

Institution: University of York		
Unit of Assessment: 15 - Archaeology		
Title of case study: Consuming prehistory: the impact of scientific research on presentation and understanding at Stonehenge		
Period when the underpinning research was undertaken: 2010 – 2019		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Professor Oliver Craig Dr Penny Bickle	Professor Senior Lecturer	1/09/2007 – present 1/09/2014 – present
Period when the claimed impact occurred: 2017 – 2020		
Is this case study continued from a case study submitted in 2014? N		
<p>1. Summary of the impact (indicative maximum 100 words)</p> <p>Research by York has challenged assumptions regarding what and how people ate in the past. Working with partners at the University of Cardiff and English Heritage the research was presented in a major exhibition at the Stonehenge Visitor's Centre contributing to increased visitor numbers; pioneering a new format for visitor engagement at the site leading to a change in practice; training and inspiring volunteers at the site creating a legacy beyond the original exhibition; changing public perception of prehistoric food and diet; and providing key resources for the teaching of prehistory at Key Stage 2 and STEM subjects at Key Stages 4 and 5. Finally, our research is also influencing government decision-making in the Stonehenge environs.</p>		
<p>2. Underpinning research (indicative maximum 500 words)</p> <p>In 2010 archaeologists and scientists from the universities of York and Sheffield, and the British Geological Survey embarked on an AHRC-funded project ('Feeding Stonehenge') to explore food consumption practices within the Stonehenge environs. At York, Craig's role was to determine the contents of pottery. The research a) identified the presence of large-scale feasting at the nearby site of Durrington Walls connected to ceremonial activities at Stonehenge; b) provided forensic detail regarding the preparation, consumption and seasonality of food, and other associated activities at Durrington Walls; and c) contrasted these with everyday 'utilitarian practices' in Neolithic Britain (3.1, 3.2).</p> <p>The project demonstrated that prehistoric food played a far more significant role in shaping social and cultural practices than previously thought and, more broadly, marked the beginning of a new research agenda into prehistoric cuisine. A second theme that emerged was the utility of cutting-edge scientific methods in revealing the role of food and its consumption in prehistory, a wider theme underpinning the work of Craig's research group at York's BioArCh facility. The project demonstrated how, in direct response to social questions posed by archaeologists, a range of disciplines, from biology, biochemistry, genetics, geology and geoscience to organic and inorganic chemistry, can be employed to reach innovative scientific solutions.</p> <p>With the appointment at York of Penny Bickle in 2014 and a series of further funded projects awarded to York (e.g. AH/L00691X/1), we were able to pursue the theme of prehistoric diet and cuisine at the international scale, including case studies in East Asia, North America and North, Central and Southern Europe deploying state-of-the-art molecular and geochemical approaches.</p> <p>Together, Craig and Bickle's research has challenged assumptions that prehistoric diets were monolithic, locally sourced and more 'natural' than modern diets. Not only did prehistoric diets evolve over time, but food played a significant role in the construction of group identity, from large-scale feasts to household meals (3.1). This forces a fundamental change in the narrative regarding prehistoric food and diet, from one traditionally focused on resource availability to one that encompasses social and cultural practice, with distinct variations within and between prehistoric societies, determined by age, gender, sex, kinship and social status and reverent to culinary traditions (3.3).</p> <p>Modern scientific approaches provide new tools to explore the social context of prehistoric food consumption and procurement. For example, through chemical analysis of pottery, we show that the use of ceramics by East Asian hunter-gatherers was under tight cultural control despite</p>		

dramatic changes to the environment governing the resources available (3.4). Furthermore, by deconstructing mixtures of foods cooked in pottery, we are able to provide insight into the expression and regulation of culinary choices, as shown at Durrington Walls and elsewhere (3.2). Using ancient DNA, we have also shown that British Neolithic populations were unable to digest milk sugars as adults, indicating that dairy economies were orientated towards fermentation and cheese-making (3.5) with different culinary and cultural implications (3.6). This shows that methods adapted from molecular genetics, biochemistry, geochemistry and the food sciences can transform archaeological understanding of the role of food in society.

