SAPIENCE

CENTRE FOR EARLY SAPIENS BEHAVIOUR

UNIVERSITY OF BERGEN

ANNUAL REPORT 2020

Norwegian Centre of Excellence

STATEMENT FROM THE CHAIR OF THE BOARD

It seems inevitable that Covid-19 must be the point of reference for any consideration of last year's academic events. Unfortunately, 2020 turned out to be an extraordinarily challenging year for international cooperation and research. Like universities worldwide, the University of Bergen has prioritized energy and resources on the digitalization of teaching, and perhaps less attention has been paid to the consequences the pandemic has had for research activities. Especially for a research project like SapienCE with extensive field trips, laboratory work, and international cooperation carefully prepared in long-term planning, it is evident that the pandemic has presented extraordinary difficulties. All the same, the director was able to report an extensive and impressive range of scientific activities at the board meeting in November 2020. It is reassuring that the staff seems to be adapting to the situation and still make progress under these difficult circumstances. However, there must surely be moments of frustration and exhaustion.

PhDs and postdocs are among those researchers who are most exposed to the negative effects of the pandemic due to their time-limited funding. SapienCE has a large number of staff in such positions, and they have had to adjust their projects due to travel restrictions and other inconveniences. The prolonging of PhD and postdocs contracts has been a particular point of debate at the University of Bergen, and some contract-extensions have been made. However, these do not always fully cover the reported delays. Hopefully, the solid framework of the SapienCE project and its experienced researchers can support and advise our younger staff under these extraordinary circumstances.

In the coming year, we expect to see a gradual return to what resembles normal conditions for international research. It is also reasonable to say that in 2021 the SapienCE Centre of Excellence will reach its age of maturity. It has been exciting to watch the centre grow and live up to the high expectations at the start. On behalf of the University of Bergen, I would like to thank the director, the scientific and administrative staff, and our international partners for all their efforts and excellent results.

Jørgen M Sejersted

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Postdoc Elizabeth Velliky excavating at Blombos Cave in March 2020.

STATEMENT FROM THE DIRECTOR

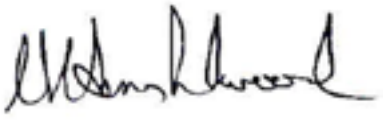
A lot of water has passed under the SapienCE bridge in 2020. The Covid-19 pandemic has resulted in all our SapienCE scientists having to rethink and adapt their research plans for 2020 and beyond into 2021. There have been some major setbacks, yet despite these unfortunate interruptions I can also report that our swift mitigatory actions resulted in several positive outcomes.

I report first on fieldwork: i) The forced cancellation of our excavation programme at Blombos Cave in March 2020 was unfortunate, but we hope to return in late 2021 or 2022 once we have a firmer idea of travel possibilities; ii) A planned geological survey of the Blombos coastline in April was also cancelled; iii) Better news is that our planned 3-week programme of experimental archaeology carried out in March at Jongensfontein, South Africa, by our Postdocs and PhDs was completed successfully. We expect that several publications will emanate from this innovative research; iv) A planned collection of speleothems at Bloukrans Cave, De Hoop Nature Reserve, was also highly successful, and these samples are now being studied in Bergen. Based on preliminary dating, three speleothems will likely provide high resolution records spanning Marine Isotope Stage 4. Two other samples date back to ~ 80 and ~ 88 thousand years ago (ka) and should provide climatic/environmental context at the time of human occupation at Blombos Cave; v) Our plans to conduct offshore sediment coring from the research vessel, *Marion Dufresne*, in February/March 2020 were successful and two cores were recovered off the coast near Blombos and Klasies. These cores are now being analysed in Bergen. The basal dates of the cores are estimated to be 240 ka and 120 ka. The climate data we recover will be highly beneficial for our project.

The pandemic resulted in intermittent periods where all our SapienCE scientists worked from home. Despite the lockdown, and the temporary unavailability of laboratories and offices, I can report that most of our research facilities in Bergen are open to a limited extent and planned research is continuing, albeit slowly in some instances. To varying degrees SapienCE research in Bordeaux, Tübingen, Royal Holloway and in our Cape Town laboratory is also continuing. As a team we have also adapted our plans and adopted innovative ways of doing research. I list here some of these actions: i) We have upgraded some key laboratory equipment in Cape Town to enable remote operation of cameras and microscopes from Bergen. For example the Olympus EP50 Microscope Digital Camera can be used to examine and photograph samples via the internet; ii) Our research plans have been revised repeatedly, shifting from a focus on fieldwork to greater laboratory based analysis; iii) We have engaged additional scientific assistants in Bergen and Cape Town to help our PhDs and Postdocs speed up analysis and access curated materials, especially those stored in Cape Town; iv) We have acquired export permits for some of our excavated materials stored in South Africa, and are now analysing those materials in Bergen; v) We have provided support for PhDs and Postdocs applying for contract extensions due to time lost as a result of the pandemic. We have also instituted a new mentorship programme for Postdocs and PhDs so that they have extended career planning assistance from senior SapienCE scientists; vi) Regular seminars and workshops have continued via virtual meetings on Zoom or MS Teams. As a group we have kept in contact with regular bi-monthly Leader Group meetings via Zoom, and bi-monthly Zoom meetings where all our scientists can join in a group chat. Supervision meetings with PhDs and mentorship of Postdocs have also continued via Zoom; vii) Lastly, we have revised our budgets in various categories, especially where large funding amounts remain unspent due to cancelled fieldwork or access to materials.

SapienCE continues to do well with publications, and our researchers have presented at a number of online academic conferences, and delivered popular science lectures. Several major conferences that SapienCE scientists were planning to attend were cancelled, for example SANORD, that was to be held in Bergen, and the Society of Africanist Archaeologists meeting in Oxford. Outreach work, taking our science to the public continues to be effective (ee page 36-43). We have been successful at appointing high quality Postdocs and PhDs, and at attracting external funding. Proposals from world class research groups to collaborate with SapienCE has in fact increased. We expect to conclude several new major collaboration schemes in 2020/2021. Unfortunately, our SapienCE (administrative) manager resigned due to personal reasons in early 2020. We have been fortunate that our SapienCE Postdoc, Dr Silje Evjenth Bentsen, has been hired to fill this post permanently and we extend a warm welcome to her.

I firmly believe that, despite the setbacks caused by the Covid-19 pandemic, SapienCE scientists and administrators are striding ahead, keeping the ship steady and continuing to produce highly innovative and multi-disciplinary science that is truly ground-breaking. We are looking forward to a productive and safe 2021.



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

Elizabeth Velliky collecting ochre samples in the area around Blombos.

FIELDWORK

The South African Animal Kingdom contains many animals that can be dangerous to humans. Snakes, scorpions and spiders are all encountered in the areas where we work. Before heading into the field in 2020, members of the excavation team attended a snake handling course in Cape Town. The course was both theoretical and practical, introducing us to species identification, behavior and habitat, before moving on to how different venoms work, how best to prevent dangerous encounters and what to do if bitten. We were then put to the test controlling, catching and securing live snakes for safe transport and re-release into the wild. Not only do snakes strike with lightning speed, but they can certainly move fast when they want to!

The excavation season at Blombos Cave was planned for 11 – 30 March 2020. Staff, Postdocs, PhDs and Master students from UiB and Wits were to participate in excavating the 100 – 72-thousand-year-old (ka) levels. We prepared the site for excavation, which entailed, amongst other things, the removal of large rocks that were hindering planned expansion of excavations and installation of a state-of-the-art solar powered lighting system. Our goal for the field season was to excavate four quadrants down to the 100 ka layers, allowing a more detailed analysis of this level, and preparing the way for excavation of deeper layers in subsequent seasons. Unfortunately, after three days of excavation, we had to pack up the site and return home due to the outbreak of Covid-19.

Wits MSc students Alexandra Pearson and Inèz Faul sorting comparative shell collection at Blombos.

Despite the short excavation season, a team of international scientists collaborating with SapienCE were able to visit Blombos Cave, including Ian Hall, Ellie Pryor, Aidan Starr (Cardiff University) and Jeroen van der Lubbe (Vrije Universiteit Amsterdam). This team had recently completed a successful cruise on the research vessel *Marion Dufresne*, partly funded by SapienCE, during which they collected several marine sediment cores from off the Agulhas bank. The cores contain records of Agulhas and South African hydroclimate variability during the timeframe studied by the centre and will be critical in our efforts to understand the nature of climatic changes experienced by our ancestors.

A field season was also planned at Klasies River main site from 2nd to 21st March, under the direction of Sarah Wurz. Students and staff from the University of the Witwatersrand, as well as the expert flint knapper, Christian Lepers from the University of Liège, Belgium, took part. This season focussed on re-opening the Witness baulk (an unexcavated portion of archaeological sediments left intact by previous excavators) and excavation of the earliest Middle Stone Age layers dating to ~110 ka. As at Blombos, fieldwork was cancelled due to Covid-19. Excavations stopped on 15th March and all participants returned home as soon as possible.

While the abrupt termination of excavations had negative repercussions for some planned material and data collection, we did successfully collect a variety of reference materials for several projects. This included Elizabeth Velliky and other team members surveying variety of geological outcrops and collecting ochre samples. The team visited several spectacular outcrops of ochre, including in the blistering hot Karoo landscape to the north of Riversdale. Samples from these sites will be used to try to determine where archaeological ochres present in Blombos Cave were collected.

We also made a good start on compiling a comprehensive modern comparative collection of non-food marine and estuarine shells, to compare with those found within archaeological sites. Shells were retrieved from nine different localities, ranging from the sandy beach to the west of Blombos Cave to the rocky fish traps in the Goukou estuary near Still Bay village to the east. Inèz Faul collected mud samples from the upper reaches of the Goukou river, to compare the ostracod species found there in the present day with those found in the Middle Stone Age layers at Klasies River main site.

Christopher Henshilwood giving a tour of Blombos Cave to Wits MSc students Alexandra Pearson and Inèz Faul.

An international team of scientists, including participants of the research cruise with *Marion Dufresne*, visited Blombos Cave in 2020.

Inèz Faul collecting Nassarius shell at Goukou.

Turid Hillestad Nel adjusting the fire.

Ole F. Unhammer and Jovana Milic capturing data at the total station.

Ole F. Unhammer doing the finishing touches on one of the boxes for the experiments.

Magnus Haaland preparing the micromorphological sampling.

EXPERIMENTAL FIELD SEASON

RESEARCH WITH A SMOKY FLAVOUR

A team of six early career researchers from SapienCE spent three weeks in Jongensfontein, South Africa, conducting, recording and cleaning up fire experiments. We came back with clothes, cameras and samples that reeked of fires and boxes full of samples. Here is a report from research with a smoky flavour.

JONGENSFONTEIN AND THE CAMP SITE

Jongensfontein is a sleepy coastal village in the Western Cape, approximately 16 km from Still Bay. The Jongensfontein Camping, Caravan and Self-Catering park is situated by the local beach and contains chalets with a sleeping room, bathrooms and small kitchens. Three of these became a home away from home during the experimental archaeology season in February and March 2020. We were able to set up a sample sorting station and a field computer laboratory in the chalets, but most of the activities took place outside.

The fire experiments were outdoor, realistic experiments, but we needed to control the conditions of the experiments as much as possible. Ole F. Unhammer had designed four standardized boxes to ensure similar set-ups for all fires. Each box was assembled and filled with a base layer of industrial sand and a top layer of local dune sand. Thermoprobes connected to thermometers were inserted within these sands and at the surface, so that the temperatures of the fires could be recorded.

