



# INTER-SECTION

Innovative approaches by Junior Archaeological Researchers

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AN ANALYSIS OF THE LOWER LIMB SKELETAL  
EVIDENCE FOR THE ENDURANCE RUNNING  
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A STUDY ON THE PURPOSE OF THE NIMRUD WALL  
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*Eline B.J. Amsing*

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September 2016 - February 2017

# EDITORIAL STATEMENT

## 3-YEARS LATER... A REASSESSMENT OF THE NEED FOR SOMETHING “IN-BETWEEN”

*Shumon T. Hussain*<sup>1</sup>, *Yannick Boswinkel*<sup>2</sup>, *Mette B. Langbroek*<sup>3</sup>,  
*Robin Nieuwenkamp*<sup>4</sup>, *Dean Peeters*<sup>5</sup>, *Roosmarie J.C. Vlaskamp*<sup>6</sup>,  
*Femke H. Reidsma*<sup>7</sup>

*Welcome to the 2017 issue of INTER-SECTION: Innovative approaches by Junior Archaeological Researchers. In this issue, we present a total of five papers written by archaeology students in close collaboration with their academic referees, reflecting the wide range of both research and teaching at Leiden’s Faculty of Archaeology from the BA to the MA level.*

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Since the inception of *INTER-SECTION* as a peer-reviewed open-access publishing platform in 2015, the journal’s primary aims have not changed substantially. Yet, what has become quite apparent during these past years is that there is more need than ever for a journal “in-between” – to bridge some of the divisions between teaching (training vs education) and research (key role of fast-and-frugal publication) that have been created by the ongoing transformation of European university systems. Whilst we adhere to *INTER-SECTION*’s core agenda (Peeters *et al.* 2015, 4-5), these developments both motivate and necessitate reconsidering the colouring and meaning of the label “*INTER-SECTION*”.

After all, the journal has demonstrated not only to be an instrument for presenting the “wide range of archaeological discourses being studied and taught at Leiden’s Faculty of Archaeology” (idem, 5), it can in fact be argued now that *INTER-SECTION* has also proven to facilitate a

platform where students and staff can meet and collaborate, where education and research productively culminate, and where the curiosity and ambition of young researchers is fuelled by the experience and advice of experienced professionals. In a nutshell, we suggest that *INTER-SECTION* can now also be regarded as an important intra-faculty *glue* holding together what is, *grosso modo*, drifting more and more apart in Dutch academia. While there exists, in fact, a large agreement for the necessity to create and maintain an academic environment in which the boundaries between teaching and research, between the role of the “scientist” and that of the “student”, are kept fluent and can easily be crossed (e.g. Ministry of Education, Culture and Science 2015, 62-74; ISO 2015), universities are still struggling to implement and cultivate such environments. In practice, it often proves difficult to translate the important lessons-learned from successful best-practices and implement these in other curricula (AWTI 2015). Bottom-up efforts such as *INTER-SECTION* can precisely help to induce and sustain such flexible

and productive academic environments, if fuelled by willing students, teachers and management, as is the case at the Faculty of Archaeology.

In what follows, we invite our readers to return to some of these general issues permeating current academic policy and to reflect on them once again. This does not say, of course, that everybody needs to agree with the assessment of current academic state-of-the-art presented here, yet some of the raised issues, regardless of the taken stance or perspective, might help to reinvigorate a broader discourse on the matters touched-upon within our faculty – a discourse that is urgently needed since the overall trajectory of change appears to be irreversible.

### Reassessment and Extension of Aims

During the last two decades, most European countries have witnessed a dramatic re-organisation of their academic systems, resulting in a radical transformation of how scientific research is done, perpetuated and ultimately communicated. Two interrelated processes can be identified to have driven this development: (i) the so called ‘Bologna Process’ based on the earlier *Magna Carta Universitatum* (1988) and the *Sorbonne-Declaration* (1998) with the aim of “harmonising the architecture of the European Higher Education system”, and (ii) the re-structuring of the scientific funding framework through the establishment of the *European Research Council* (ERC) in 2007. These two top-down adjustments have fundamentally redefined the relationship between teaching and research and the mechanisms and logic of publishing scientific results (cf. e.g. Hagner 2015). Effectively, (i) and (ii) have issued a somewhat ‘cruel’ tension between the political will to streamline and normalise university *curricula* on the one hand, thereby swinging away from humanistic ideas of ‘education’ (*Bildung*) towards the pragmatic notion of ‘training’ (*Ausbildung*)<sup>1</sup> – and, on the other hand, the tendency to primarily support cutting-edge research conducted by a small number of high-profile scientists, e.g. reflected in programs such as *Horizon 2020*.<sup>2</sup> The strong emphasis on training rather than education, in conjunction with the ongoing separation between teaching and research, has resulted in a situation where students become, ironically, more and more detached from real scientific practice while they are, at the same time, more and more expected to deliver exceptional, innovative and high-quality work in their BAs/MAs/PhDs *and beyond* to be able to compete for funding and/or positions on the next rung of the academic ladder.<sup>3</sup> Essentially, this situation has created (a) an extremely competitive environment for prospective

researchers and fostered (b) ‘academic elitism’ (Closet et al. 2015) for which students, precisely because of the relatively manageable BA/MA curriculum, are often only poorly equipped.

*INTER-SECTION* pursues two interrelated goals which closely connect with these two aspects: first, it aims to bridge the gap between well-structured training and individual research by assisting students in publishing their work in an adequate scientific standard; it helps them to translate their ideas into an article-format, to develop the necessary skills to write in Academic English and to experience what it means both to be self-critical and to be criticised in the face of peers. Secondly, it aims to counterbalance the apparent fetish on excellency that prevails in the current system. *INTER-SECTION*’s primary goal is not so much to support those who are already well-supported, but rather to offer an opportunity for those who have shown great potential yet lack possibilities and courage or simply shy away from high-impact journals and their self-proclaimed elitism. On the one hand, our agenda hence reflects the conviction that most student research is valuable *in and of itself* – and thus deserves to be visible – and that most of the skills to author a good-to-excellent scientific paper can be acquired quite easily after all.<sup>4</sup> On the other hand, *INTER-SECTION* wants to make room for a different vision of science than the one mainly propagated by institutions such as the ERC. This alternative view stresses that the scientific conduct, particularly in archaeology, must be conceived of as a *fundamentally collective* enterprise transcending one-sided teacher-student hierarchies<sup>5</sup>, and that, as a consequence, archaeological knowledge can only be substantially advanced when *wide-ranging horizontal rather than narrow vertical exchange and interaction* are promoted. This entails hearing the voice of students and being open to synergise with them. The respective vision of university and academic practices comes close to ‘and partly even extends’ what Jacques Derrida (2001) has famously termed the “unconditional university”.<sup>6</sup>

Addressing the gap between training and research also requires *new forms of engagement* between students and academic staff/researchers. *INTER-SECTION*’s referee system, where each student brings in her/his preferred referee to assist in conceptualising and writing the manuscript, can be seen as one such attempt. Ideally, this re-engagement results in close collaboration and supervision which not only improves the overall quality of the submitted papers, but also contributes to the formation of more intimate and significant student-staff interactions. In the long run, we hope that this

will help to set up a cooperative and co-inspiring climate in which the work of “Junior Archaeological Researchers” can impact and modulate research on the ‘senior’ level. To oversee a student’s thesis developing into a proper academic paper, in turn, can be quite rewarding for teachers. In the light of what has been learned while editing this journal for the last three years, we believe that this is perhaps the most significant contribution that *INTER-SECTION* can make on the faculty level.

Altogether then, counterbalancing an overly one-sided occupation with the “best-of-the-best” and providing a new and goal-directed platform for student-staff engagement throughout all stages of education and research can be defined as the primary concerns of *INTER-SECTION* as a journal “in-between”.

### Issue Contents

The five articles featuring in this issue of *INTER-SECTION* reflect the methodological, topical and intellectual diversity of Leiden’s Faculty of Archaeology: Kim Deckers’ contribution derives from research conducted in Bioarchaeology and addresses questions within the scope of Human Origins; Bo Schubert’s paper is well-situated in the research framework of the Near Eastern group in World Archaeology; the work of Nienke Verstraaten tackles questions in the Archaeology of the Americas; Vivian van Heekeren’s paper bridges Bioarchaeology and the Archaeology of the Middle Ages and the Modern Period; and Eline Amsing’s contribution, last but not least, is an expression of current work in Leiden’s department of Archaeological Heritage and Society. In what follows, the individual papers will shortly be presented in chronological order.

Deckers’ article re-examines the now classic endurance running hypothesis in hominisation in the light of new fossil data. Based on the critical review of the available skeletal evidence and the careful consideration of possible anatomical consequences of increased running stress in early *Homo*, the paper concludes that advanced running capabilities were probably not more than a by-product of a more general trend to increase walking efficiency in early human evolution. By criticising the view that endurance running represents a direct adaptive response to evolutionary pressures in the human lineage, Decker’s investigation makes an important contribution to ongoing debates on the emergence of the genus *Homo* and adds to the recent reappraisal of evolutionary complexity and

the mosaic character of anthropogenesis in Human Origins research.

Schubert’s contribution studies the wall-reliefs from the Neo-Assyrian palace of Nimrud. The author advocates the necessity to spatially contextualise the depictions before placing them into a broader socio-political and/or ideological framework. Her paper, drawing on previous studies, integrates spatial, textual (inscriptions) and iconographic data to show that our understanding of wall-reliefs can often be considerably enriched when the function and architectural characteristics of the rooms that hold them are also taken into account. Schubert concludes that architecture, space and depictions show a patterned relationship and are well-orchestrated at Nimrud. Her paper is a welcome contribution to ongoing discussions on the role of monumental architecture in legitimising early kingship and how this role is reflected in the spatial organisation of palaces.

Verstraaten’s paper investigates the relationship between Zapotec cosmology and what could be termed Zapotec ‘material practice’ during the Classic Period. Her contribution takes on the difficult task to evaluate possible links between the relative spatial position of Cocijo effigy vessels and the cardinal directions of the Zapotec world in the context of Tomb 104 at Monte Albán. Verstraaten’s approach is well-grounded in the theoretical framework of the wider anthropology of the region, allowing her to examine Tomb 104 as a *microcosm* of Zapotec cultural performances. This holistic perspective enables the recognition of non-trivial continuities between practices, materials (their shape, position and decoration) and imbricated perceptions of the world, tearing down major Cartesian dichotomies (human vs non-human, material vs non-material). Verstraaten’s contribution represents an important reflection on the co-constitutive nature of material culture and past worldview(s), yet it also reminds us of the importance of situated ‘micro-analysis’.

Van Heekeren’s article tries to re-assess the relationship between large-scale changes in living conditions during the Industrial Revolution and the formation of osteoporosis as a symptom thereof. Using London as a case study, the paper compares nine Medieval cemeteries with a total of sixteen post-Medieval cemeteries to establish whether skeletal proxies for osteoporosis increase over time. The paper advocates state-of-the-art methods of identification and upholds careful statistical comparison of osteological datasets. The

results convincingly show that developments in identification techniques greatly enhance our ability to detect cases of osteoporosis in the archaeological record and that osteoporosis ratios seem to have significantly increased from Medieval to post-Medieval times. These findings enable the author to criticise earlier work and to demonstrate that biology, social conditions and lifestyle represent deeply entangled variables. Van Heekeren's paper issues an important research mandate and adds critical insights to better understand the relationship between the social organisation of life and human health in more recent history.

In the last contribution, Amsing addresses the question of heritage in the context of Dutch society and stakeholder interests. This is an important paper since it touches upon one of the central mission statements of Leiden's Faculty of Archaeology in recent years, namely to render the relationship between past and present a society-wide undertaking again. That Amsing's paper deals with two Dutch heritage projects, the *Archaeological Park Matilo* in Leiden and the *Castellum Hoge Woerd* in Utrecht, reflects these efforts. Amsing recommends more reflexive strategies for managing heritage 'on the ground' and in a more 'bottom-up' fashion. Her results indicate that small-scale strategies of community engagement, which pay attention to regional and local particularities, seem to achieve the most satisfying outcomes for all participants. This, in turn, suggests that processes of identity-formation and 'shared-ownership' based on heritage can be actively stimulated. Amsing's paper thus once again demonstrates that heritage cannot be adequately protected when local communities are excluded from the equation.

### Acknowledgements

First and foremost, we would like to thank our contributing authors, Kim Deckers, Bo Schubert, Nienke Verstraaten, Vivian van Heekeren, and Eline Amsing, for their enthusiasm, motivation, persistence and willingness to share their ideas and findings with us in this third volume of *INTER-SECTION*. This is also the place to thank the faculty staff who acted as referees for these authors. They have demonstrated our invariable commitment and it cannot be stressed enough that *INTER-SECTION* would not be possible without their invaluable and indispensable support. We are grateful to all anonymous reviewers who participated in the review process and provided comments and constructive criticism to improve the final manuscripts.

There are many more people, of course, who have contributed in one way or another to the successful publication of this volume and it goes without saying that we are thankful to all of them even though they cannot be named individually here. As always, a special word of gratitude goes to the members of the Board of the Faculty of Archaeology, Leiden University, to our Editorial Advisory Committee and to all others who support our work in Leiden and beyond. Furthermore, we are indebted to Dr. Geeske Langejans and Dr. Gerrit Dusseldorp who generously agreed to direct this volume's skill-course for academic writing, certainly enhancing the quality of the present collection of papers. We thank Andrew Sorensen for proof-reading and revising this Editorial Statement.

Additionally, we are grateful to our new Editorial Board members, Yannick Boswinkel and Shumon Hussain, to take up the challenge and join our effort. The increasing number of applications demonstrates the added value of *INTER-SECTION*, but at the same time asks more and more of its Editorial Board members.

Last but definitely not least, we want to express our deepest gratitude to Dean Peeters, one of the founding members of our journal and a strong asset over the years. Unfortunately, the publication of this volume marks the end of Dean's editorial board membership. We thank him for his dedicated work, his great eye for details, his constructive feedback and his continuous support.

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1 'Education' (*Bildung*) pursues a holistic goal; it is a value itself since education affects the entire (educated) person; it is something that people might want to do for themselves and it will ideally change their being-in-the-world (Humboldtian ideal) (e.g. Scheler 1947). 'Training' (*Ausbildung*), to the contrary, is much stronger oriented towards utility; its value is measured in its effectiveness; training results in the ability and/or the know-how to do something.

2 Another more recent Dutch example for a funding policy that supports the few rather than the many is the 18,8 million Euro grant given to the 10-year project 'Anchoring innovation' headed by "leading scholars" of the Classical World; the project is funded by the Dutch Ministry of Education and one of the six research projects that received a so-called *Zwaardkrachtpremie* in 2017 (Gravitation programme of the Netherlands Organisation for Scientific Research (NWO)). 'Anchoring innovation' researches innovation processes in Graeco-Roman society.

3 In general, this reflects the education/training dichotomy. While education is tied to virtues such as self-reflection, general knowledge-sensitivity, epistemic curiosity and the like, training is usually linked to and valued through specific and well-defined skills. The tension between the two becomes perhaps most clear when the problem of *innovation* is concerned. Innovation - to generate new ideas and/or to come up with new creative solutions, is obviously not just a matter of having the necessary skill-set. Since the latter is mainly cultivated in the current system, however, innovativeness is a goal often difficult to reach.

4 This is the reason why each issue has so far been accompanied by an academic writing course organised by the Editorial Board and directed by faculty Post-Doctoral researchers.

5 A simple example is archaeological fieldwork where cooperation *on an equal footing* is often required to generate significant results.

6 The term “unconditional” refers to an ideal-state in which no power or interest conflicts can undermine the quest for knowledge and for critical self-reflection because tensions are positively transformed into a productive joint effort.

Peeters, D., R. Nieuwenkamp, M.B. Langbroek and R.J.C. Vlaskamp 2015. Editorial Statement – ‘Publish or Perish’?: Presenting the Work of Junior Archaeologists to a Broader Audience. *INTER-SECTION I*, 4-5.