3. References to the research (indicative maximum of six references)

3.1 Craig, O.E., et al. 2015. Feeding Stonehenge: cuisine and consumption at the Late Neolithic site of Durrington Walls. *Antiquity*, 89: 1096–1109. <https://doi.org/10.15184/aqy.2015.11>

3.2 Fernandes, R., Eley, Y., Lucquin, A. J. A., Millard, A., Brabec, M., & Craig, O.E. 2017. Reconstruction of prehistoric pottery use from fatty acid carbon isotope signatures using Bayesian inference. *Organic Geochemistry*, 31–42. <https://doi.org/10.1016/j.orggeochem.2017.11.014>

3.3 Bickle, P.F. 2016. Capturing diversity in Neolithic diets, in Amkreutz, L., Haack, F., Hofmann, D. & van Wijk, I. (eds.). *Something out of the ordinary?: Interpreting diversity in the early Neolithic Linearbandkeramik and beyond*, 89–119. Newcastle Upon Tyne: Cambridge Scholars Publishing. Available upon request.

3.4 Lucquin, A, Craig, O.E., et al. 2016. Ancient lipids document continuity in the use of early hunter-gatherer pottery through 9,000 years of Japanese prehistory. *Proceedings of the National Academy of Sciences of the United States of America*, 113(15): 3991–96. <https://doi.org/10.1073/pnas.1522908113>

3.5 Charlton, S, Ramsøe, A, Collins, M, Craig, O.E., Fischer, R, Alexander, M. & Speller, C. 2019. New insights into Neolithic milk consumption through proteomic analysis of dental calculus. *Archaeological and Anthropological Sciences*, 11: 6183–96. <https://doi.org/10.1007/s12520-019-00911-7>

3.6 Saul, H., Glycou, A., & Craig, O.E. 2014. Stewing on a Theme of Cuisine: Biomolecular and Interpretive Approaches to Culinary Changes at the Transition to Agriculture. In A. Whittle & P. Bickle (eds.) *Early Farmers: The View from Archaeology and Science*, 1–17. London: British Academy. Available upon request.

Evidence of the quality of the research: Outputs (3.1), (3.2), (3.4) & (3.5) are published in leading peer-reviewed journals; (3.4) is submitted to REF2021, (3.1) to REF2021 (reserve), and these 2 outputs have 68 and 47 citations respectively. Outputs (3.3) & (3.6) were also peer-reviewed. The underpinning research presented here was the outcome of the following competitive external funding:

Parker Pearson (PI), **Craig (Co-I)**, Albarella (Co-I), Evans (Co-I) Feeding Stonehenge, AHRC (AH/H000879/1), 1/2/2010–30/6/2013.

Craig (PI) The Origins of Pottery in East Asia (AH/L00691X/1), AHRC 01/09/14–31/08/16.

Heron (PI), **Craig (Co-I)**, Pottery use by late foragers and early farmers of the Baltic, AHRC (AH/E008232/1), 01/08/07–31/07/10.

4. Details of the impact (indicative maximum 750 words)

In 2017 Craig (University of York), and Jacqui Mulville (Cardiff University) alongside their Project Partner (English Heritage) were awarded an AHRC Follow-on Fund for Impact grant, building on previous research by Craig at Britain's most famous prehistoric site, Stonehenge ('Feeding Stonehenge'). The follow-on project sought to change public perception of what and how people ate in the past and to showcase how scientific analytical techniques can be used to investigate food and consumption, building directly on the approaches used in the underpinning research. The award ran alongside a major exhibition at the Stonehenge Visitor's Centre, facilitating the creation of educational resources, and roadshow events delivered by Cardiff University's Guerilla Archaeology. The outcomes of the follow-on funding (1) contributed to increased visitor numbers to Stonehenge, (2) pioneered a new format for visitor engagement at the site leading to a change in practice, (3) trained and inspired volunteers working at the site, creating a legacy beyond the original exhibition, (4) changed the public's perception of prehistoric food and diet, and (5) provided key resources for teaching prehistory at Key Stage 2 (KS2) and STEM subjects at Key Stage 4 (KS4) and Key Stage 5 (KS5). (6) Craig's research also led to an invitation to join the Scientific

Committee of the Stonehenge A303 Advisory Group leading to influence on government decision-making.

