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Numerical techniques for burial analysis

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26.1. Introduction

In any analysis of burials, a multidimensional framework will be required: examining only one mortuary dimension, such as grave goods, would disregard potential relationships within and between other dimensions, such as skeletal position and the age/sex of individuals, and artefacts. What will be of interest are the ways in which social and ideological relationships might be articulated in the burial ritual, reflecting both the role of the living and the nature of the deceased as well as the affinities between each party and their attitudes towards death. This paper discusses an approach developed in a recent study of early Anglo-Saxon inhumation burials (Huggett 1992) and provides an indication of the type of results which were achieved.

26.2. The background

Apart from the functional aspect of burial as a means of corpse disposal, a burial is likely to operate on two primary symbolic levels:

- the relationships between the two parties involved in the ritual — the living community and the deceased.
- the ideological relationship of both parties to death and an afterlife.

A burial may incorporate certain stylistic aspects (Huggett 1992, pp. 86–87) such as:

- ***emblemic*** (group affiliation, family and/or community identity).
- ***assertive*** (individual identity; personal or individualistic elements).
- ***magico-religious*** (beliefs relating to death and an afterlife).
- ***intrusive*** (features related to the burial party rather than the deceased).
- ***uncoordinated*** (unexplained features arising through diverse agencies including post-depositional alterations both before and after the actual closure of the grave).

These aspects can be summarised under two main categories:

- ***group-oriented*** — emblemic, magico-religious, intrusive; relating to the burial party and community at large.
- ***individualistic*** — assertive, uncoordinated; elements specific to the deceased, representing their relationships, social identities, status, and so on.

The cemetery or regional set of cemeteries consist of an amalgam of such individual decisions and activities — patterned behaviour at the cemetery or regional level represents the series of separate but similar or identical decisions made by the people doing the burying. Consequently, any conformities identified at the cemetery or regional level may represent to some extent the more group-oriented aspects of burial — mystic and emblemic elements in particular — which may in turn be identified as age or sex differentiation, and/or other factors such as family, social, or group membership. Furthermore, it may be possible to identify the nature and degree of the social relationships from the degree of individual conformity both within and between cemeteries. In addition, the identification of non-conformities is likely to be equally significant in archaeological terms. These have been largely ignored in mortuary studies, but aberrant features, rather than conforming ones, may represent the aspects of the burial which set the individual apart (assertive or intrusive elements, for example). A crucial factor here is the recognition that each cemetery must be taken on its own merits.

26.3. A statistical methodology

This then is the framework within which the statistical tools were applied to the attributes in the Anglo-Saxon dataset — essentially age, sex, body layout and associated artefacts were those available given the nature and quality of the data. A series of steps which are applied to all cemeteries in the same way can be defined:

- First, any possible sex and age identifiers are isolated using a combination of bivariate and multivariate techniques.
- Secondly, the burials are clustered according to associated artefacts and body position where known. Using the results from stage one, it may be possible to identify groups of burials which are linked by the clustering methods to specific age/sex groups. Furthermore, each cluster will be formed of burials which share a common set of attributes, but it will also be possible to examine individual cluster members for attributes that do not contribute to the coherency of the group.
- Thirdly, factor analysis is used to examine the interrelationship of artefacts within the burials of each cemetery by generating a reduced series of artefact categories (factors) consisting of combinations of artefact types which are positively or negatively related to each other. These "new" artefact categories can then be used to re-examine the burials by clustering the factor scores (the loadings of each burial on the newly created types). The results may then be compared and contrasted with those from the simple clustering of artefact types generated at stage two.

As has been argued above, non-conformities should be seen to be of as much archaeological interest as the conformities, although these may not be statistically significant. Statistical significance cannot be seen as an end in itself — the demonstration of a significant correlation is not an explanation; it says nothing about the possible reasons for the correlation which in fact may be archaeologically spurious. In a sense, therefore, there is at times a difference between what is statistically significant and what is perceived to be archaeologically significant. For example, swords from a cemetery may be only found accompanying male burials, yet the number of swords and the number of burials may well mean that the relationship is not statistically significant even though it may be felt to be an archaeologically significant observation. Consequently, a pragmatic approach was adopted — statistical significance is used as a starting point for analysis, rather than as a rigid rule. This operated in two ways: not only was patterning which was not statistically significant noted archaeologically, but in some cases significant elements were been dropped in order to focus on those with greater levels of statistical significance. This clearly runs the risk of Type II errors (i.e. the acceptance of the null hypothesis that no significant relationship exists when in fact it does) but it is seen to be a necessary step in this case given the scale, quantity, and quality of the data under study. The level of significance adopted as a basepoint was the 5% level (0.05), although as has been recently pointed out (Castleford 1991), this has as much to do with custom as with any specific reason.

