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INTERFACING THE PAST

COMPUTER APPLICATIONS AND QUANTITATIVE METHODS IN ARCHAEOLOGY CAA95 VOL. I

EDITED BY
HANS KAMERMANS AND KELLY FENNEMA

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The use of correspondence analysis for different kinds of data categories: Domestic and ritual Globular Amphorae sites in Central Germany

1 Methodological assumptions

Usually in prehistoric archaeology the application of seriation methods aims at the detection of continuous, normally distributed changes within the material remains of the past. Primarily reciprocal averaging and correspondence analysis are used to separate chronological phases, spatial differences and functional developments (e.g. Baxter 1994; Ihm 1978; Madsen 1988). The analyst presumes the classical situation of a unimodally distributed innovation pattern: at the start of a development new types or influences are represented only by a small number of artefacts out of the total. In the middle of the type's history an increasing production rate is visible. In a third and last phase the 'old fashioned' tools or decoration types are once again represented by small numbers, and finally no indication of the type remains.

I would like to name this simple approach a 'battleship' paradigm (compare Ford 1962). It combines the idea of a standardisation of human behaviour with a functional approach to the detriment of the influence of many different depositional processes.

Nevertheless, this paradigm had a huge impact on the use of correspondence analysis in archaeology. Because the first and second eigenvectors form a parabolic curve in the case of normally distributed data ('a horseshoe'), many analysts are acquainted with the manipulation of their data input: we are producing 'horseshoes' and discounting types and values which destroy the clear symmetric structure of our thinking and our results.

However, we have to admit the following mismatches:

1. The innovation of new techniques, new symbolic expressions or new ritual approaches to life produces a wide variety of expression in material culture. There might be a normally distributed representation over time, but there might also be an abrupt appearance of many artefacts at the beginning, a few in the middle and again many at the end of a development. Ethnoarchaeological case studies describe so many different distribution patterns of artefact types during time that do not have anything in common with unimodal models (Hodder 1982; Pétrequin/Pétrequin 1993). We might term this the 'effect of multimodal appearance'.
2. For example the acceptance of changes might be different in prehistoric communities, which produced the material remains of our case studies. Hence, the results are a nonlinear representation of conservative and non-conservative activity areas of our spatial record. Thus the 'spatial effect of activity areas' disarticulates the archaeologically available data.
3. Especially non-industrial societies handle artefacts in different ways, dependent on spheres of intercommunication. In the sphere of production artefacts have different distribution patterns from the ritual sphere of burial. Household organisation has a different distribution than the communal order. As a result, the handling of artefacts is non-normally distributed due to the 'effect of social spheres'.
4. To concentrate on funeral sites, the distribution of artefacts in single graves might be different, or analogous to contemporaneous burial customs of the same community. The burial items might be a representation of the goods which were available during the lifespan of the dead person. Or they might be especially produced for the day of the funeral ritual and represent the production options of daily work, or they might be the personal gifts of members of the funeral party to the deceased. The multiple possibilities for variations in funeral rituals, which are practised today by small non-industrial communities, are just as probable for prehistoric societies. Again, a non-normal distribution of artefacts is the result of this 'effect of burial variability'.
5. Last but not least, depositional processes are responsible for non-normal distributions. For example the fill of Linearbandkeramik pits might represent the original assemblage that was deposited as rubbish by the community in a period of less than fifty years. As no earlier ceramic-producing community lived on LBK-sites, the fill usually lacked non-LBK ceramics. But on sites where domestic activities took place for centuries, the fill of pits is full of pre-pit remains. The assemblages cannot represent normally distributed patterns but only skewed curves. We call this the 'effect of passive rubbish'.

