



SAPIENCE

CENTRE FOR EARLY SAPIENS BEHAVIOUR
UNIVERSITY OF BERGEN



ANNUAL REPORT 2018



STATEMENT FROM THE CHAIR OF THE BOARD

As chair of the board, it has been truly exciting to observe the progress of SapienCE through 2018. At this early stage, the project is already delivering important scientific results, a solid list of publications and attracted world-wide publicity. The University of Bergen and The Faculty of Humanities are naturally very proud hosts. Particularly, I would like to emphasise how impressive it is to see how the project has successfully brought together young, energetic talent and excellent established re-searchers in a truly cross-disciplinary and co-operative international group. This is a great achievement reached only because there is both a solid scientific core, yet also space for interpretation, imagination and vision.

Of course, a project like this also requires a high degree of organization and administration. The administrative staff in different departments and at the faculty have done a great job in setting up the project and keeping it running. From the perspective of the university, it is of particular significance that the consortium of different institutions and departments manages to cooperate smoothly. I can report that the board meetings so far have proceeded in a positive and friendly manner. It is however no secret that CoE's are sometimes known to pose challenges to institutional structures, and there will be room for differences and open discussions if such are needed in the future.

My sincerest thanks go to everybody who has contributed to the impressive results of SapienCE in 2018.



Jørgen M Sejersted
Jørgen M Sejersted

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Members of the SapienCE team at the Blombos 'Hole in the Rock' in February, 2018 during their tour of Blombos Cave and Klipdrift Shelter located in the southern Cape, South Africa.

LEADING SCIENTISTS

Interdisciplinarity is at the heart of SapienCE hence we brought together leading scientists from a range of disciplines, including Humanities, Earth Sciences, Numerical Modelling and Psychology and Neuroscience at the University of Bergen and from our international partner institutions to address core research questions about the early origins of our own species: When, why and how did humans first become behaviourally modern? Was social cohesion enhanced by symbolic material culture or vice-versa and did it lead to innovation? What cognitive skills had to be in place for other skills to develop? How adaptable were humans to environmental change? In essence, the focus of SapienCE is the prehistory of us all – the origins of *Homo sapiens* in Africa – hence embracing universal appeal. But early *Homo sapiens* research is a highly competitive research field.

In 2017 and 2018 we introduced detailed objectives and targets for our diverse, cutting-edge SapienCE team working in the disciplines of archaeology, chronology, micromorphology, climate reconstruction and modelling, and the cognitive and social sciences. We looked to attract the best scientists. In 2018 the SapienCE team was expanded to include four Associate Professor (Prof. II) positions at the University of Bergen drawn from France, Germany, the UK and South Africa. We recruited 4 post docs and 3 PhDs who are making early valuable contributions. The outputs from our new associates and post graduates was rapid and, in part, can be measured by the 33 peer-reviewed papers that SapienCE scientists published in 2018 in Nature, Science, PNAS, and other leading journals. Our milestone paper in Nature in September, 2018 on the oldest known abstract drawing, excavated from 73 ka levels at Blombos Cave, reached c. 2 billion people.

CENTRAL FOCUS

A central focus of our research over the next decade is the continuing excavations at the three archaeological sites, Blombos Cave, Klipdrift Shelter and Klasies River, occupied by early *Homo sapiens* from 120 000 – 50 000 years. Situated in the southern Cape, South Africa, SapienCE holds permits for these sites. Excavations at Klipdrift Shelter, in the 66 000 -50 000 year old levels, from 19th February – 3rd April, 2018, were highly productive and innovative chronology and geoarchaeology methods were implemented. A tour of this site and Blombos Cave by our SapienCE scientists and administrators was a highlight. Analyses of ocean cores, speleothems and climate modelling commenced in 2018 to obtain climate records. Research on cognition and neuroscience made strides with two stimulating workshops and several peer reviewed papers.

SapienCE was highly evaluated in the RCN evaluation of the humanities in Norway in 2018 receiving a top score (5). The SapienCE Scientific Advisory Committee reported that the standard of science within the CoE was 'outstanding'. Three workshops held by us in Bergen attracted collaboration agreements with leading international research groups in human genomics, proteomics, stable isotopes and neuroscience. The SapienCE 'outreach' highlight is the "Early Sapiens Behaviour Exhibition", praised by the press and public, that opened in Stellenbosch, South Africa in May, 2018.

As director my lasting impression of 2018 is that it was a year of unity – of a happy, highly skilled and motivated team working together to excel in attaining our common objectives. I am confident that SapienCE will continue to consolidate UiB's and Norway's position as a world leader in early human origins research over the next decade.



STATEMENT FROM THE DIRECTOR

On the 14 March 2017 the Research Council of Norway's Steering Committee for Centres of Excellence decided to support our project, the Centre for Early Sapiens Behaviour (SapienCE) and invited us to Oslo for negotiations. The excitement within our team was palpable and preparations were in place to move rapidly into the planning phases. Our senior SapienCE scientists, a united yet diverse team, set to addressing the key project questions and what our planning and implementation would be for the months and years ahead. The inauguration of SapienCE took place on 1st October 2017 at our tastefully renovated offices in Sydneplassen 14.

Christopher Stuart Henshilwood



SCOPE

The SapienCE team has exclusive access to sites that contain the keys for unlocking the past. The unique location of sites dated to between 120 ka and 50 ka on the southern Cape coast, South Africa, a region known to be particularly sensitive to regional and global climatic forces, makes them ideally placed for research into the marine and terrestrial environments utilised by *H. sapiens*.

The inter-disciplinary research teams will carry out a macro- and micro-scale investigation of two new and three existing Middle Stone Age archaeological sites by looking in detail at the evidence, layer by layer, site by site. This will permit the unprecedented integration of securely-dated, high-resolution records of early human cultural, social, technological and subsistence behaviours with global, regional and site-based palaeoenvironmental information. This holistic approach will provide ground-breaking insight into the diverse aspects of what it means to be human.

KEY RESEARCH QUESTIONS

- 1 When, why and how did humans first become behaviourally modern and how is this defined?
- 2 Did cognitive changes accelerate behavioural variability?
- 3 How were these groups of hunter gatherers socially organised?
- 4 Was social cohesion enhanced by the adoption of symbolic material culture and did it lead to innovation?
- 5 What cognitive skills had to be in place in order for other skills to develop?
- 6 How adaptable were humans to environmental change and did climate impacts act as drivers for technological innovation and subsistence adaptations?
- 7 Can we determine, from our planned genetic research, the relationship of these early *H. sapiens* to extant human populations?

ACTIVITIES 2018



FIELDWORK

Klipdrift Shelter excavations 19 February to 3 April 2018.
De Hoop Nature Reserve, southern Cape, South Africa

Klipdrift Shelter is a key SapienCE archaeological site that contains well preserved Middle Stone Age material dating to between 66 000 and 50 000 years ago. This time period is vital to our understanding of the behavioural development of us, *Homo sapiens*. Very few sites dating to this period have well preserved organic remains. It is located in the De Hoop Nature Reserve, southern Cape, South Africa.

In early February 2018, members of the team went to prepare the site and set up the tent camp where we stay during excavations, on a remote section of the coast in the Reserve. Excavations commenced on 19 February, with between 11 and 15 people on the team at various times during the season. Team members include undergraduate

and post graduate students and post docs from the Universities of Bergen and Witwatersrand. While some members stay at the camp to excavate during the week, others stay at the inland Potberg field house to wash, sort and curate the excavated material.

