**The Dead and their Possessions: The Declining Agency of the Cadaver in Early Medieval Europe**

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**Supplementary Material**

**GIS Methods**

Maps were created using ArcGIS 10.5.1, and the coordinates of each cemetery were obtained from the Getty Thesaurus of Geographic Names (<http://www.getty.edu/research/tools/vocabularies/tgn/index.html>; base maps by David Redhouse).

Kernel density maps were produced to show areas with contrasting levels of grave good use; all the cemeteries known to have been in use during that period were plotted as points on a map. The kernel density analysis tool then provided a way of showing where point features are concentrated in the landscape. The calculation involved spreads the value of a point, in this instance the number of objects, across a defined area, with the highest value at the centre, tapering to zero on the edge. Where these surfaces overlap, they are summed to get an overall density (see Baxter, 2003: 29–37 for a more in-depth explanation). In order to adjust for the size of a cemetery, which varies quite considerably, the mean number of grave goods per cemetery was used, rather than raw numbers. Kernel density plots were also created to show the base-level density of cemeteries across the regions in question. Because of the variation in the density of cemetery use, simple kernel density plots of numbers of grave goods become difficult to interpret, as there is an inevitable correlation with the density of the overall cemeteries. In order to compensate for this, relative surfaces were created, by dividing the kernel density plot for the average number of grave goods by the kernel density plot for cemeteries, using the Raster Math tool. These images were then digitally manipulated to remove the edge effect. This is a problem which occurs when dividing rasters: the low densities around the boundaries of the data become unfeasibly high values, distorting the patterns. Thus far there has been little attempt to mitigate this, as part of the process of raster manipulation; the values were manually removed here in order to make the variation of actual funerary practices clearer.

**Statistical Methods**

All statistical analyses were carried out using IBM SPSS Statistics 25. The changing frequency of grave goods over time at Pleidelsheim was analysed using a Spearman’s rho test, which measures the strength and direction of a correlation between two continuous or ordinal variables of non-normal distribution, in this instance the date of a burial (taken to be the mid-point of the stated date range), and the number of objects, and different types of objects in it (see Table S1 for good categories). This test produces an rs-value, which indicates the strength of correlation, and a p-value, which indicates the likelihood of such a trend occurring by chance. Rs-values between 0 and ±0.3 are considered weak correlations, while ±0.3–0.5 are moderate correlations. P-values less than 0.05 were considered statistically significant, although this was not treated as an absolute boundary, and the rs-value was given more importance in interpreting a trend than a p-value. This is because the use of null hypothesis testing in statistics has been critiqued as being too simplistic, being too focused on whether or not a certain number crosses a line rather than what that actually means in terms of archaeological importance (Drennan, 1996: 161–62). The results of the Spearman’s rho test for Pleidelsheim are shown in Table S2.

Following this, a two-way analysis of variance (ANOVA) was used to investigate the effect of object type on object location. A two-way ANOVA determines whether there is an interaction effect between two independent variables (the object type, and the location of the object) on a continuous dependent variable (the date of the grave). This is followed by post-hoc tests to determine the strength of this interaction, and the way in which the dependent variable varies with each independent variable. For a two-way ANOVA to produce accurate results, it must meet certain criteria: there must be no significant outliers, the dependent variable should be approximately normally distributed, and the variance of the dependent variables should be equal (Laerd Statistics, 2015). Although, the first criterion was met, the second, for normally distributed data, was violated. With large sample sizes, as is the case here, the two-way ANOVA is robust to skews in the distribution of the data, although the acceptable level of skew is open to debate. The violation of the homogeneity of variances criterion was more problematic. I attempted several transformations of the data, but none provided an improvement. As no alternative test more suitable to the data was possible, I continued with the two-way ANOVAs regardless, but a note of caution should be attached to the conclusions. The results of the two-way ANOVA are given in Table S3.