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# THESE BONES WERE MADE FOR JOGGING

## AN ANALYSIS OF THE LOWER LIMB SKELETAL EVIDENCE FOR THE ENDURANCE RUNNING HYPOTHESIS

*Kim P. Deckers*

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### *Abstract*

*The endurance running hypothesis proposes that the anatomical features observed in the genus *Homo* evolved to increase long distance running capabilities. Proponents of this theory argue that the need for nutrient-dense high quality food packages to sustain a larger brain and body size would require *Homo* to hunt and track game over large distances. In order to hunt proficiently, Pleistocene hominins would need a suite of anatomical features that would allow running over sustained periods of time. This paper investigates the skeletal indicators associated with endurance running within the fossil hominin archaeological record. Data on the character of these skeletal indicators in Plio-Pleistocene hominins was analysed from the literature. A complete suite of anatomical features related to endurance running is not seen until *Homo ergaster* at 1.8 million years ago. However, a mosaic of these features is present in earlier Australopiths. This, combined with the lack of evidence for long range projectile weapons in the Pleistocene, indicates these features may have been positively selected for to increase walking efficiency and increased endurance running capabilities were just a fortunate by-product. Currently, there is insufficient evidence to support the notion that anatomical changes observed in early *Homo* evolved to increase running capabilities.*

### *Keywords*

*Hominin Fossil Record, Evolutionary Morphology, Plio-Pleistocene, Locomotion, Hunting Strategies*

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### **I**ntrouction

The endurance running hypothesis poses that early members of the genus *Homo* developed the ability to run over long distances and periods of time. Although poor sprinters compared to other mammalian species (Cavanagh and Kram 1989, 469), humans are more adept at long distance or endurance running. This type of running can only be sustained at speeds ranging from 2.5 – 6 m/s<sup>-1</sup> (Cavanagh and Kram 1989, 469), but can be maintained over a significant amount of time. Sprinting animals lack the ability to sustain their speed over longer periods of time, making it necessary for them to stop intermittently to cool

down before the next sprint (Bramble and Carrier 1983, 253; Garland 1983, 166). The endurance running hypothesis proposes that early hominins developed the ability for long distance running to take advantage of this fact, which would have made it possible to hunt wild game into overheating (Bramble and Lieberman 2004, 351; Carrier 1984, 486; Lieberman et al. 2006, 77). This in turn would allow hominins to acquire the prime portions of meat before other animals would encroach to scavenge the remaining meat (Lieberman et al. 2006, 78).

During the early Pleistocene several hominin species inhabited the African landscape. During this time

period, early *Homo* species, such as *Homo habilis* and *Homo ergaster*, show a significant increase in brain and body size compared to the earlier *Australopithecines* (Antón et al. 2014, 3). Larger brain sizes require more energy to maintain and thus more nutrient-dense food packages (Antón et al. 2014, 8; Pontzer, 2012, 347), which were probably attained by an increase in meat-eating (Kaplan et al. 2000, 156). The endurance running hypothesis proposes that long distance running and persistence hunting strategies were adopted by hominins to allow them to compete for meat with other African carnivores. Persistence hunting requires knowledge of animal behaviour, the ability to track, and the necessity of sharing with peers (Pickering and Bunn, 2007, 436) in order to hunt successfully. If the endurance-hunting hypothesis can be proven to be true, this will further our understanding of when increased cognitive and social skills evolved in the hominin lineage.

In 2004, the seminal paper by Bramble and Lieberman summarising the anatomical traits necessary for endurance running concluded that the capability to run over long distances and the associated hunting strategies did not evolve until the appearance of *Homo erectus* at 1.8 million years ago. The authors hypothesised that the ability to persistence hunt would have played a significant role in the dispersal of these creatures into Eurasia (Bramble and Lieberman 2004, 350). However, the validity of the endurance running hypothesis has been questioned by scholars that were unconvinced that the skeletal markers described by Lieberman and Bramble were indicative of increased running efficiency and not increased walking efficiency (Studel-Numbers 2006, 451; Studel-Numbers and Wall-Scheffler 2009, 359). The lack of post-cranial remains for many early *Homo* fossils also made it difficult to test whether these anatomical features were present. It has been over 10 years since the Bramble and Lieberman paper was published. Since then, new fossil finds of *Australopithecus afarensis* (Haile-Selassie et al. 2010, 12121; Ward et al. 2012, 2), *Australopithecus sediba* (Zipfel et al. 2011, 1417), *Homo georgicus/erectus* (Lordkipanidze et al. 2007, 305), *Homo floresiensis* (Jungers et al. 2009, 539) and *Homo naledi* (Berger et al. 2015, 5) have been discovered. These new finds may provide further evidence in support or against the endurance running hypothesis. This paper aims to re-assess the validity of the endurance running hypothesis in light of these new discoveries.

Feature	First seen
Narrow pelvis*	<i>Homo</i>
Enlarged iliac pillar	<i>Homo erectus</i>
Stabilised sacroiliac joint*	<i>Homo erectus</i>
Expanded surface area for mm. erector spinae origin*	<i>Homo erectus</i>
Expanded surface area for m. gluteus maximus origin*	<i>Homo erectus</i>
Long legs	<i>Homo erectus</i>
Expanded hindlimb joint surface area/robusticity	<i>Homo erectus</i>
Shorter femoral neck	<i>Homo sapiens</i>
Plantar/Longitudinal arch*	<i>Homo</i>
Close-packed calcaneocuboid joint/cuboid flange*	<i>Homo habilis</i>
Enlarged tuber calcaneus*	<i>Homo</i>
Permanently adducted hallux	<i>Homo habilis</i>
Short toes	<i>Homo habilis</i>

\* argued to be beneficial for running efficiency alone

Table 1. Lower limb anatomical features related to endurance running (After Bramble and Lieberman 2004, 348).

### Methodology

Bramble and Lieberman (2004, 348) identified 26 anatomical traits related to running efficiency. Of these, 13 were features that can be identified on the lower limb (tab. 1). This study focuses on several features in the lower limb. The reason for this limitation was threefold: 1) the lower limb is the only part of the body that makes contact with the substrate during locomotion. This makes the lower limb the most likely location where endurance running capabilities would be reflected in the morphology of skeletal elements; 2) many of the species under study have associated lower limb skeletal elements; 3) detailed descriptions of lower limb bone morphology and measurable data have been reported in the literature for these skeletal elements. While the pelvis is also involved in locomotion, this bone was excluded from this analysis due to the fact that its morphology is also heavily influenced by changes in ontogeny and growth and development within early *Homo* species (Rosenberg and Trevathan 2005, 164). A subset of the lower limb features described by Bramble and Lieberman (2004, 348) was analysed in this study (tab. 2), as these features were most commonly reported in the literature.

Feature	Function	Comments
Shorter Achilles tendon (shorter calcaneal tuber)	Energy storage	Running requires more energy storage and release in muscles and tendons than walking. A shorter calcaneal tuber, which is indicative of a short Achilles tendon, has been correlated with running efficiency (Raichlen et al. 2011, 304)
Longitudinal arch	Shock absorption and energy storage	Stores 17 percent of strain energy, which is needed during push-off in running (Kerr et al. 1987, 148).
Cuboid flange	Shock absorption and energy storage	A secondary indicator of the presence of a longitudinal arch (Bojsen-Møller 1979, 166).
Increased lower limb length	Increased stride length and energy efficiency	Longer stride length requires less oxygen consumption during locomotion in many terrestrial mammals, making it more energy efficient (Cavanagh and Williams 1982, Pontzer 2007, 1760 )
Increased lower limb/joint robusticity	Stress reduction	Running causes an increase in mechanical loading.
Shortened toes	Stability and efficiency	Shorter toes are beneficial for running economy (Rolian et al 2009, 718)

Table 2. Anatomical features used in this study.

Feature	Improves Walking Efficiency?	Improves Running Efficiency	First Seen
Achilles tendon length	No <sup>1</sup>	Yes, <sup>2,3</sup>	<i>Homo sapiens</i> <sup>3</sup>
Longitudinal arch	Yes <sup>4</sup>	Yes <sup>5</sup>	<i>Australopithecus afarensis</i> ? <sup>6</sup> , <i>Homo habilis</i> <sup>7</sup>
Cuboid medial flange	Yes <sup>4</sup>	Yes <sup>5</sup>	<i>Australopithecus afarensis</i> <sup>6</sup>
Increased lower limb length	Yes <sup>8</sup>	Yes <sup>9</sup>	<i>Homo habilis</i> <sup>10</sup>
Increased lower limb/joint robusticity	Probably <sup>11</sup>	Yes <sup>12</sup>	<i>Homo erectus</i> <sup>13</sup>
Shortened toes	Yes <sup>4</sup>	Yes <sup>14</sup>	<i>Homo habilis</i> <sup>7</sup> , <i>Homo sapiens</i> / <i>Homo neanderthalensis</i> <sup>14</sup>

Table 3. Appearance of anatomical features in the fossil record.

Gaining access to original fossil hominin specimens is incredibly difficult, and thus this paper is limited to assembling the necessary data exclusively from literary sources. Any and all literature on skeletal elements of fossils ranging from 3.2 million years old to modern humans were examined for the presence or absence of a set of skeletal traits (tab. 2). Where possible, measurements from the femur were collected to infer if changes in morphology between hominin species. Due to differences in measuring techniques between articles, not enough data could be collected to run statistical tests.

## Results

The results of this analysis (fig 1. And tab. 3) contradict the earlier findings that indicated that these anatomical traits were first observed in *Homo erectus*, and that they are more likely related to running efficiency as opposed to walking efficiency (Bramble and Lieberman 2004, 346). All lower limb skeletal features under study in this paper, with the exception of the calcaneal tuber and increased robusticity of the lower limb can be identified in hominin species older than *Homo erectus* (tab. 3). Femoral length, which was used as a proxy for limb length, increased over evolutionary time. An increase can already be observed between *Australopithecus afarensis* and *Homo habilis* (fig. 1).

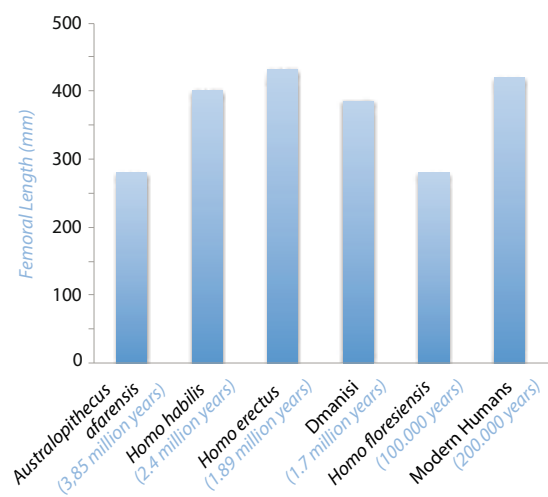


Figure 1. Femoral Lengths Across Fossil Hominins (Data taken from Jungers *et al.* 2009, 543; Lordkipanidze *et al.* 2007, 307; Trinkhaus and Ruff 2012, 35)

## Discussion

Proponents of the endurance running hypothesis argue that the anatomical traits described by Bramble and Lieberman (2004, 348) are more related to increasing running efficiency than walking efficiency. The results of this study suggest that some of these features are already present in hominins that are just starting to become bipedal (tab. 3). This would suggest that these features may have evolved to increase walking efficiency rather than running efficiency. However, it should be kept in mind that an early presence of these features does not exclude the possibility that their morphology did not become further adapted for efficient bipedal locomotion or running over evolutionary time. When a feature is solely related to running, as is the case with the calcaneal tuber, this still cannot provide conclusive evidence that endurance running evolved at around 1.8 million years ago with *Homo erectus*. Calcaneal tuber length is related to Achilles tendon length and solely correlated with running efficiency (Raichlen *et al.* 2011, 303). The comparison of calcaneal tuber length between modern humans and Neanderthals has shown that the latter does not exhibit a shortened tuber, which is correlated with efficient running, while the former does exhibit this feature (Raichlen *et al.* 2011, 304). Whether this represents an evolutionary reversal, or that shorter calcaneal tubers did not evolve until *Homo sapiens* cannot be answered until a *Homo erectus* calcaneus is found. Until such as fossil is found, it is only safe to say that modern humans exhibit the

elongated Achilles tendon necessary for endurance running. An increase in robusticity of the calcaneal tuber is observed in modern humans. This feature, combined with a shortened tuber, may be indicative of endurance running. Although too damaged to assess tuber length, a calcaneus from *Homo naledi* exhibits a gracile calcaneal tuber whose robusticity falls outside the range of modern human variation (Harcour-Smith *et al.* 2015, 2). This would indicate that this species may have been capable of running, but most likely did not engage in endurance running behaviours similar to that of modern humans. However, it has not been possible at this time to date these fossil remains to an accurate age range, which makes it impossible to assess where these creatures fall within the hominin sequence (Berger *et al.* 2015, 24; Dembo *et al.* 2016, 24; Stringer 2015, e10627; Thakerey 2015, 1).

Not only do most features described (tab. 3) appear before the appearance of *Homo erectus*, it is questionable whether these features are indicative of running at all. The increase in lower limb length (with the exception of *Homo floresiensis*) would be indicative of endurance running capabilities according to Bramble and Lieberman (2004, 348) and does occur in *Homo habilis* and *Homo erectus*. However, analysis of differences in cost of transport in walking and running in modern humans indicated that increased limb length was beneficial for both types of locomotion (Stuedel-Numbers *et al.* 2007, 195) and that endurance walking during persistence hunting is more energy efficient than endurance running (Stuedel-Numbers *et al.* 2007, 195; Stuedel-Numbers and Wall-Scheffler 2009, 359). Although it cannot be denied that *Homo erectus* shows a significant increase in lower limb length that may have been beneficial for endurance running, it should be noted that this trend of increased limb length can be observed in earlier *Homo* species as well. It could be argued that this increase in limb length may be an artefact of increased bipedal walking, not running. New fossil finds of *Australopithecus afarensis* (Ward *et al.* 2012, 39) further indicate that features such as the longitudinal arch were present much sooner in evolutionary history and are more likely related to increased bipedal walking capabilities, not running ability. The fact that shorter toes can already be observed in *Homo habilis* (Kidd *et al.* 1996, 285) further corroborates this notion.

A limitation of this study to testing the endurance running hypothesis is that it focused on the lower limb. Only one lower limb feature solely related to running efficiency was assessed; the calcaneal tuber length. The results of this study do indicate

that anatomical markers in the lower limb that were identified as indicators of running in previous studies could instead be markers of increased walking ability instead of running behaviours. Including other skeletal elements in the analysis may be beneficial. Bramble and Lieberman (2004, 348) describe several other skeletal features in the upper segment of the skeleton, such as the restructuring of the shoulders and thorax, and the shortening of the forearms, that according to the authors are solely related to running efficiency. The majority of these skeletal features are related to trunk stabilisation and redistribution of the centre of gravity during running (Bramble and Lieberman 2004, 349). Running involves a 'flight phase' where neither limb touches the ground, which would require greater control of balance than bipedal walking (Levine et al 2012, 57). However, these features may also be beneficial in walking. Future research should try to not only identify the presence of these features in the fossil hominin record, but also test their validity as markers of running efficiency over. Aside from skeletal markers, Bramble and Lieberman (2004, 348) list a number of soft tissue features, such as the increased size of the gluteus maximus, the erector spinae, and the presence of the nuchal ligament. Ascertaining the effect of differences in size of muscle insertions related to habitual running may provide additional skeletal markers to examine in the future.

Apart from the skeletal features described above as indicators of endurance running, several other lines of evidence also contradict that endurance running and persistence hunting had a significant role in the evolution of later *Homo* species. Before 400,000 years ago (Shea 2006, 823), there is no evidence of projectile weaponry, which would be necessary to initially injure the animal before running it into overheating (Pickering and Bunn 2007, 436). If *Homo erectus* did not have the technological means to persistence hunt, it is questionable that specific anatomical traits evolved to support this behaviour. This behaviour is also rarely seen in hunter-gatherers today (Pickering and Bunn 2007, 436) and less efficient than endurance walking (Stuedel-Numbers and Wall-Scheffler 2009, 359). Persistence hunting would also require the ability to track prey across large distances. Pickering and Bunn (2007, 435) note that the savannah-woodland environment in which these hominins lived, which was characterised by dense soil and vegetation covered ground, was ill-suited for tracking prey across large distances as these environmental conditions are not optimal for leaving tracks.