Excavations focused on two areas, namely the ca. 50 000 year old deposits to the North East of the shelter, and the ca. 60-66 000 year old layers in the South West. Rugged field tablets with specially customised database software for SapienCE excavations were used for recording. We plotted 561 unique artefacts in 3D using a Trimble Total Station. These include stone tools, bones, ochre and ostrich eggshell. The site also contains abundant, well preserved shellfish.

We started testing of photogrammetric recording as a primary method of visual and spatial documentation of the surfaces of layers during this season. This new strategy provides a spatially correct and photorealistic 3D record of all layer surfaces and profile sections. The potential to use a drone to record the surrounding landscape, and as a survey tool, was also tested and gave good results.

Notable finds include several fragments of ostrich eggshell engraved with geometric designs. Engraved ostrich eggshells of this antiquity have only been found at two other sites, both in southern Africa.





COLLABORATION WORKSHOPS 2018

Our cutting-edge SapienCE team commonly believe in expanding the boundaries of our research through attracting leading collaborators. Here workshops have a vital role to play and count as a major success for SapienCE in 2018. Workshops lay the groundwork for future collaborations and get new initiatives off the ground. Here is a short synopsis of our 2018 workshops from which have emanated highly promising agreements for co-operation in 2019 and beyond

CHRONOLOGY AND PROTEINS

Analysing ancient proteins present in or on materials excavated from SapienCE archaeological sites in southern Africa. Possibilities include analysis of the contents of the earliest known containers, the Blombos abalone shells and ancient ostrich eggshells. Held Thursday 14th June 2018, Bergen. Presentations: Matthew Collins, Niels Bohr Professor, Natural History Museum of Denmark & University of York; Enrico Cappellini, Associate Professor, EvoGenomics, Natural History Museum of Denmark, Copenhagen; SapienCE researchers Henshilwood, d'Errico, Armitage. Collaboration agreement in place and ongoing.

HUMAN GENOMICS AND THE MIDDLE STONE AGE IN SOUTHERN AFRICA

Obtaining human DNA from Middle Stone Age sites in Africa has not been possible yet can provide a crucial piece in the puzzle of *Homo sapiens* evolution before leaving Africa. Held. 20th June 2018, Bergen. Presentations: Matthias Meyer, Max-Planck-Institute for Evolutionary Anthropology, Leipzig; Katerina Douka, Max Planck Institute for the Science of Human History, Jena; Pontus Skoglund, The Francis Crick Institute, London; Patrick Roberts, Max Planck Institute for the Science of Human History, Jena. SapienCE researchers Henshilwood, van Niekerk, Hillestad Nel, Armitage. Collaboration agreement in place and ongoing. Samples of sediment already collected for human DNA analysis and a selection of bone shards will be supplied for ZooMS analysis in 2019.

HOW NEUROSCIENCE MAY ILLUMINATE THE HUMAN PAST

– a role for fMRI? Held 12th – 13th June 2018, Bergen. Presentations: Nathalie Tzourio-Mazoyer, CNRS Bordeaux; Emmanuel Mellet, CNRS Bordeaux; SapienCE researchers Bender, Hugdahl, Lindstrøm, d'Errico. Collaboration agreement in place and ongoing. Has resulted in plans for new workshops and collaboration on fMRI experiments in 2019.



SapienCE SEMINAR AND SITE VISIT 2018

In February 2018 the vast majority of the SapienCE team gathered in South Africa for the first SapienCE seminar. The purpose was to set the course for the forthcoming joint research work and to present the various research scopes within the team. The seminar was highly successful and paved the ground for new ideas in the crossing between the various sciences.

The visits to the two main sites, Klipdrift Complex and Blombos Cave, also gave the non-archaeologists valuable insight into this part of the work, and an indispensable introduction on-site prior to the archaeological work and research carried out here.





Example of how a South African river brings land sediments containing pollen and other land derived material out to the ocean where marine deposits we study offshore contain both land based and oceanic climate information.

HOW DID CLIMATE AFFECT THE BEHAVIOURAL EVOLUTION OF EARLY *HOMO SAPIENS* IN SOUTHERN AFRICA?

This is one of the key questions of SapienCE. Did modern human behaviour originate in part due to an ability to survive and adapt to variable and maybe harsh climatic circumstances? Or did climate affect conditions for innovation and behavioural revolutions in the sense that favourable climate conditions and the ability to easily obtain nutrition in terms of land based and marine food sources were ideally found in the Cape region. What were the climatic conditions during the Still Bay period in Blombos Cave and the Howiesons Poort sequence in Klipdrift Shelter? What happened in the interval from 72 000 -66 000 years when these sites were not occupied? Were there specific climate conditions that forced the population out of the area?

In SapienCE, the climate investigations commenced in 2018 along several lines of enquiry. 1) We have started work to obtain records of climate change from speleothems (drip-stones) in caves from the region using the FARLAB laboratories at UiB-GEO. 2) Marine sediments often contain a more complete climate record than land sediments which are more fragmented. We have started analyses of marine sediment cores from the deep marine areas off the Blombos Coast. In these we record variations in ocean temperatures, but the sediments also contain land derived material which can inform us about vegetation changes and hydro-climate on the neighbouring land regions. These are brought to the ocean by rivers. New cores spanning a longer record will be obtained in collaboration with French scientists in early 2020. 3) Inside the caves the marine faunal remains in the excavation material contain geochemical signatures that can be used

for climatic information, and the micromammal fauna contain information on climate and climatically influenced factors in the close surroundings of the caves. Such records give us proxy information. 4) To obtain information on climate conditions on the regional and landscape scales we need to use numerical climate simulations.

In SapienCE we have initiated a program of climate simulations for key periods of the 100 000 - 50 000 year period before now. This work also commenced in 2018, and in the future we will check and integrate these simulations against the data obtained from the point sources. Hopefully this will lead us closer to addressing the questions above.



Ole Unhammer (pictured) with Simon Armitage and Nele Meckler, SapienCE team members, sampling speleothems inside the Bloukranz Caves located in the De Hoop Nature Reserve, southern Cape, South Africa in 2018.

ARCHAEOLOGICAL ACTIVITIES OUTSIDE OF EXCAVATIONS

SapienCE members held regular meetings to discuss current and future projects, often with scholars from other departments and institutions, and visited laboratories in Bergen including NORCE Sclerochronology, Farlab, and the osteological collection at the University Museum of Bergen.

Members also visited other international institutions. Magnus Haaland joined the geoarchaeological working group in Tübingen to process block samples from Klipdrift Shelter, and analysed thin sections through petrographic microscopes and other micro-analytical techniques. Turid Hillestad Nel joined Sarah Wurz at Klasies River excavations in South Africa and thereafter analysed the small rodent bones from Klasies and Klipdrift at the University of Witwatersrand.

A successful full-scale 3D recording of Bloukranz Cave (South Africa) and surroundings was performed by Ole Unhammer using only terrestrial photogrammetry.

Silje Bentsen set up a blog (<https://tinyurl.com/y6b-k8uv7>) where she writes about her research, experimental archaeology, fire and other news on early modern humans.