1) Increasing visitor numbers to Stonehenge

'FEAST! Food at the time of Stonehenge' explored what people ate in prehistory, how sites were provisioned, and the social aspects of feasting focusing on the latest data derived from 'Feeding Stonehenge'. It ran for 12 months from October 2017 and featured in 44 pieces of new media, including most of the UK national press as well as *De Morgen* and *El Español*, with an estimated reach of 3,460,000 views and 15,800 social media shares (5.1). It attracted >560,000 visitors to Stonehenge, which formed part of a 14.5% increase in visitor numbers from the previous year (5.2a, 5.2b, 5.2c, 5.5). The exhibition was a key driver for visitors with 1 in 7 describing it as "very influential" in their decision to visit Stonehenge (5.2a, 5.5). It had extensive reach with 55% of the visitors from outside the UK, compared to an English Heritage average of 23% international visitors (5.2a). English Heritage estimates that the exhibition could equate to income of GBP2,700,000 based on average ticket prices (5.5).

2) Pioneering a new format for visitor engagement leading to a change in practice

Alongside the Feast exhibition, the team at York, Cardiff and English Heritage devised a series of interactive events delivered as 'The Big Feast Weekend' at Stonehenge on 1-2 September 2018. Cardiff University's Guerilla Archaeology also took a selection of activities on tour at music, arts and science festivals. Together these festival events engaged approximately 20,000 further participants in activities including cookery and butchery demonstrations, 'Stonehengeburys' a pop-up immersive Neolithic supermarket with food displays, recipe creation, pottery and flour making, gardening kits to take home, and themed catering stalls (5.3). Events included 'Ready, Steady, Cook: Neolithic,' run in collaboration with Operation Nightingale. The Senior Archaeologist with the Defence Infrastructure Organisation, reported how "Several of the team had experienced the landscape in some depth in their military training and [how] this introduced a new aspect of the area to them" (5.4). The activity was "a wonderful ice-breaker and team building exercise" and the experience of "Working outdoors, with a group of (soon-to-become) friends is crucial for our projects and this was a perfect start" (5.4).

The festival format of The Big Feast Weekend was the first of its kind at the world heritage site (5.5). Sue Greaney, Senior Properties Historian for English Heritage, noted how it "created knowledge change for staff by demonstrating that the Stonehenge site can be used to hold large-scale events successfully and showing how these events can be employed to enhance visitor experience" (5.5). Greaney explained how the events "gave confidence to English Heritage staff that event-led and outdoor activities/events are not only feasible, but successful" (5.5) with indicators of success seen not just in visitor numbers but also in the financial impact of increased visit duration on food and drink consumption, "increasing spend by 10% overall at the site (when English Heritage catering and external themed catering are combined – the latter paid a proportion to exhibit at the event)" (5.5). An independent evaluation report on the Feast exhibition and The Big Feast Weekend recommended that English Heritage adopts the "best practice and 'wow' factor of the exhibits and activities of FEAST!" (5.2a, p.39) and English Heritage have already implemented changes such as placing "a stronger focus on linking themed events to specific events to embed them into the site, a format which was first showcased by Feast" (5.5).

