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## Introduction to the problem

Studies of stylistic variation in prehistoric artifacts have played an important role in archaeological research since the beginning of the discipline. A variety of different types of studies have been done using a number of different methods and types of artifacts. The purpose of the majority of these studies, however, can be placed in one of two categories. First, the largest amount of research has concentrated on the *discovery and description of stylistic change through time in order to date sites*. Using sets of artifacts from stratigraphic sequences or from dated deposits for temporal control, it has been established in many areas that stylistic attributes changed through time. Early examples of such studies include the excavations of Kidder (1931, 1972) and Nelson (1916) in the American Southwest, Ford (1935) in the southeastern United States, Gamio (1913) and Vaillant (1930, 1931) in the Valley of Mexico, Bennett (1934) in Bolivia, and innumerable studies in Europe where stratigraphic excavations first were used as an important means of establishing temporal sequences. Such studies have continued to be important as a means of establishing new sequences, verifying old ones, or developing methods of making more precise estimates of occupation dates [e.g., the research of Drennan (1976) in the Valley of Oaxaca, Mexico, Snarkis (1976) in Costa Rica, and Thomas and others (1976) in Luxembourg].

The success of such studies led to the widespread use of stylistic attributes, such as types of ceramic designs or characteristics of projectile points, as *index fossils* (Colton and Hargrave 1937:17) for the dating of sites. In the American Southwest, for example, Martin and Plog (1973:252) have noted that within the ceramic wares defined by Colton (1955), 75 percent of the distinctions between the pottery types of different time periods are based on differences in stylistic attributes such as design elements or design layouts.

The second type of stylistic analysis has become particularly common in the last few decades and has concentrated on *stylistic variation through space rather than variation through time*. Specifically, such studies have attempted to infer characteristics of prehistoric social

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organization or interaction by measuring different aspects of stylistic variation. Two such aspects have been emphasized: (1) the similarity of stylistic attributes in different areas of a site or at different sites within a region and (2) the degree of homogeneity in the stylistic elements from a single site or within a region. These studies have been based on the assumption that the degree to which designs are shared by or diffuse between individuals, social segments, or villages is directly proportional to the amount of interaction between the units (Englebrecht 1974:53; Fry and Cox 1974:222; Kay 1975:64, 69–70; Longacre 1970:27–8; Pollnac and Rowlett 1977:170; Redman 1977:51 and 1978:172–3, 175; Whallon 1968:223). Given this assumption and others concerning the deposition of the ceramic material, the sex of the potters, and the importance of the link between mother and daughter in the daughter's learning of designs [see Baldwin (1975), S. Plog (1976a), and Schiffer (1976:22–5) for a more detailed discussion of the assumption], it has been argued that the greater the interaction between units, the higher will be the stylistic similarity between units and the lower the degree of stylistic homogeneity within sites. In contrast, if interaction is minimal and the stylistic traditions of individuals or social units are not shared to any extent, the lower will be the stylistic similarity between units and the higher will be the degree of homogeneity within units.

Based on this argument, some studies have attempted to isolate spatial units within an area in which the variation in the stylistic attributes present within the units is low relative to the variation between units or the degree of stylistic similarity within units is higher than the similarity between units. The spatial units which have been isolated have been interpreted as supracommunities or communities (Pollnac and Rowlett 1977), as groups of villages cooperating economically and ritually (Longacre 1964a), or as residence units within villages (Clemen 1976; Gerald 1975; Hill 1970; Longacre 1970). Others have used the same assumptions already outlined to describe the intensity of interaction between communities by measuring the degree of design variation within communities (Connor 1968; Englebrecht 1971, 1974; Leone 1968; McPherron 1967; Whallon 1968) or through quantification of the degree of stylistic similarity between villages (Englebrecht 1974, 1979; Fry and Cox 1974; Kay 1975; Tuggle 1970). Connor (1968), Leone (1968), and McPherron (1967:298) suggested that interaction intensities were determined by community marital rules, either virilocality versus uxorilocality or endogamy versus exogamy, while Engelbrecht (1974) has discussed the importance of increased rates of trade on interaction and stylistic variation.