26.3.1. Tests of association

Simple bivariate analyses can provide the most useful means of assessing the variation of the burial treatment afforded to individuals, particularly in investigating the relationships between sex and age of individuals and the artefacts they were buried with. More complex analysis concerning the layout of the body, for instance, required the application of multivariate techniques which are discussed later. The bivariate methods are applied as the initial phase in a data exploration loop (Colley & Todd 1985, p. 5), leading to an investigation into the relationships between a series of burial attributes using multivariate statistics.

Although the chi-square statistic is the most commonly used test of association for nominal data, as has often been the case with archaeological data, it proved to be unsuitable on the grounds that the sparse data matrices resulted in large numbers of very low expected frequencies making the application of the test technically invalid. More significantly, perhaps, while the chi-square statistic may demonstrate the existence of an association within the table, it provides no indication of the strength, location, or direction of the relationship. One means of identifying the categories responsible for a significant chi-square value is through the examination of the adjusted residuals (Everitt 1977, pp. 46–47). However, since the chi-square test is itself invalid and there are large numbers of cells with low or zero counts, it seems unreasonable to place too much reliance on the analysis of residuals.

Simply demonstrating that a relationship exists between two variables is not enough — it is difficult to discuss the meaning of an association without knowing the degree to which one is predictable from the other and the accuracy of that prediction. For this reason, Goodman and Kruskal's Lambda statistics were used to provide an index of predictive ability, Thus, for example, it can be demonstrated that the sex of an individual can be predicted on the basis of the associated artefacts, but not vice versa. However, this is of relatively little use, since unless there is some indication of the location of the relationship, it cannot be stated with any certainty which of the artefacts can be used as predictors.

A technique which can indicate the strength, direction and location of a relationship within a contingency table as well as being applicable to small and sparse data sets is the Attwell-Fletcher simulation test (Attwell & Fletcher 1987). This technique was originally developed to test for the existence of a significant association between a point pattern distribution and a second variable (an analysis of the distribution of chambered cairns against altitude in the authors' case) and a modified version was used for burial data which allowed the user to specify the direction of the simulation in the light of the Lambda statistics. Weights are calculated for each category and their significance assessed using a simulation technique. A series of simulated weights are generated and their distribution used to obtain estimates of the required 5th and 95th percentiles (assuming a significance level of 5%). Actual weights which exceed the 95th percentile indicate a tendency to favour that particular association, whilst weights which are less than the 5th percentile indicate an inclination to avoid that specific combination. Since weights are calculated for each cell of the table, the location and strength of an association may be assessed, and as the simulation works either from columns to rows or vice versa, the direction of the association can also be identified.

26.3.2. Discriminant analysis of sex and age

The use of grave goods accompanying a burial to determine the sex of the individual is a well-known assumption, and the Attwell-Fletcher simulation technique discussed above was used to demonstrate significant artefact associations. However, the simulation makes no allowance for the possibility of multiple associations — combinations of certain artefact types which might be used to signify group membership. Furthermore, other variables such as orientation or body position might have been used to signify age or sex in a burial. Discriminant analysis was used to investigate such associations. This classifies cases into one of several mutually exclusive groups on the basis of various characteristics, and can be used to establish which of these attributes are important for distinguishing between groups. The analysis is based on a set of cases for which group membership is already known and uses a list of selected variables to form linear combinations that result in the "best" separation between the groups. Thus, discriminant analysis of sex and age within a cemetery can only be carried out using those burials for which the sex and age of the individual is already known, although the resulting model may subsequently be applied to unsexed or unaged burials in order to estimate their likely sex. Clearly there is a danger of circularity in that if, for example, burials were originally sexed on the basis of grave goods rather than skeletal characteristics, then discriminating between the sexes on the basis of the artefacts is of relatively little value — it provides a check of the original assignments and can predict the grouping of unsexed burials, but does not demonstrate the existence of a relationship between sex and artefact type other than that which was imposed by the excavator.