***Table S1.*** *Grave good categories.*

|  |  |  |
| --- | --- | --- |
| **Category** | **Description** | **Object types** |
| Dress accessories | Objects that were part of an everyday costume. These are usually inalienable possessions | BucklesBelt fittingsButtonsShoe fittingsWrist claspsBrooches |
| Jewellery | Items which embellish dress but are not essential to it; there is some overlap with dress accessories. These are usually inalienable possessions. | BeadsFinger ringsNecklacesEarringsArm ringsHairpins |
| Personal accessories | Items for personal use, which could have been carried on the person. These are usually inseparable possessions. | KnivesFire-steels and flintsKeysSpoonsBagsGirdle hangers |
| Tools | Items which could have been carried on the person, but have a more specific purpose, suggesting that they may not have been carried as regularly as other personal accessories. | AwlsBurinsHooksSpatulasNeedlesQuernstonesSpindle whorlsScales |
| Weapons | Weapons, but also elements of armour; this is included here rather than in dress accessories because they are unlikely to have formed part of everyday dress. These are usually inalienable possessions | SpathaeSpearsSaxesArrowsShieldsAxesChainmailHelmetsScabbardsSpurs |
| Toilet accessories | Items of personal grooming; they have been separated from personal accessories because of their specific function. These could be inalienable possessions. | TweezersCombsRazorsShearsEar spoons |
| Vessels | Containers of all types, either for consumption or storage. Pottery sherds were included when it was suggested that they had come from a vessel placed in the grave, rather than being residual. | Glass vesselsPottery vesselsMetal vesselsPlatesBucketsWooden boxes |
| Animal remains | Animals buried with the deceased, or a single bone, which could indicate a food offering | Animal bones (single or articulated)Egg shells |
| Amulets | Objects which had an apotropaic function; from both a Christian and a non-Christian context | Animal teethPebblesAmuletsFigurinesChristian crosses‘Work-boxes’ |
| Fittings | Usually metal objects that formed part of a larger, unidentified objects. | FittingsMetal ringsOrnamental discsNails |

***Table S2.*** *Results of the Spearman’s rho test for the correlation between the date of a grave (taken as the mid-point) and the number of objects of a certain category in that grave.*

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of grave good** | **Rs-value** | **P-value** | **Date test carried out for** |
| Total number | -0.286 | 0.0380 | ad 590 onwards |
| Dress accessories | -0.404 | <0.0005 | ad 530 onwards |
| Jewellery | 0.155 | 0.0880 | Entire period |
| Personal accessories | -0.214 | 0.0530 | ad 530 onwards |
| Fittings | -0.368 | 0.0070 | ad 580 onwards |
| Weapons | 0.032 | 0.7240 | Entire period |
| Toilet accessories | 0.245 | 0.0070 | Entire period |
| Vessels | -0.251 | 0.0050 | Entire period |
| Tools | -0.263 | 0.0170 | ad 530 onwards |
| Amulets | -0.140 | 0.1230 | Entire period |
| Animal remains | -0.030 | 0.7450 | Entire period |
| Coins | 0.007 | 0.9410 | Entire period |

***Table S3.*** *Results of the two-way ANOVA for the effect of object type and location on date of a grave at Pleidelsheim.*

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| **Tests of between-subjects effects** |
| Dependent Variable: Date  |
|  |  |  |  |  |  |  |
| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
| Corrected model | 202833.795a | 30 | 6761.127 | 2.748 | .000 | .111 |
| Intercept | 40845952.987 | 1 | 40845952.987 | 16602.693 | .000 | .962 |
| Grave\_good | 26437.921 | 10 | 2643.792 | 1.075 | .379 | .016 |
| Location | 28939.543 | 2 | 14469.772 | 5.882 | .003 | .018 |
| Grave\_good \* Location | 72806.738 | 18 | 4044.819 | 1.644 | .045 | .043 |
| Error | 1623732.306 | 660 | 2460.200 |  |  |  |
| Total | 220962507.000 | 691 |  |  |  |  |
| Corrected total | 1826566.101 | 690 |  |  |  |  |
| a. R Squared = .111 (Adjusted R Squared = .071) |

