SAPIENCE

CENTRE FOR EARLY SAPIENS BEHAVIOUR

UNIVERSITY OF BERGEN

ANNUAL REPORT 2021

Norwegian Centre of Excellence

CONTENTS

STATEMENT FROM THE CHAIR OF THE BOARD

In 1976 the highly acclaimed historian John M. Roberts published The Penguin History of the World. Celebrated and controversial – this book has become a classic read for students, scholars as well as the public. Roberts wrote several revised editions before he passed in the early 2000s, when Penguin entrusted the eminent historian Odd Arne Westad to take up the torch.

An obvious task for Westad was to bring book further up to date with the events and the scholarly debate that had unfolded after it was first published. However, the greatest need for revision did not stem from the immediate, but from the most distant history. The impressive achievements of anthropological and archeological research in recent decades have both enriched and critically changed our understanding of early human life on earth.

It is in this perspective the groundbreaking research and the tremendous success of SapienCE must be understood. SapienCE has established itself as a lodestar in the study of early human behaviour. The outcome of their research demands world history to continue to be rewritten – nothing less.

A Centre of Excellence is the most competitive and highest hanging fruit of all the funding schemes of the Norwegian Research Council. SapienCE offers an important reminder to both academia at large and key funding bodies of the fantastic intellectual potential that lies in ambitious, international, and interdisciplinary research projects with the humanities both at the heart and the helm.

SapienCE also embodies how an already successful scholarly environment can breed further success in terms of merits as well as funding. 2021 witnessed the start-up of the ERC Synergy Grant project Evolution of Cognitive Tools for Quantification which involves several SapienCE PIs, and SapienCE was also an integral part of the successful SEAS COFUND bid from the University of Bergen.

One of the greatest privileges of being a new Dean of the Faculty of Humanities, has been the opportunity to gain first-hand knowledge of the amazing work of the SapienCE team. Both as a Dean and as the Chairman of the Board, I am immensely proud of how the entire team has continued to keep up an impressive level of activity and to produce outstanding scholarship despite the challenges of the pandemic. As a fellow scholar and citizen, I am also incredibly grateful for the invaluable new knowledge and insight they continue to bring forward.

That includes furthering our understanding of one, if not the, most pressing issue of our time – climate change and the human capacity for adaptation. To find answers, we need a cutting-edge, interdisciplinary, and brave approach to long history. This is exactly what SapienCE continues to offer us.

Camilla Brautaset

STATEMENT FROM THE DIRECTOR

We are all aware that 2020 and the larger part of 2021 presented considerable difficulties worldwide for individuals, for society, for states, with enormous knock-on effects for, among many other aspects, research, outreach and collaboration in academia. For the majority of 2021 most of our SapienCE Early Career Researchers (ECR's) and senior scientists were confined to home offices with some fortunate exceptions where our laboratories could be accessed. A major setback was the cancellation of the 2021 fieldwork programme in South Africa, which would have been scheduled for February-April. Despite these challenges there was a remarkable capacity and willingness shown by our SapienCE scientists to keep up their research programmes. The support provided by SapienCE administrators and scientists was admirable, especially in organising regular contact with our researchers via Zoom and Teams meetings and lunchtime talks. Our bi-monthly Leader Group meetings via Zoom have kept us in good contact. There were also a number of more general meetings allowing all our scientists to join in a group chat. Supervision meetings with PhDs and mentorship of Postdocs continued via Zoom until mid-2021 with some limited opportunities for direct meetings. The opening up of our offices and laboratories at UiB in late July/August, with safeguards in place, provided opportunities to get together as a team again, albeit in smaller discussion groups. The positivity of meeting 'live' was palpable and has fostered a new spirit amongst our scientists for promoting co-operation and planning future research, especially fieldwork. I think there was a relief amongst our PhDs and Postdocs to meet again, in person, with their supervisors and mentors, and vice-versa. Towards the end of 2021 some restrictions were again introduced with a choice of home office being reintroduced. The largely successful Covid-19 vaccination programme in Europe, the UK and USA has meant we can now look forward to welcoming back to Bergen, in person, the SapienCE scientists who are domiciled elsewhere. The Omicron variant caused another scare in late 2021/ early 2022 that threatened to shut down our planned activities once again. I am delighted to report that we are now going ahead, safely, with our fieldwork plan for excavations at Blombos Cave in February/March 2022. A substantial number of our SapienCE crew will be joining us.

In 2021 SapienCE has again been successful at attracting external funding, at appointing high quality Postdocs and PhDs. Despite the lockdown we have seen increasing interest from world class research groups and researchers to collaborate with SapienCE. We can report an increase in collaborations with universities and institutions in Scandinavia, the UK and southern Africa. We are also pleased to report that in 2021 we recruited a SapienCE project (admin) manager, Dr Žarko Tankosić, who holds a PhD in archaeology from Indiana University. Žarko, who previously headed fieldwork and research at the UiB sponsored Norwegian Institute in Athens, commenced work with us in early September. To conclude, 2021 has been hugely challenging, yet it has also been a time that has offered us new opportunities and perhaps, new ways to address what initially appeared to be insurmountable problems. I am proud to say that together SapienCE members have responded to the best of their ability and in the best interest of continuing our research and pursuing excellent science.

I, and the SapienCE team, are now feeling very positive that we can recover from the setback of 2021. Our multi-disciplinary scientists are proceeding apace with their planned research targets and excavations, and we can expect some excellent outputs in 2022. Finally, I would also like to pay special tribute to our SapienCE administrators who in 2021 again kept the ship steady, supported our scientists and provided outstanding backup despite the adversities.

Christopher Stuart Henshilwood

SCOPE

The SapienCE Centre of Excellence is built around a carefully selected interdisciplinary team of archaeologists, climatologists and psychologists. The team aims to increase our understanding of how and when *Homo sapiens* behaviour changed, making us who we are today.
Within the next decade, the SapienCE team will investigate Middle Stone Age (MSA) archaeological sites by looking in detail at the evidence, layer by layer, site by site.

HIGH-RESOLUTION RECORDS

SapienCE researchers will produce an exceptional range of securely dated, high-resolution records of early human cultural, social, technological and subsistence behaviours, alongside global, regional and site-based palaeoenvironmental information. The centre's aim is to integrate these records, allowing a holistic analysis which will provide groundbreaking insight into the diverse aspects of what it means to be human.

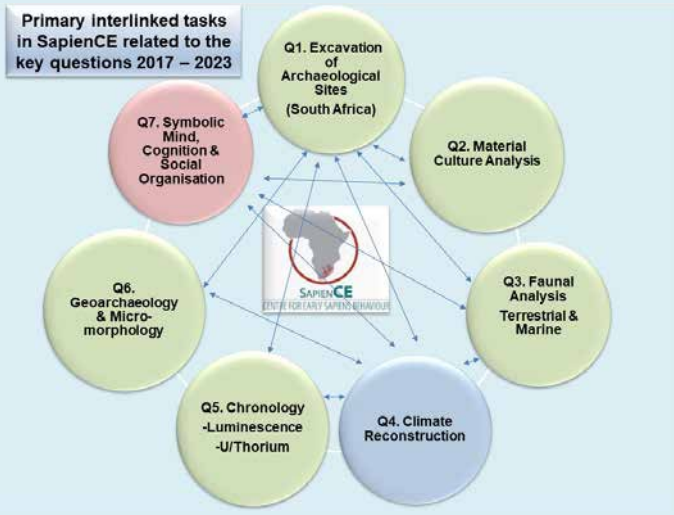
ACCESS TO UNLOCK THE PAST

The SapienCE team has exclusive access to Blombos Cave, Klasies River main site and the Klipdrift Complex; sites that contain the key for unlocking the past. Blombos Cave is known as the cradle of human culture. Engraved ochre, shell beads and the world's earliest human drawing are amongst the significant finds from this cave. Early modern humans occupied the cave between 100 000 - 70 000 years ago.

Klasies River main site is famous for its numerous human fossils and the extensive 20-meter archaeological archive of early human behaviour. Early modern humans occupied the site between 120 000 - 59 000 years ago. The Klipdrift Complex covers both the Middle and Later Stone Age. The site is particularly associated with the Howiesons Poort techno-complex dating to approximately 65 000 - 59 000 years ago.

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

ARCHAEOLOGY

2021 was a remarkably productive year for the SapienCE archaeologists, with substantial progress on a number of ongoing projects complementing successful conclusions to others. Covid-19 prevented us mounting full excavation seasons at any of the SapienCE sites, though important fieldwork was conducted nonetheless. Peter Morrissey, a PhD student at the University of the Witwatersrand supervised by Sarah Wurz, resumed his work describing and interpreting the sediments at Klasies River. Using a combination of detailed field observations and sampling for microscopic analysis, he will clarify correlations between sediments and archaeology across different parts of the site. SapienCE also consolidated our ability to work remotely from South Africa, with the appointment of Samantha Mienies as a curator in Cape Town. Sam's long association with our excavations made her the ideal candidate to fill this position, which involves development of a more integrated curation database, sourcing and sampling material for laboratory analysis and facilitating sample export permit applications.

A number of laboratory-based projects have made impressive progress over 2021. Turid Hillestad Nel demonstrated the feasibility of zooarchaeology by mass spectrometry (ZooMS) for identifying small mammal remains from the Middle Stone Age (MSA) levels of Klipdrift Shelter. Typically, species identification is carried out using tooth shape, but ZooMS should be applicable to any bone fragment, making more comprehensive analysis possible. Turid has been helped with her work this year by student assistant Åshild Stuen Jensen. Elizabeth Velliky continued her work on identifying the sources for ochre found in Blombos Cave by analysing samples collected during her 2020 geological survey season. Using the chemical and mineral composition of different ochres alongside microscope analysis of thin-sections, she aims to produce unique "fingerprints" for each source near Blombos. This work will be expanded to encompass the Klein Karoo and De Hoop regions in 2022, funded by a Leakey Foundation grant. SapienCE PhD students Ole Fredrik Unhammer and Jovana Milic continue to make progress with their projects. Ole completed the mammoth task of compiling a comprehensive 3D model of the Blombos Cave excavations, using the photographic archive extending back to 1998. Katrina Rørhus, a student assistant who also worked with Elizabeth Velliky, helped with this task by scanning old excavation photographs. Jovana conducted detailed geochemical analysis of experimentally heated *Turbo sarmaticus* (a type of sea snail) shells. The geochemistry of these shells, which are abundant in many coast-

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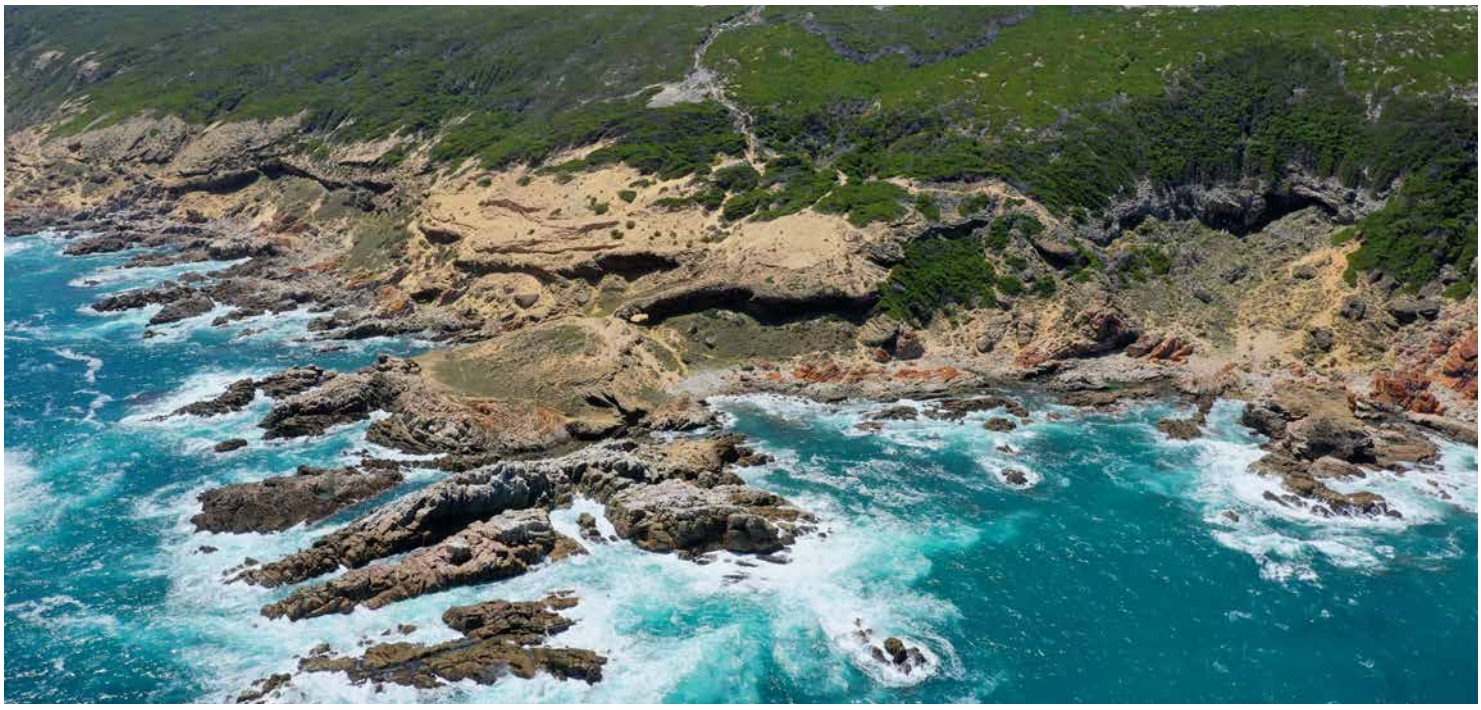
al MSA sites, can be used to determine the environmental conditions under which they lived. However, Jovana's research demonstrates that this signal can be altered by heating, e.g. in a cooking fire, so careful screening of samples is required before analysis.

Research published by SapienCE scientists in 2021 highlight the breadth of both the centre's work and our collaborations. Alexandra Coutinho from Uppsala University in Sweden extracted ancient DNA from 400 year-old human hair excavated at Vaalkrans Shelter in the De Hoop Nature Reserve. Analysis of this DNA, which was excavated by Christopher Henshilwood and Karen van Niekerk, showed that it belonged to a man who traced ~80% of his ancestry to local southern San hunter-gatherers and ~20% to a mixed East African-Eurasian source, similar to modern-day Khoekhoe individuals from the Northern Cape Province (South Africa) and Namibia. Shaw Badenhorst and Joel Ezeimo, from the University of the Witwatersrand, also worked with Karen and Christopher. They analysed species ratios from twelve MSA sites from the Eastern and Western Cape provinces of South Africa, concluding that these ratios could be used to help distinguish between bones accumulated by humans and those collected by carnivores such as leopards and hyenas. Closer to home, SapienCE postdoc Magnus Haaland collaborated with a number of colleagues from the centre to publish a geoarchaeological analysis of the MSA occupation levels at Blombos Cave. They suggest that site use varied over time, with long but infrequent visits predominating early in the record (~88-82 thousand years ago) while more frequent short stays occurred later (~77-72 thousand years ago). These changes appear to be related to changing vegetation patterns and falling sea-levels, which probably led to changes in the nature and frequency of social interaction between prehistoric populations living in the southern Cape. Outside South Africa, but still in the MSA, Francesco d'Errico and Simon Armitage were part of a large team which discovered the oldest primary burial in Africa, at Panga ya Saidi in Kenya.

Lastly, 2021 saw two new arrivals and one departure. Zahra Haghighi joined us to conduct ancient protein analysis (palaeoproteomics) on a range of MSA materials from Blombos Cave and Klipdrift Complex, as part of the European Commission funded "Palaeoproteomics to Unleash the Science of Human History" (PUSHH) training network. PUSHH is led by Enrico Cappellini at the University of Copenhagen, who hosted Zahra for a training secondment in late 2021. We were also joined by our first SapienCE baby, Konstanse, whose proud parents, Elizabeth Velliky and Magnus Haaland, are both SapienCE postdocs. Magnus has now taken up a post at the Archaeological Museum in Stavanger, but maintains a 20% position within SapienCE.



