SPECIAL THINK EDITION

UM RESEARCH EXPO 2024

Excel in your field

follow the latest UM research

Scan me
to subscribe
to **THINK**
Magazine

thinkmagazine.mt

editorial

UMRE24

In May 2024, the University of Malta Research Expo (UMRE24) made its mark as the interdisciplinary research forum of the year on our Maltese Islands. With over 300 oral presentations and posters, attendees had the opportunity to network and engage in discussions about their research, encouraging future collaborations.

UMRE serves as a meeting point for colleagues and peers to disseminate and promote strongly the wide spectrum of research activities that take place at our University. From doctoral student presentations to the multidisciplinary nature of the Expo, UMRE24 served to facilitate the formation of new ideas for further research.

> 'It is of utmost importance that the research that is conducted at University is shared among researchers within the University itself to instil multidisciplinary collaboration, and it is equally essential for us to display the results of our research outside the University to society.'
>
> – Prof. Ing. Simon Fabri
> (Pro-Rector for Research and Knowledge Transfer, and Chair of UMRE)

The University of Malta is committed to positively impacting and supporting the local and broader international community through research, innovation, and knowledge. Since its inception, **THINK** has worked to share the University's initiatives with the broader society. In the spirit of UM's commitment and UMRE24, **THINK** embraces and indeed spearheads this need for dissemination through this special edition.

As a snapshot of the UMRE experience, this edition highlights the value of research and innovation wherein it collects twelve thought-provoking articles from the four UMRE streams: Education, Humanities, and Law; Architecture and STEM; Life Sciences and Medicine; and Social and Behavioural Sciences. Now, as ever, **THINK** invites you to think and enter into the conversation.

Prof. Ing. Simon G. Fabri
Editor-in-Chief
simon.fabri@um.edu.mt

Rebekah Zammit
Editor
rebekah.zammit@um.edu.mt

THINK
IDEAS · MALTA · RESEARCH · PEOPLE · UNIVERSITY

UMRE Special Edition

EDITORIAL BOARD
Prof. Ing. Simon G. Fabri EDITOR-IN-CHIEF
Prof. Noellie Brockdorff
Prof. Nicholas Vella

EDITING
Rebekah Zammit EDITOR

DESIGN
Gabriel Izzo DESIGNER
Nicole Pace DESIGNER

PROOFREADING
Amy Borg

PRINTING
Gutenberg Press Ltd., Malta

CONTRIBUTORS

Jonathan Borg
Dr Claudia Borg
Prof. Simone Borg
Dr Analisse Cassar
Rosangela Faieta
Dr Ing. Jason Gauci
Christie Hili
Prof. Sandro Lanfranco
Prof. Robin A. Nelson
Kannan Pashupathy
Prof. Michael Spagnol
Christine Spiteri
Dr Marc Tanti
Prof. Ian Thornton
Prof. Odette Vassallo
Estelle Zahra
Dr Ing. Brian Zammit

WRITERS

Timothy Alden
Andrea Cuschieri
Jonathan Firbank
Noah Galea
Maria Chiara Grech
Christian Keszthelyi
Sebastião Miranda
David Mizzi
Erika Puglisevich
Antónia Ribeiro
Elena Said
Sarah Schembri
Neil Spiteri

ISSN 2306-0735 | Copyright © University of Malta, 2024

University of Malta, Msida, Malta
Tel: (356) 2340 2340 | um.edu.mt

L-Università ta' Malta

cover

THINK is a research magazine published by the Marketing, Communications & Alumni Office at the University of Malta.

To subscribe to our blog, log into **thinkmagazine.mt/subscribe** and fill in your details.

For advertising opportunities, please contact **think@um.edu.mt**.

contents

UMRE Special Edition • November 2024

NAVIGATING THE CUTTING EDGE:

Kannan Pashupathy

In May, I gave a talk at the UM Research Expo about lessons learned from the trenches of managing cutting-edge research and innovation at one of the largest corporate ICT organisations in the world. This article is a summary of the top 10 lessons I spoke about. The full list of lessons is long and varied, so I picked the ones that may apply to a diverse university research community looking to share their own research and innovations with the world. Since my experience is in managing research and product development within the technology realm, these lessons are about the environment and approach to building solutions in that area. With that, let's dive right in:

1. ORIENT THE WORK AROUND A CLEAR MISSION

This seems rather obvious, but it is often overlooked, leading to distractions and losing one's way around the problem being researched. If you don't have a clear mission, develop a shared one with the team or group. If you are conflicted about the different directions your work could go, test each option against the mission to see if you are aligned or not. It will help you prioritise and stay focused on the big things. For us, the big things were the tough, unsolved problems around information with non-obvious approaches to solving them. Every solution had to operate at scale – in every country, in every language, and under every typical condition. With serious competition for money, talent, and time – and so many other factors that were constantly requiring us to prioritise aggressively – we were constantly reminded that 'scarcity brings clarity'. Therefore, using our mission to amplify clarity was very useful.

2. INNOVATE RELENTLESSLY

With the advent and broader adoption of generative AI, there are ample opportunities for everybody to participate and innovate aggressively across a broad spectrum of areas. We are still in the very early days. In the past, I have felt that in Europe there have only been a handful of countries with the same amount of urgency or intensity that I have seen in Silicon Valley with respect to being at the frontiers of innovation. The lessons I mention below provide pointers to help make Europe, in general, and Malta, in particular, just as innovative and competitive as the best in the world.

3. ENCOURAGE RISK-TAKING AND CHALLENGE CONVENTION AT EVERY LEVEL

Even if you are operating under constraints, taking big swings is important since you will learn faster from mistakes than by trying to remove all risks first. This is an important lesson from hundreds of eventually successful startups and companies – even the ones that you may see today as making few mistakes. This also means that ideas need to be driven continuously from the ground up, where challenging conventional approaches is celebrated and encouraged by leaders as an integral part of the innovation environment and process.

4. CULTIVATE STRONG NETWORKS OF ACADEMIA, INDUSTRY, AND VENTURE BACKERS

The best US universities see themselves as economic engines in addition to being educational institutions, and so teachers are involved in helping drive the notion of entrepreneurship into every student and participate in it themselves. Companies are formed while students are still in university and rapidly growing their academic networks; venture capital and industry are vibrant and dynamic there. If these networks of stakeholders don't exist at scale in a country, I strongly believe that universities can play a leading role in building them.

5. ENSURE MULTI-DISCIPLINARY AND DIVERSE TEAMS THAT NATURALLY COLLABORATE ACROSS BOUNDARIES

This was an important factor in our research and innovation ecosystem. It helped us unlock amazing solutions that no single group would have thought about. It also helped resolve issues mentioned below around bias and accessibility. Sometimes, we assembled people with different

TEN LESSONS FROM MANAGING RESEARCH & INNOVATION

skill sets in the context of one team. Often, it was working across teams and organisations outside traditional boundaries that produced the best results. UMRE was an excellent way for researchers from different areas to meet and learn from each other and, hopefully, collaborate in the future.

6. CREATE RICH SCOPE FOR ONGOING UNIVERSITY-COMPANY INTERACTIONS

We found enormous value (in both directions) around university-company interactions. Faculty spent months (and sometimes years) working alongside us in a corporate setting – beyond the typical research grants that were available at the same time. It helped the tech process for sure, but it also helped update curricula and focus university departments on upcoming topics of import to companies on the bleeding edge. Student interns worked on real projects alongside regular team members and learned the practical steps in research, innovative design, development, and testing, which were rarely taught to them in the university environment. The breadth of skills that students developed in this process is strongly preferred by employers. This type of multiway interaction between academia and industry on an ongoing basis should no longer be considered optional.

7. PRODUCTS AND SOLUTIONS AROUND CRITICAL RESEARCH OFTEN SPEAK BETTER THAN PUBLISHING PAPERS

In addition to publishing seminal papers around critical technical achievements, we saw tremendous value in making products that incorporated them to show the research applied to practical solutions. This created a starting point for others to come up with newer solutions in an open-sourced arena. Looking carefully at practical applications of research became a critical mantra. Correspondingly, publishing papers for the sake of it became less so.

8. DATA IS A KEY CURRENCY IN THE AI ERA

Even before the AI era, the importance of data had become rather obvious to everybody, and now, data is even more critical. It has enabled all kinds of development, from scalable databases to machine learning, and as a result, probability, statistics, and data analytics are no longer optional. Indeed, as the currency that drives the internet, I would urge anybody who has a choice to learn data or to teach it to do so, connected to your particular discipline, whatever that might be.

9. UNCONSCIOUS BIAS IS REAL

Having spoken about the importance of data, it is also important to state clearly that data can be misused – intentionally or unintentionally. Input data that lacks diversity can give rise to bias that will make its way into platforms and systems, which generative AI will turbocharge, so it is important to get ahead of it. There is also an on-going debate on whether to let AI innovations happen quickly and without constraints, or allow them only in a carefully thought-out manner. This is a world-level question; we all need to participate in its answer. Again, these discussions can be facilitated by regular and global co-creation between academia and industry. In addition, this is an area worthy of inviting governments to get involved, as some already have.

10. TEACH ACCESSIBILITY AND HUMAN-COMPUTER INTERACTION AS A CORE PART OF TECHNOLOGY EDUCATION

If one incorporates human-computer interaction (HCI) from the earliest stages, another type of diversity becomes a natural step in the design process. To do this well, it is critical to teach and incorporate these ideas while considering people of all abilities (eg, those who are blind, deaf, or motor-impaired). Without such consideration, we would be shutting out millions of people who use technology differently. Making HCI and accessibility part of the standard curriculum in any discipline would go a long way in encouraging usability in a meaningful way for everyone.

As simple as the above lessons may seem, there's a lot of context around them. When you are in the middle of researching, they will likely not feel simple. As you experiment with these ideas in your own environment, your mileage may vary, but one thing is clear – not trying at all is a much worse option than trying, learning, and iterating!

ARTISTIC RESEARCH NEEDS ETHICS LIKE A RIP IN THE CANVAS

Professor Robin A. Nelson

Is free artistic research compatible with academic research ethics? What are the tensions between these positions, and how can we bridge them? The following article is an abridged version of a longer presentation I gave at the UM Research Expo in May. I have adapted the contentious first words of my title from film director Alan Parker's remark that 'film needs theory like a scratch on the negative'. Such a comment reflects the scepticism amongst some practising artists about what they perceive to be academic intrusions and constraints. Yet is free expression the purpose of art? Have artists ever been entirely free from constraints? Are the goals of artistic research the same as those of art?

Though I advocate for research undertaken through art practices, I feel it is a 'category mistake' simply to equate art practice and artistic research. An art-space might be both a studio and a laboratory; an artefact might simultaneously be an artwork and a research outcome. But, to undertake research in an academic context, practitioner-researchers might attend differently to their work, understanding the protocols of academia even as they baulk against them.