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| **Pairwise comparisons** |
| Dependent Variable: Date  |
| Grave\_good | (I) Location | (J) Location | Mean Difference (I-J) | Std. Error | Sig.d | 95% Confidence Interval for Differenced |
| Lower Bound | Upper Bound |
| Amulet | In grave | Next to | .a | . | . | . | . |
| On body | .a | . | . | . | . |
| Next to | In grave | .b | . | . | . | . |
| On body | 49.000 | 57.274 | .393 | -63.460 | 161.460 |
| On body | In grave | .b | . | . | . | . |
| Next to | -49.000 | 57.274 | .393 | -161.460 | 63.460 |
| Animal remains | In grave | Next to | 58.528\* | 21.872 | .008 | 15.581 | 101.474 |
| On body | 51.750 | 37.883 | .172 | -22.636 | 126.136 |
| Next to | In grave | -58.528\* | 21.872 | .008 | -101.474 | -15.581 |
| On body | -6.778 | 38.774 | .861 | -82.914 | 69.358 |
| On body | In grave | -51.750 | 37.883 | .172 | -126.136 | 22.636 |
| Next to | 6.778 | 38.774 | .861 | -69.358 | 82.914 |
| Coin | In grave | Next to | .a | . | . | . | . |
| On body | .a | . | . | . | . |
| Next to | In grave | .b | . | . | . | . |
| On body | 2.000 | 60.748 | .974 | -117.282 | 121.282 |
| On body | In grave | .b | . | . | . | . |
| Next to | -2.000 | 60.748 | .974 | -121.282 | 117.282 |
| Toilet accessories | In grave | Next to | 21.445 | 13.930 | .124 | -5.907 | 48.797 |
| On body | 34.976\* | 15.932 | .028 | 3.693 | 66.260 |
| Next to | In grave | -21.445 | 13.930 | .124 | -48.797 | 5.907 |
| On body | 13.531 | 14.614 | .355 | -15.164 | 42.226 |
| On body | In grave | -34.976\* | 15.932 | .028 | -66.260 | -3.693 |
| Next to | -13.531 | 14.614 | .355 | -42.226 | 15.164 |
| Dress accessories | In grave | Next to | -30.011 | 19.563 | .125 | -68.424 | 8.401 |
| On body | 8.711 | 16.395 | .595 | -23.482 | 40.904 |
| Next to | In grave | 30.011 | 19.563 | .125 | -8.401 | 68.424 |
| On body | 38.722\* | 12.628 | .002 | 13.927 | 63.517 |
| On body | In grave | -8.711 | 16.395 | .595 | -40.904 | 23.482 |
| Next to | -38.722\* | 12.628 | .002 | -63.517 | -13.927 |
| Fitting | In grave | Next to | 19.889 | 19.387 | .305 | -18.179 | 57.957 |
| On body | 42.704\* | 19.091 | .026 | 5.217 | 80.191 |
| Next to | In grave | -19.889 | 19.387 | .305 | -57.957 | 18.179 |
| On body | 22.815 | 13.915 | .102 | -4.508 | 50.138 |
| On body | In grave | -42.704\* | 19.091 | .026 | -80.191 | -5.217 |
| Next to | -22.815 | 13.915 | .102 | -50.138 | 4.508 |
| Jewellery | In grave | Next to | -5.909 | 23.981 | .805 | -52.998 | 41.180 |
| On body | 1.239 | 19.650 | .950 | -37.344 | 39.823 |
| Next to | In grave | 5.909 | 23.981 | .805 | -41.180 | 52.998 |
| On body | 7.149 | 16.072 | .657 | -24.410 | 38.707 |
| On body | In grave | -1.239 | 19.650 | .950 | -39.823 | 37.344 |
| Next to | -7.149 | 16.072 | .657 | -38.707 | 24.410 |
| Personal accessories | In grave | Next to | -10.282 | 23.408 | .661 | -56.246 | 35.682 |
| On body | 32.400 | 23.045 | .160 | -12.851 | 77.651 |
| Next to | In grave | 10.282 | 23.408 | .661 | -35.682 | 56.246 |
| On body | 42.682\* | 9.745 | .000 | 23.547 | 61.817 |
| On body | In grave | -32.400 | 23.045 | .160 | -77.651 | 12.851 |
| Next to | -42.682\* | 9.745 | .000 | -61.817 | -23.547 |
| Tool | In grave | Next to | 4.000 | 24.800 | .872 | -44.697 | 52.697 |
| On body | -14.333 | 26.787 | .593 | -66.932 | 38.265 |
| Next to | In grave | -4.000 | 24.800 | .872 | -52.697 | 44.697 |
| On body | -18.333 | 22.639 | .418 | -62.787 | 26.121 |
| On body | In grave | 14.333 | 26.787 | .593 | -38.265 | 66.932 |
| Next to | 18.333 | 22.639 | .418 | -26.121 | 62.787 |
| Vessel | In grave | Next to | 42.768\* | 13.376 | .001 | 16.503 | 69.033 |
| On body | 93.818 | 50.161 | .062 | -4.676 | 192.312 |
| Next to | In grave | -42.768\* | 13.376 | .001 | -69.033 | -16.503 |
| On body | 51.050 | 50.825 | .316 | -48.749 | 150.849 |
| On body | In grave | -93.818 | 50.161 | .062 | -192.312 | 4.676 |
| Next to | -51.050 | 50.825 | .316 | -150.849 | 48.749 |
| Weapon | In grave | Next to | 13.552 | 12.484 | .278 | -10.962 | 38.066 |
| On body | 24.085 | 12.554 | .055 | -.566 | 48.736 |
| Next to | In grave | -13.552 | 12.484 | .278 | -38.066 | 10.962 |
| On body | 10.533 | 11.456 | .358 | -11.961 | 33.028 |
| On body | In grave | -24.085 | 12.554 | .055 | -48.736 | .566 |
| Next to | -10.533 | 11.456 | .358 | -33.028 | 11.961 |
| Based on estimated marginal means |
| \*. The mean difference is significant at the .05 level. |
| a. The level combination of factors in (I) is not observed. |
| b. The level combination of factors in (J) is not observed. |
| d. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments). |

**References**

Baxter, M. 2003. *Statistics in Archaeology*. London: Arnold.

Drennan, R. 1996. *Statistics for Archaeologists.* New York: Plenum.

Laerd Statistics. 2015. *Two-way ANOVA Using SPSS Statistics.* <Accessed 27 June 2016> Available at: <https://statistics.laerd.com/spss-tutorials/two-way-anova-using-spss-statistics.php>