Finally, new finds in Georgia have indicated that as early as 1.7 million years ago, hominins migrated out of Africa (Dennell and Roebroeks 2005, 1099; Lordkipanidze et al. 2007, 307). These hominins do not yet have all the features necessary for endurance running. For example, the morphology of the longitudinal arch of the Dmanisi hominins does not yet resemble that of modern humans and may have impeded efficient walking and running to a degree (Lordkipanidze et al. 2007, 307; Pontzer et al. 2010, 501). The Indonesian find of *Homo floresiensis* has elongated toes, but a bipedally adapted lower limb. This elongation of the toe is puzzling, as this species is thought to be younger than *Homo erectus*. This elongation may represent an evolutionary reversal. However, it is unlikely that a feature so vital to efficient walking would reverse itself in a habitual biped (Jungers et al. 2009, 549). These new finds suggest that hominins inefficient in endurance running were able to disperse across Eurasia, contrary to Bramble and Lieberman's (2004, 351; Lieberman et al. 2006, 78) belief that running and persistence hunting would be necessary to achieve this.

### Conclusion

The aim of this study was to assess whether new fossil evidence discovered over the past decade could shed new light on the appearance of the anatomical features related to endurance running. Although limited to the lower-limb, this study cannot corroborate Bramble and Lieberman's conclusion that these features evolved for endurance running around 1.8 million years ago with the appearance of *Homo erectus*. The skeletal features discussed in this paper are beneficial to running efficiency. However, with exception of the calcaneal tuber, these features also increase walking efficiency. The results of this study suggest that endurance running may have been practiced from 1.8 million years onwards, but the earlier presence of many of these features in the fossil record suggest that endurance running most likely was not a driving force behind the evolution of these anatomical features. Furthermore, the lack of lithic evidence for persistence hunting associated with early *Homo* and the primitive morphology of the Dmanisi and *Homo floresiensis* lower-limb indicate that early *Homo* travelled long distances before the evolution of all features related to endurance running occurred. The most likely scenario at this time seems to be that the lower limb features discussed here evolved to improve walking efficiency in fossil hominins, and that increased running efficiency proved to be a beneficial by-product. Further analyses should focus on testing the validity of anatomical features identified to be

solely related to running, such as the decoupling of the thorax (Bramble and Lieberman 2004, 349), which may help identify these behaviours in the fossil record. Another avenue of study should be the effect of running behaviour on the internal structure of bone. Trabecular bone responds more sensitively to changes in mechanical loading than cortical bone (Ortner 2003, 22) and running behaviours may be reflected sooner in trabecular bone than in outer bone morphology. Combining analyses of outer bone and inner bone morphology in relation to running may give more insight or evidence in support of the endurance running hypothesis in the future.

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# CONTEXT FIRST

## A STUDY ON THE PURPOSE OF THE NIMRUD WALL RELIEFS, COMBINING THEIR SPATIAL CONTEXT AND IMAGERY

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### *Abstract*

*During the last decades, a large amount of research has been carried out concerning Neo-Assyrian palaces. The most well-known features of these palaces are the wall reliefs that adorned the palace walls, which have been extensively studied as well. These wall reliefs are mainly studied in isolation, often focussing on the iconography of the images and their meaning, without looking at their spatial context. The aim of this study is to investigate the purpose of the wall reliefs in the Northwest Palace of Nimrud, combining both the images depicted on the wall reliefs and their spatial context. Since the wall reliefs are often associated with ideologies and propaganda, this study will investigate other possible functions of the wall reliefs as well. First, the wall reliefs and the suites in which they are located will be considered, in order to see if a connection can be detected between them. Second, the wall reliefs will be examined in connection to the rooms that had the same function.*

### *Keywords*

*Archaeology of the Near East, Mesopotamia, Assyrian Empire, Northwest Palace, Ashurnasirpall II*

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### **I**ntrouction

Assyrian palaces have been extensively studied over the past decades, with a main focus on the royal palaces at Nimrud, Khorsabad and Nineveh (Barjamovic 2011; Kertai 2015; Oates and Oates 2001). Many of these studies have concerned themselves with the wall reliefs that adorned the palace walls. These reliefs have mainly been investigated in isolation, concerning the images themselves, their possible meaning, and their iconography (Albenda 1994; Ataç 2010; Watanabe 2014; Winter 2010). The reliefs are often associated with ideologies and propaganda, specifically hunting scenes and scenes of warfare (Liverani 1979; Reade 1979; Watanabe 2002). It is however problematic to make claims about these matters without studying the reliefs in their spatial contexts. Few visitors were allowed to enter the palace, yet

in order for the wall reliefs to be designated as a medium for propaganda, the reliefs needed to be seen by an audience.

In this article, Ashurnasirpall II's (r. 883 – 859) Northwest Palace at Nimrud will be investigated as a case study (see fig. 1). The Northwest Palace is particularly well suited for this research, since a great range of themes can be recognised within the depictions on the wall reliefs and the locations of the wall reliefs in the palace have been reconstructed by Meuszynski (1981), and Paley and Sobolewski (1987; 1992; 1997).<sup>1</sup> These reconstructions make it possible to study the reliefs in their original context. This article provides an examination of the spatial context of the wall reliefs in association with their imagery.



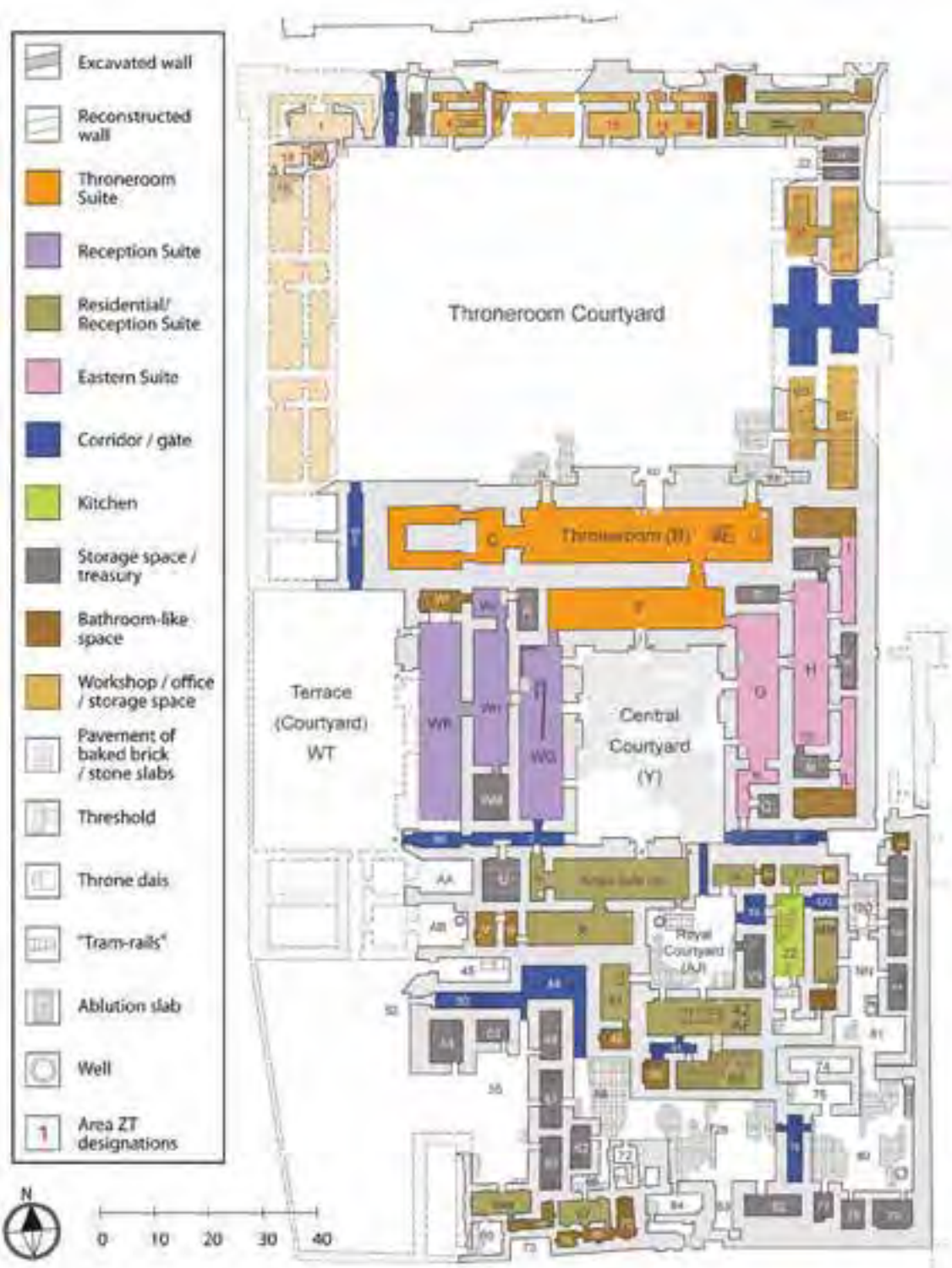


Figure 1. Floorplan of the Northwest Palace (Kertai 2014, 339; Courtesy of Dr. D. Kertai).

Wall reliefs that are associated with propaganda are expected to be located in the most accessible wings of the palace, where more visitors would be able to see the reliefs. Moreover, Russell (1998, 662) states that specific themes are present in individual rooms. This implies that the reliefs complemented the function of a room.

### **The Northwest Palace**

The Northwest Palace was situated in Nimrud and was built during the ninth century BCE by Ashurnasirpall II as the royal residence in his newly established capital (Oates and Oates 2001, 36). The palace can be divided into three areas, each having a distinct function: the administrative area, the official area and the private area. No wall reliefs were situated in the administrative area or the private area.<sup>2</sup> The official area housed four suites, which all had a distinct function, that were built around the Central Courtyard. Each suite could be reached through a courtyard or corridor, and the suites were also connected through an internal route that originated from the throneroom (Kertai 2014, 340, 344). The rooms situated in the official area were adorned with wall reliefs, but the corridors and courtyards were mainly undecorated.

The Throneroom Suite and the actual throneroom were accessible through the Throneroom Courtyard. The throneroom was the main reception area of the palace and the largest room in the palace. Its façade was decorated with narrative scenes depicting tributaries, guiding the visitors to the west entrance.

The Double-sided Reception Suite was located west of the Central Courtyard and was probably used as a secondary throneroom (Oates and Oates 2001, 55). It was both connected to the Throneroom Courtyard through corridor WZ and the Central Courtyard. Therefore, Kertai (2015, 35) states that visitors who were allowed to enter this secondary throneroom were privileged to go past the throneroom, but were not necessarily allowed to enter the rest of the palace.

The Eastern Suite housed a reception room, a retiring room, two bathrooms, and five storage rooms or treasuries. Russell (1998, 671-674) has argued that the function of the two bathrooms was to perform libation and purification rituals, which was supported by various architectural features. In room L, and possibly also in room I, there was a drain in the floor, and large slabs that could be interpreted as libation slabs and U-shaped basins were situated in both rooms. Furthermore, rooms L and I were paved with stone slabs and paved bricks, which could be

indicative of exposure to flowing liquids. The large amount of storage rooms is remarkable. These were the most centrally located storage facilities of the palace, and could be related to the rituals that were carried out in this suite.<sup>3</sup> Since this suite stood in direct connection to the Throneroom Suite, it is associated with royal activity (Kertai 2015, 38). The Eastern Suite was less accessible than the Double-sided Reception Suite, as it is not connected to the Throneroom Courtyard. However, both the Eastern Suite and the King's Suite were accessible through a back entrance connected to corridor P. It seems that this entrance would have been mainly used by the palace staff, and should not be considered as a main entrance.

The King's Suite was connected to the Central Courtyard and the Terrace Courtyard. This suite housed a reception room, a retiring room and a bathroom, and functioned both as a residential and reception suite. Architecturally, it is regarded as the most monumental Residential/Reception suite in the palace. The suite was oriented to the north, which is exhibited in the Throneroom Suite as well. This placement made the king architecturally more visible (Kertai 2015, 210). Because it is directly connected to the private area of the palace, it seems plausible that this suite was exclusively used by the king himself.

### **The wall reliefs**

Several themes can be recognised looking at the wall reliefs, which can be assigned to distinct categories, namely: hunting scenes, scenes of warfare, bringing of tribute, religious scenes, Standard-Inscription<sup>4</sup>, undecorated and undetermined (Schubert 2016, 24). Most of the reliefs consist of religious scenes which depict *genii*<sup>5</sup> and the so-called Sacred Tree<sup>6</sup>. With exception of the Double Sided Reception Suite, hunting scenes, scenes of warfare and tributary scenes are only present in the Throneroom Suite, and can also be regarded as narrative scenes. Reliefs were placed next to each other to depict a story, and could have been read like a comic book (Barnett 1970, 14).

The king is often portrayed as the central figure in these scenes, depicting hunts, warfare and the performance of rituals. Some scenes could be interpreted as historic events, whereas others had a symbolic meaning (Paley 1976, 1). Hence, Ashurnasirpal II had himself displayed in several ways. Russell (1998, 663) therefore argues that the wall reliefs are an expression of his ideologies. Even though each relief bears the Standard-Inscription, many plates are only inscribed with this text.

The doorways in the official area were mainly decorated with wall reliefs with apotropaic figures and the Standard-Inscription. Additionally, *lamassu* statues<sup>7</sup> were placed on both sides of several doorways. For the sake of the length of this article the doorways and, therefore, the colossi will not be taken into account<sup>8</sup>.

### Methodology

The available dataset is based on the earlier mentioned reconstructions of the original location of the wall reliefs by Meuszynski (1981), and Paley and Sobolewki (1987; 1992). The rooms will be discussed using the designated names that were also used in these volumes. Each relief has been assigned to one of the seven earlier mentioned categories, based on the images depicted on the reliefs. Unfortunately, at several locations it cannot be determined which reliefs and how many were originally placed there, and therefore an estimation will be made of the number of these missing reliefs. This is especially the case in The Double-sided Reception Suite, since almost no reliefs have been found *in situ*. These reliefs have largely been removed by a later king, to adorn the Southwest Palace<sup>9</sup>. The Double-sided Reception Suite will, therefore, not be incorporated in this research, because the context of the few identified reliefs cannot be determined.

There are four types of reliefs present in the Northwest Palace: (1) reliefs on which the image is depicted on the entire plate, (2) reliefs which bear two images that are separated by the Standard-Inscription, (3) reliefs of which the image partly covers the plate, and (4) reliefs that bear three images, and do not bear the Standard-Inscription. Reliefs of the last type only bear religious scenes (Schubert 2016, 24). Reliefs of type two can contain images from different categories. Therefore, the reliefs will be assigned to both categories and receive a value of 0,5, in order to make it possible to assign reliefs to two categories. In all the other cases, the reliefs will receive a value of 1,0. These values will be used in order to generate several graphs. The number of depictions of the king will also be taken into account.

First, the reliefs will be analysed per suite (thus, the Throneroom Suite, the Eastern Suite and the King's Suite). Since the Central Courtyard and several associated hallways are also decorated with wall reliefs, these will be assigned to the Central Courtyard and will also be taken account in this analysis. Second, the wall reliefs will be examined in connection to the rooms that had the same function.

### Results

Hunting scenes, tributary scenes and scenes of warfare were only located in the Throneroom Suite (see fig. 2). Both the Eastern Suite and the King's Suite were only adorned with religious scenes and the Standard-Inscription. This is also the case for the Central Courtyard, with the exception of one undecorated plate. The king was most often depicted in the Eastern Suite (n=23), followed by the Throneroom Suite (n=22) and lastly the King's suite, in which the king is only depicted once (see table 1).

Remarkably, the storage rooms are all decorated in the same manner. The bathrooms, corridors, hallways and retiring rooms are all adorned with either the Standard-Inscription, religious scenes, or both. With exception of the throneroom, the reception rooms are also decorated in a similar fashion (see fig. 3). As for the depictions of the king, these were mainly placed in the reception rooms, the adjacent hallways (rooms C and N), and the retiring rooms. Also, two images of the king were placed in the Throneroom Courtyard.