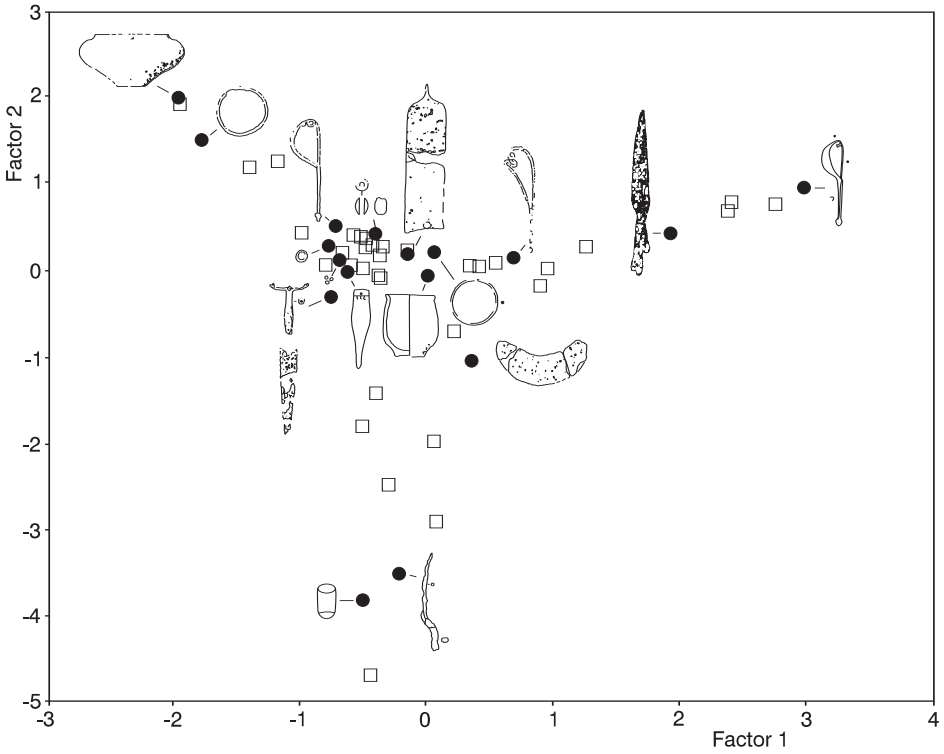

Figure 1. Scatterplot of the 1st and 2nd CA-eigenvectors for Hallstatt male burials of the Magdalenenberg, Southwest Germany.

6. Another effect, which probably destroys a 'horseshoe' in the mathematical representation, is the problem of interregional contacts. Interregional seriation was ironically called the 'Doppler effect in archaeology' by Deetz and Dethlefsen (1965) or the 'Horizon distortion effect' by Bakker (1994). 'This effect is caused by the fact that the propagation of style features over large regions takes time, and takes often different speed... While assuming that similarly styled, locally made pottery has everywhere the same date the researcher grossly distorts the chronological perspective' (Bakker 1994: 66).

As a result, artefact assemblages must not be seen as the residuals of a single closed system, where a closed archaeological system is defined as an archaeological deposit that can be precisely described in terms of units of time, location and type of deposit. Artefact assemblages represent open systems, which are significantly influenced by different channels of information on prehistoric societies and are affected by different depositional and post-depositional processes.

Obviously, the patterning of prehistoric material is not necessarily 'unimodal'. The majority of artefact deposits are not normally distributed in time and space. Therefore, we cannot test for and should not manipulate our data to form a 'horseshoe'. But at the same time they are not necessarily randomly distributed.

The interpretation of eigenvectors should therefore be done without any manipulation of the data, following an idea of Djindjian, which he expressed in 1985: the residuals from any predicted normal distribution pattern constitute a large quantity of information about prehistoric societies: every kind of figure, which appears in scatterplots of eigenvectors, may indicate unique approaches to prehistoric processes, e.g. divergence, double evolution, breaks etc. (Djindjian 1985).

An example of such a non-random distribution and functional variability, which is observable in the CA-eigenvectors, is displayed for the male graves of the Magdalenenberg, West Germany (Müller 1994: fig. 26). The scatterplot shows a threefold pattern (fig. 1): Factor 1 separates the burial items on different arms and fibulae, which on the one hand describe graves without weapons but which include ceramics, and on the other burials with daggers and lances. Factor 2 separates the graves with fibulae from graves without fibulae, but instead with iron needles and miners hammers. As the pattern contradicts chronology, it is probable that sociological differences between richly and poorly equipped male graves as well as different male roles are reflected.

