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THINK

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editorial

Disciplines

In an edition devoted to capturing the atmosphere of interdisciplinarity at Tal-Qroqq, it would be a shame not to first delve into where this term – discipline – comes from.

Our contemporary meaning has its roots firmly set in several Old French and Latin terms like: *discere* (to learn, acquire knowledge), *discipere* (to grasp intellectually, analyse thoroughly), *discipulus* (a follower or student), and *disciplina* (training or self-punishment for the sake of learning). And so, what emerges from these concepts and uses is the sense that acquiring knowledge requires labour.

This fact comes as no surprise to anyone who has ever dedicated a portion of their time to academia. And it is even more apparent at the tertiary education level and beyond when educating oneself has less to do with gaining fundamental life skills and is more about reflecting on the complexity of life itself and actively playing a role in growing it.

A strong element in taking up an education, or a discipline, also comes with the realisation that other life experiences, schools of thought, and branches of learning are needed to effectively address the multifaceted struggles that life throws at us.

In Issue 47, **THINK** has taken the opportunity to be the mouthpiece for a number of interdisciplinary projects homegrown at the University of Malta. You will need to flip the page to see what we have put together, but know that these projects are a testament to the dedication of their researchers and proof that earning a discipline is worth the time it takes.

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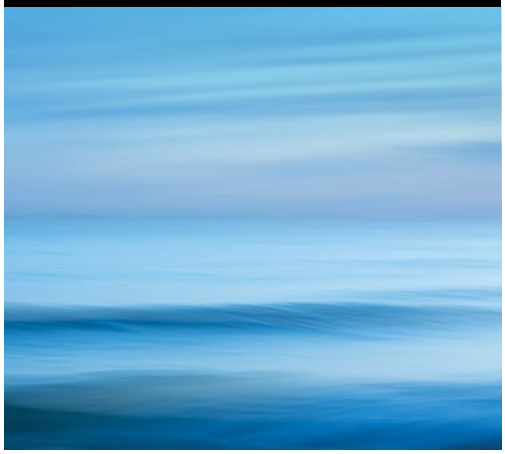
Disciplines



A blur of boundaries, a rhythm beneath the surface – this cover reflects the essence of disciplines: distinct yet interwoven, shifting over time while shaping how we understand the world.

focus articles

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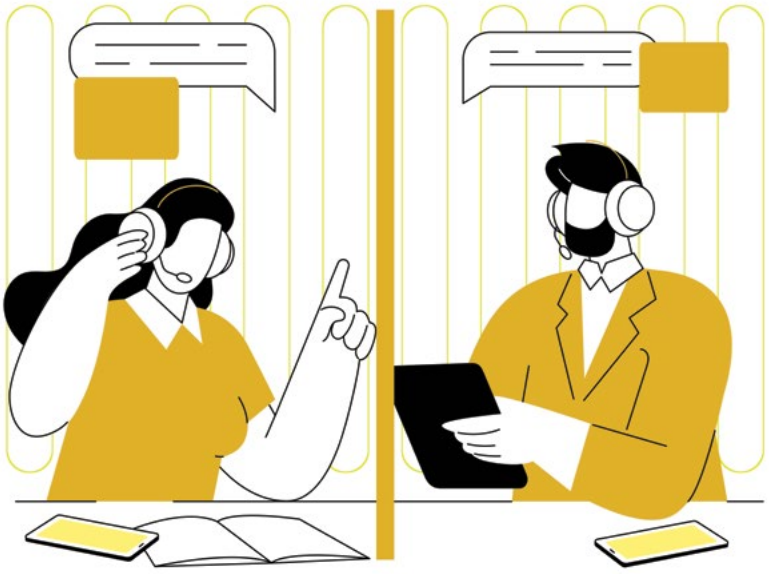
L-Università ta' Malta

Not Lost For Words: Interpreting in Action



Author: **Timothy Alden**

The University of Malta's Master in Interpreting Studies continues to grow, expanding its public outreach and student engagement. With new equipment installed at the Interpreters' Lab, ***Dr Amy Colman*** *speaks to* **THINK** *about the evolving field of interpreting.*

'Studying interpreting at UM already offered students the opportunity to pursue a career within key international institutions – notably the European Union,' explains Dr Amy Colman (Coordinator of the Interpreting Programme within UM's Department of Translation, Terminology and Interpreting Studies), whose warmth and enthusiasm make one feel immediately welcome at the Interpreters' Lab. However, the installation of new, state-of-the-art interpreting equipment offers prospective students a leap forward in what a degree in Interpreting Studies can offer.

THE INTERPRETER'S TOOLS

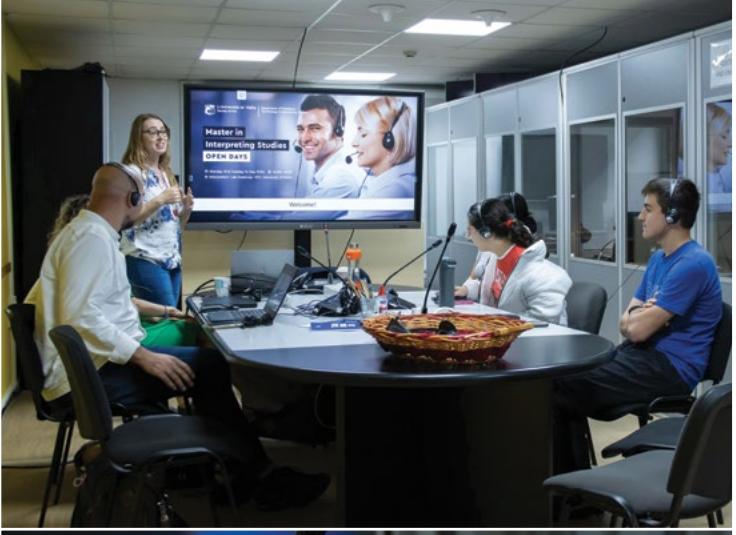
Colman explains that the two main modes of interpretation are simultaneous and consecutive. In consecutive interpretation, a speech is delivered, students take notes, and afterwards render it into the target language. Learning consecutive interpretation primes one to then learn the simultaneous technique. Simultaneous interpretation is carried out live using interpreting equipment. Both methods may be used in institutional conferences and events.

In the European institutions, interpretation is a team effort, with three interpreters sharing a booth, taking turns and helping one another – given that, cognitively, it is thought to be the most stressful job after air traffic control. The interpreters in the booth write down 'problem triggers', such as numbers and names, which can be easy to miss or forget. They also share live tools, such as computer-assisted interpreting tools that store glossaries.

The equipment utilised by interpreters, like that found in the Interpreters' Lab, includes interpreter desks, headsets, monitors, delegate desks, and receivers akin to remote controls paired with headphones. The audience can use these receivers to change channels and listen to their preferred language. Usually, conference interpreters work into their A language, which is their strongest language – but not necessarily their mother tongue. They can also work into their B language, which they will have mastered to a near-native level. C languages are passive languages: the interpreters understand them perfectly and can work from these languages into their A language. They never interpret into their C languages.

The language profiles in the European Union differ from one booth to the next, depending on the needs of each language unit. For the Maltese language unit, the current profiles are AB, where the interpreters work both from and into the A and B languages, and ACC, where the interpreters work solely into their A language – in this case, Maltese – from two passive languages. UM students are trained in accordance with the language profiles required by the Maltese language unit (currently AB or ACC).

Students are also trained in relay interpreting. Colman explains: 'One does not need to have an interpreter in the booth for each official language of the European Union –



A selection of shots showing students practising with the new equipment at the Interpreters' Lab in real-time

Photos by James Moffett

and, of course, you cannot possibly cover the 24 official languages in a single booth. So, if, for example, a Bulgarian delegate is speaking, and none of the Maltese interpreters can work directly from Bulgarian into Maltese, they need to tap into a booth where Bulgarian is interpreted into a pivot language – usually, but not necessarily, English. The speech is interpreted into English, and the Maltese interpreters then render it into Maltese. That is called relay interpreting.'

INTERPRETING IN PRACTICE

Students training in the booths either hear live mock speeches in the Lab or utilise videos from a database of speeches curated by the European Commission, which prepares them for the interinstitutional accreditation test. Colman explains that this year, the master programme was entirely redesigned and now even includes new study-units offering experiences such as mock debates, mimicking a real-life setting.

One of the first things a student learns in an interpreting booth is that the colours on the interpreter desk are inverted. Red does not mean that the interpreter is muted; it means that the microphone is on. Green, on the other hand, means that the microphone is off – a little counter-intuitive, perhaps. There is also a convenient mute button, which is preferred, as its usage filters out acoustic shocks caused by potential volume differences between the floor and the booth.

Following the upgrade of equipment at the Interpreters' Lab, four of the original desks have been relocated to the Aula Magna at the Valletta Campus. They now form part of a package of services offered on site and allow students to practise during events and conferences.

Moving forward, Colman is energised by the growth of interpreting at the University of Malta, as well as the resources and support it is receiving. The interpreting booths will soon host many more narratives, speeches, and stories, as they train students for a career at the heart of the European institutions.

The new interpreting equipment was installed at the Interpreters' Lab thanks to financial support from DG LINC, the Directorate-General for Logistics and Interpretation for Conferences of the European Parliament, and DG SCIC, the Directorate-General for Interpretation of the European Commission.

For more information about the Master in Interpreting Studies, or to book a visit to the Interpreters' Lab, do not hesitate to contact Dr Amy Colman at amy.colman@um.edu.mt.

From Barriers to Solutions in Sustainable Menstruation

Author: Izabella Apostolov

On any given day, over 300 million individuals worldwide menstruate and rely on menstrual products to collect or absorb their monthly fluid. The vast majority use disposable menstrual products. This widespread use of single-use menstrual products raises significant concerns: it contributes to environmental degradation and pollution due to their plastic content, poses potential health risks from exposure to harmful chemicals, and exacerbates period poverty because of the ongoing costs of these products.

Under the supervision of Prof. Elisabeth Conrad, my dissertation entitled *Investigating use of sustainable menstrual products among university students in Malta* explored students' attitudes and behaviours towards reusable menstrual products. Recognised for its relevance to consumers, practical applicability, and assessment of impacts on Maltese consumers, this study was awarded the Consumers' Association Malta Outstanding Dissertation Award.

In this dissertation, key barriers to the adoption of reusable menstrual products were identified, and insights and potential solutions to help address them were provided. A sequential mixed-methods approach combined a survey of 386 university students with qualitative data from focus groups. This methodology offered a comprehensive understanding of the factors influencing menstruators' purchasing decisions and the barriers to adopting reusable menstrual products.

THE BARRIERS TO ADOPTING REUSABLE MENSTRUAL PRODUCTS

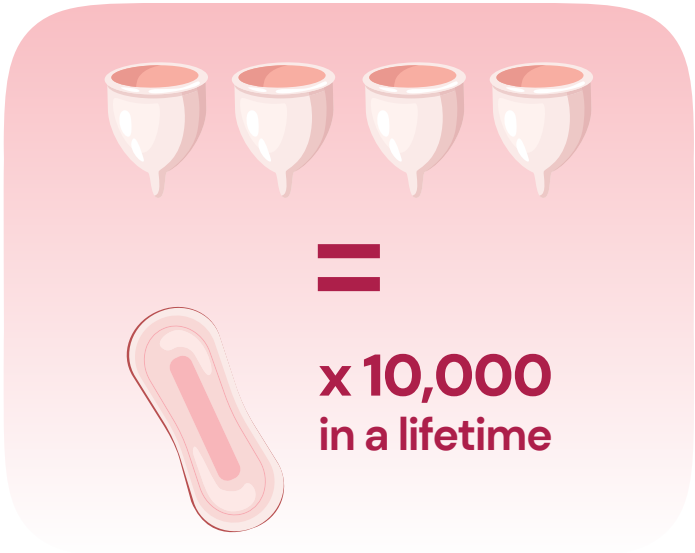
Disposable menstrual products – specifically sanitary pads and tampons – were the most commonly used among survey participants, with comfort, convenience, and habit cited as the top reasons for their use. No significant evidence of period poverty was found or linked to using inexpensive, single-use products. However, despite increasing global interest in sustainability trends, the use of reusable menstrual products remained low. Focus group discussions revealed that menstrual product choices, including reusable

Izabella Apostolov
Photo by James Moffett

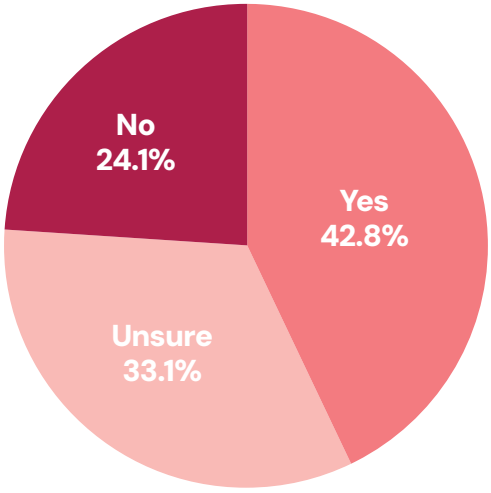
options, were strongly influenced by peers and family members.

Four significant hurdles were revealed:

1. **The survey results identified a lack of education and awareness** as the primary barrier to adopting reusable menstrual products. Many students were unfamiliar with how to use, clean, and maintain reusable products, particularly menstrual cups and menstrual discs. Focus group discussions highlighted the influential role of social media and interpersonal relationships in increasing awareness, while educational systems provided little



Over their lifespan, four menstrual cups can replace approximately 10,000 single-use pads, underscoring the environmental and economic advantages of adopting reusable menstrual products.



The survey participants' willingness to consider a shift towards reusable menstrual products.

to no information. Tackling this gap in awareness is crucial in increasing uptake. Educational institutions should improve their curricula to include information on sustainable menstrual options, rather than focusing solely on disposable options.

2. **Inadequate restroom facilities and social stigma** hinder the uptake of reusable menstrual products. Participants emphasised the absence of private washing areas in university restrooms, noting that using shared sinks made washing reusable products uncomfortable. These findings underline the need to improve restroom facilities to normalise sustainable menstruation practices.
3. **Limited product availability and a lack of advertisement** further hinder the adoption of reusable menstrual products. Focus group participants mentioned that grocery stores, where one usually finds sanitary pads and tampons, should also sell sustainable alternatives. Furthermore, both survey and focus group participants noted the need for increased advertising to make reusable products more mainstream and to raise awareness of sustainable options.
4. Lastly, almost half of the survey participants (42.7%) expressed a **willingness to consider switching to reusable menstrual products**, with a further 32.9% indicating uncertainty. Willingness is likely to increase if the aforementioned barriers are addressed. Therefore, through education, improved restroom facilities, and increased product availability and accessibility, sustainable menstruation can become normalised, benefiting both individuals and the environment.

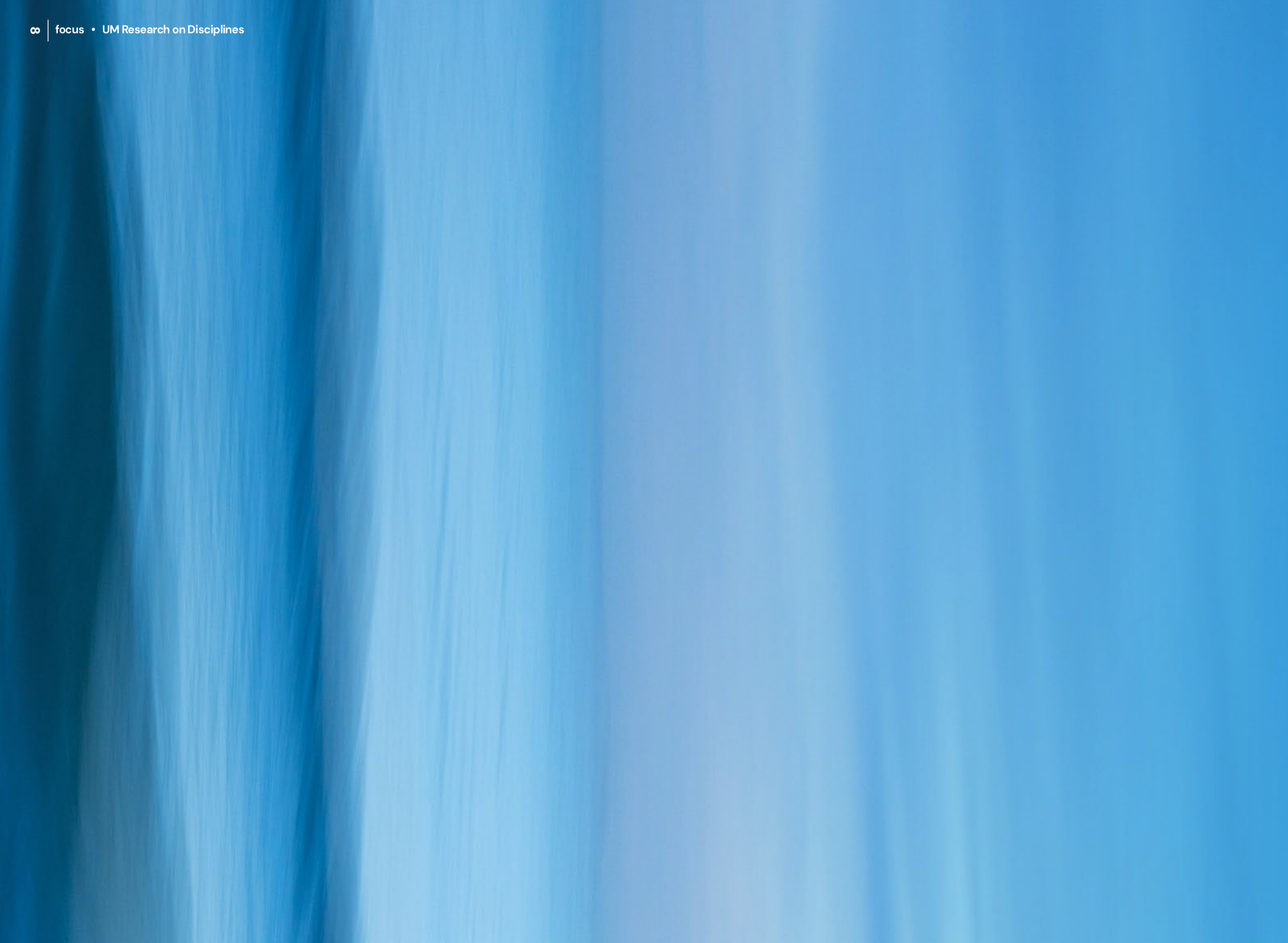
Ultimately, identifying these barriers is crucial to understanding the dynamics behind purchasing decisions and developing effective strategies to increase the adoption of sustainable menstrual products. Future research should focus on the attitudes and behaviours of menstruators under the age of 18 to evaluate if they face different barriers to trying reusable menstrual products, and to assess the extent of their awareness and education on these products. An experimental study could subsequently test whether increased education leads to higher adoption rates.

APPLICATIONS AND SOCIETAL VALUE

This research holds significant societal value and the potential to make a meaningful impact by providing practical recommendations to increase the adoption of sustainable menstruation practices. The findings can help inform and guide policymakers in developing initiatives that promote sustainable menstrual practices by addressing some of the barriers that menstruators face. Additionally, tackling these barriers can reduce environmental harm, minimise health risks, and alleviate monthly financial burdens.

Further Reading

Apostolov, I. (2024). *Investigating use of sustainable menstrual products among university students in Malta* [Bachelor's dissertation, University of Malta]. https://www.um.edu.mt/library/oar/handle/123456789/127346



Disciplines

When schools of thought or branches of learning intersect, the result always reflects the unique synergy of the individuals involved and the ideas and solutions at play. In Issue 47, **THINK** explores UM-led research that holds the essence of versatility in combining concepts and skillsets – starting with swimming and ending with the sea.

To start, let us show you how ephemeral bubbles are captured from the sea and translated onto the page. Next, a team of inventors and collaborators will guide you through the biological and technical aspects of designing tomorrow's hip replacement technology. Staying with the body, on Earth or in space, a new strategy has been developed for detecting radiation damage to the human body. Then, have a chocolate break as you learn how translation can return value to lost works of historical significance. And finally, dive back into the water, this time to discover a sea of knowledge to arm against the wave of crises at our shores.

Capturing the Unseen: The Art of Swimming and Drawing

Author: **Christian Keszthelyi**

Dr Trevor Borg *doesn't just swim in the sea – he draws in it. The Maltese artist, water polo player, and frequent swimmer has transformed his relationship with water into a unique artistic practice, using his movements to create ephemeral underwater marks. His art explores the intersection of land and sea, past and present, permanence and impermanence – an artistic practice as fluid as the waters that inspire it.*

Disclaimer: *The author is biased towards water. He has played water polo for over two decades, moved to Malta to be near the sea, and plays on the same water polo team as the interviewee of this article.*

Dr Trevor Borg grew up by the sea and lived on the coast for years. Later, he moved to inland Malta, and though no place on the tiny island is far from the shore, he still felt the distance. It affected him more than he expected. Returning to dwell by the sea helped him reconnect with his past – and inner muse. He swims daily, and as a casual water polo player, has a profound connection with the sea. 'The water is therapeutic, offering calm, openness, and space. Island life can feel confining, but the sea provides a sense of freedom,' Borg says.

His work has been place-oriented for the past 10 to 15 years, shaped by specific locations. Using anthropologist Tim Ingold's diction, Borg describes his art as being about 'dwelling'. It is not just living in or spending time somewhere, but deeply engaging with a place. His work is rooted in place, and his surroundings naturally influence his art.

FLUID SHIFTS

Walking also plays a crucial role in his creative process, allowing Borg to absorb a place's characteristics, think more clearly, and connect with his surroundings. So, it is unsurprising that his artistic vision gets sparked by walking. The muscles in the calves – often called the second heart or the venous pump – play a crucial role in circulation. When humans walk or pace, these muscles contract, helping push blood back up to the heart. People often pace when they are thinking, anxious, or restless, and this movement can help maintain blood flow, provide a mild energy boost, and even stimulate brain activity.

Now that Borg is back by the sea, he often replaces walking with swimming. 'Instead of moving across land, my movement is guided by the water. I wanted to explore this shift, so I experimented with translating my walking methodologies to the sea. I attached a submersible action camera to my limbs and began recording my underwater movements,' Borg says.

He quickly noticed an ephemeral trace left behind with every movement – disturbances in the water that are much less visible on land. Recording underwater opened up a hidden world of textures, currents, and details that would usually remain unseen. His swimming has evolved into exploring movement, memory, and the unseen aspects of land and sea.

In fact, Borg describes water as both a medium and a canvas. But what does that mean? 'Water functions much like the surface of paper. It allows for mark-making, but in a fluid, impermanent way. When you move your arms or legs underwater, you create air bubbles that form temporary traces. Being lighter than water, these bubbles immediately start rising, creating a fleeting mark that even generates sound. In a way, this process is akin to drawing in water,' Borg says.