### Discussion

There are several patterns observable in the location of the wall reliefs of the Northwest Palace, which are related to the suite and the type of room in which they were located. Reliefs depicting narrative scenes were only found in the Throneroom suite. The tributary scenes are mainly located on the façade of the throneroom (D/ED/E), and were placed there in order to direct the visitors to the west-entrance of the throneroom. Paley and Sobolewski (1997, 334) therefore stated that tribute bearers were automatically informed about the royal protocol when appearing before the king. This is further emphasized by the two tributary reliefs that were positioned in the throneroom opposite of this entrance, which would make the route "complete". Hence, the wall reliefs were used to inform and direct its tributary visitors. The throne itself was situated on the eastside of the room and the visitors were directed throughout its entire length, passing several scenes of warfare and hunting scenes. (Kertai 2015, 30). Thus, a second function of the reliefs was to impress its viewers, and to make certain that the king was present through these depictions, even if he himself was not physically present at the moment.

The Eastern Suite has been identified as the location in the palace where rituals were performed by the king (Russell 1998, 671-674). Regarding the wall reliefs this seems very plausible, as the king is often depicted performing rituals, frequently assisted by

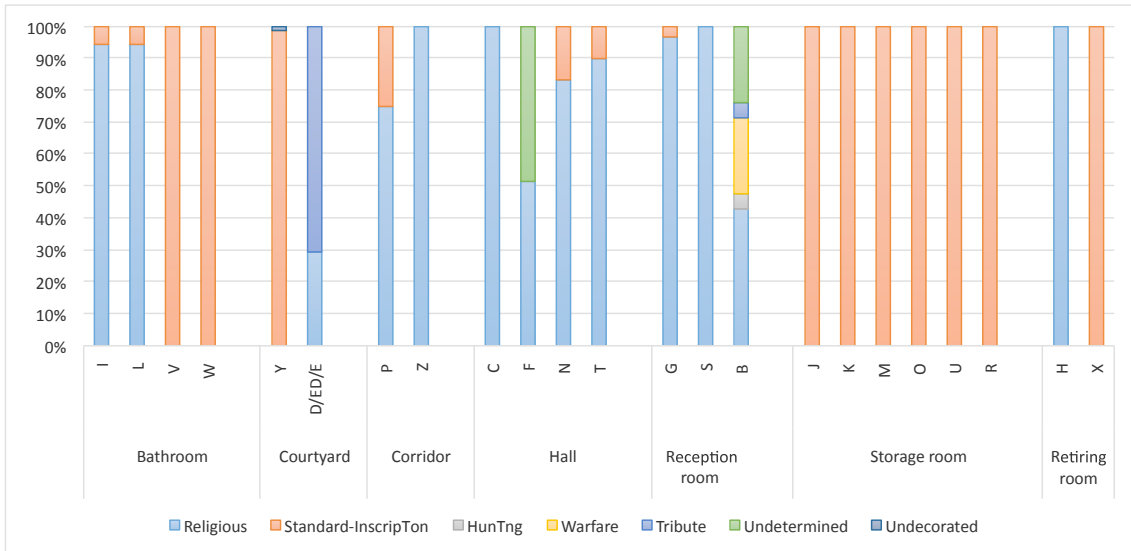


Figure 2. Percentage of wall reliefs in the corresponding suites.

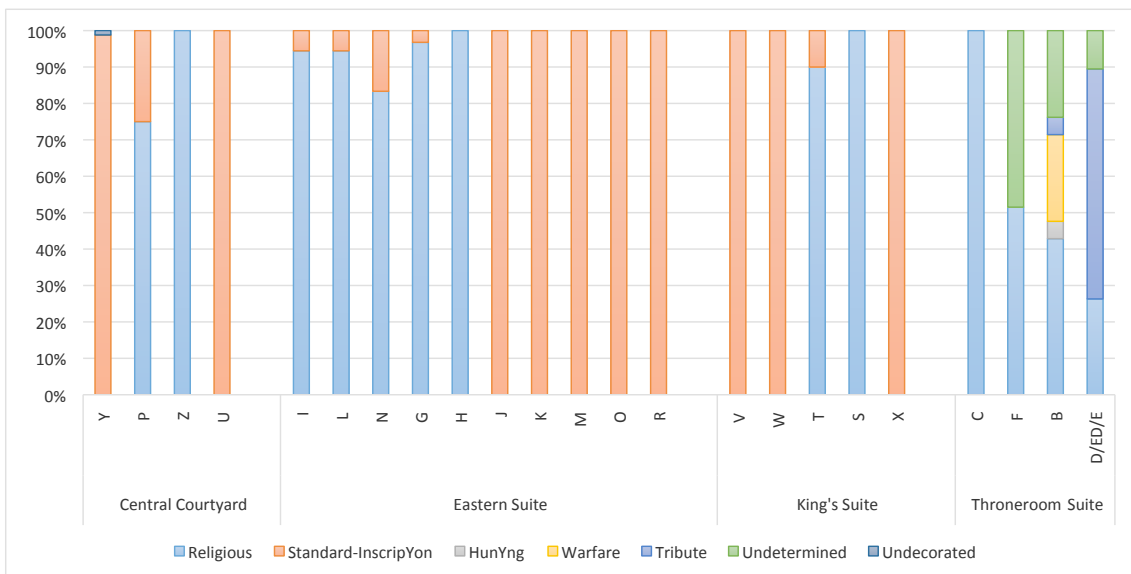


Figure 3. Percentage of wall reliefs in relation to the rooms with the same function.

*genii* and his servants. The depictions of the king are in this context not a medium for propaganda, but rather a way of designating the function of the room. This is also emphasized by the rather secluded location in the palace.

Although the reception room in the King's Suite was very monumental, it was not decorated with narrative scenes and only few depictions of the king were present. One was situated at the east-end of the reception room, where presumably a throne was situated (Kertai 2015, 41). The other depiction was

situated in a hallway, which was visible from the reception room, in the same style as the throneroom suite. The lack of narrative scenes could be related to the audience of this suite, as it probably had a more internal function, and was used only by the king and his officials.

Since the storage rooms were all decorated with the Standard-Inscription, it seems that in these rooms the Standard-Inscription served as a label of property. However, its use in the Central Courtyard and the hallways was probably more decorative, and

Suite	Function of the room	Room	Representations of the King	Religious	Standard Inscription	Hunting	Warfare	Tribute	Un-determined	Un-decorated	Total
Central Court-yard	Corridor	P	0	3	1	0	0	0	0	0	4
	Storage room	U	0	0	16	0	0	0	0	0	16
	Courtyard	Y	0	0	82	0	0	0	0	1	83
Eastern Suite	Corridor	Z	0	10	0	0	0	0	0	0	10
	Reception room	G	13	30	1	0	0	0	0	0	31
	Retiring room	H	9	25	0	0	0	0	0	0	25
	Bathroom	I	0	34	2	0	0	0	0	0	36
	Bathroom	L	0	34	2	0	0	0	0	0	36
	Storage room	J	0	0	11	0	0	0	0	0	11
	Storage room	K	0	0	14	0	0	0	0	0	14
	Storage room	M	0	0	12	0	0	0	0	0	12
	Storage room	O	0	0	10	0	0	0	0	0	10
	Storage room	R	0	0	12	0	0	0	0	0	12
King's Suite	Hall	N	1	15	3	0	0	0	0	0	18
	Reception room	S	1	29	0	0	0	0	0	0	29
	Hall	T	0	9	1	0	0	0	0	0	10
	Bathroom	V	0	0	11	0	0	0	0	0	11
Throne-room Suite	Bathroom	W	0	0	9	0	0	0	0	0	9
	Retiring room	X	0	0	24	0	0	0	0	0	24
	Reception room	B	19	18	0	2	10	2	10	0	42
	Hall	C	1	13	0	0	0	0	0	0	13
	Hall	F	0	17	0	0	0	0	16	0	33
Courtyard	D/ED/E	1	5	0	0	0	12	2	0	19	

Table 1. The amount of wall reliefs and depictions of the king per room.

had no direct relation to the function of these rooms and the surrounding suites.

As for the religious scenes, these are often only used as a way of decoration. In almost all rooms where religious scenes are situated, the corners are decorated with depictions of the sacred tree. Moreover, *genii* are often depicted on both sides of a doorway. However, this has been interpreted by Kertai (2014) as a way of directing people through the palace.

The removal of the reliefs in the Double-Sided Reception suite is however a major drawback to this research. Since it was also used as a reception suite and narrative scenes were also present, it could have given us more information on the use of these types of reliefs. Furthermore, in several rooms located in the Throneroom Suite (D/ED/D, B and F) the number and type of the reliefs could not be reconstructed. Therefore, only an estimation could be made of the original number of the reliefs.

### Conclusions and implications

This study shows that the wall reliefs had a strong relation to their location in the palace. This is reflected in both the suites and the specific rooms.

The images were not only a means of propaganda, but were used in a variety of ways. The reliefs were used to impress the visitors of the palace, to direct people through the palace, to designate the function of a room, to inform its visitors, and lastly to decorate the palace walls.

In future research, more attention should be given to the spatial context of wall reliefs. When studying these reliefs in isolation, a large amount of information is lost, while their contextualization can help us to better understand their role within human built space. Therefore, more research should be carried out with a greater focus on the images of the reliefs and their relationship to architectural geographies.

### Acknowledgements

First of all, I would like to thank Dr. B.S. Düring for his support and guidance during this research and my studies at Leiden University. Additionally, I would like to thank the Editorial Board and the peer reviewer for their feedback, and my family and friends for their ongoing support.

1 Many reliefs are now located in different museums all over the world. During the 20<sup>th</sup> century, many scholars were dedicated to trace these reliefs and to reconstruct their original positions (Kertai 2014, 338). These reconstructions were mainly based on the original excavation reports. Furthermore, sawn off reliefs could be connected to the bases that were still *in situ*, and new excavations were carried out that yielded several *in situ* reliefs (Russell 1998, 658). Although some details are still under debate, this extensive work is now considered finished.

2 The administrative area was built around the throneroom Courtyard and housed the offices of the royal secretaries and several storage rooms (Barjamovic 2012, 31; Mallowan 1966, 172). The private area was only accessible for the royal family and their servants. Two rooms were adorned with wall paintings with geometric patterns and a depiction of the king with his servants and prisoners (Kertai 2015, 43).

3 Unfortunately, we do not know what was stored in these rooms, but their primary function seemed to have been protection against humidity (Kertai 2015, 195).

4 The Standard-Inscription mentions the ancestry of the king and his achievements as a king (Paley 1976, 125-133). There is no clear explanation of its function, but several interpretations are given by Russell (1999): 1. The inscription served as a label of property (229); 2. The inscription was a means of decoration (229-300); 3. Since the Standard-Inscription bears a royal message, it was used to give every room and/or monument a royal appearance (300).

5 *Genii* are apotropaic figures, who are often depicted assisting the king while performing rituals (Black and Green 1992, 86). The king can also be assisted by his servants, which were all eunuchs.

6 The Sacred tree is often associated with purification rituals, when seen between two *genii*, or depictions of the king. However, three interpretations of the Sacred Tree exist: 1. It represents the 'tree of life' known from Genesis 2-3; 2. It represents a stylized date palm; 3. It is not a tree at all, but a cult object (Giovino 2007, 2-3).

7 A *lamassu* is an apotropaic figure which has a bull or lion body, and a human head and wings.

8 Suggested further reading: Kertai 2014.

9 Paley and Sobolewski (1987, 76, 78-79) identified thirty reliefs that presumably originated from the west-wing, but were not able to assign these to particular rooms. Some of these reliefs could have also been located on the north-wall of the throneroom.

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# INTERPRETING THREE ZAPOTEC COCIJO EFFIGY VESSELS FROM MONTE ALBÁN IN RELATION TO ZAPOTEC WORLDVIEW

## AN ANALYSIS OF CERAMIC COCIJO EFFIGY VESSELS FROM TOMB 104 AT MONTE ALBÁN, MEXICO, IN RELATION TO DIRECTIONS OF THE WORLD

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### *Abstract*

*The Zapotec Cocijo effigy vessels excavated from Monte Albán, Mexico are great in number and yet very little is known about the purpose and meaning of these objects. A lack of available data on the provenance of the Cocijo effigy vessels causes difficulty for any sort of research that is conducted on them. Regardless, in this paper an attempt is made to formulate a different methodology through which these effigy vessels may be interpreted. Data on three effigy vessels originating from the same tomb on Monte Albán will be analysed in light of the Zapotec worldview during the Classic period (±200CE – 800CE) and the meanings that were ascribed to the primary directions within this worldview. The three vessels which are examined in this study are aligned with each other within the tomb and all are oriented with their face to the east, the realm of life, and their backs to the west, the realm of death. Therefore it is suggested that there exists a connection between the position and orientation of the in situ Cocijo effigy vessels and the worldview of the Zapotec people.*

### *Keywords*

*Iconography, Worldview, Directionality, Ancestor Veneration, Animism*

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### **I**ntrouction

The research presented in this paper deals with arguably one of the most complex parts of humanity; our (religious) beliefs (Morris 1987, 21). Archaeologists are invariably limited to the material remains left behind by the peoples of the past, which puts researchers at a disadvantage when studying the religious structures, rituals and beliefs of past peoples (Insoll 2004, 1). However, a middle ground exists between the physical world of archaeological remains and the mental world of beliefs and religion that can be studied through worldview theory.

A worldview can be considered a “map” of how the world and the larger universe are constructed according to specific people an individual group of people (see for example: Arnold 1999; Hopkins and Josserand 2001; López García 2001; Radzin 1983; Roe 1982; Wilbert 2004). Researching past peoples using worldviews is possible, via extensive analysis of ritual and religious contexts such as tombs, burials, and associated material culture. This paper aims to interpret a set of three ceramic objects known as Cocijo effigy vessels in relation to the Zapotec worldview. The vessels – recovered from



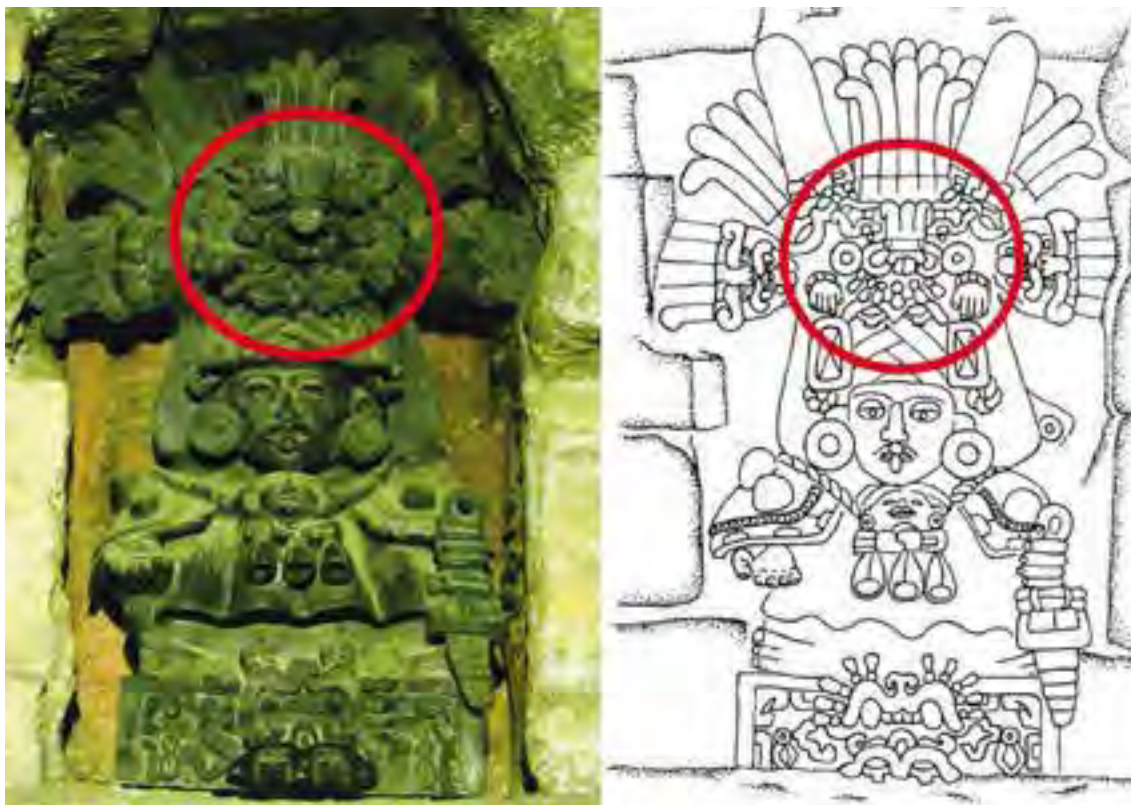


Figure 1. Side by side photo and drawing of the effigy vessel situated above the lintel of the entrance of tomb 104. It portrays a human figure sitting on a pedestal, wearing a headdress with Cocijo's mask in it. Encircled are the depictions of Cocijo's mask (editing done by author). Drawing: Farmsi.org (registration key: MAAt/104). Photo: Taken by author, courtesy to the Museo Nacional de Antropología.

