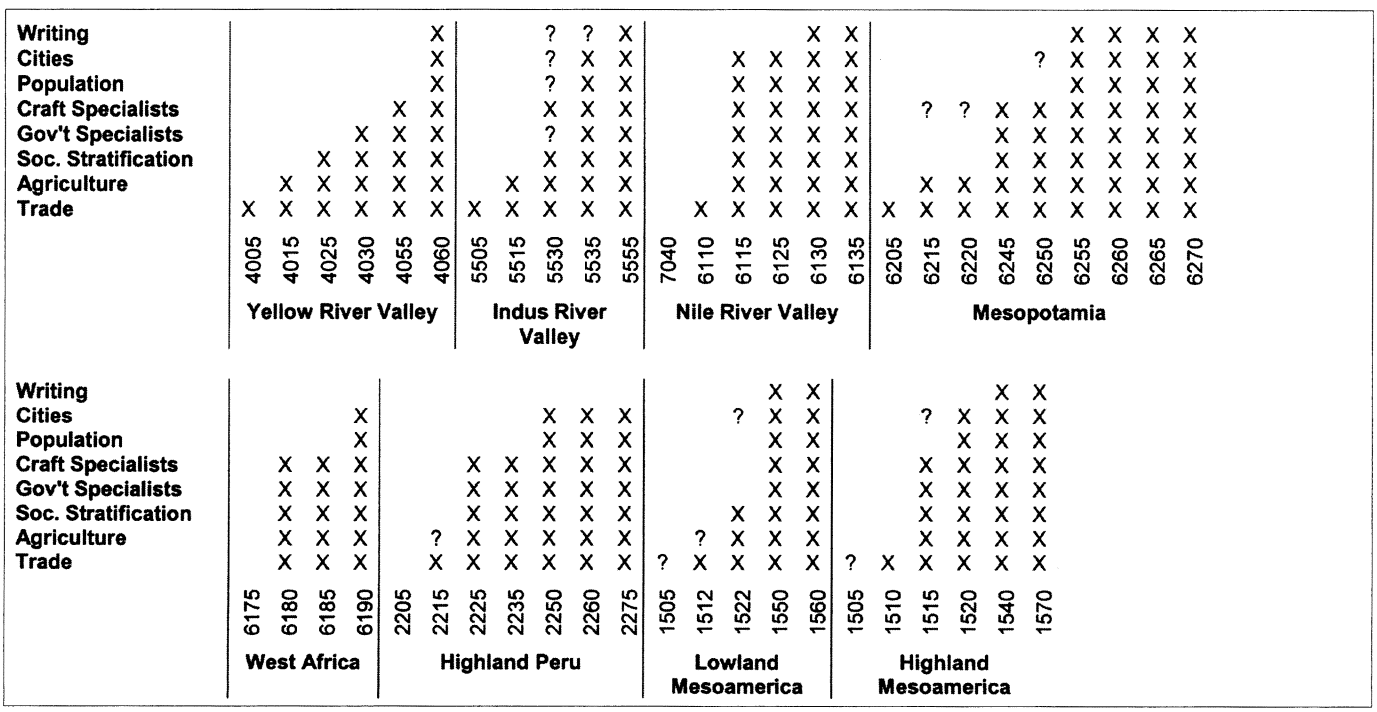

FIGURE 1. Scalograms for eight regional evolutionary sequences, based on our revision of Freeman's (1957) 11-item scale. Numbers in the bottom rows refer to case numbers in the *Outline of Archaeological Traditions.* Question marks denote uncertain codings and potential scale errors.