The value of discriminant analysis is the way it can be used as an exploratory tool — a variety of potentially useful variables can be submitted to several different analyses and the different models compared in order to determine those variables which are more or less important for group separation. However, the resulting model is not necessarily a good one: the discriminant function will include those variables which are good predictors of group membership but also some which are not, as well as some which may actually blur the distinction between groups. Consequently a step-wise analysis was used, in which only those variables which contribute most to the discriminant function are included, one at a time. Even so, a good discriminant model is almost bound to be obtained for many different combinations of variables if all the available cases were used to generate the discriminant function. So in order to test the reliability of a function, each cemetery was randomly divided into two groups — the discriminant function was generated using one of these groups and tested on the other. In this way the value of the model could be readily assessed — any function which did not perform considerably better than chance in discriminating between groups in the second sample was rejected, regardless of its performance with the first sample.

26.3.3. Cluster analysis of grave goods and body position

Cluster analysis procedures have been applied to data from individual cemeteries primarily as a means of data exploration. The classification of burials into groups sharing common sets of artefacts or body layout is considered to be a valuable approach having potential social, spatial and temporal levels of interpretation. However, since each cluster technique will result in different solutions to a greater or lesser extent when applied to the same data, a single, most suitable and robust technique had to be selected. Rather than choose a method on an *ad hoc* basis or use the default technique (average linkage (between groups) in SPSSX for instance), it was felt that it would be more useful to examine all available techniques before selecting one linkage method so as to strengthen the validity of the results obtained. A variety of methods of evaluating cluster solutions may be used (see, for example, Aldenderfer 1982; Aldenderfer & Blashfield 1984; Shennan 1988). One such approach is to analyse the data using a variety of different statistical methods. Indeed, this was adopted by O'Shea (1984) in his analysis of Plains Indian cemeteries, who argued that if the same or a complementary structure could be derived using different techniques, it would support the reality of the identified structure. Since both cluster analysis and factor analysis (below) of the same data is carried out in this study, it could be argued that this method is also adopted here, but as Shennan (1988, p. 230) notes, different solutions might arise from the different assumptions inherent in the methodologies as much as from any structure, or lack of it, in the data. Consequently, it was felt that an optimal cluster method should be identified independently of the other analyses in the study in order to increase confidence in any resulting structure.

In order to identify an optimal clustering method for each of the analyses, all available linkage techniques were applied to three cemetery data sets which had each been randomly divided into two groups. The resulting cluster solutions for each cemetery were then examined for their degree of replicability since the most suitable procedure should result in the isolation of similar clusters in the two partitioned samples. The linkage method which resulted in a solution with internally consistent clusters and a high level of replicability between the two random samples was considered to be the most robust method and was then applied to all cemeteries. Two sets of analyses were performed, one for grave goods, the other for body position, since it seemed unlikely that a method which performed well for one would be suitable for the other. (The detailed procedure and results of this analysis are in Huggett 1992, pp. 350–381).

Two different methods were identified as the optimal methods for each type of analysis: complete linkage for grave goods, and average linkage (within group) for body position. Given the criteria defined above, the success of complete linkage might have been anticipated — it is known to have a tendency to find relatively compact hyperspherical clusters composed of highly similar cases (Aldenderfer & Blashfield 1984, p. 40). Similarly, the tendency of single linkage to chain clusters together results in the creation of a series of optimally connected clusters, rather than compact homogeneous clusters, thus the rejection of single linkage as a suitable technique could have been foreseen. The fact that the linkage methods selected for grave goods and body position are not the same emphasises the importance of the application of tests to determine suitable clustering methods for each class of data. The reasons that the two different linkage methods are needed remain unclear — it may be, for example, that the smaller number of variables involved in the body position analysis mean that an average method was more likely to produce an acceptable result.