Tomb 104 - were crafted by the Zapotec people who inhabited the site known as Monte Albán between 450 BCE and 750 CE, in the Oaxaca province in Mexico (see fig. 1).

Cocijo is the Zapotec deity of storms, lightning, rain and fertility and many different representations of this character are known from Monte Albán. Much is known about the iconography and meanings of Cocijo, yet the purpose of the three effigy vessels discussed in this paper remains widely unknown. Few assumptions have been made about the purpose of the Cocijo effigy vessels, even though theories concerning the purpose of effigy vessels in general do exist (e.g.: Caso and Bernal 1952; Marcus 1983; Sellen 2007). The aim of this research is to develop new means of understanding the three vessels from tomb 104 in regards to their purpose, by analysing their iconography, position and orientation in relation to current knowledge on the Zapotec worldview.

### Methodology

This research is based on an extensive literary study of the Cocijo deity, the Cocijo effigy vessels, the tomb context from which these vessels were recovered and the worldview of the ancient Zapotec people whom inhabited Monte Albán. Tomb 104 was selected due to the fact that is one of the few funerary contexts in Monte Albán with secure provenance and positional data on the vessels. It is also one of the few contexts for which detailed archaeological maps and drawings exists, which clearly indicate the vessels' *in situ* locations. The iconography on two of the three vessels portrayed full body representations and one partial representation of the Cocijo mask in a headdress of another figure. This allows the investigation of possible connections between vessel types and representational styles, in relation to their orientations and locations in the tomb.

### Theoretical orientation

One important aspect of ancient Zapotec religious practice, was the veneration of ancestral spirits and deities through the manufacturing and ritual use of

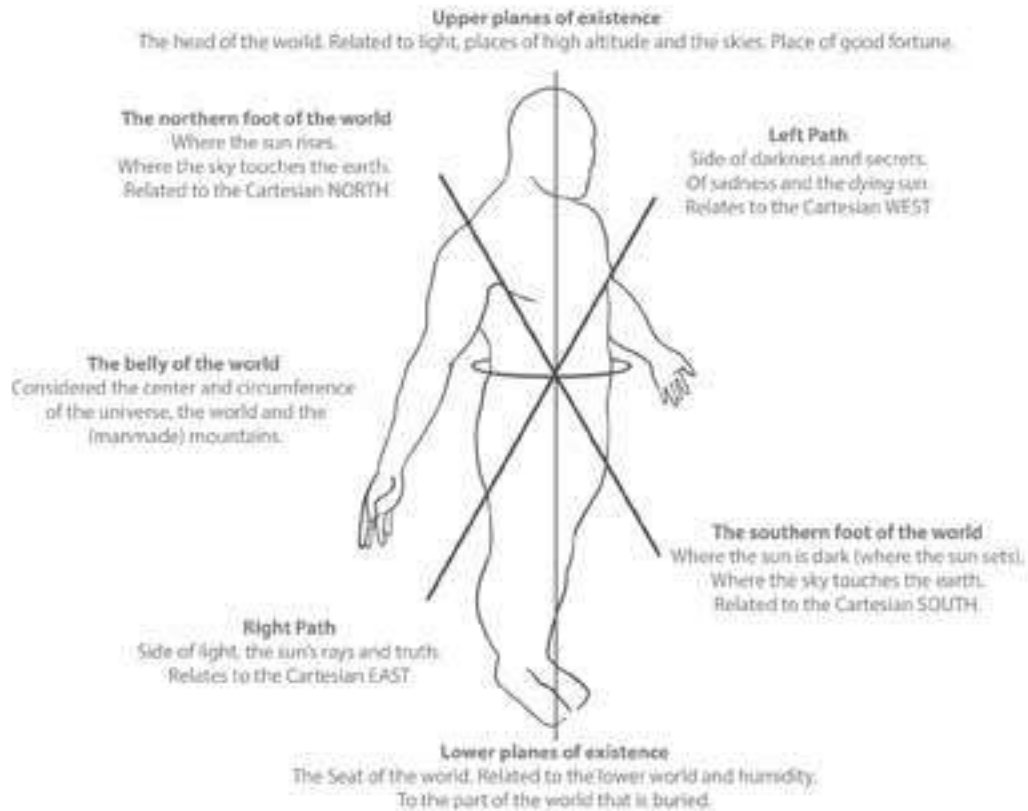


Figure 2. An illustration based on the seven recognised directions in combination with the vertical axis mundi in relation to the human physiology.

effigy vessels (Sellen 2007). For ancient Zapotec people everything in the world surrounding them was considered to be alive, animated by spirits and the forces of nature (Scarre 2011, 11; Marcus 1983). This is important when interpreting the effigy vessels because, for the people who made them, these items were believed to have been imbued with the essence of life and significant spiritual power. Representing a deity or sacred ancestral spirit in the shape of an effigy was enough to invoke the presence of these spiritual beings and to ensure a lasting connection with them (Fitzsimmons 2011, 53; Marcus 1983). A prominent theory posits that most effigy vessels do not directly depict deities and sacred beings, but more often are representations of people or sacred ancestors personifying these deities or sacred beings, by wearing masks and putting on distinctive clothing (Marcus 1983, 144; Sellen 2007, 99 en 126). The mask of Cocijo is a key element in this analysis and therefore warrants some attention (for a detailed description of the Cocijo mask, see e.g.: Caso and Bernal 1952, 17-18; Marcus 1983 and Sellen 2007, 155-159). In a Mesoamerican context the mask and its transformative powers are a widely used ritual tool (Markman and Markman 1990 XIII), which

makes it possible to temporarily adopt the identity of another person or being, without having to fully surrender your own (Markman and Markman 1990, XIV). Thus, effigies showing figures that brandish the Cocijo mask are imbued with the essence and identity of Cocijo itself, allowing the deity to be present in spaces where no (living) humans reside, such as tombs and burials.

It is a common aspect of pan-Mesoamerican belief that the world is a set of interconnected planes of existence, often referred to as a *tiered cosmology* (López Austin, 1993). In Mesoamerican worldviews this model is often shaped after the human body (Arnold 1999, 54; López García 2001, 290-291). In a tiered cosmology, the different planes of existence are connected through what is commonly referred to as the *axis mundi*; the central point of the world (Radzin 1983; Roe 1982, 136; Wilbert 2004). Where the Western world model recognises only four primary directions (north, west, south and east) the Mesoamerican worldviews commonly recognise six primary directions including west, east, north, south, up, down (see fig. 2). Sometimes, the models recognise a seventh direction: the centre of the world

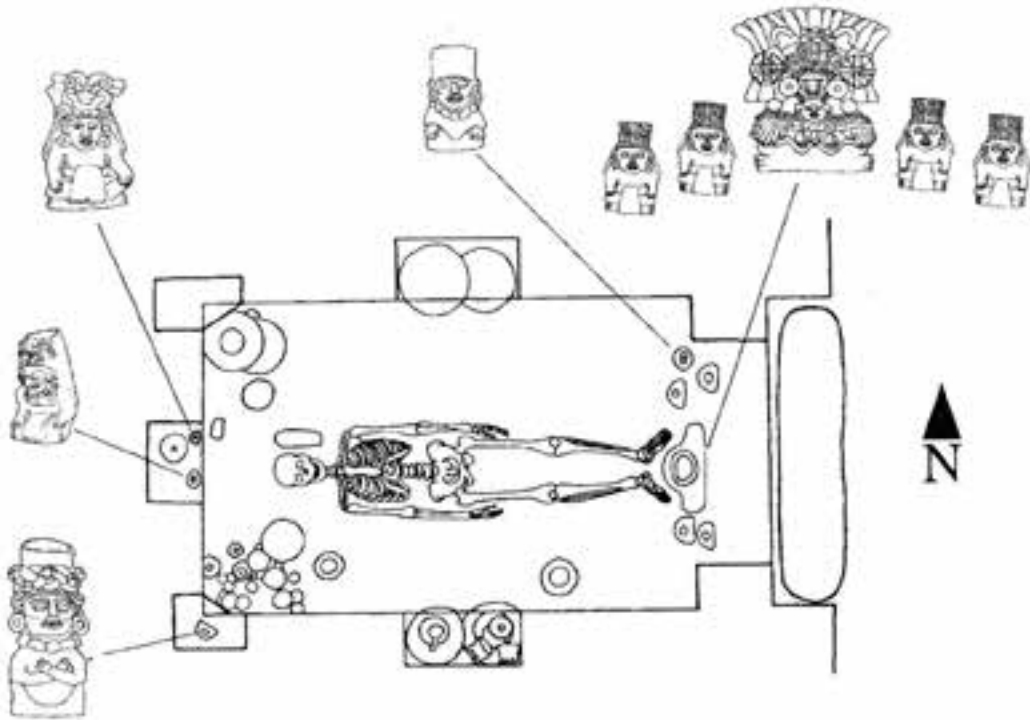


Figure 3. A schematic drawing which shows the layout of Tomb 104 and where all the different effigy vessels are located. The two Cocijo effigy vessels are located in between the feet of the skeletal remains and in the niche at the back, behind the interment's head. The drawing does not show the effigy which is located on the lintel above the entrance. It does show the doorway and cover stone. This drawing is an exact copy of Caso's original field drawing (Caso 2003, 138), with the addition of the lines and effigy vessel drawings. Source: Sellen 2007, 139.

(López García, 2001; Morris 1987, 133). This results in a set of orientations that can be represented in a three-dimensional model (see fig. 2).

An important part of ancient Zapotec worldview were the meanings they ascribed to the seven directions they recognised, based mainly on the movements of the celestial bodies and stars. The north and east were considered the directions of light, truth and where life prevailed. These directions were also associated with the rising and the shining sun (López García, 2001). Conversely the south and west were connected to darkness, secrecy and death. These directions were also associated with the setting and the dark (invisible) sun (López García, 2001). Urcid (2014) notes that burial structures which were built below houses were often located on the west side of the building, “suggesting a symbolic link between death and the setting sun” (Urcid 2014, 209). Similarly the north is related to the rising sun and the south is related to the setting sun. This is probably because during the summer solstice, the sun reaches the most northern point of its annual cycle, while during the winter solstice the sun reaches the southernmost point of its annual cycle (Hopkins and Josseland 2001, 3).

### Materials

This study focuses on Tomb 104 at Monte Albán. It was undisturbed prior to excavation, which means that all the artefacts and human remains were recovered in their original positions (Caso 2003, 107-125). This allows for a secure analysis of the orientation of the interment and the three Cocijo effigies, as well as their relative positions to one another. The single human interment is oriented west→east, with the head towards the far wall of the tomb and the feet towards the entrance (see fig. 3). The tomb contained three different Cocijo effigy vessels, two of which were located inside the tomb while the third was situated on the lintel above the entrance outside. The vessels all faced east, their backs directed towards the western wall of the tomb. This caused two of the vessels to face away from the interment and one vessel to face towards the interment. All three vessels show different representations of Cocijo. The first effigy vessel to be discussed is the one situated on the lintel above the entrance of the tomb. This effigy vessel is adorned with a very elaborate headdress in which the mask of Cocijo has been integrated (see fig. 1) and from which two small hands of the deity protrude, creating the impression that Cocijo

is actually inhabiting the headdress. The vessel was facing *away* from the tomb, towards the east.

The second effigy vessel to be discussed was situated inside the tomb, at the feet of the internment. This particular effigy portrays a figure sitting cross-legged with its hands resting on its knees. However, the character is wearing the mask of Cocijo over its face instead of in the headdress. The effigy vessel is accompanied by four smaller vessels representing the four *acompañantes*, which are often associated with the Cocijo deity (see fig. 3). This vessel too, faces to the east, away from the internment.

The last vessel to be discussed was positioned in one of tomb's western wall niches. This particular vessel is stylistically quite different from the other two. Unlike the other two vessels, it is not a representation of a human looking figure. Instead it is a cylindrical vessel, which is adorned with a seated Cocijo figure. Stylistically speaking this effigy vessel is relatively simple in its decoration, especially when compared to the two larger figurine vessels described above. It is the only vessel out of the three that is facing *towards* the internment, due to the fact that it was positioned behind the skeletal remains in the far west tomb wall.

### Discussion

As mentioned prior, Cocijo effigy vessels are believed to represent ancestral spirits who impersonate the deity through the wearing of a mask (Marcus 1983; Sellen 2007). This allows them to temporarily attain the deity's identity and powers. The different positioning of the masks, over the face or in the headdress could be related to the different ways in which Cocijo's presence is invoked. Relating this back to the vessels in tomb 104, several inferences can be made. If we consider that wearing a mask over the face is the 'true' form of impersonation, then the two vessels inside the tomb context are both true impersonations of Cocijo. By wearing the deity's mask over their faces, they effectively *solidify* him in the physical realm, on earth. On the other hand, the figure on the vessel in the niche outside is wearing the mask of Cocijo in its headdress instead of over its face. In this case the mask may signify the presence of Cocijo in spirit more than in the flesh as would be suggested with a true impersonation. This particular effigy is more suggestive of the deity watching over the individual rather than of an ancestor impersonating the Cocijo deity. Marcus (1983) takes notice of this difference as well and states that it "(...) *might represent contemporary royalty honouring both their ancestors and the supernatural by wearing*

*their likeness in the headdress*" (Marcus 1983, 148). Tomb contexts at Monte Albán were often revisited by the descendants of the deceased for ritual purposes (Middleton et al. 1988). Perhaps the vessel's position at the entrance of the tomb was to inform visitors of two things: 1) that Cocijo is represented by the ancestor who is interred in the tomb, and 2) that Cocijo's presence, or spirit, watches over the tomb, the ancestral remains interred within it and the living who visit. Thus, the vessels are not only a portrayal of the ancestral impersonation of Cocijo but also serve to tie the spiritual power of Cocijo to the context in which they are situated.

Considering the fact that all three vessels are oriented west → east, a hypothesis related to the Zapotec worldview can be formulated. The western direction is related to the realm of the *dying sun*, a place of darkness, sadness and secrecy. The eastern direction, on the other hand, is related to light, truth and the sun's rays. In other words it relates to the realm of the *living sun*. Therefore, when combining the meaning of the world directions with the orientation data of the effigy vessels, an interesting picture emerges. All three of the Cocijo effigies, which are in and of themselves an embodiment of fertility and ancestral veneration, have their backs literally turned in the 'direction of death' while they face towards the 'direction of life'. Furthermore Tomb 104 itself is oriented east → west, meaning that when one enters the tomb you face west, towards the realm of darkness and death. Conversely, when leaving the tomb one would face east, towards the realm of light and of life. The analysis of the Cocijo effigy vessels in relation to the worldview model can be taken another step further when one considers the *axis mundi*. In order for an orientation scheme to be applied to the tomb and effigy vessel, a centre point is needed from which the orientations can be determined. This point can be considered the *axis mundi* of the orientation scheme and the Cocijo effigy vessels may be fulfilling such a role in the context of this tomb. What becomes clear now is that the Cocijo effigy vessels is most likely an embodiment of the Zapotec worldview model. In the positioning and orientation of the vessels, implicit meaning related to the world directions are evidenced.

