

TESTING A TRADITIONAL TYPOLOGY USING CLUSTER ANALYSIS

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Cluster analysis is used as a grouping device to test whether vessels classified by a traditional typology will in fact group as predicted by that typology. The whole vessel data is drawn from two Mississippi sites in eastern Arkansas. Results indicate that Parkin Punctated may be a valid type despite differing assumptions of the cluster analysis and the traditional typology. Old Town Red and Carson Red-on-Buff, however, are not separated by the cluster analysis. Furthermore, the cluster groupings show the two above types to be sub-groups of Neeley's Ferry Plain rather than a separate type.

Introduction

In an earlier study (Green 1974) we explored various groupings of Mississippi ceramics using cluster analysis. That study suggested several additional research possibilities (Green 1974:89) using cluster analysis. This paper extends the earlier effort and uses cluster analysis to further test the Phillips, Ford and Griffin (1951) typology of Mississippi ceramics.

The data base for this study consists of 549 whole ceramic vessels from the Hazel and Togo sites eastern Arkansas. Samples are drawn from the data base for each of the four tests contained in this paper. Attribute analysis of the vessels was conducted by the writer under the direction of Dr. Charles R. McGimsey III at the University of Arkansas in 1964-65 (McGimsey and Green 1965). Fifty-four attributes were observed for each vessel using a standardized coding procedure. Details of the data base are found in Green (1974: chapter III). A list of the attributes may also be found in Green (1974: appendix 1).

The cluster program used in this study was written by the Taxometrics Laboratory, University of Colorado under the general direction of Dr. David J. Rodgers. It was modified by Carol Good, Arizona State University Computing Center and the analysis was run on the ASU, CDC 6400 computer. All results are in Q-mode and the clustering is single-link.

Our earlier work has shown a likelihood that part of the Phillips, Ford, and Griffin typology might be substantiated using the cluster analysis technique (Green 1974:83). However, due to the large number of plain vessels (480) vs. decorated vessels (69) in the earlier runs the decorated vessels were often obscured. This paper overcomes that problem by using samples of equal size for testing cluster groupings of plain vs. decorated vessels.

The purpose of this investigation is to test whether cluster analysis will form groups of ceramics which are identical or highly similar to the Phillips, Ford, and Griffin (1951) typology. Four specific tests are made in an effort to elucidate the above proposition. Test 1 is a cluster of 69 decorated vessels. Test 2 is a cluster of Old Town Red with Carson Red-on-Buff vessels. Test 3 is a cluster of Old Town Red-Carson Red-on-Buff with Neeley's Ferry Plain. And Test 4 is a cluster of Parkin Punctated with Neeley's Ferry Plain.

Assumptions

The reader should be aware of the following assumptions which bear on the four tests.

1. Use of single link clustering. Cowgill (1968) and Hodson (1970) prefer various forms of multiple link clustering (average link, k-means, etc.). However, single link clustering was used as no computer processing using some multiple link technique was available. Whether or not multiple link clustering would change the results of this study needs to be examined.

2. Q-mode analysis. All four tests are made in Q-mode which means that in all cases it is the vessels themselves which are being grouped on the basis of the 54 attributes. The attributes (R-mode) are NOT grouped.

3. All 54 attributes used in the study are equally weighted. This technique has been criticized by Whallon (1971) and defended by Sokal and Sneath (1963). Equal weighting must be assumed in all four tests since the statistic which computes the C-value does equally weight all valid attributes. The formula for computation is:

$$S_{a,b} = \frac{\sum_{i=1}^n (K_{a,b})_i}{N}$$

For a fuller discussion of the assumptions used in the cluster analysis see Green (1974:37-38) and Smith (1971:13-14).

4. We assume that Dunnell (1971:171-184) is correct when he points out that cluster analysis is a grouping rather than a typing device. We will, therefore, always refer to units formed by the cluster analysis as groups of vessels. Phillips, Ford, and Griffin's units will be called types following their usage.

5. When the data were gathered in 1965 they were controlled from the Phillips, Ford, and Griffin (1951) typology. Since then Phillips (1970) has recast the entire typology into the type-variety system. We will continue with the 1951 terminology under the assumption that the reader can easily relate this to the new 1970 classification if he desires.