TWO PROPOSALS

University Research Ethics Committees (RECs) typically require avoiding harm and obtaining consent from participants. Imagine you are a member of a REC tasked with reviewing the following proposals for practice research:

1. This project proposes randomly selecting somebody who was met by chance at a party. Unbeknown to them, I will follow them over the next fortnight, even if that means travelling abroad. Incognito, I will track them and take photographs which I will ultimately edit and publish in a magazine with an accompanying written text.
2. This project proposes to kidnap somebody and hold them for 48 hours in an unknown venue. The victim will previously have consented in writing on a form designed for the purpose. But they will not know if, when, or where they will be targeted.

Would you approve either of them? Before answering, let us consider the ethical terrain of contemporary practice.

THE ETHICAL TERRAIN OF CONTEMPORARY PRACTICE

Knowledge is no longer simply assumed to emerge in Enlightenment culture, validated by the scientific-rational mind. Consideration of other perspectives and cultures has become increasingly important in academia. The 2020 Psi Summer School, for example, focused on 'the numerous and alternative ways of knowing that emerge from Black, Global Majority, and Indigenous cultures'. Thus, in the past decade, cultural hegemony has surfaced, alongside appropriation as contentious issues.

At the less contentious level of achieving participants' consent, tensions are also evident. A common resistance of artists new to academic research is the requirement to say in advance what the project will involve. Artistic researchers often argue that they don't know what the project will entail because it involves a process of organic development. But, if you cannot give a provisional account of what is involved, how can you secure participants' agreement and address any ethical issues?

Researchers also need to consider the general 'experiencers' (those who encounter an experience without necessarily being fully aware or consenting). Consider Marina Abramović's *Rhythm 0* (1974): participants were invited to interact with the artist using a set of objects, including scissors, a scalpel, and a loaded gun. Had this been a formal artistic research project, there would be inescapable ethical considerations, including personal safety – for the galleries, the artist, and experiencers alike. What is at stake ethically if your work is specifically designed to take experiencers out of their comfort zone in, say, one-to-one encounters or virtual immersions?

Digital culture has thrown up additional ethical questions, particularly around the issues of sampling (or plagiarising) because the proliferation of easily accessible source material and mixing make attribution in the digital environment tricky. The possibilities of AI composition only further complicate the issue. Currently, academic protocols make it incumbent upon researchers to formally acknowledge all borrowings. But will this stance ultimately be sustainable under AI circumstances?

TOWARDS 'TENTATIVE CONCLUSIONS'

While I distinguish between innovative artistic practice and artistic research, the situation is fluid. On the one hand, artists who operate in higher education should recognise that academic protocols bind them. But I am sympathetic to artists employed to teach the practice-based curricula of modern universities on the basis of their professional experience who may be unaccustomed to academic protocols. **My first 'tentative conclusion' is that, in the context of staff development, established university staff should engage in a dialogic, educative process towards artistic research ethics.**

Taking account of what has historically been dismissed as subjective is a strength of somatic, collaborative, consciously-positioned approaches. Imagination is needed to address contemporary challenges. As far as research ethics is concerned, the ethical dimension, as much as the epistemological, is extended by the challenge of practice research, and the approach may be different. **My second 'tentative conclusion' is that an openness to research ethics is required, with a preparedness to refine and adapt protocols to meet needs as they arise.**

Academia has become increasingly risk-averse as society has become increasingly litigious. Fearful of repercussions, RECs today might be even more cautious than in the past. **We may need to treat research ethics in a similar way to risk assessment: properly considering potential issues in advance but not seeking to eliminate all elements of risk or potential challenges. This is my third 'tentative conclusion'.**

PUTTING THEORY INTO PRACTICE

Consider the two projects mentioned earlier: the photographic stalking of a stranger or the kidnapping of an individual.

Both are actual artistic projects, though not formal research projects. Project 2 is Blast Theory's *Kidnap* (1998), in which people paid £10 to enter a lottery, the winners of which were to be kidnapped. Two winners were chosen, snatched from their workplaces, and held in a secret location for 48 hours. The process was broadcast live over the internet.

You may be right to approve this project since the informed participant had given prior consent in writing. But what about potential physical and/or mental hardship? Despite giving consent, it is hard to imagine participants being entirely happy with the outcome.

Project 1 is *Suite vénitienne* (1979) by French artist Sophie Calle. Calle met a man by chance at a party in Paris and learned in casual chat that he was travelling to Venice. In disguise, she stalked him around the city, photographing him without his knowledge. The public outcome of this includes black-and-white photographs of the man, identified only as Henri B, and an accompanying text.

What might the Royal College of Arts' REC have to say about this project? You're ahead of me: it would not have approved it. But, consider, had she forewarned the man about her plan, the aesthetic aims of the project would surely have been compromised. Indeed, if it had worked at all, it would be a very different project.

Research ethics in the arts turns out to be something of a minefield. My final 'tentative conclusion' is that a balance needs to be struck between sustaining a 'let's see where this project takes us' approach whilst operating within established ethical frameworks. Practitioner-researchers need to recognise the perspective of corporate higher education institutions, which have obligations under law as well as established academic protocols, whilst institutions need equally to recognise that a narrow, rule-governed, risk-averse approach to research ethics might stifle – debar even – truly innovative approaches. Free artistic research may well be compatible with academic research ethics, but only if open-mindedness and a disposition to be flexible on all sides are obtained. T

Education, Humanities, and Law

UNCHARTED WATERS

A Legal Compass to Guide Climate Action

Author: **Timothy Alden**

As part of the UMRE 2024, ***Prof. Simone Borg*** *presented her research on governance in an era of climate change. Given the unprecedented challenges facing the world due to rising sea levels and other impacts of climate change upon our seas and oceans, there is a dire need to address the gaps in the current international legal framework to deal with these lacunas.*

Prof. Simone Borg
Photo by Kurt Mizzi

Prof. Simone Borg's independent research into how ocean governance can adapt to address the consequences of climate change faces uncharted territory. The existing legal framework is wholly inadequate to address the growing challenges. Nonetheless, in her role as a professor of law as well as Malta's Ambassador for Climate Action at a time when Malta sits on the United Nations Security Council, Borg is well placed to contribute to the crucial ongoing discussions on how these challenges might be addressed on an international level. Malta, after all, played a historically key role in 1988 in the United Nations, leading to its acknowledgement of climate change.

GOVERNANCE IN AN ERA OF CLIMATE CHANGE

Borg states that 'law can be as innovative as technology. Every single human action, in one way or another, needs to be regulated. As science continues to inform us about the links between climate change and the negative impacts on our oceans, in turn, it means we need to update our legal frameworks so that we can address the damage. In my research, I explore what the applicable laws are and whether they are adequate to deal with the issues, or whether we need new treaties, for example.'

The United Nations Convention on the Law of the Sea (UNCLOS) was established in 1982 and was itself inspired in part by Malta through its UN Ambassador, Arvid Pardo, who proposed that the ocean seabed beyond national maritime borders be considered 'the common heritage of mankind'. The UNCLOS codified new practices on the governance of ocean space. It also outlined broad responsibilities for preserving the marine environment and ensuring the freedom of scientific research on the high seas while establishing a pioneering legal framework for regulating mineral resource extraction in deep seabed areas.

Nonetheless, it was not written to account for climate change because, at the time, there was no awareness of the climate crisis in legal and political spheres. Borg states that the UNCLOS articles, which refer to the obligations of states not to pollute the oceans, are today being understood with reference to carbon dioxide and other greenhouse gases as pollutants. Carbon dioxide affects the oceans through acidification, deoxygenation, and warming, with consequences that include the mass die-offs of krill populations, which underpin the ocean food chain. Furthermore, climate change is impacting the stability of the Atlantic meridional overturning circulation, which is responsible for the world's current climate, precipitation, and even underwater nutrient distribution. This opinion on greenhouse gases was formalised by the International Tribunal on the Law of the Sea, which states that greenhouse gases are a form of marine pollution. It has therefore laid out governments' legal obligations to reduce that contamination and thus limit global warming.

However, with international agreements like the United Nations Framework Convention on Climate Change, the Kyoto Protocol, and the Paris Accord focused on reducing greenhouse gas emissions, Borg highlights areas of ocean governance which remain unaddressed through this preventative approach. International law is thus far not specialised in handling the challenges of climate change unique to the oceans. Through its seat on the United Nations Security Council, Malta is therefore promoting a dialogue to discuss the legal impacts of sea-level rise.

RIGHTS OF SUBMERGED NATIONS

Borg warns of huge political issues related to rising sea levels because, under International law, a state is a state if it has a territory and a population. Borg elaborates: 'If territories disappear due to rising sea levels, where does that leave the nation-state? What will the future of these countries be? Will they lose their nationhood, and will its citizens lose their nationality? The law as it is at present does not provide for a situation where a country loses its territory to nature. We have never before had such a similar situation. This is a very serious threat to global peace and security.'

Current maritime law, which delineates maritime borders for countries and their ownership over the continental shelf, is only possible because these zones are measured from the coastline. If a country's coast retreats, the baselines also retreat, and legally, these countries would thus have reduced maritime zones as they shrink. Borg warns that some countries are reluctant to discuss the issue but reaffirms that Malta is at the forefront of these discussions along with other sympathetic and vulnerable countries.

New Zealand and Australia are already taking action by entering into agreements with some small island states in the Pacific so that if they lose their territory, their people can migrate and retain their rights and nationality. Borg warns, however, that from a legal standpoint, the future of coastal nations impacted by sea-level rise is still very ambiguous, and that ambiguity does not serve these vulnerable nations or their people.

Malta, backed particularly by Pacific and Caribbean island nations, is proposing that no coastal state should lose any of its existing rights as a result of sea-level rise. These changes are not inflicted deliberately by the coastal state concerned, and furthermore, many of the most affected countries are those bearing the least historical responsibility for causing the problem.

Borg therefore declares that 'at this stage, the most important thing is to identify what is going to happen and to have a legal framework which anticipates these changes. We must sustain the rights of states set to lose territory. The international community needs to agree that these submerged countries will not lose their rights as nationals of that nation, and that as nationals, they will continue to hold rights to exclusive maritime zones which they may benefit from and exploit.'

UNCHARTED WATERS

While issues of maritime zones and sovereignty are at the forefront of Borg's research, she acknowledges a wide range of issues that sea-level rise will impact and which require continued focus and attention. One such issue will be the destruction of infrastructure, much of which functions based on its relationship with the coast. The arising complications will start with drainage systems and may be exacerbated to affect harbours, roads, and coastal property.

When asked about the possibilities and threats of deep-sea mining, particularly with reference to the recent discovery of evidence of dark oxygen being produced at the abyssal seafloor, Borg warns that Malta's stance has always been to adopt what is formally referred to as a precautionary approach. The science indicates that deep-sea mining is likely to cause irreparable harm as the resulting turbidity would alter the deep-sea habitat for a very long time, given the lack of currents at that level to disperse it. Economic needs cannot be addressed by resolving one problem only to create another. As there is no certainty around how deep-sea mining will affect other parts of the ocean, and as many life forms are still being discovered, there are not enough facts to make such drastic decisions. Furthermore, current technology does not allow for the necessary damage mitigation measures. So long as the science tells us that not enough precautions may be taken to exclude significant damage, it is better to play it safe.