CLIMATE
– FROM THE CAVE TO THE LAB

In March 2020, slightly oblivious of what was happening elsewhere in the world, we went to Bloukrans Cave and collected three new speleothem specimens before reality caught us and we had to fly back to Norway. As we arrived safely back in Bergen, leaving the specimens in the SapienCE Cape Town laboratory, we were unsure of when they could be shipped to Norway. Later during the summer, I received an email from Samantha Mienies (SapienCE's curator); the specimens were packed and on their way! We opened the four crates as if it was Christmas morning and started to unwrap and assemble all the different pieces: the samples were here and the lab work could start.

FROM A BIG STALAGMITE PIECE TO A SLAB

The first step was to carefully re-assemble each specimen, label each part and draw a line that would go to the approximate center of each piece. Stalagmites are 3D structures that grow vertically, layer by layer. Layers tend to thin towards the edges, so we favour sampling along the center to maximize the resolution.

Each piece was cast into a plaster block, allowing it to be mounted on a circular saw and cut lengthwise. One half was stored as archive while the other half was further cut into a ~1 cm thick slab.

FROM THE SLAB TO POWDER/CHUNKS

The suite of analytical techniques that we use consist of both non-destructive (the sample is left unaltered) and destructive (part of the sample is destroyed) methods. Each technique required a specific amount of sample (from ~10 to several hundred mg), in a specific form (powder, thin sections, chunks), and either continuous or discrete subsampling. Samples were taken at a workstation

dedicated to the technique, using either a milling stage, a diamond wire saw, or a low-speed circular saw. Subsampling is always a slow process, but Covid-19 restrictions and social distancing made it even more solitary. Eventually we had hundreds of different samples and the initial slab of sample was barely recognizable.

SAMPLE PREPARATION AND ANALYSES

Our subsamples were then further processed according to the different analytical methods being used;

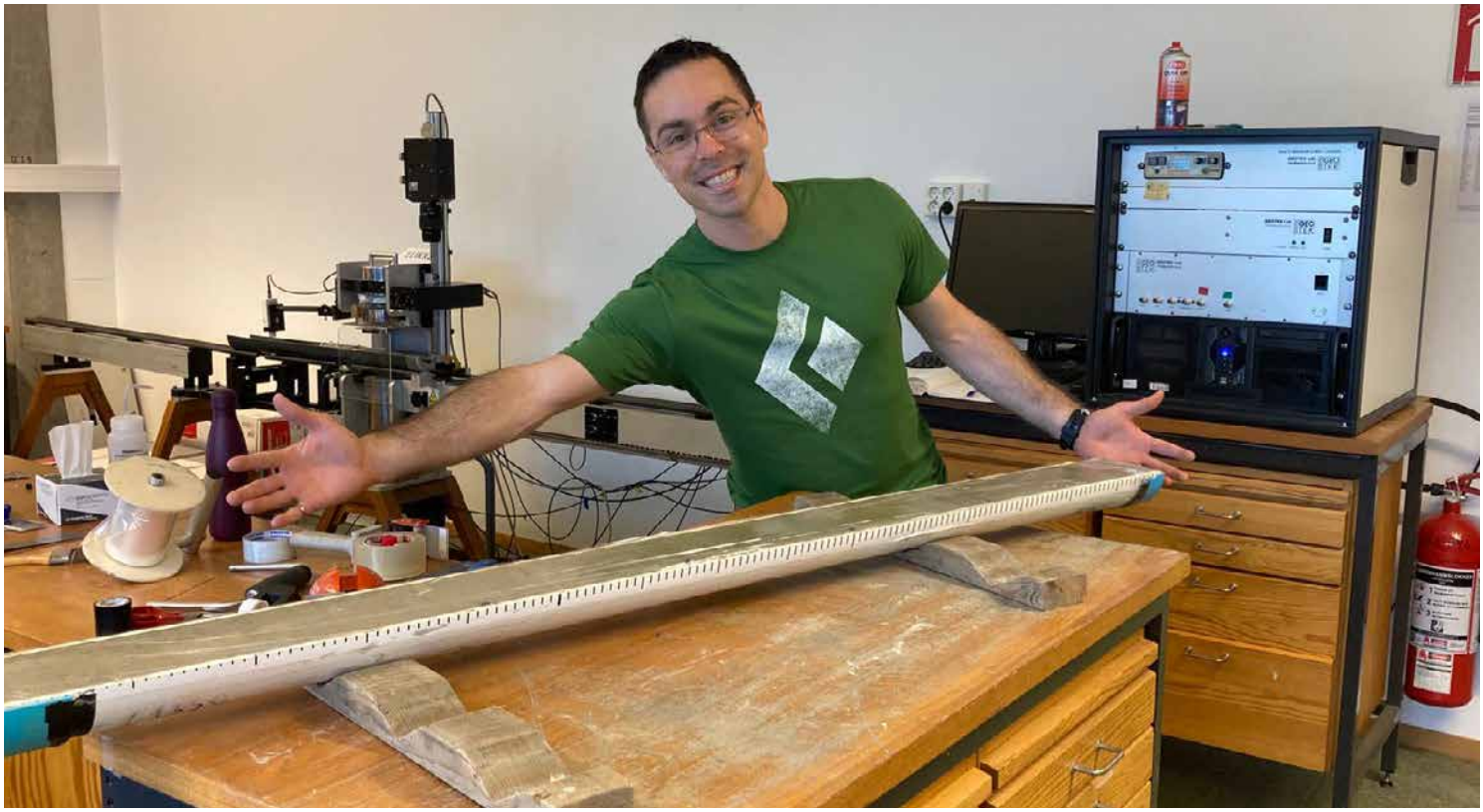
- Oxygen and carbon isotopes: the powdered sample was dissolved, converted to carbon dioxide gas and analyzed on a Thermo Scientific MAT 253 stable isotope ratio mass spectrometer at the MAT253 at the Facility for advanced isotopic research and monitoring of weather, climate and biogeochemical cycling (FARLAB), University of Bergen (UiB)

- Uranium-thorium dating: the powdered sample was dissolved, purified and analyzed on a Nu Plasma II Multicollector-Inductively Coupled Plasma Mass Spectrometer at UiB

- Water isotopes: chunks of stalagmites were heated, crushed and analyzed on a Picarro instrument at FARLAB, UiB

- Microthermometry: 4x4 mm thin pieces were cooled/heated on a Linkam THMSG600 stage coupled to a Clark-MRX CPA 2101 amplified Ti-Sapphire femtosecond laser system at UiB.

It took months, a lot of excitement, a bit of frustration, hours of discussions, litres of coffee and a fair amount of patience to go from the initial stalagmite to a spreadsheet filled with numbers that we are working to translate into a record of the climate during the formation of our stalagmites.



CLIMATE
- FROM THE OCEAN TO THE LAB

Planktonic foraminifera are tiny unicellular zooplankton with a calcite shell. Foraminifera live in the ocean water column and form their calcite shell from the seawater they are surrounded by, meaning they preserve the chemical fingerprint of that waterbody in their shell. After foraminifera die they sink to the ocean floor and are buried and preserved in the ocean mud. When we recover that ocean mud, via sediment cores, we can extract the foraminifera. By measuring the elemental composition of these ancient shells we obtain a record of variations in waterbody properties. As such we can reconstruct changes in ocean surface temperature, salinity and other parameters through time. In the context of SapienCE's research, that will tell us what the ocean conditions were like when our earlier ancestors lived near this water/ocean during the Middle Stone Age.

WHY DID OCEAN CONDITIONS MATTER FOR MIDDLE STONE AGE PEOPLE?

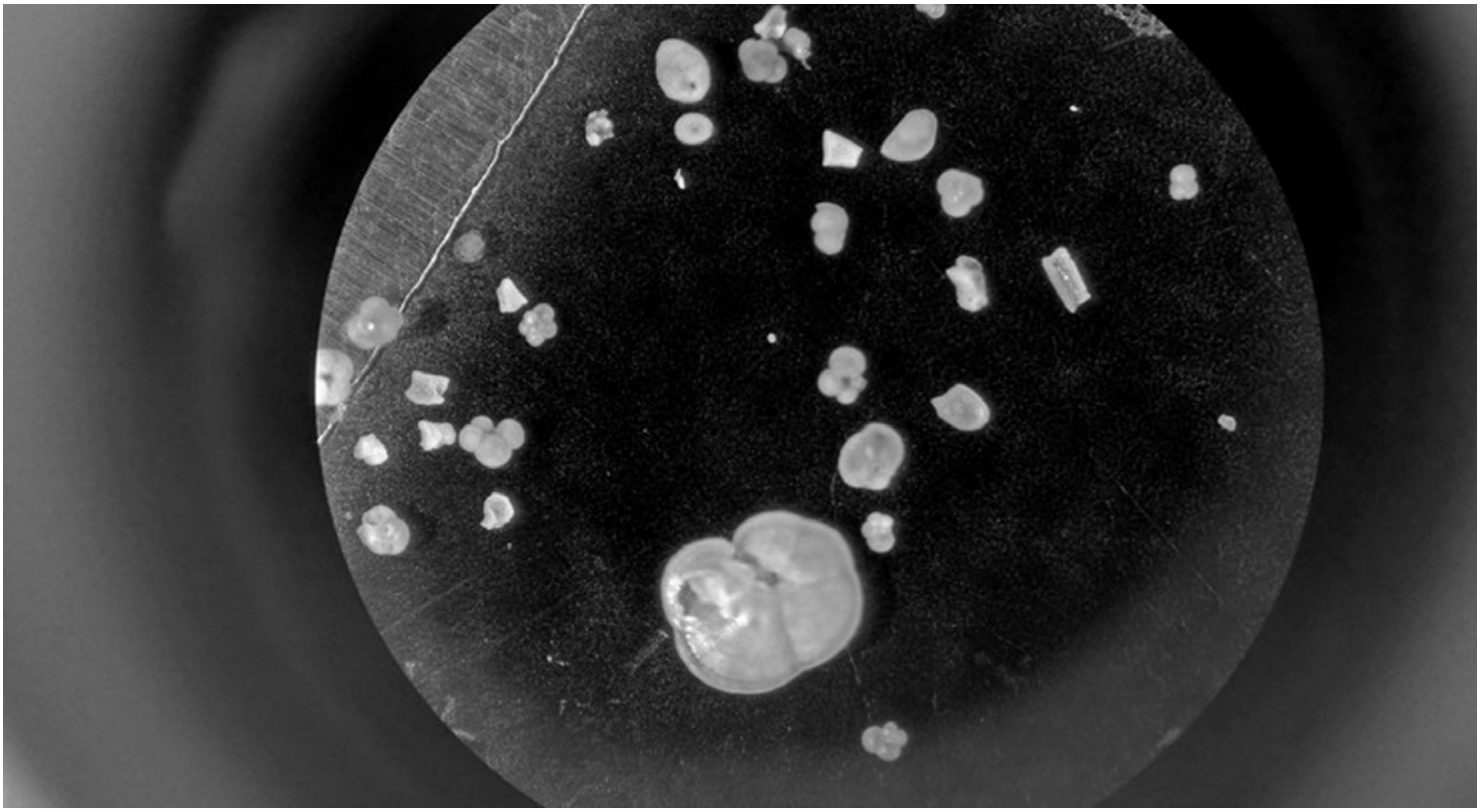
The Agulhas Current around South Africa influences marine habitats by stabilizing inshore water temperature, which supports intertidal shellfish and littoral fish communities. Ocean conditions therefore determine the marine food sources that were abvailable. Also, the warm Agulhas current today drives the convection of moist coastal air cells, causing coastal precipitation and delivering fresh water to the region. Consequently, past ocean temperatures were important since they controlled how much rainfall/ freshwater was delivered in the coastal areas surrounding the caves being excavated by SapienCE.

Mg/Ca PALEOTHERMOMETRY

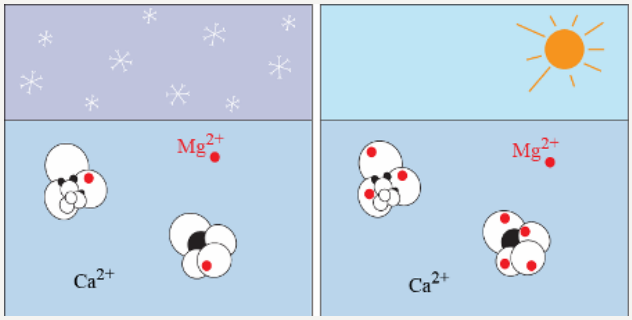
Measuring the ratio of magnesium (Mg) to calcium (Ca) in calcite shells is commonly used to reconstruct past ocean temperatures. Physical changes of the ocean have occurred during the past, and one way to get information about these physical changes within the oceans is to study the past temperatures.

HOW CAN Mg/Ca RATIOS GIVE US THE PAST TEMPERATURES OF THE OCEANS?

Most of the marine organisms build their shells out of calcium carbonate, also called calcite. Foraminifera are no exception, and they produce a shell composed by one or more chambers. Most shells are smaller than one millimeter. Different foraminifera species live in different locations. Some live at different depths within the water column, and are referred to as planktonic foraminifera, whereas others termed benthif foraminifera live at the surface of the ocean floor or even within the seafloor sediment.



Even if the element Ca is the main component of the shell of a foraminifera, other elements, such as Mg will be incorporated into the shell as it is formed. In the 1990s researchers discovered that the Mg/Ca in foraminiferal shell is temperature-dependent. Foraminifera incorporate more Mg anions (Mg2+) into their shells when the water is warmer. Therefore the Mg/Ca ratio can be used to determine past ocean temperatures.



HOW DO WE MEASURE Mg/Ca?

We determine the Mg/Ca ratios of foraminifera shells using an Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) instrument. The principle is that when the sample is introduced into the plasma within the instrument, it becomes ionised. These ions generate light at characteristic wavelengths, with the amount of light being proportional to the number of atoms present. Using sensitive detectors to measure the amount of light being emitted allows us to determine the concentration of each element. Consequently, we can measure the concentration of Mg and Ca contained in the foraminifera shells, and determine seawatwer temperature during shell formation.

COGNITION
– LIGHTING UP THE BRAIN

Are all human brains similar? Does every person in the world see, know, and think in the same way? The short answer is "no". The long answer requires us to assess the impact of culture on the human brain both in the present and over the course of human evolution. Brain and culture are tightly intertwined in a feedback loop that has shaped modern human cognition and behaviour. The work of the SapienCE subgroup Symbolic Mind, Cognition, and Social Organiza-tion addresses the questions of what cognitive styles early *Homo sapiens* (*H. sapiens*) may have had at their command and what the remains of material culture from the MSA can tell us about the minds of the humans that left it behind.

BRAIN IMAGING IN THE SPOTLIGHT

For any attempt to reconstruct early *H. sapiens* cognition, culture must be taken seriously, yet many foundational aspects of early human culture, such as language, are inaccessible. To tackle this massive challenge, several strategies can be used, for example building on cross-cultural and inter-species comparisons to infer the presence or absence of certain key aspects of cognition among early sapiens populations. Another strategy is to use the available remnants of cultural variants to trace back the necessary cognitive processes that spurred them. This year, we highlight research that focuses on the latter strategy in combination with neuro-imaging methods to infer the cognitive skills that most likely were present among the inhabitants of Middle Stone Age (MSA) sites such as Blombos Cave 100,000 years ago.

THE NEUROARCHAEOLOGY OF MSA STONE TOOLS

Brain functions are partly determined by cultural interactions, and thus studying this organ can shed light on the past cultural processes that shaped it. Brain-imaging research is one of the methods used by our researchers to better understand the cognitive mechanisms involved in the production of MSA material culture. In collaboration with the Bergen Functional Magnetic Resonance Imaging (fMRI) Group, we are applying brain imaging techniques to stone tool technologies and cultural transmission. The ongoing subproject "Neuroarchaeology of MSA stone tools", led by Kenneth Hugdahl and Torill Christine Lindstrøm, aims at measuring brain activation during the production of different Stone Age technologies in order to gain knowledge about the neural areas and connections that are minimally required for making these artefacts. By comparing production of tools related to different hominin species over different periods, the research intends to clarify whether more complex tools engage more complex neural activity. One hypothesis to be tested, for instance, is whether the simple Oldowan and Acheulean forms, made by early Homo groups, require less brain power than more sophisticated MSA artefacts attributed to *H. sapiens*, such as those from the Still Bay and Howiesons Poort traditions found at Blombos Cave and Klipdrift Shelter respectively. The data obtained can potentially inform us about the cognitive modes of these different hominins and illuminate the evolutionary history of modern human cognition.

