

MORPHOMETRIC ANALYSIS OF BRONZE AGE FUNERARY VESSELS FROM THE NECROPOLIS OF MOKRIN

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Abstract

Archaeologists commonly use subjective classifications to group ceramic vessels into different classes, but the usefulness of such tools for creating narratives about the past is seldom questioned. After noticing that certain ceramic classes from the Bronze Age necropolis of Mokrin have quite similar shape and size, we decided to undertake a morphometric analysis of vessels from this site. We show that some traditional classes largely overlap in both shape and size, and that the majority of funerary ceramics from Mokrin can be classified into two main morphological classes of vessels: (1) bowls; and (2) one- or two-handled beakers and amphorae. Our results go beyond this study, as they show how quantitative methods can be used in a complementary manner with more traditional tools to gain meaningful knowledge about the past.

Keywords: Bronze Age – necropolis of Mokrin – ceramics – morphometry – shape – size.

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Introduction

Ceramic typologies have an important place in knowledge production, especially in the culture-historical school of archaeology. They are among the basic tools that archaeologists use for creating relative chronologies, tracing interactions and migrations, making inferences about specialization, etc. When creating a ceramic typology, a researcher uses subjective assessment to classify vessels into groups based on their shape, size, number of handles, decoration, and other characteristics. Such classes are often introduced as ‘functional’, i.e., it is believed that they correspond to their use in the past.

However, while the classifications are useful for exploring general aspects of ceramic variability, such inferences should be made with caution and the classifications should be re-evaluated whenever possible using novel methods (e.g., lipid residue analysis when inferring function; Oras et al. 2017). During our work on the absolute and relative chronology of the Bronze Age necropolis of Mokrin (Radinović et al., forthcoming; see also Soroceanu 1975; Wagner 2009; O'Shea 1992), we noticed that certain classes of ceramic vessels overlap in shape to a certain degree (cf. Wilczek et al. 2014). There is also a degree of subjectivity; for instance, a vessel defined by Girić (1971) as a bowl looked more like a mug to us. Also, we noticed that 'bowls' and 'pots' can have very similar shapes but different labels. Finally, we noticed that certain vessel types have quite similar shapes, but seem to differ only in the number of handles. This seemed to be the case especially with the amphorae and one- or two-handled beakers.

There was one previous classification attempt for the ceramic vessels from all the Maros cemeteries. In his analysis of the shape and size of the Maros funerary ceramics, John O'Shea noted that both bowls and 'liquid containers' showed a strong trend of proportionality of the vessels, regardless of their size. The values of the Pearson's coefficients for correlation between the maximum rim diameters and the height of the vessels for all vessel types show a strong correlation between the two (O'Shea 1996, 93). Since bowls were classed as 'chronologically insensitive', their shape and size were considered separately from the 'liquid containers', so no clear metric distinction was made between these two groups of vessels that could resemble our results. It was noted that there was a close correspondence in vessel height between Maros bowls and liquid containers (O'Shea 1996, 95), as the size criterion used to distinguish different liquid container classes (<12 cm = cups; 12–19 cm = pitchers; 20+cm = jugs) could be applied to distinguish small, medium, and large bowls. While this analysis did indicate that there was a presumed functional distinction between bowls and 'liquid containers', the difference was not shown using any metric criteria (O'Shea 1996, 84).

Thus, we decided to undertake a morphometric analysis of the entirely preserved ceramic vessels from the necropolis of Mokrin to answer the following questions:

- Can traditional vessel classes (e.g., bowls and amphorae) be distinguished based on their shape and size?
- Can we say something about the production process based on the ceramic morphology?