Borg concludes by emphasising that we find ourselves in the uncharted waters of numerous problems and challenges. Nonetheless, we are explorers, even in the legal sense. The most important thing is not to give up. Giving up is never an option, no matter how unsurmountable the problems appear. Borg underlines the importance of being able to say that at least we tried. Looking ahead, the great hope is that humanity will succeed in cooperating, for this is not a problem which any individual or individual nation can address alone.

The Spectrum of Multilingualism

Author: **Jonathan Firbank**

Multilingualism is a broad spectrum, its nuances and complexities well demonstrated in Malta. But the study of language and how it is taught is often hampered by binary thinking. ***Prof. Odette Vassallo****, professor of English Language and Linguistics in UM's Department of English and the director of the Centre for English Language Proficiency, speaks with* ***Jonathan Firbank*** *on how we communicate.*

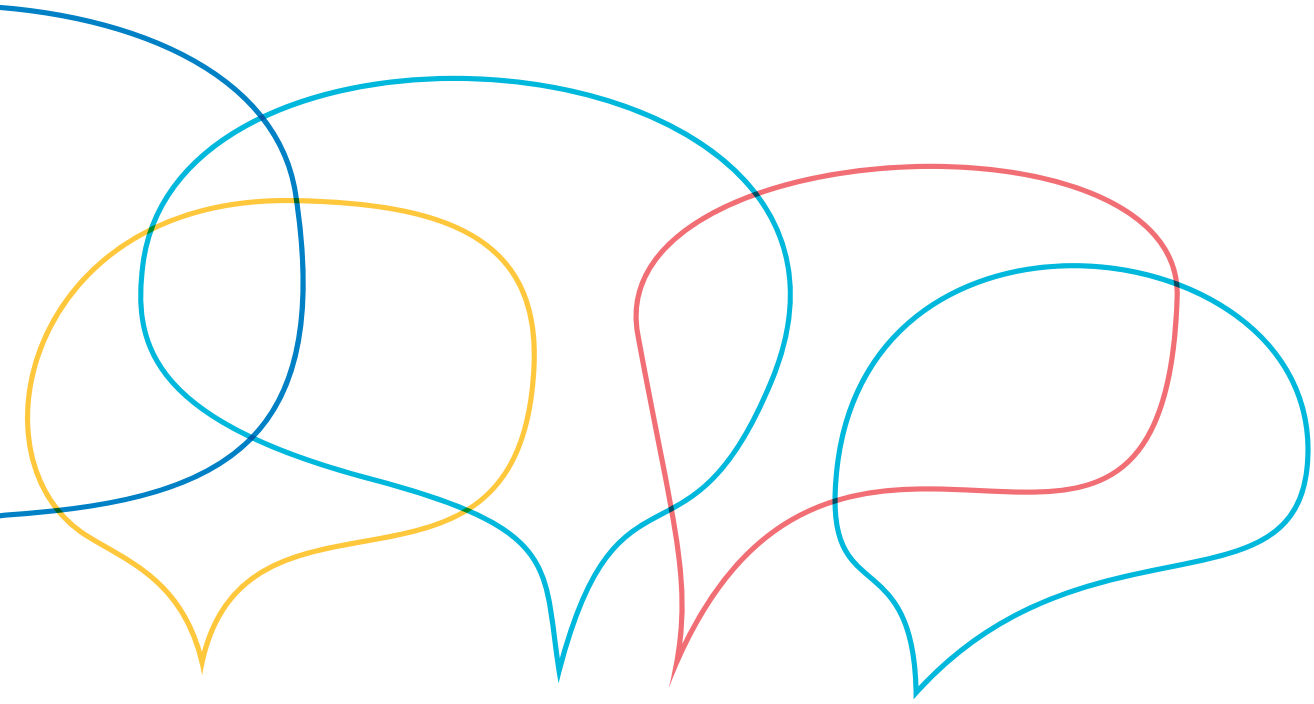
Language defines us before we learn to define it. Our development is marked by our ability to communicate. We make imitative sounds as babies, then speak our first word, then venture into literacy, all the while feeling out our existence with and through words. The ease with which we do this varies radically. We might not learn in a normative fashion. We may need to substitute spoken words with signs, or written words with braille. No two of us have the same experience. The immense complexity of this process uniquely positions each of us on a broad spectrum that changes constantly.

Our languages, too, are a continuum rather than a fixed point. Words and conventions slip in and out of languages over time. Languages split apart and evolve, animalistically, then borrow from each other, neighbourly. Those of us fortunate enough to grow up among multiple languages can pull different tools from each one, flitting between languages according to ease or context. Casual, multilingual spaces sound fluid and free. A sentence may flow between languages. Maltese can be freely adorned with an English idiom or a German loan word or an Italian greeting. An exclamation could sound better in one tongue, while its clarification is best understood in another. This linguistic flexibility is an example of what applied linguist Prof. Odette Vassallo refers to as 'multilingualism'. Again, it is an infinitely broad spectrum, in which each of us is uniquely placed.

BINARY CLASSROOMS

But in more rigid spaces, such as that of the classroom, this freedom often vanishes. Take, for example, Malta's two official languages. Maltese bridges the Mediterranean by combining Semitic and Romance language influences, all the while absorbing loan words from English, among

Prof. Odette Vassallo



others. In turn, English is an ever-changing amalgamation of historic, West-European languages. But in certain contexts, Maltese becomes *just Maltese*, and English *just English*, with strict rules about why, how, and when to deploy them. A kaleidoscopic spectrum is replaced by a strict, epistemic binary. This impacts not just how we define language but how it defines us.

This rigidity is, in no small part, because of these languages' colonial history. While the prescriptive approach in a language teaching context is typical across all languages, this is more pronounced in Malta because of the bilingual scenario. English imperialism was definitively binaric, hierarchical, and inflexible. This informed the language's cultural impact, even as it became a prerequisite for participating in the global economy. Yet the irony remains that this epistemic binary is most easily found in spaces for learning.

As a language and linguistics professor and as the director of UM's Centre for English Language Proficiency, Vassallo has observed educators across multiple stages of education working to a prescribed standard for English. Consequently, as she states, she encounters 'students that feel there's a stigma linked to English: that unless they can speak English in a certain way, in a certain variety, they shall be frowned upon.' This is a consequence of reductive, binaric notions of monolingualism and bilingualism.

Vassallo has noticed students that feel free to switch between Maltese and English amongst friends but feel judgement or guilt if they do the same in front of an academic. As such, binaric conventions seem likely to restrict opportunities for expression and experimentation, which are crucial for many learners. Vassallo proposes, instead, that we consider all of our language use as part of the multilingualism spectrum.

Vassallo's presentation at UM's Research Expo focused on binaric approaches having a 'deficit framing' which perpetuates impressions that monolingual or 'native language speakers' have access to a language standard that multilingual speakers detract from. This 'native speakerism' bias is extremely visible in language teaching – not being born in the Anglosphere excludes people from many job postings despite them being demonstrably qualified. Although this issue is not so much the case in Malta, it is in other parts of the world where job openings in teaching insist on recruiting 'native speakers of English'. Vassallo suggests that we should see multilingualism as a benefit rather than a deficit, one that allows us to 'tap into different resources – it provides a broader linguistic repertoire – as well as making us more efficient users of multiple languages.'

MULTILINGUAL RESEARCH

To map the use of English by young multilingual learners within an educational setting, the Framework of Competence in English (ForCE) project was launched,

funded by the UM. Spoken and written data was collected from 14–25-year-old students for the purpose of constructing a corpus which traces different stages of English language attainment amongst a multilingual group.

Past means of assessing English use has been to treat it as a monolithic, arbitrary standard to which students must aspire to reach. As Vassallo states, if we instead observe and document the practical use of English amongst multilingual students, it 'gives us insight into how a multilingual user grows and develops a linguistic repertoire as they mature, cognitively as well as socially.' Investigating the use of language across this range of notably developmental ages allows a deeper understanding of multilingualism on a continuum and spotlights the speaker's development apart from their proficiency. This is an example of what Vassallo describes as 'marrying the practice to the research'. The data ForCE has collected can serve as a springboard for further research into this nuanced subject.

ForCE, as its name implies, was originally intended to be a framework that measured proficiency in a more traditional sense. 'But when we started to analyse the data, we noticed this was restricting us. We needed to move beyond monolingual ideology.' Rather than documenting accuracy in language use, a more pressing question became, 'How do you capture the development of communicative complexity? To that end, the series of studies that make up ForCE describe rather than assess and look at language influence over language interference.' Native-speakerism bias is partially founded in the notion that 'one language interferes with the other. But in reality, we see influence. We're looking at growth instead of proficiency. We're looking at gradient multilingualism instead of the comparative fallacy of "monolingual versus bilingual or multilingual".'

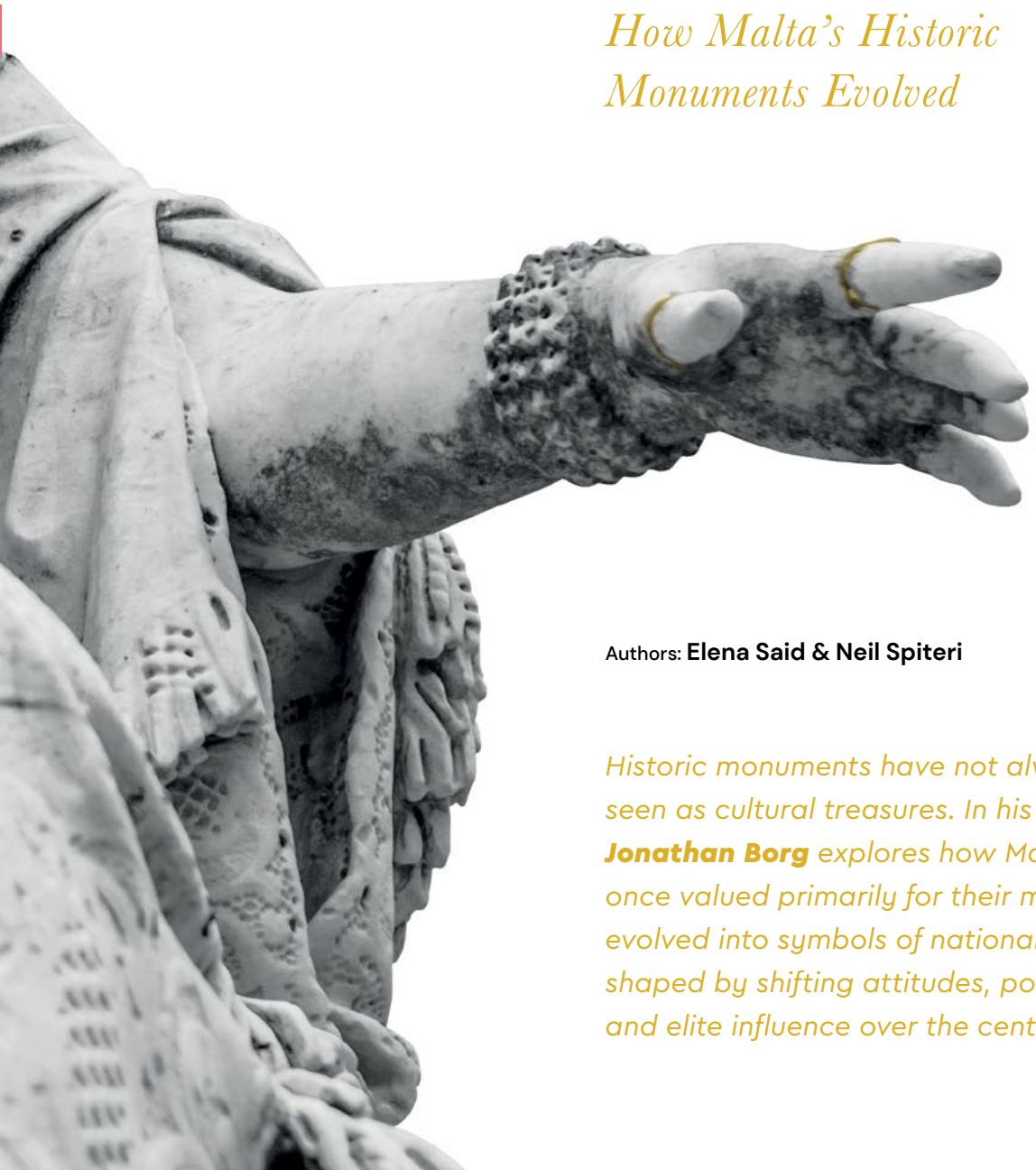
The level of communication found in universities exemplifies how unimportant normative accuracy can be, compared to the fluid skills developed through multilingualism. Linguistic dexterity and a broad linguistic repertoire, for example, are vital in many academic fields. Novel loan words and phrases have proved crucial for framing complex ideas. In fact, for centuries, academic texts floated freely between several languages to better convey meaning.