NEURAL ACTIVITY IN KNOWLEDGE TRANSFER

Human cognitive abilities are extraordinary, if not unique, in that they allow us to generate, transmit, and preserve knowledge and information, supporting an elaborate system of cumulative culture. The subproject "Brain activation in cultural evolution (BRACE)" looks into the cognitive bases that allow for and sustain different modalities and dimensions of cultural transfer, including imitation, pedagogy, and copying fidelity. The study is led by PhD researcher Heidi Øhrn, in collaboration with Kenneth Hugdahl, Natalie Uomini, and master student Emilie Pettersen Sjursen, and supervised by Andrea Bender and Larissa Mendoza Straffon. In an innovative set up, this project combines transmission-chain studies with neuroimaging (fMRI) techniques, using evolutionary relevant, archaeologically grounded behaviours, such as knot-making and geometric pattern production. The goal is to reveal how different technologies pose distinct cognitive demands and how these, in turn, affect cultural transmission and innovation. By studying brain activation patterns during the acquisition and transfer of knowledge in these domains, and the potential variations generated in the process, we hope to gain results that will offer new insights on the cognitive and behavioural components of cultural evolution.

A MIND FOR SYMBOLS

Human culture is symbol-based. Language is the prime example of a human symbol system that permeates almost

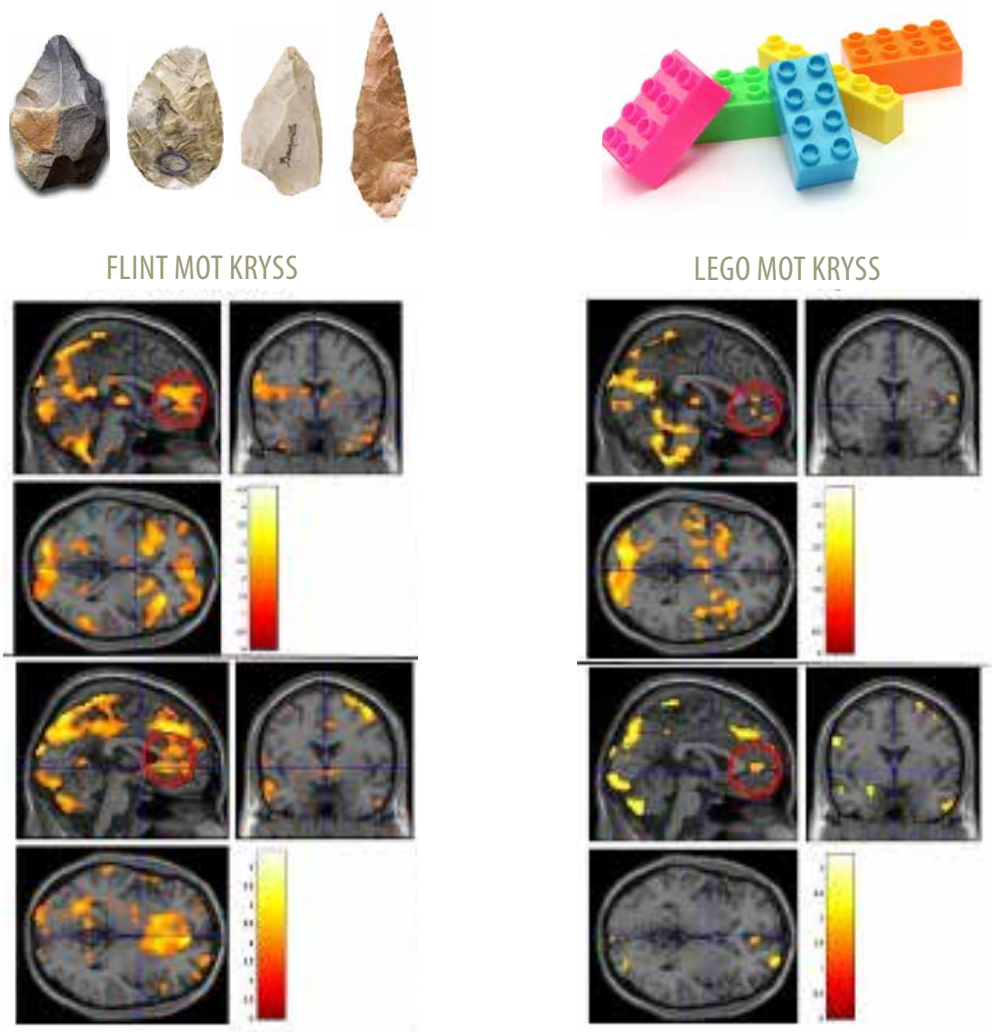


Figure 1 Data collection from the pilot study of the project Neuroarchaeology of MSA stone tools. Left: Brain activation under tool making condition. Right: Brain activation under control (Lego making) condition.

all of cognition and behaviour, with visual symbols as a close second. Symbols allow us to communicate across time and space, to carry out complex operations, and to represent the world around us – and even the realms beyond the tangible. Recent research suggests that the modern human brain is uniquely tuned in to perceive and process visual symbols. In a project on "Neural correlates of visual symbolism", Francesco d'Errico and collaborators attempt to reveal the brain networks that specialize in identifying and interpreting visual symbols, and to test the extent to which the same neural regions are involved in 'reading' early symbols such as the geometric engravings from Blombos Cave. The brain areas and mechanisms involved in making, interpreting, and transmitting visual symbols are also in the focus of Heidi Øhrn's project. Overlaps and differences found in these two studies will thus provide rich data for testing hypotheses about the cognitive mechanisms that support visual symbolism in humans, and their origin.

BRAIN IMAGING OF THE ORNAMENTED BODY

Body ornaments in the form of shell beads are particularly meaningful finds from the Still Bay layers at Blombos Cave. Ochre is one of the most abundant materials at this site, and evidence that it was turned into red pigment goes back 100,000 years. Collectively, beads and ochre point to cultural interventions in the human body and indicate the prevalence of personal decoration practices in the MSA. Francesco d'Errico and a team of experts from the University of Bordeaux are investigating the cerebral circuits and cortical regions involved in the perception of the culturalised body. The results of their experiments will shed light on the neural networks involved in processing cultural signals displayed on the body, such as ornaments, body painting, and tattoos. This, in turn, will generate new hypotheses on the selective pressures that may have given rise to the culturalisation of the human body in the MSA.

Despite the impact of the Covid-19 global pandemic, the SapienCE cognition group had significant output and achievements. Collectively we produced some 15 publications, we gave over 20 talks, and were present at more than 10 international meetings, two members received external funding, and we welcomed a new PhD candidate.

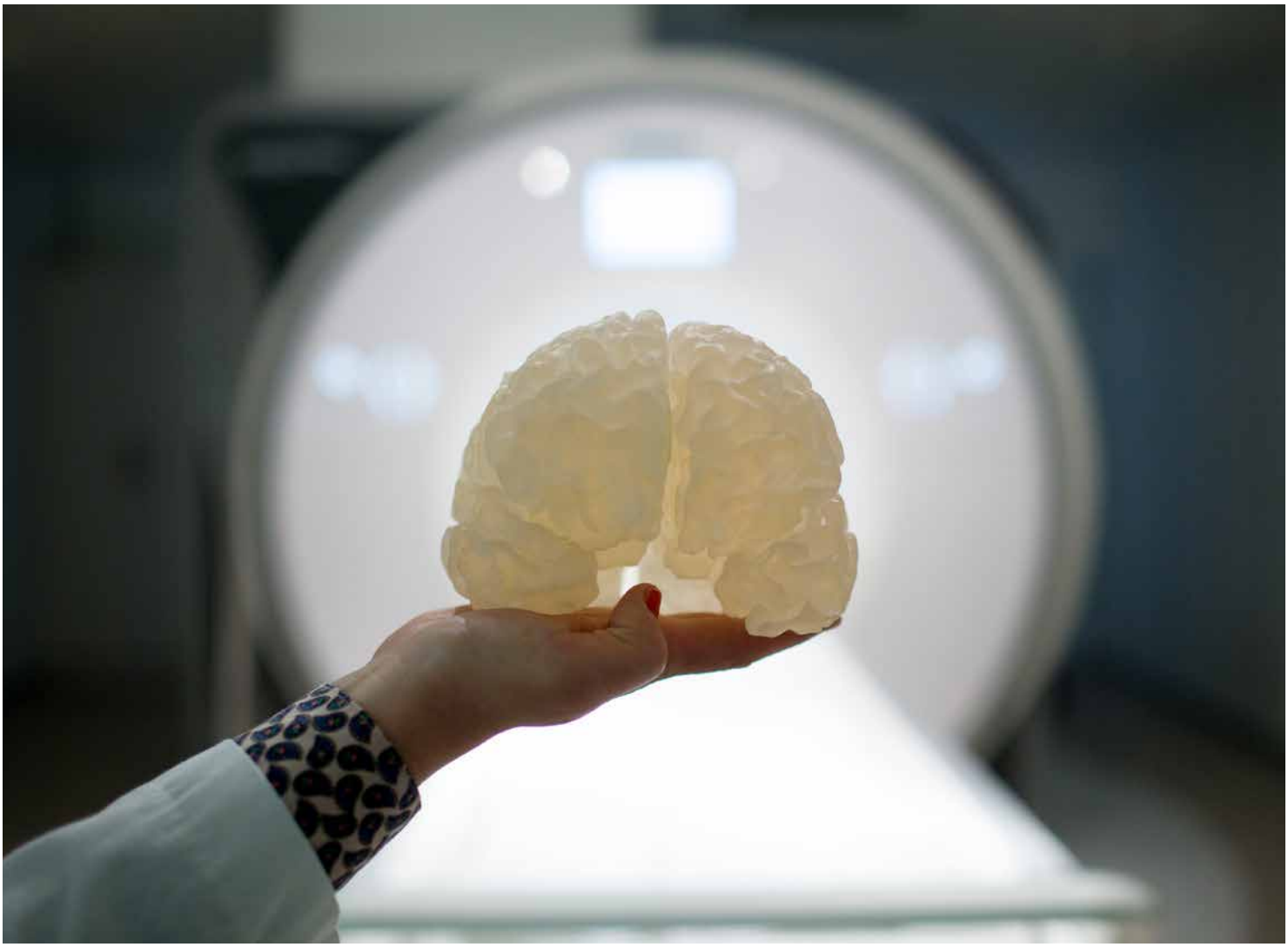
One of our highlights of the year involved the official kick-off of the ERC Synergy Grant project QUANTA Evolution of cognitive tools for quantification, which involves two of our group senior scientists, Andrea Bender and Francesco d'Errico, alongside Rafael Núñez (University of California San Diego), and Russell Gray (Max Planck Institute for Evolutionary Anthropology, Leipzig). This initiative intersects with the aims and activities of SapienCE at different levels, and has already started to yield novel approaches to the evolution of modern human cognition. Andrea was interviewed about this project by the BBC, while Francesco was featured in a piece by Nature News.

In 2021, our group continued developing projects that take advantage of state-of-the-art innovative brain imaging techniques. After a successful pilot study and a break due to the pandemic, Torill Christine Lindstrøm, Kenneth Hugdahl, and Andrea Bender resumed activities on a project entitled Neuroarchaeology of stone tools. Furthermore, a new project, Brain Activation in Cultural Evolution (BRACE), also made a promising start. This is led by Andrea Bender and our new PhD student Heidi Øhrn, supported by Kenneth Hugdahl, postdoc Larissa Mendoza Straffon, MSc student Emilie Pettersen Sjursen, and Dr. Natalie Uomini (Max Planck Institute for Evolutionary Anthropology, Leipzig). In a short time, Heidi and the team managed to acquire ethical approval and generate a set of visual stimuli to undertake a pilot study in early 2022. In addition to this University of Bergen based projects, Prof. Francesco d'Errico continued to work with a team from the University of Bordeaux on the neural correlates of visual symbolism, focusing on Middle Stone Age (MSA) geometric engravings, like those from Blombos Cave. His team also started looking into how the brain processes the perception of the culturalised body, for example the reaction to body paint and ornaments, whose use can be traced back to the African MSA. The results of these projects will likely generate fascinating results and even more interesting new research questions.

Torill Christine Lindstrøm further developed her study on the aesthetics of MSA stone tools, which had been delayed by the pandemic. She is optimistic that she will soon be able to get some interesting insights on the aesthetic judgement of MSA lithic artefacts. Larissa Mendoza Straffon continued her research on the phylogeny and ontogeny of symbolic cognition. This year, in collaboration with Leiden University, she concluded a study on the developmental factors that influence the production and understanding of symbolism in drawing during early childhood, and started planning a comparative study to test the perception of visual signs on great apes and humans.

During 2021, our members were present in several academic meetings such as those held by the Society for Applied Anthropology, Society for Anthropological Sciences, Cognitive Science Society and the European Association of Archaeologists, but one stood out due to its unique location. In October, Francesco d'Errico gave a talk in a very special venue, at the workshop titled "Symbols, Myths, and Religious Sense in Humans" held at the Pontifica Academia Scienze in Vatican City.

The publications by our group members included articles and commentaries in prestigious journals including Nature, PNAS, Plos One, topiCS, Frontiers in Psychology, and Behavioral and Brain Sciences, covering several topics from the earliest modern human burial, to Neanderthal rock art, to numeral cognition, and the role of art in sexual selection.



STORIES

THE SEARCH FOR VOLCANIC ASH IN BLOMBOS CAVE AND OFFSHORE SOUTH AFRICA

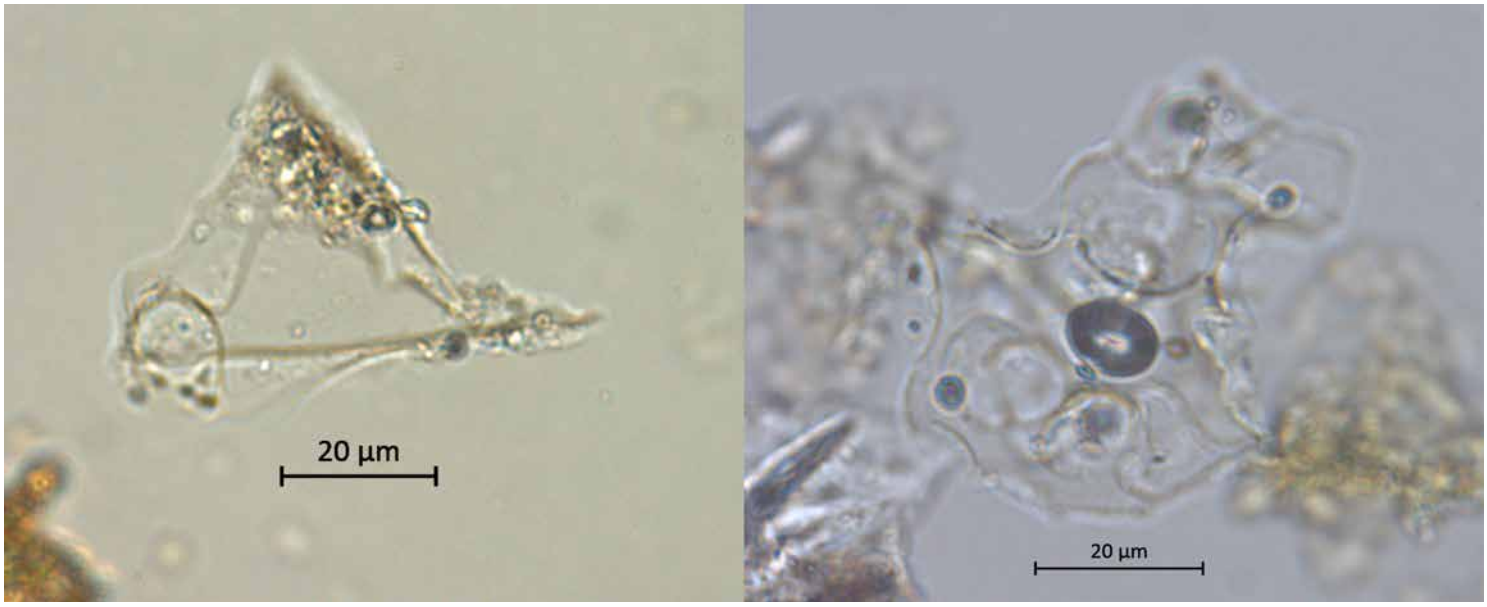
Volcanic ash (tephra) ejected from explosive volcanic eruptions can be rapidly transported within the atmosphere and deposited in a range of different sedimentary settings. If the ash is preserved in sedimentary sequences this creates time synchronous marker horizons which can be precisely dated and correlated across palaeoclimatological and archeological sites. This correlation is achieved by the distinct geochemical signature of volcanic ash layers which allows for tracing the volcanic source and in some cases the specific volcanic eruption.