Aldenderfer & Blashfield (1984, 59–60) have identified four main factors which appear to influence the performance of clustering methods:

- the elements of cluster structure
- the presence of outliers and the degree of coverage required
- the degree of cluster overlap
- the choice of similarity measure

In this case, Jaccard's coefficient was used as the similarity measure, and in the absence of any extensive study on the effects of the choice of similarity measure on the performance of the clustering method, its impact on the results cannot be estimated. However, Aldenderfer and Blashfield suggest that any effects are likely to be overshadowed by the influence of the remaining factors (1984, p. 61). Since complete coverage was required, i.e. a total classification of all cases except those with a high level of missing information, it is to be expected that a number of outliers would occur, representing anomalous burials (which might in fact represent poorly sampled groups rather than unique occurrences). In such cases, it is considered that space-dilating cluster methods such as complete linkage may be adversely affected by the presence of large numbers of outliers (Aldenderfer & Blashfield 1984, p. 61), whereas average linkage methods tend to be more successful. Certainly the overall quality of the body position data in the Anglo-Saxon sample is poor in comparison with the artefact data, which might help to explain the better performance of an average linkage method.

26.3.4. Factor analysis of artefacts

While cluster analysis techniques are applied to sets of burials in order to examine the similarity between burials and classifying such data on that basis (Q-mode analysis), factor analysis methods may be applied to variables as a means of isolating interrelationships between attributes rather than cases (R-mode analysis). Factors are derived which consist of one or, more usefully, several interrelated or correlated attributes which are often taken to be descriptive of the group, assumed to represent common characteristics, and, in some instances, capable of being labelled or interpreted. Here, factor analysis was applied to the artefacts from each cemetery to in effect generate a series of "new" artefact categories based on the identification of interrelationships between the artefacts.

Orthogonal rotation methods have often been employed in archaeological situations (for example, O'Shea 1984). These methods result in a series of uncorrelated factors. An alternative method which has not been widely used in archaeology is oblique rotation, which allows some correlation between factors. This technique has gained some favour, not only because it often results in a simpler pattern matrix, but also because it is argued that it is unlikely that influences in nature are uncorrelated, and even if they are not correlated in the overall population they may be correlated in the sample (Norusis 1985, p. 146). Since it seems unlikely that a series of mutually exclusive factors would bear any relationship to a realistic appraisal of burial attributes, the oblique rotation method has therefore some attraction. An empirical comparison of the results of orthogonal (varimax, quartimax and equamax) and oblique rotations demonstrated that oblique rotations did indeed tend to result in simpler, less ambiguous solutions. In other words, each factor consisted of high non-zero loadings on only a few artefact types, and each artefact type had high loadings in rarely more than one factor.

The identification of the significant co-varying artefact types within a factor using factor loadings appears to have been done on an *ad hoc* basis in most studies. The simplest method, described by Child (1970, p. 45), is to use a rule of thumb, extracting those attributes with loadings greater than ±0.3 provided the sample is of reasonable size (a minimum of 50 cases at least). A higher level could clearly be set, both to allow for the smaller sample size in some cemeteries, and also to attempt to reduce the occurrence of otherwise spurious inclusions. However, this again results in an *ad hoc* process which risks either an overly conservative approach or an insufficiently rigorous level of significance, both of which would reduce the value of the analysis. A more acceptable criterion would take into consideration both the number of cases in the data set and the factor number being examined — since the factors represent an increasingly small amount of the overall variance in the sample, the acceptable value for a loading should increase moving from the first to the highest factors (Child 1970, pp. 45–46). The Burt-Banks formula makes allowance for sample size, the number of attributes, and the factor order: standard error of a correlation:

$$\left(\sqrt{\frac{n}{n+1+r}}\right)$$

where n = the number of variables in the analysis and r = the factor number under consideration (Child 1970, pp. 45, 97). The Burt-Banks formula was used to extract significant (at the 0.05 level) factor loadings which provided the basis for interpretation. This gave a consistent method of extraction but was not used as a rigid rule. In many instances it became apparent that the formula isolated sets of loadings which loaded both very highly and also around the minimum acceptable level. As a result, the lower loadings, which were still significant, were dropped in order to filter out borderline attributes. This is a more conservative approach than was strictly necessary but it simplified the results by concentrating only on those attributes which loaded heavily on a factor.

In addition, factor scores were calculated for each case using the regression method (Norusis 1985, pp. 148–149), providing a measure of the relative strength of each factor for each grave and the results were then clustered and compared with the complete linkage results.