*Top: Francesco d'Errico and Andrea Bender:
Interdisciplinary meeting over ochre powder making
Bottom: Bone Screen at Early Sapiens Behaviour Exhibition*

SYMBOLIC MIND, COGNITION AND SOCIAL ORGANIZATION

This sub-project of SapienCE focuses on the neurobiological, cognitive, and social processes involved in creating technological innovations, novel ideas, and symbolic behaviour. As the subject of our interest leaves no direct traces on the remains left by early humans, we design methods to reconstruct the cultural evolution of cognition and to infer cognition from past material culture.

PROCESSES OF CULTURAL EVOLUTION

Cultural evolution, the main driving force in the history of our species, involves several mechanisms. One is cultural transmission and accumulation (also referred to as cumulative culture), which accounts for changes in cultural practices that were caused by cultural innovations. Another is known to impact on natural selection through gene-culture co-evolution. Members of our team elaborated on two additional processes operating at intermediate levels – cultural exaptation and cultural neural reuse – that account for the impact of cultural innovations on cognitive skills and on cortical networks, respectively.

NUMERICAL COGNITION

One example for which these processes are investigated more deeply, is numerical cognition. The ability to use symbol systems for numbers is peculiarly human. By comparing archaeological and experimentally notched bones we identified the earliest known numerical notation, found in Africa, and proposed a five-stage model for the evolution of number representations.

RECONSTRUCTION OF 'PAST COGNITION' BY EXTRAPOLATION

If early modern humans indeed had the same cognitive capacities as contemporary humans, then the former can be extrapolated from today's skill set minus those brought about by cultural evolution. Members of our team therefore also started to collect comparative data across a broad range of disciplines to 'distil' the essential components. In a first step, this was done for causal cognition, which is essential for technological progress.

INVESTIGATION OF COGNITION ENGAGED IN 'PAST ACTIVITIES'

The other option for reconstructing the cognitive skill set available in the past is to scrutinize which cognitive processes are activated when people engage in the activities of that past. Brain imaging studies help to illuminate the neuronal underpinnings of the activities involved, for instance, in creative or symbolic behaviour. Members of our team currently test two examples: symbolic processing (at U Bordeaux) and flint-knapping (at UiB). A workshop held at UiB in June 2018 aimed at creating synergy effects between the two.



STORIES

SAPIENCE ARCHAEOLOGISTS FIND THE WORLD'S OLDEST DRAWING

Archaeologists from the SapienCE team made the front page of newspapers across the world when *Nature* published their discovery of the world's oldest human made drawing.

Within minutes, the story about the 73,000-year-old drawing had reached media all over the world, including the front page of the New York Times, Wall Street Journal and the BBC. More than 1000 unique stories were written and published in 70 countries, with a possible outreach of two billion people.



LETTER

<https://doi.org/10.1038/s41586-018-0514-3>

An abstract drawing from the 73,000-year-old levels at Blombos Cave, South Africa

Christopher S. Henshilwood^{1,2*}, Francesco d'Errico^{1,3}, Karen L. van Niekerk¹, Laure Dayet^{3,4}, Alain Queffelec³ & Luca Pollarolo^{5,6}

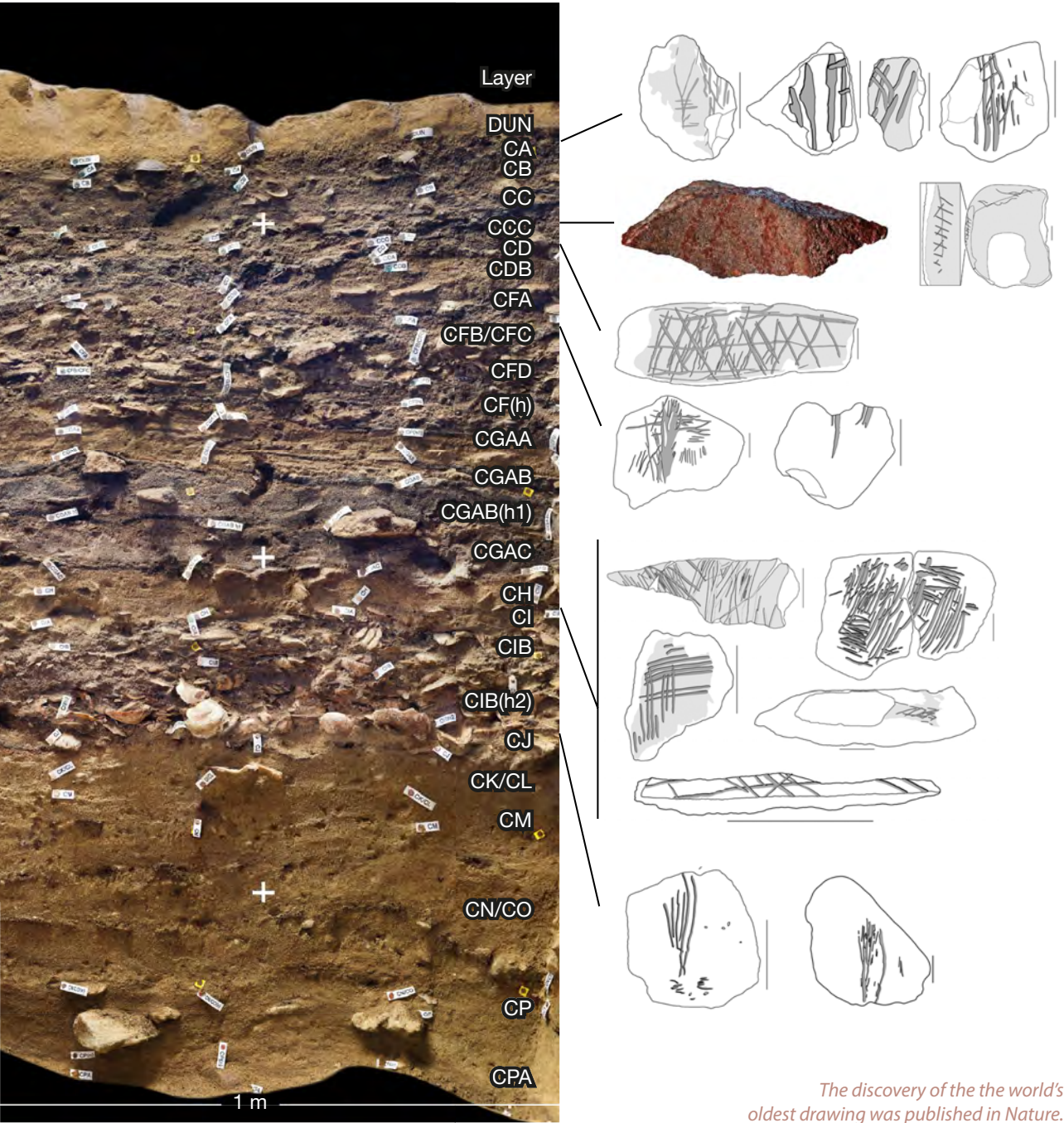
Abstract and depictive representations produced by drawing—known from Europe, Africa and Southeast Asia after 40,000 years ago—are a prime indicator of modern cognition and behaviour¹. Here we report a cross-hatched pattern drawn with an ochre crayon on a ground silcrete flake recovered from approximately 73,000-year-old Middle Stone Age levels at Blombos Cave, South Africa. Our microscopic and chemical analyses of the pattern confirm that red ochre pigment was intentionally applied to the flake with an ochre crayon. The object comes from a level associated with stone tools of the Still Bay techno-complex that has previously yielded shell beads, cross-hatched engravings on ochre pieces and a variety of innovative technologies^{2–5}. This notable discovery predates the earliest previously known abstract and figurative drawings by at least 30,000 years. This drawing demonstrates the ability of

early *Homo sapiens* in southern Africa to produce graphic designs on various media using different techniques.