### Concluding remarks

The aim of this paper was to investigate the purpose of the three classical Zapotec Cocijo effigy vessels in relation to the Zapotec worldview, their iconography, as well as position and orientation within Tomb 104. The effigies are hypothesised to represent the ancient Zapotec worldview in the

shape of a microcosm, as their positioning inside the tomb seems to illustrate. All three vessels are oriented west → east, away from the realm of death and towards the realm of life. They therefore seem to serve as a means to exemplify the natural order of the Zapotec world view in their orientation and positioning. Furthermore, the vessels display different representational styles of the Cocijo deity, indicating a difference in their purpose. They may have served to either manifest the deity in a physical form or to represent Cocijo spiritually. If an effigy vessels portrays a human figure wearing the mask of Cocijo over their face, it is a means of manifesting the deity *physically*. If Cocijo is represented as a mask in the headdress of an effigy it may be indicative of the deity being present *in spirit*.

The analysis of the ancient Zapotec worldview in relation to the Cocijo effigy vessels is a new approach and warrants extensive further studying. Regardless, the initial results seem promising for the research field at large. If more vessels are recovered from future excavations it will certainly be worthwhile to include their orientation data in the study and analyses of these effigies, for it is a source of information that has yet to be further explored.

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# DETECTING SOCIAL CHANGE

## AN EXAMINATION OF THE ROLE OF THE INDUSTRIAL REVOLUTION ON OSTEOPOROSIS IN LONDON, UNITED KINGDOM

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### *Abstract*

*The period of the Industrial Revolution brought major changes in nutrition, lifestyle, and living conditions in London. These changes are conducive to the development of osteoporosis in the population. Osteoporosis is a metabolic bone disease, which is characterised by increased bone porosity, and may result in more fragile bones and fractures. The World Health Organisation has identified osteoporosis as one of the most prevalent diseases in the modern world, however archaeological sources remain mainly silent on the subject.*

*Data from London provided by the Museum of Archaeology London (MOLA) is compared to observe whether there is a change in prevalence of osteoporosis between the Medieval and post-Medieval period. This research shows that if advanced techniques, such as radiography, are incorporated within the osteological analysis more osteoporosis cases are found within the archaeological record. Structural incorporation of modern techniques will provide new insights in past populations.*

### *Keywords*

*Paleopathology, Metabolic bone disease, Medieval period, Post-Medieval period, Osteoarchaeology*

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### **I**ntrouction

According to the World Health Organisation, osteoporosis is one of the most prevalent chronic diseases in the modern Western World (Kanis 2007, 6). For instance, in the United Kingdom (UK) 53.2% of women and 20.7% of men aged 50 years and over will have an osteoporotic fracture in their remaining lifetime (van Staa et al. 2001, 519-520). Since it is such a prevalent disease today, it is remarkable that documentary sources on archaeological human remains remain generally silent about osteoporosis in the past (Mays 2010, 206).

Osteoporosis is a skeletal disorder characterised by increased porosity of bone. In elderly females, it is

especially associated with the menopause and the drop in oestrogen levels. This results in an increase in bone remodelling and bone resorption (Brickley and Ives 2008, 153). The balance between bone resorption and formation is thus disturbed and results in a reduced bone density (fig. 1). Affected bones are more fragile and prone to fracture (White et al. 2011, 447). There are different types of osteoporosis and it can be caused by multiple factors. Although the development of osteoporosis is known to be age and sex related, other influential factors include; genetics, ethnicity, physical activity, calcium intake, vitamin D deficiency, smoking, alcohol and caffeine intake (Agarwal 2008, 391; Karlsson et al. 2006, 620-624). The known relationship between these

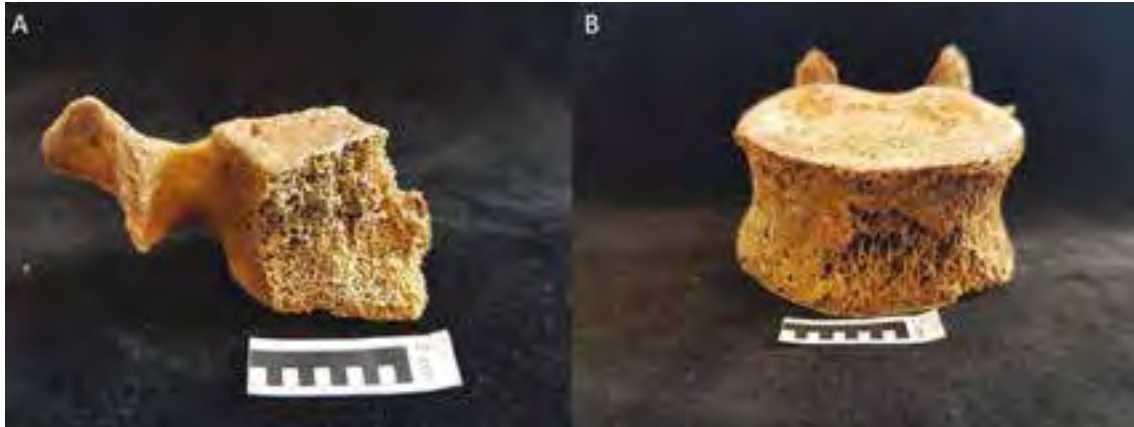


Figure 1. On the left (1a) is a section of a normal vertebrae visible and on the right (1b) a vertebrae affected by osteoporosis. The difference can be seen in both the external (cortical) and internal (trabecular) bone. The cortical bone in the right vertebrae is thinner and void spaces emerge in the matrix of the trabecular bone. Due to the thinner outer layer and larger gaps in the internal structure is the bone less dense and therefore more prone to fractures (photographs by S.A. Inskip, 2017).

factors and osteoporosis make it relevant to study this disease in past populations since its prevalence can reflect socioeconomic and environmental conditions in the past (Brickley et al. 2006, 136).

During the Industrial Revolution in Britain there was a change in nutrition, lifestyle and living conditions. London's population more than doubled in size during the eighteenth and nineteenth century, which had a dramatic influence on living conditions, especially for the poorer population (Schwarz 1992, 126). The urban expansion of narrow streets and industrial growth resulted in smog formation and blocked sunlight (Bucholz and Ward 2012, 333; Henderson et al. 2013, 256). Sunlight provides vitamin D, which is an important substance in the protection against osteoporosis. However, less sunlight would have affected the whole population of London.

These recorded changes in nutrition, lifestyle and living conditions during the Industrial Revolution are largely conducive to the presence of osteoporosis in a population. This leads to the expectation that a greater prevalence of osteoporosis would be expected in the post-Medieval period than in the preceding period. However, earlier research by Roberts and Cox (2003), using a crude prevalence rate (CPR) demonstrated a decrease in prevalence between the Medieval and post-Medieval period in Great Britain (2.62% Medieval and 1.20% post-Medieval period). Although, CPR is a sufficient method to examine a change, the authors admit that the percentage value for their post-Medieval sample is only based on two cemeteries in London.

Roberts and Cox (2003) recognise their limitations and therefore the rate based on the two sites could be a bias. This raises the question whether or not the crude prevalence rates presented for the Medieval and post-Medieval period are representative for the whole period and the whole of Britain. This is especially important since recent archaeological studies on osteoporosis in the UK compare their rates with the presented results from the study by Roberts and Cox (e.g. Miles et al. 2008, 155).

This study therefore aims to assess this trend by researching multiple sites from London. It will examine whether there is an increase or decrease in prevalence of osteoporosis during the time of industrialisation by comparing osteoporosis rates between analysed individuals from Medieval cemeteries and post-Medieval cemeteries in London.

#### Materials and methods

The data used in this research is derived from information provided by the Museum of London Archaeology (MOLA). The osteological material has been analysed by the Centre of Human Bioarchaeology (CHB) and has been published by MOLA in monographs or in the Wellcome Osteological Research Database (WORD). Using data generated by MOLA and CHB has the advantage that it all follows the same methods and analysis strategy. Biased comparisons between data derived from different institutions are thereby excluded.

Site	Date	Type of Cemetery	Status	Total*	Adults	F	F (OP)	M	M (OP)	I and U	I and U (OP)	Reference
Dominican Friary Carter Lane (PIC87)	13th c. - 1538 AD	Monastic	N/A	57	48	12	1	16	–	20	–	WORD database, 2015a
East Smithfield Black Death Cemetery (MIN86)	1348 - 1350 AD	Epidemic	N/A	636	420	104	1	189	–	127	–	WORD database, 2015a
Guildhall Yard (GYE92)	1050 - 1150 AD	Parish	N/A	68	47	15	–	18	–	14	1	WORD database, 2015a
Merton Priory (MPY86)	1117 - 1538 AD	Monastic	N/A	676	643	53	–	485	–	105	–	WORD database, 2015a
Saint Saviour Monastery Cemetery, Bermondsey Abbey (BA84)	1089 - 1538 AD	Monastic	N/A	201	200	–	–	147	–	53	–	WORD database, 2015a
Spital Square (NRT85)	circa 1200 - 1500 AD	Hospital	N/A	54	35	8	1	20	–	7	–	WORD database, 2015a
St Benet Sherehog (ONE94)	1280 - 1666 AD	Parish	N/A	39	24	4	–	8	–	12	–	WORD database, 2015a
St Mary Graces (MIN86)	1350 - 1540 AD	Monastic	N/A	389	283	68	–	136	1	79	–	WORD database, 2015a
St Mary Spital (SRP98)	circa 1120 - 1539 AD	Hospital	N/A	5387	4360	1883	2	2237	2	240	–	Connell et al. 2012
Total Individuals				7507	6060	2147		3256		657		
Total with Osteoporosis					9		5		3		1	

Table 1a. Synopsis of the Medieval cemeteries (Connell et al. 2012; WORD database, 2015a). Abbreviations: F=female, M=male, I=intermediate, U=unknown, and OP=osteoporosis. \*Total in this respect means total individuals analysed.

The data for nine Medieval cemeteries was collected for this research. The cemeteries date between 1050 and 1538 AD, with one exception: the Medieval burials from St Benet Sherehog (ONE94) which date to 1666 AD (tab. 1a). Data was also collected for a total of sixteen post-Medieval cemeteries, which date between circa 1540 and 1853 AD (tab. 1b). The distribution of the sites in Greater London can be found in figure 2a and 2b.

The prevalence of osteoporosis at the cemeteries calculated as the CPR will be compared with the results of Roberts and Cox (2003). The ratio

visualises the percentage of affected individuals with osteoporosis in relation to the entire excavated population. This approach has its limitations since the outcome of the CPR is applied to the overall population over a certain period of time, which also includes non-analysed adults and subadults. Type 3 of primary osteoporosis, which only occurs to subadults, is rare and secondary osteoporosis accounts for less than 5% of all modern clinical osteoporosis cases (Schultz 2003, 175, 177). Therefore, the statistical analysis will be based on adults only. Research also demonstrates that osteoporosis is related to sex and age and therefore



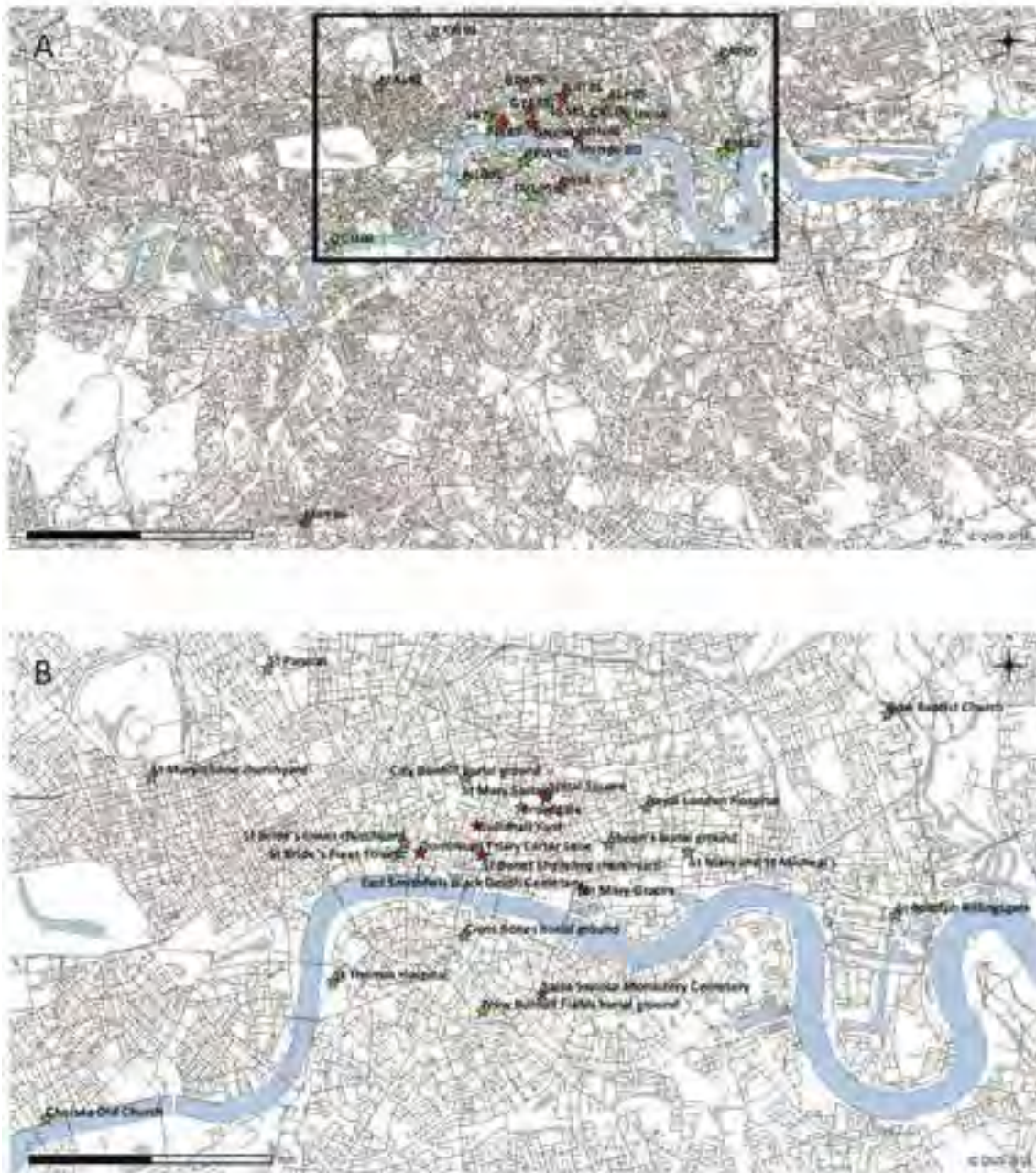


Figure 2a. Distribution of the Medieval and post-Medieval cemeteries with their corresponding site codes in Greater London. Red stars represent the Medieval cemeteries and the green stars the post-Medieval cemeteries (WORD database, 2015a and b). The outlined area has been enlarged in figure 2b.

Figure 2b. Enlargement of the outlined area of figure 2a. Distribution of the burial grounds in central London (WORD database, 2015a and b).

the prevalence data will be analysed separately per category to examine whether these factors influence the data. The CPR calculation will be followed by a statistical analysis of the collected data.

