

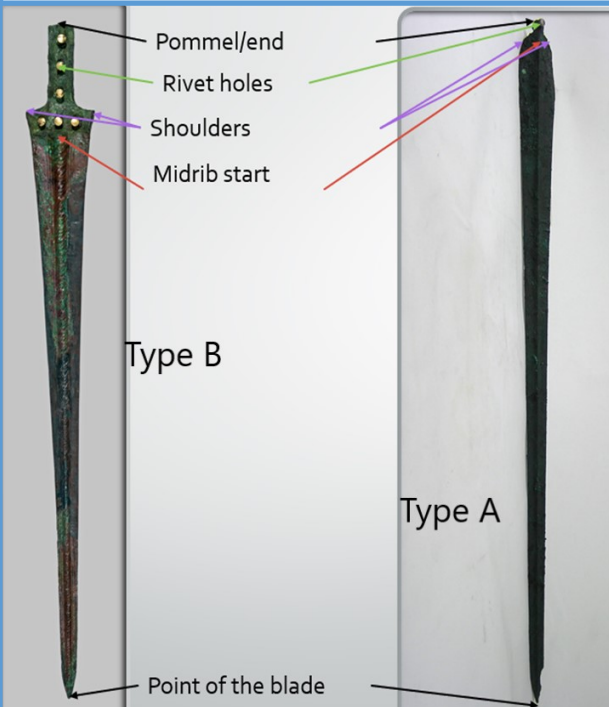


# Can Geometric Morphometric be a tool to scrutinise archaeological typology?

## Introduction

Geometric morphometric is a programme that has been around for the last 30 years, however the transition from the biological and anatomical world to material culture is relatively recent. In the last 5 or so years, archaeologists have started to use it in their research for material culture purposes. One of these avenues is in the field of typological evaluation of artefacts. One of the aims of my Research Thesis uses Geometric morphometrics on the two types of bronze swords that are found in both Grave Circle A and Grave Circle B at Mycenae.

This poster will explain my methodology and what geometric morphometrics is. It will also explain how I believe it can be useful in material culture research. After a brief historical introduction, I will also discuss one case study, with a brief explanation about what their project is, and their results and the impact that geometric morphometric had on their research. Lastly. There is a small section about my ongoing project, which is in the middle of the data collection phase due to the delay caused by the pandemic and will not be finished until after the conference.



## My Project – Research Master’s Thesis

My project is part of my Research Masters here at the University of Groningen. I am using geometric morphometrics to scrutinize the current typological description of the bronze age swords of the Aegean. Specifically, I am researching the two swords types (A and B) from each of the circles of Shaft Graves at Mycenae.

I believe that the use of this computer programme will lead to a better typological description than the current one that has been in place since its inception in the 1930’s by Professor Karo. By using a new innovative approach, I want to check if this typology is still fit for purpose. As part of this I also want to highlight the effectiveness and simplicity of using geometric morphometric on material culture in an area (in particular Greece). This process will create an online database with accurate measurements of objects that anyone can use if made freely available. This will open up these areas for further research without the need to visit the collections and can be used for further analysis without involving the real artefacts.

Unfortunately as much as I would like to use this poster to show off more of my project, due to the current pandemic situation around the world, I have not had the enough time in Greece to collect my data and process it to provide sufficient results for discussion. I was only able to travel to Greece in September. This is why I am using this poster as a platform for my theory and methodology, as well as to highlight the use of Geometric morphometrics on artefacts.

## What is Geometric Morphometric?

Geometric Morphometric is a quantitative study that explores the shape of objects with the application of a multivariate statistical and geometric programme in the evaluation of the data that is produced. It can be used as a methodological approach that uses geometry landmarks configurations of an object that can be repeated across a corpus of the same object. It compares the relative position of these landmarks. The statistical outcome will produce a mean of all the measurements. The identification of the different groups can be seen by the output of a scatter plot.

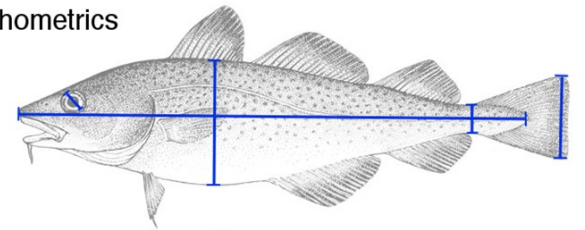
There are different ways of using geometric morphometrics on objects. The traditional morphometrics which uses measurements of length, the area, and the ratio of an object. A second one, is the use of landmark points. These are specific points on an object that are able to be repeated on all other examples of the same object. These landmarks points create a linear distance, ratio or angles that capture the complete spatial shape of an object. Then there is outline analysis, which uses the mathematical decompositions of the outline using the mathematical sine and cosine functions. Essentially it is a measurement drawn around the extent of the object, imagine you are tracing the object with pen and tracing paper, but on a computer

The end result will be a data set that has the accurate measurements of all the landmarks on the individual object. Also, when all the data is collected together it can be represented in a scatter plot graph which can show how many objects are variations of the standard (mean) form. It can also, show groups of objects with the same measurements and overall shape. This data can be used in different ways. From a research perspective, it can be used to look at the standardisation of an object type in its assemblages. It can either show that the object of the assemblage has a standard shape that it follows, or possible regional variations, or that there was not a pattern that the creators of the object used.