6. The Phillips, Ford, and Griffin typology was constructed using potshards while the cluster analysis is conducted on whole vessels. The attribute data base for the cluster analysis is, therefore, much broader.

7. Hierarchical clustering is used so that all vessels eventually form a single group.

8. The data is drawn from only two sites Hazel (3PO6) and Togo (3CS24) in eastern Arkansas. The vessels are all mortuary offerings and do not represent the full range of Mississippi ceramics.

For information purposes it is noted that the vessel numbers listed in Figures 1-4 along the top of the tables and in the text are those given in Green (1974). The specific attributes of each vessel may also be found in Green (1974:appendix 2) under their vessel numbers. The numbers down the left hand side of Figures 1-4 are the C-values at which the vessels group.

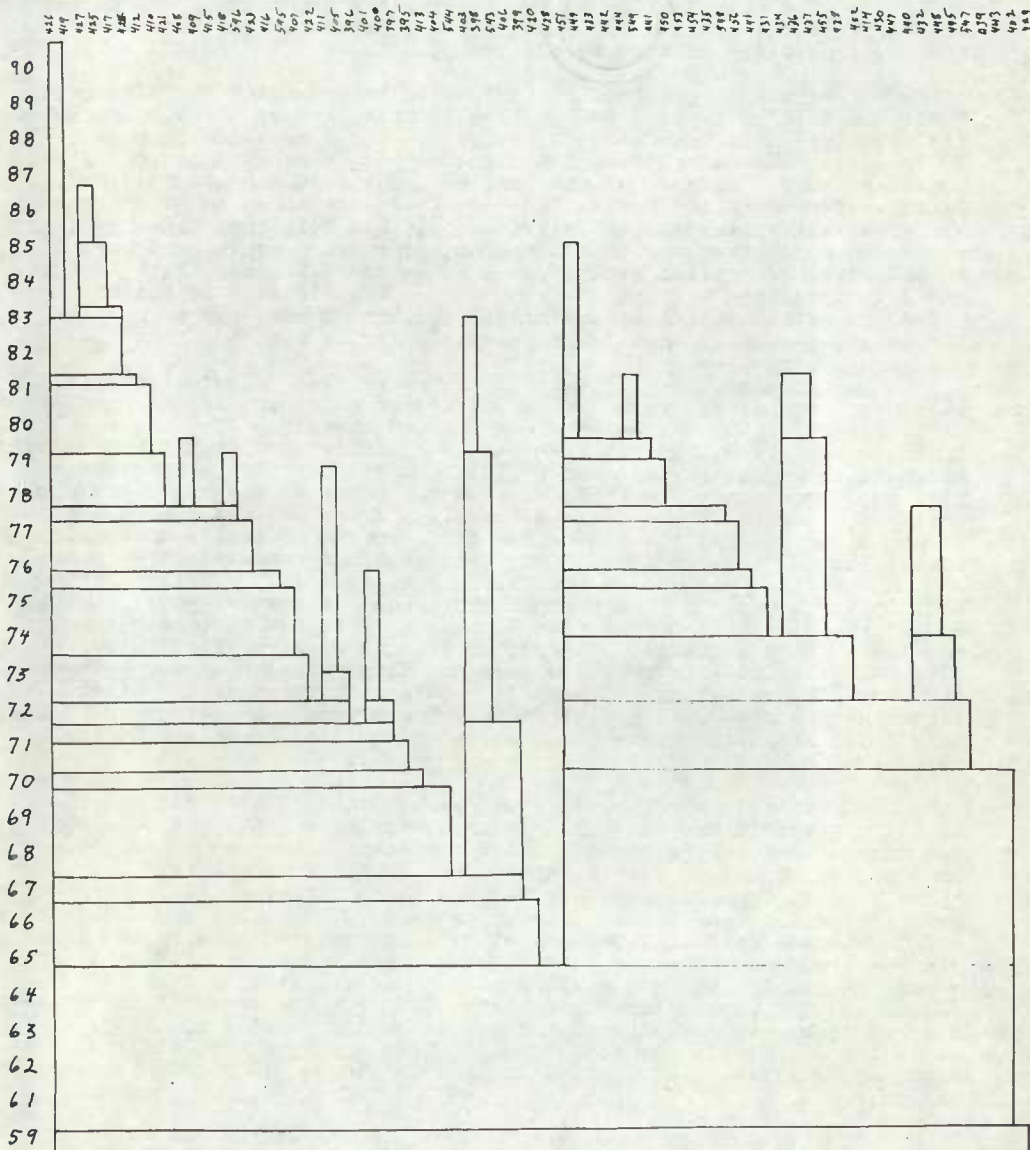


Figure 1 - Extra die decorated essels.

## Tests

Each test was performed by: 1. searching the computer output for the C-values of every mutual pair of objects (vessels) in the test; 2. entering these values in a matrix; and 3. constructing a SKYLINE plot (cluster) using the single link technique. Computer processing for steps two and three was not available for this study but would normally be done automatically.

Test 1 was performed on 69 vessels representing 10 Phillips, Ford, and Griffin types. Of these only three types: Parkin Punctated (19 vessels): Old Town Red (12 vessels): and Carson Red-on-Buff (10 vessels) had enough vessels in the sample to warrant serious consideration. Because of the earlier study in which Old Town Red, Carson Red-on-Buff and Nodena Red-and-White were shown to have strong overall similarities (Green 1974:80-81) it was felt that these vessels would group together and that a second major group would be formed around Parkin Punctated with types such as Ranch Incised, Kent Incised, and Barton Incised as part of the group. Vessels such as Fortune Noded and Vernon Paul Applique might separate themselves out but low sample size (1 and 2 vessels respectively) would preclude this.