Such studies have been made in a number of different areas, but are most numerous in analysis of North American prehistory. Studies focusing on stylistic similarity include the research of Long-

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acre (1964a, 1970), Hill (1970), Cook (1970), Tuggle (1970), Wiley (1971), Gerald (1975), Hanson (1975), Clemen (1976), Redman (1978), Washburn (1977, 1978), Washburn and Matson (1980), and Kintigh (1979) in the American Southwest and Whallon (1969), Engelbrecht (1974, 1979), and Kay (1975) in the midwestern or north-eastern United States. The work of Connor (1968) and Leone (1968) in the American Southwest and McPherron (1967), Whallon (1968, 1969), Engelbrecht (1971, 1974), and Braun (1977) in the midwestern or northeastern United States are examples of studies measuring stylistic homogeneity.

Outside of North American research, relatively few such analyses have been made. In the Old World, examples of studies of stylistic similarity for the purpose of inferring prehistoric organization or interaction include Pollnac and Rowlett's (1977) attempt to isolate communities and supracommunities using stylistic data from Marnian sites of the La Tene Ia period in Western Europe, Voss's (1976) research on intercommunity interaction in northwestern Europe from 2900 to 2200 B.C., and Redman's (1978) and Rubertone's (1978) analyses of organization and ceramic variation in the Moroccan site of Qsar es-Seghir. In Mesoamerica, Pyne's (1976) study of ceramic design distributions within three Formative (1150–650 B.C.) communities in the Valley of Oaxaca in Mexico, my analysis (1976b) of intersite stylistic similarities in the same area, and a study of interaction and stylistic similarities in the Tikal, Guatemala, region (Fry and Cox 1974) also are examples of the type of study just described. Although the number of these studies done using materials from areas outside of North America is small, many comparisons of stylistic similarities and differences between different regions, rather than individual sites, have been based implicitly on the same principle as the subregional studies listed here, as Flannery (1976:253) has argued. Statements such as the following are typical of such studies: "similar designs on pottery and textiles in the Interlocking and Recuoid cultures indicate that cultural relations existed between them" (Strong and Evans 1952:244).

The two general types of studies of stylistic variation described have been important for two reasons. First, artifact types, often distinguished by stylistic attributes, are the major analytical unit used by archaeologists in dating sites in many areas. Since the estimation of site dates is a prerequisite of most archaeological research, the knowledge that stylistic attributes changed through time has been and remains important. Second, the study of stylistic variation in order to infer characteristics of prehistoric organization and interaction has increased in importance as archaeologists have become more concerned with explaining prehistoric culture change. Many anthropologists have argued that culture change must be under-

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stood in terms of a society's adaptation to its physical and social environment. Yet, as Kushner (1970) and Flannery (1972) have argued, emphasis by archaeologists on the natural environment has exceeded emphasis on the social environment. This is a result of a lack of methods for measuring interaction between communities or for isolating sets and hierarchies of interaction units among or within villages. If the method recounted here can aid in the measurement of these aspects of the social environment, it will contribute significantly to our ability to describe and explain prehistoric culture change. Thus, studies of stylistic variation have provided and, in the future, may continue to provide important archaeological information.

**Problems in the use of stylistic variation**

While the different types of stylistic analyses have been and continue to be important to archaeologists, they conflict in their interpretations of stylistic variation. One interpretation views stylistic attributes as primarily varying temporally. The other interpretation views designs as primarily varying spatially. To accommodate this contradiction, most studies assume implicitly that stylistic change is sporadic, with periods of stability followed by rapid change. Stylistic characteristics are used to date sites according to periods of time or phases, emphasizing the temporal aspect of style variation; but within phases, stylistic change over time is assumed to be minimal and spatial patterns of stylistic variation are stressed. However, few if any studies have tested this assumed pattern of stylistic change. Given that the two primary interpretations of stylistic variation may be contradictory, we must ask whether there are problems with either of the interpretations.

First, are there problems with the use of designs to date sites? The series of studies by Deetz and Dethlefsen (Deetz 1968a; Deetz and Dethlefsen 1965, 1967; Dethlefsen and Deetz 1966) indicate definite problems. Their analysis of motifs carved on eighteenth and nineteenth century gravestones in New England revealed variation through space in the date of the initial appearance of designs and in the date of the highest relative frequency of designs because of factors such as distance from Boston where some motifs first occurred, the rate of religious change over space, and changes in subsistence bases and market orientations. Their analysis also demonstrated that the motifs changed continuously over time rather than sporadically. In a second study, Martin and Plog's (1973:257) analysis of Breternitz's dates for Southwestern ceramic types suggested that "the rate of adoption of artifacts including pottery does not vary uniformly in time and space." These studies do not contradict the proposal that stylistic attributes do change through time or that de-

sign variation between sites can be used to assign gross dates to sites. They do, however, suggest that significant errors can be made in dating sites on the basis of stylistic attribute frequencies if rates of change and the causes of differential rates of change are not known and/or are not constant. Information on the cause of stylistic variation is thus needed.