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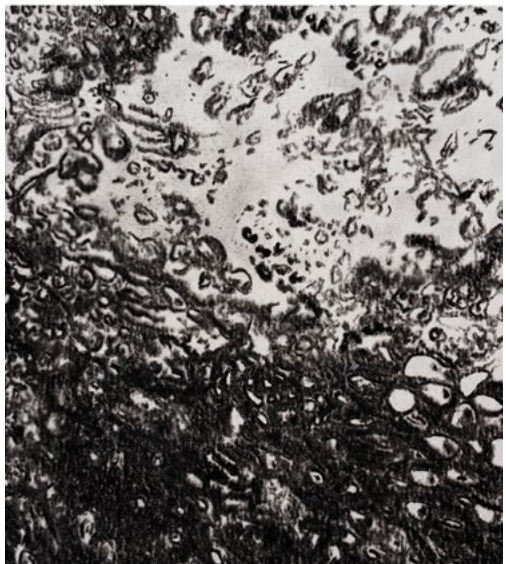


2

1. **Drawing underwater: A trail of air bubbles captured by an action camera**
2. **Two charcoal drawings based on digital images captured underwater**

Images courtesy of Dr Trevor Borg

At first, his approach was unconscious – just an observation of the traces left behind. However, by experimenting with controlled movements over time, he began to see how specific patterns or marks could be generated. This evolved into an intentional practice of underwater drawing.

'What's fascinating is that, in this setting, the body becomes part of the drawing. In traditional drawing on paper, you create a mark from a distance, but in water, you are both the creator and an integral part of the work. It's almost like a performance – a deeply immersive and multidimensional form of drawing,' Borg says.

CHARCOAL TRANSLATIONS

The process itself is layered: first, there is the experience of movement in the water; then, capturing it digitally; reviewing and selecting meaningful frames; and finally, translating that into drawing. Charcoal serves as a bridge between these stages, maintaining a sense of immediacy and physicality – much like the movement of the sea itself.

Why charcoal? 'Charcoal is an incredibly immediate and primitive medium; it connects to something raw, organic, and essential in mark-making. Historically, it was created from desiccated willow twigs, originally left to dry naturally, but now processed in kilns to speed up production. This gives it a natural, almost elemental quality, similar to clay. It is soft, responsive, and does not require much pressure to leave a mark – making it ideal for capturing fluid, gestural movements, such as the trails of bubbles underwater,' Borg says.

His choice of charcoal was initially experimental, but it proved ideal for capturing water's ephemeral qualities. Your columnist could not help but notice how charcoal may be the perfect conduit for translating water onto paper. Life on Earth began in the sea, and all life is carbon-based – so with charcoal being a form of carbon, this was almost a poetic choice. It is a material that carries the cyclical essence of creation and return, mirroring how the ocean is both a beginning and an end.

Another intriguing aspect of water is that it always takes the shape of its container – unless it hovers in an anti-gravity environment where it naturally forms a sphere. This occurs because surface tension pulls the molecules into the smallest possible surface area – a sphere or a bubble. Water's ability to adapt and assume any shape is remarkable. This adaptability gives water a paradoxical nature: it is formless, yet it can fit into any form; it is fluid, yet it can exert immense force.

Beyond the visual joy of underwater scenery recorded on paper by charcoal, sound is another crucial element of submerged environments – one that charcoal alone cannot convey. Bubbles create a distinct auditory experience that Borg ponders to incorporate into future installations. With today's technology – such as ASMR microphones, which are used to capture gentle sounds that elicit a tingling sensation in listeners – it would be possible to record and play back the actual sounds of the underwater drawing process. This could enhance the immersive experience, allowing viewers to see and hear the artwork being created.

CREATIVE CONTRAST

As quick AI-generated content reshapes our world (and keeps academics thinking, see page 60), drawing remains a slow, manual process. Does this contrast enhance the value of hand-drawn work in an era saturated with AI visuals?

'One of the key distinctions is that AI-generated images often prioritise the outcome – the final product – whereas drawing is about the process. Prompting an AI tool gives you a quasi-instantaneous result, but you do not fully witness the steps it took to get there. You only see the output, not the experience,' Borg says.

Creating, on the other hand, is thinking. It is evaluating, refining and engaging deeply with the subject. It is about the journey, and not the destination.

'For example, when I create my underwater drawings, I have to physically immerse myself in the sea, experience the movement of water around me, and observe the bubbles and patterns they create. That phenomenological experience – feeling the water, sensing the resistance, understanding the refractions of light – is something unique,' Borg concludes. T

MaltaHip Project: What's Next?

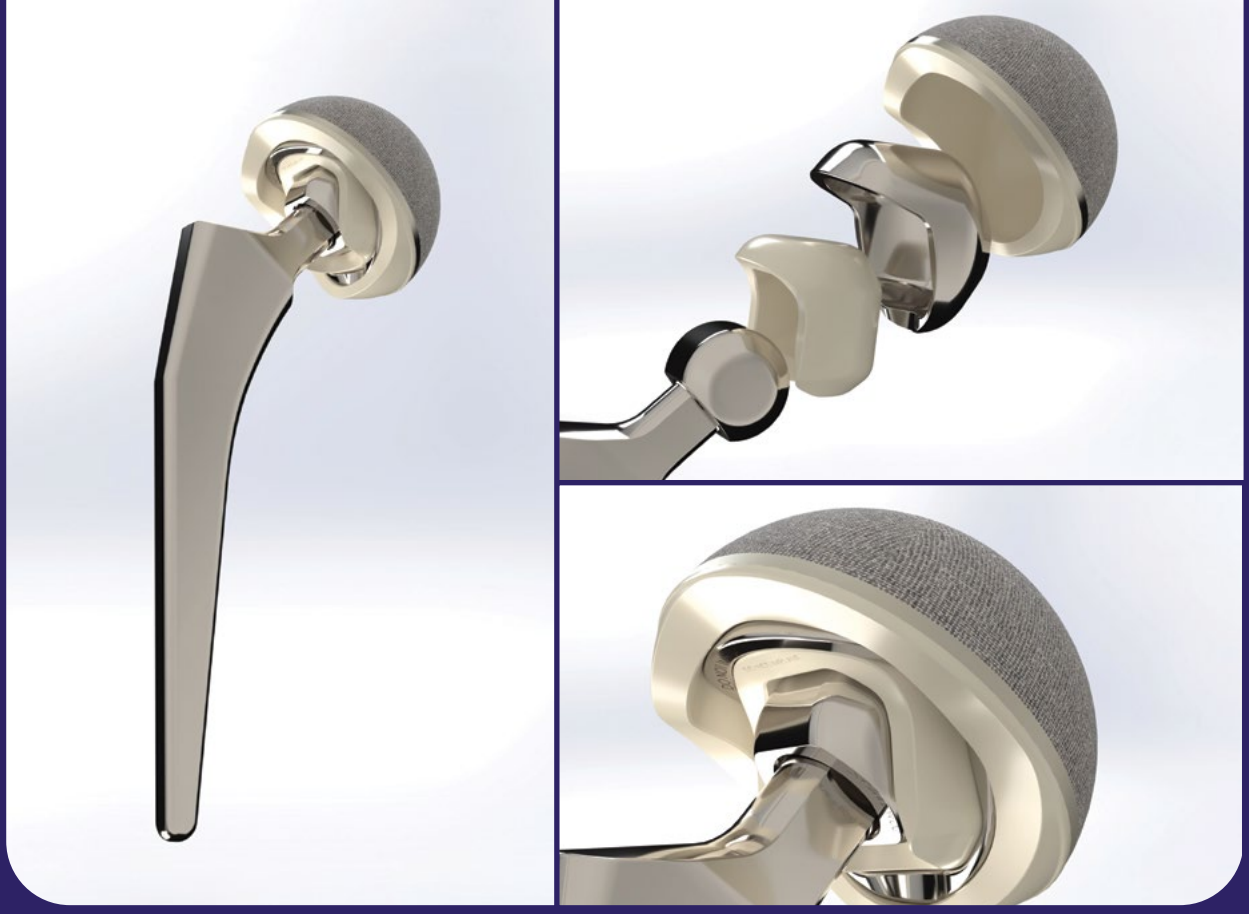
Author: **Inês Ventura**

*When the **MaltaHip** project was first introduced, it marked a rethinking of hip replacement. Now, with successful early testing, new international partnerships, and a growing pipeline of funding, that leap is well on its way to becoming a globally significant reality.*

From its inception, the MaltaHip project aimed to address some of the persistent challenges associated with traditional hip implants in the ever-evolving field of medical devices. Requiring an interdisciplinary approach, the project brought together Prof. Pierre Schembri-Wismayer (Department of Anatomy); Prof. Ing. Pierluigi Mollicone (Department of Mechanical Engineering); and Prof. Ing. Joseph Buhagiar, Dr Ing. Donald Dalli, Dr Leonardo Fanton, and Prof. Ing. Bertram Mallia (Department of Metallurgy and Materials Engineering). This multifaceted team from the University of Malta, now collaborating with Garland Surgical Ltd – a UK-based start-up company – is working towards a solution for the millions suffering from joint-related issues worldwide.

FROM LAB TO REAL-WORLD READINESS

Research is the backbone of innovative technology development. However, without guidance on the criteria that must be met, it is hard for researchers and entrepreneurs to know the optimal moment to bring their ideas and products to market. Technology readiness levels (TRLs) – a ranking system originally developed by NASA – was designed to do just that. The TRL system assists in evaluating and managing



Photorealistic renderings of the prosthetic hip joint
Images courtesy of the MaltaHip Team

the progression of new technologies from concept to deployment. It ranges from level 1 (basic research) to level 9 (fully proven technology in real-world use), and has specific criteria required at each stage to advance to the next.

For MaltaHip, the journey has progressed from TRL 3–4 (university prototype testing) to TRL 6 (refined prototype successfully tested in cadaveric implantation). Reaching even TRL 3 was no easy feat, explains Buhagiar, one of the MaltaHip inventors. The researchers had to design and build a custom machine that replicates all the movements of the hip joint while applying a variable load to simulate body weight. These initial wear-simulation tests were performed to 'see if the sizing was correct, if the parts were moving correctly, and to identify any obvious problems,' says Buhagiar. 'As everything was functional, we could proceed to the next step.'

Once it was clear that the proof-of-concept was viable, the UM research team – with the assistance of EMPAV Engineering Ltd, a Maltese manufacturing engineering workshop – produced additional prototype prostheses that met all the functional criteria for a hip replacement. This prototype was then sent to EndoLab® in Germany, a facility specialising in biomechanical testing. There, MaltaHip surpassed expectations. Following simulations mimicking millions of gait cycles (the cyclic pattern of movement that occurs while walking), the device exhibited significantly less wear than traditional commercial hip implants. In fact, in some cases, the wear was too minimal to measure. This result alone demonstrated that the prosthesis could handle high loads without degradation, while also suggesting longer-lasting use – a factor that could redefine standards in orthopaedic care. At this time, MaltaHip was no longer just an innovative concept.

What are the next steps?

'We incorporated Garland Surgical Ltd to further develop what was a promising proof-of-concept project into a commercially viable hip replacement system. We raised initial funding of around €1.5 million to further develop the implant design into a device that would suit a global population – addressing the three key limitations of the existing available implants: namely, reduction of wear, stability, and range of motion,' explains Simon Mifsud, CEO of Garland Surgical Ltd.

'Now that we've completed the initial verification of the latest prototype, we are raising more funds to complete product development. This will allow us to complete something called the design history file – organised documentation of all the product design

The Garland Team, supported by their Clinical Advisors, Board Members, NLC Health Ventures, and Engineering Consultants at the MaltaHip Revision System Cadaveric Testing Lab (West Midlands Surgical Training Centre, Coventry)

Photo courtesy of the Garland Team

and development processes – and then begin the regulatory clearance needed to sell it worldwide.'

A SMARTER DESIGN, PROVEN BY SCIENCE

What explains the exceptional wear resistance at the heart of MaltaHip's novel design? A considerable difference from all of the traditional hip replacements, which simulate the ball-and-socket nature of the human joint, lies in 'the molecular behaviour of the used polymeric materials in the prosthetics,' says Schembri-Wismayer. Unlike current implants on the market, the unidirectional curvilinear articulations of the MaltaHip allow the molecular chains in the polymer components to align in a single direction under pressure. This alignment reduces a common phenomenon known as 'cross-shear' and significantly improves resistance to degradation.

During the initial cadaveric implantation performed by orthopaedic surgeons, the device's excellent mobility was also confirmed – their impression being jovially relayed by Schembri-Wismayer as 'even allowing the "patient" to do yoga (another proof of its range of motion)'. These real-world assessments are key to demonstrating that the device can support not only routine activities, but also higher mobility demands, such as sports or physically active lifestyles.'

SERVING A GLOBAL POPULATION

Manufacturers develop a full range of implant sizes to accommodate anatomical differences across gender and ethnicity – MaltaHip is no exception. However, the company's commitment to inclusive design goes far beyond size alone. 'Traditional implants last for a maximum of 25 years if they're placed well and use the current state of the art, which is based on a regular ball-and-socket replication of the natural hip,' states Mifsud. 'But those hip replacements have been developed in the same basic format for 120 years, and their longevity has only increased by 10 to 15 years – thanks to improvements in surgical technique and surgical approach, as well as advances in material technology.'

'This is a major concern when it comes to younger patients,' he adds. 'They don't have much choice now. They will either bear discomfort, chronic pain, and restricted mobility, or undergo surgery knowing that traditional implants may last only 20 to 25 years – meaning multiple revision surgeries over the course of their lifetime.' However, even for those who choose to undergo a hip replacement, there remains a risk of dislocating the new joint, especially within the first 12 months post-operation. This can impact not only their activity levels, but also their overall health.

'Due to its design, the MaltaHip prosthetic cannot be dislocated easily. That means the patient is able to perform daily activities like tying a shoelace, sitting cross-legged, or swinging their affected leg out of bed without dislocating their hip after surgery. These are things we all take for granted. They will also be able to pursue their interests, whether that's playing tennis, practising yoga or

The MaltaHip Team

Top: Prof. Ing. Joseph Buhagiar (Project Leader), Prof. Pierre Schembri-Wismayer (Main Inventor) and Prof. Ing. Pierluigi Mollicone (Inventor)

Bottom: Dr Ing. Donald Dalli (Inventor), Prof. Ing. Bertram Mallia (Collaborator) and Dr Leonardo Fanton (Research Support Officer IV)

surfing; they can feel confident in their implant,' Mifsud points out. By offering greater longevity and a lower risk of failure, MaltaHip provides a viable option for younger patients who want to reclaim their mobility and quality of life early – without sacrificing long-term outcomes.

The Team also highlighted a final point about the device's long-term value. Culturally, certain ethnicities require a larger range of motion than others – for example, some Asian and Middle Eastern populations sit cross-legged or in a squatting position to socialise or pray. With a standard hip replacement, this can be risky. 'With our device, we believe they will be able to do that. This device has been designed to suit a global population, addressing a lot of the current health inequalities in hip replacements,' Mifsud notes.

STRATEGIC INVESTMENT IN MALTA

Beyond medical innovation, MaltaHip is becoming a symbol of successful technology transfer and international collaboration. Garland Surgical Ltd has recently opened a subsidiary in Malta, establishing operations at the Malta Life Sciences Park and securing grant support from Malta Enterprise. This includes R&D funding, business development incentives, and hiring local engineering talent, including Dalli – one of the original MaltaHip inventors.

These investments are not just a win for the project; they represent a vote of confidence in Malta's growing biotech and medtech sectors. With UM retaining shares in the company and serving as an R&D partner, the MaltaHip project is also a textbook case of how academia and industry can work hand-in-hand to build globally competitive products.

While much has been achieved, there is still a long road ahead. Garland Surgical Ltd is currently raising a £3.5 million seed round to complete its design history file – the cornerstone document required for medical regulatory approval. Following that, the company will begin rigorous production-level testing on multiple implant sizes and prepare for regulatory submissions to meet the criteria for TRL 7.

MaltaHip is not just an invention – it is a reinvention of what orthopaedic medicine can achieve. With its roots firmly planted in research from the University of Malta and its branches reaching into global markets, it offers a rare fusion of innovation, inclusivity, and impact. As Garland Surgical Ltd advances clinical and commercial development, the MaltaHip project may well become one of the island's most remarkable contributions to global health.

Scan the QR code to read more about the MaltaHip Project

A New Hope Against the Invisible Threat of Space Radiation

Author: **Sofia Dias**

Space exploration missions face numerous challenges. However, cosmic radiation – which damages human cells and causes mutations in DNA – is one of the biggest problems that scientists are striving to address. How are they approaching it? **THINK** *talks to researchers from the* ***DeepAFQ*** *project, whose work will help in understanding the impact of radiation on human health and to developing strategies that protect both astronauts in space, and patients undergoing radiation-based treatments on Earth.*

Imagine you are an astronaut in space, on a mission to explore new parts of our solar system. The idea sounds exciting, doesn't it? But what challenges would you face during the mission?

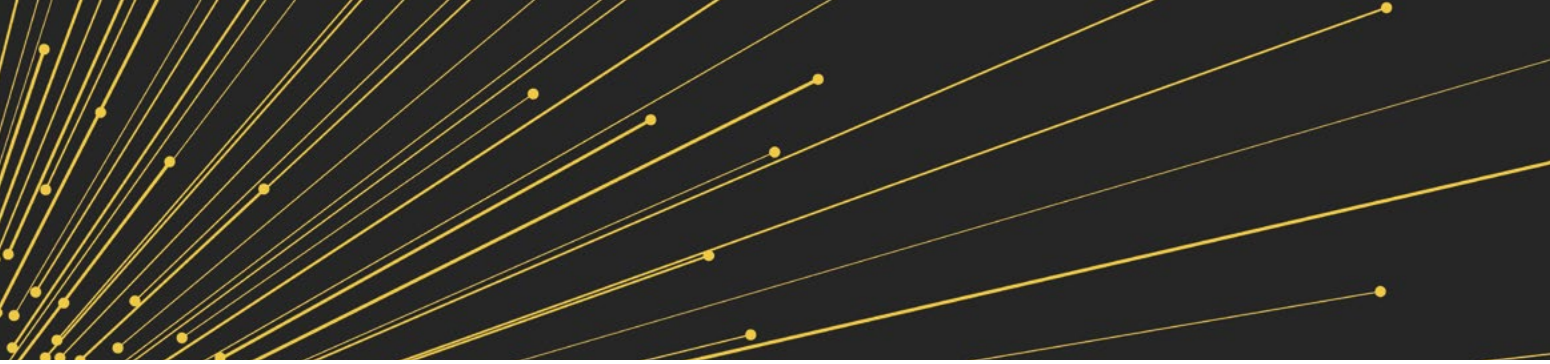
One of the biggest challenges for long-term space missions is radiation exposure, which poses a serious risk to all living cells and threatens the health of astronauts. When radiation penetrates the body, it can damage our DNA (the molecule that carries the genetic information in our cells) by causing lesions that may lead to mutations. These mutations can disrupt normal cell function and, in some cases, trigger cancer, making radiation a serious threat. Therefore, research into the effects of radiation on our DNA is not only important for those venturing beyond our planet's atmosphere, but also has vital implications for medicine and healthcare here on Earth.

The DeepAFQ (Deep learning for Automatic Foci Quantification) project, an international collaboration between researchers from the University of Malta and NASA Ames Research Center, aims to revolutionise how scientists detect and analyse radiation-induced DNA damage. By using artificial intelligence (AI) techniques, the project automates the identification of DNA lesions in cells, making it easier and faster to quantify radiation-induced damage. This is a crucial step in understanding the extent of cellular harm and evaluating protective measures or treatments. But why are astronauts exposed to the risk of radiation damage in the first place?

When we look up at the sky, we don't see them, but Earth's atmosphere and magnetic field protect us from dangerous particles, such as cosmic rays and solar storms. In space, astronauts are exposed to these particles, which can penetrate their cells, alter their DNA, and increase the risk of cancer and other diseases, including cardiovascular problems. Understanding how cells respond to radiation is crucial for developing protective measures for astronauts, whether on the International Space Station (ISS) or on future missions.

DEEPAFQ: AUTOMATING THE ANALYSIS OF DNA DAMAGE

To study radiation damage at the cellular level, scientists rely on specialised imaging techniques to capture irradiated cells – microscopic



images of cells that have been exposed to radiation. These cell images reveal DNA lesions as darker areas where the cell's genetic material has been damaged. These darker areas appear because the DNA in these regions has been altered due to radiation exposure, highlighting the spots where the cell's DNA is most affected. Although identifying and quantifying these lesions is essential, the analysis of those images is still carried out manually, making it both time-consuming and prone to human error. This is where AI comes in.

The DeepAFQ project is developing a state-of-the-art AI algorithm that can automatically identify DNA damage in images of irradiated cells. Its main innovation is automating the identification of DNA damage based on cell images. However, since these darker areas, called foci, can vary in shape, size and intensity, they are difficult to detect with simple image-processing tools. By using machine learning, DeepAFQ can quickly analyse large datasets, providing a more consistent and efficient alternative to manual counting methods. To advance this, postdoctoral researcher Dr Saeed Ullah (Department of Communications and Computer Engineering) uses deep learning models trained on thousands of images with identified foci to detect these patterns with high accuracy. This allows researchers to process and analyse the data much faster than ever before.

According to Prof. Ing. Gianluca Valentino (Department of Communications and Computer Engineering), the project's principal investigator, 'The main challenge of the project has been the availability of ground truth data (the previously existing, manually labelled images) to serve as reference points for training AI models.' To overcome this, the team developed algorithms to generate synthetic datasets that mimic real images of irradiated cells. By training the AI on both real and synthetic data, 'we were able to get very good results; the model is doing a good job,' adds Valentino.

AUTONOMOUS LABORATORIES: THE FUTURE OF DEEP SPACE MISSIONS

One of the long-term applications of DeepAFQ is its potential contribution to the development of self-sufficient research platforms that can operate with minimal human intervention – so-called autonomous laboratories. These systems could be installed on space stations or deep space missions to continuously monitor how biological samples respond to radiation and other environmental factors.

Maltese researchers have already made progress in this area. The space programmes Maleth I, II, and III – led by Prof. Joseph Borg (Department of Applied Biomedical Science) – sent biological samples into space to evaluate the effect of radiation on human tissue, such as by monitoring the growth of bacterial cultures. In future space missions, these biological samples could also be sourced from astronauts themselves, helping to assess the direct impact of radiation exposure during long-term space missions.

