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Hirst, C S and Lockey, A L 2017 MORPH17 Aarhus, Denmark. *Papers from the Institute of Archaeology*, 27(1): Art. 22, pp. 1–4, DOI: https://doi.org/10.5334/pia-531

REVIEW

MORPH17 Aarhus, Denmark

Cara S. Hirst and Annabelle L. Lockey

MORPH17 was hosted by the Department of Archaeology and Heritage Studies, Aarhus University. The two-day conference consisted of a day of workshops on the 4th of May followed by podium presentations and a poster session on the 5th. Presentations discussed a range of studies which utilised 2D and 3D Geometric Morphometric (GMM) methods to answer a series of archaeological questions. Conferences delegates also had access to the new Moesgaard Museum.

Keywords: Geometric morphometrics; Aarhus; Archaeology; R environment

Introduction

This year MORPH17 was hosted by the Department of Archaeology and Heritage Studies, Aarhus University. The two-day conference consisted of a day of workshops on the 4th of May followed by podium presentations and a poster session on the 5th. Presentations focussed on the application of GMM research in archaeology, with an emphasis on new and exciting ways in which GMM research is developing, incorporating other methods, such as chemical analysis, pathological lesions and discussing the ways in which GMM research can be utilised by archaeological research, without the requirement of specialised GMM training.

The morning workshop on the 4th was run by Dr Christian Steven Hoggard (Aarhus University), which provided an introductory lecture and practical session on Geometric Morphometric (GMM). The afternoon session led by Sara Stark and Christianne Fernee (University of Southampton) provided an introduction to 3D GMM analysis in the R environment.

The first session of the conference began with Cara S. Hirst (University College London) presenting on 3D vs. 2D: "Investigating current opinions and guidelines regarding the ownership and use of 3D data compared to photographic and written data". Her recent study stressed the importance of research agreements, and discussed the lack of formal guidelines for 3D data, although groups generally held the opinion that there was joint ownership for 3D data. These beliefs did not align with practical experiences recorded concerning the use of this data by external and internal researchers, or for teaching and outreach programs. Her results drew attention to the great level of uncertainty in the field over the ownership and sharing of data, especially 3D data.

Josef Wilczek and colleagues (UMR 6298 ArTéHiS, UBFC Dijon) then presented their research on "3D Geometric morphometrics of Middle Bronze Age axes and ingots". This research incorporated 2D and 3D GMM analysis as well as chemical analysis, demonstrating the value of a multi-disciplinary

UCL, GB

Corresponding author: Cara S. Hirst (cara.hirst.13@ucl.ac.uk)

approach. Analysis of French bronze age axes and ingots was conducted to determine if morphology and chemical space displayed regional differences in axe and ingot morphology. Chemical analysis of the ingots was found to relate to both 2D and 3D shape. The comparison between 2D and 3D GMM also demonstrated that, 3D data does not always provide significantly more morphological data than 2D.

In "Diet and getting into shape: investigating isotopic and developmental trajectories from Wharram Percy", Stark analysed biological markers of developmental and nutritional stress and disease such as Cribra orbitalia, Harris lines, Periostitis and rickets and compared these to 3D GMM analysis of juvenile long bones among different age groups. Among the results, it was found that there were statistically significant morphological differences between bones with specific pathological lesions compared to those without skeletal evidence of pathology. She also observed a marked level of developmental stress irrespective of status at 2 years of age potentially associated with weaning, and that levels of variation between stressed and non-stressed individuals decreased with age.

This was followed by João d'Oliveira's (University of Coimbra) presentation "Coelho Sex estimation based on outline shape analysis of the posterior distal humerus". d'Oliveira discussed the application and value of GMM research in a way that can be utilised by researchers without the requirement of GMM training. This research focussed on sex estimation methods, proposed by Rogers (1999) argued to have an accuracy between 74–94%, although later research suggested lower accuracy rates (Falys et al, 2005; Rogers 2009). By conducting a landmark GMM analysis of the features proposed in Rogers (1999) sex estimation method, d'Olivira determined the Procrustes Coordinate (PC) which significantly corresponded with sex differences. The results from this PC was used to create an application using the sex differences shape deformations, the outlines of these features could be manually adjusted to display sexual dimorphic changes. This application can be utilised by non GMM specialists to visually compare human remains improving sex estimation accuracy (this application can be accessed at http://osteomics.com/Ammer-Coelho/).

In the penultimate talk of the morning Katrien G. Janin (University of Cambridge) presented her research titled "Sex estimation of non-adults: can it be done? A geometric morphometric approach". This presentation discussed the lack of standards for the sex estimation of juvenile skeletal remains proposing the use of GMM in creating a more agile approach to tackle the issue of subjective visual comparison methods. A 3D GMM analysis of variation in the ilium between male and female juveniles from Iron Age and Post Medieval sites, demonstrated sexually dimorphic differences in morphology. Further analysis using discriminate function and jack-knife statistical analyses revealed correct sex estimation for the juveniles 90% of the time.