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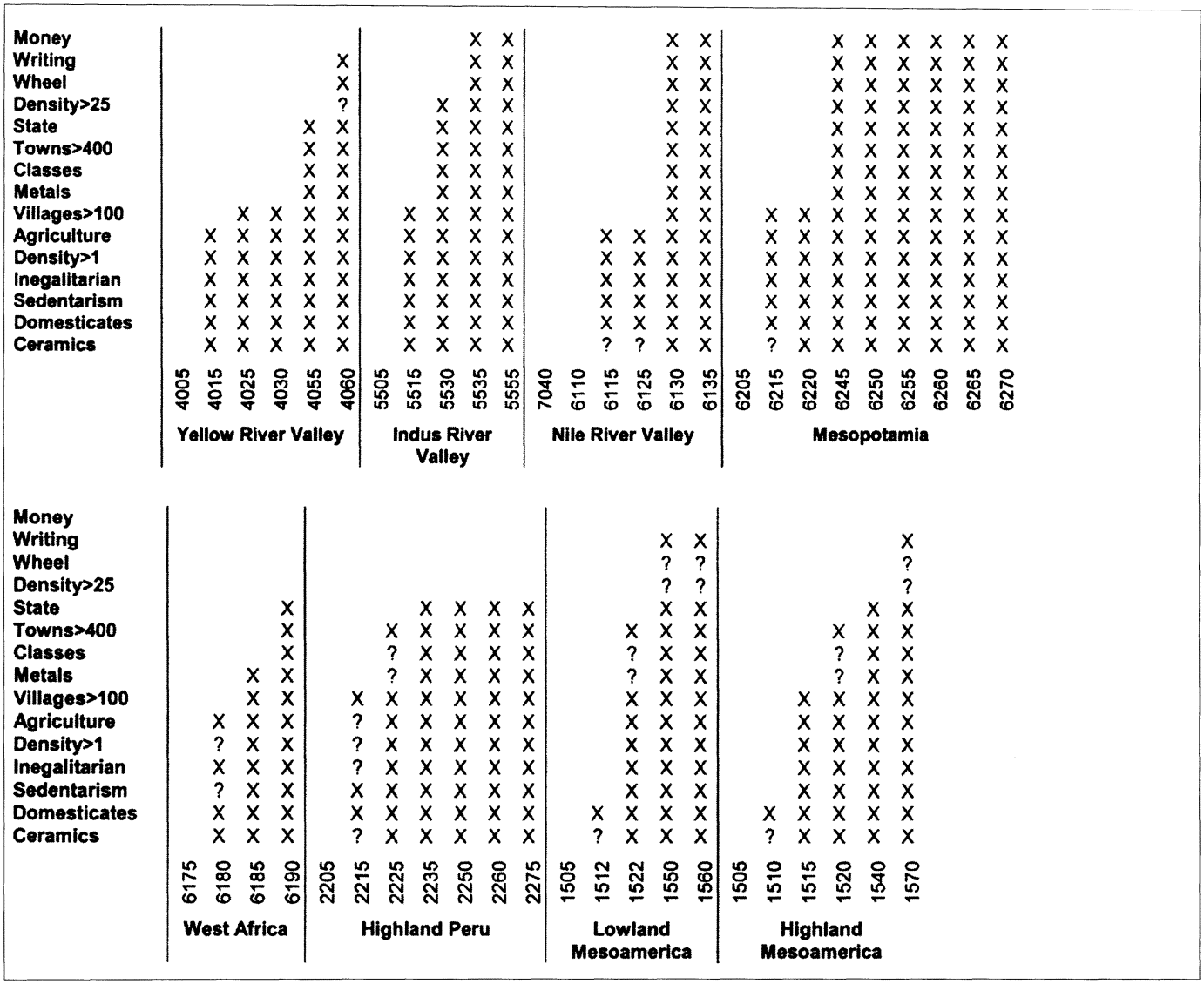

FIGURE 2. Scalograms for eight regional evolutionary sequences, based on our revision of Murdock and Provost 1973. Numbers in the bottom rows refer to case numbers in the *Outline of Archaeological Traditions.* Question marks denote uncertain codings and potential scale errors.

only two scale errors (CR = .988; CS = .943; MMR = .781).[2]

From this replication we conclude that there are general sequences in cultural evolution that hold for both historic and prehistoric cases. While not all cases must evolve in precisely this way, a valid Guttman scale cannot occur unless most cases behave in the manner described in the scale. We have some concern, however, with the fact that other scholars have noted that Guttman scales with fewer than nine or ten items may produce a high coefficient of reproducibility (over .9) by chance (Schooler 1968). Our scale, composed of only eight items, should be approached with caution but fits the data with such accuracy that chance seems an unlikely cause. Indeed, it far exceeds standard guidelines for evaluating the acceptability of a Guttman scale (CR > .9; MMR < .9; CS > .6; see McIver and Carmines 1981:70).