When searching for volcanic ash in sedimentary archives located far away from active volcanic provinces, such as the Blombos Cave (BBC), the tephra layers will be "cryptic" or non-visible to the naked eye (cryptotephra). In other words, the tephra grains will frequently be below 125 µm in size and layers may contain less than 10 grains per gram sediment.

Over the last year, efforts were made to establish a cryptotephra record for Blombos Cave. Initial results reveal one tephra marker horizon containing 8 grains per gram sediment. The ash grains are in the size range between 25-80 µm and transparent in color indicating a rhyolitic composition. The sample containing the identified tephra layer is from the M2 Upper archaeological phase. Previous work at Blombos suggests that this phase is around 73 to 79 thousand years (ka) old.

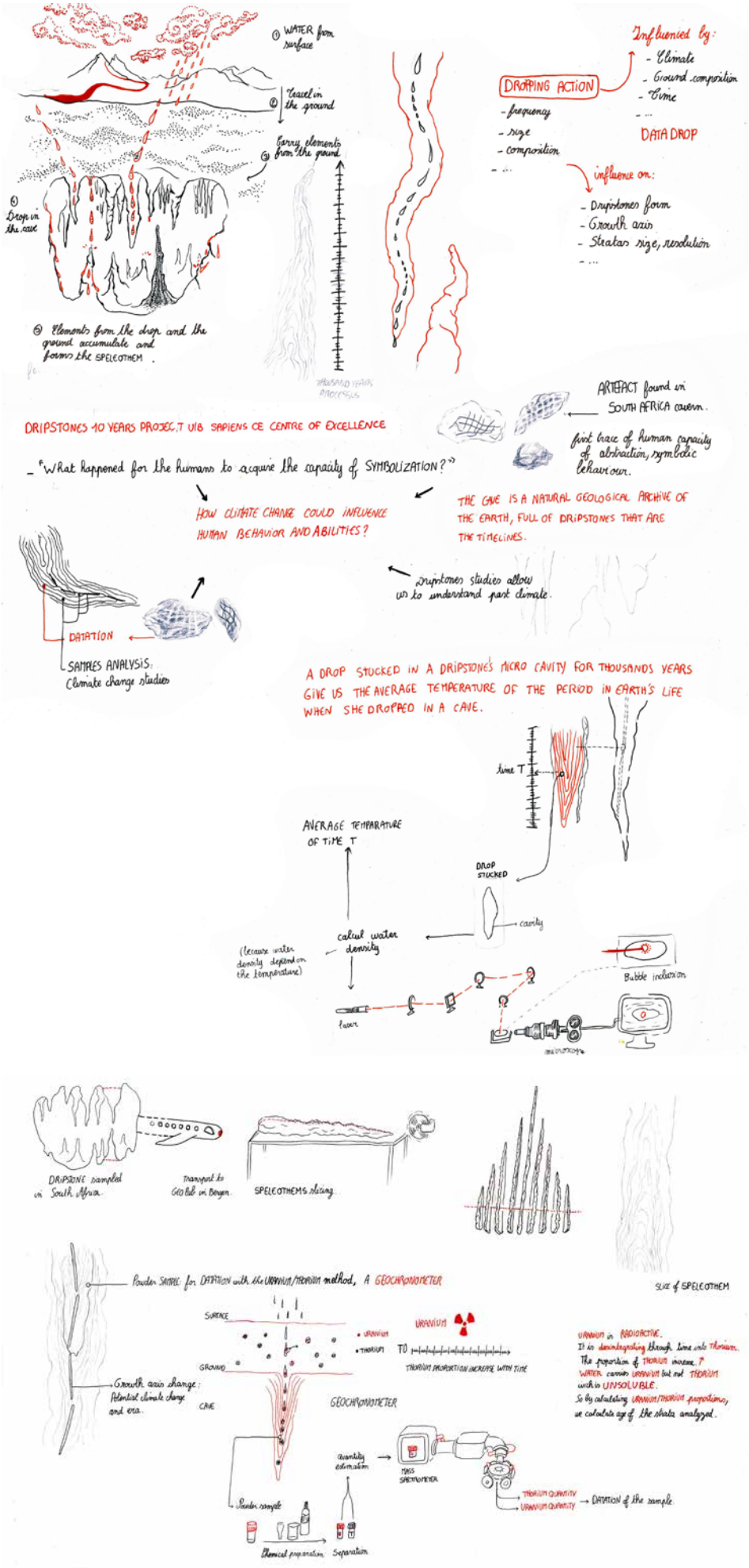
With the promising find from Blombos Cave in mind, we carried out cryptotephra investigations in a marine sediment core retrieved offshore the southern Cape coast of South Africa (a core called MD20-3592). This work is ongoing, but if successful, the aim is to independently synchronize this marine environment to the archaeological Blombos Cave site using tephrochronology. Targeting the same time-interval as our finding in the Blombos Cave, we identified several potential tephra marker horizons aged between 73.5 and 75 ka.

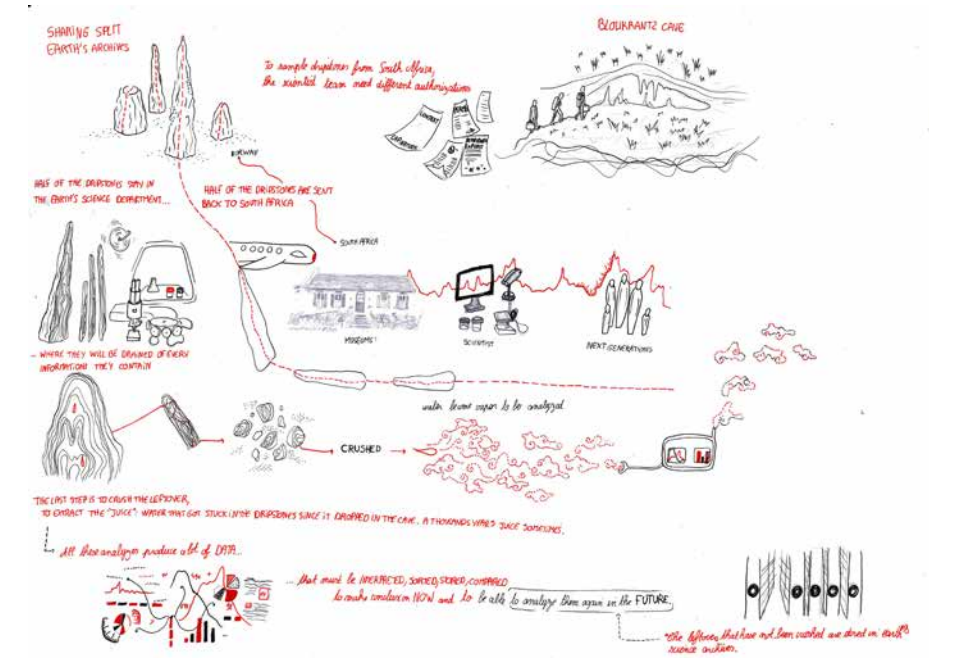
The next step is to acquire the geochemical composition of the ash grains identified in the Blombos Cave and in marine sediment core MD20-3592. This would allow us to determine from which volcano and potentially which volcanic eruption the identified tephra layers originated. More importantly, we can resolve if the tephra layers identified in the Blombos Cave and marine sediment core MD20-3592 were caused by the same volcanic eruption.

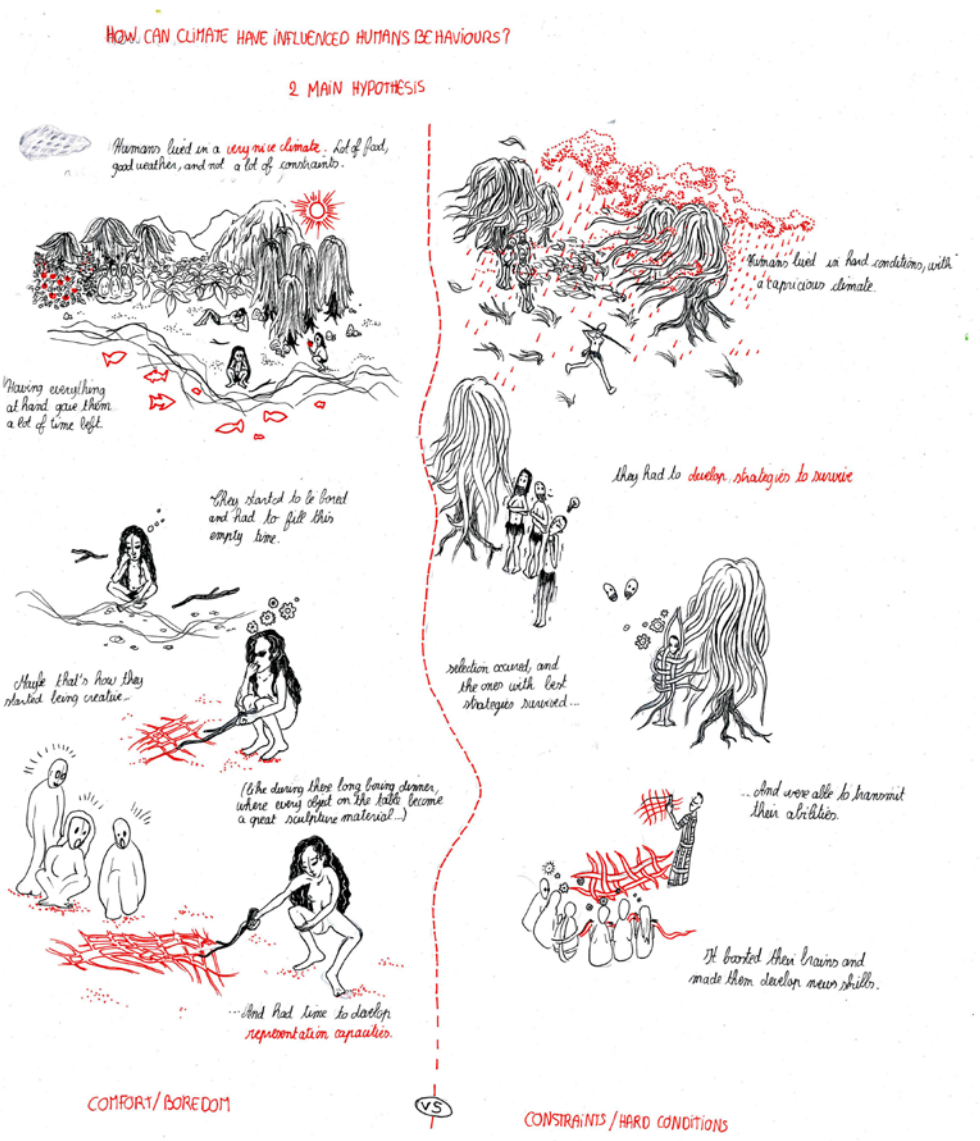


Left: Ash grain from Blombos Cave. Right: Ash grain from marine sediment core MD20-3592.

SPELEOTHEM STORY







FLAVIA PERONE

At the start of my project I met Jenny Maccali, a SapienCE postdoc, to discuss her dripstone project. My first challenge was to make sure I had understood her research project, the methods that she would use, and to memorize all this new information. Transforming this information into graphical form helped me to achieve an active understanding of the work: I drew as if I had to explain Jenny's research to someone else.

My drawings also allowed me to target what I wanted to work on next. As an outsider to the project, I allowed myself to bring together different aspects of the work that intrigued me during our discussions: geological, technical, but also social, cultural and poetic dimensions.

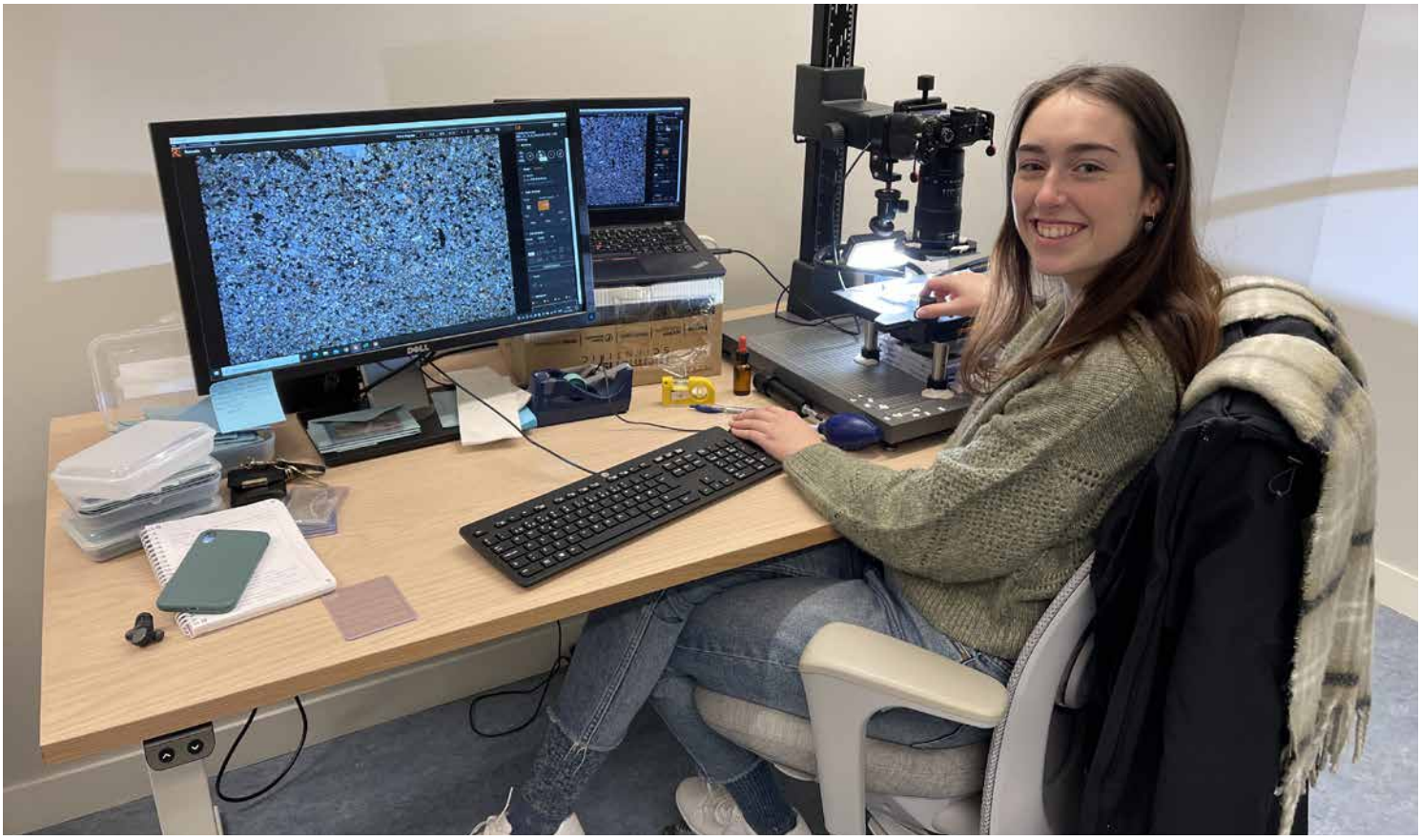
I'm thankful to the SapienCE researchers for their generosity and the range of topics that we discussed. It was a very inspiring exchange for me and my artistic orientation: I believe in the richness of the intersection between art and science for both disciplines as a symbiosis. This is the area that I want my work to evolve in.