Second, there are also problems with the use of designs to measure interaction intensities between sites. A more detailed criticism can be made of this type of study for two reasons. First, ethnographic analyses of studies of stylistic variation through space are easier to carry out than ethnographic studies of variation through time and are thus more numerous. Second, archaeological studies of stylistic variation through space frequently have provided more precise quantification and statistical analyses of patterns of stylistic variation. As a result, problems with the use of stylistic variation to measure characteristics of prehistoric organization or interaction are easier to document. Both ethnographic and archaeological data that do not equate degrees of stylistic similarity or variation with interaction intensities will now be considered.

### **Ethnographic studies**

A number of studies of stylistic variation in artifacts from modern preindustrial communities have been made since the initial proposals of a relationship between stylistic variation and organization and interaction. These studies include the research of Friedrich (1970), Stanislawski (1969, 1973), Stanislawski and Stanislawski (1974), Hodder (1977), and Longacre (1974, n.d.). While Longacre's fieldwork and analysis are still in progress, conclusions have been drawn from the other studies. On the basis of a study of Hopi ceramic production, the extent to which the diffusion of stylistic attributes is channeled by organizational units such as lineages, clans, or villages has been questioned (Stanislawski 1969, 1973; Stanislawski and Stanislawski 1974). The analysis indicated that among the Hopi, who occupy several villages on three mesas in northeastern Arizona, there are "mesawide styles, rather than tribal, village, or lineage or clan-owned designs" (Stanislawski and Stanislawski 1974:11). Friedrich's (1970) study of ceramic decoration in a Tarascan village in Mexico indicated that patterns of variation in some stylistic attributes but not in others were useful as indicators of interaction intensities between the potters. (The specific attributes will be discussed in Chapter 4.) In addition, her analysis suggested (1970:342) that "the success of any attempt to reconstruct interaction patterns depends upon the extent to which the artisans who produced the archaeological style were actually interested in the designs they painted." Finally, the study by Hodder (1977) included several types of objects

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used by three tribal groups in western Kenya, and it is thus more comprehensive than Friedrich's or Stanislawski's analysis in regard to both the number of different groups and the variety of material items included. Hodder found that despite frequent interaction between individuals of different tribes, the distributions of many stylistic characteristics and material items primarily were confined to distinct tribal areas. He therefore concludes (1977:269) that "the distribution of material cultural traits . . . are not necessarily and wholly structured by patterns of interaction. It is quite possible to have distinct groups with distinct material cultures but who have very strong and frequent interaction." Thus, a number of ethnographic studies either have not supported or have suggested modifications in the use of stylistic similarities or variation to measure interaction intensities.

The results of these studies should not be accepted uncritically, however. In both the Hopi and Tarascan cases, for example, the context of pottery making is very different from many prehistoric situations. In both areas, ceramic vessels are produced to be sold in commercial markets, and there is evidence, at least for the Hopi (Bunzel 1972:83), that this trade has had important effects on the diffusion of designs from one potter to another. More importantly, none of these studies have provided quantified, objective measures of interaction intensities or of degrees of stylistic similarity. Thus, it is impossible to measure precisely the degree of relationship if any, between the variables.

**Archaeological evidence**

In addition to the ethnographic studies already discussed, a variety of archaeological evidence also does not support the use of degrees of stylistic similarity or variation to measure interaction intensities. First, if intersite design similarities do measure the intensity of interaction between communities, then the similarity between contemporaneous sites should decrease as distance between them increases. This relationship has been supported by studies of the movement of goods and people in industrialized societies (Olsson 1965; Zipf 1949), in contemporary nonindustrialized societies (Chisholm 1968; Hayano 1973; Kasakoff and Adams 1977), in historic groups (Deetz and Dethlefsen 1965) and in prehistoric societies (Ericson 1977; Hodder 1974; Pires-Ferreira 1973; Renfrew 1969; Sidrys 1977; Warren 1969). However, I have examined several sets of data on stylistic attribute distributions among prehistoric communities and have shown that in the majority of cases similarity between sites does not decrease with increasing distance between them (S. Plog 1976b). This relationship between distance and stylistic similarity also has been measured in some other recent studies. One of these analyses



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also has shown no relationship between the variables (Fry and Cox 1974:221), while others have suggested a definite correlation (Engelbrecht 1979:5; Kay 1975:68; Washburn 1978:112–19; Washburn and Matson 1980).