26.4. Some results

To illustrate the application of these methods, an example based upon the Anglo-Saxon cemetery at Saxton Road, Abingdon, Berkshire (Leeds & Harden 1936) will be briefly discussed (for full details, see Huggett 1992, pp. 137–146, 216–218, 274–283).

26.4.1. Sex differentiation

The simulation results indicated that a number of artefacts are significantly associated with one or other sex. Beads, brooches, rings, and fittings are associated with females, while spears, shields, and knives are associated with males. These are mutually exclusive relationships, in that each of these artefact categories is significantly avoided by the opposite sex. These associations only relate to one artefact at a time, whereas the discriminant analysis seeks to determine whether combinations of variables may be gender-linked. A number of artefacts appear to be restricted to one or other sex (for example, pins, coins, finger rings, and swords) but these occur in insufficient quantities to be significantly associated with a group — at least at the 5% level.

Overall, the artefact discriminant function using spear and beads was the most successful at discriminating gen-

Cluster	Members	Common Artefacts
I	48, 125, 6, 33, 121, 106, 122, 52, 88, 27	Bead, Brooch
II	99, 107, 32, 82, 104, 118	Brooch
III	7, 53, 14	Brooch, Vessel
IV	61, 77, 62, 123, 68, 80, 3, 110, 55, 63, 35, 96	Bead, Brooch, Knife
V	98	Bracelet
VI	40	Pin
VII	25	Vessel
VIII	47, 90, 31, 37, 119, 44	Knife, Belt fittings
IX	102, 114, 20, 93, 100, 65, 74, 64, 46, 10, 72, 19, 78	Knife
X	38, 117, 5, 30, 9	Toilet instrument
XI	26, 41, 23, 71, 92, 79, 85, 54, 115, 51, 36, 75, 22, 4, 11, 34, 57, 50	Spear, Knife

Table 26.1: Artefact cluster solution for Abingdon.

der (74.5% of burials in the group which were not used to generate the function were correctly sexed, compared with an expected 50% by chance), with beads being used to distinguish females and spears males. 50% of the burials which were incorrectly classified by the discriminant function have no grave goods to use in determining sex, and the discriminant function appears to default to male where there are no associated artefacts. In all, 77% of burials with known sex are correctly classified by both discriminant functions.

Grave goods at Abingdon can therefore be used to identify the sex of burials with some degree of accuracy (about half way between random occurrence and complete accuracy). Several artefact types are significantly associated with one or other sex group, and the discriminant analysis suggests that spears and beads are the most diagnostic of these. However, some female-associated artefacts are found accompanying male burials (and are the sole artefacts in four cases) and similarly male-associated artefacts (particularly knives) may be the only artefacts accompanying female burials. This means that some error in assigning sex using artefacts is inevitable. The discriminant functions are particularly effective in identifying male burials, which means that there is a tendency to err in favour of classifying doubtful cases as males rather than females.

26.4.2. Age differentiation

There did not appear to be a strong relationship between age and artefacts or body position at Abingdon. No artefacts could be demonstrated to be individually important in predicting age. Lambda suggested a weak predictive association between artefacts and age, and the artefact discriminant function correctly aged 40 burials out of 123 (32.5% compared to an expected 16.6% by chance alone), an identical overall performance to the body position function. The fact that both functions perform better than chance alone suggests that a very weak relationship may exist, and that the age of burials at Abingdon may have been differentiated on the basis of certain artefacts and/or body position.

26.4.3. Cluster analyses

Seventy-six burials with associated grave goods were clustered using the complete linkage method (Huggett 1992, p. 278) and the eleven cluster solution was selected. A number of clusters are clearly sex-related (Table 26.1). Clusters I, IV and X are all female groups (burial 125 in cluster I is of unknown sex but classified female by the discriminant analysis). Cluster XI is the only all-male group, although cluster IX is virtually a male group with the exception of burials 65 and 78. Some of the clusters appear to be age-related — the majority of burials in clusters I, II, IV, IX, and XI are adults — but none of the clusters are entirely of one age group. The three single burial clusters are all infants (V, VI, and VII).

One hundred and one burials were clustered according to their body position (Huggett 1992, pp. 279–280). Any burials with more than one position variable missing was dropped from the analysis. The nine cluster solution was selected. Only one cluster may be linked to gender — all three members of cluster IV are male (Table 26.2). None of the clusters are age-related, although cluster II are all adults with the exception of the juvenile in burial 61.