'Autonomous laboratories will have to be present on future missions – especially long-term missions, for instance, to Mars and other planets – as astronauts will be exposed to much higher levels of radiation,' says Valentino. Automating some laboratory analyses would free astronauts from time-consuming manual tasks, allowing them to focus on mission-critical activities. These laboratories could analyse biological samples in real time and send the data back to Earth for further study.

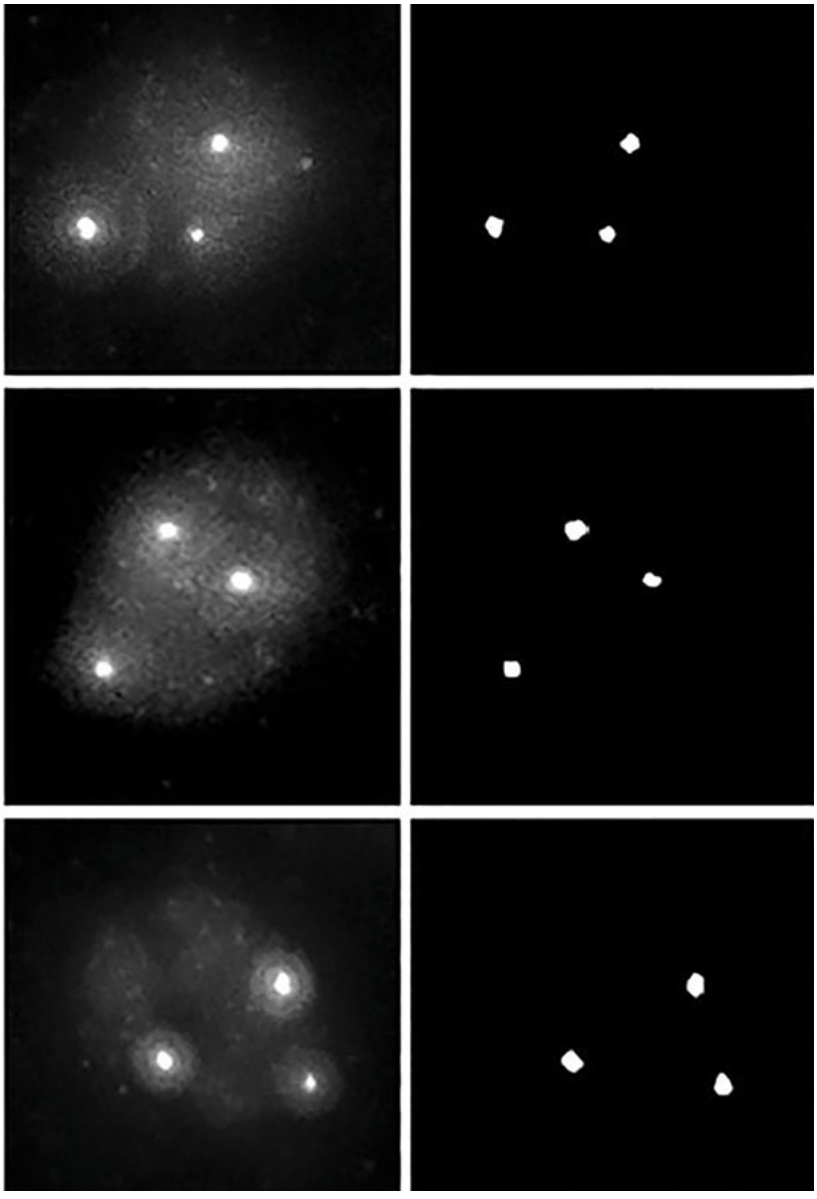
A WIDE RANGE OF COLLABORATIONS AND IMPACTS

The DeepAFQ project forms part of a broader collaboration involving the NASA Ames Research Center. Known for its expertise in life and space biosciences, NASA Ames has played a key role in developing methods to study the effects of radiation on biological systems. DeepAFQ researchers are members of an international, multidisciplinary working group called the Artificial Intelligence and Machine Learning Analysis Working Group (AI-ML AWG), which applies its expertise to addressing problems posed by space exploration.

Beyond space exploration, DeepAFQ has significant implications for medicine. Dr Anu Rasalam Iris (Department of Applied Biomedical Sciences) notes, 'Radiotherapy, a common method of cancer treatment, works by targeting and damaging tumour cells. However, accurate assessment of DNA damage is essential to optimise treatment plans and minimise harm to healthy cells.' Dr Josef Borg (Department of Applied Biomedical Sciences), who is developing the synthetic dataset, adds, 'The whole

point of creating such models is to be able to apply them to different datasets.'

Whether the damage is caused by space radiation, medical radiation or other sources, the underlying biological processes remain similar. This means that DeepAFQ has the potential to be used in a range of research and clinical settings, making it a valuable tool beyond the space sector.



Examples of three irradiated cellular nuclei images (left), with their corresponding masks (right) for foci detected by the deep learning model
Images courtesy of the DeepAFQ Team

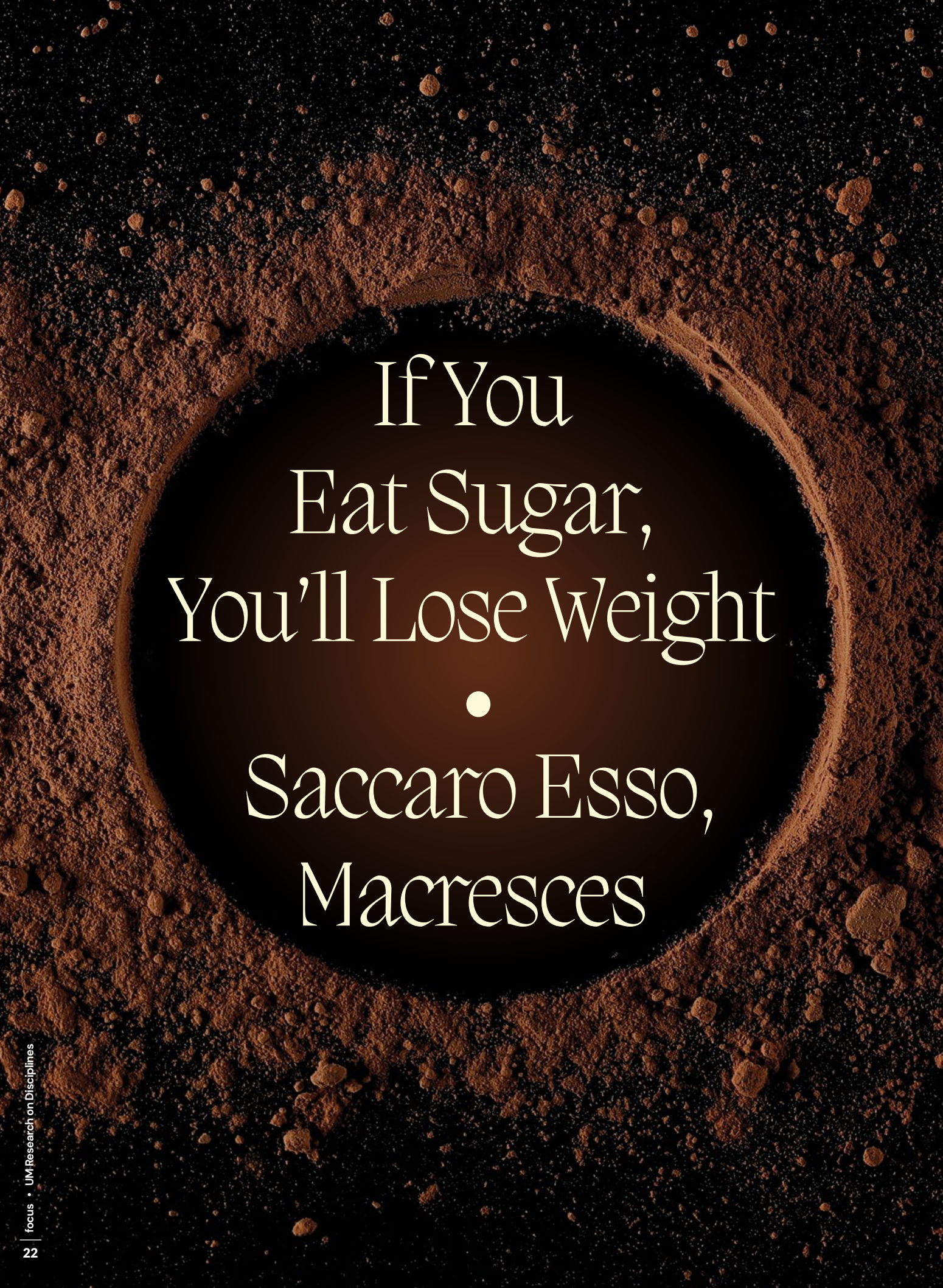
WHAT'S NEXT FOR DEEPAFQ?

As the project enters its final stage, the team is also trying to extend the applicability of its AI model. By refining its algorithms, DeepAFQ aims to create a flexible tool that can adapt to different research needs. 'The applicability of the tool to other datasets should be a reality. In the future, when we have access to different datasets, I think we will be able to prove that,' says Dr Borg.

'This is very recent, but we are getting interest from local scientists working in radiography and radiology – so-called nuclear medicine,' co-investigator Prof. Borg continues. 'With DeepAFQ, we are one step closer to having the tools available to quantify the DNA damage caused by radiation treatments.'

By creating a link between space science and medical research applications, the project is encouraging new collaborations that could improve healthcare outcomes. In future, the DeepAFQ model could be used in hospitals to help radiologists and oncologists analyse cellular responses to radiotherapy with greater precision.

The future of human space exploration depends on our ability to manage and mitigate health risks – and DeepAFQ provides a critical piece of the puzzle. At the same time, its innovations have the potential to transform radiation medicine, proving that space exploration is not just about venturing into the cosmos – it is also about improving life here on Earth. 'The project is not developing a very exclusive tool. It can be used for everything else!' emphasises Prof. Borg.


If You
Eat Sugar,
You'll Lose Weight
•
Saccaro Esso,
Macresces

Author: **Noah Galea**

It's easy to see how chocolate relates to one's health, but what does chocolate have to do with religion? How could an innocent little snack be viewed as the source by which one's spirituality is called into question? To this question, ***Dr Giuseppe Demarco*** *may have an answer.*

If you eat sugar, you'll lose weight. No, really. Or at least that's what people believed to be true during the time of the gifted Maltese doctor, Giuseppe Demarco. This is just one interesting insight from his chocolate-centric work, *Dissertatio de Cocholata*. Originally written in Latin to appeal to the upper classes of Demarco's time, the work has now been painstakingly translated into English by Dr Jurgen R. Gatt. In doing so, Gatt has opened a portal through which we may peer into the concerns of Maltese intellectuals during the Enlightenment.

GIUSEPPE DEMARCO – MALTESE MAN OF MEDICINE | MEDICUS MELITENSIS

Cospicua-born Giuseppe Demarco is a man adorned with impressive intellectual feats. Remembered as both a prolific writer and a professional doctor, he also assumed the role of chemist and philosopher. This begs the question: why is Demarco, unlike contemporaries such as Michelangelo Grima, not as well-known in the history of Maltese medicine?

The answer may lie in the dated nature of his works. For instance, many of the findings Demarco researched and committed to paper in his *Dissertatio* have since been debunked by modern medical knowledge. The main flaw in his treatise actually stems from the scientific methodology of the time. Ideas were often developed from first principles – meaning they were assumed to be true without first being tested through observable evidence. As Gatt notes, 'Modern medicine does it the opposite way – going from the particular to the general,' thereby ensuring that scientific knowledge is grounded in evidence rather than abstract assumptions.

Left: Medical Sciences in Early Modern Malta: Giuseppe Demarco on the use and abuse of chocolate in Medicine (1760), edited by Dr Jurgen R. Gatt
Photo by Krista Bonnici

Right: Book launch and discussion at last year's book festival
Photo by Luke Zerafa / National Book Council

This is not to say that Demarco lacked credibility or capability as a doctor. Having graduated from our very own University of Malta, and obtaining his medical licence from Montpellier, Gatt believes that 'Demarco's title as a doctor would still hold weight even today'. Furthermore, certain points made in his *Dissertatio* still remain relevant. For instance, Demarco advocates for temperance in one's diet, attributing to it such remarkable benefits as 'security to the senses, vigour to memory and clarity to one's intellect'. Even with regard to chocolate, a little self-control never hurts.

He also rightly noted that chocolate may be used in the treatment of extreme cases of phthisis. When the body is consumed by tuberculosis, a calorie-rich chocolate drink may aid in sustaining a patient. That said, none of these points exempt chocolate from the generally negative reputation it has garnered in relation to health. For the most part, Demarco acknowledged that chocolate could do more harm than good – an observation that remains true today, especially when consumed in excess.

SPIRITUALITY, MEDICINE | RELIGIO ET MEDICINA

Spirituality. Medicine. Today, many would consider these two domains unrelated – and perhaps best kept that way. This, in part, explains why Gatt observes that 'there is a noticeable disjunct between what Demarco expresses within the *Dissertatio* and what current doctors may think'. Although this work is explicitly scientific in nature and intended for scientific and medical applications, Gatt notes that 'Demarco seems to concern himself a great deal with the spirituality surrounding chocolate and its consumption'.

For instance, one question Demarco raises is whether eating chocolate breaks the Catholic fast. Any contemporary reader might assume that such a question should be answered by a priest rather than a doctor. While this judgement is not necessarily incorrect, it is arguably short-sighted in its scope. Gatt points out that this blending of medicine and religion is not simply a matter of interdisciplinarity; rather, during Demarco's time, the two were not divided into distinct disciplines to begin with.

Even so, asking whether Demarco was wrong to incorporate spirituality into his work may not even be the right thing to ask. When we think of Demarco, we think of Malta – he stands as a symbol of the early Maltese intellectuals. With this in mind, a more fitting question might be if spirituality still has a place in medicine today, and what the Maltese people think with regard to this.

The Maltese, like all people, feel for their own and for others. We possess an inherent sense of empathy that

prevents us from viewing any one patient as just a problem to be solved. This is, in essence, what any good doctor – as well as Demarco – would want. As Gatt remarks, 'We ought to look beyond the biomedical aspect of viewing the patient as a body and nothing more'. A patient is a human being with a voice. To recognise the soul is to acknowledge spirituality. In this sense, medicine and spirituality are inherently linked – and perhaps the Maltese have always understood this intuitively. In fact, at the heart of Mater Dei lies a chapel – a deliberate architectural choice designed to foster a sense of community through a village-like layout.

BEYOND THE *DISSERTATIO* | ULTRA DISSERTATIONEM

The primary source itself is a trove of insight – made more accessible thanks to Gatt's translation. Nonetheless, the publication goes beyond a simple rendering from Latin into English. Various additional authors have attributed their own critical input to pad the text with information that presents itself as undeniably rigorous.

Among them, Skye Vassallo, who wrote her undergraduate dissertation on Demarco, interestingly builds upon the translatorly dimension of Gatt's work, remarking on Demarco's own experience as a translator. Additionally, Prof. Carmel Cassar explores chocolate's dual role in early modern Malta – as both a medicinal product and a leisure drink. These contributions, along with further insights from Prof. Charles Savona Ventura, Prof. William Zammit, Dr Giovanni Bonello, and Maria Giuliana Fenech, form part of this extensively well-researched text.

Published in 2024 by the Malta University Press, the book is available for purchase via the Press's webstore. This first edition is tastefully bound in a chocolate-hued cover and is a worthy addition to any reader's Melitensia, science, or history collection.

As for the translator himself, Gatt is currently considering another of Demarco's works: a 30-year diary documenting the various weather patterns observed in Malta between the 1750s and 1780s.

If you are curious to learn more about Giuseppe Demarco's observations during the Enlightenment, scan the QR code.

A Platform in a Sea of Knowledge

Author: **Sarah Schembri**

*The **University Maritime Platform** is an initiative that blends all maritime-related research and teaching at the University of Malta to serve industry and society.*

The conventional Western approach to research, with subjects carefully categorised and kept separate, struggles to keep pace with the increasingly interconnected modern world that we inhabit. We face global problems with synergistic and cascading effects. What happens in the natural environment affects society and our industry, prompting policy responses that, in turn, generate their own repercussions. It is becoming increasingly crucial that academics continue to move towards a more interdisciplinary approach to research.

The ocean clearly demonstrates the need for diverse disciplines to work in tandem. Even a simple act such as going out to sea requires individuals with different skills and expertise to be, quite literally, on the same boat. A project such as the recently proposed breakwater at St Elmo Point involves the technical input of engineers and oceanographers to determine how best to mitigate wave impact, but also necessitates the contributions of marine biologists, heritage experts, and marine traffic controllers. Only through effective collaboration – where parties understand each other's concerns and limitations – can large-scale infrastructural projects strike an optimal balance between operational efficacy, longevity, cost, and impacts on the natural environment and cultural heritage.

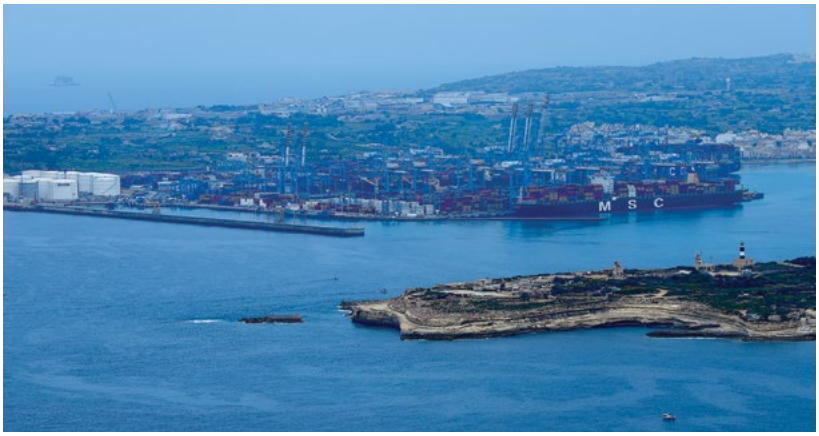
Prof. Ing. Claire De Marco, founding chair of the University Maritime Platform (UMP) in 2017, says that the platform aims to serve as a link between the University of Malta (UM), the maritime industry, and other stakeholders. The UMP also provides a collaborative space for both UM and international academics with various specialisations connected to the maritime sector. 'The mission of the University Maritime Platform is to facilitate and promote the collaboration and networking capacity of the University of Malta with the world,' says Prof. Adriana Vella, the current chair. 'The UMP is like the trunk of a living tree with many branches growing from it, ramifying and intersecting – the platform holds all the branches together.'

Numerous issues in the Mediterranean demand attention, from large-scale projects like offshore wind farms to discussions about the

region's increasingly crowded coastline. The UMP provides a forum for such discussions, ensuring that focus is directed where it is most needed.

WHAT ARE THE MARITIME ISSUES?

In conversation with some of the UMP committee members, several maritime issues were foregrounded. One such issue is maritime transport – Dr Thérèse Bajada's area of expertise and a central theme of the European Ocean Pact, which is expected to be adopted by the European Commission. The maritime transportation industry is a major emitter of greenhouse gases, yet the global economy remains heavily reliant on it. The UMP actively participates in ongoing discussions aimed at reducing the industry's environmental impact, adapting to climate change, and addressing abuse in the supply chain. This is done with a continued focus on improving health and safety standards, reducing exploitation in employment, and making inclusive practices the norm. Other pressing questions related to the shipping industry include: What should be the standard for ship recycling? How can international governance be transparent? And how can we reduce bribery?



Aerial photo of Delimara Point
Photo by Prof. Adriana Vella

Another issue is that offshore wind farms require extensive planning, including how the turbines are recycled at the end of their lifetime. The impacts of noise, damage to the seabed, and the effect on the fisheries industry also need to be taken into account. Are environmental impact assessment reports sufficient to reflect the full implications of offshore wind farms? Conversations facilitated by the UMP can help answer such questions.

MEMBERSHIP IN THE UMP

With UM forming part of the SEA-EU alliance, the European University of the Seas, the UMP is the ideal contact point for anything related to the marine sector, as over 60 UMP members come from UM departments and faculties that are active within this international alliance. UM academics with expertise in maritime-related areas can join the UMP alongside those already involved. Membership in the UMP is voluntary, as is the work done within it. The UMP committee comprises 12 members who volunteer their time in addition to their regular duties.

However, the work of the UMP goes beyond financial compensation. Apart from supporting the University and research in general, the interviewed UMP members believe that being part of the Platform also offers personal benefits. Prof. Vella states, 'The University Maritime Platform gives me the opportunity to extend and expand the capabilities that I have developed over the years.' Dr Ritienne Gauci, vice-chair and outreach contributor for the UMP action group, asserts that some of her most significant professional successes as a geographer originated from cross-sectoral collaborations with geomorphologists, geologists, and coastal heritage professionals.

Aerial photo of Filfla
Photo by Prof. Adriana Vella

THE UNIVERSITY'S MARITIME CAPABILITIES IN ONE PLACE

One of the convenient things that the committee has done is to create a comprehensive list of all marine and maritime-related study units

Front (left to right): Ing. Elisa Vella, Prof. Luciano Mule' Stagno, Prof. Adriana Vella (Chair), Dr Ritienne Gauci (Deputy Chair), Prof. Patricia Vella de Fremeaux. Back (left to right): Ms Ruth Zammit, Ms Elda Belja, Prof. Ing. Simon Fabri (Pro-Rector), Prof. Robert N. Farrugia, Dr Thérèse Bajada, Ms Angie Mifsud. Other active UMP committee members include: Prof. Michael Briguglio, Prof. Matthew Montebello, Prof. Norman Martinez (from IMLI), Ms Miriam Camilleri (from MMF).
Photo courtesy of the UMP Committee

offered at UM. Compiling this list required a lot of interdepartmental communication, but its value is now evident: browsing through it reveals the wide range of options available at UM. From law to geosciences to sociology, maritime topics are approached from a multidisciplinary perspective.

This list also makes it easier to design and promote potential courses for specific needs, which would especially cater for the needs of industries looking to upskill their workforce. The committee is also in discussion with entities such as the National Skills Council, Transport Malta, and other governmental departments, to make the University's potential for skills development and consultation more visible. This, in turn, would encourage a two-way system whereby academia provides advisory support to industry and government, while also drawing on their input to shape educational strategies.

ACADEMIA AS A BRIDGE

Academia could play a key role in cross-disciplinary bridge-building. In its societal position as a provider of objective – or as close to objective as possible – information, academia not only has the capability but also the responsibility to share knowledge. For marine and maritime issues, this is the reason why the UMP was founded.

Prof. Michael Briguglio, who introduced a new study unit called Maritime Sociology, maintains that the University – through the UMP – has a key role to play in advising both government and industry. Prof. Briguglio argues that social impact assessments should become mainstream. Such assessments indicate the intended and unintended social outcomes of projects, policies, or plans. This is done to limit unintended adverse outcomes and to help create a more equitable and sustainable society.