With such an approach in mind, the author would like to analyse Globular Amphorae sites of Central Germany and tackle the results of correspondence analyses.

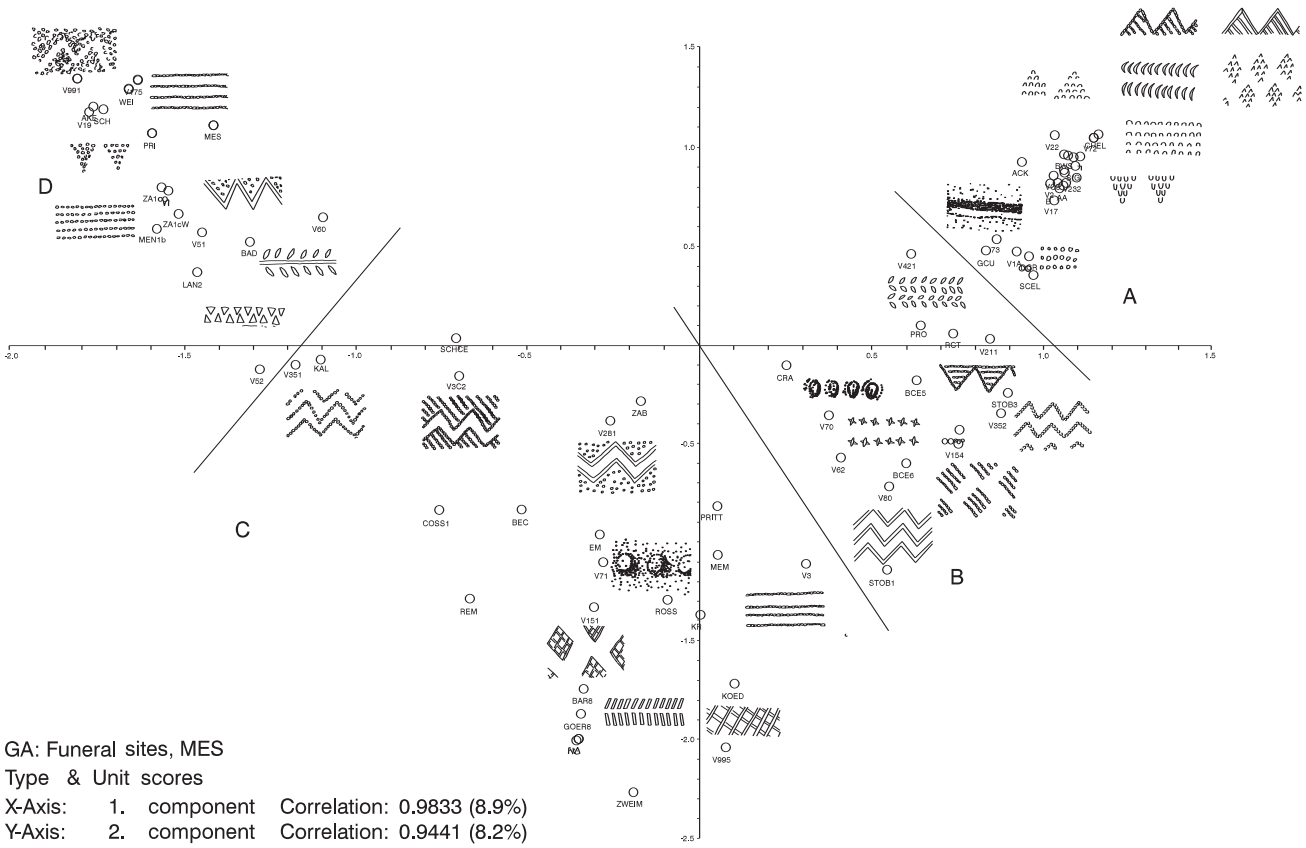

Figure 2. Scatterplot of the 1st and 2nd CA-eigenvectors for Globular Amphorae burial sites. The decoration motifs describe four assemblage groups A-D.