Link to the art and science research group blog:
art-science-research-group.online/

Articles about the dripstone project:
art-science-research-group.online/post/storage

art-science-research-group.online/post/millenium-juice-when-a-millenary-water-inclusion-met-the-scientists-breath-by-flavia-parone

art-science-research-group.online/post/dripstones-by-flavia-parone



STUDENTS

KATRINA MARIE RØRHUS

I've been working at SapienCE for one year now, and it has been one of the most fulfilling and educational jobs I've had. It was only by luck that I got the job. One of SapienCE's doctoral fellows, Ole Unhammer, taught my very first lecture in the archaeology degree at the University of Bergen. He had talked about the centre in his lecture, and since I'd heard of Blombos Cave and the work done by SapienCE during an archaeology class I took at the University of Boulder in Colorado, I decided to talk to him and ask if the project needed any volunteers. A week later he got back to me offering a position with Elizabeth Velliky, a SapienCE postdoc, who was analyzing ochre samples to find out where our ancestors gathered their ochre from. For the next semester, I ground around 240 ochre samples from all across South Africa. Some samples were soft and satisfying to grind, while others were hard and needed at least an hour to powder. While repetitive, the work was very interesting and Elizabeth taught me a lot about ochre, coloring, and rock art.

Ole also needed assistance, digitizing the slides and photographs of Blombos from the 90's and 00's. This was a fascinating job, as it gave me a glimpse into how 'real' archaeology was done (at least back in the 90's!) There were lots of photographs of archaeological finds, the people at the site, and of the nature around Blombos Cave. Ole was very helpful, and always willing to answer my questions about the practical side of archaeology. The pictures I digitized were used to produce 3D model of Blombos throughout the years, which was fascinating to see.

The third project I became involved with was to photograph thin section slides of rock layers around Blombos for Magnus Mathisen Haaland, another SapienCE postdoc. This has been really fascinating because it is directly relevant to the field of archaeology I would like to work in. The microscopic layers hold bone fragments, ochre dust, and sediments that make each thin section extremely interesting to photograph. The learning curve was very steep, as I had almost no previous knowledge of photography, and the thin section images often required a huge amount of fine tuning.

The work at SapienCE has greatly influenced how I think about archaeology, and it has been a huge help in deciding which sub field of archaeology I would like to focus on!

ÅSHILD STUEN JENSEN

I started working as an assistant for Turid Hillestad Nel, a SapienCE postdoc, in the spring of 2021. The job consists of sorting bones from small mammals (micromammals) that have been consumed by owls, and later regurgitated as pellets containing the indigestible parts such as bones and fur. The pellets are of modern mammals and are going to be used to compare with material found during archaeological research on reconstructing past environments. While my main focus is on the micromammals such as moles, shrews, gerbils, rats and bats, the pellets can also contain an array of non-mammals that needs to be sorted away, namely various species of beetles, birds, and small reptiles and amphibians. The stage of decomposition and the number of individuals contained in one pellet vary, which makes some loose and easy to work with, while others are compact and time consuming. Some bone types are more fragile than others and are therefore often fragmented. In particular the scapula, ribs and the posterior part of the skull can pose a challenge.

I find the work enjoyable and very exciting, as I never know exactly what I will encounter when I open one of the pellets. Ever since I was a child I have been deeply fascinated by animals, and in the later years I have also developed a passion for osteology, the study of bones. Working as an assistant at SapienCE has given me the opportunity to cultivate these interests and to familiarise myself with skeletons. These practical tasks have given me knowledge and experience that goes far beyond what I could have expected to obtain from only reading books, making my work with Turid an incredibly valuable experience to me.

EARLIEST HUMAN BURIAL

SAPIENCE-RESEARCHERS IDENTIFY THE EARLIEST HUMAN BURIAL IN AFRICA

A team including two SapienCE two scientists has discovered the earliest human burial in Africa, at an archaeological site north of Mombasa in Kenya. Excavations at Panga ys Saidi revealed the body of a three-year-old child, who had been buried around 78,000 years ago. Dubbed Mtoto (Swahili for 'child') by the researchers, the child was carefully placed in an excavated pit and deliberately buried. The study, which was published in Nature in 2021, was led by archaeologists from the Max Planck Institute for the Science of Human History (Jena, Germany) and the National Museums of Kenya (Nairobi) and includes SapienCE researchers Francesco d'Errico and Simon Armitage.

Simon Armitage says that the importance of this research is that it provides us with new evidence about early human behaviour in Africa. In particular, Mtoto's burial shows that by 78,000 years ago, our ancestors disposed of the dead in a stylised manner, implying some form of community involvement or funerary rite. Through analysis of sediments and the arrangement of the bones, the research team showed that the body had been protected by being wrapped in a shroud made of perishable material, and that the head had probably been pillowed by an object also made of perishable material. The researchers don't know what material was used, but possibly vegetation or hide.

DATING FROM SAND GRAINS

Armitage was responsible for determining the age of the burial, using luminescence dating. Luminescence dating is a technique which determines the amount of time that has passed since sand grains were last exposed to sunlight. In this case, sand grains from within the grave fill and surrounding sediments yielded ages of ~78,000 years, giving the researchers a robust age for Mtoto's burial. Francesco d'Errico, a senior scientist in SapienCE, analysed archaeological material and sediment from the burial pit and including surrounding layers. He was able to show that the pit was intentionally dug and that the child's body deliberately buried with sediment. This is important because the child could have been buried accidentally by geological processes, whereas deliberate burial gives us important information about early human behaviour.

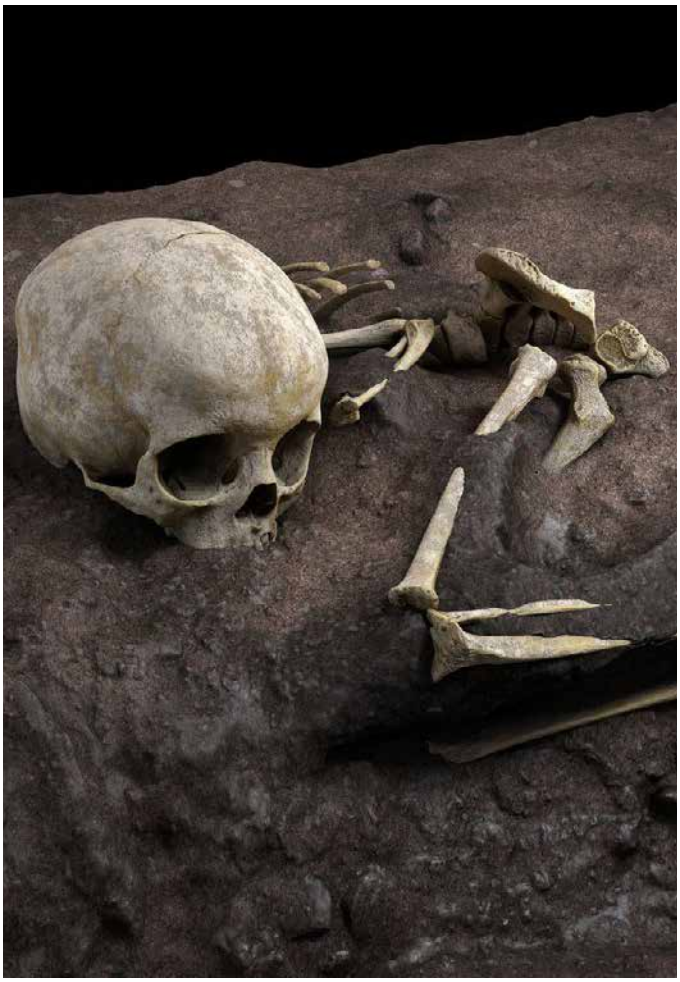
COMPLEX SOCIAL BEHAVIOUR

d'Errico explains that the grave contained no offerings or ochre (an orange to red rock used as pigment by ancient populations), both of which are common at more recent burial sites. Nonetheless, the funerary treatment given to Mtoto suggests a complex ritual that likely required the active participation of many members of the child's community. Although Mtoto was a *Homo sapiens,* the child's dental morphology, in contrast with that observed in other human remains of the same period, preserves certain archaic traits connecting it to distant African ancestors. The discovery of this burial also confirms the theory, often proposed in recent years, that our species has extremely old and regionally diverse roots in the African continent where it arose.

"We know that modern humans did not originate in a single place and at a given moment, but are the result of a long process starting 300,000 years ago. Populations living in Africa have gradually acquired modern morphological characters. The fact that the child excavated in the burial retains some archaic character is consistent with the overall long-term scenario" explained d'Errico.

Even though the discovery of Mtoto may be a small piece in the big puzzle, it is significant for understanding how we have developed into who we are today.

"We have very few ancient burials in Africa, some are not well dated, and we may not find others for decades. Our study shows that 78,000 years ago Middle Stone Age populations living along the Kenyan coast were burying their children, and were paying particular attention in protecting their body during the inhumation process" says d'Errico.

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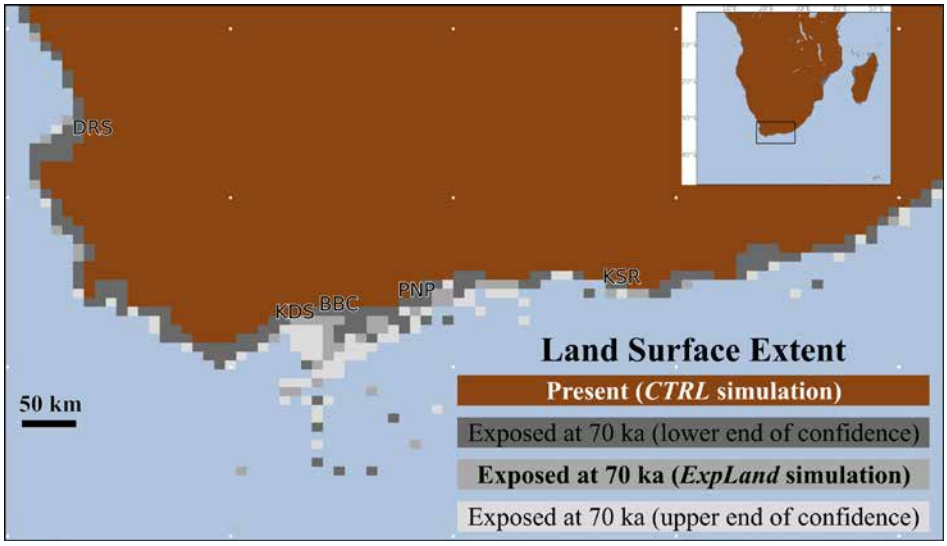


INTEGRATING PEOPLE IN CLIMATE MODELING – A FUTURE SAPIENCE INITIATIVE

A major goal of SapienCE is to understand how environmental and climate changes may have impacted on the Middle Stone Age sapiens populations in Sothern Africa and their capabilities to innovate and develop advanced tools and cultural habits in the period from 120 to 50 thousand years ago (ka). In SapienCE we have so far worked on reconstructing climate during this period from sediment cores and findings in the archaeological excavations, and applied global and regional models to simulate the climate state during various time intervals through this period. These models are set up to simulate the effects of concurrent changes in solar radiation due to changes in the Earth´s orbital parameters, and in atmospheric CO_2-content, sea level changes and ice sheet variations in both hemispheres. The regional modeling downscales global models to a level of few kilometers, and one intriguing result of the regional simulation is the effect that glacial sea level lowering has on the coastal climate of the Cape Region: When sea levels drop due to ice sheet build up in glacial periods, the coast changes and large areas currently under water were exposed as an additional coastal plain on the Agulhas Bank. These changes apparently also changed the seasonal temperature range and distribution along the coast and further inland.

In SapienCE we wish to take these results two steps further: One step is to use vegetation models to simulate the concurrent vegetation and ecosystem changes, including primary productivity, that result from the changing climate at the times of occupation of the archaeological sites studied in SapienCE. Another is to place humans and large herbivores into the simulated ecosystem and landscape, allowing us to investigate the impacts of climate changes on food resources, reproduction rate, migration opportunities and population dynamics of humans living at this time. Two model concepts are being evaluated for this purpose:

- Ecological niche models. These use environmental data to make a correlative model of the environmental conditions that meet a species' ecological requirements and predict the relative suitability of habitat and to estimate changes in the suitability of habitat over time given a specific scenario for environmental change.

- Agent based (or individual based) models, where individuals (agents) and their reproduction, food resources, migration opportunities, population size etc. are modelled within their ambient climate, biomes, vegetation and ecosystem.

With these approaches we wish to highlight the interactions of climate change and humans at critical times of interest in SapienCE and to provide answers to the overarching questions of our Centre plan relating to the role of climate and environmental change for human developments in South Africa. To start off this development and initiate further activities in Phase 2 of our CoE, we held an international online workshop in January 2021. In in addition to many SapienCE scientists, the workshop included world-leading experts from the groups of Christoph Zollikofer at Zurich University and Axel Timmermann of the IBS Centre for Climate Physics in Busan, Korea as well as experts from the Department of Biosciences at the University of Bergen. Ideas from this workshop will be developed in individual project proposals and woven into our plans for the 2nd half of the Centre of Excellence.

LUMINESCENCE DATING:
FROM ARCHAEOLOGY TO DEEP SEA SEDIMENT CORES

WHAT IS LUMINESCENCE DATING, AND WHY USE IT?

Marine sediment cores taken from the bottom of the ocean contain exciting climatic information that is just waiting to be revealed. But there is a problem: to interpret this information the age at each depth in the core needs to be known. The well-known radiocarbon dating method is useful for this purpose, but is limited in time to "only" the last 50 000 years. Beyond this range other methods are needed and luminescence, which has the potential to date material up to half a million years old, is one such technique.

Over the last two decades, this method has become a trusted tool for archaeologists and geologists. However, its potential to be used for marine sediments has not been fully explored, and it thus represents an interesting methodological challenge.

HOW DOES IT WORK?

Luminescence dating techniques determine the amount of time that has passed since sand grains were last exposed to sunlight. The principle of this method is as follows: when a grain of sand is buried in soil, in sand dunes, or at the bottom of the ocean, it absorbs the natural radiation coming from the radioactive elements contained in the surrounding soil or sediments. The amounts of naturally occurring radioactive elements in soil are tiny and pose no health risk. However, the absorption of small quantities of radiation by the grains of sand can be used to record time: the longer they are buried, the more radiation they have absorbed. Importantly, when grains are exposed to sunlight, the record of absorbed radiation is erased and the luminescence age of the sample is set to zero. Consequently, by measuring the amount of radiation a sand grain has absorbed, we can we can determine how long it has been buried for.

A very simple equation describes how the age is found:
Age = (absorbed radiation dose)/(dose rate)
Where the dose rate is the amount of radiation absorbed by the sample in a time interval such as a year.

LAB WORK

To get the ages at different depths in the core, samples were taken throughout marine sediment core MD20-3592. Care was taken to avoid exposing the sample to light since light erases the record of absorbed radiation. Measurement of the natural radioactivity of the sediments has already started in Bergen. The sediments are first dissolved in acid and then measured by mass spectrometry to determine the quantities of the radioactive elements uranium, thorium and potassium. From these measurements, the dose rates can be calculated. Absorbed radiation doses for the MD20-3592 samples will be measured at Royal Holloway University of London in spring 2022. Then we will be able to calculate ages. These ages will help us to understand better the timing of southern African climate fluctuations over the last ~250 thousand years.

ORIGIN OF ART :
CAN IT BE EXPLAINED BY SEXUAL SELECTION?

The record of Pleistocene art has grown exponentially since the first discoveries of Ice Age artworks came to light in Europe in the late 1800s. The past three decades, particularly, have seen more frequent, more remarkable, and more ancient examples. The discovery of Chauvet Cave in the 1990s completely reshaped previous ideas of art in the Upper Palaeolithic, demonstrating that figurative painting was older than 30,000 years. Similarly, ivory figurines depicting animals and humans now go back some 40,000 years in Germany. Even more significantly, since the beginning of the present century, Blombos Cave has yielded some the oldest art, constituted by body ornaments and painted and engraved geometric patterns, making us reconsider not only the time depth of visual art practices, but also the location of its earliest emergence. Whereas such finds are helping us clarify when and where humans started making visual art, we still do not fully understand why and how visual art-making evolved as a human behaviour in the first place.