While academics are sometimes perceived as isolated within an 'ivory tower', producing research that may feel insular or niche, the UMP offers a way to start breaking down this barrier. Dr Ritienne Gauci says, 'Outreach is a very important component of the UMP's work because it is helping to build bridges between the Platform and the University as well as with society, especially our stakeholders.' Reaching out to stakeholders helps ensure that the research produced is needed, fulfilling, and ultimately usable by the stakeholders involved.

Between 7 and 9 May, the UMP held its Maritime Platform Conference to discuss themes such as the necessity of sustainability in the maritime field, adaptation to environmental changes and a new climate regime, and recent developments in technology, governance, and society, among others. The conference was structured in a way that enabled professionals working in different fields to participate in any discussion, without being limited to sessions within their own sectors. It stands as an example of interdisciplinary collaboration and a result of interdisciplinary conversations following consultations with different ministries and stakeholders.

Bringing about change takes both time and dedication. Whilst time is a limited resource, dedication is something that academics have in abundance. While cross-sectoral collaboration may be time-consuming, its rewards are well worth the investment, opening the doors to new frontiers.

Knowing our Universe

Author: Jonathan Firbank

*The **Institute of Space Sciences and Astronomy** (ISSA) has recently celebrated its tenth anniversary. Jonathan Firbank speaks with the ISSA's leading staff about their contributions to the field and some of the most important research projects today, which place ISSA at the intersection of modern astronomy.*

Founded by Prof. Kristian Zarb Adami, a leading figure in Maltese Space Sciences, the Institute of Space Sciences and Astronomy (ISSA) has flourished as an organisation at the intersection of fields crucial to our understanding of the universe.

Collaboration is ISSA's bedrock. The institute works on flagship projects with institutions and space agencies from across the globe. Many readers will be familiar with eye-catching achievements such as European Space Agency missions and the James Webb telescope. Soon, many will also become familiar with the Square Kilometre Array, which is capturing radio images of the universe's infancy and, in many respects, represents the field's future.

ISSA has produced over a dozen Ph.D. graduates and benefits from a broad swathe of affiliate and support staff. However, the easiest way of examining its multidisciplinarity is through its key members. Its director, Prof. Alessio Magro, along with Dr Andrea De Marco and Prof. Jackson Levi Said, each pursue distinct yet interconnected areas of astronomy.

THE SOUND OF SPACE – PROF. ALESSIO MAGRO

As Magro explains, 'Currently, ISSA has three main research areas. I'll let Jackson and Andrea discuss theirs, but my focus is what's called "instrumentation"'.

Instrumentation refers to the development of devices vital to astronomy – the telescopes, satellite dishes, and antennae required to study the stars. 'These instruments generate a huge amount of data, which must be processed. A key focus is on building software that can handle this. More specifically, my focus is on radio astronomy, including the search for "fast radio bursts". These are bursts of extremely high energy originating outside the Milky Way. Nobody knows what causes them.' Magro's goal is to identify as many of these fast radio bursts as possible in order to lay the groundwork for a deeper investigation.

Another main focus of Magro's research involves detecting "21 centimetre emissions" – radio wavelengths emitted by hydrogen atoms, some of which may have originated only a few hundred million years after the Big Bang. At that time, hydrogen was so abundant and dense that it obscured all detectable light, creating the "dark ages of the universe", invisible to optical instruments. The radio wavelengths produced by hydrogen can be used to map its distribution from eons ago, and through it, the structure of the early universe. As hydrogen was ionised by ultraviolet light, the dark ages came to an end, allowing optical instruments to become viable once again.

Magro describes searching for the earliest perceptible light as 'trying to spot a match's flame drowned out by foglights.' These primordial emissions are overwhelmed by the visual noise of later cosmic epochs. Detecting them requires incredibly well-calibrated instruments – vast telescopes with equally vast exposure times.

Magro's field is concerned with maximising the information we can glean from the stars. But all that information must be processed and analysed. 'This is a computationally expensive procedure, so we must create systems that can keep up.'

THE PLACE FOR ARTIFICIAL INTELLIGENCE – DR ANDREA DE MARCO

The sheer scale and breadth of astronomical data are making machine learning an increasingly important tool. This leads us to one of De Marco's specialities: AI and machine learning. Integration with machine learning began shortly after the ISSA's inception in 2014.

As De Marco describes, 'There was already an interest in the application of AI and machine learning to astronomical data. ISSA was working with other institutions in designing the Square Kilometre Array.' This is an enormous radio telescope being built in South Africa and Australia – a product of equally enormous international collaboration. It promises to be far more powerful than existing instruments, meaning there will be exponentially more data to process. 'In its early days, this raised the question of how we would ingest but also process and utilise this data – and whether this process could be automated in an intelligent way using deep learning. My work explores the analysis and application of which machine learning techniques are good for radio astronomy and what we can do with them.'

ISSA's growth coincides with the rapid development of AI, meaning the institute must continually update its hardware to keep pace. 'The complexity of AI models is measured in terms of "parameters". Originally, we were working with models that had a few million to 20 million parameters. Now, we are working with models with up to 10 billion parameters – and one more than twice as powerful is currently being developed. These models don't just label data; they have a contextual understanding of it.'

The Square Kilometre Array's first operational subset is located in Australia. 'They had their first simulated data release a few years back, and we are currently applying cutting-edge vision AI models to the survey,' De Marco notes. 'The idea is to detect radio sources – remnants of supernovas, or traces of uninvestigated radio galaxies. Individually, these tasks are not too difficult for an astronomer.

ISSA group photo from the 10-year anniversary event
Photo courtesy of Xjenza Malta

But there is so much data coming in all the time that it would take an army of astronomers to stay on top of it.' AI is ideally suited to perform what De Marco describes as a "first pass" of this analysis – a methodology that could eventually be applied beyond his current focus on radio astronomy, including in the analysis of optical data.

QUESTIONING THE UNIVERSE – PROF. JACKSON SAID

In overly simplified terms, the instruments Magro develops observe our universe, both from beyond our galaxy and from billions of years in the past. The immense volume of data they generate is then processed using De Marco's AI techniques. This brings us to Said's work: comparing and interpreting the results.

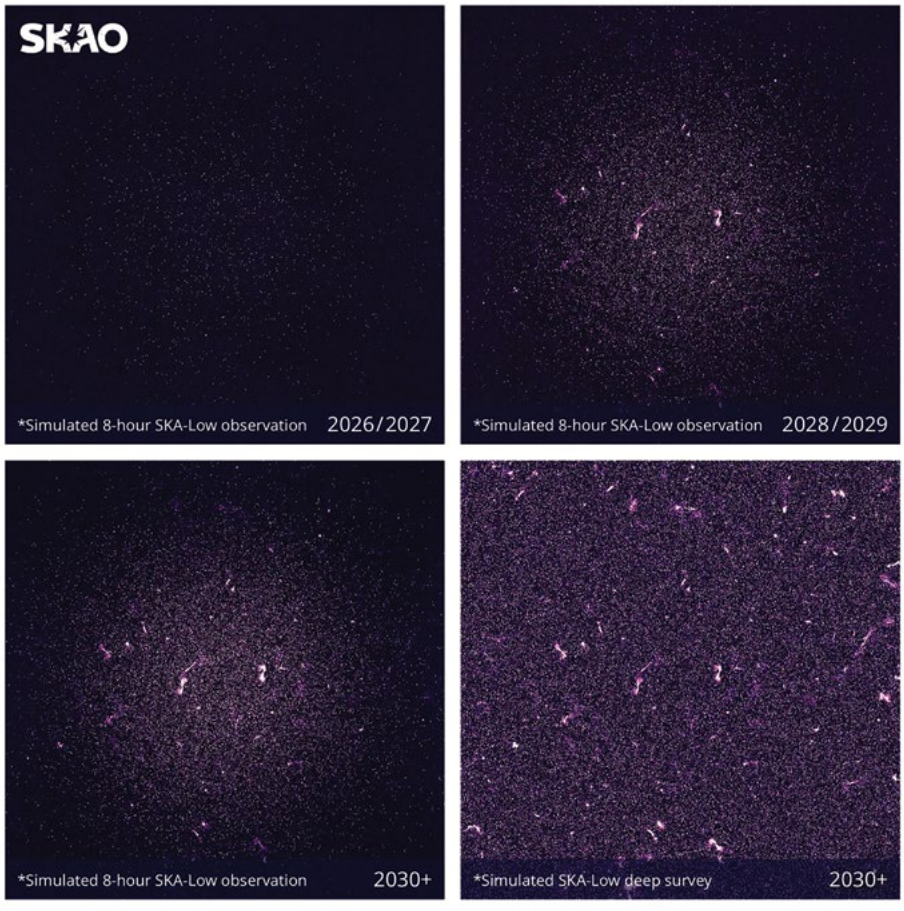
Said explains, 'As Magro was saying, he is working on these huge telescopes, which are observing data from the very, very early universe. Our data analysis team works on applying that data to what is known as the standard cosmological model – our current understanding of the Big Bang and the universe's subsequent evolution to today. One thing our research group does is suggest new cosmological models that tackle open questions arising from these observations, and questions arising from relevant theory.'

Said is the chairperson of CosmoVerse, a large, international network of researchers working on "cosmic tensions" – mismatches between different measurements of the universe. 'We're working on developing models that tackle this issue, among others, and to that end, we're also developing machine learning tools that will derive new models from existing data. This turns theory on its head a little,' he explains, as normally a model is theorised before comprehensive data is available. 'We can then compare these models to established ones.' This will raise new questions or answer old ones, further consolidating our understanding of the universe.

These questions cut to the core of who we are. Said continues, 'One of the first questions we asked as a species was, "What are the dots in the sky?" And now we're asking, "Where did the universe begin?" These investigations are always something we have cared deeply about. We have always been ready to invest time and effort into them as a society. Now we have the technological tools – the instruments developed by academics like Magro; the data analysis tools that De Marco specialises in; and the analytical models investigated in my field. These unlock the capacity to really understand what happened after the Big Bang, in the epoch of reionisation that followed the universe's dark ages, and beyond.'

ISSA stands at the intersection of three pillars of modern astronomy that are bringing us tantalisingly close to understanding our origins. It bridges past and present, near and far, and the global human effort to know our universe.

Infrared, optical, and X-ray views of a galaxy group
Photo by ESA/Webb, NASA & CSA



Simulated views of the evolving capabilities of SKA-Low, showing increasing sensitivity from 2026 to 2030+

Image of simulated observations by the Square Kilometre Array Observatory

Unravelling the Mystery of the Big Bang

Author: **Antónia Ribeiro**

*Researchers at the University of Malta are developing new ways to study the universe by mimicking processes that occur in the human brain. The **CosmicLearning** project involves creating artificial neural networks (ANNs) to understand how the universe is expanding and, in the process, reframing how astrophysicists study the cosmos.*

What pops up in your mind when you hear the words 'machine learning'? A robot sitting at a desk? A row of computer chips with beeping noises and flashing lights? Or perhaps an amorphous shape – a kind of magic genie? Machine learning is an ever-present concept in our daily lives, employed in a wide range of technologies: from facial recognition, to voice-to-text functionalities in our smartphones. Yet, we hardly understand what it means, what it can do and how it is applied in technology and science. **THINK** spoke with the researchers behind the CosmicLearning project at UM to find out what machine learning is, and how it can be used to create better predictive models of our universe.

WHAT CAN MACHINE LEARNING DO FOR YOU?

Machine learning is a type of artificial intelligence. A Google search will tell you that a machine learning model is created through the analysis of data by a program. The more data is fed into the programme, the more accurate the machine learning model becomes. As research support officer Dr Rebecca Briffa explains, machine learning models 'learn patterns from the data without being explicitly programmed to do so'.

Machine learning identifies patterns that enable machines to do certain tasks with accurate results. Ever scrolled through Facebook and seen an advertisement about something you were just discussing with your co-worker? That's machine learning – analysing your data and identifying patterns in what you might like.

The team behind CosmicLearning – including Briffa, Dr Jurgen Mifsud, and principal investigator Prof. Jackson Said from UM's Institute of Space Sciences and Astronomy – is using this technology to untangle the history of the universe, specifically to determine how it is expanding.

THE BIG BANG THEORY AND ALL THAT CAME AFTERWARDS

In 1929, Edwin Hubble proved that the universe is expanding. In 2011, the Nobel Prize-winning physicists Saul Perlmutter, Brian P. Schmidt, and Adam G. Riess discovered that not only is the universe expanding, but the rate of expansion is increasing.

Much of the research done on the universe, its expansion, and its future relies on statistical models. The most prevalent of these, the Standard Model of Cosmology (SMC), assumes that 'the universe was created in the "Big Bang" from pure energy, and is now composed of about 5% ordinary matter, 27% dark matter, and 68% dark energy'. Dark matter sustains the structure of galaxies, while dark energy appears to be responsible for the universe's accelerating expansion.

However, no model is perfect, and current empirical observations seem to contradict the long-standing SMC. Not only do direct observations of dark matter continue to elude scientists, but, according to Said, the universe is also expanding at a faster rate than the model predicts. This discrepancy between observed and calculated results is what physicists refer to as cosmic tension. The CosmicLearning project is attempting to solve this tension using machine learning – more specifically with artificial neural networks (ANNs).

WHEN PHYSICS MIMICS THE BRAIN

ANNs are machine learning methods inspired by the structure of animal brains – specifically how neurons are organised into layers and communicate with one another. The team believes that ANNs offer a superior approach for studying the expansion of the universe compared with other methods. They make fewer assumptions and are more adaptable when interpreting new data, leading to more accurate results. ANNs are also able to infer correct data for different time points of the universe – from billions of years ago to the present-day universe – and can even be used to calibrate other indicators of universe expansion.

As Mifsud explains, 'The team constructed the ANN model using observational data, and the resulting ANN was then tested with the same data.' The datasets collected through direct observations – in this case, cosmic expansion data and data related to the growth of large-scale structure – are both related to the expansion of the universe. While cosmic expansion data tracks how the universe stretches, large-scale structure data examines how matter clusters together.

The challenge was getting the ANN to reconstruct the same information that was used to train it. The group successfully showed that the ANN model is more

effective at recreating empirical data than currently used models.

Besides solving a long-lasting cosmic tension, the research will open doors to novel ways of developing models around data. While traditional cosmological models are built upon statistical predictions, this innovative approach by the CosmicLearning team aims to use existing empirical data to create a model that mimics the natural processes that generated it.

WHAT WAS I MADE FOR?

The ultimate aim is not only to develop a new model capable of explaining and predicting the universe's rate of expansion, but also to serve as a proof of concept demonstrating that ANNs can be used to build new models across different fields – from astrophysics to health. This promises to create adaptable frameworks that help scientists better understand natural phenomena and tailor solutions to specific issues.

With vast datasets available, astrophysics is the ideal starting point for training this type of machine learning. Particularly in astrophysics, having a new predictive model for cosmic expansion may help answer one of the oldest philosophical questions: where, and how, did the universe originate? 'Just as Einstein's theory of relativity would, decades later, help create GPS systems, this knowledge may very well shape our future technologies,' remarks Prof. Said.

The team emphasises the value of intradisciplinary collaboration throughout the process, with Briffa noting that, 'Collaboration with people gives a fresh perspective'. This view aligns with the team's objective of developing toolkits that can be used by researchers from diverse disciplines, encouraging the use of ANNs in predictive modelling. Mifsud concludes, 'it is important to collaborate with people who are working with similar models and datasets, so they can exchange tips and knowledge.'

The CosmicLearning project is funded by Xjenza Malta through the Technology Development Programme (TDP-2024-014).

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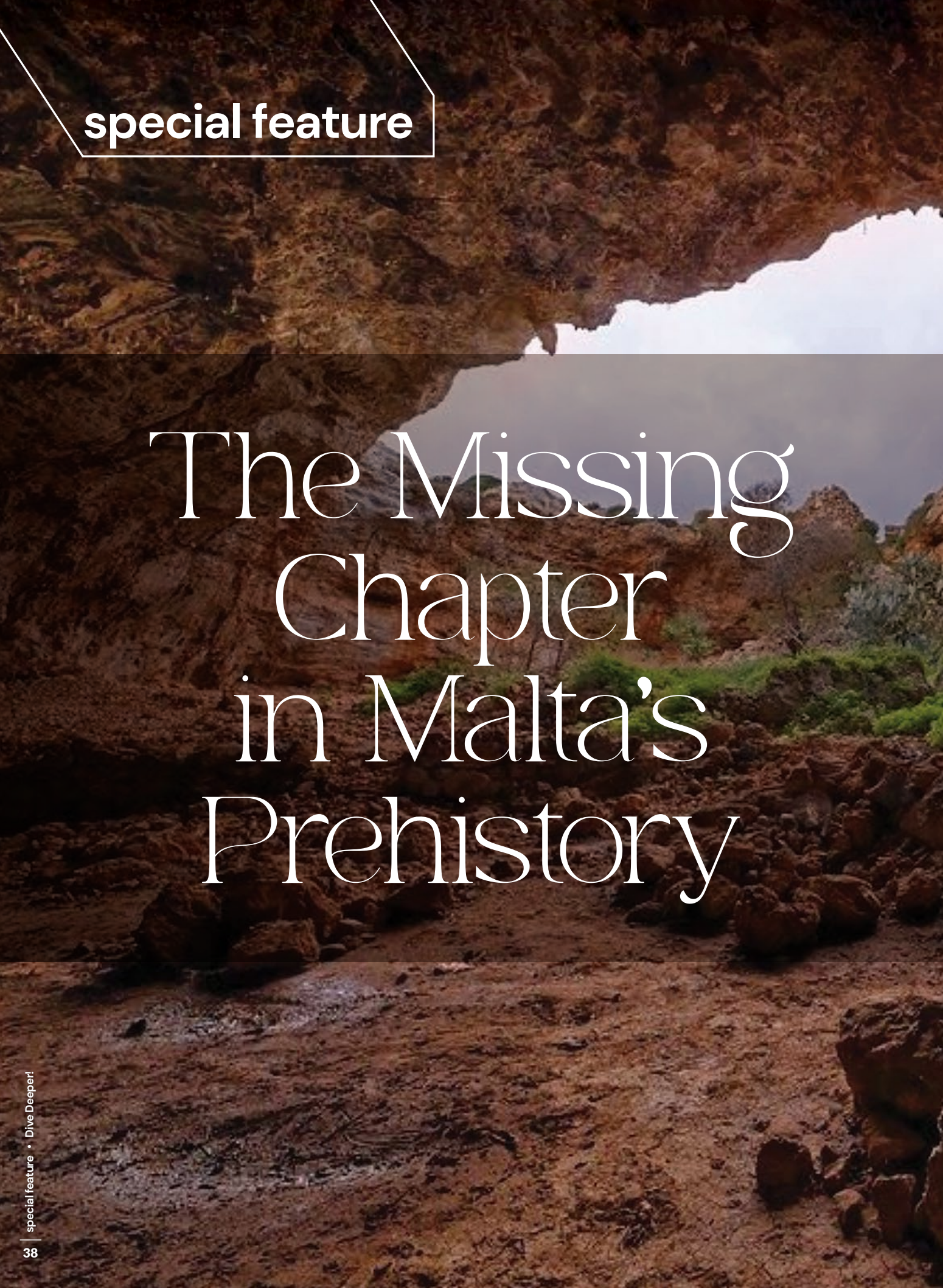
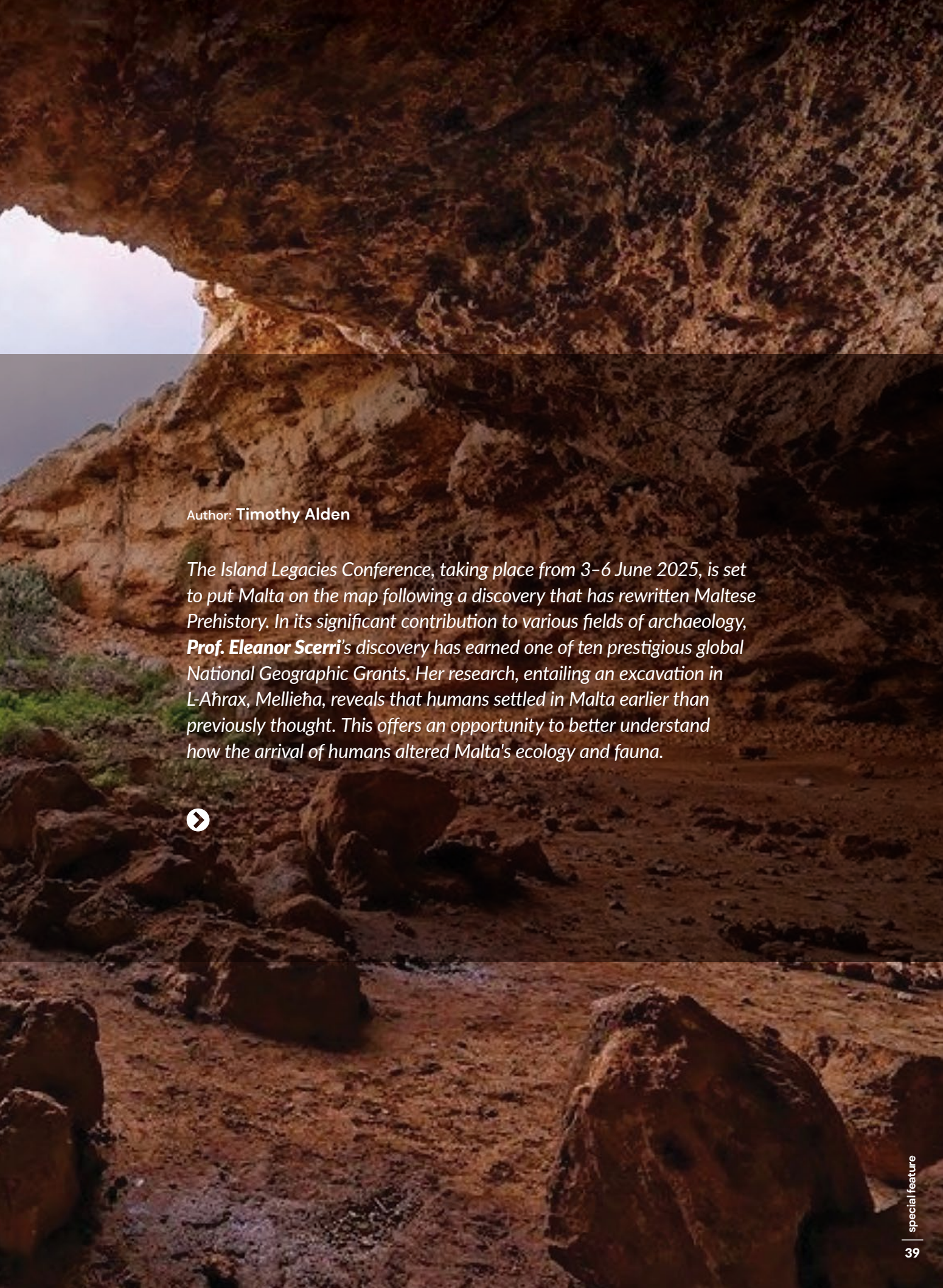


The Missing Chapter in Malta's Prehistory



Author: **Timothy Alden**

The Island Legacies Conference, taking place from 3–6 June 2025, is set to put Malta on the map following a discovery that has rewritten Maltese Prehistory. In its significant contribution to various fields of archaeology, ***Prof. Eleanor Scerri****'s discovery has earned one of ten prestigious global National Geographic Grants. Her research, entailing an excavation in L-Aħrax, Mellieħa, reveals that humans settled in Malta earlier than previously thought. This offers an opportunity to better understand how the arrival of humans altered Malta's ecology and fauna.*

Top view of Latnija Cave
Photo by Dr Andrés Currás

Prof. Eleanor Scerri's recent groundbreaking research, in collaboration with the University of Malta's Department of Classics and Archaeology, Department of Geography, and the Max Planck Institute of Geoanthropology in Germany, started with an interest in Malta's iconic miniaturised megafauna – originally discovered in Għar Dalam. The famous remains of pygmy elephants found there are a prime example of smaller versions of the large animals we recognise today. Against a backdrop of international debate regarding the relationship between humans migrating out of Africa and the extinction of megafauna worldwide, Scerri figured that Malta could serve as an effective control study for megafauna, since humans supposedly only inhabited Malta roughly around 5400 BC. What she discovered, however, surprised her.