Our proposition for Test 1, therefore, is: cluster analysis will group the 69 decorated vessels into two major groups one consisting of incised vessels and the other of painted vessels. The three applique vessels will group with one of the first two at a low C-value. Figure 1 shows the results using a SKYLINE (rather than a dendrogram) plot and demonstrates that the proposition holds. The major group on the left consists of the incised vessels and the major group on the right is the painted vessels. The three applique vessels do enter the cluster at low C-values. The Fortune Noded vessel (428) groups with the incised vessels as the last object to join. The two Vernon Paul Applique vessels join the painted group one (vessel 429), at the end of the cluster and the other (vessel 430) in the first gap from the left. A significant subgroup consisting of five vessels (403, 398, 543, 406, 399) is formed within the large incised group. These five vessels are Barton Incised (4) and Ranch Incised (1). Given a larger sample size they may separate out and form a better group. Or, they could simply be viewed as a subgroup ("variety") of the incised vessels.

On the basis of the earlier study (Green 1974:80-81) and the Test 1 cluster it was not possible to determine whether Old Town Red and Carson Red-on-Buff. showed sufficient distinctiveness to be placed in separate groups. Test 2, therefore, was designed to test only those vessels typed as Old Town Red and Carson Red-on-Buff. Our proposition for Test 2 is: cluster analysis of Old Town Red (13 vessels) and Carson Red-on-Buff (10 vessels) will produce two groups, one of Old Town Red and the other Carson Red-on-Buff vessels. Figure 2 shows the results using a SKYLINE plot. Only a single group is formed and the proposition does not hold. For the reader's information the two types are distributed through the entire cluster. Thus, While the 23 vessels are separated into two types by the Phillips, Ford, and Griffin typology they are only a single group using cluster analysis.

In our earlier study (Green 1974) the relationships between the decorated types and the plain type Neeley's Ferry was obscured due to the large number (441 of 549 vessels) of Neeley's Ferry Plain vessels. The decorated vessels tended to distribute themselves through the entire cluster with only an occasional small group forming often near the end of a cluster. The following tests (3,4) cluster equal numbers of Neeley's Ferry Plain vessels with the decorated

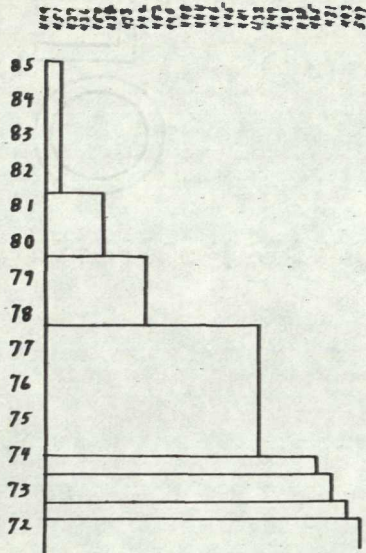


Figure 2 -- Old Town Red and Carson-Red-on-Buff.