In recent years, some of the most influential theories about the origins of art have been developed not by archaeologists but by evolutionary scholars. Ever since Charles Darwin first pondered about the role of nature in the foundation of the human "sense of beauty", there have been several attempts to account for art as a biological phenomenon. Evolutionary explanations of art assume that art has had some adaptive value throughout human evolution, meaning that it has contributed towards human survival and reproduction (i.e. fitness). Accordingly, the key question guiding the evolutionary study of art has been: what did art evolve for? The variety of answers have generated several evolutionary hypotheses on the origins of art, but none has captured the attention of academics and the public alike as much as the 'peacock hypothesis'. Based on the principle of sexual selection, this suggests that art, like the peacock's tail, evolved as a strategy to signal the genetic quality of the individuals that display it in order to attract mates (Dutton 2009; Miller 2000; Zahavi & Zahavi 1997).

Art has long intrigued evolutionary scholars due to its apparent lack of an utilitarian purpose. Often, aesthetic production is seen as a useless behaviour that consumes energy and resources that could be invested in survival instead. But, whereas natural selection generally filters out the persistence of impractical behaviours, sexual selection often results in the development of wasteful but attractive traits, like the colourful plumage of the peacock or the large antlers of many ungulates. Therefore, the evolution of art would seem to be better explained by the principle of sexual selection.

This seemingly simple idea has been widely accepted and is often reproduced in academic literature and popular science texts. Some critics have suggested that such models cannot fully account for the diverse functions of art, or its role in human interactions not only between the sexes but also among peers and across generations. However, the fundamental arguments of the peacock hypothesis have rarely undergone a detailed critical analysis. In a recent paper (Straffon, 2021), I assessed three of its key premises, namely that humans, like peafowl, chose mates based on genetic fitness cues, that art constitutes one such cue, and that the evolution of art can only be explained by sexual selection.

Looking at empirical studies and cross-cultural data of human mate choice strategies soon reveals that people behave very different from peafowl when selecting a reproductive partner. The birds primarily have a male-display and female-choice pattern in which genes are the

only parental contribution of the male. In contrast, human males generally offer some parental care, both males and females exert mate choice, and the partnership typically lasts beyond copulation. More importantly, human mate choice is most often guided by the potential direct benefits offered by the partnership, such as territory, resources, protection, status, or fertility. The provision of resources and social status seem particularly relevant and have been proven to positively influence in the long-term fitness of the offspring, that is, children of high-status individuals have higher rates of survival and reproduction. Whereas, there seems to be no fitness advantage related to creativity or artistry.

Still, this leaves us with the challenge of explaining the apparent wasteful nature of art, and the fact that it is often displayed to impress rivals and potential mates. In 1900, the economist Thorstein Veblen already came up with an explanation based not on biology but on social theory. Veblen suggested that art is a conspicuous signal that is used to convey and obtain social prestige. In this way, art can still have many of the effects suggested for sexual signals (e.g., attract mates, impress rivals), but its actual function would be advertising not good genes but social membership and status which, as mentioned above, are important factors in human mate choice.

Finally, the peacock hypothesis argues that because art has no practical purpose, it cannot be explained by natural selection, leaving sexual selection as the only possible account. However, we must ask whether the presupposition that art has no utility is at all correct. Art, in fact, is a communication signal and, like language, it is used as a means of expression, a way to coordinate behaviour, and to transmit information. Understood within a communication framework, it immediately becomes evident that art has a purpose and adaptive value, and thus its evolution can be explained by natural selection processes.

In the peacock hypothesis, art is conceived as an indicator of individual quality to guide mate choice. Through my analysis, I concluded that although art has the characteristics of a signal, it does not seem to have evolved under pressure of sexual selection. Furthermore, cross-cultural studies on human mating systems do not support the premise that human mate choice is based on good genes, but rather indicate that mate preference is based on direct benefits. The latter is actually more compatible with data on human fertility, fitness, and parental care.

In addition, the earliest manifestations of art are constituted by an increasing corpus of geometric signs and body ornaments (seashell beads) that show a low degree of internal variation, and a high level of standardization and formal redundancy, which is the opposite of what one would expect if the makers of early art were 'showing off' their individual choices, resources, or skills. This contradicts the idea of the first artworks as displays of genetic quality.
In sum, art should be conceived as social signal, but one that can still have major effects in human biology. It influences mate choice as it advertises one's membership and status, but it can also foster cooperation and mediate intersexual, intergroup, and intergenerational relations. As a human communication signal, the function of art includes but goes beyond mating, and evolutionary explanations should be able to account for both the functional and formal diversity of art over time.

PROTEIN RESIDUES

IN THE FIRST EVIDENCE OF COMPLEX MODERN HUMAN COGNITION

The processes that have led human populations of the past to develop the cultural innovations that make us different from our phylogenetically closer relatives (e.g. making composite tools, creating symbolic items, developing numerical symbol systems etc.) are the subject of an intense debate. The emergence of cultural innovations implying the use of organic material (resins for hafting, poison for hunting, binders to produce paints, etc.) are highly relevant to these debates since the preparation of such compounds is often cognitively demanding and complex to transmit to new generations. We know that complex organic compounds were produced by both Middle Stone Age (MSA) populations in Africa and Neanderthals in Europe and the Near East since at least 180,000 years ago, but evidence for these innovations remains circumstantial.

In my PhD project, I aim to further our understanding of the use of organic materials by *Homo sapiens* in South Africa during the MSA. In my project I will analyse several key archaeological artifacts from Blombos Cave (BBC) and Klipdrift Shelter (KDS) using palaeoproteomic methods, which allow the identification of ancient proteins in archaeological materials. It is expected that my PhD will allow a better understand of how humans used organic materials (in particular protein rich materials) during their use of Blombos Cave and Klipdrift Shelter. In particular, knowledge of the precise nature of the organic compounds used for different tasks, and the consistency of the "recipes" used, will dramatically improve understanding of the complexity of our ancestor's material culture.

BRACE
BRAIN ACTIVATION IN COGNITIVE EVOLUTION

Most people will agree that humans are different from non-human animals in a major way. One of the ways in which we differ is in our capacity for cultural transmission. Although social learning and cultural transmission can be found in non-human animals, we are the only species known to have cumulative cultural transmission. Cumulative culture is a term that describes how skills and knowledge are passed from one generation to the next, with changes and adjustments accumulating along the way, often resulting in artefacts that are more effective and/or complex than the original. This process has enabled us to produce powerful technology, complex societies, and the symbolic form of communication that we all use and are a part of every day life.

Several factors have been proposed as critical for cumulative culture, and to explain why it is a uniquely human phenomenon. Two factors that have received a lot of attention from researchers are the human capacity for social learning and communication. In the BRACE project we wish to explore the brain activation associated with this form of cultural transmission, for different skills and types of social learning.

WHAT IS SO SPECIAL ABOUT HUMANS?

To investigate how humans differ from other animals, we are often compared to our closest animal relatives, the chimpanzees. Studies show that chimpanzees are capable of learning from each other, and different groups of chimpanzees solving challenges in different ways is seen as a form of chimpanzee culture. When comparing social learning in humans and chimpanzees we find that humans pay more attention to imitating the actions of the person they are watching. Chimpanzees on the other hand rather try to replicate the effect of the actions on the environment. This limits the complexity of what the chimpanzee is able to learn. The human tendency to imitate actions leads to faster and more faithful replication of the target object or skill, compared to asocial forms of learning, like trial-and-error or observation without feedback.

Our ability to communicate with each other is also suggested to play a central role in our ability for cumulative cultural transmission. Not only are we able to communicate abstract information, but the recipient is predisposed to recognize this as an attempt of communicative demonstration – a tendency that is apparent in humans from infancy. This lets more experienced individuals direct the attention of the learner to important aspects of what they are trying to learn, and react to the specific needs of the learner. Still, high fidelity transmission and communication is not enough to explain why cumulative culture only happens in humans, and there are several questions within this field yet to be answered.

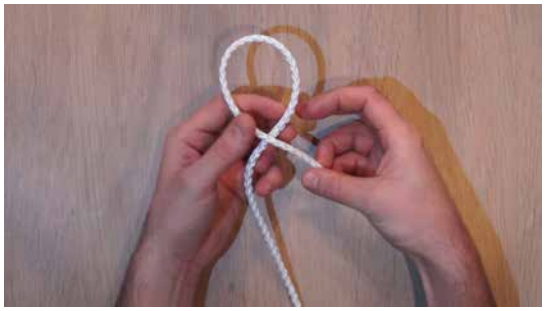
WHAT DO WE WANT TO FIND OUT?

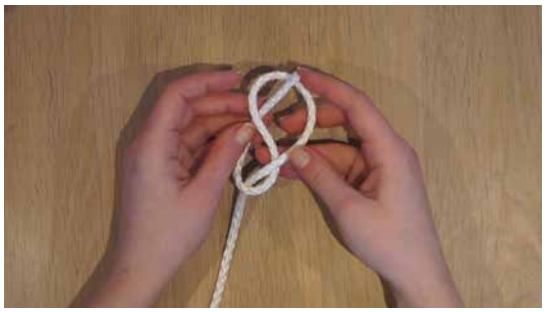
It is reasonable to believe that our capacity for cumulative culture is the result of a series of interconnected, complex evolutionary processes. Some explanations focus on the interplay between increasing intelligence and production of increasingly complex artefacts. Other explanations propose that humans' cooperative nature made cumulative culture possible. Investigating these explanations is complicated by the fact that these things evolved over timescales we are not able to replicate in the laboratory.

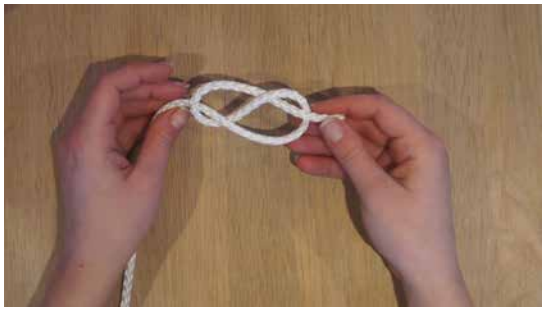
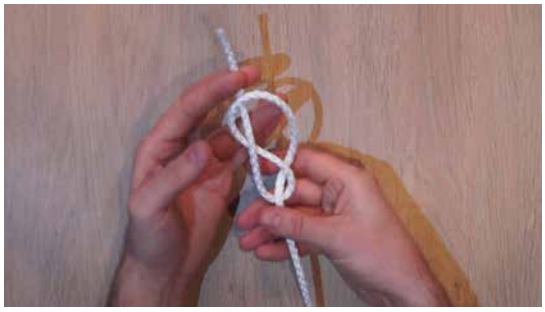
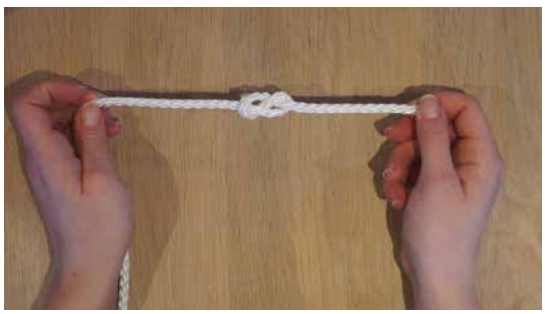
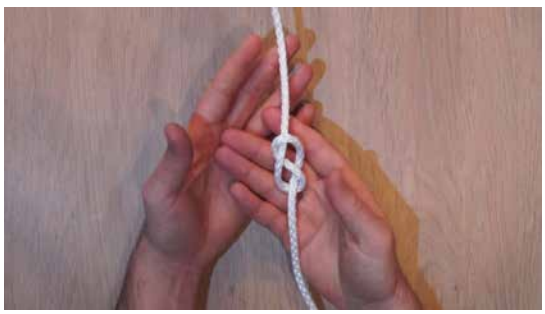
When investigating cumulative culture in a laboratory a common approach is to use transmission chain designs. In this design the first participant receives instructions in some form, usually to make some sort of artefact. The first participant builds the artefact and can relay information about the process and outcome to the second participant in the chain. The second participant then builds their own artefact, and pass information along to the third participant. This continues until all the participants in the chain has built their artefact. After this process is repeated for several chains you can usually see patterns emerge for how the artefacts change as a consequence of transmission. These studies generally find that information about how best to build the artefact accumulates along the chain, so that the artefacts built by the later generations are of better quality and/or perform better than the artefacts from the earlier generations, like you would expect for a real world cumulative cultural transmission.

In the BRACE project we will combine brain imaging techniques and a transmission chain design with transmission of evolutionary relevant tasks (knot tying and geometric design production) in order to look at the mechanisms of cumulative culture in a new way. With this new information we hope to be able to shed light on how the process of cumulative cultural evolution has affected the domains of tool-making and symbol-production, how brain activation might differ in the transmission of different skills, and how active teaching might differ from plain demonstration.



SAN ELDERS SPEAK

Ancestral knowledge of the oldest known hunter-gatherer cultural adaptation is known by a few remaining Kalahari elders. The subject of numerous research accounts, the richness of San material culture has rarely been documented in detail, and never through the eyes of the people themselves.

Present-day San are not living fossils, and cannot be equated with the hunter-gatherers that populated southern Africa tens of thousands of years ago. However, traditional San communities use technology that in many respects parallels that found by archaeologists when excavating prehistoric sites attributed to the Early Later and Later Stone Age (c. 45,000 – 200 years ago). Gaining a better insight into how objects similar to those used in the remote past are manufactured, used, repaired, and discarded by people with a personal knowledge of such items, enables archaeologists to better understand the significance and implications of that technology for past populations.

Sophisticated scientific techniques enable archaeologists to reconstruct human behaviour from artefacts and organise the gathered information into plausible scenarios. However, irrespective of the method applied to analyse material, our knowledge of the items is nevertheless relatively limited. As archaeologists we know that the symbolic value attached to ancient objects is lost forever. However, we believe that the knowledge of traditional San elders about these items provides new insights, and can help in understanding the social, economic and environmental factors, and implications for the way of life that led to the production of similar artefacts long ago.

A book recently published by SapienCE researcher Francesco d'Errico, in collaboration with Lucinda Backwell, represents the first attempt to document that knowledge by presenting to San elders the world's largest assemblage of their artefacts, collected a century ago, and now housed in South Africa. Explanations given by the elders provide a novel perspective that enriches scholarly knowledge on past and present San way of life. By accompanying their narrative with high quality photographs of the described items, archived black and white images, and contemporary examples of the use of these objects, the authors initiate the reader into many aspects of this ancient and vanishing culture.

This book is the result of a trip made in 2012 by four San elders from the Kalahari, invited by d'Errico and Backwell to examine a century-old collection of San artefacts, and describe in their own words the manufacture, use, and

meaning of traditional artefacts which were collected by Dr. Louis Fourie between 1916 and 1928 in that region. A medical officer in the Protectorate of South West Africa, now Namibia, Louis Fourie worked in direct contact with groups of Bushmen, during which time he amassed the world's largest collection of San artefacts. Extraordinarily for that time, he also documented photographically the different stages of production of many types of artefacts, and labelled who made them. Meticulously catalogued by him, the Fourie Collection, composed of over 3,000 artefacts, is now housed at Museum Africa in Johannesburg, South Africa. Because of his endeavours, at a time when Bushmen had little contact with the outside world, he was able to acquire first-hand knowledge of their culture. Unfortunately, he left only a limited written account of his ethnographic knowledge. The objects, photographs and catalogues are silent. In the case of more symbolic items, the profound meaning attached to them is a mystery, and even though each item is labelled by type, in some cases the function was unknown.

The book summarizes ten days of lively discussions and demonstrations, documented in 24 hours of subtitled video footage that will be soon freely available online. The elders rediscover objects last seen in their childhoods, telling stories inspired by their handling of them. They provide the traditional names (available in a glossary of terms), and explain how they were made, from which material, who used them, why and when. In a number of instances the elders change the identification given by Fourie.

The people in this story, Bushmen and archaeologists, each owns a piece of knowledge about the recent and ancient past. The journey of the San elders from Namibia to Johannesburg, with the goal of examining the artefacts used by their parents and grandparents, becomes a metaphor for an excursion into the past, and the means by which they can establish a dialogue with researchers, and share knowledge of their culture. The book tells the story of how this collaboration is beneficial to both parties. The archaeologists gain invaluable insight that assists in their interpretation of fragmentary archaeological remains, They also secure as much as possible the recording of the elders' knowledge before it is lost forever. The book provides the opportunity for San elders, and their community in general, to preserve for posterity, in their own words, the memory and indigenous knowledge of their vanishing traditional culture. It is an historical document of a culture in transition, facing many social, cultural, political and demographic challenges. It also contributes to making the Fourie Collection known and facilitates its preservation and exposure.