Blombos Cave (BBC) is situated on the southern Cape coast, about 300 km east of Cape Town (34° 24' 51" S, 21° 13' 19" E). Excavations commenced in 1991 and are on-going. The site contains well-stratified Middle Stone Age (MSA) deposits dating to between 100 and 72 thousand years ago (ka)⁶, topped by a layer of sterile aeolian dune sand (dated to 70 ka) and Later Stone Age layers dated to 2 ka (Fig. 1). The MSA sequence consists of four phases, of which the upper two—'BBC M1' and 'BBC M2 upper'—are associated with the Still Bay techno-complex, dated to about 77–73 ka⁷. These phases contain bifacial foliate points, of which 12% were heated before final shaping using pressure flaking^{5,8}. Other cultural markers of the Still Bay from these layers include bone awls and spear points⁴, possible engravings of parallel and joining lines

RECOVERED IN 2011

It was Christopher Henshilwood, Professor at UiB, and Director of the Centre of Excellence at the University of Bergen, Centre for Early Sapiens Behaviour (SapienCE) and Dr Karen van Niekerk, senior SapienCE scientist, who recovered the piece in 2011 when they were excavating the 73 000 year old layers in Blombos Cave. They did not recognize that it was a drawing then as it was covered in dirt and ash. These dusty stone flakes were taken to the Wits University/SapienCE satellite laboratory in Cape Town to be rinsed and examined. And from here we can only imagine the scene when their close colleague and archaeologist, Dr Luca Pollarolo, noticed a pattern made up of lines on a small silcrete flake amidst the hundreds of similar flakes he was examining.



The discovery of the the world's oldest drawing was published in Nature.



THE RESEARCH JOURNEY

Many questions needed answers. Were the lines on the stone natural, a part of the matrix of the rock, or were they, perhaps, made by humans living in Blombos Cave 73 000 years ago?

“Our first step was to take the silcrete stone flake to our colleague Francesco d’Errico at the CNRS-PACEA lab of the University of Bordeaux in France, also part of the SapienCE team at the University of Bergen. Together we agreed on a systematic approach to answering the challenging questions about the small, but interesting L13 piece”. After much research their conclusion was that the cross-hatched drawing had been made 73 000 years ago with a pointed ochre crayon with a tip around 1–3 millimetres in width. This confirms that the drawing on the Blombos Cave silcrete flake is the oldest known drawing made by *Homo sapiens*.

A NEW DIMENSION

The drawing adds a completely new dimension to our ability to understand when early humans became like us. The drawing demonstrates that early *Homo sapiens* in southern Africa had the skills to make graphic designs in various media using different techniques at least 30 000 years before drawings first appear in Europe.





SHEDS NEW LIGHT ON THE ORIGIN OF SEWING TECHNOLOGIES

The earliest known bone awls, suitable for making clothing from animal hides, are 73 000 years old and come from a key SapienCE site, Blombos Cave in South Africa. A recent study, led by SapienCE researcher Francesco d'Errico, clarifies the origin and evolution of the technology that allows us to keep warm.

“
Our research shows that eyed needles were probably independently invented in China and Siberia, around 42 000 years ago
”

Genetic studies on human lice suggest the speciation between head lice and those living on clothing occurred between 100,000 and 70,000 years ago. This finding implies that some human populations were regularly wearing clothing prior to this event and kept on with this practice after it.

THE ORIGIN OF SEWING

Eyed needles made of bone and ivory have been found at many Palaeolithic sites in Europe, Asia, and North America. However, prior to this study, no research had been undertaken to gather all the available data, i.e. information on thousands of needles from hundreds of sites and combining them with analyses of new collections with the aim of understanding the first 30,000 years of the history of sewing. The results of this study, in which Chinese, Canadian, Czech and French researchers have participated, was published at the end of 2018 in the Journal of Human Evolution.

THE EVOLUTION OF SEWING

“Our research shows that eyed needles were probably independently invented in China and Siberia, around 42 000 years ago, and became more and more diversified, probably to fulfil new tasks such as the production of embroidery, undergarments, clothes for children and similar”, says d’Errico. “In traditional societies, clothes are submitted to both cultural and functional requirements. Needles have played an important role

in expanding the range of possibilities that humans have of culturalising their body and make visible and explicit social differences and ethnic affiliations. The use of needles to manufacture tailored clothes requires a long apprenticeship”.

THE FIRST EUROPEAN NEEDLES

“In Europe, bone needles appear sporadically around 26,000 years ago, and were part of the toolkit used by hunter-gatherers that colonized the American continent some 14,000 years ago. The variability of the earliest European needles reveals variable technological traditions, which probably reflect different ways of making clothes and clothing styles specific to each European region. This suggests that, since the Palaeolithic, fashion was an important aspect of social life and that the manufacture of quality clothing satisfied both physiological needs and social norms”, says d’Errico.

In sum, d’Errico explains, the production and use of needles can only occur in complex societies, able to transmit complex technical knowledge.

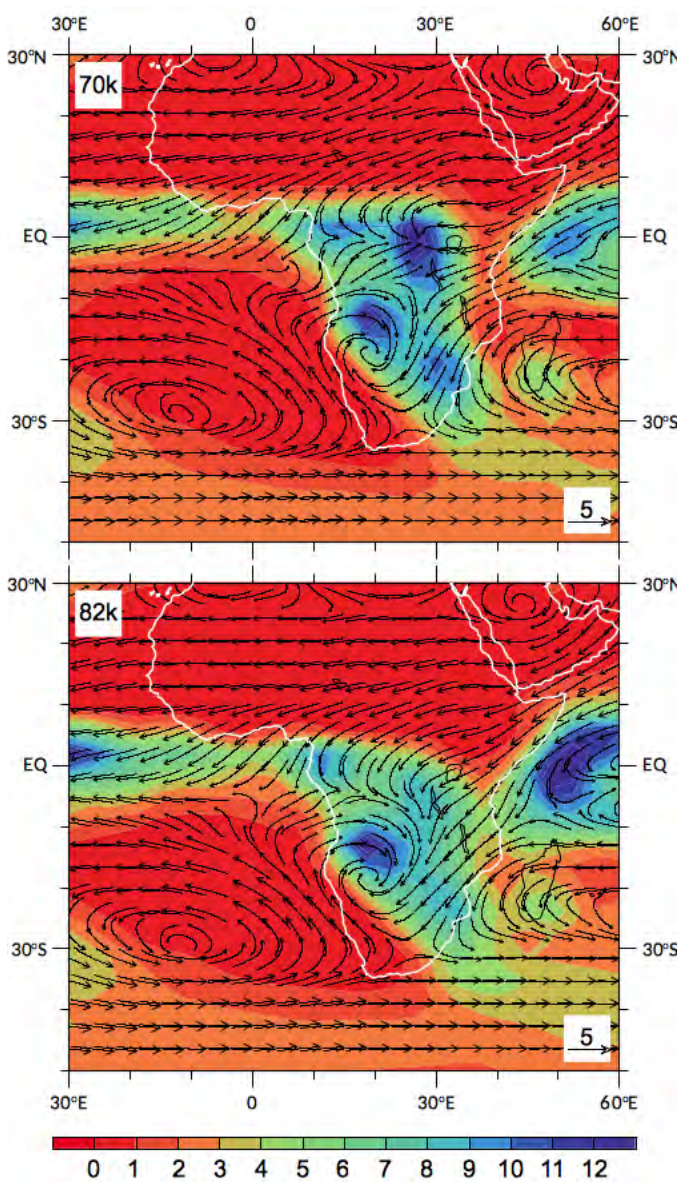
Simon Armitage (left), a PI in SapienCE, visited Klipdrift Shelter for a week to collect sand samples for optically stimulated luminescence dating (OSL), to confirm the antiquity of the layers in which the artefacts are found. With him is Elizabeth Niespolo (centre), PhD student from University of California Berkeley, who is developing a second, independent, method of determining the age of Middle Stone Age sites using U-Th dating of ostrich eggshell from Klipdrift Shelter.