26.4.4. Factor analysis

Factor analysis extracted 6 factors and following the application of the Burt-Banks formula significant loadings within each factor were isolated (Table 26.3). Artefacts with significant loadings close to the minimum level were dropped from the analysis.

All the factors apart from factor 3 are grouped factors with high positive loadings. Factor 3 is a bipolar factor with high positive and negative loadings indicating mutually exclusive sets of artefacts. A number of the factors

Cluster	Members	Common Position
I	54, 122, 100, 27, 114, 22, 82	Facing up, right arm alongside, legs parallel
II	95, 117, 41, 61, 80, 43, 60, 119, 55, 52	Facing up, left arm on pelvis, right arm alongside, legs parallel
III	32, 48, 47, 51, 63, 75, 26, 33, 35, 13, 46	Facing left, right arm on pelvis, legs parallel
IV	14, 24, 84	Facing right, arms on chest, legs flexed right
V	109, 121, 28, 64, 94, 1, 68, 96, 20, 44, 123, 77	Facing right, left arm on pelvis, legs parallel
VI	66, 69, 23, 65, 92, 108, 3, 76, 89, 10, 59, 7, 83, 87, 91, 30	Arms alongside, legs parallel
VII	90, 99, 5, 85, 88, 72, 78, 62, 71, 50, 57, 110, 58, 56, 4, 34, 98, 116	Facing right, arms alongside
VIII	53, 107	Facing left, arms doubled up, legs flexed left
IX	102, 106, 11, 81, 19, 113, 31, 36, 38, 115, 118, 39, 93, 104, 49, 79, 40, 45, 8, 6, 105, 15	Facing left, arms alongside, legs parallel

Table 26.2: Body Position cluster solution for Abingdon.

Factor	Artefact
Factor 1	+Fittings, +Pin, +Beads
Factor 2	+Bucket, +Fastenings
Factor 3	+Shield, +Spear, -Brooch, -Belt fittings
Factor 4	+Knife, +Coin
Factor 5	+Vessel, +Finger ring
Factor 6	+Sword, +Comb

Table 26.3: Artefact factor loadings for Abingdon.

may be sex-related from the artefacts. Factor 1 may be female, and negative loadings on factor 3 would also suggest female association. Male factors are represented by factors 3 (positive loadings) and possibly 4 (although coins are only found with female burials and knives are also found with both females as well as males).

Factor scores were calculated for each burial with grave goods (Huggett 1992, p. 282). The cluster solution differs markedly from that obtained by clustering burials simply according to grave goods. The overall structure has two large general clusters (I and XI) and several smaller clusters (Table 26.4). The single burial clusters (III, IV, and VIII) are not the same as those identified by the artefact cluster analysis, and correspond to well-equipped female burials. A number of other clusters are clearly sex- and/or age-related: clusters V, VII, X and the majority of I are female burials, while clusters IX and XII are male burials. Clusters II, VII and the majority of clusters VI, IX and X are adult burials. Clusters I and XI are large mixed groups of different ages and genders.

If the significant factor loadings within each factor are combined with the mean factor scores, the artefact loadings for each cluster may be identified (Table 26.4). As noted above, cluster XI appears to be a general grouping of mixed ages and sex and this is matched by the mean factor loadings. The group does not load heavily on any factor, although there is a weak tendency to avoid factors 1 and 2. Two sets of clusters (II & XII and III & IV) load heavily on the same factor. However, the remaining loadings indicate that there are differences between the two groups, with opposed loadings on the lesser factors.

The factor results might suggest a hierarchical structure with several female and male levels based on the generalised artefact categories derived from the factors. Two mixed-sex groups would form the lowest category of burials: those burials without goods, and those falling into cluster XI. Subsequent groups are defined primarily along gender lines, with a large group for each sex — clusters I (female) and IX (male) followed by a series of groups with more restricted membership.

None of the clusters (except the large cluster XI) display any spatial relationship apart from occasional pairs of graves from the larger clusters appearing close to or adjacent to each other.