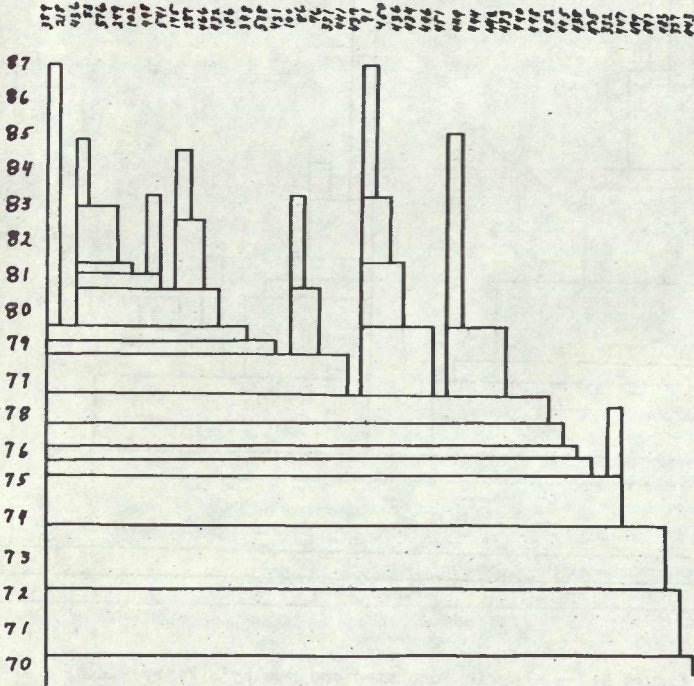


Figure 3 -- Old Town Red/Carson Red-on-Buff and Weeley's Ferry Plain.