THE TEAM AND EXPERIMENTS

Silje Evjenth Bentsen initiated and managed the experimental season, but all participants were deeply involved in the planning process and in making everything run smoothly. All team members of the field season had prepared a project with a set of questions to be explored during the experiments. Ole F. Unhammer worked to determine the best method for recording and documenting the fire experiments, while the effects of heat on micromammal bones, owl pellets, ostrich eggshell, seashell and ochre were examined by Turid Hillestad Nel, Silje Evjenth Bentsen, Jovana Milic and Elizabeth Velliky. Magnus Haaland's primary experimental interest was the effects of heating upon the sediments themselves. In addition to the early career researchers, the experimental team also included senior researcher Carin Andersson-Dahl, who supervised Jovana Milic in between helping out on the site. Senior researcher Simon Armitage also spent some days with us, supervising Ole F. Unhammer, and collecting samples to determine the effects of heating on the properties of luminescence dating samples.

Each experiment consisted of two boxes, each containing one fire. The two fires were lit at the same time and burnt the same type and mass of wood. The duration of the experiments lasted from a few hours to 12 days, during which the fires were fed continuously. This meant that we had to work in shifts to monitor the fires 24 hours a day. In addition, we had to document and excavate the boxes after each experiment had finished. Our three weeks in Jongensfontein were thus filled with action both night and day!

THE RESULTS

We were able to collect enough data on temperatures, methods and heating effects to keep us busy for a long time! The samples from the season were shipped to Bergen, where analyses are ongoing. We are thus still waiting for many of the scientific results. Nevertheless, one very positive outcome of the season was that we coordinated efforts and results and organized a session at the experimental archaeology virtual conference (EXARC World Tour). The team will present preliminary results and experiences with a wide audience in March 2021, and updates will surely follow in our next report.

And in case you were wondering, were these experiments smelly? The answer is: We all smelled like we were heavy smokers, as did our equipment. The smell of freshly unpacked samples in Norway is powerfully evocative of a productive and enjoyable three weeks of experimental archaeology in Jongensfontein 2020.

MD225 ACCLIMATE-2 crew and scientific team

MARINE CORES

SAMPLING MARINE SEDIMENT CORES

In February 2020, Margit Simon, Dag-Inge Blindheim, and Trond Dokken from SapienCE, in collaboration with colleagues from Cardiff University, UK and Vrije Universiteit Amsterdam, Netherland, joined a research expedition on board the French research vessel *R/V Marion Dufresne*.

SAMPLING MARINE SEDIMENTS

The main objective for the team was to core marine sediments that will be analysed to establish the sensitivity of the southern Agulhas Current to climatic changes during the Late Pleistocene. These cores will also be used to determine the influence of the Agulhas Current on African terrestrial climate, as part of SapienCE's ongoing research into understanding the factors influencing human behavioural evolution. Two coring sites specifically targeted locations close to the archaeological sites at Blombos Cave (100-72 ka) and Klipdrift Shelter (66-59 ka) in the west, and Klasies River main site to the east. Before the 2020 research expedition, no marine sediment cores in close proximity to these key sites and covering the time period of interest existed.

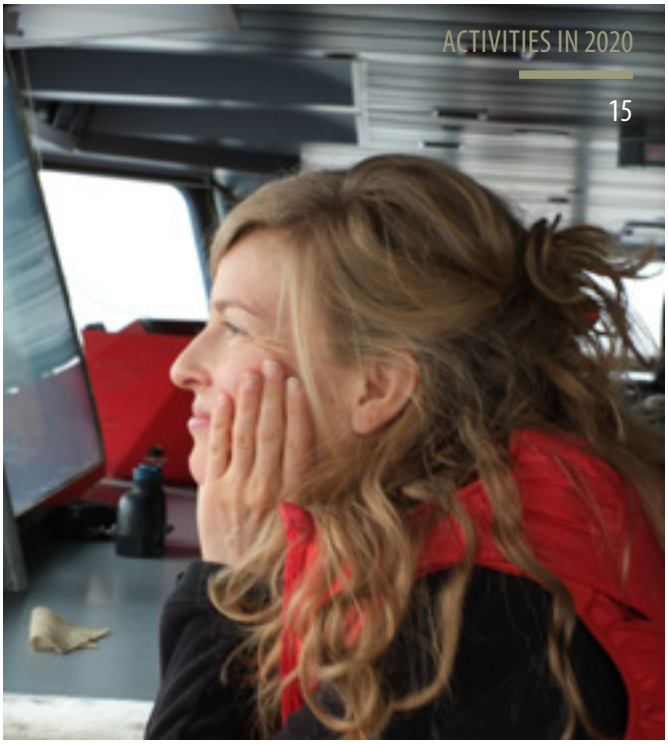
The Agulhas Current is the strongest western boundary current in the Southern Hemisphere, transporting some 70 Sv (Sverdrup, 1 million cubic metres of water per second) of warm, saline surface water from the tropical Indian Ocean along the East African margin to the tip of Africa. The Agulhas Current is a key component of South African coastal ecosystem, supporting intertidal shellfish and fish communities and hence influencing the marine food sources that Middle Stone Age *H. sapiens* foraged. Moreover today, the warm Agulhas current drives the convection of moist coastal air cells that are important for coastal precipitation, delivering a source of freshwater to the region. This suggests that in the past the ocean temperature was important for controlling how much rainfall/freshwater was delivered to the coastal areas where the SapienCE sites are located.

The cruise retrieved two cores of excellent quality sediment, which will provide unique medium-to-high temporal resolution records, spanning the timeframe covered by SapienCE. The cores consists of terrestrial sediment transported out from land by rivers mixed with material from the ocean. Consequently, systematic analysis of material along the length of the core will allow us to reconstruct simultaneous variations in past ocean and land climate conditions during the Middle Stone Age.

STUDYING PAST CLIMATE

To study the coastal climate of South Africa, we use geochemical analysis to trace plant remains in the sediment, and elements such as iron or titanium that we know were transported from land to the ocean. These analyses allow us to reconstruct vegetation changes and variations in the amount of material transported from land to the

Ian Hall (Cardiff University) Trond Dokken (NORCE), and chief scientist Clair Waelbroeck (LOCEAN)

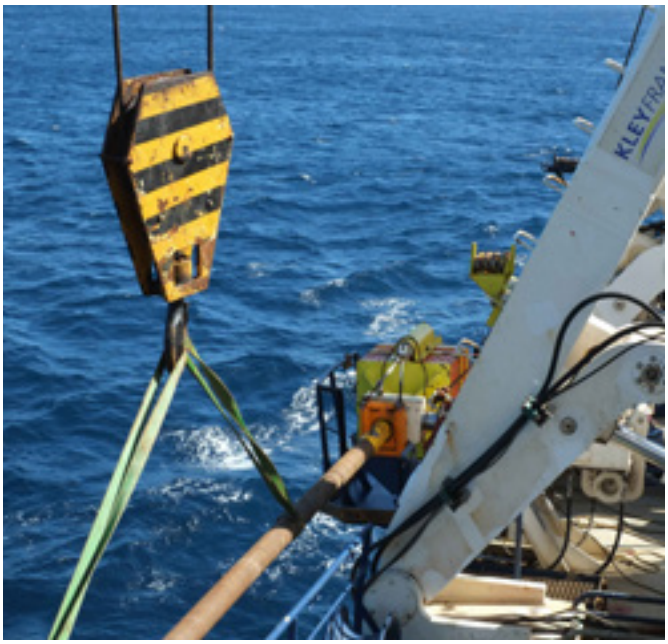


SapienCE researcher Margit Simon (NORCE) joined the cruise and authored this report

ocean over time. Using different geological dating methods, we can determine the age of each layer in the sediment core. With this information we can link our records of changing climate and vegetation with the archaeological information acquired from excavations along the South African coastline.

Moreover, we will analyse the ocean component of the core via planktonic foraminifera that we find in the sediment. Foraminifera are tiny unicellular animals with a calcite shell. Planktic foraminifera live in the ocean water column and form their shell from the seawater in which they live, meaning they preserve the fingerprint of that water mass in their shell. After they die, they sink and are buried and preserved in the sediments at the seafloor. By extracting ancient foraminifera from the core, and analysing their shell chemistry, we obtain a record of water mass properties (e.g., temperature and salinity) through time. With this data, we will, for example, be able to find out when ocean conditions were colder or warmer, hence more or less favourable for rainfall on land.

Overall, the data from our sediment cores will enable us to reconstruct environmental change through time, allowing us to interpret archaeological data in an accurate climatic context.



The Calypso coring system onboard *R/V Marion Dufresne*

Shipboard scientist with one of the retrieved a sediment cores.

COLLECTING STALAGMITES FROM BLOUKRANS CAVE

In early March 2020, a group of four SapienCE researchers went to the De Hoop Nature Reserve in the Western Cape of South Africa, to collect stalagmites from Bloukrans Cave. These stalagmites contain long, highly detailed records of ancient changes in temperature, rainfall and vegetation.

Although Bloukrans Cave isn't an archaeological site, it is close to the excavations at Klipdrift and Blombos, so the information preserved in the stalagmites will help the SapienCE team to understand the climate and landscape experienced by our ancestors. This wasn't our first trip to Bloukrans. In February 2018 we took small test samples from a number of stalagmites. Analysis of these samples by Stein-Erik Lauritzen, Nele Meckler and Jenny Maccali showed that they contained good climate records, and one particular stalagmite called "BL18-01" covered exactly the time period that SapienCE is interested in. By the end of the week BL18-01 would have another name: Stalzilla!

INTO THE DARK

The entrance to Bloukrans is a small hole at the foot of a cliff. Once inside, daylight fades quickly as you descend a long steep slope of sand and bat guano to reach the cave floor. Here it is pitch black, but noisy, with the dripping of water and screech of a thousand bats. Playing the light of your head-torch around the cave reveals a hundred stalagmites and stalactites and the occasional low-flying bat. BL18-01 stood on the sandy slope just above the cave floor. Impressive certainly, but not massive. Our jobs for the week were twofold. Firstly, we wanted to take a number of small samples from around the cave. Dating these samples, together with material collected in 2018, will give us a picture of when the cave was wet enough to produce

speleothems (the collective name for stalagmites and stalactites). Since speleothems are produced by constant dripping water, prolonged dry periods cause formation to stop. Consequently, gaps in the record from BL18-01 may represent either periods of drier climate, or periods where the drip forming the stalagmite moved elsewhere. Dating the small test samples will allow us to determine which of these scenarios occurred, and is critical for understanding the climate record from BL18-01. Our second task, of course, was to remove BL18-01 from the cave.

STALZILLA

Exploring the cave and building a collection of small test samples took up most of the first day at Bloukrans. BL18-01 is more than 2 m long, and made from strong, dense calcite. Removing it from the cave took two further days of drilling and hammering, breaking it up into portable pieces and carefully labelling each. The walk from Bloukrans to where we were able to park our vehicle takes about an hour and involves a strenuous climb up the very steep coastal cliff, and several sections through thorny undergrowth. This is tricky enough without a heavy piece of stalagmite in your backpack. On the evening of the third day, we had removed less than half of BL18-01, but the news from the outside world was clearly bad. On the fourth day we made extra effort, overloaded our backpacks with speleothem, and removed the remainder of BL18-01. In total, Stalzilla weighed 170 kg. It was a tough afternoon! That evening we were told to fly home immediately, to avoid being stranded in South Africa by the pandemic. Had this happened one day later, we would have been able to retrieve Nele Meckler's temperature monitor from Klipdrift, our last task for the fieldtrip. One day earlier, and Stalzilla would still be in Bloukrans, rather than in the University of Bergen yielding a vital record of the climate and landscape experienced by our ancestors. Sometimes, science is all about timing!