CLIMATE SIMULATIONS

The interval between 100 000 to 50 000 years is characterised by high climatic contrasts. It also lies inside the last glacial period which lasted from 115 000 to 11 000 years ago. The glacial was a period of marked and sometimes rapid climate change. In the southern Cape this resulted in changes in precipitation, winds and sea level. The fundamental drivers of these changes were cyclic changes in the Earth’s orbit and greenhouse gas content in the Earth’s atmosphere.

In 2018 we started a program of simulations with the Norwegian Earth System Model (NorESM), a state-of-the-art climate model that is also used for climate projections for the future. The model simulates the global climate with input from the changes in solar irradiation from changes in the orbital parameters, greenhouse gases and sea level. We have focussed first on periods with significant changes in these drivers. An example of the output is given in the figure.

Later in the project, starting in 2019, the results from the global simulations will be downscaled using a much more detailed model for the southern African region. Thus, we can obtain climate input on a few kilometre wide scale, and also simulate landscape and vegetation changes for the various intervals we have records from that occur in the archaeological material. We also plan to develop this into constructing models of possible human migration and dispersal.



Simulations of January precipitation in colours (mm/day) and winds (arrows) over Africa at 70ka and 82ka with the NorESM model.



DATING THE PAST

One of the reasons that Middle Stone Age archaeology fascinates us is that the materials we excavate are so old. For example, the ochre processing toolkit from Blombos Cave was produced around 100,000 years ago. To put that age in context, the toolkit is more than twenty times as old as the Great Pyramid of Giza in Egypt! But knowing the age of the archaeology also serves an important scientific purpose. It allows us to understand how human behaviour changes over time and to compare those changes across sites. It also allows us to understand early human behaviour in the context of contemporaneous climate and environments.

Within SapienCE we use two methods, called optically stimulated luminescence dating (OSL) and uranium-series dating respectively, to calculate the age of our

samples. OSL dating measures the amount of time that has elapsed since sand grains were last exposed to sunlight. Small quantities of sand were constantly being blown into our sites while they were occupied by early humans, and over time these sands became buried and shielded from sunlight. We can therefore date the Middle Stone Age (c. 120 000 – 50 000 years) materials at our sites by OSL dating sand extracted from the sediments in which they were buried. Uranium-series measurements allow us to date the formation of new carbonate minerals, such as stalagmites in caves, and ostrich eggshells. Stalagmites from the De Hoop Nature Reserve are being analysed by SapienCE team members to produce detailed records of climate during Middle Stone Age times, whilst dating ostrich eggshells from Blombos Cave and Klipdrift Shelter add important extra detail to the OSL ages for these sites.

DOCUMENTATION METHODS

During the course of an excavation the 3 primary types of information recorded are; descriptive, visual and spatial. These manifest in the form of written descriptions of observations, still images, and the recorded coordinates of excavated archaeological artefacts respectively.

With the aim of creating a more thorough and flexible spatial and visual record, the excavation at Klipdrift Shelter in 2018 saw the first full scale implementation of digital photogrammetry. This method uses conventional digital still images and computer software to re-

construct precise and spatially accurate 3D models of recorded surfaces. It was used to record each uncovered archaeological surface, section profiles as well as the greater site and surrounding landscape.

The new datasets allow us to accurately piece together living surfaces and combine this with any other spatially recorded data we produce, such as the recorded position of archaeological artefacts and various scientific samples collected. In turn this provides a useful and intuitive basis for interpretation and discussion.

3D model of the Klipdrift Complex created using digital photogrammetry. Shown as textured (left) and untextured (right) with the position of the drone images used for model reconstruction represented as blue squares.



OWL PELLETS AS ARCHIVES OF ENVIRONMENTAL CONDITIONS

My post-doc project is a part of the SapienCE aim to reconstruct how humans lived and coped with changing environments along the South African coast during the Middle Stone Age from 120 000 – 50 000 years ago. By analysing small mammals (mice, rats, shrews, golden moles, gerbils etc.) from the Howiesons Poort sequences (66 000-59 000 years) at Klipdrift Shelter, De Hoop Nature Reserve, and Klasies River on the Eastern Cape coast, I am able to reconstruct local vegetation and climate during this period.

Small mammals are suitable as informants of past vegetation and climate is due to their small home ranges, their precise ecological requirements and role as primary consumers in the food chain. Small mammals became part of the archaeological deposits in caves and shelters when avian predators, such as barn owls and spotted eagle owls, occupied the sites during periods of low human activity. Owls swallow their prey whole and regurgitate pellets containing fur and bones that they cannot digest. The pellets decomposed on the cave floors and the bones then became part of the

archaeological sediments. Thus, the owl pellets are important as information about the distribution of small mammal species both at present and in the past.

I am currently collecting modern pellets from owls in the greater southern coastal area, with the help of local birding societies, farmers and Cape Nature Conservation rangers. Collecting owl pellets is a good way of sampling the small mammals currently living in the area to gain knowledge of current species distribution. I need the bones from a wide range of small mammal species to build a comparative collection, which will be used to develop new methodologies for small mammal identification by bone collagen, reconstruction of vegetation and rainfall seasonality by carbon and oxygen isotopes and taphonomic analyses. With the aid of local volunteers, I am able to gain valuable information for my project while creating awareness of our research activities in the local communities.

Turid Hillestad Nel collecting owl-pellets





HOW AND WHY DO WE STUDY THE MICROARCHAEOLOGICAL RECORD?

Archaeological sites are places where the physical remains of past human activities can be found. It is the job of archaeologists to painstakingly excavate and document such remains in high detail. We then use all the information available to put the puzzle back together to gain a picture of how people in the past lived and developed through time.

The best archaeological sites are those with great preservation and where the archaeological material recovered has not been destroyed or disturbed by other agents, such as humans, plants or animals. At the other end of the scale, we find sites with poor preservation. Here the excavated material may have been broken down to tiny fragments no longer visible to the naked eye, or it may also have been physically removed or even dissolved by geochemical processes present in the soils and sediments. At poorly preserved sites, therefore, the archaeological puzzle can become immensely time consuming to solve. In fact, if the break-down processes at these sites are not properly accounted for, there is a real chance that the archaeologists may end up obtaining the entirely wrong picture!