The necropolis of Mokrin

The archaeological site of Lalina humka at the village of Mokrin, near Kikinda in the northern Banat, was first excavated in the 1960s and 1970s. During several campaigns, the team of Serbian and American archaeologists uncovered 312 Maros culture graves, making it, together with Ostojićevo, one of the biggest Maros necropolises (fig. 1). Most of the graves were oriented S-N/N-S, and contained a single burial of an individual

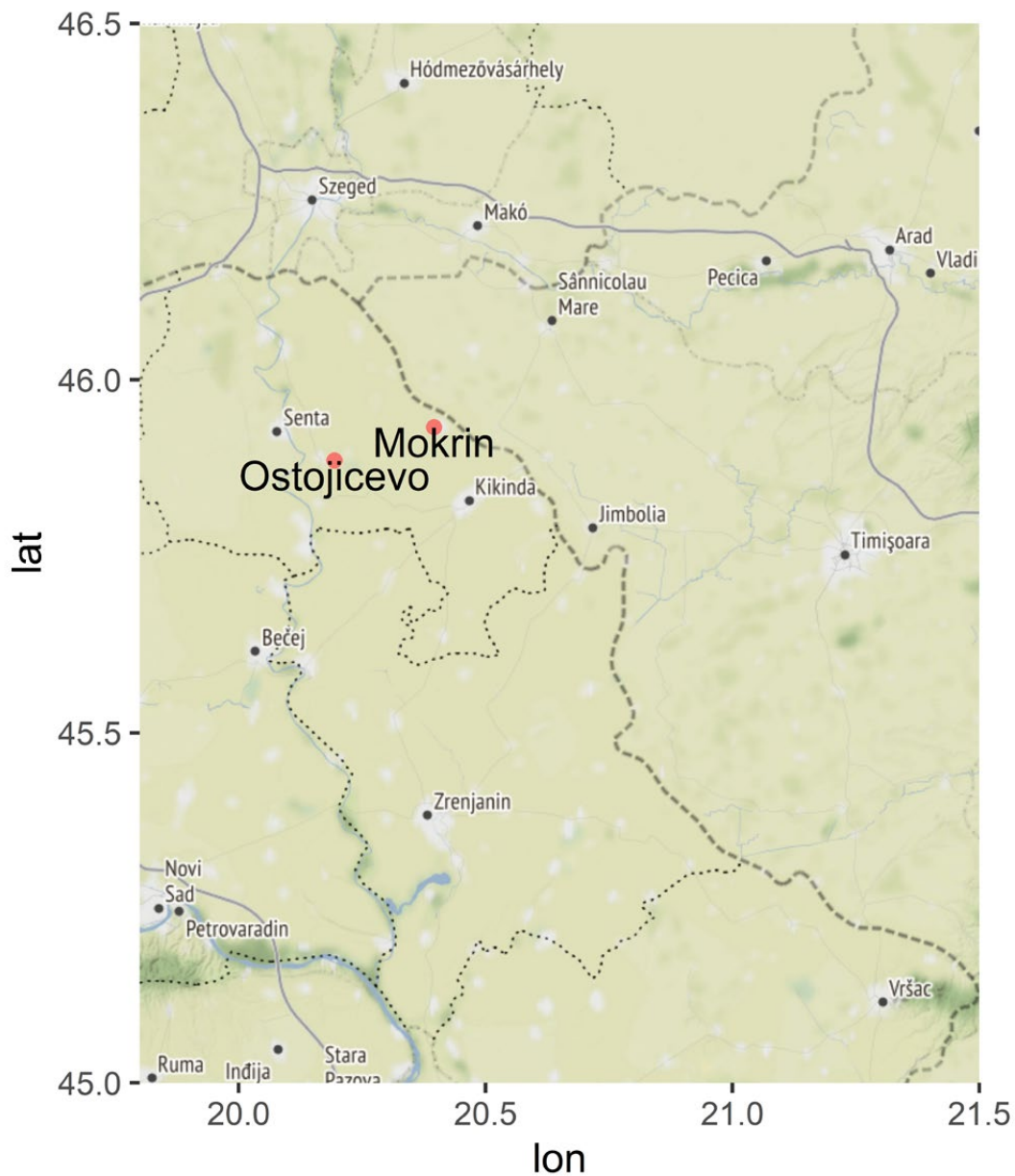


Figure 1. Map showing the location of Mokrin and the nearby necropolis of Ostojicevo in the northern Banat. Image Credit: Generated by the authors with the R programming software (ggmap and ggplot2 packages).