The first keynote speech of the conference was given by Philipp Gunz (Max Planck Institute for Evolutionary Anthropology) titled "Evolution and Development of the human face and brain" and discussed several important contributions that 3D GMM can provide to our understanding of the evolution of cranial development. GMM was utilised to access the unique modern human endocranial and facial development in comparison to Neanderthals and Bonobos infants. His analysis concluded that modern humans begin the pronouncement of their cerebrum and parietal regions in neonates and continues a year after birth, differing from Neanderthals and Bonobos who followed a different trajectory leading to an elongated cranium. His research also revealed that size not shape change has driven human facial evolution, with the Khoe San having a gracilised face similar in shape to Qafzeh 9, an early modern human from ninety thousand years ago.

The afternoon session focussed on GMM analysis of lithic technology, commencing with Knut Bretzke's (University of Tübingen)

presentation "Testing the regional traditions hypothesis in the MSA sequence of Mumba Cave, Tanzania". GMM analysis of temporal changes in the morphology determined that the diversity in lithic technology remained high in the Mumba cave over time, and as such did not support the regional tradition hypothesis, although this study only analysed one site so further research is required.

The second presentation of the session was given by Christian Hoggard (Aarhus University) titled "Towards a better understanding of Final Palaeolithic backed-points". This presentation demonstrated the use of GMM in assessing the robustness and suitability of classifications of lithic technology. This study focussed on Ikinger (1998), and determined a classification success rate of 92%. This presentation also promoted open access data, and all the data utilised in this study will be made available online.

Kamil Serwatka (Wroclaw University) then presented their paper "Geometric morphometric shape analysis and lithic projectile point technology: the case of Final Palaeolithic Swiderian points". This study analysed the cross-sectional area of Swinerian lithic technology, and determined that while the cross sectional area was similar to other arrow points, its morphology differed in other ways. It was suggested that this form of lithic arrow point was most similar to short range high power arrows.

This was followed by Atsushi Noguchi (The University of Tokyo) who discussed the paper "Morphometrics of the world's oldest edge ground stone tools in the Japanese Upper Palaeolithic: comparative study on mechanical function of axe-shaped stone tools". He detailed his research on axe-shaped lithics in the Early Upper Palaeolithic from several sites of the Japanese Archipelago. How these axe-shaped items function is a controversial topic and their high level of asymmetry shows greater variation than later periods in Japan, suggesting they served a more diverse function than being restricted to a woodworking tool.

The penultimate presentation of the conference was given by Cory Marie Stade (University of Southampton) who presented the results of an experimental study to investigate the relationship between cognitive ability and standardised morphology of lithic technology, in a paper titled "Shaping hominin cognition: range of morphometric lithic variability as an indicator of complex cognitive ability in the Lower and Middle Palaeolithic". The development of standardised lithic technology was suggested to be related to the development of 'theory of mind', with low copy error being the result of astute perception. Therefore, the decrease in morphological variation in lithic technology arguably indicates cognitive development. The experimental study involved participants attempting to recreate a handaxe by knapping standardised pieces of porcelain with varying levels of instruction provided to different groups. Results determined that the group which received no knapping instructions had the greatest level of variation in porcelain axe morphology, supporting the hypothesis that cognitive evolution is related to the standardisation of tool morphology.

The conference concluded with the second keynote speech by Radu Iovita (Panjab University) titled "Coming of age in archaeological morphometric: integrating scale, process, and behaviour". Iovita encouraged future researchers to look at combining different forms of analysis and methods into GMM research to utilise the full extent of GMM studies capabilities, and to develop GMM away from simply creating robust classification systems. Other areas for future research were also suggested such as the use of GMM methods in microscopic analysis, as well as for researchers to focus on shape change instead of simply analysing morphology, and to consider the behaviour which may be related to morphological changes.

Acknowledgements

We would like to thank the conference organisers Christian Steven Hoggard, Felix Riede (Aarhus University) for all of their hard work creating a platform in which GMM researchers

can develop their skills and discuss new analytical methods and approaches to GMM research.

Competing Interests

The author presented a paper at the conference, which is referred to in this review.

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How to cite this article: Hirst, C S and Lockey, A L 2017 MORPH17 Aarhus, Denmark. *Papers from the Institute of Archaeology*, 27(1): Art. 22, pp. 1–4, DOI: https://doi.org/10.5334/pia-531

Submitted: 22 May 2017 **Accepted:** 22 October 2017 **Published:** 15 November 2017