BRAIN ACTIVATION DURING FLINTKNAPPING

Archaeological findings tell us that our Middle Stone Age ancestors were dexterous flintknappers, but they remain silent on the cognitive preconditions for engaging in such activities. This is where neuroscience steps in: by opening up a window into the workings of the human brain via brain-imaging studies.

For our studies, we make use of functional magnetic resonance imaging (fMRI). While lying in the magnetic resonance scanner, participants are asked to envision as vividly as possible how they would perform a specific task. If a region of the brain is in use, more blood flows to it. Because fMRI data reveal such changes of blood flow in different brain regions, they point to those neural networks that are involved in the activity being envisioned by the participant.

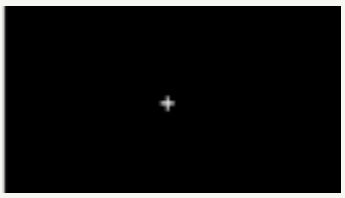
THE DESIGN OF THE STUDY

In spring 2020, we had several meetings discussing the experimental paradigm and design of the planned fMRI study on flintknapping. In order to obtain necessary and proper contrasts, we applied a design with alternating periods of (a) resting with no instructions, (b) envisioning producing a tool from a piece of unworked flint, and (c) envisioning producing a LEGO object from disjointed LEGO bricks. During each of these periods participants were shown images on a headset.

The table presents examples of the three types of visual stimuli used. These were shown to the participants, with repeated 40 and 20 sec presentations for each category. The participant's task in the two imagery conditions was to envision constructing the intended object, either from the unworked flint or from the scattered LEGO pieces. This means that, for the key condition (i.e., the tool-making imagery), we would have two control conditions, or "contrasts": a passive resting condition and an active condition with demands for visuo-spatial and motor imagery, but unrelated to the process of producing a flint axe or arrow-head. We also decided to investigate making four different types of tool – Oldowan, Acheulean, Levallois, and Still Bay. These were presented to the participants in either ascending or descending order by age, and each tool type was paired with a different LEGO object to be assembled.

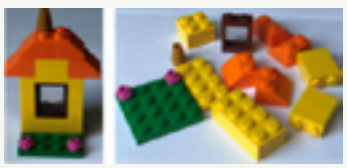
This protocol was approved by the regional ethics committee for medical research in western Norway.

(a) During resting periods, the participant in the scanner would see a blank screen, with a fixation cross in the middle.



(b) While envisioning tool-making, the participant would see an unworked flint to imagine knapping. The picture shows one of the unworked flint images used.

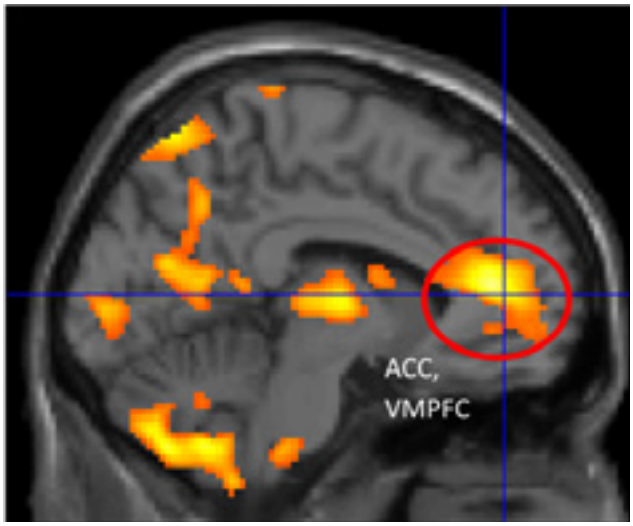
(c) While envisioning LEGO construction, the participant would see an assembled LEGO object together with the pieces used to construct it, scattered on a background. The picture shows one of the different LEGO objects used.



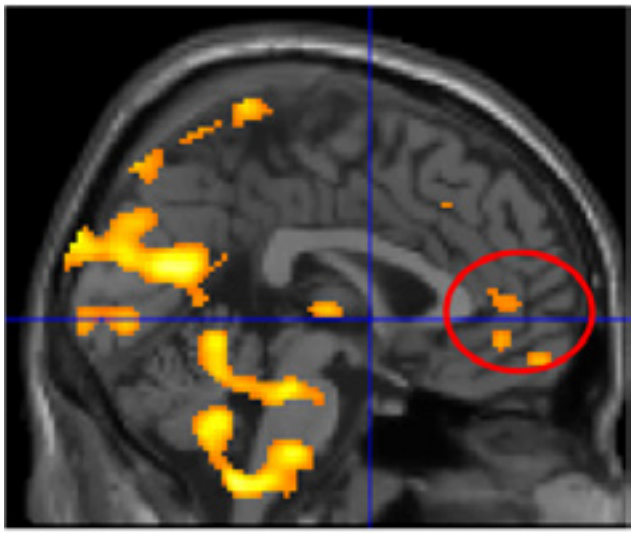
A FIRST PILOT STUDY

Despite the Covid-19 situation, we were able to run a first pilot study in the autumn of 2020. The participant volunteering for the test was a Norwegian flintknapping expert. The Figure below illustrates the (highly preliminary and tentative) results, indicating that flintknapping – in contrast to LEGO assembling – recruited areas in the ventromedial prefrontal cortex, including the anterior cingulate cortex, the orbitofrontal cortex, and the medial part of the superior frontal gyrus.

Single subject, SPM2, .05 uncorr



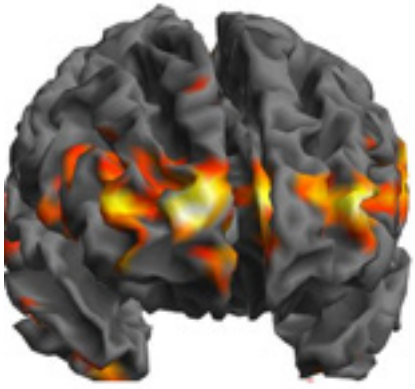
Flint imagery -1 0 1



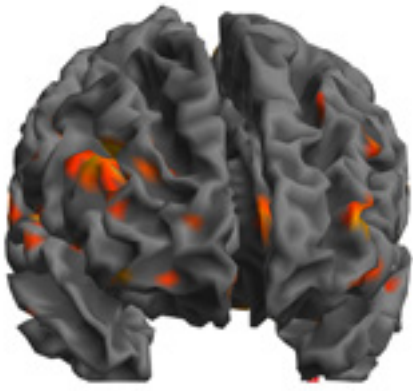
LEGO imagery -1 0 1

A sagittal slice through the midline of the brain with .05 significant fMRI-BOLD activations (yellow/orange) overlaid on T1 anatomy images. Note the difference in activation in frontal regions between the Flint and LEGO conditions (marked with a red circle), both contrasted against rest. ACC = Anterior cingulate cortex, VMPFC = Ventromedial prefrontal cortex

The activation extended laterally into the inferior frontal gyrus and Broca's area on the left side. The ventromedial prefrontal cortex, and the anterior cingulate are regions involved in focused attention and higher-order sensory-motor coordination; and in particular the anterior cingulate cortex has been shown to be involved in higher-order cognition, including focused attention and concentrated efforts.



Flintknapping periods



LEGO assembly periods

Precautions need to be taken when interpreting this pattern due to the single participant, an uncorrected .05 significance threshold, and the risk for movement artefacts in the data. Yet the findings are compatible with the assumption that regions in the prefrontal cortex played a role in early human tool making.

The difference between the flintknapping and the LEGO conditions was present when envisioning making all four different tool types (from Oldowan to Still Bay, i.e, from oldest to youngest). No significant differences were observed between the four tool types, which, however, could be due to the preliminary nature of the study which is based on a single participant. We will therefore await further data before interpreting these results in more depth.

SYMBOLS IN MIND AND BODY

What were visual symbols used for by Middle Stone Age (MSA) humans, and how? Why did communication through material symbols arise in the first place? Can their current uses inform us about their origin and evolution? How are they perceived and processed in the brain? These are all questions that researchers of the SapienCE subgroup Symbolic Mind, Cognition, and Social Organization are addressing in various ongoing studies. The results of these projects will widen our understanding of the emergence of characteristic aspects of the modern human mind and behaviour, such as aesthetic and symbolic cognition.

Whereas archaeological material such as lithics and faunal remains can inform us about past subsistence strategies, diet, and technology, so-called symbolic artefacts can tell us about the ways in which people viewed and interacted with their world.

THE ROLE OF SYMBOLIC COMMUNICATION IN THE MSA

The postdoctoral research of Larissa Mendoza Straffon looks at the role that symbolic communication technologies, like ochre, personal ornaments, and visual signs may have played in the social lives of modern humans living in the Western Cape coast during the MSA. One possibility being explored is that these practices emerged within the context of cooperative relations, at a time when hunter-gatherer bands were establishing increasingly complex exchange networks.

Testing this proposal requires a meticulous review of archaeological data, climate research, and cognitive anthropology, and hence synthesizes data from across all SapienCE research groups. Information from each group theme can help identify possible occupation and material exchange patterns that point to the existence of social networks within which group relations may have been mediated by symbolic communication. The focus is on artefacts from the Still Bay layers at Blombos Cave, which include early examples of geometric engravings, ochre pigment production, shell beads, and stylized lithics. Ascribing a social context and function for MSA symbolic technologies, beyond their aesthetic aspect, can help us integrate the archaeological evidence from this period and region with our understanding of modern human cognition and its capacity for problem solving in the past and in the present.

DISENTANGLING THE ONTOGENY OF DRAWING

As part of the Visual Signs as Cognitive Tools: Phylogeny and Ontogeny project, funded by the John Templeton Foundation and in collaboration with Leiden University, Larissa Mendoza Straffon is carrying out a study on the ontogeny of drawing. Working with psychology students, the team plans to gather data related to the development of children's minimal skills required to identify complex visual stimuli, on the one hand, and to produce hierarchically organized patterns and designs, on the other.

Visual signs, together with language and gestures, constitute the basic forms of human symbolic communication. Throughout children's early development, these symbolic systems organize cognition and drive learning processes. They act as a cognitive tool or means of mental problem-solving that helps us to think, to communicate, to remember, to judge, and to make decisions.

Despite much research into the ontogeny of pictorial representation, the underlying cognitive and behavioural mechanisms of drawing remain relatively unknown. This study aims at disentangling some of the core perceptual, cognitive, and social processes that lay the foundation for visual marking and, eventually, visual artistic behaviour. For example, the basic motor/cognitive capacities that allow for mark-making at an early stage, such as the average age at which children can manipulate tools, or direct and sustain attention, and whether or to what extent these are affected by socialization and cultural scaffolding.

Subjects will include children ages 2-7. The lower range is the age at which children have been reported to start understanding symbolic visual signs, whereas the upper range includes the age at which they fully use symbolism across different domains. The results are expected to contribute towards theoretical debates regarding the developmental sequence of symbolic cognition (e.g, Piagetian vs. Vygotskian models) and its potential adaptive benefits in human evolution.