in a crouched position, with a wealth of different grave goods: pottery (fig. 2), weapons, animal bones and jewelry made of kaolin, animal teeth, seashells, bronze, copper and even gold (Girić 1971). Based on the artifacts found in the graves, the necropolis was first dated to the Early Bronze Age Maros culture (Girić 1971), which was subsequently confirmed by the radiocarbon dates (2100–1800 BC; O’Shea et al. 1992). Through the years, the material from Mokrin has been extensively analyzed and employed in studies on social differentiation (O’Shea 1996), physical activity (Porčić & Stefanović 2009; Stefanović & Porčić 2013), kinship (Žegarac et al. 2021), zooarchaeology (Blagojević 2020; Ljuština et al. 2019; Vitezović, 2017), and health (Krečković Gavrilović 2022). A new ongoing excavation campaign started in 2020 aimed at the establishing of the exact boundaries of the site, radiocarbon dating, as well as collecting samples for modern bioarchaeological and sediment analysis (Pendić et al. 2022). The results of the new radiocarbon measurements are still in preparation for publication (Radinović et al., forthcoming).

Materials and methods

A total of 227 graves with ceramics were found at the necropolis of Mokrin. However, for our research we focused on 282 whole vessels and excluded fragmented pottery from our analysis. Additionally, we noticed slight disparities in the ceramic classification of Girić (1971), with similar vessels having been assigned to different classes, or to different types in the Serbian text as opposed to the English version. (The original monograph



Figure 2. Example of an entire vessel from the necropolis of Mokrin. Image Credit: Jugoslav Pendić.

was published bilingually in Serbian and English). To amend this problem, we developed our own classification for this paper. To avoid small samples and to make our results more comprehensible, we selected only four vessel classes for our analysis: bowls (96), one-handled beakers (34), two-handle beakers (64), and amphorae (41). After doing these selections, we were left with the sample of 235 whole vessels for the morphometric analysis.

In order to generally describe the ceramic production, we recorded a number of attributes for these ceramic vessels based on the drawings and grave descriptions in Girić (1971): vessel class (as defined by us), presence of foot, decoration, pronounced shoulder, texture, vessel height, as well as perforations and lid in the case of amphorae. To quantitatively assess vessel shape, we measured 10 widths at equal distances from top to bottom (fig. 3; see Shennan 1997, 288). These measurements were made on drawings of ceramic pots from Girić (1971). They were done in several steps: (1) equidistant points were taken along the vertical axis using the tpsDig 2.32 software (Rohlf 2018); (2) widths were calculated by subtracting the x values of the corresponding two points; (3) widths were standardized by the height of the vessel for removing the effect of size; (4) as the drawings might be somewhat skewed, the ratios were calibrated by a known ratio between vessel height and rim diameter.

We used multivariate statistical methods to investigate the shape of whole vessels; principal component analysis (PCA; Shennan 1997) was applied to vessel widths. The PCA is appropriate for summarizing multivariate data in a lower number (usually two or three) of dimensions. To compare the vessel height among the classes, we used a box plot for visualizing our data and the appropriate statistical tests, the ANOVA test and the Tukey post-hoc tests, to assess the significance of differences in the height of vessels. All the statistical analyses and visualizations were done in R programming language (R Core Team 2022) and the following packages: caret (Kuhn 2008), MASS (Venables & Ripley 2002), ggplot (Wickham 2012), and ggpubr (Kassambara 2020). In the spirit of open access science (Marwick et al. 2017), our data and code are available at OSF platform (<https://osf.io/mkwtv/>).

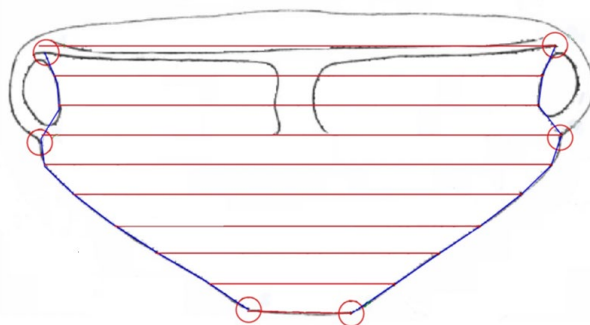


Figure 3. *Example of the position of widths and equidistant points. Image Credit: the authors.*