Now, universities have a multilingual student community, thus universities would benefit from the practised fluidity fostered by multilingual spaces. If Maltese students are to access universities, they must jump through the inflexible hoops of binaric syllabuses. But it may be the fluid, free communication in multilingual playgrounds – improvised not memorised – that allows them to excel.

ForCE Project was awarded the University of Malta Research Fund

The TRANSFORMATION *of* ANTIQUITIES

How Malta's Historic Monuments Evolved



Authors: **Elena Said & Neil Spiteri**

Historic monuments have not always been seen as cultural treasures. In his Ph.D., ***Jonathan Borg*** *explores how Malta's antiquities, once valued primarily for their material use, evolved into symbols of national heritage, shaped by shifting attitudes, politics, and elite influence over the centuries.*

Drawing of the Punic sarcophagus that Giovanni Francesco Abela found and placed in his garden. Source: Giovanni Francesco Abela *Della descrittione di Malta* (Paolo Bonacota, 1647)

View of the Marina with Upper Barrakka Gardens by W. Anderson (1787–1837) showing the Amati Column on a pedestal underneath the long balcony of the Ġnien is-Sultan (now destroyed) *Photo by Jonathan Borg at MUŻA – Malta Museum of Art*

The Maltese archipelago, steeped in history, is home to a rich array of antiquities. Over the centuries, these ancient objects, initially seen as relics or mere curiosities, underwent a remarkable transformation to become historic monuments – symbols that evoke a deep sense of the past. But how did this transformation take place? What attitudes, behaviours, and sociopolitical contexts shaped the way we view these artefacts today? Jonathan Borg, a scholar with extensive experience in heritage management and cultural conservation, explores these questions in his doctoral research.

Borg's project examines the trajectories of 20 diverse ancient objects, including statues, sarcophagi, inscriptions, coins, ceramics, and glass. By studying how these objects were treated over time, from their initial rediscovery to their eventual recognition as historic monuments, he uncovers the factors that contributed to this transformation. He traces these histories over 400 years, from the early 16th century to the introduction of formal legislation for the protection of antiquities in Malta in 1925. His study is unique in that it focuses on objects rather than buildings, a relatively unexplored area in Maltese heritage research.

WHAT MAKES A MONUMENT?

The word *monument* derives from the Latin *monere*, meaning 'to remind'. As Borg explains, 'an object becomes a historical monument the moment someone recognises it as a testimony of the past, choosing to preserve and valorise it rather than destroy it.' This transformation occurs when an object is recognised not merely for its physical or utilitarian value but as a testament to history. This doesn't necessarily mean placing it in a museum, but rather showcasing it in a way that highlights its historical significance.

In Malta, as in Europe, this recognition often took time, with objects initially serving practical purposes before being seen as historical treasures. 'Take, for instance, an excavation ordered by the Mdina town council in the early 16th century. The explicit goal was to retrieve marble, which was to be turned into lime for painting town buildings,' points out Borg. The fact that the marble came from ancient ruins was secondary to its utilitarian use.

Similarly, Borg recounts an incident in which ancient coins were melted down to create new objects despite their historical significance. These examples illustrate how objects in the past, even when recognised as old, were often valued more for their material benefits than for their cultural importance.

NOT ALL TRANSFORMATIONS ARE LINEAR

The process of transforming antiquities into monuments is gradual. While some objects were still repurposed or even destroyed, a definitive shift in thinking began to take hold over the last 400 years.

In the 19th century, private collectors of antiquities began to come under scrutiny. Scholars lamented that these private

collections deprived the public from viewing and appreciating Malta's cultural heritage. In this period, much as in the rest of Europe, Malta saw the establishment of the first museums, which played a crucial role in preserving and displaying these collections for future generations. By the mid-20th century, we see the emergence of patrimony – the idea that certain objects represent the collective heritage of a people. This modern notion would form the basis for later legal frameworks designed to protect such historically significant objects.

Despite the growing appreciation for antiquities, Borg emphasises that the process of transformation was not linear. There were instances where objects were destroyed, particularly when disputes arose over their ownership or value. Before the introduction of legal protections, some individuals would deliberately damage ancient objects to prevent them from being sold or taken by the government.

'A key moment in Maltese history came in 1647 when Giovanni Francesco Abela found a sarcophagus and placed it prominently in his garden with a copperplate inscription,' claims Borg. He explains that by doing so, Abela ensured the sarcophagus' memory would not be forgotten, demonstrating the early stages of recognising an object's historical value. 'Writing about it and providing a description was a way of preserving its memory and elevating its significance beyond its original purpose.'

According to Borg, another critical step in an object's transformation into a monument is when specific actions are taken to reuse that object without destroying it. For instance, the Amati Column, a marble column originating from the Classical period, was re-shaped into a commemoration monument of the Italian Hospitaller Fra Giulio Amati in the 17th century to celebrate his sponsorship of infrastructural works in the Grand Harbour. A century earlier, such an object might have been destroyed, but by reusing it, people began to harness its symbolic value, marking it as an important historical monument. It can now be found and appreciated at the Malta Maritime Museum.

GROUNDED THEORY: A DIFFERENT APPROACH TO RESEARCH

Borg's methodology, based on the principles of grounded theory, allows him to draw insights directly from the data on the chosen objects rather than imposing preconceived hypotheses. 'Unlike traditional research, which begins with a clear hypothesis, grounded theory starts with data collection, allowing theories to emerge organically,' Borg explains. Initially, he conducted a literature review and identified gaps in existing studies. Then, he examined the data without a specific focus, allowing themes and patterns to emerge.

A key advantage of this approach is its flexibility. As Borg delved deeper into the history of these objects, he refined his research objectives, ensuring that his conclusions were not shaped by preconceived ideas. This reflexivity, periodically pausing to reflect on

The Amati Column is a marble column originating from the Classical period, which underwent re-shaping in commemoration of Fra Giulio Amati's sponsorship of infrastructural works in the Grand Harbour.
Photo by Jonathan Borg at Malta Maritime Museum

'The recognition of the "passage of time" is one of the attributes for an object to acquire the status of a historical monument.'

Jonathan Borg
Image courtesy of Jonathan Borg

his own biases and interpretations, allowed Borg to minimise the influence of subjective judgments, ensuring that his findings remained rooted in the evidence.

Throughout his research, Borg noticed that the individuals most interested in Maltese antiquities tended to be members of the educated elite. 'In the 17th and 18th centuries, it was local and foreign elites who valued these objects, often as symbols of their own aspirations. Maltese intellectuals, many of whom identified as European and were strongly influenced by Italian culture, saw these objects as a link to a glorious past.' For them, collecting and preserving antiquities was a way of asserting their European identity. Foreign scholars on the Grand Tour (a cultural journey through Europe taken by wealthy young men from the 17th–19th centuries to enrich their education and social status) also played a role, viewing Malta's antiquities as part of the larger Mediterranean legacy.

Religious scholars, too, had their reasons for valuing ancient objects. Inscriptions on certain artefacts were seen as proof of biblical events, further enhancing their cultural and spiritual significance. Over time, these layers of meaning contributed to the objects being viewed as more than just relics – they became symbols of a shared history.

THE MODERN IMPLICATIONS OF BORG'S RESEARCH

Borg's research has important implications for modern Maltese society. As he points out, 'the government does not operate in a vacuum. Rather, it is shaped by the aspirations and values of the people it serves.' The selection and preservation of monuments are influenced by broader societal trends, as well as political considerations. For example, the statue of Queen Victoria in Valletta is a point of contention for some Maltese, as it represents colonial rule. However, the statue of Grand Master de Vilhena, another foreign ruler, is largely accepted due to the Knights' more favourable place in Maltese history. 'The recognition of the "passage of time" is one of the attributes for an object to acquire the status of a historical monument,' states Borg.

These differing attitudes toward monuments highlight the complex relationship between cultural heritage and national identity. Borg hopes his study will encourage a more nuanced understanding of how and why certain objects are preserved while others are neglected. He believes that by examining trends in valorising ancient objects, we can better understand how to treat monuments today.

Transforming Maltese antiquities into historic monuments is a fascinating and complex process. Through his research, Borg sheds light on the shifting attitudes and behaviours that shaped this transformation over the centuries. In turn, the biographies of ancient objects reveal patterns in the way Malta's cultural heritage has been shaped by both local and European influences. His work not only contributes to our understanding of the past but also provides valuable insights into how we might approach the preservation of antiquities in the future.

Architecture and STEM

Keeping the Maltese Language Alive:

AI Chatbot Breaks Through Bilingual Boundaries

Author: **Christian Keszthelyi**

Researchers at UM are developing a chatbot that communicates in Maltese and can carry out a conversation flawlessly as if it were human. The project is unique, as previously most chatbots handling Maltese were rule-based, meaning their interactions were limited to predefined menus.

Working with the Maltese language is challenging. Unlike English, building a Maltese digital corpus (a large, structured set of texts) is difficult due to the restricted availability of resources – both textual and human labour.

Dr Claudia Borg, from UM's Department of Artificial Intelligence, is working on this titanic task through the framework of The New Era of Chatbot Project. Borg leads the project with Dr Marc Tanti (Institute of Linguistics and Language Technologies) and Prof. Michael Spagnol (Department of Maltese). Two Ph.D. students, Kurt Micallef and Kurt Abela, and a postdoctoral student, Dr Marthese Borg, are also contributing to this task. The team's main aim is to create a conversational Maltese chatbot, so that instead of predetermined menus and rigid prompts, users can converse with the software in a more natural form.