How to tell, then, whether a site is well or poorly preserved? This is not always a straight forward task. Often, we need to study the smallest components of the archaeological record before reaching a robust conclusion; that is the sand, dirt and sediments, and all the microscopic fragments within them. In the SapienCE project, we achieve this level of analysis through archaeological micromorphology. This method involves the collection of intact blocks of sediments in the field, and results in the making of petrographic thin sections at specialized laboratories. The thin sections, which essentially are glass shards (6 x 9 cm) on which intact archaeological sediments have been glued, allow us to evaluate the preservation of the ancient occupation debris in minute detail through powerful microscopes.

A slice of domestic life 65 000 years ago. This thin section image shows intact microscopic debris from the main occupation areas in Klipdrift Shelter. On top we see grey ash. The orange fragments are bone, the grey fragments are burnt shell fish and black is organic matter. The width of this image is 30 mm.



Magnus Haaland, post-doctoral fellow in SapienCE, carefully taking a block sample from the deposits for micromorphological study

MOTHER AFRICA - WELCOME HOME

ORIGINS OF EARLY SAPIENS BEHAVIOUR EXHIBITION

In 2018 the SFF Centre for Early Sapiens Behaviour (SapienCE), University of Bergen and the DST/NRF Centre of Excellence in Palaeosciences, University of the Witwatersrand, Johannesburg jointly designed an exhibition to showcase early modern human origins and innovations in southern Africa.

The exhibition features the unique archaeological discoveries their scientists have made at three of their core archaeological sites, Blombos Cave, Klipdrift Shelter and Klasies River situated on the southern Cape coast, South Africa. Occupied by early *Homo sapiens* the deposits at these sites date from 120 000 – 50 000 years – a key period in the evolution of modern human behaviour. Hence the title of the exhibition ‘Origins of Early Sapiens Behaviour’ with the sub-title ‘Mother Africa – Welcome Home).

WE ARE ALL ONE

In 2018 the Origins of Early Sapiens Behaviour Exhibition opened at the Spier Wine Farm in Stellenbosch, near Cape Town. Curated by Craig Foster and Petro Keene it is a multimedia compilation of presentations and excavated artefacts. It is designed to explore key aspects of archaeological research, linked to the SapienCE/Wits research programme that focuses on early human origins and innovations in southern Africa.



Sixteen display panels including six videos by the filmmaker Craig Foster illustrates the rich archaeological record of these archaeological sites.

The ‘We are all One’ message features strongly pointing to the evidence that all *Homo sapiens*, people like us, have their origins in Africa and promotes an understanding of our common ancestry. Current genetic evidence and a ‘people’s history’ is richly portrayed to educate visitors of all ages about their own past and to encourage a sense of pride in us knowing that we all come from Africa.

The daily life of these early *Homo sapiens* is captured on film, and the artefacts they made and used have been finely replicated and displayed to highlight the fascinating discoveries from these archaeological sites. The videos illustrate the remarkable scientific work of the SapienCE/Wits archaeologists and recreate scenes of the daily activities of our early human ancestors on this southern African coastline. The Origins of Early Sapiens Behaviour Exhibition is a showcase of 30 years of archaeological research in the southern Cape, undertaken by Professor Christopher Henshilwood, Dr Karen van Niekerk, Professor Sarah Wurz and their research teams at Blombos Cave, Klipdrift Shelter and Klasies River.

HIGHLY SOPHISTICATED AND ADVANCED

Of the many exciting finds displayed perhaps one of the highlights is the ochre-processing toolkit excavated from the 100 000 years old levels at Blombos Cave. This remarkable discovery, found almost perfectly intact, provides the earliest evidence for the manufacture of a red ochre-rich paint that was mixed and stored in the first known containers, abalone shells. The mixture contains ground red ochre, seal fat and ground bone, charcoal and a liquid. It is the same

recipe used in ancient Egypt 2000 years ago. The people living in Blombos Cave made beads out of tiny estuarine shells and strung them in various ways to be worn perhaps as necklaces or pendants. They also engraved abstract designs on more than fourteen pieces of ochre, some 100 000 years old, and made the earliest known drawing that dates to 73 000 years -an abstract design made with an ochre pencil on a stone flake. These engravings and the drawing are regarded as the first evidence for art. Aesthetically beautiful, bifacially worked stone spearheads, made from specially heated stone and then pressure flaked using a technique thought to have evolved in Europe 20 000 years ago, add to the repertoire of technologically and symbolically advanced material culture that these early humans produced.

EXPANDED AND UPDATED EXHIBITION

The exhibition also showcases finds from Klipdrift Shelter at dated at around 66 000 – 59 000 including engraved eggshell fragments and engraved ostrich egg water flasks as well as replicas of finely crafted stone tools. Small flakes, essentially tiny pieces of stone, were shaped to form crescents, or half-moons and these were attached to wooden shafts with glue made from plant resins and ochre to make arrows. The wood shafts of the arrows and the bows have not preserved, but the wear patterns on the stone flakes tell us the whole story. This southern African evidence, that is also found at Klasies River, is the oldest for bows and arrows anywhere and ranges from 70 – 55 000 years.

From 17th of April 2019, visitors can experience an expanded and updated version of the Exhibition, that now includes finds from the Klasies River site, at the Iziko South African Museum in Cape Town titled Early Sapiens Behaviour (Mother Africa – Welcome Home).



SELECTED PUBLICATIONS 2018

Christopher Henshilwood, Francesco d’Errico and Karen Loise Van Niekerk et al.

An abstract drawing from the 73,000-year-old levels at Blombos Cave, South Africa
Nature, 562, 115 – 118

Jerome P. Reynard and **Christopher Henshilwood**
Using trampling modification to infer occupational intensity during the Still Bay at Blombos Cave, southern Cape, South Africa
African Archaeological Review, 35- 1, 1 – 19

Jerome Reynard and **Christopher Henshilwood**
Environment versus behaviour: Zooarchaeological and taphonomic analyses of fauna from the Still Bay layers at Blombos Cave, South Africa
Quaternary International, online

Katja Douze, Anne Delagnes, **Sarah Jacoba Deborah Wurz, Christopher Henshilwood**
The Howiesons Poort lithic sequence of Klipdrift Shelter, southern Cape, South Africa
PLOS ONE, 13- 11, 1 – 24

Turid Hillestad Nel, Sarah Jacoba Deborah Wurz, Christopher Henshilwood
Small mammals from Marine Isotope Stage 5 at Klasies River, South Africa - Reconstructing the local palaeoenvironment
Quaternary International, 471, 6 – 20

Sarah Jacoba Deborah Wurz, Silje Evjenth Bentsen et al.