The large sample size of this study allowed the data to be statistically analysed with the Chi-squared ( $\chi^2$ ) method with Yates' correction. The latter provides a conservative statistical outcome for large data. This method is suitable to determine the correlation

Site	Date	Type of Cemetery	Status	Total*	Adults	F	F (OP)	M	M (OP)	I and U	I and U (OP)	Reference
Bow Baptist Church (PAY05)	Circa 1816 - 1853 AD	Urban - Baptist		416	214	115	3	86	–	13	–	Henderson et al. 2013
Broad gate (LSS85)	1569 - 1714 AD	Urban - Municipal	Low	150	76	33	–	20	–	23	–	WORD database, 2015b
Chelsea Old Church (OCU00)	1695 - 1842 AD	Urban	High	198	165	74	8	78	1	13	2	Cowie et al. 2008; WORD database, 2015b
City Bunhill Burial Ground (GDA06)	1833 - 1853 AD	Urban - Dissenters	Low	239	117	58	2	55	–	4	–	Connell and Miles 2010
Cross Bones Burial Ground (REW92)	1729 - 1853 AD	Urban	Low	147	44	27	1	12	–	5	–	WORD database, 2015b
New Bunhill Fields Burial Ground (DVL05)	1821 - 1853 AD	Urban - Private	Low	514	157	72	–	85	–	–	–	Miles and Connell 2012
Royal London Hospital (RLP05)	1825 - 1841 AD	Hospital	N/A	640	607	57	1	152	1	398	–	Bekvalac, pers. comm. 2015
Sheen's Burial Ground (CXL06)	1763 - 1853 AD	Urban - Private	Low	254	166	78	–	51	–	37	–	Henderson et al. 2013
St Benet Sherehog (ONE94)	circa 1670 - 1853 AD	Urban - Parish	Mixed	231	167	46	5	81	2	40	–	WORD database, 2015b
St Botolph Billingsgate (BIG82)	1540 - 1666 AD	Urban - Parish	Unknown	23	18	4	–	13	–	1	–	WORD database, 2015b
St Bride's Church Fleet Street (SB79)	1676 - 1853 AD	Urban - Parish	High	227	213	103	8	109	1	1	–	Bekvalac, pers. comm. 2015
St Brides Lower Cemetery (FAO90)	1750 - 1849 AD	Urban - Parish	Low	544	369	125	19	194	9	50	3	WORD database, 2015b
St Mary and St Michael's Burial Ground (LUK04)	1843 - 1854 AD	Urban - Catholic	Low	705	268	105	2	143	–	20	–	Henderson et al. 2013
St Marylebone (MAL92/MBH04)	circa 1740 - 1840	Urban - Parish	High	301	223	86	2	105	–	32	–	Miles et al. 2008
St Pancras (YKW01)	Late 18th c. - 1853 AD	Urban - Parish	High	715	532	224	6	231	–	77	–	Emery and Woolridge 2011
St Thomas' Hospital (NLB91)	1540 - 1714 AD	Hospital	Low	193	160	33	–	58	–	69	–	WORD database, 2015b
Total Individuals				5497	3496	1240		1473		783		
Total with Osteoporosis					76		57		14		5	

Table 1b. Synopsis of the post-Medieval cemeteries (Bekvalac, pers. comm. 2015; Connell and Miles 2010; Cowie et al. 2008; Emery and Woolridge 2011; Henderson et al. 2013; Miles and Connell 2012; Miles et al. 2008a; WORD database, 2015b). Abbreviations: F=female, M=male, I=intermediate, U=unknown, and OP=osteoporosis. \*Total in this respect means total individuals analysed.

between two variables within categorical data. It demonstrates an association between variables and whether the outcome is statistically significant (Fletcher and Lock 2005, 125). When the outcome of the Chi-squared method is close to zero then there is no evidence of association (Fletcher and Lock 2005, 131). There is a significant relation between evidence when the result is equal to or larger than  $\chi^2 = 3.84$  (Fletcher and Lock 2005, 202). Results were determined to be statistically significant when the P-value was equal or below the 0.05 level.

**Results**

In total, the data from 9556 individuals analysed by MOLA were available for this research. From the nine Medieval cemeteries included in the WORD database and monographs, 6060 adults were analysed of which nine individuals showed skeletal changes conforming osteoporosis. Of the sixteen post-Medieval cemeteries evaluated, which contained 3496 adults, 76 individuals show skeletal changes diagnosed as (possible) osteoporosis. The distribution per site of males and females of different ages affected with osteoporosis can be found in the previous mentioned overview tables: 1a and 1b.

The CPR calculated for the Medieval period is 0.07%. Three of the sites contained zero individuals with osteoporosis and five cemeteries had one individual in their excavated population with osteoporosis. The calculated CPR for the post-Medieval period is higher with 1.08%. Five cemeteries contained no individuals with osteoporosis. However, four post-Medieval cemeteries exceed this average post-Medieval CPR with large numbers. These cemeteries are: St Benet Sherehog (post-Medieval graves) with 2.55%, Chelsea Old Church with 3.79%, St Bride’s Church Fleet Street with 3.96% and St Brides Lower Cemetery with 5.16%. Overall, the result of the Chi-squared test demonstrated a strong statistically significant difference in the prevalence of osteoporosis between the samples from the two periods (P-value = < 0.0001,  $\chi^2 = 100.879$ , 1df). These results demonstrate that here is more osteoporosis in the post-Medieval period.

Since osteoporosis can be linked to sex, it is useful to look at statistical differences between males and females with osteoporosis in the Medieval and post-Medieval period. However, the number of affected adults in the Medieval period is too small to make any meaningful comparisons. The result for the post-Medieval period (tab. 2a) shows an extremely significant result for the relationship between sex and osteoporosis (P-value = < 0.0001,  $\chi^2 = 33.707$ , 1df). This indicates that females are more affected with osteoporosis than males in this period.

	OP	No OP	Total
post-Medieval Males	14	1459	1473
post-Medieval Females	57	1183	1240
Total	71	2642	2713

Table 2a. Contingency table for analysed males and females from the post-Medieval period.

	OP	No OP	Total
Medieval Males	3	3253	3256
post-Medieval Males	14	1459	1473
Total	17	4712	4729

Table 2b. Contingency table for analysed males with osteoporosis between periods.

	OP	No OP	Total
Medieval Females	5	2142	2147
post-Medieval Females	57	1183	1240
Total	62	3325	3387

Table 2c. Contingency table for analysed females with osteoporosis between periods.

To assess if one or both sexes were more or less affected, prevalence rates were calculated for each sex. To assess whether osteoporosis prevalence rates differed between Medieval and post-Medieval males, their prevalence rates were compared (tab. 2b). The difference is again highly significant (P-value = < 0.0001,  $\chi^2 = 18.531$ , 1df). The relationship for females with osteoporosis (tab. 2c) between the Medieval and post-Medieval period is extremely significant (P-value = < 0.0001,  $\chi^2 = 80.887$ , 1df). This suggests that both sexes are more affected with osteoporosis in the post-Medieval period.

	OP	No OP	Total
post-Medieval 36-45 Years	6	650	656
post-Medieval ≥46 Years	59	683	742
Total	65	1333	1398

Table 2d. Contingency table for individuals with osteoporosis in two different age categories for the post-Medieval period.

## Discussion

It is known that osteoporosis correlates with an increasing age. Therefore, the two affected age categories, 36-45 years and the  $\geq 46$  years and older, have been studied for both periods. Unfortunately, the data does not provide enough results for the Medieval period to calculate the expected frequency for the Chi-squared method. The relationship between these two categories for the post-Medieval period (tab. 2d) shows a significant correlation (P-value =  $< 0.0001$ ,  $\chi^2 = 37.318$ , 1df). Effectively, this means that with the increase of age there is an increasing chance to develop osteoporosis as well.

At the end of the Medieval period, significant advances in science and technology resulted in the Industrial Revolution. The changes brought about by this had a dramatic effect on environment, lifestyle, and diet. As many of these changes would favour the development of osteoporosis, this study aimed to see whether there was a general increase in the prevalence of osteoporosis from the Medieval to the post-Medieval period. The results demonstrate that the crude prevalence rate of individuals affected by osteoporosis increases from 0.07% for the Medieval period to 1.08% for the post-Medieval period, a statistically significant outcome. Analysis of sex specific changes show that the increase of affected females with osteoporosis was a significant factor in the rise of the overall percentage.

It is known from clinical research that elderly females are systematically more affected by osteoporosis than males and younger individuals. This expectation is confirmed in this research with the statistical results for females and older adults that suffer from osteoporosis. In addition, the expected factors that could have influenced the prevalence of osteoporosis during the Industrial Revolution are reflected in again significant results for the post-Medieval period with the increase of individuals with the disease in general. However, the problem with the older adult category is that this is a very large category wherein no distinction can be made between individuals in their forties or nineties. It might be possible that more individuals reached this age during the post-Medieval period or became older in general, which could have led to an increase in osteoporosis during this period.

It is questionable whether the osteoporosis CPR composed by Roberts and Cox (2003) for the post-Medieval period in Great Britain is representative for other cemeteries. This current study presents more results from multiple sites in London and

shows the opposite trend. Nevertheless, care should still be taken when comparing these results to cemeteries from elsewhere in Britain, since the industrialisation was far more extensive in London than it was in smaller cities or rural areas.

While this paper tries to limit the impact of inter-observer error by using data collected by the same institution, it is of course possible that some differences may still be a product of different data collectors or by when they were researched. The Medieval cemeteries discussed in this research were excavated between 1984 and 1998, while more than half of the post-Medieval ones were excavated in the 21<sup>st</sup> century (Van Heekeren 2015, 60). The WHO determined the definition of osteoporosis in 1994. It is likely that the increase in osteoporosis cases in archaeology was influenced by the introduction of this definition and the development of methods to detect osteoporosis in archaeological human remains (Waldron 2009, 120). An example of improved detection of osteoporosis in archaeological human remains are the results from the St Brides Lower Cemetery. This site was used for composing the CPR found in Roberts and Cox (2003) and eight individuals were affected with osteoporosis in the original study from Molleson and Cox in 1993 (Roberts and Cox 2003, 355). The population of this cemetery has been re-examined by Brickley (1997) using modern techniques and this resulted in 31 individuals with skeletal changes conforming to osteoporosis (WORD database, 2015b). The advances of science and the use of medical technology, which is recently also more frequently used in osteoarchaeology, allow for better detection of osteoporosis and will most likely result in an increased detection of affected individuals in the future.

Despite the availability of improved detection techniques, osteoarchaeologists still struggle with the definition of osteoporosis and how to determine when an individual was affected by this disease or not. This is also visible within the MOLA database where osteoporosis sometimes was recorded as a pathology, although based on different characteristics. The diagnosis could be based on the bones feeling lightweight and the age and sex of the individual, while on other occasions an individual should at least have one osteoporotic fracture (WORD database, 2015). Waldron (2009) argues that the true prevalence of osteoporosis will be underestimated in past populations when researchers only count the individuals with an osteoporotic fracture. However, counting osteoporotic fractures is the only way to

make the results repeatable and comparable for future research (Waldron 2009, 121). It is a sincere problem that there are no standards at the moment for investigating osteoporosis in past populations. This research shows that there is certainly potential for future research to study osteoporosis in past populations, nevertheless a clear defined definition and systematic method for diagnosis should be developed.

### Conclusion

The aim of this paper was to reveal whether there is a change in prevalence of osteoporosis from the Medieval to the post-Medieval period in London. Earlier research pointed to a decrease, while the change in nutrition, lifestyle and living conditions would suggest an increase in osteoporosis. With the presented results in this paper, it becomes clear that during the industrialisation period in London there is an increase in prevalence of individuals affected by osteoporosis. This increase is shown by both the crude prevalence rate and the statistical analysis using the Chi-squared method. Although there is a trend visible in this data, it is unclear whether this is a specific result of the Industrial Revolution or the increase in advanced research methods. Future research should incorporate advanced methods in osteological analysis to examine more closely the influence of the Industrial Revolution on health, disease, and the development of osteoporosis.

It is a limitation that there are currently no standards for investigating osteoporosis in past populations. This is especially problematic when researchers would like to make their results repeatable and use them to measure trends. It is recommended for future research to produce a standard for the examination of osteoporosis in archaeological human remains. Even though research could be improved, the findings from this study contribute to the current literature. This is the first study that demonstrates an increase in osteoporosis during the Industrial Revolution in London based on a larger dataset than mentioned in previous studies. It therefore provides new crude prevalence rates for osteoporosis and statistical results for sex and age categories in the Medieval and post-Medieval period in London. When the recommendations for further research will be incorporated in the future it will provide new insights on osteoporosis and therefore on lifestyle and living conditions in the past.

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# ASSESSING STAKEHOLDERS' VALUES AND INTERESTS FOR ARCHAEOLOGICAL PARK MATILO AND CASTELLUM HOGE WOERD, THE NETHERLANDS

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## *Abstract*

*Heritage is a dynamic concept. The significance of heritage and the values attributed to it differ from person to person. This has influence on how we deal with heritage and the decisions we make in heritage preservation. In the heritage sector, values assessments have gained attention in academic research on international level. However, a better understanding of the values attributed to archaeological heritage by different groups of stakeholders is needed to better respond to the various perspectives on heritage values in heritage preservation and public archaeology projects. More knowledge about stakeholders' values and interest will also contribute to effective stakeholder engagement practices. This study contributes to this by means of a values assessment and stakeholder analysis of two case study projects, Archaeological Park Matilo in Leiden and Castellum Hoge Woerd in Utrecht.*

## *Keywords*

*Heritage Values, Stakeholder Engagement, Archaeological Site Park, Roman Castellum, Heritage Preservation*

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## **I**ntrouduction

“One should wonder what identity really is”, a frustrated farmer living next to the archaeological site of the Hoge Woerd said. “Well, here identity is imposed on you. (...) The Romans are declared sacred and everything has to make way for it”. To this farmer, this particular site has a social value, as it is his home territory. He feels attached to the place because his grandfather started a fruit orchard at this location over a hundred years ago. He also values the location for economic reasons, because it is in his interest to maintain a prosperous business. Archaeologists, on the other hand, value the site for its historic and scientific significance, as it conveys a relation to the past and provides data for research. How can these diverging values and sometimes conflicting interests and contrasting ideas be united in heritage preservation projects?

Heritage is a dynamic concept (Frijhoff 2007) and the values attributed to heritage differ from person to person, change over time, and are influenced by political ambitions, social ideals, and economic strategies (e.g. Avrami et al. 2000; Duineveld and Kolen 2009). This has considerable influence on how people deal with heritage; values strongly shape the decisions that are made in spatial development, policy directions, and heritage preservation. Values-based management considers the creation of a dialogue with other stakeholders in cultural and spatial transformations as important, as well as the assessment of all the values attributed to heritage by different stakeholders with an interest in heritage preservation projects (e.g. Jerome 2014; Kolen 2008; Mason 2002; Myers et al. 2010).



Figure 1. Archaeological Park Matilo (Buro JP)

Participation in heritage management is not (yet?) common in the Netherlands, but this topic has gained more attention in academic research in the last few years (Duineveld 2007; Duineveld et al. 2008; Groenendijk 2015; Van den Dries 2014). From the literature, it seems that there is a discrepancy between studies about the benefit of value-centred heritage management and policies that stimulate participatory governance on the one hand, and the current practice in archaeological heritage management on the other. Although it is known that we have an interested and supportive audience (Van den Dries 2014), more understanding of the values attributed to archaeological heritage by different groups of stakeholders is needed for sustainable heritage management and effective community engagement.

For my master thesis in heritage management (Amsing 2015) I intended to identify for what reasons archaeological sites are valued and what the interests are of the stakeholders involved. Which values are prioritised by those in charge and what are the thoughts of stakeholders about this? I evaluated this for two case study projects, Archaeological Park Matilo in Leiden and Castellum Hoge Woerd in Utrecht. I chose these case studies, because they both concern archaeological site parks in the Netherlands situated in the middle of lively neighbourhoods. Also, in both projects a range of stakeholder groups were involved and both sites are part of the Roman Limes, which is on the World Heritage tentative list.

### **The case study projects**

Archaeological Park Matilo in Leiden, which officially opened in September 2013, covers and protects the archaeological remains of the listed monument of the Roman *castellum* Matilo (fig. 1). The idea of the city council was to incorporate the archaeological monument in a park, a green area where people from the socially very different neighbourhoods of Roomburg and Meerburg could meet and recreate. Besides, it was hoped that the history of the site would add identity to the new neighbourhood of Roomburg, and that it would attract tourists to visit Leiden and Matilo too (Gemeente Leiden 2008 & 2009; Bureau Buiten 2012; Provincie Zuid-Holland 2014).

The archaeological site of De Hoge Woerd is situated in the relatively new city district Leidsche Rijn, West of Utrecht. The site is listed as a monument since the 1960s as it consists of a Roman *castellum* from around 50 CE on a meander of the river Rhine. The reconstructed *castellum* forms a park, named Castellum Hoge Woerd (fig. 2). It contains a museum (developed by the municipal Heritage Department), a restaurant, a city farm and a theatre (Projectbureau Leidsche Rijn 2007). Castellum Hoge Woerd opened in August 2015.