WHAT IT TAKES

Training a chatbot to move beyond predefined prompts happens through immersion in real-life scenarios. 'We developed user stories related to banking and finance, envisioning scenarios where users might inquire about opening a bank account in Maltese. We trained the chatbot to understand various ways users might phrase their questions and how to respond,' says Borg.

The chatbot prototype has already been tested in controlled lab environments. In this step, the software is exposed to preset, real-life scenarios so it can learn how requests should be handled and start becoming conversational. The next step is interacting in a real-world setting to allow broader public usage. However, such a trial comes with challenges, as people express themselves in diverse ways in writing, and grammatical or typographical errors can occur. Still, the researchers are confident that their preparation and extensive research in Maltese language processing will help the chatbot perform well.

'Ultimately, our mission is to ensure that Maltese remains relevant in today's technology-driven communication landscape. We commit ourselves to developing the necessary technology to keep the Maltese language vibrant in the digital sphere, alongside other ongoing efforts,' Borg says.

The training happens in an exciting language environment, as Maltese natives are practically bilingual and often switch between Maltese and English in the same sentence. Users might say, 'Kif nistgħu niftħu kont?' the Maltese equivalent of 'How

Dr Claudia Borg
Photo by James Moffett

Prof. Michael Spagnol
Photo by James Moffett

Dr Marc Tanti
Photo by James Moffett

can we open an account?' But, in a country that has been bilingual for decades, someone may use both languages in their query, saying: 'Kif nistgħu niftħu account?' This would involve elements of code-switching, the practice of alternating between two or more languages or language varieties in a conversation or within a single utterance. For an older, rule-based chatbot, this may have caused issues. Not so for the chatbot in Borg's project, though.

'We are training the chatbot to recognise these different expressions and potential spelling mistakes. While we aim to be creative in our training, we understand it won't be foolproof. After the launch, we expect unforeseen challenges, such as unanticipated spelling errors,' Borg tells **THINK**.

The project aims to ensure that the technology they develop understands how people mix and express themselves in Maltese (and English). Nevertheless, the chatbot prioritises responding in proper Maltese, free of grammatical or spelling errors, which is crucial for effective communication.

LEARNING TO SPEAK

Language models have been evolving in size, particularly in Maltese. Currently, the researchers are working with a BERT-based language model. Bidirectional Encoder Representations from Transformers, or BERT, is a model developed by Google that has been influential in natural language processing tasks. But BERT predates technologies like ChatGPT, whose models are large neural networks that rely on vast amounts of data. ChatGPT's neural network of English far exceeds the digital corpus that is currently available in the Maltese language.

'Our ongoing experiments aim to develop a Maltese large language model (LLM), using open-source models that we further train with Maltese data to enhance integration. Although we are in the early stages and have seen some promising results, creating an LLM for Maltese is expensive,' Borg says.

Researchers need to balance research goals with environmental impact when training these models. Artificial intelligence – especially as the public has recently come to know it: generating text, images, and videos in seconds – is a power-intensive technology. Every processing task is fuelled by immense computational power using graphics processing units (GPUs), which consume natural resources through electricity. Researchers' computing resources are finite, and they have to make sure that whenever they use computing power, it is used wisely. Many LLMs require significant GPU power to operate. For Borg, it is imperative that the Maltese model they are working on is not just a theoretical exercise but one that has practical applications and cost-effectiveness in mind.

'Given our data and computing power limitations, we focus on maximising existing resources. We prefer smaller, multilingual models that can leverage cross-lingual transfer, where a model can be trained on similar languages like Italian or Arabic. This strategy allows us to use less data in Maltese while achieving effective results by incorporating knowledge from similar languages,' Borg says.

But shouldn't ChatGPT (by OpenAI) be helpful for such research, since you can speak to it in Maltese and it will answer? Well, one of the main issues with ChatGPT is that it is closed-source, and OpenAI retains ownership of the code. 'We generally prefer open-source models versus closed-source. Moreover, small industries in Malta need economically

Kurt Abela
Ph.D. student

Kurt Micallef
Ph.D. student

Dr Marthese Borg
Postdoctoral student

viable solutions to integrate Maltese-language technologies,' says Borg.

A significant challenge with Maltese is the lack of established benchmarks to evaluate model performance. Unlike English, which has numerous benchmarks across various tasks, Maltese benchmarks are limited and primarily available for more straightforward tasks like machine translation. The researchers are currently working on creating datasets to test and assess models on more complex tasks, such as summarisation, to improve language model performance for Maltese.

BATTLING FOR MALTESE

The chatbot aims to serve an essential, nobler purpose than one might assume. In Malta, the English language has lived in symbiosis with Maltese, and for this, the native tongue has suffered. Maltese might very well lose relevance within our society against the utility of speaking English. The chatbot the UM team is working on could help Maltese speakers use their native language in more scenarios, thus keeping it alive.

'Maltese should be seen as a language for reading and writing, not just casual conversation. Making technologies available in Maltese helps reinforce its use, though it's not the sole solution to keeping the language alive. The goal should be to make using Maltese the default choice – something that happens naturally, without needing encouragement,' Borg says.

But as English has been adopted as the native language of international communication, how much hope is there that Maltese will not suffer further in this tiny nation of roughly half a million native speakers?

'I'm optimistic about the future of the Maltese language, and history gives me good reason to be. When Malta joined the European Union, Maltese became an official EU language, which led to a surge in literature, novels, and translations in Maltese. Suddenly, we saw more works by both professional translators and Maltese authors writing original content. This change created more opportunities for using Maltese, even though the immediate impact was on a relatively small group – authors, translators, and publishers. However, it showed how making Maltese more visible could inspire people to use it more confidently,' Borg says.

Intuitive, well-working digital tools available in Maltese can have a similar impact. The more integral the Maltese language becomes to its speakers in everyday digital experiences, the more it becomes a default choice for communication. It is an unconscious shift, encouraging people to think in Maltese. Native Maltese speakers would then feel more comfortable not just speaking in Maltese but also writing in Maltese, whether for emails or other forms of communication.

'The real difference between Maltese and English isn't the languages themselves but the digital tools and resources available to support them. English dominates because of its accessibility through TV programs, apps, and platforms. By making Maltese just as accessible and visible in the digital world, we can create an environment where using Maltese is effortless and intuitive,' Borg concludes.

The New Era of Chatbot Project is financed by a Research and Development Grant funded by Malta Enterprise. Cartesio Ltd is the lead project manager, and Noovle International, a subsidiary of TIM Enterprise, is the technical implementer. The University of Malta is responsible for the research component of the project.

MAYDAY

NAVIGATING AIRBORNE EMERGENCIES WITH AI

Author: **Sebastião Miranda**

You are 12,500m above the ground, halfway through your flight, and everything so far resembles a normal trip. Suddenly, both engines fail, and the noise of the jet engines is transformed into absolute silence. Now the plane is essentially a 90-ton glider, dependent completely on the skill of the pilots to reach the ground safely.

In 1983, this nightmare became a reality aboard Air Canada Flight 143, in an episode known as the Gimli Glider. Fortunately, the flight crew managed to glide the plane to an abandoned airstrip and land safely, relying completely on their expertise. Though dramatic, such events are extremely rare thanks to the robust engineering of modern aeroplanes. Yet, when all engines fail and thrust is lost, the pilots' decisions become more critical than ever. Under intense pressure and without much time to take action, the crew must choose a safe landing site and define the right trajectory, knowing that a single miscalculation can end in catastrophe.

But what if a system could assist the pilots, offering real-time recommendations and a precise course to safety? UM academics Dr Ing. Jason Gauci and Dr Ing. Brian Zammit are conducting research on systems that can support pilots in navigating emergency situations with the aid of artificial intelligence (AI) and other technologies as part of the STELA Project – **S**ite Selection and **T**rajectory Generation for **E**mergency **L**andings of Commercial **A**ircraft.

Dr Ing. Jason Gauci
Photo by Christopher Cauchi

THE LOGIC OF THE UNCLEAR

When faced with an emergency, pilots must quickly evaluate several factors: Are there airstrips or other suitable places for landing within the gliding range of the plane? Are there mountains, lakes, or densely populated areas in the vicinity? What are the current weather conditions? These variables are critical in evaluating the safety of a landing site, and STELA must be able to assess them to assist the pilot in making the best decision. But how can a machine do this?

According to Zammit, the STELA system was designed 'to replicate the thought process of a pilot in assessing the risk of different landing sites.' To do this, STELA implements a fuzzy logic framework. Instead of relying on simply yes-or-no decisions, fuzzy logic allows the system to capture and assign different levels of risk to various landing sites. Like human reasoning, this type of logic must handle uncertainty and incomplete information. For instance, a runway that is not ideal might be considered a good landing site if the weather in its area is clear or if there are no major obstacles in its surroundings.

The fuzzy logic framework has to be designed to account for the relative importance of the different parameters of the fuzzy logic. To do so, experienced pilots are presented with different emergency scenarios and are asked to describe their course of action and which variables are of greater importance in their decisions. The fuzzy sets and fuzzy rules of the framework are then tuned based on the pilots' answers so as to balance the different variables in the site-selection process. This tuning enables the computer to adapt to new situations and make informed decisions based on the answers collected.

One of STELA's most impressive features is its ability to identify non-conventional landing sites. When there are no viable airstrips within reach, the crew must find alternative landing spots such as fields or highways. For this, STELA analyses terrain maps of the area and detects differences in the terrain's slope and roughness. This allows the system to identify regions that are flat, smooth, and mostly clear from obstacles, which are desirable features for a landing site.

CHARTING THE COURSE

So far, we have seen how STELA finds and assesses the risks of different landing sites. The next concern is how to make the aeroplane reach a site and land safely. There are many possible trajectories between an aeroplane's initial position and a landing site, and executing a suitable descent path in a total loss of thrust scenario can mean the difference between success and an absolute disaster.

Zammit notes that 'once a trajectory is generated, the pilot can upload it to the automation systems of the aircraft and focus on communicating with the air traffic controller while planning what to do after landing.' That said, Gauci points out that 'the final decision is always up to the flight crew, as they might be aware of certain things that the system is not considering.' This approach ensures that the crew is still in control of the decision-making process, but it frees them to focus on other vital issues by automating most of the operation.

But what is a good path? Firstly, it must ensure that the aeroplane lands with the right amount of energy at the desired site. Moreover, difficult manoeuvres should be avoided to reduce the margin of error and ensure a smooth path. This can be achieved by minimising the number of turn manoeuvres and the bank angle of the plane. Additionally, the path should avoid other risks, such as flying over densely populated areas, mountains, or other obstacles.

There are many factors that impact the trajectory's choice: the aeroplane's speed, initial altitude and glide ratio, the terrain and weather, and more. To find the

Dr Ing. Brian Zammit
Photo by James Moffett

best route, STELA explores a wide range of possibilities through what is known as a genetic algorithm.