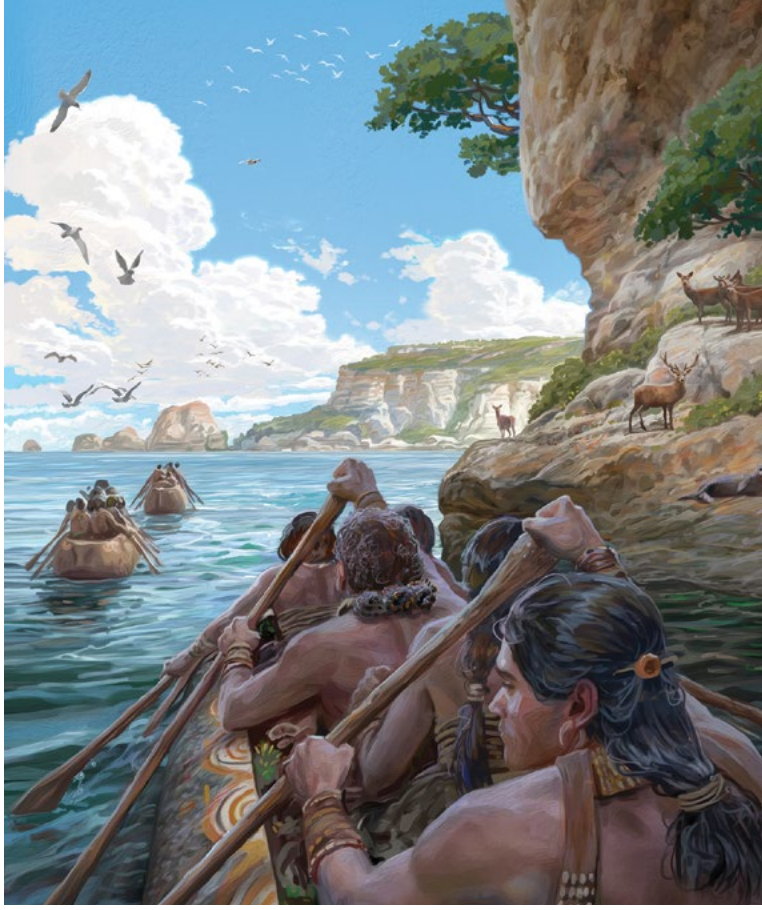
Digging through a cave in L-Aħrax, the soil layers first revealed what one would expect: remains dating to the Roman period, the Bronze Age, and even early neolithic farmers, who were believed to be the first arrivals. However, as the team dug deeper, the pottery and domesticated animals disappeared, giving way to signs of hunter-gatherers – who were never thought to have existed in Malta at all. In Latnija Cave, the team discovered hearth ash containing the remains of stone tools and cooked wild food, including birds, fish, marine mammals, local species of tortoise, and red deer. This pushed the timeline of human presence in Malta further back by at least a thousand years.

The scientific consortium for this project included Prof. Nicholas Vella, Dr Huw Groucutt, and master students and project technicians Nicolette Mifsud and Rochelle Xerri, all from UM's Department of Classics and Archaeology, as well as Dr Ritienne Gauci from UM's Department of Geography, who also contributed to this study. In addition to receiving a National Geographic Grant, the research was funded by the European Research Council and a Research Excellence Award from the University of Malta.

OUT OF AFRICA

While modern humans (*Homo sapiens*) originated in Africa around 300,000 years ago, they began to leave and spread across the globe approximately 120,000 years ago. Nonetheless, all modern humans are descended from a group that left Africa roughly 50,000 years ago. At that time, the ancestors of all modern non-African populations successfully dispersed into Eurasia, where they encountered Neanderthals and other evolutionary cousins – whom they ultimately replaced and absorbed. By 30,000 years ago, *Homo sapiens* were the only remaining human species.

Inside Latnija Cave
Photo by Dr Andrés Currás



Hunter-gatherers were crossing at least 100 km of open water to reach Malta 8,500 years ago
Illustration by Daniel Clarke

As humans spread across Eurasia, Australia, and the Americas, small and remote islands became the final frontiers of human migration, requiring seafaring knowledge and technology. As hunter-gatherers require large spaces to sustain themselves through foraging and hunting, small islands posed significant challenges for their survival. There was, therefore, an impression that islands could only be colonised via farming, where intensive crop cultivation could maximise food production.

'The oldest indications of the development of farming can be traced to the Middle East, Mesopotamia, and Turkey around 12,000 years ago. Farming reached the Central Mediterranean about 8000 years ago, and it is even more recent in southern Italy, Sicily, and Malta. Malta's prehistory is very interesting, but the story of the temples is a relatively recent one,' Scerri explains.

While Malta boasts some of the oldest free-standing buildings in the world, thanks to its temples, Scerri notes that, in the broader sweep of history, Malta's temple-builders were still in the Stone Age at a time when mainland European farming communities were already producing copper. From this perspective, the Maltese temples are younger than most people assume.

CHALLENGING THE GARDEN OF EDEN

The main question in the study of human evolution has long been: where in Africa did humans first evolve? In 2018, Scerri's research challenged a dominant narrative that presented human origins as emerging from a singular 'Garden of Eden' – a single location, habitat, and ecosystem from which *Homo sapiens* originated. Instead, her work revealed that the roots of our species lie in a constellation of populations, dispersed across diverse environmental and geographic settings in Africa. We now have proof that humans lived in early African rainforests 150,000 years ago – double the previous earliest estimates. Furthermore, the evidence takes us to West Africa, challenging conceptions that the cradle of humanity was confined to East Africa.

'Over the course of this research, I generally became knowledgeable about the human niche – how humans expand into, adapt to, and shape their own habitats. We look not only at plants and animals but also at pathogens, human adaptation, and gene co-evolution,' Scerri says. 'We can talk about humans adapting in a rainforest, savannah, or desert niches. We understand this, too, for people in tundras and polar environments. However, the ability to cross water represents an entirely different kind of niche – a sea niche. The capacity for long-distance water crossings marks a crucial expansion of the human niche.'

Animal bones and stone artefacts recovered during the excavations at Latnija Cave
***Photos by Prof. Eleanor* Scerri**

MYSTERIES OF MEGAFAUNA

Scerri remarks that in learned more about the human niche, she found herself questioning the long-standing narrative about our species: humans lived in harmony with nature in Africa, only to begin killing everything upon migrating beyond it. The global disappearance of megafauna remains an ongoing debate, with climate change also acknowledged as a contributing factor. This is what makes Malta's miniaturised megafauna, discovered in Għar Dalam, such a fascinating case study: they are thought to have gone extinct without human intervention.

It is for this reason that Scerri chose Malta as the location for a control study – to assess megafauna extinction in the absence of clear human interference. It was only then that the team inadvertently discovered traces of prehistoric hunter-gatherers, a discovery that now rewrites Maltese prehistory.

The discovery of the L-Aħrax archaeological site is particularly valuable given that Għar Dalam was excavated a century ago, at a time when advanced scientific techniques were not available. As a result, much of its context and value were lost. It is for this reason that, until now, Malta had largely been excluded from global academic

View of excavations at Latnija Cave in 2023
Photos by Dr Huw Groucutt

discussions about megafauna, despite the richness of its history. L-Aħrax offers us a second chance.

Understanding more about megafauna and their extinction lies also in anticipating climate change today. Scerri says that scientists are only beginning to understand the ecological functions of megafauna: from regulating soil nutrients to their impact on wildfire regimes. Their roles may have been so significant that scientists are only recently recognising how our entire understanding of the biosphere and the functioning of the earth is based on a world artificially devoid of megafauna, one which has already been fundamentally altered beyond its original state. Malta, she argues, deserves its place in this wider discussion, and it will earn it through the groundbreaking discoveries at L-Aħrax.

PUTTING MALTA ON THE MAP

The Island Legacies Conference marks the first time Scerri is presenting the scientific details of her research at the L-Aħrax cave to the international academic community. Fields such as archaeology, biogeography, and climate studies, which have traditionally overlooked Malta due to lack of data, will now take it into account. As significant climate shifts in the Earth's past mirror those we face today, understanding their effects on plants, animals and human societies may offer valuable insight. Investigating what enabled ecosystem resilience in the past – and the role megafauna played in that resilience – might offer valuable lessons today.

'Discovering that these hunter-gatherers arrived in Malta isn't the end of the story. We want to know whether people were here even earlier. The excavation taught us not to take things at face value and to keep questioning. It took us time to accept the evidence before our eyes. We found remains of red deer, foxes, wild tortoises, and even some kind of large lizard. Some of these animals – especially the smallest form of deer – had feet evolved like those of mountain goats, allowing them to live on cliffs and boulders, and we may have lost these species fairly recently,' Scerri remarks. 'We even uncovered evidence of animals we were not certain had existed based solely on Għar Dalam.'

The importance of the discoveries at L-Aħrax prompted the award of a National Geographic Grant. Scerri hopes that communicating its full importance will lead to the protection and recognition the site deserves – especially now that Malta finds itself at the heart of an international academic debate. She believes that the archaeological site in L-Aħrax is not only one of the most important in Malta, but amongst one of the most significant globally. With Maltese history already rewritten, who knows what more remains to be uncovered – with time, research, and adequate care.

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Empowering the Future: Strengthening Renewable Energy Grids with Advanced Storage Systems

Author: **Sebastião Miranda**

As the world rapidly transitions toward cleaner energy, renewable technologies like solar and wind power are gaining increasing importance in how we generate electricity. These energy sources are clean, sustainable, and essential for reducing our reliance on fossil fuels, but come with a challenge: they don't produce a steady flow of power. The sun isn't always shining, and the wind doesn't always blow.

In Malta, photovoltaic (PV) solar panel installations on rooftops account for the largest share of renewable energy generation. The amount of energy produced varies throughout the day, depending on sunlight intensity and other factors that can be harder to predict, such as cloud cover. Meanwhile, electricity consumption also fluctuates as households, factories, and businesses have different energy needs at different times. This creates a problem for electricity grids, which need to balance supply and demand at all times.

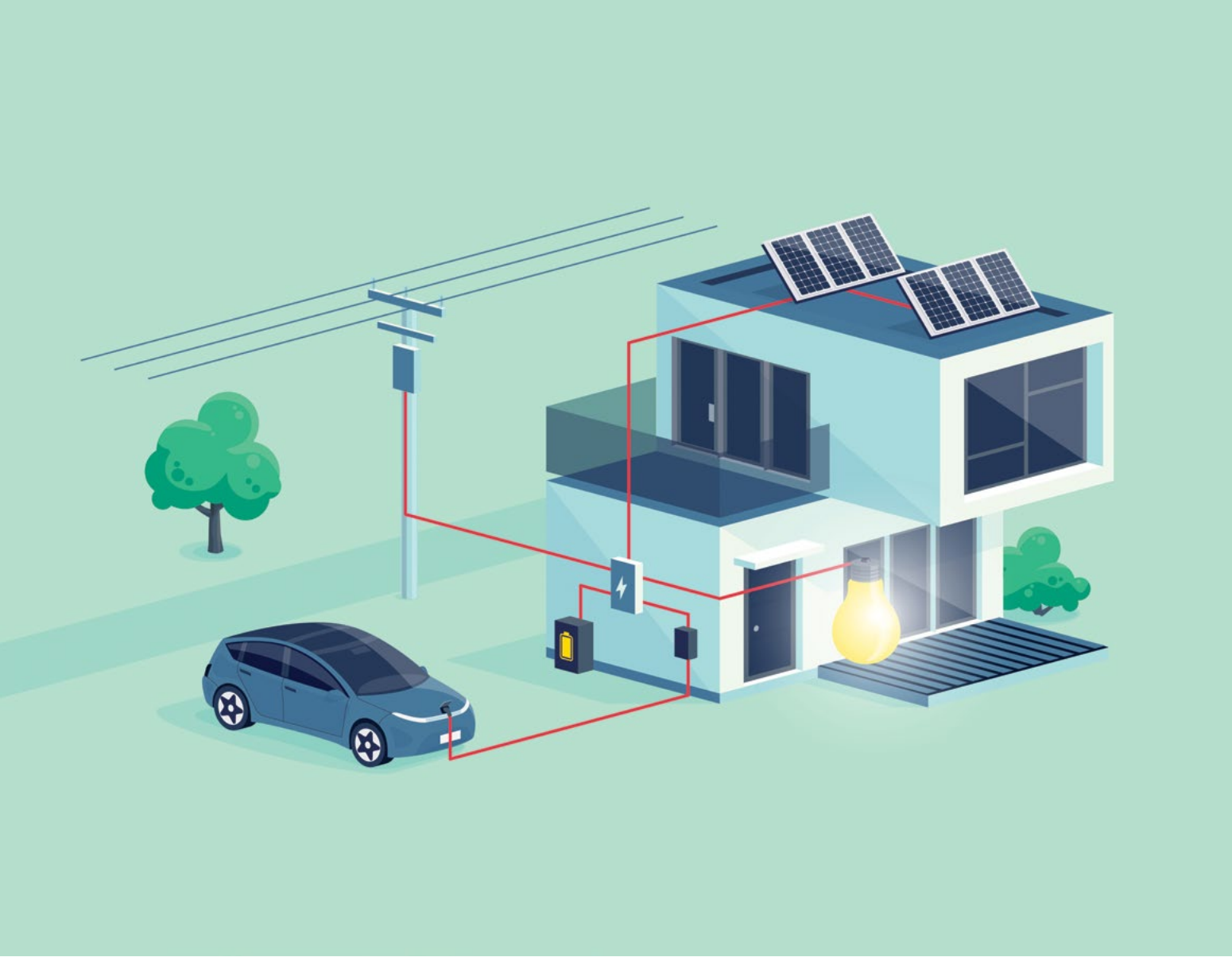
Traditionally, electricity grids relied on fossil fuel power plants, such as coal, natural gas, and oil plants. These power plants were designed to be highly flexible, able to increase or decrease their energy output quickly in response to changing demand or renewable energy-generation fluctuations. However, with the growing reliance on renewable energy, the traditional power stations' capacity to manage supply and demand is increasingly under pressure.

In regions like Malta, where PV panel installations are growing rapidly, this challenge is becoming more pronounced. The task now is to maintain a stable, reliable grid while decreasing reliance on fossil-fuel plants and integrating renewable energy sources. The ASPIRE project, carried out by Prof. Reiko Raute, Prof. Cedric Caruana, and Dr Gowthamraj Rajendran from UM's Department of Electrical Engineering, aims to address these issues by integrating smart-controlled battery energy storage systems into the electricity grid.

THE ROLE OF BATTERIES IN STABILISING THE GRID

Batteries can store excess electricity when supply exceeds demand and release it when generation is insufficient. In essence, batteries act as buffers, absorbing and storing energy during periods of excess, and supplying it when there's a shortfall. This ability to store energy for later use is crucial in mitigating the fluctuations that come with renewable energy sources.

In recent years, many residential and commercial PV panel installations have been paired with battery storage systems. These systems, however,



are often set up in 'self-consumption' mode. In this mode, when local solar generation is high, a household or business disconnects from the grid and uses only the energy it generates, storing any excess in the batteries for later use. When local PV generation falls short of meeting demand, the battery is used to supply the remaining power. If both the solar generation and the battery are insufficient, the system reconnects to the main grid to draw power, which generally comes from fossil fuels.

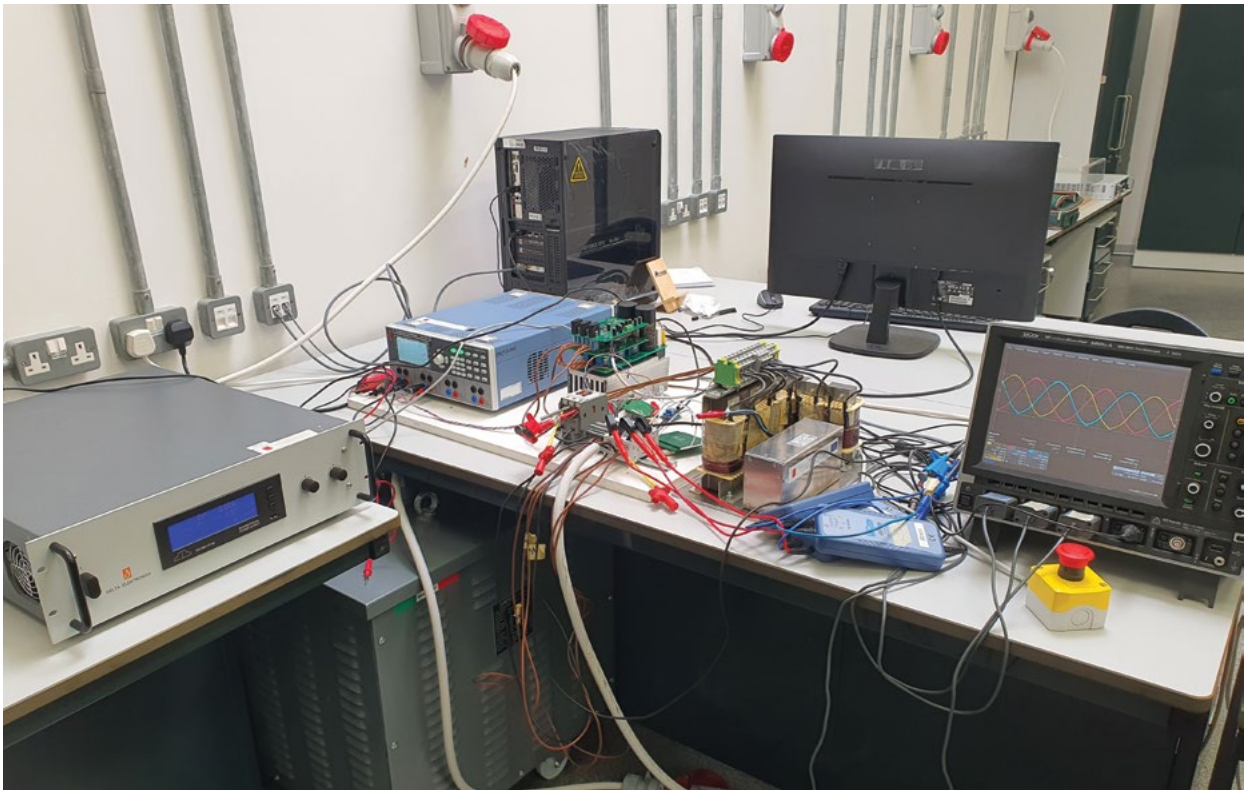
While this self-consumption mode helps alleviate the load on the grid and improves local energy security, it does not contribute directly to stabilising the larger grid or mitigating the broader power quality issues that may arise. In other words, while these batteries optimise energy use at an individual level, they do not actively participate in balancing the grid as a whole.

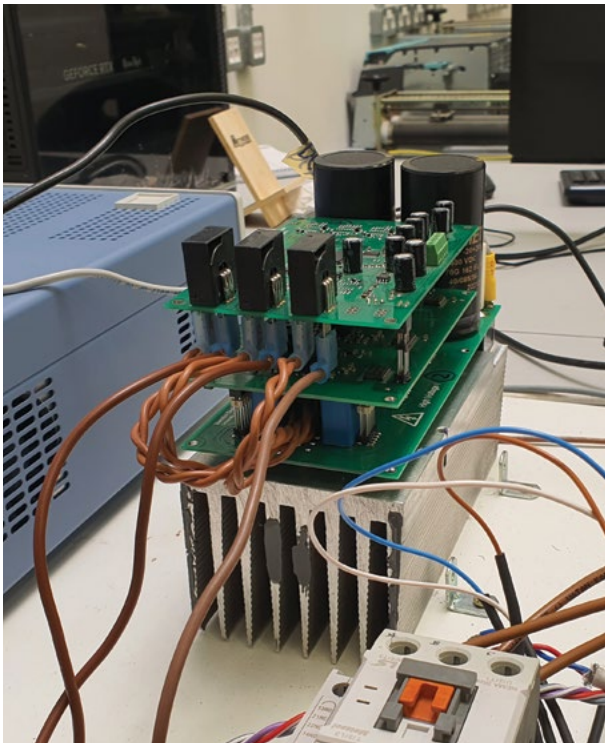
THE VISION FOR GRID-CONNECTED BATTERY SYSTEMS

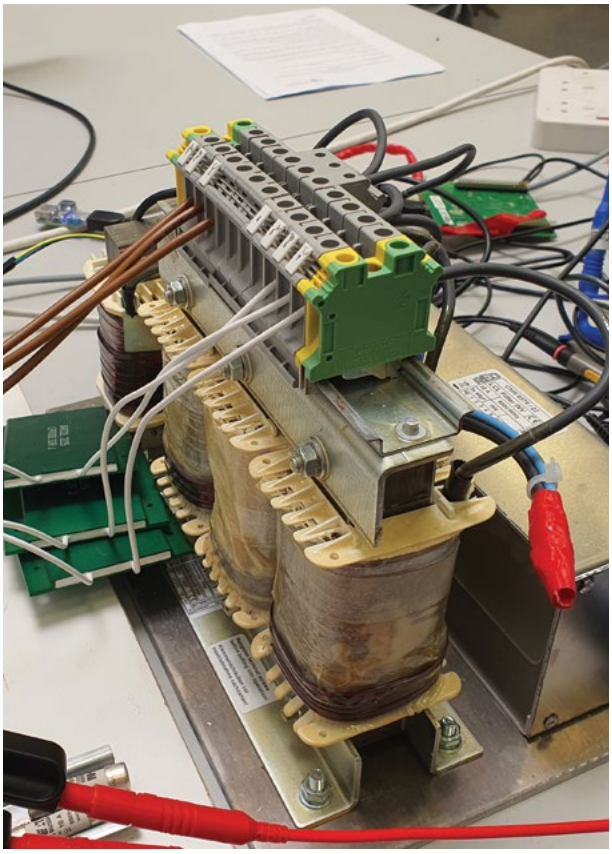
The ASPIRE project envisions a shift in how battery storage systems interact with the grid. Rather than operating in isolation to serve individual houses or businesses, battery systems can be connected to the grid's control mechanisms. In this model, residential and commercial battery storage systems contribute to the stability and reliability of the entire grid's operation. With this approach, batteries can help in several ways:

Balancing Supply and Demand: Batteries can help keep energy supply and demand in balance by storing excess electricity when too much is generated and releasing it to the grid when there is a shortage. By being active elements in the grid's network, each battery now contributes to the overall stability of the grid. This produces a much more stable output, as each battery has an effect beyond its immediate surroundings.