THE CULTURALISED BODY

Numerous neuroimaging studies have in recent decades focused on the identification, in humans and in primates, of the cerebral circuits involved in the recognition of faces and body parts, and on the processes involved in the development of these mechanisms during the life of individuals. The existence of cortical regions specialised in the recognition of faces has thus been demonstrated. These regions include the lateral part of the fusiform gyrus, the lower occipital gyrus and the posterior part of the upper temporal groove, the activations in these regions being rather lateralised in the right hemisphere when faces are perceived. No research has yet been conducted on the study of the perception of the culturalised body. This question is essential for SapienCE because the perception of individuals is, in any human culture, inseparable from cultural codes expressed by the different ways of modifying the biological body (tattoos, scarifications, body paint, hairstyles, objects of adornment etc.). Little is known about the neural networks involved in processing these signals or their emergence during the evolution of our genus.

Body ornamentation has very deep roots. The earliest pigments, possibly used for body painting, date back 300,000 years and were discovered in Africa and Europe. The earliest ornaments have been found in North Africa, the Near East, and Southern Africa. They date to 140,000, 110,000 and 80,000 years ago, respectively. Among these early occurrences, Blombos Cave is the only site in which a change in the way ornamental objects were assembled has been identified. How do these communication and identification devices modify the perception of the body?

In 2020 Francesco d'Errico has developed, in collaboration with neuroscientists from the University of Bordeaux, an fMRI paradigm including different reference tasks in order to identify the specificities of the neural bases for the treatment of stimuli linked to the culturalisation of the body. The results of these experiments should enable them to identify the cerebral regions involved in the perception of the social value of body ornaments and paintings, and propose hypotheses on the processes which have led, in the course of our biological and cultural evolution, to move from a perception of the biological body to that of a body enriched by culturally determined and increasingly complex visual stimuli.

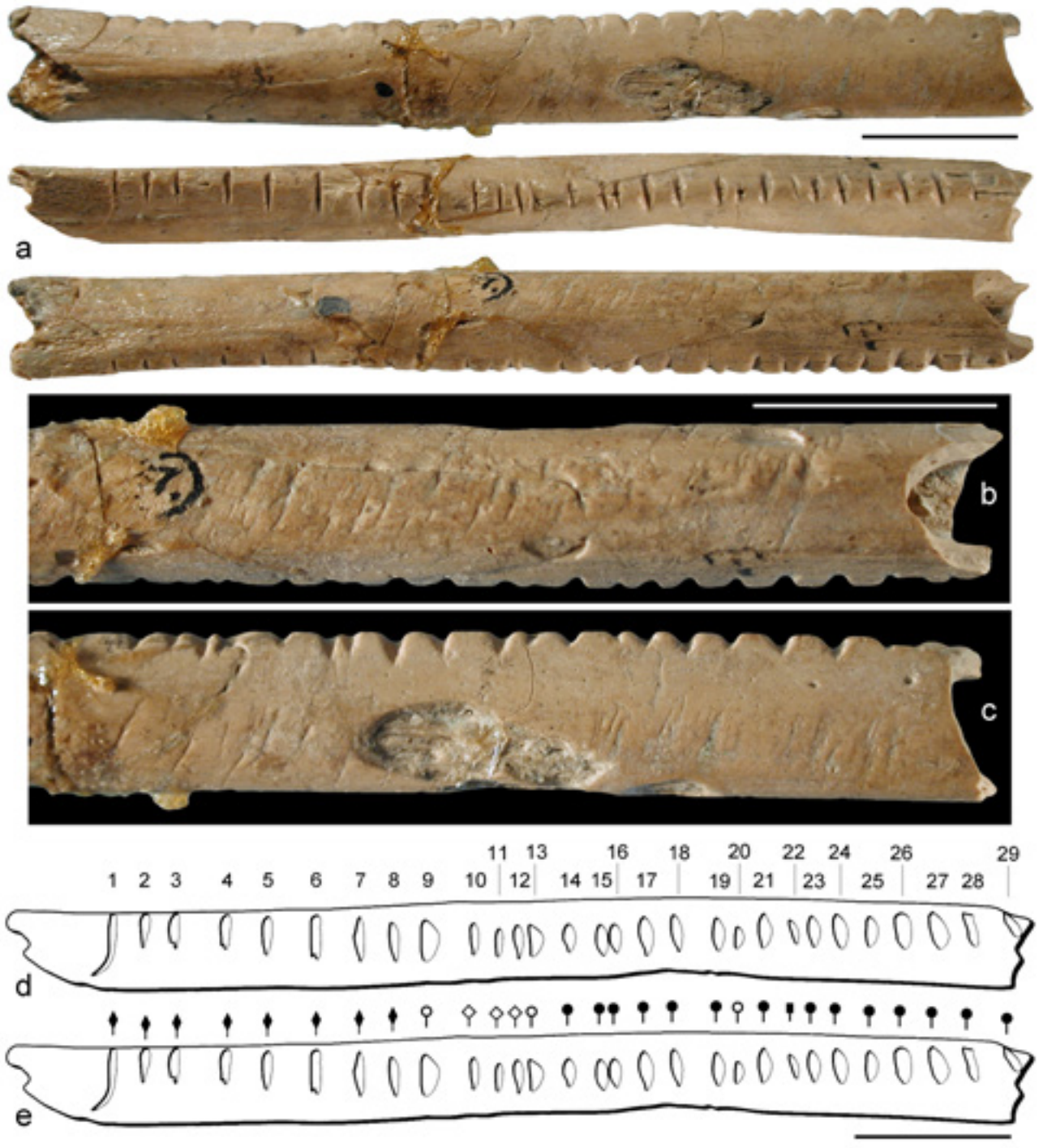
73,000-year-old ochre drawing from Blombos Cave, South Africa.

75,000-year-old shell beads from the site of Blombos Cave, South Africa

STORIES

THE EVOLUTION OF COGNITIVE TOOLS FOR QUANTIFICATION (QUANTA)

All humans – like many other animals – are able to perceive approximate quantities, but only humans can precisely count them. We are also the only species that uses symbols to express quantities (with words such as "one, two, three"), communicate them visually (for example with our fingers), or record them (by writing them down with digits). These verbal and nonverbal numeral systems are our cognitive tools for quantification, and we employ them to understand and transform the world. And yet, while we do have an entire scientific discipline to teach us what we can do with numbers, we know very little about their origin and evolution. When, why, and how did our ancestors develop these tools? Were those seeking shelter in Blombos Cave and Klipdrift a hundred thousand years ago (100 ka) already interested in exact quantities? And did they possess, or develop, such cognitive tools for counting? Questions like these lie at the heart of the QUANTA project, funded by a European Research Council (ERC) Synergy Grant.



A baboon fibula found at the famous site of Border Cave, South Africa, represents one of the earliest known devices for storing numerical information. Microscopic analysis of the 29 surviving notches identifies four, possibly five, groups, each made by a different tool. In two cases, new notches were added in between already carved notches. This observation – together with the heavily polished appearance of the bone surface from long-term handling and curation – indicate that the sets of notches were added at different times, suggesting a notational rather than a decorative purpose. As the layer in which the bone was found is dated to 44-42 ka, this device for storing numerical information predates the ones that were previously thought to be an innovation of the European Upper Palaeolithic. One exciting possibility to be explored is whether similar or different devices (or antecedents thereof) of an even greater age can be found in one of the SapienCE sites.
[from d'Errico et al. (2018), Phil. Trans. R. Soc. (photo and drawings by F. d'Errico)]

COUNTING PRESUPPOSES COGNITIVE TOOLS AND CONCEPTUAL BREAKTHROUGHS

Abstract reasoning and the active usage of symbols are considered hallmarks of cognitively and behaviourally modern humans; and dealing with numerical information is a paradigmatic instance of both. Some of the preconditions of numerical cognition, such as the ability to keep track of up to three items via subitizing (immediate, accurate judgement of small quantities) and to approximate larger quantities, are biologically evolved and shared with a range of non-human species. **Exact quantification**, however – that is the ability to accurately assess, remember, express, and convey discrete quantities beyond the subitizing range in an exact manner – is uniquely human. For this ability to unfold, both cognitive tools and conceptual breakthroughs are indispensable.

Presumably the most fundamental cognitive tool for exact quantification is a conventionalised sequence (such as "one, two, three, …") that allows for counting. Lacking such a tool or being prevented from using it impairs people's ability to count or recall exact quantities beyond the subitizing range. Each such sequence constitutes a numeral system, the properties of which depend on the number and shape of its elements, their order and relations, or the modality in which they are realised (e.g., as number words, body-based representations, or written notations). These properties may, in turn, affect the efficiency with which discrete quantities are represented and processed. Such counting sequences have been in use, to various degrees, in almost every speech community around the world for at least several millennia, and today exhibit striking diversity. However, their origins and the driving forces in their diversification have remained in the dark.

The conceptual breakthroughs needed for being able to count comprise the insight that numbers are systemic and refer to categorically discrete quantities: that, say, "five" indicates exactly five objects and not more or less, or that it is the same as three and two. Learning to count with number words - including comprehension of the numerical meaning of these words - requires realizing of several principles, such as that each number word has to be assigned to exactly one object, that number words occur in a fixed order, or that the number word for the last object represents the cardinality of the set.

Yet, inventing tools for quantification – even apparently simple ones such as number words – is a much more challenging task than it may seem. A whole series of developmental studies demonstrate that achieving the conceptual breakthroughs depends on the cognitive tool already being in place. That is, children can recite the basic number words long before they begin to grasp the numerical meaning of the words, the concept of numbers, or the principles involved in counting; and they appear to need guidance for achieving this understanding. This poses a **tantalizing paradox:** If the ability to count does indeed presuppose a counting sequence, how could such a tool ever be invented in the first place?

A MULTIDISCIPLINARY APPROACH

This question is surprisingly challenging to answer: not only because we know so little about counting practices in the past, but also because quantification is a multi-dimensional phenomenon at the intersection of several disciplines, ranging from anthropology, evolutionary biology, and archaeology to linguistics, psychology, and cognitive science. Integrating theoretical perspectives, conceptual models, data sets, and analytical methods across disciplines is therefore critical. Only a profoundly multidisciplinary approach will enable QUANTA to identify the earliest quantification tools in prehistory, to assess just how diverse such tools can be across space and time, and to understand when and why they emerge and change. For achieving these goals, QUANTA will harness a theoretical grid for analysing all types of quantification tools in a unified way, and powerful computational means to reconstruct how they evolved and diversified.

WORKING THROUGH THE PANDEMIC

Daily excavations, surveys, sampling and archaeological experiments. The SapienCE team were right in the middle of their annual field expedition to South Africa, when the Covid-19 pandemic became a reality, forcing the world into lockdown.

Curator Samantha Mienies and postdoc Turid Hillestad Nel in Zoom meeting, busy organising micromammal samples for isotope analyses.

Samantha Mienies is the Curator at the SapienCE/University of Witwatersrand laboratory in Cape Town. She curates the archaeological material found during excavations, helps visiting researchers, conducts permit applications for sampling and export of material, maintains research infrastructure and countless other tasks associated with running a research laboratory.

During the pandemic, she became the essential lifeline for SapienCE research activities in South Africa.

WORKING THROUGH LOCKDOWN

Faced with lockdown, work halted and we had a laboratory full of samples, including 130 kg of stalagmites. Samantha had her hands full.
"As the realities of a prolonged pandemic and lockdown were dawning, I had to find new ways of organizing my work"

She moved the material to her home, and continued work despite the adverse conditions brought about by the lockdown. She facilitated the shipment of material from her home to Bergen and curated excavated material. Samantha ensured that researchers quickly received their samples from South Africa, shortening the delays experienced by a number of SapienCE projects.