The Big Feast Weekend was particularly innovative in its use of space, encouraging English Heritage to "think more creatively about the use of the outdoor space available" (5.5). Changes in the use of space have already been implemented, for example, "other heritage practitioners ...inhabiting the area in a tented encampment, rather than working predominantly to train volunteers or within the houses" (5.5). Greaney noted how this change "increases visitor engagement and enhances experience by presenting information in multiple different ways, creating interactive narratives, and presenting a visual use of space that draws people around the site" (5.5). In 2020 the availability and use of outdoor space became increasingly significant as the Covid-19 pandemic continued to unfold. For English Heritage "maximising the use of outside space will be a priority" (5.5) and the festival format of The Big Feast Weekend provided "a vital demonstration of capacity" in this respect (5.5). With this in mind, English Heritage aims to

construct a Neolithic garden alongside additional buildings and shelters that are more open-air and increase its ability to hold such events (5.5). According to Greaney, “Covid means that we are having to think more about our out-door spaces, and so unexpectedly Feast will also factor into these considerations as a novel example of site use” (5.5).

Looking ahead, English Heritage is currently reviewing how it will present Stonehenge for the next 10 years and Greaney notes that “One of the big questions within this is do we at Stonehenge carry on with temporary themed exhibitions, or do we move towards a more events-based format with interactive activities. As such the Feast exhibition and Big Feast Weekend are influencing discussions of practice at Stonehenge and contributing to future decision making” (5.5).

The innovative approach of Feast! is also influencing the development of a new exhibition on Bronze Age Europe to be held at the British Museum in 2022. The Director of Scientific Research at the British Museum noted that: “This innovative approach is of great interest to the British Museum as we explore new ways of presenting scientific evidence to communicate the significance of objects in the collection” (5.6). Craig has since been appointed Honorary Research Fellow of the British Museum and has been invited “to advise on the narrative elements of the exhibition... A key element of the Fellowship is to explore, with Museum colleagues, how best to capture the latest scientific research in the exhibition content. This is an excellent example of co-production linking the academic and museum sectors to the benefit of visitors to the British Museum” (5.6).

3) Training and inspiring volunteers

The impact of the research was also felt by volunteers leading visitor engagement at Stonehenge. Half-day workshops drawing on Bickle’s research on the diversity of, and innovation in, European Neolithic diets, directly enhanced English Heritage’s volunteers’ knowledge and enabled them to practically demonstrate food preparation techniques that were subsequently disseminated to the thousands of people who visit the site daily (5.7). The Volunteer Manager at the site noted how the training designed and delivered by Bickle and Best (Cardiff) enabled volunteers to “talk with increased confidence to visitors” and contributed to volunteer professional development through engaging them “in developing their own research projects” (5.7). The material provided by Bickle has since been incorporated into the volunteers’ training and “cheese making has been shared with other volunteers at a skills swap day, and with the wider volunteer community via Volunteer Focus” (5.7).

Building on the success of the Feast exhibition and The Big Feast Weekend, English Heritage has made permanent changes to their volunteer-led visitor engagement programme. Food making demonstrations are now a regular feature (5.7) and the volunteers have run other visitor activities such as moving and raising a stone (5.7), now an annual event (5.5), and a volunteer project to build a timber sledge using prehistoric techniques and tools (5.7). The Volunteer Manager also emphasised the value demonstrated in the workshops of “having volunteers engaging directly with experts” and has since invited “a palaeobotanical specialist from Reading University...and [is] soon to have a visit from a specialist in sarsen working” (5.7). In these ways she confirms how “Prof Craig’s work analysing the residues preserved in Grooved Ware pottery and Dr Bickle’s research on cheese-making technology and recipes has changed the ways in which we interpret Stonehenge for our visitors” (5.7).