AN ALGORITHM INSPIRED BY NATURE

One of the most important mechanisms of biological evolution is natural selection. In nature, the individuals who are better adapted to their environment – the 'fittest' – are more likely to survive and pass on their genes to their offspring, naturally selecting the traits/genes that lead to better success in surviving. Genetic algorithms use the same principle to solve complex problems, which in the case of STELA, is to find the 'fittest' parameters for the aeroplane's path. Here is a simple representation:

1. The algorithm starts by randomly generating a population of possible flight paths.
2. A 'fitness' function calculates a fitness score for each path.
3. The paths with the highest scores (i.e. the fittest) are selected to pass on their parameters to the next generation. These are the paths that are closest to the optimal solution in their generation.
4. A 'crossover' occurs when the parameters of each optimally selected path merge together. Following this, 'mutation' can occur, as in genetics, and introduce small changes in certain paths, allowing for more diversity and reducing the influence of the initial population on the final result.
5. This process is then repeated until the optimal solution is found or a maximum number of repetitions is reached.

The randomness introduced by the genetic algorithm allows for exploring less obvious paths, thus increasing the model's robustness.

On the other hand, traditional deterministic algorithms use a mathematical model to find the best path and tend to converge quicker on a final solution; however, they explore fewer trajectories and may miss safer alternatives. While the researchers made use of both these approaches, the genetic algorithm stood out due to its innovative application in the field and has shown great results in the test scenarios.

The STELA project is a great example of how artificial and human intelligence can interact to save lives. As AI quickly evolves, projects like this give us a glimpse into a future where humans and machines cooperate to improve the world.

The STELA project was led by Dr Ing. Jason Gauci from the Institute of Aerospace Technologies, in collaboration with Dr Ing. Brian Zammit from the Department of Electronic Systems Engineering and QuAero Ltd., a local aviation consultancy company. The project was financed by the University of Malta through the Transdisciplinary Research and Knowledge Exchange Complex (TRAKE).

Further Reading:

Gauci, J., Zammit, B., & Galea, M. (2024). ***A Genetic Algorithm for Trajectory Generation in Engine-Out Emergency Landing Scenarios of Commercial Aircraft*****. ICAS, Florence, Italy. https://www.icas.org/ICAS_ARCHIVE/ICAS2024/data/preview/ICAS2024_0364.htm**

Baldacchino, S., (2024). ***Path planning for emergency landings*** **[Bachelor's dissertation]. University of Malta. https://www.um.edu.mt/library/oar/handle/123456789/125732**

Rahman, A., Zammit, B., & Gauci, J. (2022). ***A fuzzy-based site selection framework for emergency landings of commercial aircraft*****. AIAA AVIATION Forum. Chicago, IL, United States. https://doi.org/10.2514/6.2022-3221**

Breaking Through: The Threat of Decaying Limestone in Malta's Prehistoric Sites

Author: **Noah Galea**

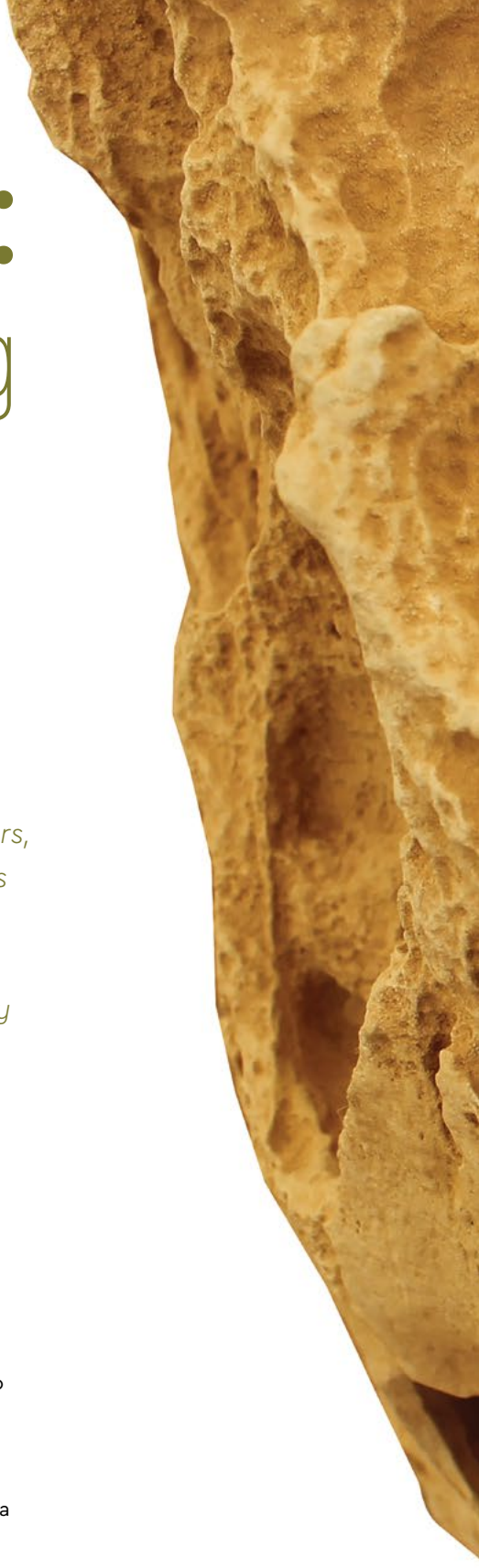
Serving as the prime building block for our prehistoric ancestors, Malta's gold-hued Globigerina Limestone has earned its status as an internationally recognised heritage stone. However, the combination of a marine environment, previous restorations, and the loss of their original roof makes the research on decay processes at Malta's Megalithic Temples an urgent matter.

The question of conserving our limestone and its associated built heritage is something that concerns Rosangela Faieta, research support officer with UM's Department of Conservation & Built Heritage. Faieta's current research, entitled *Understanding Structural Chemistry and Salt Crystallisation in the Pore Network of Globigerina Limestone*, forms part of a wider interdisciplinary project led by Prof. JoAnn Cassar, who heads the same department. The Evaluating Shelters over Megalithic Temples Project aims to evaluate the performance of the shelters protecting our Megalithic Temples. To simplify the demanding work required by the adopted research methodology, the project focuses on a very specific case – the Mnajdra Temples.

With an extensive background in conservation science thanks to her bachelor's and master's degrees from the University of Tuscia in Italy, Faieta hopes to address a lack of knowledge regarding the micro-processes relating to salt-induced deterioration and decay on Globigerina Limestone. Faieta seeks to deepen this area of knowledge through her doctoral research, which she is conducting in collaboration with UM's Department of Chemistry (based at CrEMa Laboratories), under the joint supervision of Prof. Ulrich Baisch and Prof. Cassar.

ON THE PREMISE OF DECAY

When speaking about 'decay', what we're really referring to is the progressive deterioration of the micro-structure of the stone. This breakdown happens due to chemical, physical, and biological



Typical alveolar weathering patterns observed in Globigerina Limestone
Photo by Rosangela Faieta

Evidence of stone scaling on the surface of Globigerina Limestone
Photo by Rosangela Faieta

Rosangela Faieta
Photo by Mantas Valantinavicius

factors. In this instance, the soft and porous nature of Globigerina Limestone and, arguably, Malta's aggressive marine environment amplify the factors which lead to the stone's decay. The fact that the stone is prone to absorb water is already problematic, but when considering the type of water present in the Maltese environment, the potential for decay becomes even more concerning. Situated in the middle of the Mediterranean, Malta's Globigerina Limestone is not absorbing pure water but rather water containing a high concentration of soluble salts – saltwater.

With these qualities in mind, why did this stone become a staple of Maltese architectural application? In this regard, there are two things to consider: first, the abundant local availability of the stone has ensured its easy accessibility over time. In addition, its weakness is also its strength. While Faieta notes that the limestone's softness and its porous nature make it more susceptible to deterioration, she adds that these same qualities are very practical for quarrying and shaping, in both building and decorative contexts.

ON THE CYCLE OF DECAY

Generally, the absorption of saltwater pushes forward the cycle of deterioration. Considering the many sources of water to which stone may be exposed, be it rain, rising dampness, or even condensation on the stone surface, the opportunities for rock decay are numerous. This, coupled with the warm and humid Maltese maritime environment, ensures that our limestone is well-saturated with moisture.

When the stone eventually does dry, the salts left behind on its surface or within its porous network start to crystallise. This is the process that begins deterioration: a process which gets progressively worse with subsequent wet and dry cycles. Nestled within the stone's porous network, the growing salt crystals exert stress on the pore walls, leading to cracks.

Faieta highlights the fact that 'measuring the factors affecting this process is no simple task.' This is particularly true since the environmental parameters which need to be considered, such as relative humidity and temperature, are always in flux. Thus, the process of crystallisation leading to progressive deterioration is ubiquitous, its effects commonly seen in Globigerina Limestone irrespective of where on the island it may be found. 'Alveolar weathering', 'stone powdering', and 'flaking' are just a few of the deterioration patterns which have been visibly recorded in the heritage stone.

ON THE DETERIORATION PROCESSES

Yet the type of stone being studied is not the sole factor that needs to be considered. Salt, too, can be categorised into different

Detail of stone flaking at the Megalithic Site of Mnajdra, macro photo
Photo by Rosangela Faieta

'species'. Faieta explains: 'When referring to "salt species", this means different soluble chemical compounds (ionic forms) which can all lead to stone deterioration. In this sense, the goal of this project is to identify and study the behaviour of different salt species that are present on site and to understand their interaction with the porous stone.'

Every salt species exhibits varying solubility and different behaviour in response to fluctuating environmental parameters (especially relative humidity). Depending on which salt species are present within the stone, specific processes of deterioration may be triggered. Since different salt species can be present in salt mixtures throughout the real environment, they can influence each other's behaviour, making the situation more complex. In other words, what we know about a single salt species in isolation may not hold true when said species is present in a mixture with other salts. Therefore, the specific salt mixtures, sampled from Mnajdra during the project, need to be analysed: first, to determine the different salt species present, and second, to understand each salt's behaviour in relation to the others. And all of this must be done in a non-invasive way so as to retain the integrity of the megaliths.

There is also the case of the stone's porous structure, which affects how water acts during absorption. Both the size and distribution of pores within the stone's microenvironment need to be considered when analysing the stone's salt-induced deterioration process. Given that each and every stone may have its own unique porous network, 3D scans of several test samples are essential, since the deterioration process will inevitably vary according to stone type.

ON THE WAY FORWARD

'The first step of the project is to identify – in a non-invasive way – salt species that are present on-site. Once completed, lab analyses and tests will be carried out to better understand the behaviour of the salt mixtures identified,' Faieta explains. 'This information will be analysed in conjunction with the information of the porous network of the specific type of Globigerina Limestone being studied. The identified processes will then be reproduced in a controlled environment with the salt mixtures identified on site in Mnajdra.' This process will allow the team to observe and monitor the crystallisation cycles and gain insights into how identified salts interact with the stone's porous network to cause decay.

With this part of the wider research having begun in February 2024, Faieta mentions that 'the project is presently in the process of identifying the salt species and associated mixture at Mnajdra.' Ideally, should everything progress according to plan, the project will improve the knowledge on stone deterioration processes at the micro-level within the individual pores of the stone. In this way, means of mitigating salt weathering may be explored and promoted in the future, beyond the project's end. This will help conservationists make better-informed decisions with regard to the preservation of our heritage sites.