ZOOMING THE SAMPLES

Samantha is still working from home after 10 months of lockdown. "I have decided to continue working from home, to minimize the risk of being infected. Zoom-meetings have become my new normal" she said.
She tried new ways of facilitating research with Turid Hillestad Nel, a SapienCE postdoc specialising in rodents. They used Zoom meetings and live image sharing to sort through rodent remains in the excavation archive at Cape Town. This allowed Turid to select samples suitable for analysis, and carry out her planned research despite not being able to view the material in person.

AN ESSENTIAL ASSET

Christopher Henshilwood is extremely grateful to Samantha for the effort she has made during these trying times.
"She has really gone beyond what could be expected during this situation. She has played an eminent role in ensuring that progress is made in SapienCE despite the lockdown. Samantha has been a great asset," he says.

Samantha says she thrives on her work and really appreciates the variety of tasks. She is used to a hectic schedule and coordinating all the various activities at the laboratory. "There is never a dull moment working with the SapienCE team and I am very happy if my efforts have helped them to stay on track with their work."

Samantha had her hands full with a laboratory full of samples that needed to be packed and sent to Bergen.

Samantha Mienies showing how excavated material is curated in the field.

TELL ME WHAT YOU EAT AND I WILL TELL YOU WHAT YOU ARE

New research proves that our ancestors cooked starchy rhizome 170 000 years ago. The study also implies that the food was shared as a social act around the fire.

"Tell me what you eat and I will tell you what you are" is an old French saying. Reconstructing the diet of our ancestors and understanding how it changed through time are key goals of all archaeological research", says Francesco d'Errico. He is professor II at the University of Bergen (UiB) and senior scientist in SapienCE.

INSIGHT TO EARLY BEHAVIOR

d'Errico co-directs the excavation at Border Cave, South Africa, with Lucinda Backwell financed by the National Scientific and Technical Research Council in Argentina (CONICET) and Lyn Wadley at the , Johannesburg, South Africa. Their excavations led to the astonishing finding of rhizomes that were cooked, shared and eaten by our ancestors 170,000 years ago. This work was recently published in the prestigious Journal Science.

"This discovery is much older than earlier reports for cooking plants and it provides a fascinating insight into the behavioural practices of early modern humans in southern Africa. It also implies that they shared food and used wooden sticks to extract plants from the ground", says Professor Lyn Wadley, based at the Evolutionary Studies Institute at the University of the Witwatersrand.

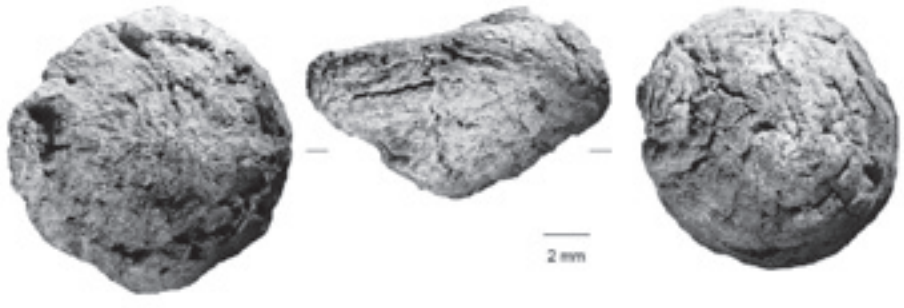
d'Errico explains that the rhizomes were not eaten raw on the spot, but brought to the cave to be cooked, and presumably shared with other members of the group who may have spent their day in other activities such as hunting. "In other words, eating rhizomes is not important in itself. What is important is the ability of some modern populations to transform food into a social act, to share it according to elaborate cultural rules that allow everybody to get a bit, thus creating more cohesion within the group", d'Errico explains.

Cooking the rhizomes also makes them easier to digest, maximizing the assimilation of nutrients. It provides carbohydrates that are, apart from the occasional collection of honey and fruits, otherwise quite difficult for a hunter-gatherer to find and integrate in their diet on a regular basis.

PART OF THE CULTURAL PUZZLE

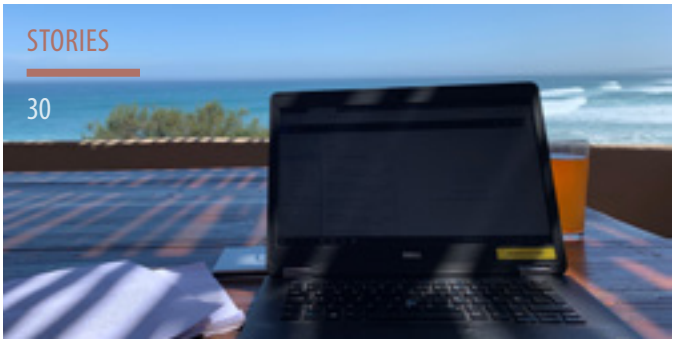
d'Errico says that this finding is relevant in the context of the work SapienCE is carrying out at other South African sites, such as Klasies River and Blombos Cave.

"Current scenarios regarding the emergence of our species in Africa predict a changing geography, with human population genetically and culturally connected at some times and isolated at others. When disconnected, these populations may have developed original cultural adaptations, and when connected they may have shared innovations. To reach a global understanding of the phenomenon we need to reconstruct and compare coeval cultural adaptations from different regions, and follow their evolution through time. Blombos Cave and Klasies River are, like Border Cave, key pieces of this puzzle".



Three views of the rhizome identified at Border Cave.

Reconstructing the diet of our ancestors and understanding how it changed through time are key goals of all archaeological research. Photo is showing a modern *Hypoxis augustifolia* fresh rhizome.



HOME OFFICES ALL OVER THE WORLD

2020 was the year when everyone worked from home. SapienCE researchers sat in different parts of the world, connected through Zoom or Microsoft Teams. Virtual meetings, seminars and lunches were chances to meet and get a glimpse into the homes of fellow team members. We learnt about our colleagues' different work contexts, from gardens and backyards to fully fitted offices, and could share photos of our own views. We are happy to share photos from home office settings – and maybe you can guess who the office belongs to? Take a look at the back cover for more home office photos!

RAMPENISSEN VISITS SAPIENCE

In December our Facebook and Twitter accounts were taken over by Rampenissen, the Norwegian version of Elf on the Shelf. He and his friends had real fun in the SapienCE offices while most people were working from home. They also took the time to visit researchers at home or at the University of Bergen. Keep an eye on our social media feeds to see updates on our research and occasional fun glimpses into life as a SapienCE researcher!

MEMBER OF THE NORWEGIAN ACADEMY OF SCIENCE AND LETTERS

The Norwegian Academy of Science and Letters has elected Professor Christopher Henshilwood, Director at the Center of Excellence in Early Sapiens Behaviour (SapienCE), as a new member.

"It is a great honour for me to be accepted by the Norwegian Academy of Science and Letters for my contribution to Norwegian academia. Norway has been my second home since 2002 and I am humbled to be accepted as a member of such an august institution." Henshilwood says.

The Norwegian Academy of Science and Letters is the national science academy of Norway. The Academy was founded in 1857 and is a non-governmental, nationwide body which embraces all fields of science. The main purpose is to support the advancement of science and scholarship in Norway. The Academy has approximately 900 Norwegian and foreign members. The elected members are highly respected academics in all fields of science, social science and humanities. To become a member is considered a great honour.

The Academy is, among other things, involved in scientific advice on policy. It also awards some of the most prestigious prizes in science, such as the Abel Prize in mathematics and the Kavli Prize in nanoscience, astrophysics and neuroscience.

Magnus Haaland recording exact position of samples with a total station in Blombos Cave.

TRACKING OUR EARLIEST HUMAN ANCESTORS

Blombos Cave is famous amongst archaeologists as the site where excavators have found the world's first art objects, the world's first drawing, the advanced use of pigments and some of the oldest items of jewellery known in the history of mankind.

PREHISTORIC SETTLEMENT

These relatively large, rare items capture the imagination, but Magnus Haaland and colleagues at SapienCE have shown that analysis of microscopic archaeological fragments can also be essential for obtaining a more comprehensive picture of the everyday at Blombos.

"Until recently, we've known very little about the camps people lived in 70,000 years ago. We have obtained knowledge about what they ate and what tools they made, but we've had few clues as to how they chose to organise their settlements or how they moved around in the landscape," says Haaland.

He argues that getting a better understanding of prehistoric settlement and occupation patterns is important because it tells us something fundamental about the daily routines – the lifeways – of early hunter-gatherers. Due to the new research methods that Haaland has helped to develop, we are now able to get one step closer to our distant ancestors in the Middle Stone Age.

BLOMBOS: Blombos Cave is located on the eastern coast of South Africa.
The cave is near the coastline and it has served as a settlement for people who lived 70,000 years ago.

LIFEWAYS IN THE SAND

"Geoarchaeological analyses of archaeological cultural layers involves using techniques that were originally developed in fields such as geology, sedimentology and geochemistry. In a cave like Blombos, where there are layers consisting of many different types of sediments, we must carefully extract samples from each of these layers and then try to explain them as best we can," says Haaland.

The aim of such analysis is first to identify the fragment and then find out where it originally came from and how it ended up in the cave. In practice this involves identifying, mapping and analysing fragments of a range of different materials, including bone, wood, ash, charcoal, pigments, plants, debitage after tool production and shellfish. This information can reveal everyday details of how people chose to organise their camp sites and what they did while they lived there. For example, if a part of the cave contains thousands of tiny fragments of shellfish, this can tell us something about what food the residents ate, how much they consumed and whether they cooked the shell.

A CULTURAL REVOLUTION 70,000 YEARS AGO

Research at Blombos Cave shows that the earliest residents of the cave, around 94,000 years ago, left behind very little evidence for complex cultural expression. By 70,000 years ago, however, people at the site made some of the earliest art and jewellery in the world. What happened to the people between these periods of occupation? How do a group of hunter-gatherers go from being completely uninterested in decorative items and artistic expression, to suddenly producing them in huge quantities? Something must have changed, but what?

Haaland's analysis of sediments from each time period shows that the hunter-gatherers who first used the cave stayed there for long periods of time before moving on. Conversely, by 70,000 years ago, visits were far more frequent but short-lived.

"It was when we made this simple but very important discovery that we asked ourselves: could there be any connection between mobility and complex cultural expression?" says Haaland.

SEDIMENT SAMPLES: Haaland extracting a sediment sample from the cultural layers in Blombos Cave (left). After a sediment sample has been processed it can be cut up and its contents can be studied in detail under a microscope (right).

SETTLEMENT ACTIVITY DURING THE STONE AGE – A SOURCE OF NEW KNOWLEDGE

During the Middle Stone Age, it is thought that the most important factor that determined how long a group of hunter-gatherers would live in one place was the amount of food available in their local environment. The more food available nearby, the longer the stay.

"Our sediment analyses shows that the earlier cave inhabitants lived there for long periods of time. They brought back more food and material to the cave, they made huge, long-lasting fires and they performed a range of different domestic activities at the site, before they moved on. In contrast the more recent occupants only visited for a few days or a week, making small fires, leaving considerably less material, and quickly moving on to their next campsite" says Haaland.

During the earliest stage of occupation, Blombos Cave was a coastal site, with good access to marine resources, such as fish, shellfish and seals. Ethnographic and archaeological research shows that coastal hunter-gatherers can settle for long periods of time on the same spot, because of the abundance and predictability of marine food sources. However, by 70,000 years ago sea-levels had dropped, moving the coast as much as 15 km away from the cave. With predictable marine resources further away, visits to the site became shorter but more frequent, suggesting that the inhabitants were more mobile than earlier populations.