Enhancing Power Quality: Non-linear loads and power electronic devices, like electric car chargers, can cause distortions in the normal flow of electricity in the grid. These fluctuations affect the quality of the power supply and could cause electrical equipment to malfunction. This project shall develop special control algorithms for grid-







Top: Experimental hardware setup in the laboratory
Left: Inverter prototype
Right: Grid connection inductance
Photos courtesy of the ASPIRE Team

Left to right: Prof. Cedric Caruana, Prof. Reiko Raute and Dr Gowthamraj Rajendran
Photo courtesy of the ASPIRE Team

connected battery units that can help smoothen out these variations of the normal electricity flow and ensure the quality of power supplied to customers.

Keeping the Grid's Rhythm Steady: The electricity grid runs on alternating current (AC), meaning that the flow of electricity reverses direction at a steady rhythm. Just as the human heart beats with an approximately stable frequency to keep our body working, the grid must also maintain its frequency as constant as possible to ensure a proper flow of electricity. However, the intermittency of renewable energy generation can suddenly disturb the AC voltage frequency and cause problems. This is where batteries come into play. By adjusting their charge and discharge cycles, batteries can help the grid recover from unwanted frequency disturbances. In other words, they act like a pacemaker, stepping in to regulate energy flow and keep the grid's 'heartbeat' steady.

A network of smart, grid-connected batteries tackles one of the biggest challenges of the energy transition, taking over the balancing functions that are still provided by fossil-fuel power plants.

A NEW ECONOMIC MODEL FOR BATTERY STORAGE

A key innovation of the ASPIRE project is an incentive programme that allows customers to register their battery storage systems with the grid operator and receive financial compensation for the services their batteries provide to the grid. These services would include balancing supply and demand, improving power quality, and supporting the grid in maintaining stable voltage and frequency. This approach could create a new avenue for customers to profit from their battery investments while contributing to the greater good of the energy transition.

Under this model, grid-connected batteries would essentially become participants in a Virtual Grid Support System (VGSS) – a network of distributed energy resources that work together to support the grid. By integrating these resources into a common coordinated system, the grid operator could more easily manage energy fluctuations, reducing the need for fossil-fuel power plants, while ensuring a reliable, stable energy supply.

TOWARDS A FOSSIL-FREE FUTURE: THE ROLE OF ADVANCED STORAGE SYSTEMS

The ASPIRE project is paving the way for the development of advanced battery storage systems that not only store energy but also actively contribute to grid stabilisation. These systems, with smart control features and power-filtering capabilities, will be crucial in building a green electricity grid that can operate without the need for fossil-fuel-powered generation stations.

The ultimate goal is to create a stable, reliable, and sustainable energy grid that can seamlessly integrate increasing levels of renewable energy without compromising on power quality or reliability. By embedding these advanced capabilities directly into battery storage systems, we can help create a more flexible, resilient, and cost-effective power grid.

As renewable energy adoption continues to grow, these innovations will be vital in ensuring that the electricity grid remains robust and capable of supporting the future energy needs of homes, businesses, and entire communities. With these advancements, we move closer to achieving a truly sustainable and resilient energy system – one that operates efficiently, relies on clean energy, and is no longer dependent on fossil fuels.

Project 'Active Support of Decarbonised Weak Power Distribution Networks' (ASPIRE) is financed by Xjenza Malta, through the FUSION: R&I Research Excellence Programme.

Lighter, Stronger, and Space-Ready: How 3D-Printed Magnesium Could Revolutionise Satellites

Author: **Christian Keszthelyi**

What if the key to cheaper, lighter spacecraft is not aluminium but a metal that burns, corrodes, and challenges everything we know about aerospace engineering? **THINK** *talks to* ***Danjel Grima*** *from the* ***Wire Arc Additive Manufacturing of Magnesium for Satellites (WAAMMS) team*** *at the University of Malta to find out the answer.*

In the race to make space travel more efficient, every gram counts. For decades, aluminium has been the backbone of satellite structures. But what if there was a lighter alternative – one that could cut launch costs and revolutionise spacecraft design?

A team of researchers at the University of Malta is testing that theory, exploring how 3D-printed magnesium could be the next game-changer in aerospace engineering. The research team chose magnesium because it offers a strong structural foundation while being significantly lighter than materials such as aluminium. It meets key requirements for aerospace applications, balancing strength, weight reduction, and manufacturability.

The catch? Magnesium is highly flammable, prone to corrosion, and tricky to work with. Yet, if the researchers succeed, this material could reshape the future of satellites, and space exploration as we know it.

MATERIAL BREAKTHROUGHS

The WAAMMS (Wire Arc Additive Manufacturing of Magnesium for Satellites) project brings together expertise from SMW Engineering (Latvia); The Hong Kong Polytechnic University, represented by Prof. Runsheng Li; the University of Malta team, comprising Prof. Ing. Glenn Cassar, Prof. Ing. Ann Zammit, Danjel Grima, and Nejmeddine Layeb from the Department of Metallurgy and Materials Engineering, and Dr Ing. Bonnie Attard from the Malta College of Arts, Science and Technology.

The international collaborators developed advanced three-dimensional metal printing techniques essential to the project, while the UM team focused on post-processing, and the subsequent microstructural and mechanical characterisation of the magnesium and aluminium materials used.

'This process involves analysing the structure of the materials, their composition, and mechanical properties. Specifically, we conduct measurements to understand the material's phase composition, elemental composition, and surface characteristics, which in turn influence the overall mechanical properties of the metal itself,' Grima says.

In their research, the UM team performs heat treatments, exposing the magnesium to high temperatures and then rapidly cooling it (quenching) to enhance hardness. This allows the team to study how the material changes before and after thermal

processing. The key aim is to analyse these alterations, optimise the material's properties, and refine its surface engineering to improve overall performance in satellite applications. This is important both during printing and once a satellite is in orbit.

But how can we 3D-print magnesium? The process begins with a magnesium wire, which is melted using a high-powered heat source – much like welding. The molten material is deposited precisely in a layer-by-layer format to form the part. Tiny air pockets (porosity) may form, affecting strength, so the material is analysed and treated to meet standards. Samples, grossly differing in pore content, have been produced to study the effect of such defects and determine whether the post-processing routine being developed can reduce their impact in application.

At this stage of the research, printing happens on a small scale. 'Right now, the pieces we're printing are relatively small, but the goal is to eventually scale up to larger components while maintaining precision and minimising material waste. One of the key advantages of 3D printing is that it allows us to create complex shapes efficiently, whilst being scalable, and reducing excess material compared to traditional manufacturing methods,' Grima says.

WEIGHT ADVANTAGE

The goal is to determine whether magnesium can replace aluminium in satellite structures. Aluminium remains the primary choice due to its strength, lightweight nature, and resistance to space conditions, though composites, titanium, and specialised alloys are also used for specific components.

While an entire satellite made of magnesium is unlikely, replacing select aluminium parts could offer significant weight and cost advantages.

Potential cost-cutting occurs during the satellite's launch. The raw material costs of magnesium and aluminium are relatively similar, so the price difference is negligible at the sourcing stage. However, the manufacturing process – particularly with advanced surface treatments – makes magnesium a highly efficient alternative.

'The real cost advantage comes from the weight reduction. Since launching a satellite into orbit is extremely expensive, with costs ranging between €4,000 and €18,000 per kilogram, any reduction in weight leads to significant savings. For example, if a satellite structure that weighs 100 kg with aluminium could be reduced to around 65 kg using magnesium, that weight

difference alone could translate into substantial cost reductions in launch expenses,' Grima says, with reference to findings published by The European Space Agency.

Magnesium's density is approximately 35% lower than that of aluminium, enabling notable weight reductions when it is used in aerospace applications. So a 35 kg weight reduction could result in savings of between €150,000 and €600,000, depending on the specific launch service used.

But does lightness come at the cost of durability? This is another crucial question the UM team is investigating. 'We are actively studying magnesium's durability and have conducted initial fatigue life tests. So far, the results are promising. In one test, before applying surface treatments, the material withstood around 60,000 cycles before failure. After treatment, the fatigue life increased significantly to over 500,000 cycles,' Grima says.

In addition to heat treatment, the surface is strengthened through a process called shot peening, where the material is impacted with small spherical media. This induces compressive stresses within the material that do not dissipate over time. These stresses hinder the formation of cracks, enhancing the overall durability and fatigue resistance of a component.

AZ80 magnesium alloy tensile specimens prepared for mechanical testing.
Photo by Kristov Scicluna

The UM project's early findings suggest that magnesium can perform well under stress, but the team is conducting further tests to confirm consistency and evaluate susceptibility to residual porosity. Another batch of tests is under way to ensure that the observed improvements were not isolated results. While the team is still in the research phase, magnesium shows strong potential in terms of durability.

GLOBAL MOMENTUM

Magnesium is an increasingly prominent material in aerospace research. A collaboration between Mitsubishi Electric Corporation, the Magnesium Research Center at

The WAAMMS Team – Dr Ing. Bonnie Attard, Danjel Grima, Prof. Ing. Glenn Cassar and Prof. Ing. Ann Zammit
Photo by Kristov Scicluna

WAAMMS research support officers, Nejmeddine Layeb and Danjel Grima, running fatigue tests under cyclic uniaxial loading.
Photo by James Moffett

Kumamoto University, TOHO Kinzoku Co., Ltd., and the Japan Aerospace Exploration Agency (JAXA) has developed a high-precision additive manufacturing technology for magnesium alloys using a wire-laser metal 3D printer. This innovation aims to reduce rocket weight and lower launch costs. Additionally, a recent review highlights the increasing use of magnesium alloys in aerospace due to their lightweight properties – crucial for weight reduction in this field.

These studies align with the UM team's findings, reflecting a broader interest in leveraging magnesium's potential to advance aerospace engineering. But the trajectory to lighter satellites is star-studded with challenges.

'One major challenge we faced,' Grima notes of the WAAMMS project, 'is that magnesium is highly reactive and oxidises quickly when exposed to air and moisture. This can cause unwanted surface degradation. To address this, we switched to alcohol-based polishing solutions instead of water-based ones, which helped prevent oxidation.'

Another challenge was ensuring safety during handling, as magnesium is highly flammable. The team had to take extra precautions to minimise fire risks throughout the process.

The researchers also needed to strike the right balance between improving fatigue life and maintaining surface integrity. Small dimples formed on the surface during post-processing, which could affect durability. 'To counter this, we used composite treatments that helped smooth the surface while strengthening the material. However, increasing strength can also make the material more brittle, so we carefully adjusted the intensity of surface treatments to optimise durability and smoothness,' Grima explains.

With the foundational work mostly completed and aluminium testing finalised, the UM team focused on concluding the magnesium tests in mid-April, aiming to complete the project by the end of May. A gold coating was added to enhance conductivity and oxidation resistance without affecting mechanical properties.

Prof. Ing. Cassar, principal investigator for the WAAMMS project, remarks, 'The WAAMMS project is an excellent addition to our broader effort in advanced materials research, driven by international collaboration, outstanding researchers and state-of-the-art laboratory facilities. Through this and other collaborative projects, we aim to integrate micro-structural control, surface engineering, and additive manufacturing to deliver high-performance, application-driven solutions for aerospace and other demanding sectors.'

Is the manufacturing process implemented in the UM research unique enough to be patented? 'We're still in the research phase, so we haven't explored the potential for patenting the process in depth. However, our techniques, particularly in manufacturing, are becoming more widespread across various industries. That said, there is certainly potential for this technology to be patented and eventually commercialised. Selling it to major aerospace companies could be possible, but for now, our focus is on refining the process and evaluating its full potential,' Grima concludes.

Magnesium may be a challenging material, but if the UM team succeeds, it could redefine satellite construction as we know it – making them lighter, cheaper, and more efficient for the next generation of space exploration.

The WAAMMS (Wire Arc Additive Manufacturing of Magnesium for Satellites) project is funded by Xjenza Malta (Project Code: SUP-2023-07).

Green by Design: The Smart Science Behind Sustainable Food Packaging

Author: **Neil Spiteri**

*As concerns over plastic waste and food safety grow, a pioneering EU-funded project called **NOVISHPAK** is working to replace traditional seafood packaging with a smart, biodegradable alternative made from seaweed and fish production waste. The initiative aims to revolutionise how we package, protect, and perceive Mediterranean fish products.* **THINK** *speaks with the **NOVISHPAK team** to learn how sustainability and freshness are prioritised in their design.*

Plastic pollution continues to be one of the most pressing environmental issues of our time. From the depths of the ocean to the highest mountaintops, plastic waste has found its way into virtually every ecosystem on Earth. A significant proportion of this waste originates from food packaging – materials that are often used once and discarded, ending up in landfills and in our seas.

In the Mediterranean region, where fish and seafood are staples of the local diet and a key driver of the economy, this problem is particularly acute. Traditional plastic packaging is not only a major contributor to marine pollution but also a missed opportunity for resource efficiency and innovation.

That's where NOVISHPAK comes in – a European-funded research project that aims to completely rethink how we package fish and seafood by creating biodegradable and intelligent packaging films. What makes this initiative stand out is its holistic approach: the packaging is not just environmentally friendly but also smart, safe, and designed with the food it protects in mind.

At its core, NOVISHPAK embodies the principles of the circular economy, transforming what would otherwise be discarded into something of value: 'We're using resources that would otherwise go to waste,' says Roderick Abdilla, research support officer at the University of Malta. Rather than relying on fossil fuel-based plastics, NOVISHPAK's materials are developed from seaweed extracts and fish production waste, combining sustainability with functionality. The result? An elegant example of how waste can become a resource – and how food and environmental safety can go hand in hand.

WHY FOCUS ON MEDITERRANEAN FISH?

Fish is not only a culinary mainstay in the Mediterranean; it is also a major industry that spans fishing, aquaculture, processing, and export. Yet the industry remains highly reliant on traditional single-use plastic packaging, much of which ends up in the very waters that provide its livelihood.

With growing concerns about microplastics and the environmental footprint of food packaging, there is a clear demand for more sustainable options. NOVISHPAK's

biodegradable films, sourced from locally available by-products, could offer a compelling solution.

The benefits are multifaceted:

- Environmental: By replacing plastic with biodegradable materials, the packaging can naturally decompose, reducing the long-term impact on marine ecosystems.
- Economic: The use of fish waste and seaweed adds value to by-products that would otherwise go unused, supporting a circular economy.
- Social: With built-in indicators for spoilage and possibly mercury, the packaging enhances food transparency and consumer trust.

'The current materials used are mostly plastic,' Abdilla explains. 'We want to replace those with something that's made from waste and can biodegrade – supporting both the circular economy and environmental goals.'

SMARTER PACKAGING FOR FRESHER FISH

Of course, the push for sustainable packaging is not new. But what sets NOVISHPAK apart is its integration of intelligent features directly into the packaging material. Unlike traditional food packaging, which simply acts as a barrier between food and the outside world, NOVISHPAK's films are designed to actively monitor the freshness of the food they enclose.

One of the project's key innovations is a colourimetric freshness indicator embedded in the packaging film. 'One of the main aims is to make these films colourimetric,' Abdilla explains. 'They will change colour when the fish inside starts to spoil – so the consumer knows immediately whether the product is still edible.' This colour change occurs in response to spoilage-related compounds. It's a simple yet powerful tool that could change how both consumers and retailers manage food storage and sales.

Rather than relying on expiration dates or a 'sniff test', people could soon be able to tell at a glance whether their fish is still good to eat. This has the potential to reduce food waste significantly, particularly in the retail and hospitality sectors, where uncertainty about freshness often leads to premature discarding of food.

Even more ambitiously, the NOVISHPAK team is exploring the development of mercury detection sensors. Given the increasing concern over heavy metal contamination in fish, this feature could add an entirely new dimension to food safety, alerting consumers to dangerous levels of mercury in real time. If successful, this innovation could empower people to make more informed choices – particularly vulnerable populations like pregnant women and children, for whom mercury exposure can be especially harmful.

TURNING SEAWEED AND FISH WASTE INTO PACKAGING

Creating packaging from biodegradable materials is no small feat – particularly when that packaging must perform just as well as plastic. The NOVISHPAK team has had to carefully engineer a material that is not only sustainable but also durable, food-safe, and functional under real-world conditions.

Right: The Novishpak film without an indicator incorporated into it

Bottom: The Novishpak film with a green indicator in it that turns red in the presence of amines released from decaying fish

Photos courtesy of the Novishpak team

The packaging film is composed of two main ingredients:

- Gelatin derived from fish waste – This protein-based polymer provides structural integrity, forming a strong and flexible matrix.
- Sodium alginate extracted from seaweed – A carbohydrate polymer that enhances film flexibility, water resistance, and biodegradability.

This combination of biopolymers yields a compostable material tailored to the unique needs of seafood packaging. However, this did not come without its challenges. Seafood packaging – especially for fresh or processed fish fillets – must withstand moisture while maintaining barrier properties and mechanical strength. To address this, the team crosslinked the polymers in a way that enhances strength without sacrificing flexibility.

One of the main technical hurdles was achieving hydrophobicity – that is, making the film resistant to water so that it does not degrade or dissolve prematurely. This was essential to ensure the material remains intact in the cold and wet conditions commonly associated with seafood packaging. Another key consideration was the integration of freshness indicators, which need to remain chemically stable, non-toxic, and unable to migrate into the food. This added another layer of complexity, as the indicators must remain effective without compromising the film's integrity or safety.

THE UNIVERSITY OF MALTA'S ROLE IN NOVISHPAK

NOVISHPAK is a multidisciplinary and multi-institutional effort, drawing on expertise from across several European states. As a key player in the project, the University of Malta is actively involved in research on the synthesis and analysis of the packaging films. The UM team, headed by Prof. Ruben Gatt and including Prof. Pierre-Sandre Farrugia and Dr Roderick Abdilla from the Metamaterials Unit, is focused on studying the chemical, mechanical, and structural properties of the materials. Their work involves understanding how different polymer ratios and treatments affect the strength, elasticity, moisture resistance, and biodegradability of the films.

Meanwhile, together with the University of Malta, partner institutions (listed below) are handling other components of the project. These include the development of colourimetric freshness indicators and antimicrobial functionality, as well as testing various synthesis methods for scalability. By exploring several pathways in tandem, the consortium aims to identify the most efficient and cost-effective route to market. This collaborative model allows NOVISHPAK to tackle the challenge from multiple angles, integrating scientific, technical, and commercial expertise.

A BROADER IMPACT FOR MALTA AND BEYOND

The potential impact of NOVISHPAK goes beyond technical innovation. Locally, it could reduce Malta's reliance on imported plastic packaging while creating new opportunities in green technology and food safety research.

'Since we import nearly all of our plastic packaging, creating a local alternative made from by-products available here would be a major advantage,' Abdilla notes. 'It's also a great platform for students and researchers to explore further innovation.' Perhaps more importantly, the project could benefit public health. 'People will be eating fish with fewer toxins, less microplastic contamination,' says Abdilla. 'That's not just a packaging issue – it's a food safety issue.'

Although still in the development phase, NOVISHPAK is making encouraging progress. Having launched just six months ago, the project is already showing promise and is set to continue through to 2027. Currently, it sits slightly below the midpoint on the Technology Readiness Level (TRL) scale, indicating that it has moved beyond the theoretical idea and proof-of-concept stage, and into further material improvement and sensor development. With interest growing among fish industries across the Mediterranean, there is strong potential for real-world application and wide-reaching impact.

NOVISHPAK is more than just another eco-friendly innovation – it is a blueprint for the future of food packaging. By combining waste reduction, intelligent monitoring, and circular design, it has the potential to redefine not just how we package fish, but how we think about packaging altogether. It could become a scalable model for a range of other food products and fresh produce. It is a powerful demonstration of how applied research can deliver real-world benefits, striking a balance between technological sophistication and environmental responsibility.

The University of Malta is a participating partner in NOVISHPAK, in consortium with Hellenic Agricultural Organization (Dimitra), the National Kapodistrian University of Athens, Greca Pesca, École Supérieure des Sciences de l'Aliment des Industries Agroalimentaires, Université Mohammed Premier Oujda, Leibniz Institute for Agricultural Engineering and Bioeconomy, the International Centre for Advanced Mediterranean Agronomic Studies (Montpellier), and the University of Tunis El Manar. The NOVISHPAK project is financed by Xjenza Malta (formerly the Malta Council for Science and Technology) through the PRIMA initiative of Member States, Associated Countries, and Participating Countries, which is in turn supported by the European Union.

Waddling into Words: A Board Game for Language Disorders

Author: **David Mizzi**

What if therapy could feel more like play? For children with Developmental Language Disorder, acquiring language can be challenging – but a team of researchers and game developers in Malta has created a board game that makes the process fun, engaging, and effective.

Seeing children grow up is magical. The way they absorb information – especially words they shouldn't, like a quick cuss that slips out – puts a sponge to shame. But while every child learns language at their own pace, there are, unfortunately, cases where children experience difficulties.

Neurodevelopmental conditions, such as ADHD, dyslexia, and autism, are well known; however, a growing number of children are being diagnosed with Developmental Language Disorder (DLD). In the UK, 7.5% of children are affected – the equivalent of roughly two children in every class of 30 pupils struggling to progress academically. At the time of writing, no data is available on the number of diagnosed cases in Malta.