In some of the latter cases, however, a statistical measure of the strength of the correlation suggests little relationship between the variables. For example, Washburn and Matson (1980) have suggested that one of their analyses revealed a close approximation between the geographical distance among a set of nine sites in the northwestern New Mexico area of the American Southwest and their stylistic distance as measured by their similarity in frequencies of ceramic design symmetry classes. They suggest (1980) that this was a result of groups interacting most intensively with adjacent populations. However, if a Pearson's correlation coefficient is calculated between the stylistic and geographical distances measured on the maps that they provide (Washburn and Matson 1980: Figures 3 and 6), the value of the coefficient is only 0.19 which is not statistically significant at the 0.05 level. Similarly, Washburn (1978:112–19) has argued that frequencies of ceramic design symmetry classes from the El Morro area of New Mexico are more similar to such frequencies in the nearby Upper Gila area than the more distant Salmon area, and this pattern is attributed to greater interaction between potters who live closer to each other (Kintigh 1979:59; Washburn 1978). However, Kintigh (1979:59) has noted that for two of Washburn's four symmetry indices the Salmon and Upper Gila areas are more similar to each other than to ceramics from the El Morro area despite the greater distance between the former areas.

An additional characteristic of those cases for which a relationship between geographic distance and stylistic similarities has been supported is that sites more distant than 30 to 40 kilometers are included. The relationship between the variables for sites located closer than such distances is not considered in these studies (e.g., Kay 1975) or does not appear to be strong (e.g., Engelbrecht 1979). However, many studies of actual interaction patterns (e.g., Olsson 1965) have shown decreases in interaction frequency over smaller distances, such as 5 kilometers or more. Thus, the proposed stylistic similarity–interaction relationship again is not supported.

A second problem with the stylistic similarity–interaction relationship is illustrated by a comparison between ceramic design similarities among prehistoric communities in a single valley, the Hay Hollow Valley in east-central Arizona, and design similarities among rooms within a single community, the Carter Ranch Site, in that valley. A discussion of these data is given in two papers by Longacre (1964a, 1970). It is clear from the following statements that those who have proposed the relationship between stylistic similarities and

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interaction intensities would expect that rooms within a single site would have more similar ceramic designs than would two separate communities.

Closer bonds might be created through more intimate contact among the villages of a single valley . . . There may be more similarities in shared elements of design among the pottery of these villages when compared to the ceramics of other villages in neighboring valleys. Below this level of analysis would be the ceramics of the village. We may discover an accepted style of design common to a village within the broader sphere of the areal or “valley” tradition. If present, this village tradition would be based on intimate daily contact and would to some extent be kin-based [Longacre 1964a:28].

Most archaeologists seem to agree that these style zones reflect learning: potters watched and copied the styles of nearby potters. There is more shared information within settlements than between settlements, within settlement clusters than between settlement clusters and so on [Martin and Plog 1973:259].

These statements should hold for contemporaneous communities if the proposed relationship between design similarities and interaction is true, but it certainly should hold when the comparison, as in this case, is between similarities among a set of noncontemporaneous sites [according to dates in Martin, Rinaldo, and Longacre (1960, 1961a, 1964)] and similarities among rooms in a pueblo in which there is “only a weak case for temporal differences causing sample variation” (Freeman and Brown 1964:140). Histograms of the design similarities among sites and among rooms are presented in Figure 1.1. The similarity measure is Pearson’s  $r$ , and the coefficients were calculated using all 175 elements in Longacre’s design classification (1970) and all sites in the Hay Hollow Valley for which design frequencies are given in Martin, Rinaldo, and Longacre (1964). The mean for each set of similarity coefficients is indicated by the vertical dotted line. The histograms show that contrary to expectations, design similarities among different sites are higher than similarities among rooms of a single site.