SETTLEMENT PATTERNS AND MOBILITY STRATEGIES

The archaeological layers which contain the most complex cultural expressions were produced by these more mobile populations. It seems likely that the abstract symbols and jewellery served some type of social and communicative function.

"We know from contemporary traditional and Western societies that the use of decorative items and symbols is a highly efficient way of communicating who you are and what you stand for, both as an individual and as a group" says Haaland.

He believes that in a world where access to resources was reduced, the development of more efficient and complex ways of communicating may have been essential to survive. If the hunter-gatherers around Blombos became more mobile, then it is likely that their neighbours did too, making encounters between groups much more frequent. It may have become quite important to develop communication strategies designed to reduce conflict – and to encourage new forms of cooperation across different groups.
Haaland's hypothesis is that the first people who developed art and cultural objects in Blombos Cave did so because the need to cooperate with and relate to other people was becoming increasingly essential for surviving in a changing environment.
"However, we still need to search for more pieces of this jigsaw puzzle. There are many details that we don't fully understand, so our investigation will continue" says Magnus Haaland.

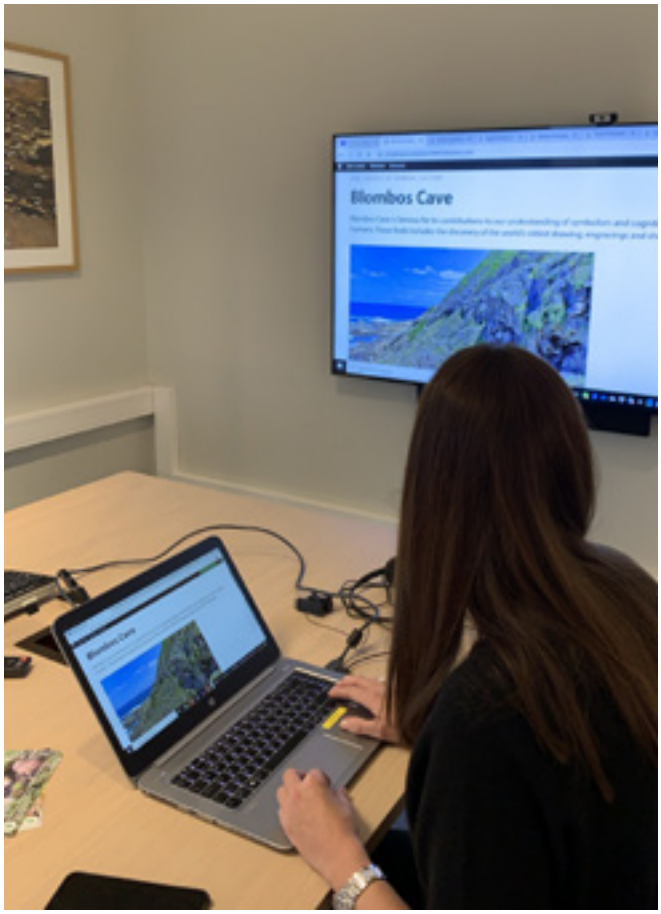
HYDROCLIMATIC AND VEGETATIONAL RECONSTRUCTIONS USING LEAF WAXES IN CAVE SEDIMENTS

The duration and multidisciplinary nature of SapienCE has given rise to a number of promising spin-off projects that were not envisaged when the centre was formed. One of these initiatives, called CAVEWAX, is led by SapienCE researcher Margit Simon. Within this project, a team of researchers aims to reconstruct hydroclimate using leaf waxes extracted from sediments within cave archaeological sites. Because these sediment samples come from the archaeological horizons themselves, the relationship between the archaeological and hydroclimatic records is clear, making it more straightforward to compare paleoclimatic changes with cultural changes. Moreover, limited information about terrestrial hydroclimate in the locations and timeframes studied by SapienCE is currently available, a gap in our knowledge which CAVEWAX will fill.

The rationale behind this project is that detailed analyses of the chemistry of leaf waxes found in cave sediment samples can be used to reconstruct various aspects of hydroclimate. For the year-round rainfall zone that Blombos Cave is situated in, the CAVEWAX-team will investigate the modern relationship between the hydrogen isotope composition of leaf waxes and moisture sources. Furthermore, the long-chain n-alkanes distribution and compound-specific stable carbon isotope composition of leaf wax in modern soil samples will be compared to vegetation types in the region. If these relationships can be established successfully, the variability of hydrological and environmental conditions, as well as vegetation shifts in the area immediately surrounding the cave, can be reconstructed. This approach allows a direct comparison of hydroclimatic shifts with behavioral innovations and faunal changes seen in the cave sequence.

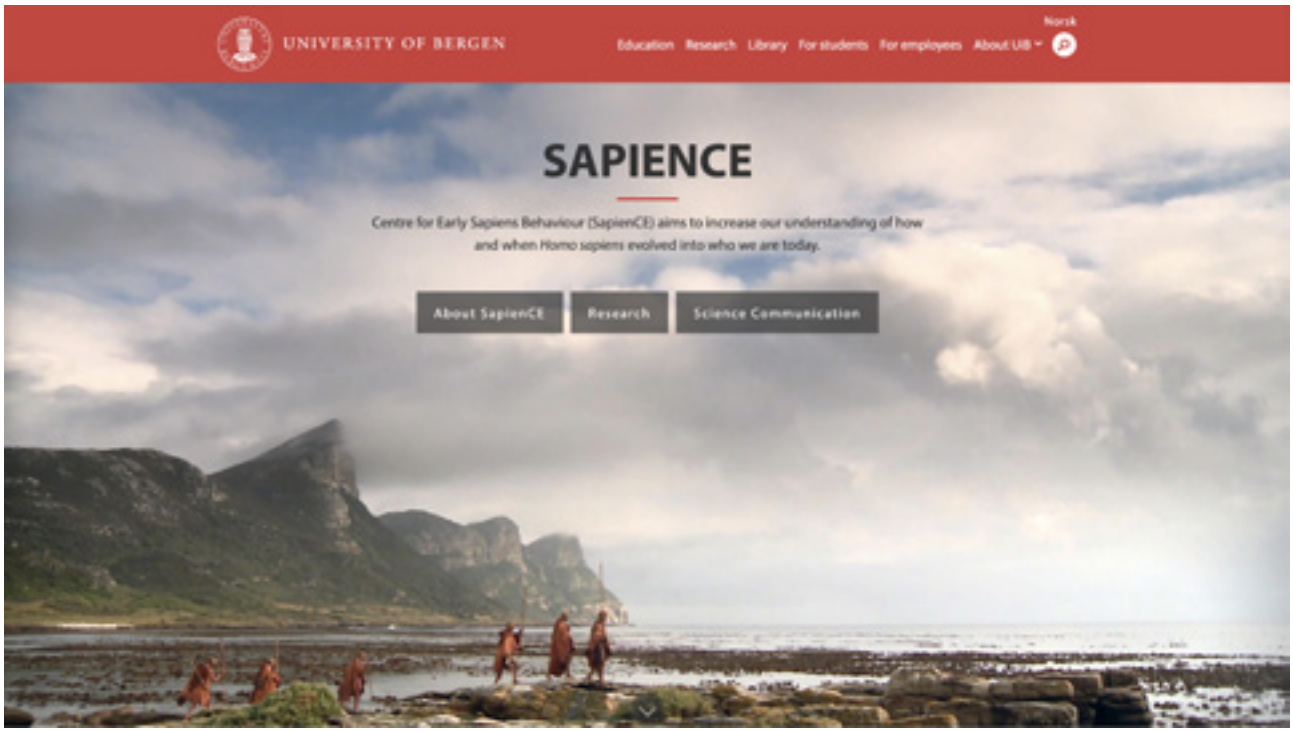
As part of a pilot study, the long-chain n-alkanes distribution and hydrogen isotopic composition of leaf waxes occurring in a few soil samples from the archeological sequence in Blombos cave have been analyzed. The results from these samples indicate that the proposed approach is promising. The pilot study data show changes in humidity throughout the sequence, which can potentially be linked to changes in wind direction and hence moisture source, over time. In 2021, funding for this project idea will be sought from the Research Council of Norway and the European Research Council.

OUTREACH



NEW WEB PAGES

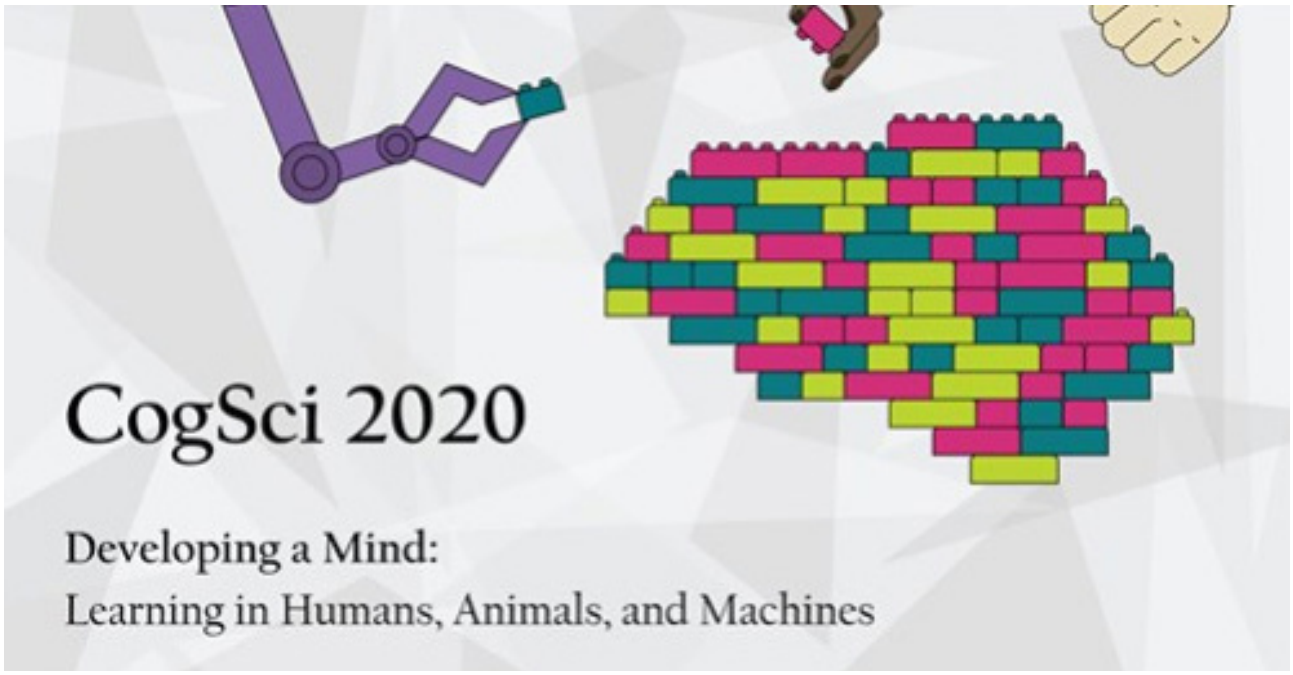
During late summer and autumn Janne-Beate Buanes Duke, communication adviser at SapienCE, led a project to develop new web pages for the centre. These pages aimed to explain the core fields of research investigated by centre members, and to explain our multidisciplinary research questions. The revamped web pages also highlight our researchers and their projects, improving the quality of our science communication and giving the public easier access to information about SapienCE. In addition, there is now a platform for showing the vast array of outreach activities and research output within SapienCE. The team, led by Buanes Duke assisted by Silje Evjenth Bentsen, Torunn Gjøringbø Saunes and Turid Hillestad Nel developed texts and content for the pages, aiming to showcase SapienCE research to the widest possible audience. Senior scientists, postdocs and PhDs at SapienCE also contributed specific information about their specialist areas of research. Please visit our pages at **uib.no/en/sapience**



OUTREACH IN JONGENSFONTEIN

The experimental field season in Jongensfontein was great both for data collection and for showing the public how a research team works. We set up a blog which was updated every day with short progress reports, shared photos and small movie clips. The blog is still available for those who want to read our diary from the field.