Figure 2. Castellum Hoge Woerd (Your Captain Luchtfotografie)

### Methodology and data collection

Different kinds of stakeholder groups were involved in the two projects, from people involved because of their expertise, to public officials, volunteer representatives of groups of people (lay stakeholders), and the wider public. To understand their role in the development of the park, their values at stake, and their interests in the park, interviews were conducted, because they are sensitive to contextual relationships and therefore indispensable in research to heritage values (Mason 2002, 16). Questions related to what they found successful and less successful in the development of the park, their role in the project, what they cared about in relation to the park, and what recommendations they had for future projects.

Twenty interviews were conducted with selected stakeholders of local organisations and businesses, authoritative bodies, and community interest groups. In order to get a solid grip on the viewpoints of different stakeholders, representatives of the

most obvious and largest stakeholder groups were interviewed. Because of a possible subjectivity bias, additional interviews were held that led to the same results. Information gaps that could not be filled during the interview phase were investigated during an adjacent literature study.

To position the stakeholders, a division was made between direct/primary stakeholders and indirect/secondary stakeholders. In the development of Castellum Hoge Woerd, the municipal project manager, the State Service for Cultural Heritage (RCE), and the four-partner coalition (museum, theatre, restaurant, city farm) were the direct stakeholders. In Archaeological Park Matilo, similar parties formed the project management. They were the key players that were directly involved in governance, held power over decision-making, and formed the programs. Other stakeholders were indirect stakeholders. They had an interest in the park and values at stake, but they lacked the power to have a main voice in the decision-making process.

Comparing the degree of power or influence in the planning and decision-making process with the degree of interest in the project, further differentiated the groups of stakeholders. Commitment to the project, as demonstrated by the investment of time and resources and eagerness to engage in debates around the project, determines the degree of interest in the project of a certain stakeholder group. The resulting diagram (fig. 3) is commonly used to determine stakeholder engagement strategies (Fung 2006). Here, the diagram helps to understand who were the key players (high influence), the context setters (middle influence), and the crowd (low influence).<sup>1</sup>

All kinds of values are attributed to the archaeological heritage sites. Values are positive characteristics that make a site important to that specific stakeholder. The stakeholders also have wide ranging interests, which are the underlying needs or wants that they hope to have fulfilled with respect to the site (Myers et al. 2010). Assessing the values and interests and comparing the assessment with the outcome of the projects, allowed for an analysis of the values that were prioritised in the development of the site parks, as well as the differences and similarities between the case study projects. In addition, the interview data provided contextual information about the thoughts and feelings of the stakeholders.

**Results of the values assesment**

The interviewees positively reviewed many things, like the archaeologically inspired designs of the park, small scale co-production projects, and the involvement of (partially) commercial parties. From the analysis, it is clear that for those in charge, the historical and scientific values of the site predominated. To them, these determine the significance of the sites and legitimised the development of the site parks. Both parks convey a relation to the past through the archaeologically inspired designs and the exhibitions about the history of the site. Paradoxically, the site parks preserve archaeological remains for future scientific research, but at the same time the monumental status prevents scientists from conducting archaeological research for many years to come.

In both site parks, the project management chose to put a strong focus on educational values as well. The capability of the archaeological site to teach visitors about the past is incorporated in both parks; the story of the past is translated into a contemporary visitor program, with workshops, guided tours, etc. Through these properties, archaeological heritage is associated with themes like natural environment and sustainability. Placing archaeology in a wider context makes it more interesting for a municipality to invest in an archaeological site park, because the

		Castellum Hoge Woerd			Archaeological park Matilo		
Influence of stakeholder group	High		Councillor			Councillor	
			State Service for Cultural Heritage	Municipal Project Manager		State Service for Cultural Heritage	Municipal Project Manager
				Municipal Heritage Department			Municipal Heritage Department
	Middle			Theatre, City Farm, Restaurant			
			Historical association				Foundation for 'school gardens'
			Local Fruit Farmer				Association for 'city gardens'
	Low		Two community interest groups			Two community interest groups	
			Local residents			Local residents	
		Low	Middle	High	Low	Middle	High
Interest of stakeholder group				Interest of stakeholder group			

Figure 3. Position of stakeholder groups (by author).

site serves as a multifunctional centre that attracts a wider spectrum of people and enterprises, and is therefore more likely to provide social and economic means to the location.

The multifunctionality of both site parks is particularly apparent in Utrecht, where cultural and economic values are more emphasised than in Leiden. Both parks provide cultural activities related to music, dance, and theatre, but in the Castellum, theatre Podium Hoge Woerd is committed to form a full program of performances. In Leiden, there is no long-term involvement of a similar commercial party and the community associations had difficulty with planning activities. The case studies indicate that the involvement of commercial parties, like a theatre and a restaurant, contributes to a sustainable exploitation concept for an archaeological site, which has the potential to make heritage profitable.

Including the social values of the indirect stakeholders turned out to be the most challenging in both projects. The site parks provide a public space where local people can meet, recreate, participate in social gatherings, and feel attached to. However, community interest groups would have wanted the project management to focus more strongly on other social values as well, like the transparency in information provision and open attitudes in communication strategies. It is the course of the project development that they are not content with, as they have the feeling they are not listened to, or that there is a lack of mutual understanding about, for example, the functions and design of the park.

Interestingly, the primary stakeholders were most positive about the level of community engagement they had achieved. In Leiden, the councillor said they "had very close contact with the neighbourhoods". The councillor, however, noticed that local people had different ambitions; while he was very enthusiastic about the importance of the site in Roman history and its significance to Leiden, the residents were more interested in a soccer field for their children. And in Utrecht, where much effort was put in 'place-making' and local engagement prior to the project, the project manager noticed that some people responded to the project plan in a way like "great plan, but not in my backyard".

What appeared to be successful in both projects are small-scale co-production projects. The trust of the project management in local organisations to develop parts of the park, like the kitchen gardens and artwork, stimulated feelings of shared ownership. These findings demonstrate that social

values not only include the potential functioning of a site as a public space, but also collective decision-making and community engagement throughout the project. Here, values-centred decision-making could contribute to effective stakeholder management in future projects, as the assessment of values and interests demands the involvement of stakeholders from the initial phase of the project.

These case studies illustrate that people value heritage for various reasons and define heritage differently. Social research has indicated that the assumption of cultural heritage as being a driver for identity is too general and not always a correct reflection of reality (Van Assche 2004). This can be observed in these case studies as well. In both projects, local authorities valued the incorporation of cultural heritage in spatial design. The councillor of Leiden believed that cultural heritage, including Roman history, is one of the characteristics of the identity of the new neighbourhood of Roomburg, and the Castellum is thought to add identity to the new city district of Leidsche Rijn, which was said to be still somewhat inanimate. However, whilst the projects have contributed to awareness of and appreciation for these archaeological sites, it is somewhat exaggerated to argue that Roman history is what people living in these neighbourhoods identify themselves with, as the fruit farmer made clear by saying that "identity is imposed on us".

### **Conclusions**

The case studies of Castellum Hoge Woerd in Utrecht and Archaeological Park Matilo in Leiden and the data collected by means of interviews with representatives of all stakeholder groups in the projects, indicate for what reasons archaeological sites are valued and what the interests are of the stakeholders involved. For those in charge, the historical and scientific values of the sites are prioritised, as they legitimised the construction of the archaeological site parks. However, the site parks were not realised because of archaeology only. From the case studies, it is apparent that local authorities and businesses are willing to invest in a project that places archaeology in a wider context and associate it with cultural, environmental, and educational values. Multifunctionality contributes to a sustainable concept for archaeological heritage preservation.

The historical significance of an archaeological site seems to be of least importance to stakeholder groups with an economic interest at stake. They are less interested in archaeology than they are in a healthy business model. Also, community interest groups

prioritise recreational and social values and they find it important to have a voice in the decision-making process. This underlines the importance of the values assessment per stakeholder group in an early stage of the project, because then values-centred choices can be made and sustainable outcomes are secured because the places created are appreciated by the people they are created for.

The insights from this study contribute to a better understanding of the values attributed to archaeological heritage by different groups of stakeholders. However, more data from a larger group of people about their views on archaeology would aid further research on heritage values and how the heritage sector could respond to this, both in the type of projects we initiate and the ways in which we engage with various stakeholders in heritage management.

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<sup>1</sup> The modes of communication (Fung 2006) and the level of participation on the 'participation ladder' (Van Houwelingen et. al. 2014), as well as the efforts of the direct stakeholders to engage with the indirect stakeholders are further elaborated upon in Amsing 2015. These analyses are not included in the present article, as exceeding the scope of this article.

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# THESIS OVERVIEW

SEPTEMBER 2016 - FEBRUARY 2017

**A**t the moment of graduation, an archaeology undergraduate student has produced a minimum of 50,000 words in total in the form of written assignments. In the graduate phase, regular master students will increase this amount by 45,000, whilst research master students produce an additional 70,000 words. The majority of these texts, including the thesis, are only read by a handful of people. Since 2009 the Faculty of Archaeology requires all theses from both graduate and undergraduate students to be uploaded in the digital repository. Currently, most people are unaware of the fact that information on these theses, including extensive abstracts and author contact information, can be found online. A substantial part of these works is openly accessible as well (<http://openaccess.leidenuniv.nl/handle/1887/16590>). In order to stimulate the use of this invaluable database, and to promote student research beyond the publications in INTER-SECTION, we have decided to provide a complete overview of new theses in every edition. The list presented here contains all theses effectuated between September 2016 and February 2017. We encourage our readers to consult the Leiden Repository for more information on the titles listed below.

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- Berge Henegouwen, D. *Beenmerg, geliefd product van de paleolithische jager? De voedingswaarde van beenmerg, aan de hand van de paardenassemblage van Schöningen13II-4, Noord-Duitsland, een vroeg-paleolithische site.*
- Dijk, van C. *Crumbling Castles. Exploring the differentiation between besieged and non-besieged castles using military material, with a case study of eight castle in the county of Holland during the period 1250-1450.*
- Harteveld, T. *Physical Activity in Rural Archaeological Sites. What Variation can be Expected Between Rural Sites in Terms of Physical Activity on Bones in the Netherlands during Post-Medieval Times?*
- Kerkhof, M.J.H. *From the Man-the Hunter to Ladies-in Waiting. Mainstream Archaeology and Gender Bias in Dutch Elementary School Books.*
- Sep, N. *What about the Archaeology? A thesis on Mexico's Yucatan and Campeche Archaeological remains endangered by Monsanto's soy cultivation.*
- Versteeg, A. *De aanwezigheid van vrouwen binnen de Romeins-militaire gemeenschappen in West-Nederland tussen de eerste en de derde eeuw n. Chr.*
- Vroom, R. *Revisiting the Caribbean Architectural Mode. A study of the structures at the Late Ceramic site of Argyle, St. Vincent.*

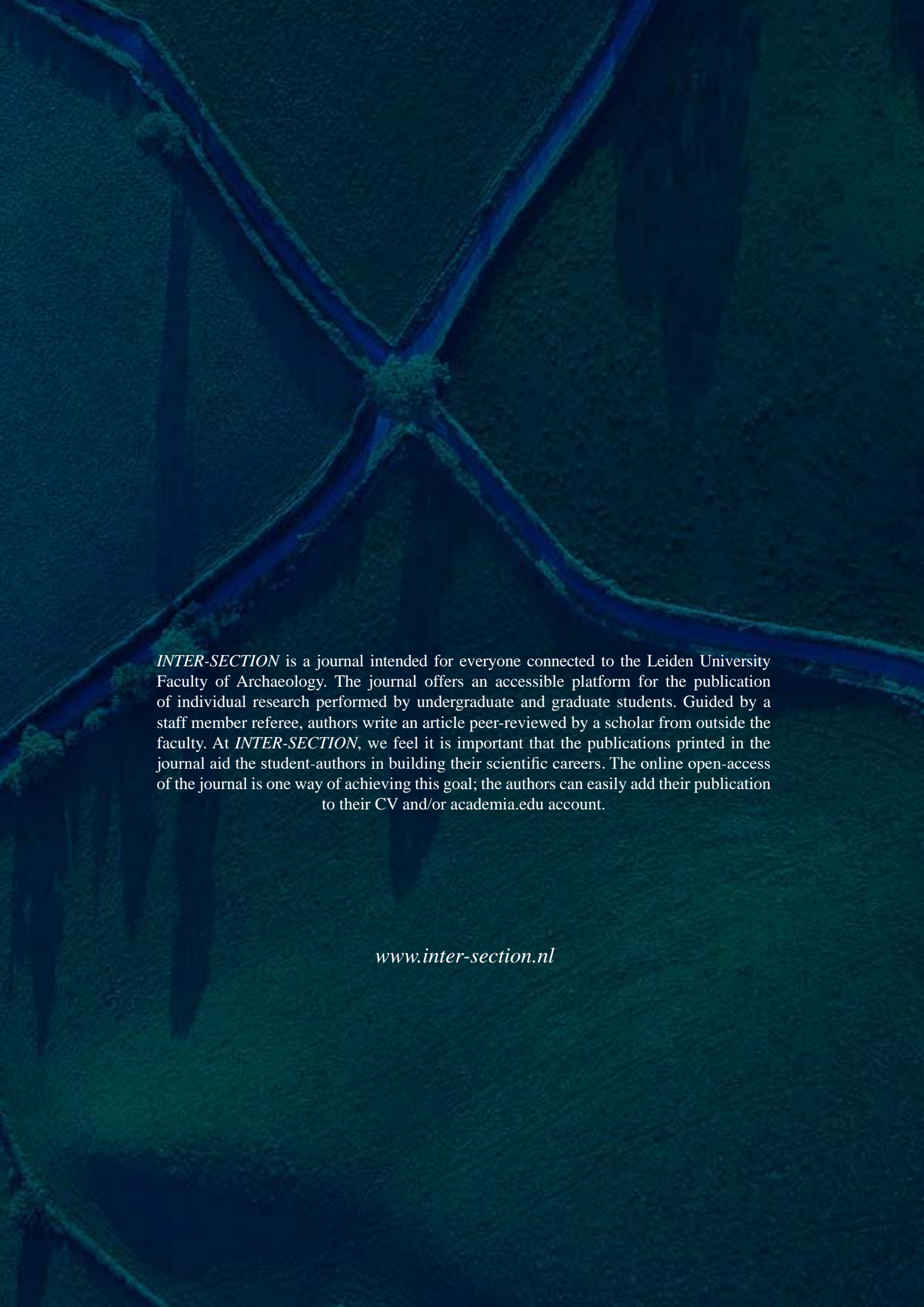
## Master theses

- Baetsen, W. *Geometric morphometric analysis of the 'skeletal vocal tract': A first step in involving osteoarchaeology in the search for a potential 'genetic bias' for language, using two Dutch historical skeletal populations.*
- Beuger, S. *Predictive modeling for Bronze Age depositions in East-Drenthe, Netherlands.*
- Bulder, A. *The Carthusian monastery near Delft 1469-1573: Sober hermits?*

- Cali Erazo, C.D. *The Provenance of Iron Age I Ceramics from the Site of Tel Kinrot. Sea of Galilee, Israel.*
- Casale, S. *Pre-Hispanic clay roads. Evaluation and interpretation of ceramic production and raw clay procurements in the Rio Mayales Subbasin, Chontales, Nicaragua.*
- Chen, Y.T. *The neglected heritage rites of indigenous peoples: the indigenous and government perspectives on developing Saqacengalj and Jinja in KusKus, Taiwan.*
- Colijn, J. *Plan or Process? The construction of Late Medieval Town Walls of 's-Hertogenbosch, Zevenbergen and Breda: a well prepared masterplan or an evolving process?*
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- Heijman, K. *Mummies on display: will they remain a person or do they become an object in the Drents museum's exhibition Mummies life beyond death?*
- Holstein, C. *Juvenile physiological stress as risk factor to Tuberculosis. Examining non-specific skeletal stress markers (stature, Harris lines, cribra orbitalia, and dental enamel hypoplasia) and their association to tuberculosis in the Dutch populations of rural post-medieval Middenbeemster and urban medieval Alkmaar.*
- Jørgensen-Lindahl, A. *Microscopic Differences - A micro-wear approach for the extraction of behavioural information from lithic artefacts from the Upper Palaeolithic Aurignacian occupation of Les Cottés, France.*
- Kapsali, K. *Archaeogenetic Research and Greek Heritage: Constructing bloodlines to the past.*
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