'DLD is the white whale of speech and language therapy,' explains Speech and Language Pathologist (SLP) Donia Stellini. As a relatively unknown condition, DLD is difficult to diagnose. 'If, until age five, we see a child experiencing language difficulties, we try to identify the cause – this could be Autism Spectrum Disorder, for example. We carry this out alongside a multidisciplinary team, as speech and language therapists do not diagnose medical or neurodevelopmental conditions,' says Stellini, 'If language difficulties persist beyond the age of five, and no neurodevelopmental or social causes are identified, then – if the clinical markers are present – we would consider a diagnosis of DLD.'

Treating DLD and other communication conditions is an SLP's bread and butter. While therapy sessions can help children, their impact needs to be reinforced through regular use – and what better way to reinforce learning than through play? Flying Squirrel Games and the University of Malta (UM) have collaborated to create *Olly's Adventures: The City of Two Languages*, a board game developed alongside SLP specialists to support children diagnosed with language difficulties.

MEET THE TEAM

Flying Squirrel Games is a local video game studio that has developed titles such as the popular *Dirt Trackin'* and *Dirt Trackin' Sprint Cars*, both of which consistently rank in the Top 10 on the App Store and Play Store. In addition to mobile and VR games, the studio is no stranger to therapeutic games or games with a learning element (referred to as serious games), and has regularly collaborated with UM.

Character design of Olly the penguin
Image courtesy of Anthony Demanuele

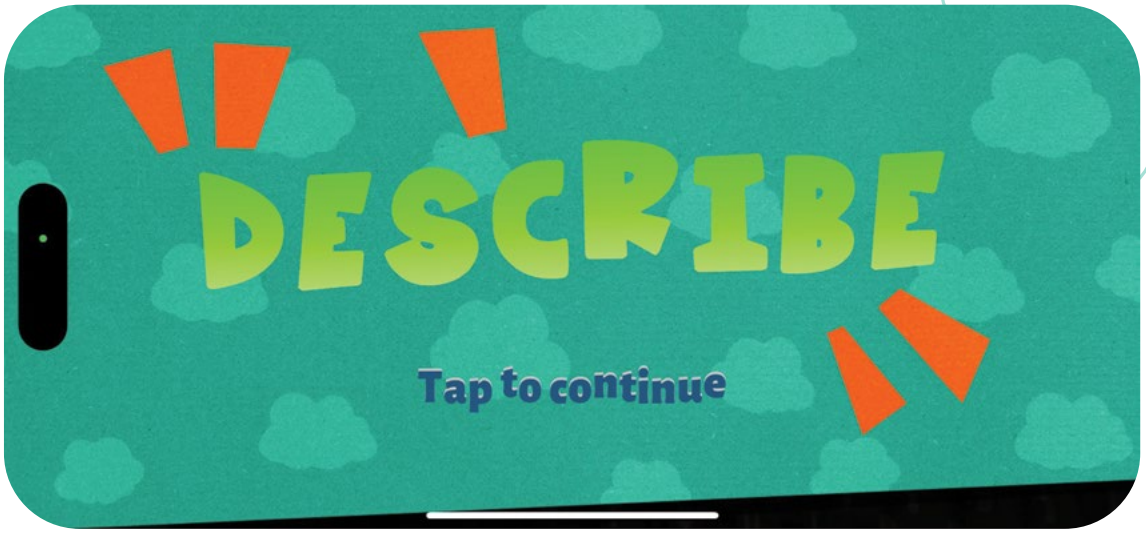
Anthony Demanuele, the studio head of Flying Squirrel Games, explains: 'Our collaboration with the University of Malta began in 2016 when we contributed to the development of *Olly Speaks* – an innovative toy that resulted from the SPEECHIE Project led by the Department of Industrial and Manufacturing Engineering (DIME). Our primary role was to develop digital games installed on *Olly Speaks*, working closely with experts in DLD and SLPs from the Department of Human Communication Sciences and Disorders. *Olly Speaks*, an interactive penguin toy with an embedded screen, allows children with DLD to play games. It even featured blinking eyes and a backpack that opens up. The first 3D-printed prototypes were tested locally and in Spain. Although it was well received, the endeavour proved too expensive to push to market.'

'The next step was *Olly's Adventures: The City of Two Languages*. We tried to keep the same benefits as the first Olly, but this time as a board game. We toyed with some exciting ideas, such as using electronic boards; however, the cost of the final product was always in the back of our minds,' says Demanuele. While serious games that help language development exist, they are usually trivia-based. A serious board game with a companion app is virtually nonexistent, making *Olly's Adventures* one of a kind. The studio worked alongside Prof. Ing. Philip Farrugia and Dr Ing. Edward Abela from DIME, Prof. Daniela Gatt and Prof. Helen Grech, SLPs from UM's Department of Human Communication Disorders and Sciences, as well as Stellini, who at the time, was reading for her master's with the latter department.

HOW DOES THIS GAME WORK?

Games need to be fun. The challenge for *Olly's Adventures: The City of Two Languages* is to be both educational and fun, even for players who do not have a language issue.

A typical game lasts around 30 to 40 minutes and involves 2 to 4 players: a moderator (such as a parent or therapist) and 2 to 3 players. You will have a deck of cards, a board, and a companion app for your phone. It is important to note that this is not a mobile game; the app is there to facilitate gameplay. The game is turn-based, and the goal is to get your own brightly coloured penguin to the finish line first.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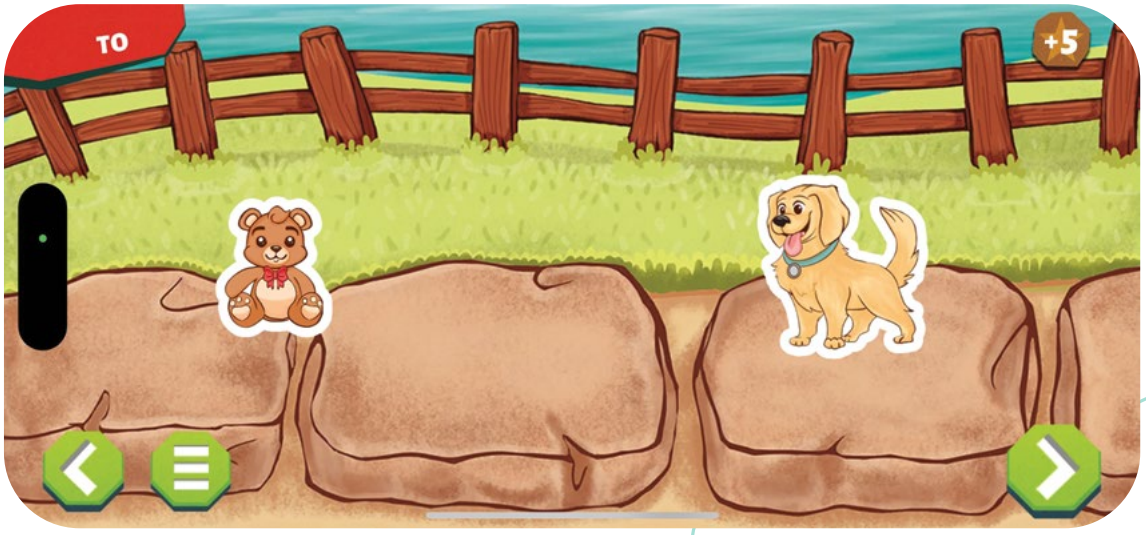
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Left: A selection of screenshots showing the minigames within the companion app for the boardgame.

Images courtesy of Anthony Demanuele

There are eight types of cards, each with its own QR code. Each card correlates to a different minigame. Winning these minigames earns players points, which are used to race their penguins across the board. These minigames are inspired by activities that children engage in during therapy sessions. For example, one minigame called *Describe* shows the player a picture through the app, and players must describe what they see. Another minigame, called *Odd One Out*, requires players to choose the odd word out from a selection displayed on the companion app.

The game is designed to allow players with varying language abilities to play together. So you might have a five-year-old with language difficulties playing with their older sister, with each minigame adjusted to suit the individual player's level, keeping the overall experience fun and challenging. 'On the companion app, each player has a specific profile set according to their level,' explains Demanuele. 'So, the questions in each minigame are tailored to the individual player.'

While each minigame awards players a fixed number of points, bonus points can be granted at the moderators' discretion. For example, in *Odd One Out*, players may earn extra points if they can explain their reasoning. 'The moderator plays a critical role; losing is a natural part of any game, but in ours, positive reinforcement is crucial, as we are trying to encourage language development,' emphasises Demanuele.

Another family-friendly feature of the app allows the game to be paused (for example, at dinner time) and resumed later. Each player can also choose whether they want to play in English or Maltese.

HOW CAN A GAME HELP?

Games are incredibly effective at keeping children engaged – as any parent who has tried to drag their child away from a PlayStation will know. Play is also an effective pedagogical tool. 'It is the language of children – they learn about the world through play,' says Stellini. 'My role was to create the minigames used in *Olly's Adventures*. I brought in therapeutic insights about what might work with children, as these games are inspired by activities used in therapy sessions.'

'When you put people in a game environment rather than a clinic, the differences are astounding,' says Anthony. 'The challenge was making these games work in a board game format. In the clinic, they use a variety of games; for *Olly's Adventures*, we were trying to bring all the games together in one box,' he explains. 'We brought the therapeutic process into the game. It supplements a therapy session, with the moderator acting as a mini-therapist,' adds Stellini.

FUTURE PLANS

There are around 50 public speech clinics in Malta, as well as SLPs in all public schools, each supporting numerous children with varying language difficulties. A board game like this not only helps undiagnosed children but also those simply trying to learn the language.

'There are a lot of benefits to having something like this. We want to see the game in every speech clinic. While *Olly's Adventures* is specifically tailored to Malta, in the future, we want to try and address STEM as well – creating a game to teach Science or Mathematics in a more engaging way,' explains Demanuele.

The goal along the way has been to make *Olly's Adventures* affordable. The game itself, along with lifetime access to the companion app, is priced like any typical board game – at €40. *Olly's Adventures: The City of Two Languages* can be used to supplement speech therapy sessions, help those trying to learn Maltese, or be a fun addition to family game night! The game is currently in its final stages of development and will be available in stores later this year.

Olly's Adventures: The City of Two Languages stems from the SALTT-CITY project, a collaboration between various researchers at UM and Flying Squirrel Games. Initially funded through Xjenza Malta (Project Reference no. SCP-2022-007).

Further Reading

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AI in the Classroom: A Tool for Learning or a Shortcut to Superficiality?

Author: **Christian Keszthelyi**

Artificial intelligence, specifically generative AI, has taken centre stage, forcing universities to rethink learning, assessment, and academic integrity. At a recent panel discussion, academics and students grappled with a key question: Does GenAI enhance education or encourage intellectual shortcuts?

Once upon a time, the great debate in education was whether students should be allowed to use calculators. Today, the conversation has shifted to generative artificial intelligence (GenAI) – an even more transformative tool, challenging traditional teaching, assessment, and learning methods.

At a recent panel discussion, educators pondered whether GenAI – such as ChatGPT, Copilot, or DeepSeek – is an enabler of deeper intellectual engagement or whether it fosters a generation of students who outsource their thinking. As universities scramble to adapt, the debate rages on. Should AI be embraced, restricted, or fundamentally redefined in academic settings?

THOUGHTFUL DISTINCTIONS

Introducing the panel discussion, the organiser, Dr John Ebejer, took the floor to clarify an important distinction. 'When discussing AI and GenAI, we must be clear about the difference between the two. GenAI scrapes data from the internet, using Large Language Models (LLM) to generate text. AI, on the other hand, refers to software that facilitates specific complex tasks such as computation, drawing, and data processing. Some professions, such as engineering and architecture, have been using AI for decades. The use of AI is overwhelmingly beneficial. GenAI, however, requires careful oversight in student use to maximise learning.'

Prof. Matthew Montebello opened the panel discussion with a firm opinion. He believes AI empowers students and educators, but must be used wisely. 'In early 2023, I brought students before the disciplinary board for submitting AI-generated work they couldn't explain. It was an experience that highlighted the risks of blind reliance on GenAI. It is just a tool, not a sentient entity. When

misused, it bypasses learning rather than enhancing it. True education requires critical thinking, and GenAI should support, not replace, that process,' Montebello said.

Prof. Lidija Petrić, who has extensive experience in teaching and research, said that although the University of Split, Croatia, is still in the early stages of discussing the implications of generative AI both for students and professors, they are beginning to see cases where students use AI to generate assignments in a way that borders on academic dishonesty.

'We are still figuring out how to address these challenges, but it's clear that GenAI is reshaping the academic landscape, and we must find the right balance between embracing innovation and maintaining academic integrity,' Petrić said.

Student Michael Awanah offered a foundationally different point of view: 'In Ghana, where I attended high school, we often faced challenges accessing quality education. Sometimes, we had to wait for delayed or absent teachers, and we didn't have textbooks. If we'd had AI-driven learning tools, students could have engaged in self-directed study instead of waiting passively. In this sense, GenAI has the potential to bridge educational gaps and make learning more accessible.'

Using GenAI, however, requires careful attention. Ease and convenience may put students at risk of over-relying on the technology without grasping the reasoning behind their work. A balanced approach maximises GenAI's benefits while ensuring genuine learning. Education systems must guide responsible AI use, emphasising human responsibility over mere capability. The goal is not to replace intelligence, but to enhance it in the pursuit of meaningful progress.

'As an educator and researcher, I see AI as a permanent fixture in our lives, enhancing efficiency in transportation, communication, and marketing. It also fosters

collaboration by bridging disciplines and perspectives,' Dr Karen Mugliett said.

However, responsible AI use is crucial. Digital literacy is essential for educators and students, ensuring informed engagement in a rapidly evolving landscape.

'Ideally, generative AI should serve as a tool for discussion, creativity, and intellectual exploration. AI plays a role in brainstorming, refining ideas, and improving one's work. Researchers and students have been using it, and there's no reason to be ashamed. AI has even helped me improve my English, and I'm proud of the high-quality texts it has enabled me to produce,' said student Lola Mindt.

TRANSFORMING PEDAGOGY

The gradual integration of GenAI into everyday life represents a broader trend in education: the use of technology to facilitate learning. AI has the potential to be a game-changer in higher education, transforming traditional models of teaching, learning, and assessment.

Higher education has long relied on lectures as the primary method of knowledge dissemination. However, lectures often involve minimal student interaction, especially in large groups. GenAI offers an opportunity to engage students more actively in the learning process. Educators adopting a constructivist approach can use GenAI to promote critical thinking, decision-making, and problem-solving. When used effectively, GenAI can enhance the learning experience rather than serve solely as a passive tool for information delivery.

If used effectively, GenAI can enhance students' cognitive processes and critical thinking skills. However, this requires proper training for educators, supported by systemic changes and both methodological and technological support. Panel participants posed the question: are we adequately prepared to integrate GenAI into our teaching methods? Do we have the necessary skills to guide students in using GenAI responsibly? These questions remain open, but they must continue to be asked if the education system is to evolve for the benefit of the students and society at large.

AI is a disruptive innovation in education, much like previous technological advancements. The challenge lies in ensuring that educators receive proper training and continuous professional development to maximise the use of these tools, the panellists discussed. In many universities, a Ph.D. is enough to qualify someone to teach, but effective teaching demands a distinct skill set – one that AI can support. Rather than resisting GenAI, the focus should

Tertiary Teaching and Learning: The Challenges and Opportunities of GenAI was the focus of a roundtable discussion held at the University of Malta on 11 February 2025. The panel brought together academics from the University of Malta, the University of Split, and Nord University, along with student representatives. The discussion featured the following panellists:

- **Prof. Matthew Montebello, specialising in Artificial Intelligence at the Faculty of Information and Communication Technology (University of Malta)**
- **Prof. Lidija Petrić, Full-time Professor at the Faculty of Economics, Business, and Tourism (University of Split)**
- **Prof. Albina Pashkevich, Associate Professor in Tourism Studies at the Faculty of Social Sciences, History, Geography and International Relations (Nord University)**
- **Michael Awanah, student of Artificial Intelligence (University of Malta)**
- **Dr Karen Mugliett, Senior Lecturer at the Faculty of Education (University of Malta)**
- **Lola Mindt, student of the Department of Tourism Management (University of Malta)**
- **Dr John Ebejer, Senior Lecturer at the Department of Tourism Management (University of Malta), with a career spanning academia, consultancy, and urban planning**

Photo by James Moffett

be on harnessing its potential to benefit students and educators alike.

Panel participants agreed that, at university level, the focus must remain on teaching – on direct communication and the encouragement of critical thinking – regardless of whether GenAI is used. Educators must adapt, but not at the expense of the pedagogical fundamentals. Teaching students how to research effectively has, and always will be, crucial. It is not just about Googling for answers; it requires an understanding of what constitutes credible academic sources, how to analyse information, and how to distinguish reliable research from misleading content. Proper referencing is one area where GenAI presents challenges. 'I have encountered several students submitting references that do not exist,' Ebejer noted.

Representing their academic institutions, the panel participants agreed that educators are responsible for ensuring that learning remains rigorous. 'We need to rethink how we design assessments and assignments. We must ensure that students engage deeply with their work rather than passively rely on AI-generated material. This is an issue we need to address proactively,' Montebello concluded.

ETHICAL EVOLUTION

Discussions around GenAI are polarising. Some people fully embrace it, while others completely reject it. However, GenAI should be approached with a balanced perspective rather than reacting with fear or resistance.

Before the spread of technology, knowledge was exclusive to universities. Professors and lecturers were the beacons of knowledge. Students went to university to hear lectures and to the library to access information. That was where knowledge lived.

Knowledge is no longer confined to universities, as smart devices and e-book readers have democratised access, breaking down barriers that once excluded many. That said, access to knowledge remains expensive for many, and the technological divide still exists.

This shift redefines the role of educators, not just as sources of knowledge, but as guardians of academic integrity – a vital and demanding responsibility. Every field has both ethical and unethical players. "Free riders" have always existed, and educators, now more than ever, must hold them accountable.

AI is neither a threat nor a shortcut. It is a tool, and its impact depends on how it is used and regulated. The challenge for educators is not to resist change but to guide students in using AI responsibly, ensuring that learning remains deep, critical, and meaningful.

Into the Deep: How Neil Agius Pushes Human Limits to Inspire Change

Author: **Christian Keszthelyi**

***Neil Agius**'s swimming grips beyond a Guinness World Record-book-worthy publicity stunt. It is a story of endurance and becoming one with Mother Nature and the mind – one stroke at a time.*

Neil Agius is not just pushing the limits of human endurance – he is redefining them. The Maltese Olympian turned ultra-swimmer has spent days swimming in open water, battling exhaustion, hallucinations, and the relentless pull of his limits. But for Agius, the true challenge is not just physical – it is mental. Through his record-breaking swims and environmental activism, he is not only testing himself, but also inspiring a movement that challenges people to embrace discomfort, push beyond perceived boundaries, and protect the waters that connect us all.

But what is it like to be in a multi-day swim? 'When I swim for 60 hours straight, it's like a roller coaster inside my head. The key is to maintain a high level of focus and stay present for as long as possible. The moment I lose that focus, my efficiency drops. Unlike walking or running, swimming requires overcoming drag – we aren't naturally built for it. Every movement – tucking my chin, engaging my core, using my hips for momentum – affects the longevity of the swim,' Agius says.

Initially, staying consistent is easier, but after two days without sleep, he starts forgetting those crucial details. There are moments of pure flow when everything feels smooth, and then there are times when exhaustion sets in, and Agius starts questioning his life choices.

MIDNIGHT CURRENTS

Swimming through the night is wildly surreal. 'It's pitch black except for the red navigation lights on the boat beside me. Sometimes, I glimpse a shadow below me and wonder – was that real? Am I imagining things? It's a constant balance, not a battle, with the elements. The sea dictates the movement, and I must dance with it rather than fight against it. When the waves get rough, I move with them, weaving into their rhythm rather than resisting,' Agius says.

In such a delicate situation, breathing is everything. Agius always swims freestyle and takes a breath on every second stroke – this feels most efficient. Keeping a steady supply of oxygen is crucial for his lungs and muscles to sustain swimming for many hours. He never switches strokes or swims backstroke. He engages in a continuous rhythm of freestyle because that has proven to be the most efficient way to keep moving forward.

That is the rhythm that takes Agius into a near-meditative state. 'The repetitive motion creates a

Photo courtesy of Neil Agius

kind of moving meditation. But even in that state, I have to stay very present because small details matter. It's easy to slip into autopilot, but maintaining presence and focus is essential,' Agius says.

But not even mindfulness and meditation can counter the effects of being awake for many hours. 'Sleep deprivation, repetitive movement, and rhythmic breathing create the perfect conditions for hallucinations. The key is not to engage with them. If you focus on them, they grow, becoming more vivid, and before you know it, you're completely immersed in them, losing all sense of presence and efficiency,' Agius says.

And, while hallucinations may sound fun, on a sixty-hour swim – in pitch darkness and cold water – this full-on 3D experience can get intense. 'This one time, for example, I would turn to breathe and think my team was passing me something. I'd see them reaching over the boat, so I'd stop only to realise there was no one there,' Agius says.

The hallucinations fascinate him, and once he is on land, not dancing with the elements anymore, he likes his retrospective introspection to assess what he saw. 'During my 2021 swim, I hallucinated an underwater city, almost like Atlantis, with people holding hands and waving at me – some welcoming, others afraid. This time, I saw manta ray-like creatures gliding beneath me, then flipping their wings around themselves and walking together in groups,' Agius says.

So what does the science say?

Recent academic research has begun to unpack the complex mental and physical demands of ultra-endurance open-water swimming. A case study published in *Frontiers in Sports and Active Living* highlighted the critical role of team closeness and emotional support in coping with stress and recovery during such extreme feats – underlining how collective psychology affects performance and resilience in swimmers like Agius (Lykesas et al., 2023).

Complementing this, a 2023 *European Journal of Sport Science* paper examined neurocognitive function and perceived exertion in long-duration events. The study suggests that extended physical efforts significantly impact mental acuity and decision-making – insights that mirror Agius's own experiences with sleep deprivation, hallucinations, and the importance of mindfulness (Zinner et al., 2023).