We spent much time talking to our neighbours at the campsite, discussing our work and explaining the long archaeological history of the region. Some neighbours only stayed for a day or two, but Bob and Jenny lived in a van next to the fires for almost three full weeks. These traveling pensioners visited us and kept track of the fire every day, and even featured us on their own blog!



CogSci 2020 SESSION REPORT

UNRAVELLING PAST COGNITION: APPROACHES ACROSS DISCIPLINES'

On July 30th 2020, postdoc Larissa Mendoza Straffon chaired an online symposium during the Annual Meeting of the Cognitive Science Society (CogSci 2020). Co-organized by SapienCE Principal Investigator, Andrea Bender, the session focused on the historical dimension of cognition from an interdisciplinary perspective. It brought together experienced scholars from different backgrounds with a common interest in human cognitive evolution. The session began with talks by Claudio Tennie (University of Tübingen, Germany), Dietrich Stout (Emory University, USA), Simon Greenhill (Max Planck Institute for the Science of Human History, Germany), and Francesco d'Errico (University of Bordeaux, France & SapienCE).

The fact that cognition changes over time and geography is often overlooked by narratives of human cognitive evolution, but is now being reassessed as fundamental for explaining the processes that have shaped the modern human mind. This in turn raises new questions, for example: Were such processes sudden or gradual? What factors spurred them? What role did culture play? The four talks and the panel discussion which followed them addressed some of these challenging issues head on.

While acknowledging that understanding past cognition is a necessarily inferential exercise reliant on present-day cognition, the speakers presented important contributions from comparative psychology, evolutionary neuroscience, cognitive linguistics, and cognitive archaeology, all of which advance this understanding through novel methods and evidence-based hypotheses. One of the themes that emerged as a key issue in the current state of the field was the processes of information transmission that lead to typically human cumulative culture, such as imitation, instruction, and verbal communication. The participants also agreed that future studies should account for human cultural and cognitive diversity throughout evolution.

PUBLIC TALKS IN SOUTH AFRICA

On the 5th of March 2020 SapienCE provided a morning of public talks in the coastal town of Still Bay, where we were the guests of the Hessequa Society of Archaeology. Still Bay is the nearest town to Blombos Cave, and local people feel a strong connection with the excavations there, making it an ideal location for the event. The first session, led by Prof. Christopher Henshilwood, aimed to keep local residents up to date on the ongoing research at Blombos. Dr Elizabeth Velliky presented her work on the use of symbols by ancient populations. Film maker Craig Foster closed the session discussing the Sea Change Project, ending with an impassioned plea to treat our oceans and their inhabitants better in the present-day. The second session was aimed at school-age learners who were bussed in from surrounding communities. Prof. Simon Armitage opened the session with an introduction to Middle Stone Age archaeology, after which two University of the Witwatersrand Masters candidates, Alexandra Pearson and Inèz Faul, presented their work. Alexandra explained how she became interested in studying animal bones, and then discussed what bones in archaeological sites tell us about the way our ancestors lived. Inèz explained how studying tiny marine organisms can help us to understand past environments and the influence that the environment had on human activity. There were 100 people attending the first session, while 170 attended the second session.

PINT OF SAPIENCE

– SCIENTIFIC OUTREACH THROUGH THE FIRST PINT OF SCIENCE FESTIVAL IN NORWAY

From September 7-9th, 2020, Norway hosted its first series of presentations as part of the Pint of Science (PoS) festival. PoS began in 2012 in the United Kingdom, and has since become a global science festival encouraging scientists to share their research with the public in their local pub, bar, café, or other public space. The goal is to foster science in a fun and lighthearted setting and encourage public interaction and scientific dissemination within the larger community. In 2019, PoS reached thousands of researchers across 400 cities in 24 different countries. Due to the Covid-19 pandemic, many of the events switched to a virtual format in 2020, which, though less than ideal, allowed talks to be watched live and recorded for the PoS YouTube channel.

Two post-doctoral researchers from SapienCE; Dr. Larissa Mendoza Straffon and Dr. Elizabeth Velliky, presented back-to-back as part of a session entitled "Anthropology & Life from Earth to Mars." Larissa began the session with her talk "The Prehistory of Art" where she explored the origins of art-making in our hominin lineage. During Larissa's talk, she argued against the perspective that art suddenly appeared around 30,000 years ago and showed that visual art practice in our species began much earlier than was previously believed. Much of the key evidence for Larissa's argument comes from Blombos Cave and Klipdrift Shelter, SapienCE archaeological sites, which have yielded some of the earliest evidence for visual artistic practices, such as numerous shell beads dating to 75,000 years ago and a 100,000-year-old "ochre toolkit". Elizabeth Velliky spoke next, giving a presentation entitled "The past isn't black & white: the role of colour in the story of humans" in which she discussed the function of colouring materials, and more specifically red ochre, in human cultural evolution. Thousands of collected and transported red ochre pieces have been found from Blombos Cave and Klipdrift Shelter. Elizabeth showed that studying these materials can illuminate past symbolic, cognitive, and artistic processes during periods of rapid cultural complexification. Both talks, as well as those from other PoS sessions, can be seen on YouTube (see QR code).

SapienCE LUNCH SEMINARS

07.05	Ane Landøy and University Library staff	How to make our research data openly available	University of Bergen
17.09	Hanneke Meijer	New horizons: Past, present and future palaeoanthropological research on Flores, Indonesia	Associate professor, University Museum of Bergen
23.09	Ellie Pryor	Provenance of Southern Cape Rivers	PhD candidate, Cardiff University
15.10	Karl Purcell	Reconstructions of southern South Africa hydro-climate during the last glacial cycle, and potential linkages to human behavioural development	PhD candidate, SapienCE, University of Bergen
21.10	Joshua Kumbani	The music archaeology of southern Africa	University of the Witwatersrand
12.11	Janne-Beate Buanes Duke	Launch of the new SapienCE website	Communication adviser, SapienCE, University of Bergen
19.11	Ozan Mert Göktürk	Local climate information in southern Africa 125-50 ka BP: Preliminary results	Postdoctoral researcher, SapienCE, University of Bergen
26.11	Kari Årrestad and Siri Jansen	Virtual tour of the museum and exhibition workshop	University Museum of Bergen
03.12	Siri Helena Halvorsen and Dorothy Denkel	How do you use social media strategically as a researcher? What channel and tone should you choose to reach your targeted audience?	University of Bergen
18.12	Silje Evjenth Bentsen	Christmas Lunch Quiz	SapienCE, University of Bergen

THE BRAIN POWER AWARD

"MOTHER AFRICA – WELCOME HOME" EXHIBITION

The Norwegian Association of Researchers (NAR) presents the Brain Power Award annually. The purpose of the award is to acknowledge the important role of NAR members in many research areas, as well as highlighting the contributions that research and development (R & D) work makes to society. By presenting the Brain Power Award, the NAP aims to establish a greater public understanding of the importance of investment in knowledge generation and R & D for the future.

The exhibition «The Origins of Early Sapiens Behaviour –'Mother Africa – Welcome Home'» housed at Iziko South African Museum in Cape Town, South Africa, was designed and installed by a team of researchers, curators, filmmakers and photographers from South Africa and Norway. SapienCE director Christopher Henshilwood and senior scientist Karen van Niekerk were part of this team. Although Henshilwood was awarded the prize, he emphasised that it was shared with the entire team, who spent three years creating the exhibition.

"Mother Africa" is the result of 30 years of excavations and research along the southern coast of South Africa. The core theme of the exhibition is the evolution of human modernity, with an emphasis on our equality as humans through our shared ancestry.

The NAR jury's review of the Mother Africa exhibition states, "The exhibition has contributed to an awareness and development of perspective on our common past, cultural origins, identity and heritage. This in turn can contribute to the knowledge of our common global identity and future. By going back 100,000 years in time, we can find fertile ground for the future, not dwelling in xenophobia, but in cooperation that stems from a common global humanity".

FORSKER FORBUNDET

SAPIENCE STAFF AND MANAGEMENT

SAPIENCE LEADER GROUP

Karen van Niekerk
Senior Researcher
PI

Carin Andersson Dahl
Research Professor
PI

Andrea Bender
Professor
PI

Simon Armitage
Professor
PI

Christopher Miller
Professor
Senior scientist

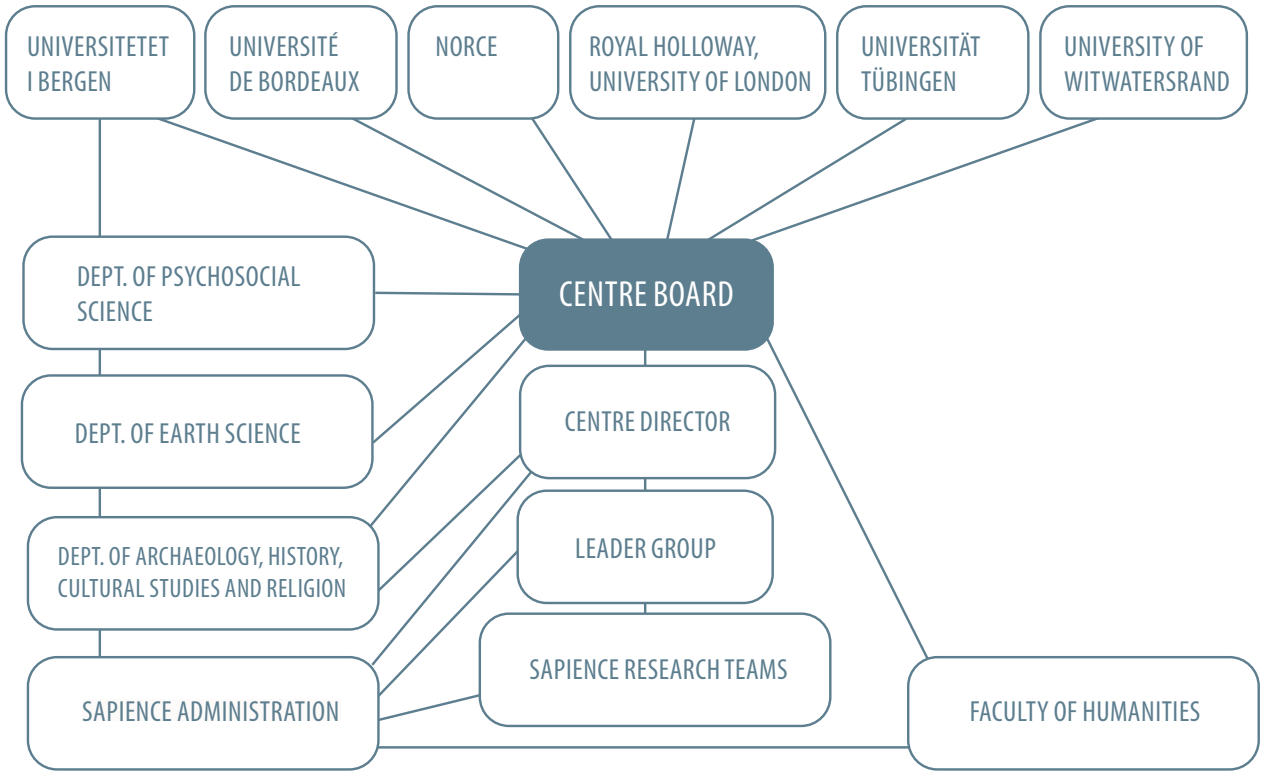
Eystein Jansen
Professor
Deputy Director, PI