HOW IRON-RICH ROCKS SHAPED US INTO MODERN HUMANS

In addition to the work funded by the Research Council of Norway, SapienCE provides a springboard to its members to pursue related side projects. One of those is a project designed to study the complexities of past ochre use in the South African Middle Stone Age (MSA) by Dr Elizabeth Velliky, one of SapienCE's postdoctoral fellows. Dr Velliky has received a prestigious grant from the Leakey Foundation for her innovative research.

The results of her project will create a new understanding of when, why, and how our ancestors collected and used ochre from as far back as 100,000 years ago, and ultimately tell us more about ancient humans and how they first developed language, cognition, and culture on the southern coast of Africa.

EARLY SYMBOLIC BEHAVIOUR

A crucial aspect of Dr Velliky's project is determining when our hominin ancestors started to use symbols to communicate certain ideas and with each other. This would be the origins of a practice that continues to the present day expressed, for example, in the way people wear specific brands, clothing, or jewellery to communicate certain cultural ideas or messages to one another.

One of the earliest ways in which symbols were communicated in the past is through the use of red earth materials, particularly iron-rich rocks referred to as ochre, which were employed by early humans to create colourful pigments and paints. Although this practice has ancient origins, its use continues to the present day in many parts of the world. For example, in the past, it can be found in rock and cave paintings, in burials and graves, and was likely used as a body paint and/or sunscreen. Today, people still use ochre as paint, but also for medicine, for religious reasons, in industry, and even in cosmetics.

USE OF OCHRE EMERGED DURING OR EVEN BEFORE MSA

Because ochre is one of the earliest pieces of evidence for symbolic behaviour in the past, exploring when, why and how ancient humans collected and used ochre could give us valuable information on the culture, cognition, and society of early modern humans in southern Africa.

Previous research shows that ochre was used as far back as 300,000 years ago in south-central Africa, and as far back as 200,000 years ago in Europe by Neanderthals. It is found on stone tools, bones, shells, beads, and cave and rock walls. The use of ochre likely began during or before the African MSA (ca. 300,000 years ago) and then spread to the Middle East, Europe, Asia, Australia and the Americas.

With funding from the Leakey Foundation, Dr Velliky has organised the ROSA project (Reconstructing past Ochre-scapes in South Africa), the goal of which is to explore past southern African cultural complexity by studying where – and possibly how and why – ancient humans collected ochre during the South African MSA.

SAMPLES FROM SOUTHERN CAPE

In this project, Dr Velliky, along with her team of ochre specialists - Dr Brandi MacDonald and Cuan Hahndiek - will locate and sample sites along South Africa's southern Cape where ancient people could have collected ochre. These places, referred to as "outcrops", often contain unique elemental and mineralogical signatures based on their geological origins and location in the landscape. Dr Velliky and her team will record the unique signatures, traits, and location of these places using multiple geochemical methods.

The recording and understanding of the subtle variations between these locations will ultimately allow the team to compare the archaeological ochre artefacts from Blombos Cave, Klipdrift Shelter, and other archaeological sites to these ochre outcrops, making it possible to determine where people collected ochre in the past. To understand how and why humans collected and used ochre during the MSA, we first need to understand where they travelled to obtain the raw material.

OUTREACH

MATTER, GESTURE AND SOUL

Matter, Gesture and Soul is a cross-disciplinary artistic research project which departs from several encounters between Contemporary Art and Archaeology, such as seminars, fieldwork, publications and exhibitions. SapienCE contributors include Professor Francesco d'Errico, an archaeologist, Petro Cecilia Keene, archaeologist and curator and Professor Torill Christine Lindstrøm, a specialist in psychology and archeology.

One meeting point in Matter, Gesture and Soul was an exhibition entitled Dig It Up and Put It in a Bag, held in autumn 2021 at the University Museum in Bergen. The exhibition provided insight into how art and archaeology offer different points of view and approaches to meeting ancient material. The exhibition included work on prehistoric symbols and stone engravings in Fontainebleau (France), cave paintings from South Africa, the Neolithic burial ground of Newgrange in Ireland and the practical and mythical significance of the abalone shell to our ancestors. The exhibition explored how the past is repeated, how we remember and how the past constantly changes character because the point from which it is viewed is also continuously changing. Petro Cecilia Keene contributed to the Matter, Gesture and Soul exhibition with a cave painting from Ezeljagdspoort, Southern Cape.

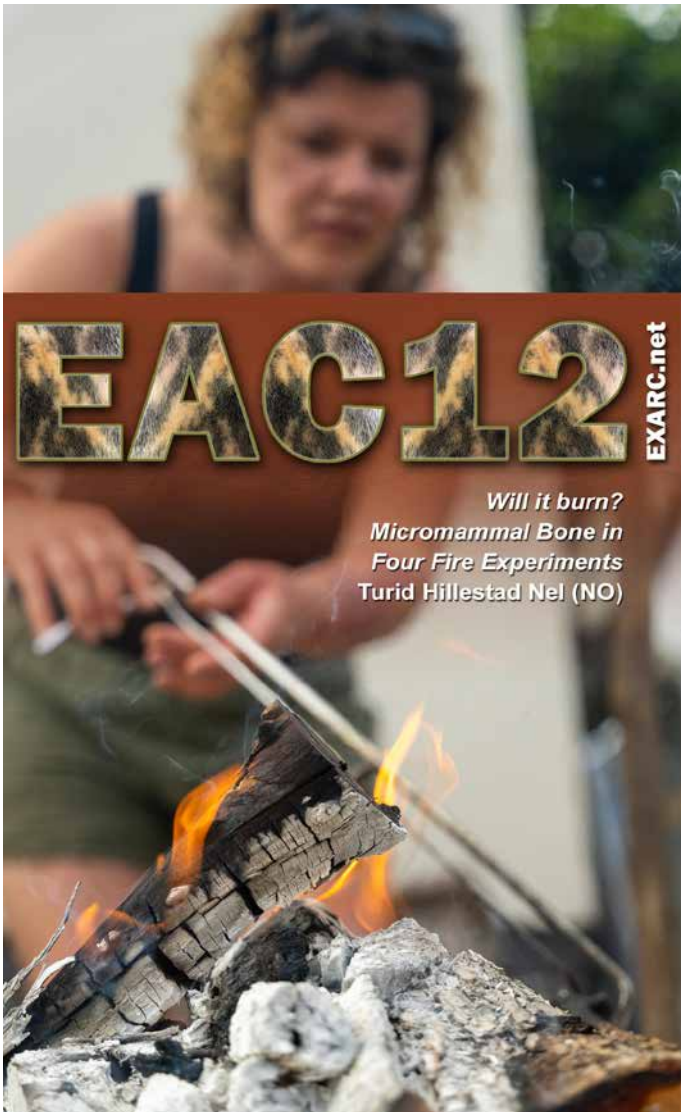
The project is supported by the Norwegian Artistic Research Program (DIKU), University of Bergen and Global Challenges (University of Bergen)

SAPIENCE HOTSPOTS:
THE EXPERIMENTAL ARCHAEOLOGY CONFERENCE #EAC12

In 2020, archaeology postdocs (Silje Evjenth Bentsen, Turid Hillestad Nel, Magnus M. Haaland, Elizabeth Velliky) and PhD candidates (Ole Fredrik Unhammer, Jovana Milic) at SapienCE carried out a range of fire experiments during a three-week field season at Jongensfontein, South Africa. These were discussed in the SapienCE annual report for 2020. However, to convey the preliminary results of the fire experiments to a larger audience, SapienCE sponsored two hotspot sessions during the #EAC12 Experimental Archaeology Conference World Tour 29.03-01.04.21. The conference was virtual, with 16 hosts for hotspots spread across Australia, Asia, Europe, Africa, North and South America. The conference was open access with no conference fees, making it possible for anyone interested in experimental archaeology to join. There were 1,100 people registered, and 130 lectures presented during the four days. Of the sponsored hotspots, one session was hosted by SapienCE at the University of Bergen, while the other was hosted at the University of the Witwatersrand (Wits) in Johannesburg, South Africa. Each session of the conference was streamed live on You Tube.

The three-hour hotspot session hosted in Bergen had presentations discussing fire related experiments, including functional studies, the impact of fire on material such as ostrich eggshell, micromammal bone and traces of fire maintenance in sediments and also how to record fire experiments. In addition there were also presentations on ochre related experiments on staining and also recording of anthropogenic markings on ochre artefacts. The one-hour hotspot at Wits was focused on fire and ochre experiments, but also included presentations on the impact of trampling on bone flakes and land transportation in Egypt.
All presentations are still available through https://exarc.net/meetings/eac12 with links to the sessions on You Tube.

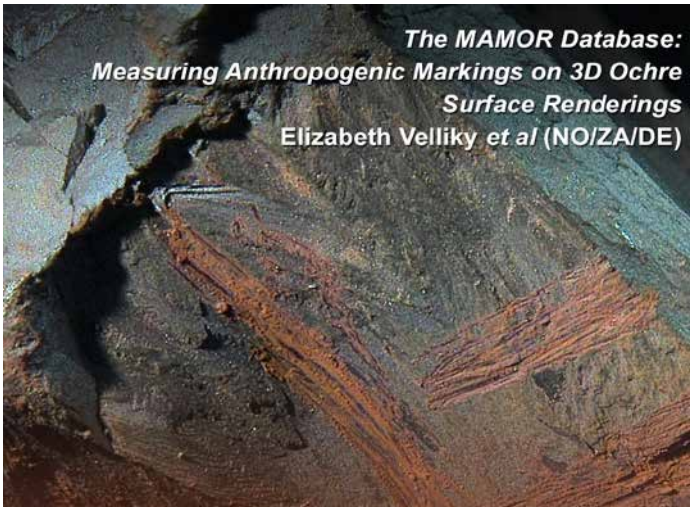
Enjoy!


EAC12
EXARC.net
Will it burn?
Micromammal Bone in
Four Fire Experiments
Turid Hillestad Nel (NO)


Investigating the Effect of systematic Hearth Maintenance
(Ash Removal) on the Size, Morphology and Microstratigraphy
of Long-Duration Fires
Magnus M. Haaland (NO/DE)
F1
F2


4-Dimensional Recording of Fire related Experiments
Ole Fredrik Unhammer and S.J. Armitage (NO)


Beautiful and like a Rainbow: Experimenting
with true Colours and heat-affected Ostrich Eggshell
Silje Evjenth Bentsen (NO)


The MAMOR Database:
Measuring Anthropogenic Markings on 3D Ochre
Surface Renderings
Elizabeth Velliky et al (NO/ZA/DE)

EXHIBITION:

ORIGINS OF EARLY SAPIENS BEHAVIOUR

We are very proud to announce that SapienCE's Origins of Early Sapiens Behaviour exhibition has been updated to a new format and is on display at the Origins Centre at the University of the Witwatersrand in Johannesburg. We are very excited to have this opportunity to engage with a whole new audience.

This is the third iteration of the Origins of Early Sapiens Behaviour exhibition, which was first showcased late in 2018 at the Spier Wine Farm in Stellenbosch, near Cape Town. It was subsequently expanded and updated to include finds from the Klasies River site, and moved to the Iziko South Africa Museum in 2019. The latest version has been on display in Johannesburg since November 2021.

The exhibition includes unique archaeological discoveries that have been made over the course of some 30 years of excavations at three of our core archaeological sites: Blombos Cave, Klipdrift Shelter and Klasies River, all situated on the southern Cape coast of South Africa. The sites were occupied by early *Homo sapiens* (humans like us) between 120 000 and 50 000 years ago, a key period in the evolution of modern human behaviour. Archaeological deposits found in the sites have been meticulously dated using the latest available technology. In addition to viewing archeological discoveries, visitors can also enjoy the extraordinary multimedia presentation comprising 16 unique display panels including six videos by Academy Award winning documentary filmmaker Craig Foster. The exhibition now also features an interactive kids' area for the South African archaeologists of the future!

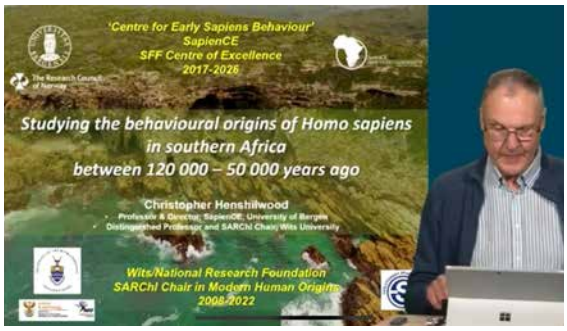
Read more about the exhibition here at Origins Centre Museum, Wits University: www.wits.ac.za/wam/

SANORD CONFERENCE 2021

Between the 8th and 10th of September 2021, SapienCE participated in the SANORD (Southern African-Nordic Centre) online conference, which attracted 400 delegates and was sponsored by the University of Bergen and The Western Norway University of Applied Sciences. The conference focused on how the SANORD partners can use and strengthen their partnerships with the aim of addressing the United Nations 2030 Agenda for Sustainable Development. SANORD also aimed to organize a meeting place for trans-disciplinary exchange of ideas and research for scholars and institutions in the respective regions. South African Nordic research collaborations and trans-disciplinary research topics were much in evidence as shown by the variety of session themes including: 1) Climate and climate impacts on humans; 2) Epistemic challenges, intellectual labour and South-North partnerships and 3) Moving forward: Music and arts. SapienCE was highlighted as a "flagship" project, which embodied the ideals of collaboration across disciplines and continents.

In the opening session Professor Christopher Henshilwood gave a keynote lecture entitled "Studying the behavioural origins of *Homo sapiens* in southern Africa between 100 000 – 50 000 years ago." This was followed by a lively studio discussion with SapienCE scientists Francesco d'Errico, Sarah Wurz and Christopher Henshilwood led by Dr Margit Simon. The live discussion covered a range of topics including the personal experiences of researchers with projects that span both hemispheres. More socio-political questions were also discussed, such as why Norway should spend millions of NOK on research outside of Norway and how/whether South African citizens and students benefit from international collaborative projects like SapienCE. The second half of the discussion focussed on more specific research themes such as the uniqueness of archaeological discoveries in South African sites, the origins of music and what the burial of a child in East Africa 78,000 years ago tell us about the development of modern human behaviour. We received very positive feedback on the live session, with the audience getting involved with plenty of questions and comments.

Later in the conference, SapienCE was well represented in the "Climate and climate impacts" session, where our PhDs Jovana Milic and Karl Purcell presented their research. Jovana and Karl's presentations discussed terrestrial climate variability in Southern Africa during times when *Homo sapiens* settled in the southern Cape coast and the effects of prehistoric fire on shellfish from South African archaeological sites respectively. Both were well-received.