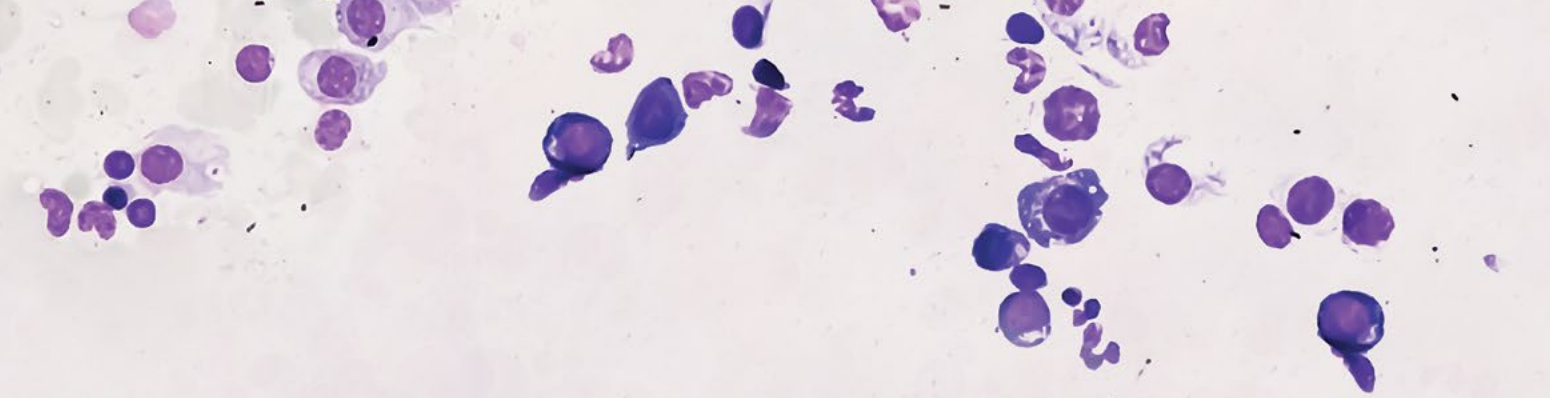
Faieta is conducting her research as a Research Support Officer at the Department of Conservation & Built Heritage, forming part of a wider project in collaboration with Heritage Malta, funded by the Ministry of Finance and Employment (Government of Malta).

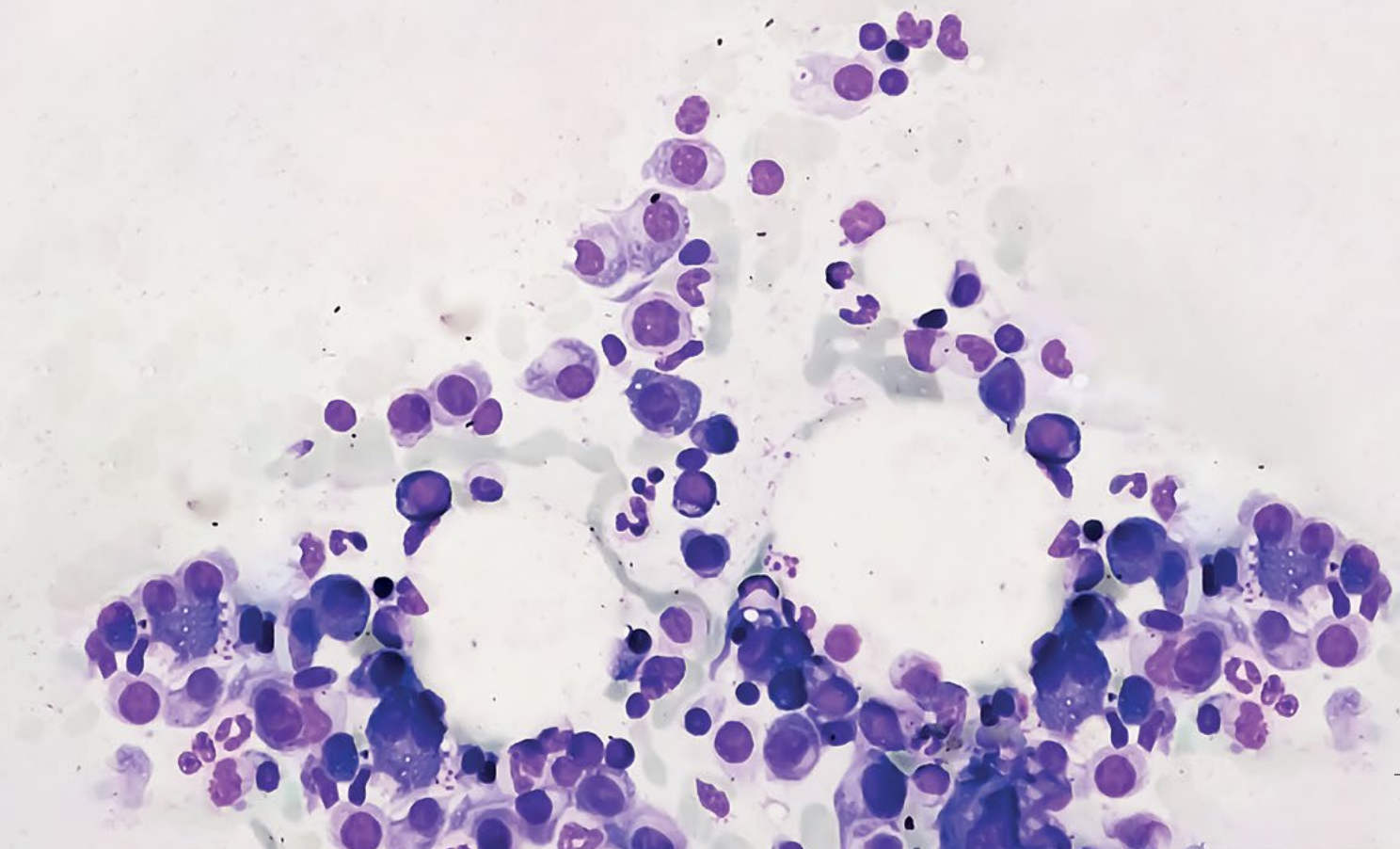
Life Sciences and Medicine

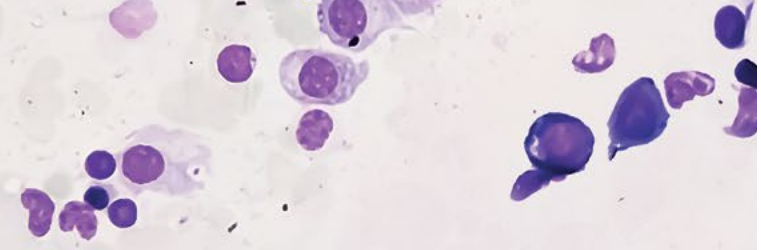
Harnessing Nature to Accelerate

CANCER CELL AGEING

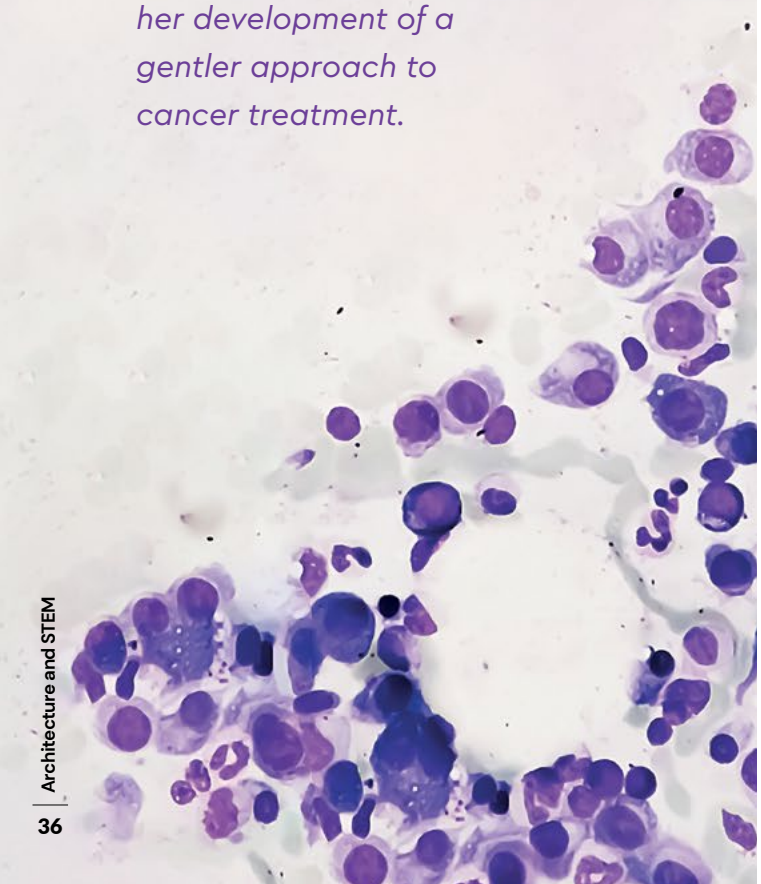
Author: **Andrea Cuschieri**







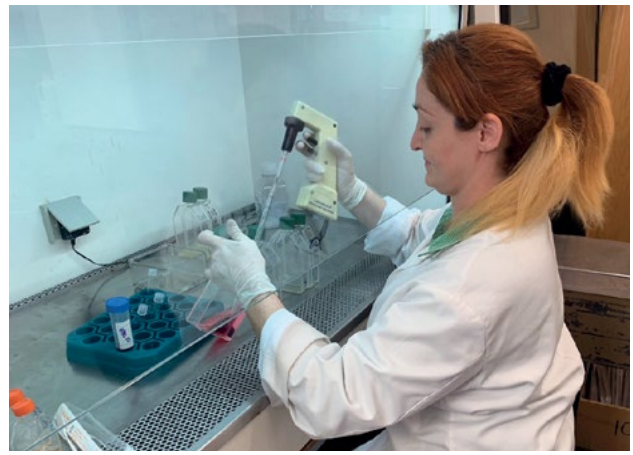
When thinking about cancer, we often imagine an uncontrolled multiplication of cells spreading throughout the body. For decades, the primary methods of combating cancer have involved aggressive approaches that focus on killing off cancer cells. **THINK** *speaks to* ***Dr Analisse Cassar*** *on her development of a gentler approach to cancer treatment.*



Cancer treatments like chemotherapy and radiation can be harsh on patients, as they inadvertently kill healthy cells vital for our body's daily functioning. Taking lessons from treatments for acute promyelocytic leukaemia, a new approach to cancer treatment is gaining traction by encouraging cancer cells to mature more quickly, rather than aggressively killing them. Led by Dr Analisse Cassar, a UM-based research team is developing a gentler approach that forces cancer cells to mature or 'age' with the help of compounds derived from natural sources. With further research, this innovative method offers a gentler alternative to traditional therapies, reshaping the way we think about cancer treatment.