4) Changing the public’s perception of prehistoric food and diet

Sharing the findings of the underpinning research during the Feast exhibition, The Big Feast Weekend and the series of events taken on tour by Cardiff University’s Guerilla Archaeology demonstrated influence on, and changes in, the understanding of visitors. Changes in understanding were apparent, for example, around food intolerances in prehistory and the range of foodstuffs available; participants were surprised to learn that Neolithic populations were lactose intolerant (5.2a, p.28), with one visitor noting that she could now “use this as evidence when people claim her own intolerance is a “modern fad”” (5.3). Such thought-provoking activities “made people reconsider how they think about allergies and intolerances today” (5.3). Participant feedback also revealed that most people previously thought that rabbits were native to Britain

(approximately 74% of participants), whereas the activities revealed that they are in fact a Roman introduction (5.3). Participants also thought that sheep and/or chickens were native (approximately 50% of participants) while both are again introductions (5.3). “Discovering that food-miles was relevant in prehistory also surprised visitors. Learning that animals were brought to Stonehenge from varied locations across much of Britain changed how people thought of food in prehistory – moving away from locally sourced survival and instead including pleasure and large scale feasting” (5.3).

To coincide with the launch of the exhibition in October 2017 Bickle and English Heritage released a YouTube video drawing on Bickle’s research into Neolithic cheesemaking. “How to Make Prehistoric Cheese” has been viewed over 173,262 times (5.7). The video sparked interest from viewers revealed in the comments and led to contributions to other media outlets (Channel 5, BBC Radio, Radio New Zealand).

5) Impacts on learning

Prehistory features heavily in the English primary curriculum, and educators local to Stonehenge and nationwide have been particularly keen to incorporate our findings into their teaching. Considering the scientific analytical approaches deployed, our research is also a vehicle to deliver STEM learning across key stages. Responding to this demand, the team at York and Cardiff worked with English Heritage’s educational team and STEM Learning (the UK’s largest provider of STEM education and careers support) to create a series of web-based educational resources for KS2 (Primary Science), KS4 (GCSE Chemistry and General Science) and KS5 (A-Level Chemistry) informed by our research at Stonehenge. These were designed to bridge students’ interests in humanities and science subjects and facilitate cross-subject teaching at primary level. Each resource is closely aligned with relevant UK curricula and engages students in the science behind the original research. Since launch they have received 7,211 unique views and been downloaded 3,079 times by national and international users (5.8). Respondents to a teacher survey showed that the resources provided “good subject knowledge...for a busy teacher who may not be confident about these areas” and were “very likely” to encourage students to engage with STEM subjects (5.9).

6) Influencing government decision-making

In July 2017 Craig was invited to join the Scientific Committee advising Highways England on the proposed road alterations in the Stonehenge environs (A303 Stonehenge: Amesbury to Berwick Down Road, 5.10). Craig advised on the potential (or loss of potential) for conducting scientific analysis on finds recovered within the affected area. The underpinning research and Craig’s involvement in the Scientific Committee have contributed to the mitigation strategy leading to the government’s decision in November 2020 to go ahead with the GBP2.4 billion road tunnel scheme.

Craig and Bickle’s research has thus created a legacy at Stonehenge, influencing how the site will be presented in the future and, through participation in the A303 committee, how its immediate environs will be managed. Statistics from YouTube and STEM Learning demonstrate sustained high levels of usage of the e-resources, highlighting the fact that people are still using them long after the exhibition has closed, showing the universal attraction of Food and Feasting, and why it has become a key component of how we present Stonehenge to the world.

5. Sources to corroborate the impact (indicative maximum of 10 references)

5.1 CoverageBook report on media coverage of *Feast! Food at the time of Stonehenge*.

5.2a BVA BDRC Project Summative Evaluation Report; 5.2b Visit England Most visited paid attractions: 2017, and 5.2c 2018.

5.3 Blog: [Cooking up Prehistory: Festival knowledge change, incorporating social media statistics](#).

5.4 Operation Nightingale, Senior Archaeologist with the Defence Infrastructure Organisation.

5.5 Testimonial from English Heritage: Sue Greaney, Senior Properties Historian.

5.6 Testimonial from the British Museum: Director of Scientific Research.

5.7 Testimonial from English Heritage: Volunteer Manager.

5.8 STEML stats for ‘Feeding Stonehenge’ e-resource collection, 1/1/2018–31/12/2020.

5.9 Stonehenge Teaching Resources Survey 2020.

5.10 Letter of invitation from Highways England.