The other objective for research is to use it in typological scrutiny. The final outcome has the accurate measurements of all the landmark points on an object, so it creates the shape of the object, it’s morphological shape. It can also create the average form of all the measurement making the ideal object form of that type, meaning the perfect shape and measurements of that object as derived from all object type data. Combining this alongside all available data, such as provenance of deposition, grave site, time of burial, composition etc. Then you can make a better choice for the main feature to be that type characteristics, rather than the easiest one to use.

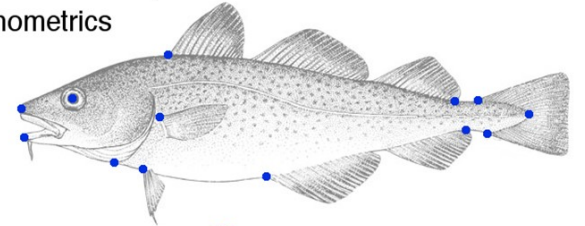
### a. Traditional morphometrics

measurements  
 of length, area,  
 and their ratios



### b. Geometric morphometrics

relative position of  
 homologous points,  
 called landmarks



### c. Outline analysis

mathematical  
 decomposition of  
 the outline in a  
 sum of sine and  
 cosine functions

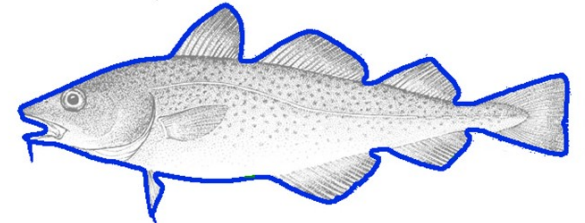


Figure 1—highlighting the different ways of using morphometrics. From shapes to numbers, and back again - MARmaED. (2014). Retrieved September 14, 2020, from Marmaed.uio.no website: [https://](https://marmaed.uio.no)

**Case Study – Bitch, T. Martín-Torres, M. 2019. Shape as a measure of weapon standardisation: From metric to geometric morphometric analysis of the Iron Age ‘Havor’ lance from Southern Scandinavia. Journal of Archaeological Science. 101. P. 34–5**

In this study, they used geometric morphometrics to look at the standardization of Iron Age Havor lances through the shape, size, and composition of the object as a useful approach to finding different typological differences as well as possible provenance in production.

Their reasoning of what standardization could tell them, is that the high degree of it ‘may be taken as indicative of a relatively small number of producers, rigid quality control or high manufacturing skill among other possibilities’ (Birch et al 2019: 34). Meaning that it could show a tightly controlled industry amongst its makers. It also shows that each region had their own style that made them unique, according to the shape produced from the analysis. The author used seven specific points on the lance for the landmarks and analysed over 78 lances (Figure down below, shows all 78 measurements and shape together, against the mean shape). The analysis showed that there was a high degree of standardisation amongst the areas where the individual objects were deposited meaning that different areas had their own style of the Havor lance. Although, this study was purely looking at the shape of each individual object, what information could be produced, such as different region styles. This study did not go into manufacture, into how they were produced, the mode of production, tools, techniques. It only explored the possible shapes of the object corpus and if they correlated with regional deposition

## Brief Typology History and Meaning

Typology is the practice that is used to provide a classification of objects by general type. It enables large samples of data to be classified for ease of analysis. It has various biases dependent upon objective and subjective judgements made by the person or persons creating the typology and dependent upon the circumstances of the requirement of those persons. This classification can cover shape, size, colour, markings, materials, basically anything that can assist the ordering of data into a relevant sample.

However, one should make the choice on setting the classification of a type based on the best. most logical choice for the object, rather than the most convenient and easiest choice. Once all information possible is gathered on an object corpus, then a methodical selection for the best feature should be picked as the correct choice. This does not mean that a typology is fixed, much like human knowledge as it expands new information and technologies should be used to re-evaluate and scrutinize typology and challenge existing definitions as appropriate.

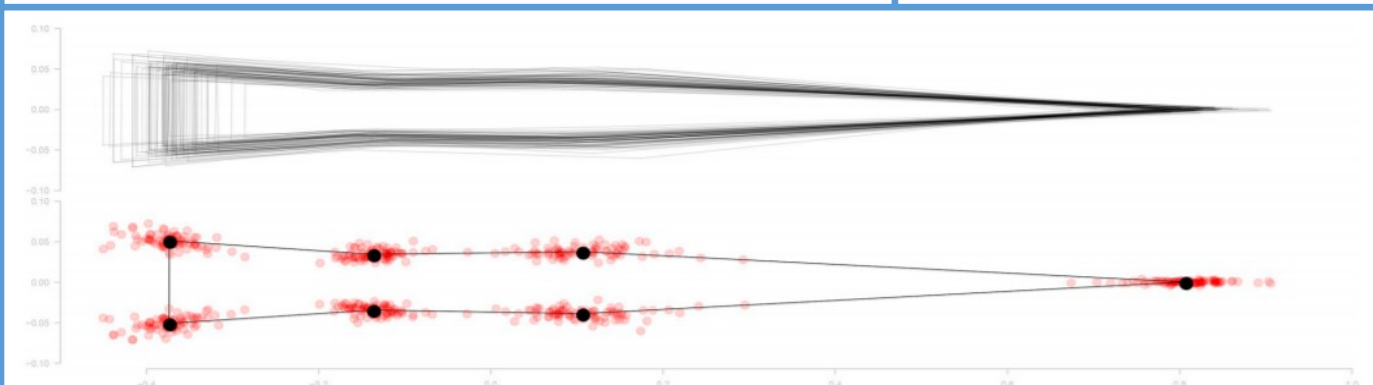


Figure 3 - A plot graph and overlay of all the Havor lances landmark points and shape against each other an the mean value