2 Central German Globular Amphorae

During the Neolithic, Central Germany displays regional traditions of social differences, which are discernible in settlement hierarchy as well as in grave construction. Within such a framework wider influences play an important role (Beier/Einicke1994). Until now, the representation of such widespread phenomena as Corded Ware pots or Globular Amphorae has not been investigated in detail with respect to the contemporaneous local and regional substrata. In this paper I would like to discuss results of CAs, which are prepared for Globular Amphorae (GA) sites.

Apart from Bernburg-Walternienburg, the earliest phase of Corded Ware and the latest Alttiefstich and Salzmünde Globular Amphorae are present in different kinds of funeral and domestic sites between 3200 and 2600 cal BC. While Globular Amphorae represent a general phenomenon of Late Neolithic societies, which spans from the Ukraine to the western Baltic sea, clear differences are observable from region to region (Nortmann 1985). Until now a chronological differentiation of GA has not been demonstrated by research. Interaction with Bernburg has been discussed, but not explained (Beier 1988: 40-46). Yet, important inter- and intraregional differences are on record.

Correspondence analysis was chosen to investigate the similarities and dissimilarities, firstly between the decoration pattern of the assemblages of single and multiple burial sites, including cattle graves; secondly, between the assemblages of domestic structures, mainly pits; thirdly, between both domestic and funeral sites in a combined seriation. It was hoped to discover a relation between ritual and domestic sites. With respect to the basic assumptions, non-continuous results were expected along with normal distributed artefact patterns.

3 The recording system for decoration

Until now, Globular Amphorae pots of Central Germany have been analysed only by classification systems that underline the connection between pot shape and decoration and interrelate decoration patterns in a hierarchical order (Beier 1988; Meyer 1993). In this study I prefer a classification system that decodes the ornamentation as independent, equally weighted design elements. These

elements appear on every shape and — ideally — in every position on the pot. 93 design motifs were classified, and their presence stored in a data bank for each assemblage.

4 CA of the Globular Amphorae funeral sites

For the purpose of the analysis, only closed or nearly closed assemblages are used. From 177 sites with 204 funerals only 66 single, multiple or cattle graves fulfil the condition that they are not disturbed by later intrusions and/or are properly reported. The correspondence analyses describe a 'horseshoe structure' for the first and second eigenvectors (fig. 2). By the exclusion of vertical line ornaments, the first component has a correlation of 0.98, the second of 0.94. Four clusters of decoration elements and corresponding assemblages are detectable in the graph: assemblage group A with a high degree of curved and angular dots; B with angular bands and diamonds of corded lines; C with incised diamonds and D with punctate decoration, e.g. triangles.

What do the clusters indicate? Stratigraphies and mixed assemblages of GA sites with older and younger Bernburg or Corded Ware prove the chronological character of the observed sequence with A being the oldest and D the youngest association. Based on C14 dates this development starts around 3200 cal BC and ends around 2600 cal BC (Müller in prep.).

Beside the chronological effect, other differences are visible, if we plot special aspects of artefact distribution into the graphical display. For example the third eigenvector shows different loadings, especially concerning cluster D (fig 3). The burial association helps us to describe lower loadings of Factor 3 as a representation of multiple burials, whereas higher loadings are mainly of single burials. Furthermore, some chronological order of the funeral rites is visible: cattle graves only appear during the phases A, B and C, while double and multiple burials are only known from C and D. Similar developments are visible with items or indicators of ritual behaviour: the range of the number of associated vessels is the highest in A, the lowest in D (fig. 4). In A-C parts of cattle are deposited in human graves, in C-D only caprovids. The range of the number of adzes in A is higher than in D. Otherwise, no differences are visible with respect to sex or age. All results mentioned have been tested with the χ^2 and Fisher's F test.