But even if this apparent order to the evolution of cultural traits is not a statistical artifact, did these traits actually evolve in the stipulated sequence in many, if not most, parts of the world? To answer this question we examined individual sequences of cultural evolution in eight world regions: Yellow River Valley, Nile River Valley, West Africa, Mesopotamia, Indus River Valley, Highland Peru, Lowland Peru, and Highland Mesoamerica. The sequences were derived from the *Outline of Archaeological Traditions* (Peregrine 2001a), and scalograms for each sequence are shown in Figure 1.[3] Question marks illustrate places where either scale errors appear or in which there were missing data (which we took to be scale errors—if the scale is accurate, then traits should be readily apparent). In all eight regions cultural traits appear primarily in the order suggested by Freeman's Guttman scale.

EXPANDED GUTTMAN SCALE OF CULTURAL EVOLUTION

Because the Freeman scale had only eight items and, thus, may have produced a high coefficient of reproducibility by chance, we decided to develop a scale with additional

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items based on data coded by the first author (Peregrine 2001b, 2003). The data were derived from entries in the *Encyclopedia of Prehistory* (Peregrine and Ember 2001–02) and based on a ten-item scale of cultural complexity developed by Murdock and Provost (1973; also see Chick 1997). The data were recoded into 15 present–absent variables and then scaled. We found they formed a Guttman scale (CR = .968; CS = .892; MMR = .709) with the order presented in Table 1, column C. This 15-item Guttman scale is large enough that scaling is improbable by chance, and because it is based on 289 cases, it also avoids the potential problem of the small sample size involved in our replication of the Freeman scale. Thus, this larger Guttman scale reinforces the conclusion that there are universal patterns in cultural evolution.

Figure 2 presents scalograms based on this scale for eight regional evolutionary sequences. While the sequences support the Guttman scale, there is a consistent error that can be seen in five of the eight sequences—ceramic production is not present before domesticates. This error occurs only eight times in the entire 289-case data set, and six are represented in these eight sequences. All occur in locations where domesticates are thought to have been independently developed, which may hint at an explanation for this repeated error. But why ceramics, as a storage or cooking technology, should go hand-in-hand with the development of domesticates is a question that requires further research.

PUNCTUATED EVENTS IN CULTURAL EVOLUTION

Evidence for punctuated evolutionary events, where several traits appear together, is clear in both Figures 1 and 2. In Figure 1 it appears that, while trade may evolve alone or with agriculture, once social stratification evolves both government and craft specialists also evolve. Similarly, once the population of polities grows above 10,000, both cities and writing tend to appear. Such evolutionary leaps are clearer in Figure 2, where it appears that once sedentarism evolves so does social inequality and a reliance on domesticates. A second leap appears to occur when metals evolve, as social classes, towns, and political states appear to evolve as well. The presence of these punctuated events may help to explain why, despite the general rejection of the idea that there are universal patterns in cultural evolution, anthropologists still tend to classify cultures typologically, for example, as bands, tribes, chiefdoms, or states (Service 1962). Commonly used typologies may reflect the regular co-evolution of some cultural traits.

Cluster analysis provides a means to test whether some traits tend to co-evolve, and Figure 3 presents the results of a cluster analysis of the 15-point Guttman scale. There appear to be two major groups that match the order of the 15-point Guttman scale and divide at the Metals variable. The variables below Metals on the scale form one cluster (A), while those above form a second cluster (B). Within the higher cluster, the variables State, Towns > 400, Classes, and Metals form a unique cluster (C), while