Finally, as noted, both a high level of intersite stylistic similarity and a low level of intrasite homogeneity have been considered to be indicative of high intensities of interaction between communities as a result of the increasing diffusion of designs between villages with increasing interaction such as the movement of women upon marriage (Connor 1968; Engelbrecht 1974; Leone 1968; Tuggle 1970; Whallon 1968). However, the two measures have not covaried in the



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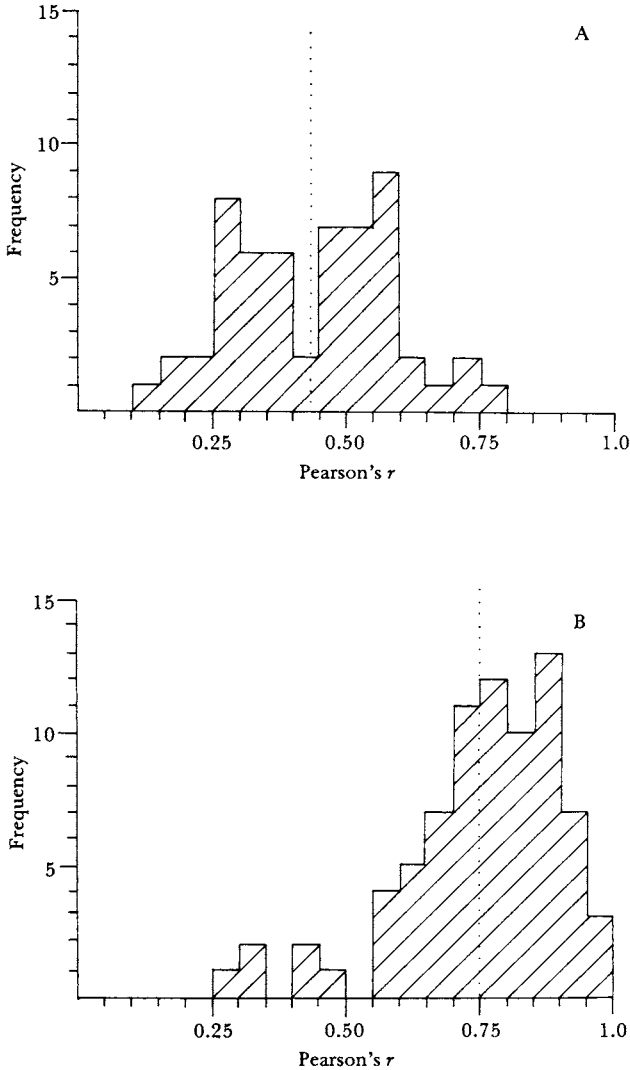


Figure 1.1. Histograms of similarity coefficients among rooms in the Carter Ranch Site (A) and sites in the Hay Hollow Valley (B).

expected manner. Whallon's (1968, 1969) studies of stylistic variation in twelfth century through fifteenth or sixteenth century ceramics from New York State showed that while the level of style homogeneity increased through time, intersite similarity also increased. In an additional study of sixteenth and seventeenth century ceramic designs from New York State, Engelbrecht (1974:57–9) found no patterned covariation between within site homogeneity and intersite

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similarity. Intersite similarity tended to increase while intrasite homogeneity did not consistently increase or decrease. In the American Southwest, Leone's (1968) and Connor's (1968) studies showed increasing village stylistic homogeneity at a period of time for which Tuggle (1970) found increasing intersite design similarity. Thus, the predicted relationship between intersite stylistic similarity and intrasite homogeneity has not been supported empirically.

Whallon (1969:15) has explained the covariation of intrasite homogeneity and intersite similarity in his data in the following way:

As long as all communities share a common pool or repertoire of frequent and rare elements, which is maintained through communication or more strongly through the actual movement of women, an increase in . . . homogeneity will produce an intensification of the frequency or rarity of elements in the repertoire and thereby bring about a more or less automatic increase in similarity between sites.

However, this statement is not consistent with an earlier proposal by Whallon (1969:15).

Increasing internal homogeneity of assemblages in terms of discrete stylistic elements may thus be seen as a result of the influence of [two] factors . . . which restrict, in a regional and within-community sense respectively, the range of variation to which a girl is exposed in the constant and regularly repetitive manner necessary for definitive habit-formation in the learning process.

If all communities initially share a common pool of stylistic elements, then why should decreased interaction among villages result in a decrease in "the range of variation to which a girl is exposed"? The first statement assumes that the range of variation is the same within all communities whereas the second assumes that it is not. Furthermore, if all communities share a common pool of frequent and rare stylistic elements, then they should be highly similar initially. Increased homogeneity should not increase this similarity.

In addition to the expected pattern of covariation between intrasite stylistic homogeneity and intersite similarity, another test implication of the proposition that stylistic variation is determined by interaction intensities is that as intrasite homogeneity changes, overall regional homogeneity should remain constant. The same number of design traditions should exist in the region, but as interaction between villages decreases, these design traditions diffuse less and become more restricted to individual villages. Also, as intrasite homogeneity increases in an area, it would be expected that the level of homogeneity would be more than the degree of homogeneity within