Christopher Stuart Henshilwood
Professor
Director, PI

Francesco d'Errico
Professor
Senior scientist

Sarah Wurz
Professor
Senior scientist

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
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	NORCE Norwegian Research Centre
Zhongshi Zhang	Researcher	NORCE Norwegian Research Centre
Odd Helge Otterå	Researcher	NORCE Norwegian Research Centre
Stefan Pieter Sobolowski	Research Professor	NORCE Norwegian Research Centre
Dag Inge Blindheim	Researcher	NORCE Norwegian Research Centre
SapienCE Postdoctoral Research Fellows 2020		
Turid Hillestad Nel		Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
Magnus Mathisen Haaland		Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
Jenny Maccali		Department of Earth Science, University of Bergen
Silje Evjenth Bentsen		Department of Archaeology, History, Cultural Studies and Religion, University of Bergen
Ozan Mert Göktürk		Department of Earth Science, 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) 2020		
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

COLLABORATION WITH PONTUS SKOGLUND

The SapienCE initiative is a unique project to understand one of the most crucial periods of human origins from multiple perspectives. Our recent improved understanding of ancient DNA from the past 15,000 years in Africa, when integrated with information from present-day genomes, have shed new light on what we know and don't know about the origins of modern human ancestry. Further, these findings have highlighted the rich complexity of recent population history in Africa in a way that may guide understanding of more ancient prehistory. Integrating our understanding of genomic ancestry with the diverse expertise of the SapienCE network has been very beneficial, and we are hopeful that further unravelling of the Holocene and Terminal Pleistocene population landscape in southern Africa will further improve our interdisciplinary understanding.

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.

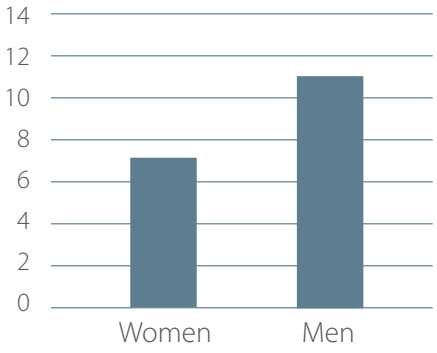
The guidelines state that SapienCE is led by a centre director responsible for all activity at the centre and who reports to the board. The centre has a leader group consisting of the centre director, vice director and research directors (PIs). The leader group shall participate in the preparations of 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 2020	
Silje Evjenth Bentsen	Administrative leader (from May 2020)
Turid Hillestad Nel	Temporary administrative leader (until May 2020)
Janne-Beate Buanes Duke	Adviser, Media and communication
Mari Knudsen	Adviser, Economy 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

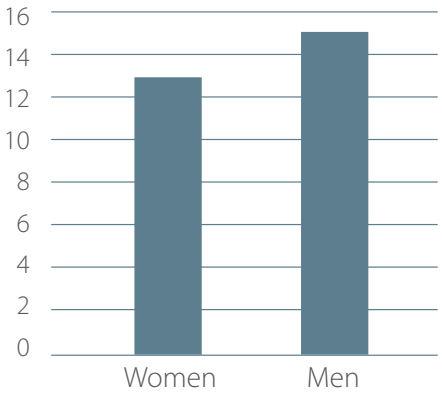
DISTRIBUTION OF GENDER IN SCIENTIFIC POSITIONS AT SAPIENCE

Senior scientific positions				
	Number of	% number of	FTEs*	% FTEs*
Women	7	39	2,75	45
Men	11	61	3,3	55
Total	18	100	6,6	100



All scientific positions (including early career researchers)				
	Number of	% number of	FTEs*	% FTEs*
Women	13	46	7,75	53
Men	15	54	6,9	47
Total	28	100	14,65	100

* Full time equivalents

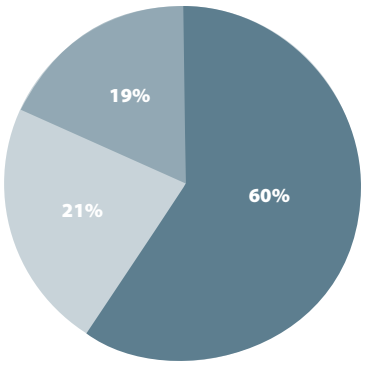


SAPIENCE FUNDING IN 2017-2020

In 2020, 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 2017-2020 is given below:

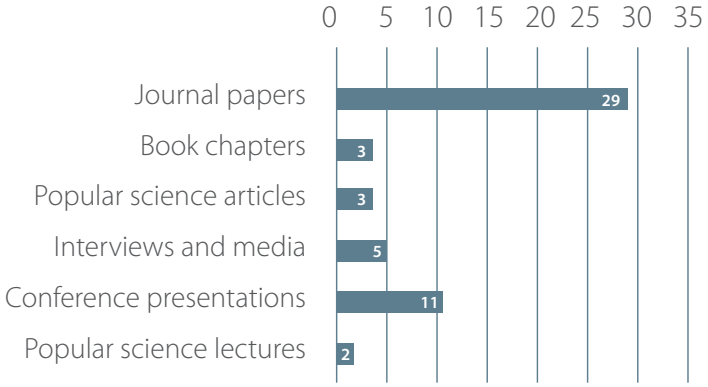
SapienCE Funds 2017-2020 (*1000 NOK)				
Source	**2017**	**2018**	**2019**	**2020**
Own financing (Host Institution)	1 630	7 640	9 450	12 567
Agreed in-kind plus additional estimated in kind (Partner Institutions)	248	1 275	1 109	662
RCN contribution	0	11 725	9 607	11 641
Additional project funds (University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

SCIENTIFIC AND ACADEMIC OUTPUTS



- Academic publications: **32**
- Academic presentations: **11**
- Popular scientific outputs/ outreach: **10**

SapienCE OUTPUTS 2020

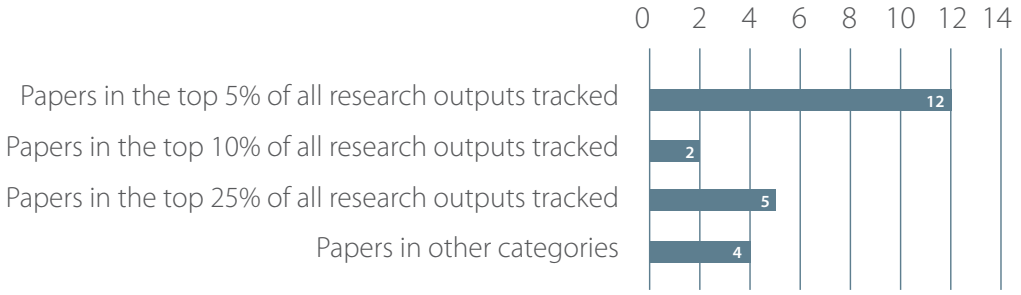


ALTMETRIC SCORES

Altmetric score is a measurement of mentions in social media. It only tracks published journal papers in selected journals. Altmetric compares research outputs and these are data on SapienCE publications from 2020:

Papers in the top 5% of all research outputs tracked	Papers in the top 10% of all research outputs tracked	Papers in the top 25% of all research outputs tracked	Papers in other categories	Total number of SapienCE papers tracked
12	2	5	4	23

SapienCE PAPERS 2020



SOCIAL MEDIA STATISTICS

	Total impressions/reach	Total posts	Average impression/reach	Top post seen by
Twitter	167 600	104	1611,5	20 481
Facebook	26 126	111	235,4	4400

SELECTED PUBLICATIONS 2020

Bender, A. The sense of obligation is culturally modulated. *Behavioral and Brain Sciences 43: 16-17.* http://dx.doi.org/10.1017/S0140525X19002371

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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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Carin Andersson Dahl
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Turid Hillestad Nel

DESIGN & LAYOUT:
Renate Paulsen

PHOTOS:
Andrea Bender: p. 30
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Lyn Wadley: p. 29

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Page 21: Illustrations from Henshilwood et al. 2018:
An abstract drawing from the 73,000-year-old levels at Blombos Cave, South Africa. *Nature* 562:115-118.
Page 22: Illustrations from d'Errico et al. 2018: From number sense to number symbols.
An archaeological perspective. Philosophical Transactions of *The Royal Society* B 373: 20160518
Page 29: Illustrations from Wadley et al. 2020: Cooked starchy rhizomes in Africa 170 thousand years ago.
Science 367: 87-91

COULD YOU GUESS THE HOME OFFICES?
Page 30:
Top: Karen van Niekerk (Blombos).
Middle: Francesco d'Errico (Bourdeaux).
Base: Andrea Bender (Bergen).

Back cover (Page 56):
Top row:
Left: Elizabeth Velliky (Frafjord).
Middle: Karen van Niekerk (Bergen).
Right: Stein Erik Lauritzen (Bergen):
Middle row:
Left: Francesco d'Errico (Bourdeaux).
Middle: Silje Evjenth Bentsen (Bergen).
Right: Christopher Henshilwood (Bergen).
Base row:
Left: Torill Lindstrøm (Bergen).
Middle: Karl Purcell (Canada).
Right: Silje Evjenth Bentsen (Bergen).

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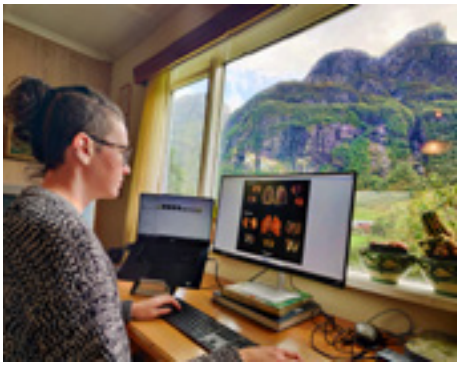




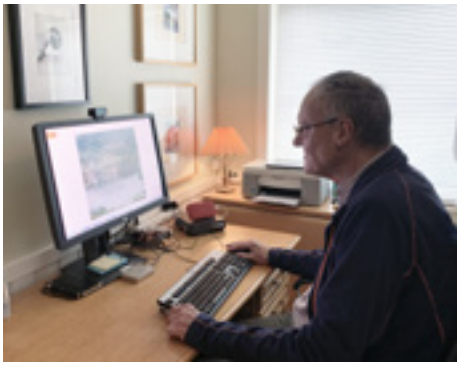
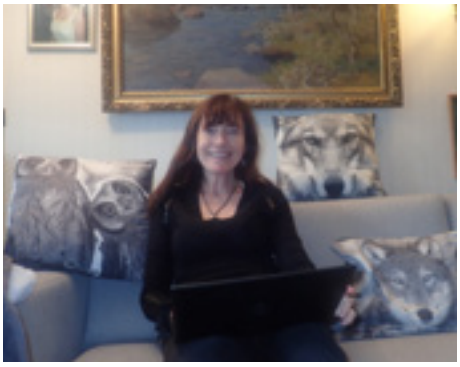

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