In summary, the sequence reflects the socio-chronological development of the Globular Amphorae society or of the practice of Globular Amphorae funerals within a regional social framework: the process starts with elaborated differences of grave furniture and the rite of cattle graves. It changes around 2800 cal BC to the practice of rather less 'expensive' sheep/goat associations, a reduction of the differences between grave items and an emerging practice of double and multiple burials. Perhaps the change to Corded Ware graves that started around 2800 cal BC in

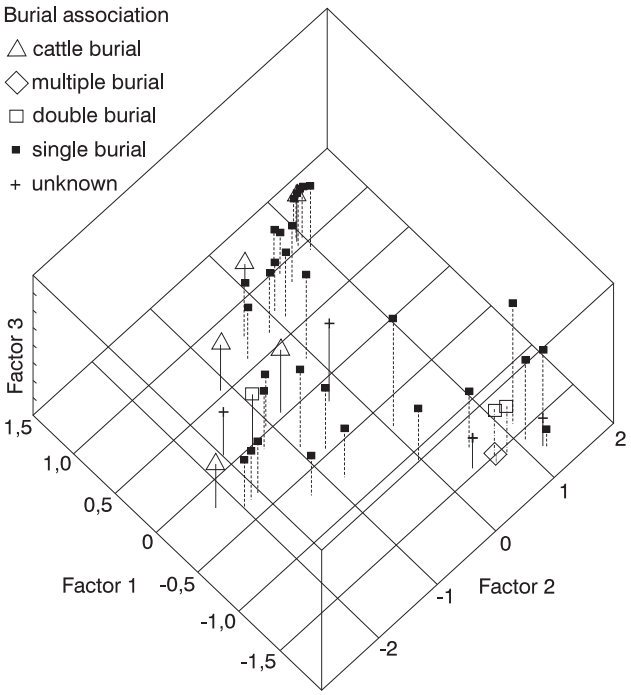

Figure 3. Plot of three CA-eigenvectors for Globular Amphorae burial sites. Different burial associations are indicated.

Central Germany represents a new ritual system of status expression during the funeral rite for important members of the communities.

5 GA ceramics in domestic structures

There are only a few settlements where GA forms the only ceramic tradition. Normally, GA ceramics are found on Bernburg sites (Beier 1988). In all, only 40 pit structures have been evaluated as 'geschlossene Funde' (closed finds). Although only 30 sites are useful for the analyses, a clear sequence appears within the ordered matrix of the first eigenvector. The scatterplot of the first and second eigenvectors (not illustrated) does not display a horseshoe, but a 'cloud' along the first axes. Still three clusters of pottery design are visible: SA with incised diamonds, partly with curved and angular dots, SB with partly curved and angular stabs and plastic decoration and SC with angular bands. Again, the association of mixed assemblages and the stratigraphic order at Görschen (Beier 1988: 132) point towards a chronological interpretation.

6 GA: Domestic and funeral sites

The common seriation of both domestic and funeral sites with GA has a twofold problem: on the one hand the two types of sites possess different depositional histories that result in different qualities of chronological closeness. On

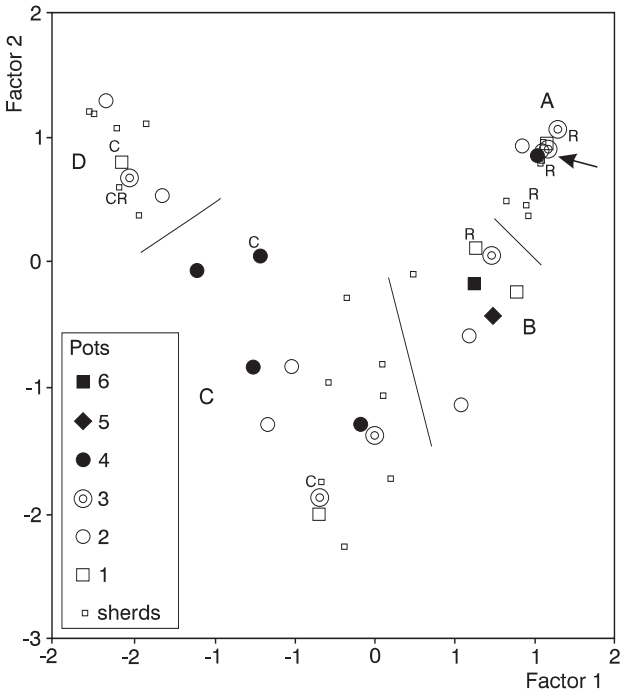

Figure 4. Scatterplot of the 1st and 2nd CA-eigenvectors for Globular Amphorae burial sites. The number of pots per grave, bones of caprovides (C) and cattle (R) and the burial with the highest number of adzes (arrow) are indicated.