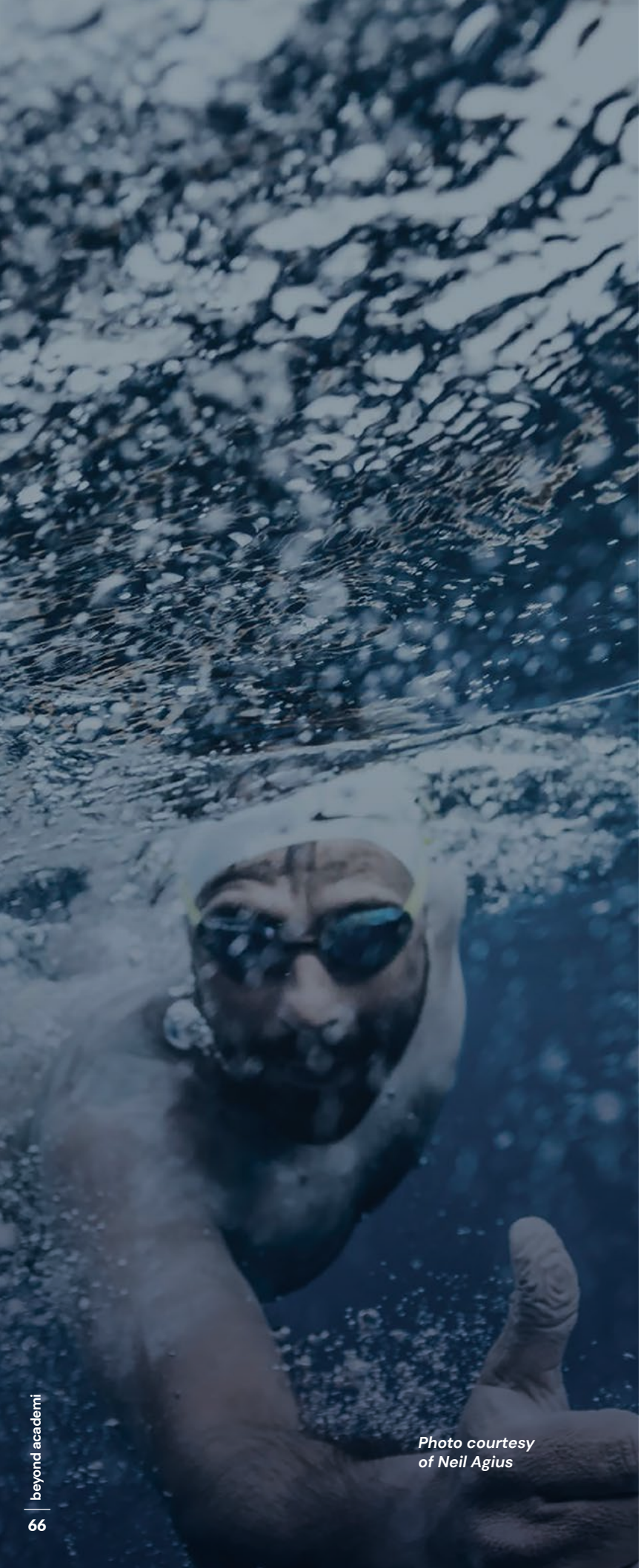


Photo courtesy of Neil Agius

Furthermore, nutritional considerations are gaining attention in the scientific literature. A recent review in *Nutrients* explored the dietary strategies needed to support ultra-endurance swimming – such as maintaining energy availability and mitigating muscle damage – key factors in sustaining performance in multi-day swims like Agius's (Rojas-Valverde, 2023).

MIND STORMS

Preparing for a long, sleepless, hallucination-ridden swim is best done by getting used to swimming for stretches at a time. However, Agius uses many other approaches to prepare.

'There's a lot of mental training beyond the physical. But it's not something you can just Google; there's no set formula. It's all self-taught, and my entire life is built around testing myself. I constantly put myself through challenges on land to train my mind – things like two-week detoxes from alcohol, sugar, or coffee. These exercises teach me how to control cravings and override impulses, which translates directly to endurance swimming,' Agius says.

But how can you get centred in the middle of a sleep-deprived, wandering, flailing mind? Sleep deprivation worsens over time. After 24 hours, it impairs focus and coordination; at 36

hours, microsleeps and cognitive issues begin; by 48 hours, hallucinations and paranoia set in; and beyond 72 hours, severe mental and physical breakdowns occur. The longest recorded case of someone staying awake is 264 hours, 11 days, but while sleep deprivation is highly harmful, no confirmed human death has yet occurred solely from lack of sleep.

Good news. That must mean one can train for sleep deprivation. 'You can't train for sleep deprivation in the traditional sense. It's not like I can decide: okay, once a month, I'll stay awake for two days to get used to it for my swims. It doesn't work that way. In fact, it's the opposite – the more you sleep and build up a sleep bank, the better your ability to stay awake when needed,' Agius says.

In Neil's experience, everyone has a different baseline – and his seems to be relatively high. In his last swim, he was in the water for 61 hours, but counting the time he was awake before and after, it was probably around 75 hours. Agius is still some 198 hours behind 17-year-old Randy Gardner, who completed the longest scientifically documented period without sleep in 1964. Granted, Gardner did not continuously swim in the sea, but he played basketball, listened to the radio, conversed, and even attempted to play pinball as part of his controlled science fair experiment.

The herculean sleepless swimming taught Agius to be more methodical about his sleep. 'When it's time to sleep, I know how to wind down. I use breathwork techniques to bring all the noise down to zero. Sometimes, it's not even about screen time but about managing my work schedule to ensure I can properly prepare for sleep.'

He works on maintaining a consistent sleep routine to ensure quality rest. He also uses wearable technology to track his sleep cycles, which he finds helpful – but does not treat the data like gospel. 'Just because my watch tells me I didn't sleep enough doesn't mean I have to accept that I'll have a bad day, and the opposite is true, too. It's important to take control of your state of mind and not become overly dependent on external metrics,' he says.

PURPOSE RIPPLES

As the once-Olympic swimmer became known as a force to be reckoned with, he realised the broader impact of his swims: inspiring others to take on personal challenges, prioritise movement, and develop mental resilience. Beyond endurance, his message is about overcoming pressure – whether from work, relationships, or social expectations – and finding ways to navigate life with strength and purpose.

Is he satisfied with the waves he is making? 'Yes. For me, it's about building community, bringing people together, and sharing stories and tools. We've come a long way in Malta, especially regarding sustainability and awareness of how much we're polluting our seas and our land,' Agius says.

When he and his team started Wave of Change in 2018, only a handful of people were involved in this kind of movement. Now, the team sees NGOs organising cleanups, companies taking an interest, and actual momentum building. Agius believes they have played a significant role in creating that shift.

What is the biggest lesson from all his discipline and swims? 'Our mindset towards challenges. In life, in sports, and in work, we train to avoid difficulty. People work hard to prevent moments where they feel overwhelmed. But for me, that moment when my body and mind are telling me to stop is precisely what I train for. I don't avoid the "pain cave". I seek it out to test everything I've learned in those hours of training, breathwork, and mental preparation to see if they work. Instead of dreading discomfort, I embrace it as the actual learning ground,' Agius concludes. And while he has nothing planned for the future, he loves what he is doing – so it would be difficult to say there will not be another swim coming up. Well, as the Stoics say: the obstacle is the way.

The Menstruating Mind: Metacognition Across the Cycle

Author: **Catherine Camilleri**

Can the menstrual cycle impact cognition? Is there a link between the cycle and the mind? ***Dr Nicole D'Amato Caruana*** *set out to answer these questions in her award-winning Ph.D. thesis, offering the future of research a deeper understanding of the connection between biology and cognition.*

At UM, researchers regularly make innovative and intriguing findings that push the confines of what we know to be true. The university's community of thinkers contributes to diverse fields, unearthing new knowledge and bringing fresh yet integral perspectives to phenomena. One such academic visionary is Dr Nicole D'Amato Caruana, whose groundbreaking research study exploring the impact of the menstrual cycle on metacognition won her the Faculty of Media and Knowledge Sciences Outstanding Ph.D. Thesis Dean's Award in 2024.

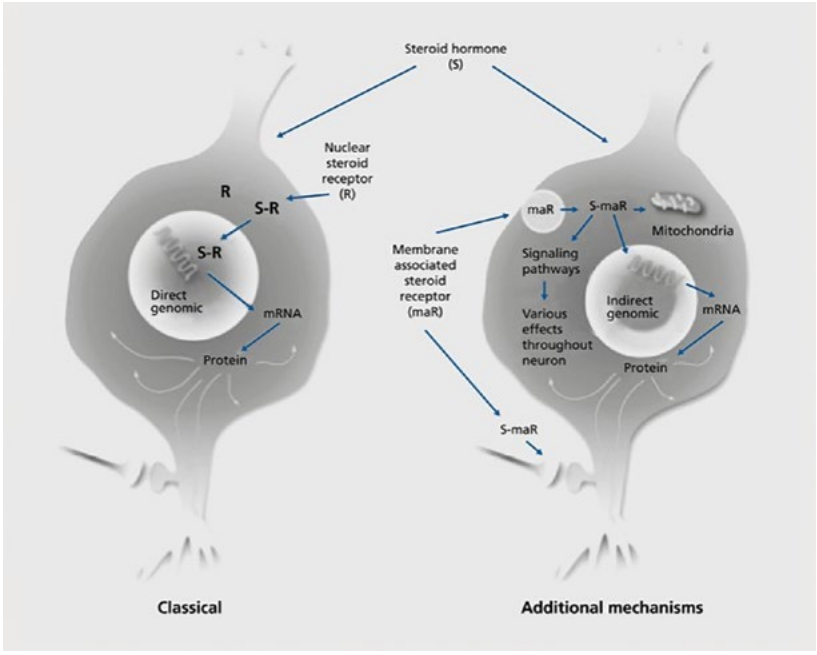
Her study – a juggernaut of scientific and social understanding – is a true game-changer in cognitive research and has weaved an important yet underrepresented perspective into academic discourse. D'Amato Caruana set out to understand how the monthly fluctuation of hormone levels that occurs during the menstrual cycle impacts women's perception of cognitive ability. In doing so, she has helped dismantle common misconceptions and challenged misinformation about how hormonal changes influence the way different women experience and interpret the world.

STARTING THE JOURNEY – WHO IS DR D'AMATO CARUANA?

D'Amato Caruana's Ph.D. journey began after completing her master's degree in cognitive neuroscience at Durham University, UK. She originally assumed she would undertake her Ph.D. studies abroad, but fate drew her back to the Maltese islands when she was offered the opportunity to continue her academic journey at UM. Settling at the Department of Cognitive Science marked a turning point in D'Amato Caruana's career trajectory when she was introduced by her supervisors, Prof. Ian Thornton (Department of Cognitive Science, University of Malta) and Prof. Jeff Kiesner (Department of Developmental Psychology and Socialisation, Università di Padova), to a school of research that explores the relationship between cognition and the cycle.

Dr Nicole D'Amato Caruana

Like many researchers, D'Amato Caruana was drawn to the topic through personal experience. As a scientist living with endometriosis – a chronic condition that affects roughly 10% of reproductive-aged women globally, according to the World Health Organization – 'I've experienced the suffering of the menstrual cycle firsthand, and I wanted to see what I could contribute to the field. That's



Sex hormones binding with brain receptors via genomic and non-genomic mechanisms[1]
Image courtesy of Dr Nicole D'Amato Caruana

what really motivated me to explore this area – it felt both personally meaningful and scientifically important.'

The relevance of understanding the relationship between cognition and the cycle is not to be underestimated. Billions of people worldwide experience the menstrual cycle – a recurring physiological process that is part of the broader menstrual cycle, which involves four phases and various hormonal and physical changes. But as D'Amato Caruana explains, the menstrual cycle is not just biological. There are psychological, societal, and cultural factors that play a role in how a person experiences their cycle, which is unique to each woman.

Hormonal fluctuations across the menstrual cycle are thought to influence cognitive functions such as memory, attention, behaviour, and mood. While many report symptoms such as forgetfulness, confusion, and indecision during certain phases, studies on actual cognitive performance remain inconclusive. Some show effects; others do not. Brain imaging research also presents mixed findings.

One possible explanation is metacognition – how individuals perceive their own cognitive performance – which may help explain the gap between how people feel and how they perform. D'Amato Caruana's goal? To investigate how metacognitive symptoms vary across the cycle, how this differs between individuals, and what biological mechanisms underlie these changes.

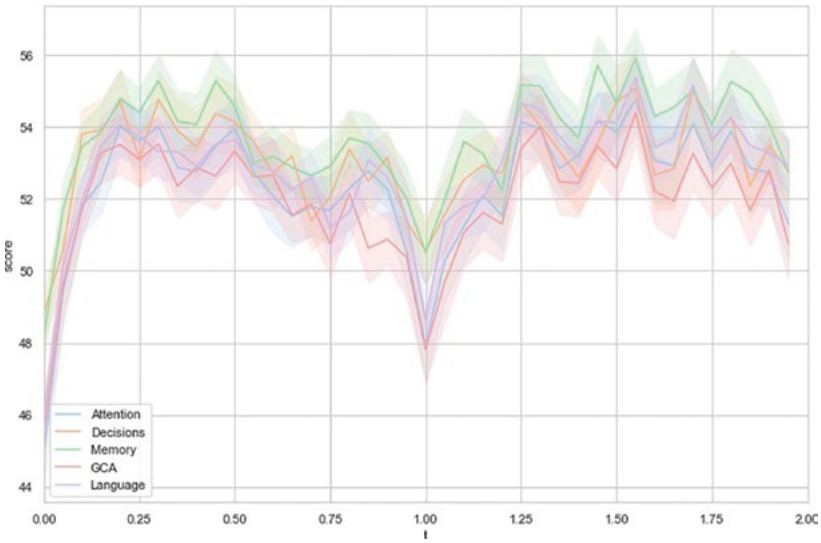
D'Amato Caruana created a research tool specifically for her study: the Daily Online Metacognitive Evaluation – a novel questionnaire that could track the participants' daily cognitive, physical, and affective symptoms throughout two menstrual cycles. Period apps and trackers were also used to chart the participants' different phases through their monthly cycle since everyone's cycle varies. In this systematic way, D'Amato Caruana could observe how menstrual symptoms differ between participants, looking into the individual's experience and providing a deeper insight into the relationship between cognitive, physical, and affective changes that can occur during the menstrual cycle.

QUANTIFYING METACOGNITION AND THE MENSTRUAL CYCLE

Before tackling the core of her research, D'Amato Caruana began with a pilot study to test her methodological approach using both male and female participants. She immediately sensed the gender bias. As individuals who commonly experience the effects of the cycle, it was clear that women were eager for and engaged with this kind of research; as D'Amato Caruana explains, 'if you're going through the experience regularly, you are more invested in understanding its nuances'. Therefore, during the recruitment process, she contacted UM departments that draw in a larger demographic of female students, such as psychology, education, and nursing, to attract participants. In addition to contributing to groundbreaking research, participants were able to receive specialised information unique to their cycle and see how their individual hormone fluctuations impact them personally. D'Amato Caruana's recruitment efforts were successful; she had 120 participants and minimal dropouts along the way, leading to a robust data collection that fuelled her research.

What struck her most was how invested people were in participating

[1] Marrocco, J., & McEwen, B. S. (2016). Sex in the brain: Hormones and sex differences (pp. 374)



Metacognition oscillates in time to the menstrual cycle showing mid-cycle improvement and perimenstrual decline. The figure shows score–time plot for cognitive variables

Image courtesy of Dr Nicole D'Amato Caruana

in the study, despite needing to complete daily questionnaires about their symptoms for two full menstrual cycles – even up to three months of daily monitoring, depending on the length of their cycle. 'This was hard work for the people who took part,' D'Amato Caruana says. 'It was a real commitment. But everyone wants to share their own experience. Everyone wants to tell you what they went through and are suffering from, which is exactly what I was looking into.' The participants' commitment to documenting their daily menstrual experiences shows just how fruitful this kind of research is – not just for women, but also for scientists and scholars eager for data on real-life experiences.

At the end of data collection, D'Amato Caruana could see just how massive the response was – a total of 7,172 questionnaires were collected from participants, and she had the task of sifting through them all! However, despite the gruelling undertaking, D'Amato Caruana believes that the sheer volume of data collection was a significant strength of her research. Using multilevel modelling and structural equation modelling, D'Amato Caruana was able to extract results that clearly captured an effect of the cycle on metacognition: all reported metacognitive abilities declined at the start of the cycle and improved in the middle of the cycle.

Specific cognitive, physical, and emotional symptoms were correlated, suggesting that they may share an underlying biological mechanism, with pathways such as stress-induced inflammation possibly affecting metacognition. D'Amato Caruana also mapped individual differences between participants, echoing Prof. Kiesner's own research findings, shedding light on variations in cyclical changes that reflect the uniqueness of menstruation. 'That's the beauty of it,' D'Amato Caruana relates. 'Everyone is so similar but so different at the same time'.

LOOKING TOWARDS THE FUTURE – ADVICE FOR FUTURE COGNITIVE SCIENTISTS

D'Amato Caruana's study has not only opened the door for future research on the menstrual cycle and metacognition, but also offers an important perspective for academics across various fields. Future research on the menstrual cycle must take individual differences into account, rather than focusing solely on average effects across all women. Given the significant role these differences play, it is essential to consider more personalised approaches to both diagnosis and treatment in women's healthcare. Additionally, the hormonal effects observed in menstruation should open up the conversation on current policies, such as the potential implementation of menstrual leave, to better support those who are affected.

Inspired by her findings, D'Amato Caruana's passion for research continues to grow, driving her to uncover new insights that contribute to human understanding. D'Amato Caruana is currently lending her knowledge to the Research Support Services Directorate (RSSD) at UM, where she works on building the research infrastructure to create a more collaborative and conducive environment for interdisciplinary research to thrive. As an active researcher who continues to explore the unexplored areas of human cognition, D'Amato Caruana's goal is to build on what she achieved with her Outstanding Ph.D. Thesis by advancing knowledge in the field and facilitating larger cross-disciplinary projects that can have far-reaching societal implications.

D'Amato Caruana also has advice for future cognitive science researchers: stay curious and embrace the diversity of the field. 'That's where you'll find unique insights into how the brain works,' she says. 'With cognitive science evolving rapidly and new technologies constantly emerging, gaining hands-on experience through internships, lab work, or independent studies is crucial for the development of practical skills. And if you're considering further study, the master's programme at UM is an excellent choice.'

Happily Ever After?

Written by
Ella Nordfeldt

Every girl dreams of her wedding day. A day above all others – placed on a pedestal, sheltered by a glittering glass dome. We hear stories from our mothers about that special day, when bands of gold and a kiss bind two souls for eternity. The music of applause, the laughter, the pure joy filling the air alongside flower petals, or rice. But of all the precious moments, there is one that is rehearsed endlessly in a little girl's mind: the aisle. Walking down a path decorated with flowers and ribbons, countless doting eyes are trained on you. You, and that dress. Fabric softer than a childhood blanket wrapped around you, and featherlight tulle just barely grazing the ground as each step carries you forward, your arm linked through your father's. Your future waiting for you at the end, tears in his eyes, and a blinding smile.

Finally, that day is here. My day, my turn. I squeeze my hands around my bouquet, a bundle of bright red spider lilies. Not a flower I would have chosen, but he said it had a special meaning to him. He's always right, so I never even thought of questioning them. I hear my cue in the soft tones of the piano and take my first step. Alone. Everyone is looking at me – faces I do not recognise, all his guests. Nerves shake through my body – not the flutter of butterflies, but something sharper. The feeling washes away as I glanced at my soon-to-be husband.

He doesn't smile at me. There are no tears in his eyes. But I walk towards him anyway. I'm drawn to him by something indescribable. It feels like a cord is pulling my heart to his – but it's more than that. I need to be with him. Every step closer feels like the first breath after drowning.

In all mothers' stories, the bride walks slowly, gracefully, her dress floating around her. I feel as if I'm running. My dress – the one he bought me – clings to me. Tight lace covers my arms, keeping them locked around the lilies. The bodice, rigid, cuts into me as if it's offended by my every breath. Even the constricting mermaid silhouette keeps me from outright sprinting towards the altar. Or running away. I don't know where that thought came from. I love that man, right? Something starts crawling up my throat – cold hands scratching at my insides. My mind screams the closer I get to him. What is happening? Why do I feel like this? I love him. I. Love. Him. I love him? Who? I don't even know his name. My heart pounds in my chest. This is a mistake. I need to run. I can't. I'm already here. His hand grabs mine.

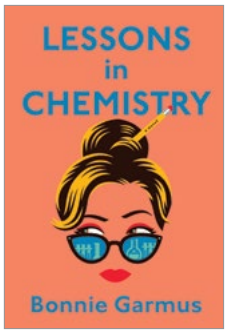
I can't hear the officiant speak. I feel my lace sleeve rip on his cufflink. He splays open my hand, and gold catches my eye. Everything slams into me at once – his face, that ring, the spell. I want to scream. But he's stolen my voice. The cold metal touches my skin and–

I smile at him and I can see it in his eyes: Our happily ever after.

Ella Nordfeldt is a third-year student with the Department of English and has received writing support through study units such as Creative Writing 1, Creative Writing 2, and the Undergraduate Writing Tutorials.

to-do list

book



Lessons in Chemistry *by* ***Bonnie Garmus***

After her career in chemistry is abruptly put on hold, Elizabeth Zott finds herself the reluctant star of America's most beloved cooking show, *Supper at Six*. But what she teaches goes beyond the kitchen.

videogame

Hellblade: Senua's Sacrifice *developed by* ***Ninja Theory***

Created in collaboration with neuroscientists and lived experience advisors, *Hellblade* is an action-adventure game that stands out for how sensitively and accurately it portrays mental illness, particularly psychosis, through audio-visual hallucinations.

series

Chernobyl

A factual dramatisation of the real-life 1986 nuclear disaster and the cleanup efforts that followed, immersing viewers in the creeping dread of the worst man-made accident and the institutional rot covering it up.

film

Interstellar *directed by* ***Christopher Nolan***

Melding visual and musical artistry with physicist Kip Thorne's scientifically-accurate calculations of black holes, wormholes, and time dilation, *Interstellar* is both a cinematic and intellectual achievement.

Brian's Corner

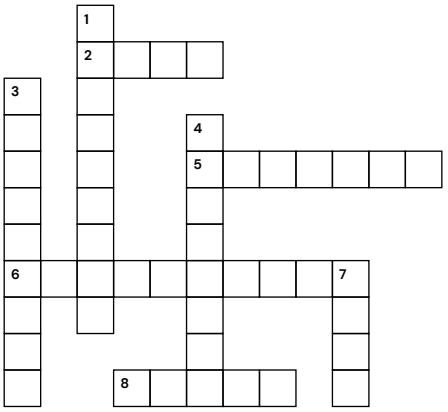
Crossword Puzzle

Across

2. Plenty of ___ in the sea
5. A solid area of rock; a stable foundation for ideas and principles
6. A group of people, organisations, or companies working together
8. Old-fashioned and outmoded

Down

1. Someone who performs the ceremony at a wedding or funeral
3. To repeat a process in exactly the same way
4. The opposite of concrete; a short overview of a study
7. To make fun of someone; practice before a real exam



THINK Edition 46 Crossword Answers

Across: 5. Microbiome, 6. Sample, 8. Waste **Down:** 1. Alien, 2. Hubris, 3. Drone , 4. Signal, 7. Stasis


103.7
campus
THE SOUNDTRACK TO
THINKING DEEPER
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