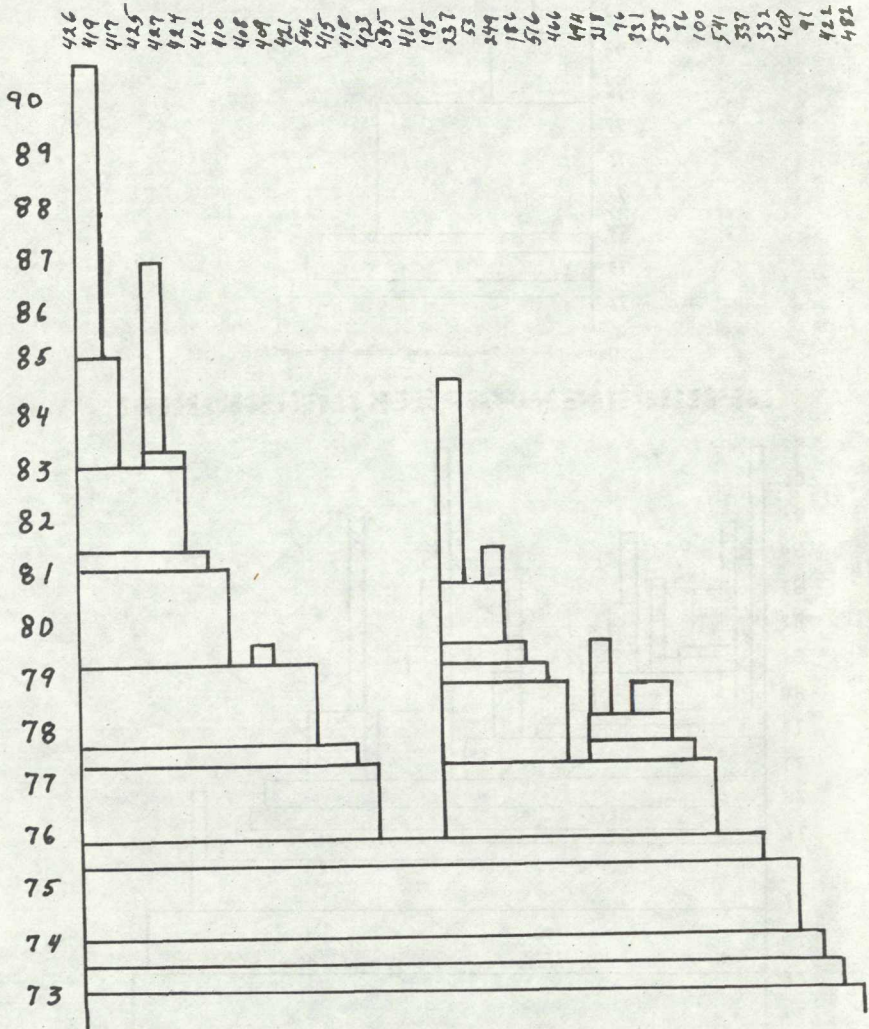


Figure 4. -- Parkin Punctated and Neeley's Ferry Plain.

types. The Neeley's Ferry Plain vessels were chosen using the random number table in Blalock (1960).

Our proposition for Test 3 is: cluster analysis will group the 23 Old Town Red-Carson Red-on-Buff vessels into a group separate from 23 randomly selected Neeley's Ferry Plain vessels. Figure 3 shows the results using a SKYLINE plot. A single group is formed with two strong sub-groups. All of the vessels in the sub-groups are from the OTR-C/RB types except for vessel 91 which is Neeley's Ferry Plain. Note that vessel 91 clusters with vessel 437 (OTR) with a C-value just as high as the highest two Neeley's Ferry Plain vessels (389, 218). Proposition 3 is NOT confirmed.

Our proposition for Test 4 is: cluster analysis will group 19 Parkin Punctated vessels into a group separate from 19 randomly selected Neeley's Ferry Plain vessels. Figure 4 shows the results using a SKYLINE plot. Two good groups form the one on the left consists of 17 Parkin Punctated vessels and the one on the right consisting of the Neeley's Ferry Plain vessels. The other two Parkin Punctated vessels (407, 422) drop in at the end of the cluster. The proposition is upheld.

#### Discussion

Dunnell (1971:184) has pointed out that the proper role for clustering techniques, "lies in the generation and testing of hypotheses about classes, not in the construction of the classes". In this paper we have used cluster analysis in just that fashion. Vessels which have been placed in Phillips, Ford, and Griffin's "classes" (types) have been tested with cluster analysis to see if they group according to the proposed classification. In so doing it must always be kept in mind that the assumptions under-lying the Phillips, Ford, and Griffin classification and the cluster analysis are different. The former do not weight attributes equally and they based their classification on shard attributes. The cluster program does weight each attribute equally and the attributes are derived from whole vessels. Since a different set of assumptions are operating it can be argued that none of the classification should be confirmed. Nevertheless it was possible to separate the incised from the painted types and the Parkin Punctated type was confirmed. In the latter case the reader is reminded that the analysis was run using the full 54 attributes available. Only the three attributes which describe the punctated decoration are known to influence the grouping. Others of the 51 remaining attributes must be involved in the separation suggesting that more than the decoration is responsible. At this point we would speculate that form is involved. This can be tested by running an R-mode (attribute) cluster.

The failure of cluster analysis to separate Old Town Red and Carson Red-on-Buff from each other nor effectively from Neeley's Ferry Plain suggests that the differences in the assumptive position is responsible. Looking at the problem from the other way about it appears that the cluster results would support a classification which would establish a basic plainware type with one or more painted varieties. At this point the analysis argues for the separation of the incised vessels into a separate class or type. However we do not want to yet rule out the possibility that they are similar to the painted vessels. That is, basically a plainware type with an incised variety. Such notions can be tested in the future using our data base and cluster analysis.

The cluster technique has proven and, we believe, will continue to prove useful in ceramic analysis.

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