Connections, culture and environments around 100 000 years ago at Klasies River main site
Quaternary International, 495, 102 – 115

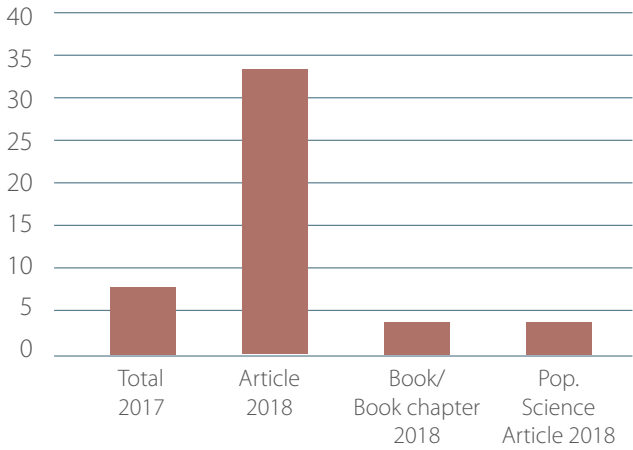
Francesco d’Errico et al.
Cultural Exaptation, Cultural Neural Reuse: A mechanism for the emergence of modern culture and behaviour
Biological Theory, 13- 4, 213 – 227

Francesco d’Errico et al.
From number sense to number symbols. An archaeological perspective
Philosophical Transactions of the Royal B: Biological Sciences, 373- 1740, 1 - 10

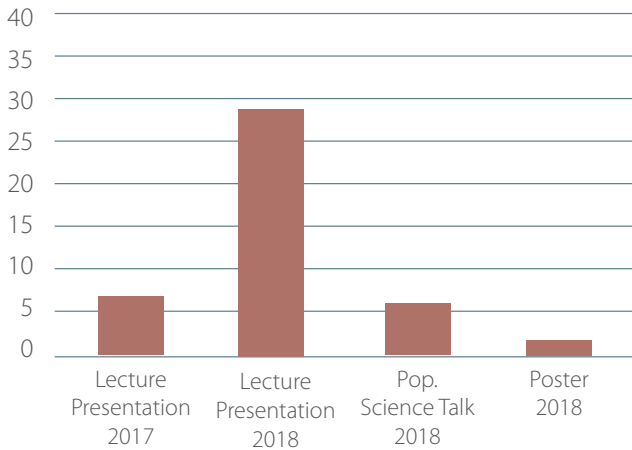
Andrea Bender, et al. Incl. **Sieghard Beller**
Variability in the alignment of number and space across languages and tasks
Frontiers in Psychology , 9, 1 – 19

Andrea Bender, Sieghard Beller et al.
Gender congruency from a neutral point of view: The roles of gender classes and conceptual connotations
Journal of Experimental Psychology. Learning, Memory and Cognition, 44- 10, 1580 – 1608

SAPIENCE PUBLICATIONS 2017-2018



SAPIENCE PRESENTATIONS AND TALKS 2017-2018



Alastair C Cunningham et al. incl. **Simon James Armitage**
High-precision natural dose rate estimates through beta counting
Radiation Measurements, 1 – 6

Alice Novello et al. incl. **Sarah Jacoba Deborah Wurz**
Phytoliths in modern plants and soils from Klasies River, Cape Region (South Africa)
Quaternary International, 464, 440 – 459

Lucinda Backwell et al. Incl. **Francesco d’Errico**
The antiquity of bow-and-arrow technology: evidence from Middle Stone Age layers at Sibudu Cave
Antiquity, 92- 362, 289 – 303

Ivan Colagé and **Francesco d’Errico**
Culture: the driving force of human cognition
Topics in Cognitive Science, online

Sieghard Beller, Andrea Bender et al.
The Cultural Challenge in Mathematical Cognition
Journal of Numerical Cognition , 4- 2, 448 – 463

Eleanor ML Scerri et al. incl. **Francesco d’Errico,**
Did Our Species Evolve in Subdivided Populations across Africa, and Why Does It Matter?
Trends in Ecology & Evolution, 33- 8, 582 – 594

Alison S Brooks et al. incl. **Francesco d’Errico**
Long-distance stone transport and pigment use in the earliest Middle Stone Age
Science, 360- 6384, 90 – 94

IN PRESS

Magnus M. Haaland et al.
Documenting archaeological thin sections in high-resolution: a comparison of methods and discussion of analytical applications.
Geoarchaeology.

Silje Eventh Bentsen and Sarah Jacoba Deborah Wurz
Color Me Heated? A Comparison of Potential Methods to Quantify Color Change in Thermally Altered Rocks.
Journal of Field Archaeology.

Sarah Jacoba Deborah Wurz
Human evolution, archaeology and the South African landscape during the last 100 000 years.
Knight, J. & Rogerson, C. The Geography of South Africa - Contemporary Changes and New Directions. Springer: Amsterdam

SAPIENCE STAFF AND MANAGEMENT

PIs AND RESEARCHERS AT SAPIENCE

Christopher Stuart Henshilwood	PI, Professor, SapienCE Director	Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
	DST/NRF SARCHI Chair in Modern Human Behaviour	Evolutionary Studies Institute University of the Witwatersrand Johannesburg, South Africa
Eystein Jansen	PI, Professor, SapienCE Deputy Director,	Department of Earth Science, University of Bergen
Karen van Niekerk	PI, Researcher	Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
Andrea Bender	PI, Professor	Department of Psychosocial Science, University of Bergen
Simon Armitage	PI, Reader	Department of Geography and Centre for Quaternary Research, Royal Holloway University of London
Carin Andersson Dahl	PI, Researcher	NORCE Climate (Former Uni Research Climate)
Francesco d’Errico	Directeur de recherche de classe exceptionnelle	CNRS Université de Bordeaux
	Professor II	Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
Chris Miller	Professor	Geoarchäologie, Institut für Naturwissenschaftliche Archäologie, Universität Tübingen.
	Professor II	Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
Sarah Wurz	Associate professor	School of Geography, Archaeology and Environmental Studies, University of Witwatersrand
	Professor II	Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
Kenneth Hugdahl	Professor	Department of Biological and Medical Psychology, University of Bergen
Sieghard Beller	Professor	Department of Psychosocial Science, University of Bergen

Torill Kristine Lindstrøm	Professor	Department of Psychosocial Science, University of Bergen
Stein-Erik Lauritzen	Professor	Department of Earth Science, University of Bergen
Anna Nele Meckler	Researcher	Department of Earth Science, University of Bergen
Margit Simon	Researcher	NORCE Climate (Former Uni Research Climate)
Zhongshi Zhang	Researcher	NORCE Climate (Former Uni Research Climate)
Odd Helge Otterå	Researcher	NORCE Climate (Former Uni Research Climate)
Stefan Pieter Sobolowski	Researcher	NORCE Climate (Former Uni Research Climate)

Temporary research staff in 2018

Magnus Mathisen Haaland	Researcher	Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
Ole Fredrik Unhammer	Research Assistant	Department of Archaeology, History, Cultural Studies and Religion, University of Bergen

SapienCE Postdoctoral Research Fellows 2018

Turid Hillestad Nel		Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
Magnus Mathisen Haaland		Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
Jenny Maccali		Department of Earth Science, University of Bergen
Silje Evjenth Bentsen		Department of Archaeology, History, Cultural Studies and Religion, University of Bergen

Doctoral Fellows (Ph.D. students) 2018

Ole Fredrik Unhammer		Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
Evi Linda Naudts		Department of Earth Science, University of Bergen

In addition, one more postdoc was hired in 2018, but will not operate before May 2019