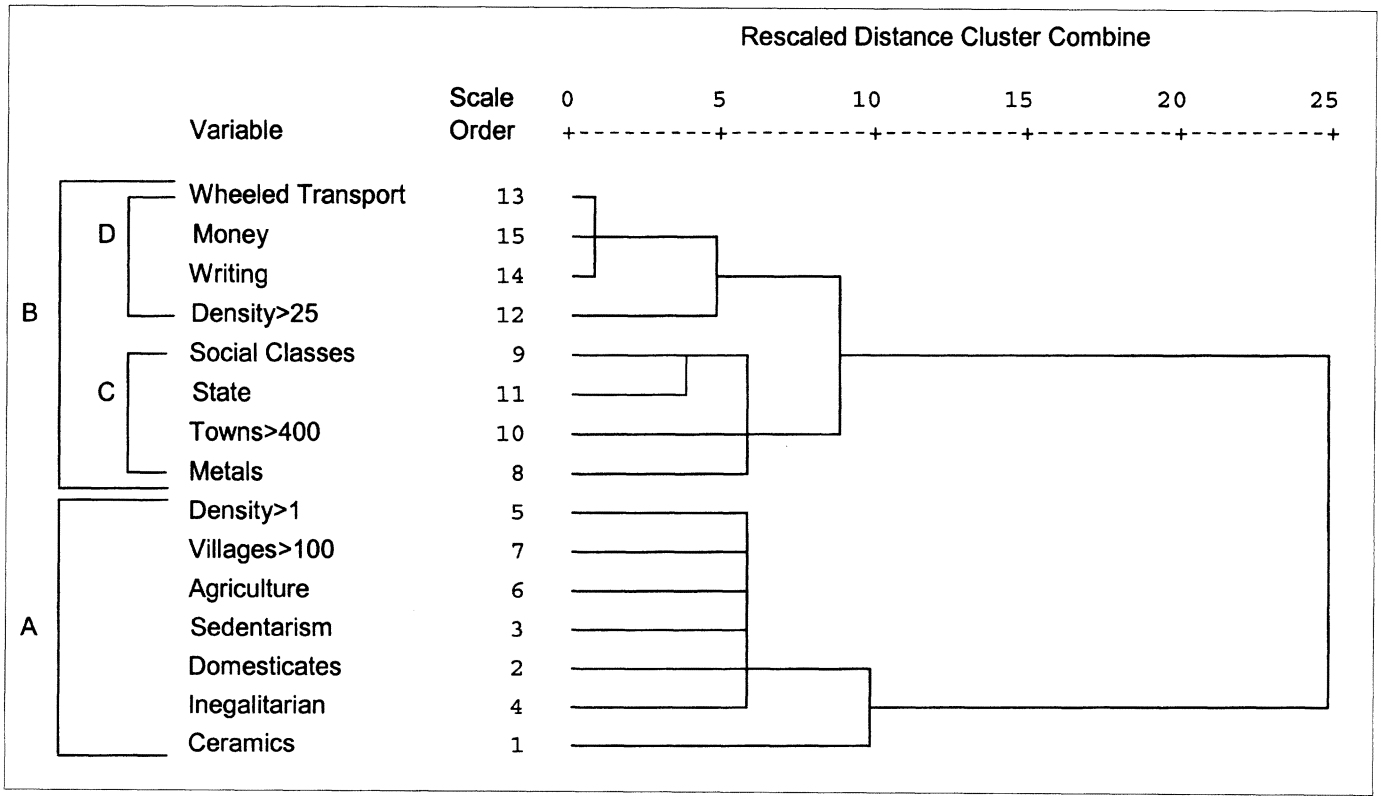

FIGURE 3. Dendrogram of the 15-item Guttman scale variables, produced using SPSS 10.0 Hierarchical Cluster routine, the centroid method, and squared Euclidean distance measure. Labels A, B, C, and D denote clusters of variables that match groups of traits that the scalograms suggest coevolve.

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Money, Writing, Wheel, and Density > 25 form another cluster (D). These clusters appear identical to the punctuated evolutionary changes evident in the scalograms and suggest that both reflect the co-evolution of specific groups of cultural traits. One might see these as evolutionary "stages," similar to those proposed by a number of anthropologists in the middle of the last century that are now considered highly suspect (Blanton et al. 1996).

We conclude that there are universal patterns in cultural evolution. Cultural traits evolve in regular ways, and some traits appear to co-evolve in punctuated evolutionary events that may parallel the typologies through which anthropologists frequently classify the cultures of the world.

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NOTES

1. All cases were coded in random order by the first author.

2. Guttman scale statistics were calculated using Anthropac 3.2 and the minimized errors method. CR refers to the coefficient of reproducibility, which measures the degree of scalability of the empirical data. CS refers to the coefficient of scalability, which is a measure of a scale's ability to predict item responses in comparison to predictions based on marginal frequencies and is, thus, basically a proportional reduction in error (PRE) statistic. Finally, MMR refers to the minimal marginal reproducibility, which, as its name implies, is a measure of reproducibility based on the marginal frequencies for each item.

3. Data for these scalograms were derived from entries in the *Encyclopedia of Prehistory* (Peregrine and Ember 2001–02) by the first author and were coded in random order (see Peregrine 2003). While not nearly as detailed as the information in the eHRAF Collection of Archaeology, the entries in the *Encyclopedia of Prehistory* provided enough information to make confident codings in most cases. In those where codings were unclear, additional sources, including the eHRAF Collection of Archaeology, were examined.

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