26.4.5. Summary of Abingdon results

At Abingdon, artefacts can be used to distinguish between the sexes, with beads, brooches, rings, and fittings being significantly associated with females, and spears, shields, and knives with males. Not all these artefacts are restricted to one sex or the other — some male burials also have brooches and beads, for instance, and knives are clearly not restricted to males. However, it has been demonstrated that spears and beads can be used to discriminate successfully between the two sexes.

Clustering burials according to associated grave goods (Table 26.1) resulted in a number of groups which were age- and/or sex-related. The three single burial clusters are all infants, accompanied by a single artefact, examples of which also occurred in other burials but accompanied by other artefact categories. The remaining two infant burials with associated grave goods are subsumed within the other clusters (9 in X, and 65 in IX). Clustering burials with goods according to factor scores again produced a solution with a series of successively restricted clusters associated with sex groups, and some age groups (Table 26.4). Three unique burials were identified (35, 63 and 55) which, unlike the cluster analysis by grave goods, are indeed unusual burials, with 63 being the richest female burial in the cemetery in terms of quantity and variety of accompanying artefacts.

Given that there is no clear relationship between artefacts and age, it is difficult to extract both the gender- and age-related features from the cluster results (Table 26.1). However, based on those clusters which are clearly related to age from their exclusive membership (artefact clusters I, II, IV, IX, and XI are all adults) it is possible to make some suggestions. Looking at female burials, the possession of a knife might signify a status within females related to both sex and age, such as adulthood — beads and brooches are strong indicators of females but not of female adults, whereas knives are generally only found among females where they accompany adults. For males, the possession of a knife

Group	Members	Artefacts
I	48, 125, 6, 99, 107, 32, 118, 30, 38, 117, 19, 52, 27, 9, 33, 40, 121, 7	absence of knife and coin
II	14, 88	sword, comb
III	35	bucket, fastenings
IV	63	bucket, fastenings
V	61, 77, 53	fittings, pin, beads
VI	3, 110, 25, 115, 119	vessel, finger ring
VII	62, 123, 68, 80	knife, coin
VIII	55	knife, coin, vessel, finger ring
IX	10, 92, 72, 34, 57, 41, 4, 11, 50, 71	shield, spear
X	82, 104, 5, 96	brooch, belt fittings
XI	47, 90, 31, 37, 106, 122, 78, 36, 75, 22, 102, 114, 20, 93, 100, 65, 74, 64, 79, 85, 54, 46, 23, 26	(see text)
XII	44, 51	sword, comb

Table 26.4: Cluster solution for Abingdon artefact factor scores.

and/or a weapon (spear, shield) might be related to age as well as sex in the same way, with weapons primarily associated with adults.

There is clearly a strong overlap in the artefact cluster solution between clusters which are exclusively of one or other sex, and adult clusters (I, IV, IX, X, and XI are either male or female, and I, II, IV, IX, XI are all adults) (Table 26.1). None of the remaining clusters (excluding the three infant single member clusters) are related exclusively in this way. This might indicate that only the burials of adults were afforded treatment in such a way as to signify both age (adulthood) and gender. However, the fact that this pattern does not hold across all male/female adult burials at Abingdon would suggest that the situation is more complex — there are a number of adults of either sex which do not conform to these groupings, possessing fewer (or no) age- and/or gender-related artefacts. An obvious conclusion would therefore be that these distinctions are not simply related to adulthood, but to a state of adulthood that is not achieved by all adults, such as marital status. Thus, for example, adult burials which do not observe the brooch/bead/knife model for females or the knife and/or weapon for males may be the burials of single or unmarried individuals, hence their appearance in groups consisting of mixed gender young burials.

Other sub-groupings within the clusters noted above appear to be more restricted in terms of membership. A ring/vessel/toilet instrument/finger ring combination in the female cluster IV is one such example (Table 26.1). Rings are associated with, but are poor indicators of, females, and toilet instruments are also found with males, but this particular combination is only found with a group of individuals within cluster IV and it does not define the cluster. It would seem reasonable to identify such a pattern as group-oriented in nature, but its precise meaning remains unclear. A parallel could be drawn between this group and the a group of male burials in cluster XI which have toilet instruments and shields — one possibility would be to link these two groups on the basis that these burials are marked out within their respective gender and age groups in terms of the quantity and type of artefacts.