Trimble


Vagabond
Noble Eels


BLOMBOS CAVE
STRATIGRAPHY

SapienCE LUNCH SEMINARS

21.01	Margit Hildegard Simon	Climate, Environment and Early Human Innovation: Leaf wax n-alkane and hydrogen isotope evidence from Blombos Cave in the Western Cape, South Africa	NORCE
11.02	Elizabeth Velliky	Identifying direct anthropogenic ochre use on personal ornaments: a case study from the European Aurignacian (ca. 43-35 kya)	Postdoctoral fellow, SapienCE, University of Bergen
25.02	Flavia Parone	Time Tales	Bjerknes Centre for Climate Research
20.05	Francesco d'Errico & Simon Armitage	Earliest known human burial in Africa	University of Bordeaux & Royal Holloway University of London, respectively
03.06	Gerrit Dusseldorp	Can we reconstruct Pleistocene technological niches and determine the causes of technological change?	Leiden University & University of Johannesburg
17.06	Tyler Faith	Rethinking the ecological drivers of hominin evolution	University of Utah
23.09	Jovana Milić	Effects of prehistoric fire events on the mineralogical and stable oxygen isotope composition of *Turbo sarmaticus* opercula	PhD candidate, SapienCE, University of Bergen
04.11	Maarten Vanden Eynde	Ars Memoriae: The Art to Remember	PhD candidate, The Art Academy – Department of Contemporary Art, University of Bergen
18.11	Žarko Tankosić	In Pursuit of Insular Neolithic: Gourimadi Archaeological Project	Project Manager, SapienCE, University of Bergen

SAPIENCE STAFF AND MANAGEMENT

SAPIENCE LEADER GROUP

Christopher Henshilwood
Professor
Director, PI

Carin Andersson Dahl
Research Professor
PI

Andrea Bender
Professor
PI

Eystein Jansen
Professor
Deputy Director, PI

Žarko Tankosić
Administrative leader

Karen van Niekerk
Senior Researcher
PI

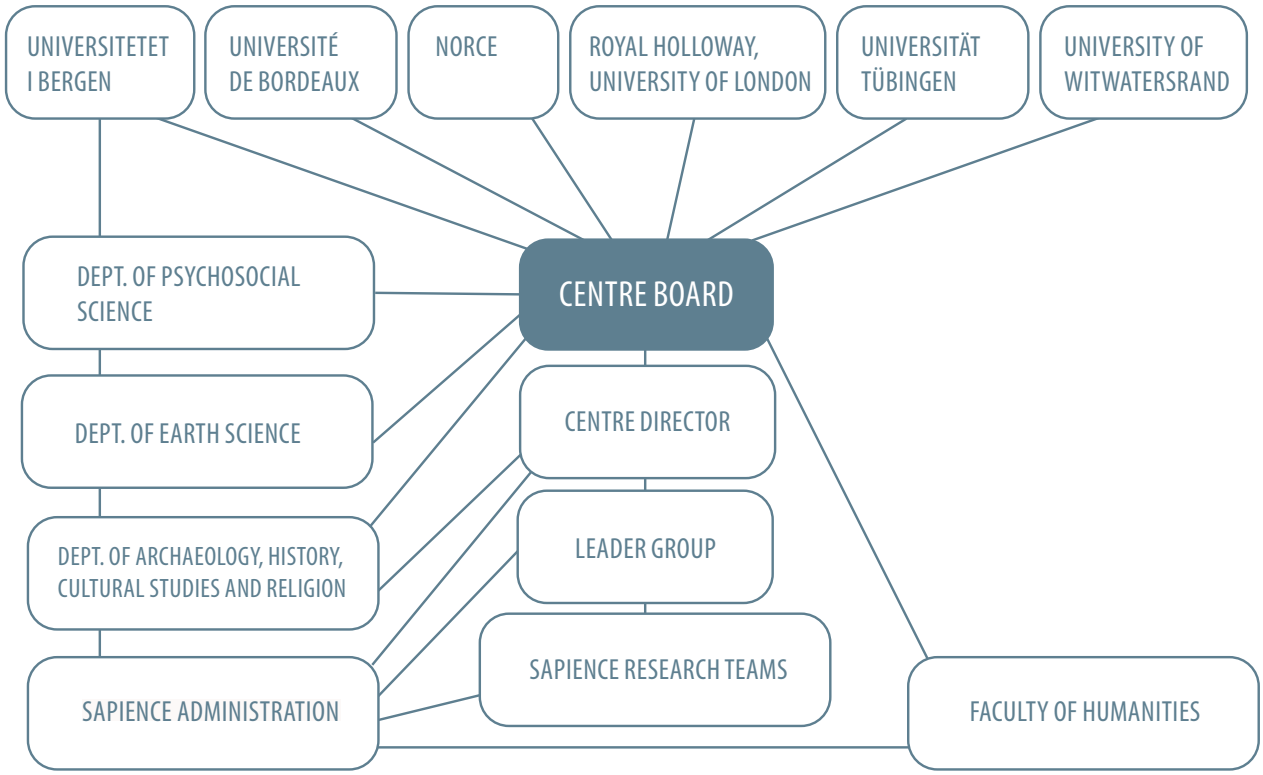
Sarah Wurz
Professor
Senior Scientist

Francesco d'Errico
Professor
Senior Scientist

Christopher Miller
Professor
Senior Scientist

Simon Armitage
Professor
PI

CENTRE STRUCTURE



PIs AND RESEARCHERS AT SAPIENCE

Christopher Stuart Henshilwood	PI, Professor, SapienCE Director DST/NRF SARChI Chair in Modern Human Behaviour	Department of Archaeology, History, Cultural Studies and Religion, University of Bergen 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, Senior 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, Professor	Centre for Quaternary Research, Department of Geography, Royal Holloway University of London
Carin Andersson Dahl	PI, Research Professor	NORCE Norwegian Research Centre Division of Climate & Environment
Francesco d'Errico	Directeur de recherche de classe exceptionnelle Professor II	CNRS Université de Bordeaux Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
Christopher Miller	Professor Professor II	Geoarchäologie, Institut für Naturwissenschaftliche Archäologie, Unversität Tübingen. Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
Sarah Wurz	Professor Professor II	School of Geography, Archaeology and Environmental Studies, University of Witwatersrand Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
Kenneth Hugdahl	Professor	Department of Biological and Medical Psychology, University of Bergen

Torill Christine Lindstrøm	Professor	Department of Psychosocial Science, University of Bergen
Stein-Erik Lauritzen	Professor	Department of Earth Science, University of Bergen
Anna Nele Meckler	Associate professor	Department of Earth Science, University of Bergen
Margit Simon	Researcher II	NORCE Norwegian Research Centre Division of Climate & Environment
Zhongshi Zhang	Researcher II	NORCE Norwegian Research Centre Division of Climate & Environment
Odd Helge Otterå	Researcher II	NORCE Norwegian Research Centre Division of Climate & Environment
Stefan Pieter Sobolowski	Research professor	NORCE Norwegian Research Centre Division of Climate & Environment
Dag Inge Blindheim	Researcher	NORCE Norwegian Research Centre Division of Climate & Environment
Amandine Tisseran	Researcher	NORCE Norwegian Research Centre Division of Climate & Environment

SapienCE Postdoctoral Research Fellows 2021

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
Ozan Mert Göktürk	Department of Earth Sciences, University of Bergen
Elizabeth Velliky	Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
Larissa Mendoza Straffon	Department of Psychosocial Science, University of Bergen

Doctoral Fellows (Ph.D. candidates) 2021

Ole Fredrik Unhammer	Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
Karl Purcell	Department of Earth Science, University of Bergen
Jovana Milic	Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
Zahra Haghighi	Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
Heidi Øhrn	Department of Psychosocial Science, University of Bergen

SAPIENCE ADMINISTRATION

The organisation, management and administration of SapienCE is regulated through the "Guidelines for Centre of Excellence (SFF-IV) at the University of Bergen". The guidelines are based on the requirements and guidelines of the Research Council of Norway, and were adopted by the University Board 24 August 2017.

The guidelines state that SapienCE is led by a centre director responsible for all activity at the centre and who reports to the board. The centre has a leader group consisting of the centre director, vice director and research directors (PIs). The leader group shall participate in the preparations of the items to be discussed by the board. In addition, SapienCE has a scientific advisory committee to support the centre by providing input on the centre's scientific strategy and challenges throughout the project period. The centre has an administrative leader who shall assist the centre director in the day-to-day operations of the centre, serve as secretary to the leader group and be the liaison to other administrative personnel and partners. Additional administrative resources shall possess expertise to meet the needs of the centre; infrastructure, finance, HR, research administration and advisory services, administration of doctoral education, information dissemination and communication. The administrative resources are partly funded by the Research Council of Norway and partly by the University of Bergen.

The resources are organised so that the centre's administration, beyond the position of administrative leader, shall be an integral part of the ordinary administration. This ensures administrative expertise at the department and faculty levels, and ordinary guidelines and procedures are followed as in the regular units. Thus, administrative support is provided for their respective employees by all the SapienCE partners, which either contribute with in-kind funding or receives dedicated grants from the Centre. The employer's liability follows the employment, and the local administrations are responsible for HR related and ordinary financial matters.

Personnel involved in SapienCE administration in 2021	
Žarko Tankosić	Administrative leader (from September 2021)
Anna Polster	Temporary administrative leader (April - September 2021)
Silje Evjenth Bentsen	Administrative leader (until April 2021)
Janne-Beate Buanes Duke	Adviser, Media and communication
Mari Knudsen	Adviser, Finance and accounting
Vibeke Wallacher Enæs	Executive officer, Front desk
Sarah Sharif Hordvik	Senior Executive Officer, Doctoral education coordinator
Anna Lisa Arefjord	Senior Executive Officer, HR
Torunn Saunes	Senior Executive Officer, Web support
Grethe Bruvoll	Higher Executive Officer, Front Desk
Bjørg Anja Teigland	Senior Executive Officer
Faculty of Humanities	
Asbjørn Sæther	Senior Executive Officer, HR
Kirsten Moen	Senior Adviser, Research
SapienCE administrators, curation and field support in Cape Town, South Africa	
Samantha Mienies	Curator/Collections Manager Evolutionary Studies Institute, University of the Witwatersrand
Lisa Hulett	Assistant Evolutionary Studies Institute, University of the Witwatersrand

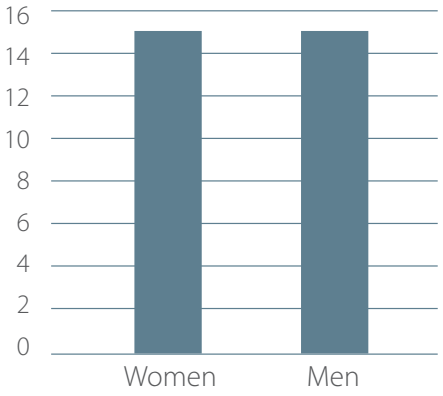
SAPIENCE FUNDING IN 2017-2021

In 2021, the principal sources of funding for SapienCE were the RCN and own-financing from the host institution, in addition to a substantial level of in-kind contributions. SapienCE obtained additional funding from national and international sources. These funds in particular allowed for a higher activity level and broader scope, predominantly within the archaeological research conducted by SapienCE. An overview of SapienCE funds for 2017-2021 is given below:

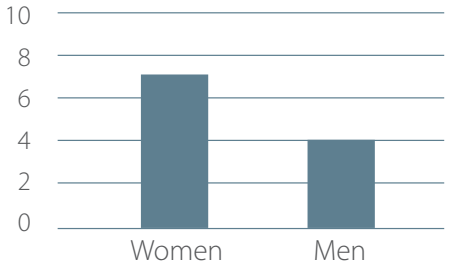
SapienCE Funds 2017-2021 (*1000 NOK)					
Source	**2017**	**2018**	**2019**	**2020**	**2021**
Own financing (Host Institution)	1 630	7 640	9 450	12 567	10 142
Agreed in-kind plus additional estimated in kind (Partner Institutions)	248	1 275	1 109	662	683
RCN contribution	0	11 725	9 607	11 641	18 962
Additional project funds (University of the Witwatersrand, South Africa; HU-MEVAL, Norway	0	2 880	3 316	2 852	14 550
TOTAL FUNDING OF CENTRE ACTIVITY	**1 878**	**23 656**	**23 483**	**27 946**	**44 337**

DISTRIBUTION OF GENDER IN SCIENTIFIC POSITIONS AT SAPIENCE

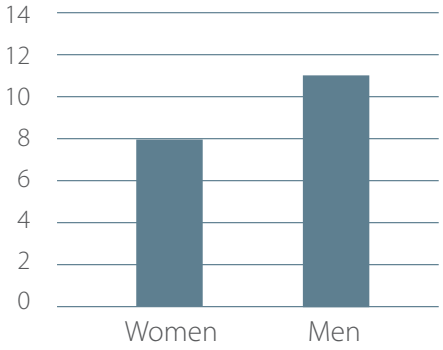
All scientific positions		
	Number of	% number of
Women	15	50
Men	15	50
Total	30	100



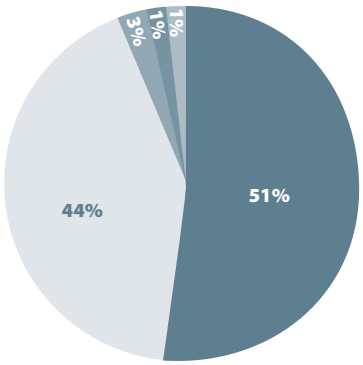
Early career researchers		
	Number of	% number of
Women	7	64
Men	4	36
Total	11	100



Senior scientific positions		
	Number of	% number of
Women	8	42
Men	11	58
Total	19	100

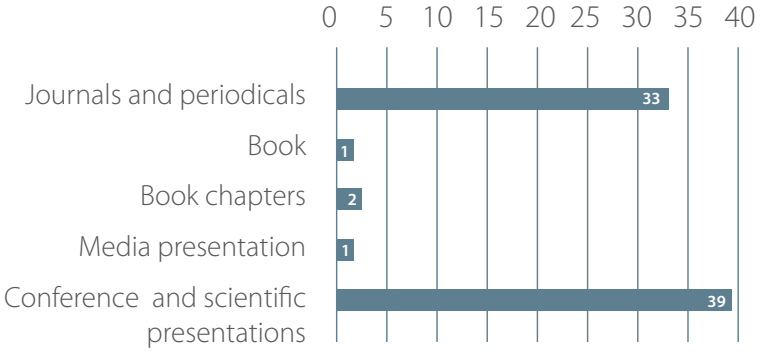


SCIENTIFIC AND ACADEMIC OUTPUTS



- Conference and scientific presentations: **39**
- Book: **1**
- Book chapters: **2**
- Media presentation: **1**
- Journals and periodicals: **33**

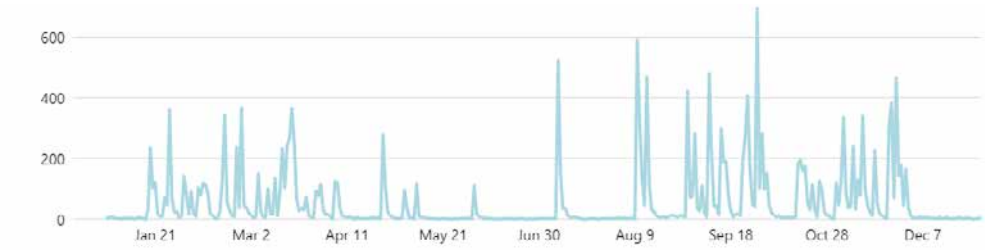
SapienCE scientific OUTPUTS 2021



FACEBOOK STATISTICS

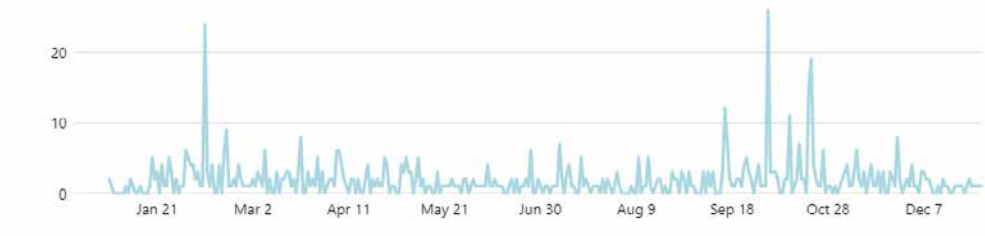
Facebook Page Search:

5 470



Facebook Page Visits:

685



New Facebook Page Likes:

143

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SOCIAL MEDIA

Join us on Twitter! Be the first to receive interesting news and information about SapienCE events in Norway and South Africa. Our Tweets were viewed more than 167,000 times in 2020. The most popular tweet of 2020 announced that Andrea Bender had published a paper entitled "What Early Sapiens Cognition Can Teach Us: Untangling Cultural Influences on Human Cognition Across Time". Links to new publications and events are regularly posted to Twitter. Scan the QR code to stay up to date.

Of course, we have a Facebook page! We post news, events and papers here, but there are big differences between the interests of our Twitter and Facebook followers. Our most popular Facebook post, which reached 4400 people, was an announcement of a PhD opening in collaboration with the PUSHH project. The candidate is to work on palaeoproteomics and is hired, but follow our Facebook page for future announcements of grants and vacancies. Scan the QR code and reflect on the fact that, like our SapienCE archaeologists, you're interested in yesterday's cutting-edge technology.

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P. 34, 35 from Backwell, L. & F. d'Errico 2021 San elders speak: Ancestral knowledge of the Kalahari San. Wits University Press.

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