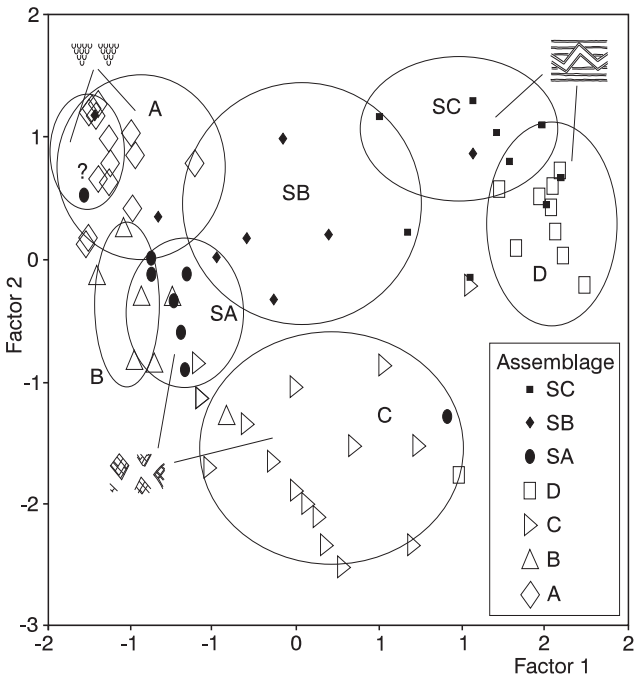

Figure 5. Scatterplot of the 1st and 2nd CA-eigenvectors for Globular Amphorae burial (open symbols) and domestic (filled symbols) sites. The assemblage groups and some characteristic decoration motifs are shown.

the other hand the change within the social life of things, here perhaps the change of symbolic expressions used on pottery may lead towards a different value of things.

In spite of this there exists the chance to investigate the mode of symbolic change within the society or at least a part of the society.

The result is displayed in figure 5. Again we find the horseshoe structure of funeral sites with their sequence of decoration clusters and the stretched structure of the domestic assemblages with their sequence of domestic clusters. It seems interesting that the sequences overlap and are correlated, because parts of the domestic dots form a part of the parabolic structure.

We observe the following sequence:

1. The funeral A group and two domestic sites represent the beginning of the common sequence with motifs of curved and angular dots.
2. The domestic SA group with incised diamonds follows along with the funeral B group on the parabolic structure, followed by the funeral C group with incised diamonds.
3. As a parallel the domestic B group is contemporary with the funeral C group. It is of interest that the assemblages with angular and curved stabs are distributed with negative values, while those without these attributes have positive values.
4. The funeral D group and the domestic C group form the final part of the sequence on the right hand side.

There is no question concerning the chronological order which appears here. Obviously, the interrelation of symbolic expressions is different in domestic and funeral sites. While 'Bogen/Winkelstich' is no longer used in funeral rites, it is still present on some domestic sites. In contrast, incised diamond motifs first appear on domestic sites and are later introduced (and restricted) to the funeral sites.

7 Conclusion

Having equipped ourselves with a time scale, we can turn to the question: what happened? Obviously, the changing role of ceramic decoration is visible in the distinction between domestic and funeral pottery. The denotation of the symbolic expression of the ceramic decoration changes. Perhaps this is related to the changes of ritual behaviour within the GA sequence and the appearance of Corded ware.

With respect to methodology, correspondence analyses of different site categories can be applied for the modelling of such changes.

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