Layout of the body does not appear to have been used at Abingdon in terms of identifiable differentiation between groups of burials. There may be a very weak relationship between artefacts, body position and age, although this could not be demonstrated satisfactorily. Clustering burials according to body position resulted in a number of clusters, very few of which may be related to age or sex. The high degree of uniformity within the different body position clusters might however suggest that the layout of the body denoted some other feature of the deceased, not related to gender or age.

26.5. Conclusions

It should be stressed that the results obtained for Abingdon were not duplicated across the remaining eleven cemeteries from the Anglo-Saxon sample studied. Not surprisingly, different cemeteries produced different results. However, a number of common features could be identified.

Distinctions based on sex are very apparent in the results — in the factor analyses, for example, the first one or two factors isolated are always clearly related to males or females. Throughout the cemeteries studied, to a greater or lesser extent certain artefacts or combinations of artefacts could be successfully employed to assign gender to burials, although there was a much less clear relationship with age. Looking at both the cluster and factor results, three features are apparent:

- A large number of the groupings (both in terms of burial clusters and artefact groups/combinations) may clearly be seen to be sex-linked and some may be age-linked.
- A number of groupings have no clear association with age and/or sex. In general, such groups are large diverse sets of burials with an ambiguous relationship to sex and age.
- Groupings identified as being sex/age-linked on the basis of associated artefacts are not restricted to the sex/age-linked artefact types themselves — they may be accompanied by additional sets of artefacts, and in some cases possession of these additional non sex/age-linked artefacts substantially contributes to group membership.

Furthermore, three general levels of artefact patterning can be seen within the clusters:

- artefacts held in common by a group and which in effect defined the cluster. These were often but not exclusively related to sex or age.
- artefacts which were shared by a subset of a given group. Generally, these had no demonstrable relationship with gender or age group.
- artefacts which occurred rarely in a cemetery. These did not usually warrant a separate group since burials which contained such objects normally fitted into existing groups on the strength of other associated artefacts. These might well be related to age or sex but too few examples occurred to demonstrate more than an apparent restriction to a particular category.

Of these, the first two categories can best be interpreted in terms of group-oriented characteristics, and the last in terms of individualistic features. As has already been said, many of the more group-oriented properties can be directly linked to age and gender group membership, but other social categories — race, religion, status, rank, or profession, for example — might be more speculatively identified.

It seems clear therefore that sex, and to a lesser extent age, can be seen as primary burial referents, particularly in terms of artefact associations. What this implies is that aspects of burials cannot be examined in isolation without taking into consideration the age and sex of the individuals concerned. Consequently much of what has tended in the past to be interpreted as status-related artefact patterns can undoubtedly be seen to be associated primarily with the age and sex of the individual rather than any notion of social rank.

Nevertheless sex and age are by no means the only burial referents that can be identified. It has proved possible to isolate underlying patterns which are not specifically associated with sex or age, but which may be related to other stylistic functions. A number of gender and age-related patterns were highlighted above (and see Huggett 1992, pp. 216–236), especially associated with adult males and females and their relationship to non-adults. In many instances, a common pattern emerged: the presence of single-sex adult groups differentiated through artefact associations from non-adult groups. However, these non-adult groups incorporated some adults who conformed more closely with the non-adult grouping. This, it is argued, does not simply represent status within gender groups, but discrimination within age groups as well; the implication here is that burials should not be examined in terms of sex or age alone, but in combination. From the observation of such patterning, a variety of interpretations were proposed: marital status, fertility, parenthood, and warriorhood, for example, and in some instances the nature or context of the patterning made one of these possibilities seem more acceptable than the others. The significant point here is that these distinctions are not related simply to sex or age — they do not represent "adulthood" or "childhood" for example — but are variations within specific sex and age categories, which, it is suggested, represent different social categories which underlie and have a complex relationship with the primary referents of gender and age. The implication is that the type of patterning visible in the burials does not have a single meaning — "male" or "female" or "adult" or "juvenile" — but the patterning conveys several messages at once — "female" *and* "adult" *and* "single", for instance (see also Pader 1982).

The combination of these techniques, together with constant reference back to the data themselves, enables elements of this complex relationship to be identified. It should be stressed, however, that the process is quite unlike removing the rings from an onion: it is not possible to remove the gender identifiers, then from what remains extract the age-linked referents, and so on. The same pattern is used to communicate a range of possibilities.

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