SAPIENCE LEADER GROUP



Karen van Niekerk
Researcher
PI



Carin Andersson Dahl
Researcher
PI



Andrea Bender
Professor
PI



Simon Armitage
Reader
PI



Eystein Jansen
Professor
Deputy Director, PI

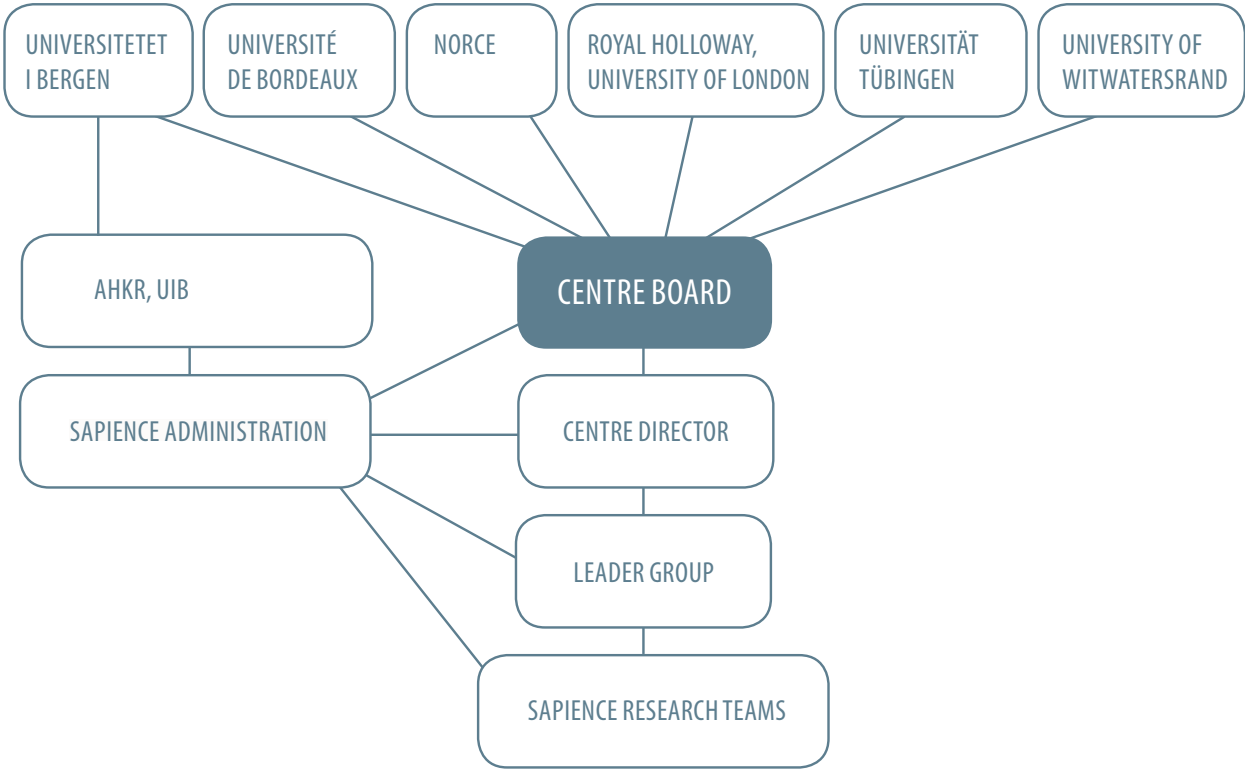


Christopher Stuart Henshilwood
Professor
Director, PI



Ståle Berglund
Project Manager
Administrative Leader

CENTRE STRUCTURE



SAPIENCE ADMINISTRATION 2018

The SapienCE administration comprises one full time project manager and several part time contributions from existing staff at The Faculty of Humanities and The Department of Archaeology, History, Cultural Studies and Religion at University of Bergen. The centre has in total three FTE's (Full-time equivalents).

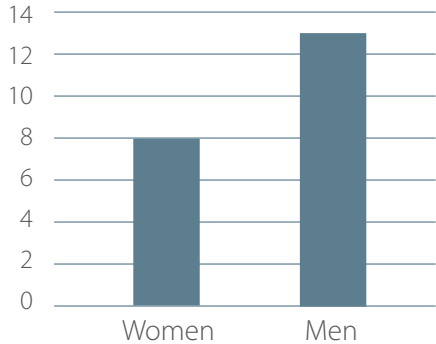
Personnel involved in the SapienCE administration in 2018	
Ståle Berglund	Project Manager, Administrative leader
Mari Knudsen	Adviser, Economy and accounting
Janne-Beate Buanes Duke	Adviser, Media and communication
Hanna T. Husabø	Executive Officer, Front desk
Trygve Svarstad	Senior Executive Officer, Doctoral education coordinator (up to July 2018)
Anna Kristina Polster	Senior Executive Officer, Doctoral education coordinator (from July 2018)
Anna- Lisa Aarefjord	Senior Executive Officer, HR
Björg Anja Teigland	Senior Executive Officer, Research dissemination monitoring
Eirik Kvam Goksøy	Senior Executive Officer, Web support

In addition, the Faculty of Humanities contributes back-office functions for the centre. The three other Departments involved at the University of Bergen also provide administrative services to the research teams of the centre.

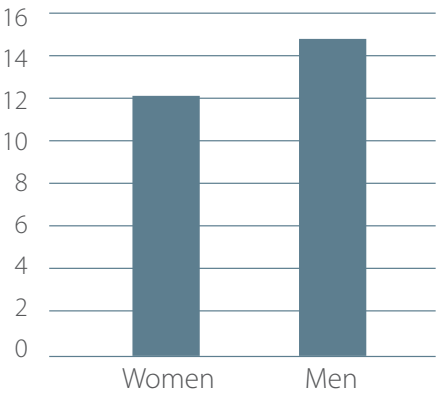
SapienCE administrators, curation and field support in Cape Town, South Africa	
Petro Keene	Curator/Collections manager Evolutionary Studies Institute, University of Witwatersrand
Lisa Hulett	Assistant Evolutionary Studies Institute, University of Witwatersrand
Samantha Mienies	Sorter (part time) Evolutionary Studies Institute, University of Witwatersrand

DISTRIBUTION OF GENDER IN SCIENTIFIC POSITIONS AT SAPIENCE

Senior scientific positions				
	Number of	% number of	FTEs*	% FTEs*
Women	8	38	3,7	44
Men	13	62	4,6	56
Total	21	100	8,3	100



All scientific positions (including doctoral and postdoctoral fellows)				
	Number of	% number of	FTEs*	% FTEs*
Women	12	44	5	47
Men	15	56	6	53
Total	27	100	11	100



* Full time equivalents

SAPIENCE FUNDING IN 2017-2018

In 2018 the principal source of SapienCE funding came from the RCN and own-financing from the host institution, plus a substantial level of in-kind contributions. SapienCE obtained additional funding from national and international sources. These funds allowed for a higher activity level and a broader scope, predominately within the archaeological research conducted by SapienCE. The numbers for the 2017/2018 financial year are shown below.

SapienCE Funds 2017-2018 (NOK)		
Source	2017	2018
Own financing (Host Institution)	1 630 360	7 640 249
Agreed in kind plus additional estimated in kind (Partner Institutions)	248 200	1 371 650
RCN contribution	0	11 725 500
Additional project funds (University of the Witwatersrand, South Africa; HUMEVAL, Norway)	0	2 986 916
TOTAL FUNDING OF CENTRE ACTIVITY	1 878 560	23 724 315



Design & Layout:

Renate Paulsen

Photos:

Magnus Mathisen Haaland, UiB (p. 6, 15, 18, 19, 26, 27)

Ole Fredrik Unhammer, UiB (Cover, p. 4, 9, 10, 13, 23, 24, 25)

Christopher Henshilwood, UiB (p. 40)

Craig Foster (p. 15, 17, 28, 29)

Stephen Alvarez, National Geographic (p. 38/39)

Silje Evjenth Bentsen (p. 40)

Mathias Czechowski (p. 13)

Sarah Wurz (p. 13)

Kim Andreassen (p.35)