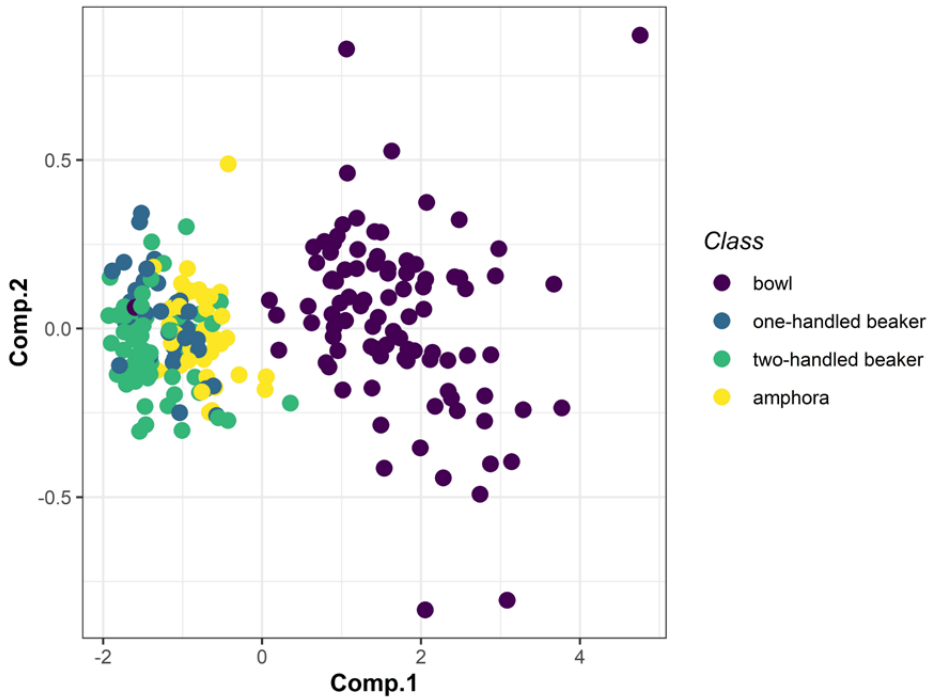


Figure 4. A scatter plot of the first two principal components. Image Credit: the authors.

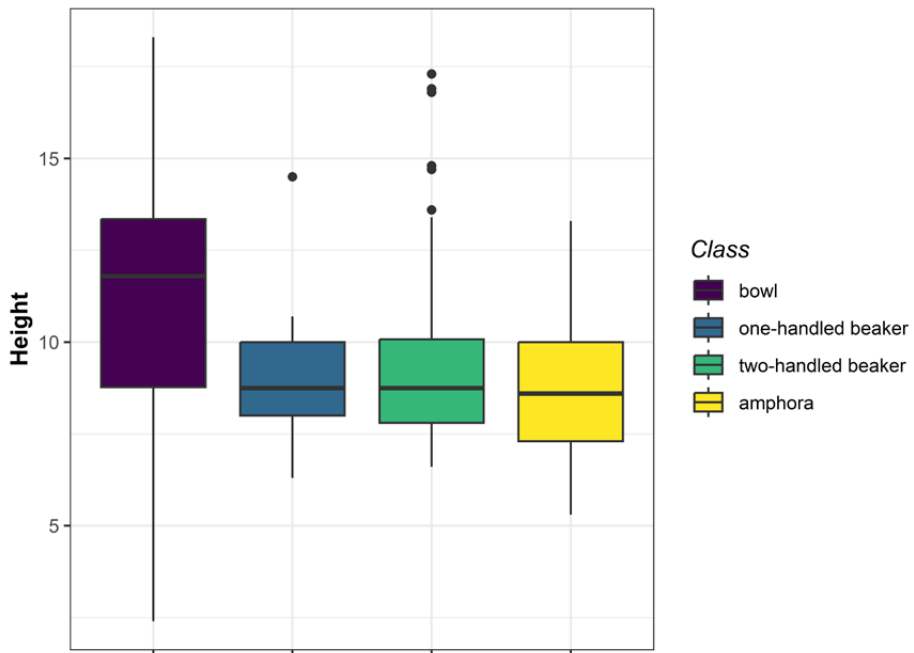


Figure 5. A box plot comparing the height of different classes of vessels. Image Credit: the authors.

Results and discussion

Girić did not systematically record the vessel texture. In the grave descriptions in his monograph, we noticed that 52 vessels (22.4%) are entirely or partly polished, three have fine texture (3.3%), and 19 (8.3%) have rough texture. We can tentatively guess that other vessels (around 66%) had medium texture. A foot is present in 103 out of 235 vessels (43.8%), while the pronounced shoulder is frequently present: in 64.7% of the vessels. Decoration is fairly common: 25.5% vessels.

Figure 4 shows the plot of the first two principal components for our sample of whole vessels, i.e., their widths. The first principal component clearly separates bowls from one- and two-handled beakers and amphorae. It is also clear that one- and two-handled beakers and amphorae overlap in shape. The second principal component mainly explains variation within these two broad groups, and indicates that bowls have higher diversity than the other three vessel classes. The existence of two broad classes is also true when we consider vessel size in figure 5. Bowls are generally larger than the other three classes, while beakers and amphorae are smaller and similar in size (more standardized). This is confirmed by the one-way ANOVA test (DF(231,3), $F = 15.65$, $p < 0.01$), which indicates that at least some means differ significantly. The Tukey post-hoc tests show that the mean height of bowls is significantly different from the mean height of other classes of vessels, while for the other comparisons the null hypothesis of no difference is not rejected.

Thus, both vessel size and shape indicate that there are two main types of vessels at Mokrin: bowls and beakers/amphorae. Considering our results (PCA and ANOVA), bowls and amphorae/beakers could have had different functions, but this should be confirmed using organic residue analysis (cf. Heron & Evershed 1993). A similar presumption of distinction between bowls and 'liquid containers' was previously done by O'Shea (1996, 84), but the difference between the two groups of vessels was not expressed through any metric analysis.

The overlap of beakers and amphorae indicates that they could have been part of the same production process, which seemed to be significantly different from that for bowls. In this scenario, a vessel was first modified into desired amphora/beaker-like shape, while other features – handles, decoration, perforations, etc. – were added subsequently. Thus, depending on the specific goals of the study, they might not be separated in different classes as they could differ only in the number of handles.

In her analysis of the Maros pottery recovered from two settlements – Kiszombor-Új-Élet and Klárafalva-Hajdova – Kostalena Michelaki (2008) showed that bowl production required different skill levels of the potters, and indicates specialization in the case of this class. It was proposed that bowls and other larger vessels were made in parts which were later combined into one vessel (Michelaki 2008, 34), due to the clear visual separation in the profile of biconical bowls, as well as the distinct band of clay added to the surface of some vessels in lieu of decoration. Additionally, it was hypothesized that in the Late Maros, potters were specialized skilled workers, with a distinct social status,

evidenced by unmodified mussel shells, pebbles and bone spatulas, possible tools for the burnishing and decoration of ceramic vessels, which were found in a number of graves (Michelaki 2008, 376; O'Shea 1996, 227). While the significant difference in the shape of bowls as opposed to amphorae and beakers could be the result of differing production techniques, current evidence on chronology and social status at Mokrin is lacking any substantiated conclusion on possible 'higher status values' of the bowls. A detailed comparative and functional analysis of ceramic assemblages from funerary and settlement contexts is necessary for a better understanding of the use, function and life histories of different types of ceramic vessels in the Maros culture.

Conclusions

This simple analysis shows that the traditional subjective classifications and typologies are not suitable for every research. We showed that there might be no reasons to make distinctions between, for instance, one-handled and two-handled beakers, and that they might be part of the same production process. Depending on the goals of the study, it could be more suitable to group them differently than in the usual, traditional way. Like many other cases, quantitative methods show that artifact classification is more complex than generally assumed, and it gives novel and different insights in comparison to traditional methods. On the other hand, we are not arguing against qualitative methods such as technological analysis, which can be used as complementary to more formal, quantitative methods. They can both provide very useful insights about the past regarding the use, production, specialization, division of labor, etc.

It should be noted that here we analyzed only funerary vessels, and that the comparison of these vessels with pottery from settlements could be an important area for further research. Another prospective analytical tool would be the application of geometric morphometric analysis (cf. Wang et al. 2023).

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