A NEW WAY OF THINKING ABOUT CANCER CELLS

Cassar, a cancer researcher with the Cancer Therapeutics group within UM's Faculty of Medicine and Surgery, is leading her team in discovering novel approaches which can be used to combat cancer. She explains that cancer cells, like stem cells, behave as if they are 'stuck' in time. 'The truth about many cancers is that the cells are immature,' says Cassar. 'They multiply quickly



Dr Analisse Cassar
Photo by Dr Oriana Mazzitelli

without ever maturing fully into functioning cells, which is why they're so harmful.'

In healthy bodies, cells grow, mature, and eventually die, making room for new, fully functional cells. However, cancer cells are different. They don't follow the usual life cycle. Instead, they multiply without maturing, leading to an overgrowth of useless, immature cells that accumulate in the body's systems. In the case of leukaemia, for instance, the problem isn't just that cancer cells multiply quickly; it's that these immature cells take up space that should be filled by mature, fully functioning blood cells.

FORCING CANCER CELLS TO MATURE

This is where differentiation therapy comes in – a technique that forces cancer cells to mature. Think of it as pushing these cells to 'grow up' and stop multiplying. Differentiation therapy has already seen significant success in the treatment of a specific type of blood cancer known as Acute Promyelocytic Leukaemia (APML). Once considered 90% fatal, APML is now approximately 75% curable thanks to the use of ATRA-differentiation therapy, which pushes immature cancer cells toward maturity.

Cassar's work builds on this success but expands it further, using natural compounds to achieve the same results in other types of cancers. 'The cancer we tackle often has a block in maturation, and forcing it to age removes its ability to proliferate rapidly. Once a cancer cell matures, its lifespan is short,' explains Cassar.

THE ROLE OF NATURAL COMPOUNDS IN CANCER TREATMENT

What makes Cassar's approach even more unique is her team's use of natural compounds to drive this process of inducing cancer cells to mature. 'We've been studying a wide range of natural chemicals', says Cassar, 'including extracts from plants and even sea cucumbers and axolotls, which are known for their regenerative properties.'

Unlike synthetic drugs used in conventional treatments, these natural compounds offer a gentler approach. They are less toxic, making them ideal for patients who cannot tolerate aggressive chemotherapy or radiation treatments. 'Our aim is to provide an effective treatment that doesn't harm patients,' Cassar emphasises. 'Natural compounds are promising because they can target cancer cells with potentially fewer severe side effects than those often seen in traditional cancer treatments.'

EPIGENETICS: TWEAKING THE CELL'S GENETIC MATERIAL

In addition to using natural compounds, Cassar and her team also employ epigenetic modifiers to tweak the genetic material of cancer cells. Epigenetics refers to changes in how genes are expressed without altering the actual DNA sequence. This is crucial because cancer cells can often resist treatment by shutting down the genes that would otherwise make them susceptible to drugs.

'Epigenetic modifiers allow us to "unzip" or "open up" parts of the cancer cells' genetic material that were previously closed off to treatment,' explains Cassar. 'By doing this, we make the cells more vulnerable to the natural compounds we're using, increasing the effectiveness of the treatment.'

This two-pronged approach – using natural compounds to push cancer cells toward maturity and employing epigenetic modifiers to enhance the effect – has already shown promising results in various cancers, including leukaemia, osteosarcoma, and neuroblastoma.

A GENTLER APPROACH FOR VULNERABLE PATIENTS

One of the most significant advantages of Cassar's approach

'Our aim is to provide an effective treatment that doesn't harm patients [...] Natural compounds are promising because they can target cancer cells with potentially fewer severe side effects than those often seen in traditional cancer treatments.'

is that it does not work by directly killing cancer cells and thus doesn't kill healthy cells, either. Conventional treatments like chemotherapy can be extremely hard on the body, causing severe side effects such as immune suppression, hair loss, and nausea. In some cases, these treatments are so toxic that they pose serious risks for vulnerable patients.

'Our treatment avenues offer a potentially less harmful alternative,' says Cassar. 'This makes it ideal for patients who are too frail to undergo aggressive treatments. It's also a much better option for children and young adults, whose bodies are still developing. These groups are particularly vulnerable to the long-term effects of harsh cancer treatments, such as infertility or developmental issues.'

By offering a treatment that focuses on ageing cancer cells rather than killing them outright, this strategy promotes a future where cancer therapies are not only more effective but also kinder to patients.

THE ROAD AHEAD

While this new approach is promising, there's still much work to be done. Cassar's team has made remarkable progress, but they are now applying for funding to test their novel therapeutic approaches in animal models to ensure that the treatment is safe and effective. 'It's a long road to clinical trials, but the results so far give us hope,' she says.

Cassar is optimistic about where this research is headed. 'We're not there yet, but the potential for this treatment to be used alongside conventional therapies is promising,' she explains. 'The idea is not to find one miracle drug that cures all cancers, but to combine different approaches. The more angles we can attack cancer from, the better our chances of success.'

A MORE COMPASSIONATE FUTURE FOR CANCER TREATMENT

In the end, Cassar's work represents a shift toward more compassionate, patient-centred care. By focusing on natural compounds and less toxic therapies, her team hopes to offer patients an alternative to the harsh treatments of the past.

'Cancer treatment doesn't have to be as brutal as it's been in the past,' she says. 'By harnessing nature to age cancer cells, we're offering a gentler, but equally effective, path forward.'

As this innovative research moves toward clinical trials, it offers new hope for cancer patients everywhere – especially those who have suffered most from the side effects of conventional treatments. With a combination of natural compounds and epigenetic tweaking, this approach could pave the way for more effective and much kinder cancer therapies in the future.

The University of Malta is responsible for the research component of the project, with the support of TOSFA and Xjenza Malta.

The Puzzle of Endemic Plants on the Mediterranean Islands

Author: **Erika Puglisevich**

Have you ever wondered why some plants are only found on the Maltese Islands? How did they come about? ***Prof. Sandro Lanfranco*** *has spent a good amount of time trying to uncover the mysteries of the plant world.*

'Fundamentally an educator, a teacher, and a researcher', Prof. Sandro Lanfranco has dedicated the past 25 years to understanding the world of plants, including their taxonomy, conservation status, and dynamics (i.e. the study of changes and processes that occur within plant populations, communities, and ecosystems over time). His most recent research focuses on analysing the factors that influence endemic plant diversity on Mediterranean islands and archipelagos.

The Maltese Everlasting (top) and the Maltese Rock Centaury (bottom); are two examples of endemic plants found on the Maltese Archipelago.

WHAT MAKES A PLANT 'ENDEMIC'?

Before starting to unravel the complex dynamics of the plant world, we need to understand what we are talking about. Simply speaking, an endemic species is any species that is found in a specific area, and in that area alone, within what is called a 'biogeographic boundary'. 'Endemic species' is therefore a hefty term that says a lot and also very little. As Lanfranco points out, even finding a proper definition for what we consider a species is something scientists struggle with, let alone trying to define which of those species can be considered unique.

On the Maltese Islands, we boast a number of endemic plants, such as the Maltese Everlasting and our national plant, the Maltese Rock Centaury. These plants not only form part of the Maltese ecosystem, but they are also part of our cultural identity. Although we tend to hold these plants in high esteem, in the natural world, endemics are unique because they are underachievers. A harsh truth is that these are plants that ended up trapped and isolated in a specific area, evolving into a new species while unable to increase their ecological spread. They struggle to compete with other plants in different environments and fail to reproduce elsewhere.

Prof. Sandro Lanfranco
Photo by Dr Edward Duca

The idea of endemism, like many other things, is a term coined by scientists to help communicate a concept, one which we first need to understand the context behind. Lanfranco says that 'the phenomenon of endemism exists exclusively because of the scale at which we observe the phenomenon.' What this means is that if we were to look at plants which are only endemic to the Mediterranean region, that means we would be grouping plants found in Italy, Spain, and Malta all together. However, if we narrow our focus, we can see that some plants endemic to the Mediterranean are found exclusively in specific locations – some only in Sicily, others in Cyprus, or even just in Malta. Certain plants may be limited to a particular mountain range, while others might only grow near a specific valley, pool, or pond.

In countries like France or Switzerland, it would be much more difficult to narrow down unique plants because plants do not care about political boundaries. Luckily for us, living on the archipelago known as the Maltese Islands, it is much easier to note plants belonging only to our territory. This is something that Lanfranco and his fellow researchers (Leanne Camilleri, Katya Debono, and Reeya Ghose Roy) have also noted. To make life easier for themselves, they decided to focus on the islands of the Mediterranean in their research.

HOW DOES MALTA COMPARE TO OTHER ISLANDS?

Lanfranco explains that the number of species one can get on an island depends on the size of the island and its distance from the continent. If an island, which is an isolated land mass, has a large number of species, there is a greater chance that some will become specially adapted and become a unique species. Similarly, an island that is far from the continent will make it harder for new species to arrive, so there will be fewer species that have the chance to become trapped and evolve into a new species.

Lanfranco states that relative to the size of Malta and Gozo, 'other Mediterranean islands have more endemic unique species than we do. We don't fit the theory.' In fact, the proportion of endemic species to total species is only 2%.

So what have species done to adapt?

Looking at some of the larger islands in the Mediterranean – Crete, Corsica, Cyprus, Sardinia, Malta, Sicily, the Tuscan Archipelago, and the Balearics – one thing that was immediately apparent is that islands are not uniform in shape. One can get an island with only one point close to the mainland and the rest of the edges exposed to the sea. Therefore, researchers noted that just measuring the distance from

the mainland was insufficient, as it only looks at the space between two points. So instead the researchers looked at proximity, which gives more of an idea of the connectivity of the island to the mainland.

Another thing to keep in mind is that what really matters is not especially the size of the island but the variety of its topography. Lanfranco explains that if a 10-mile-wide desert with only sand might support five species, expanding it to 100 miles would not increase that number, since no new habitats would be included.

The more complex the topography, the more habitats there are for different species to live in, and the more opportunity there is for some of these species to become trapped. Therefore, as a part of Lanfranco and his team's research, they took a reading of different elevations. They looked at how 'wrinkled' each island is. The findings of their research confirmed that the size of an island is a good determinant of the proportion of the endemic species to total species, and it confirmed that topographic diversity is also an important determinant in the proportion of species. In the case of the Maltese Islands, the fact we have a relatively monotonous landscape might account for why we have a small proportion of endemics.

HAS THE PUZZLE BEEN SOLVED?

Unfortunately, Lanfranco answers that no, the larger puzzle has not been solved – the picture is still incomplete. One big influence in species dynamics will always be human population density. Lanfranco notes that among the islands studied, the population density on the Maltese Archipelago is by far the highest, with density seven times higher than the second-ranked islands, the Balearics. This very likely also plays a role in the country's species richness.

However, the study has revealed a very important implication for the conservation of species. Lanfranco clarifies that we can only make statements that the Maltese Islands should have more species if we know the general rules. We can only classify our islands as species poor or rich according to the number of species we are expected to have. He states, 'the study has helped us identify and provide a cutoff point on how many species we should have, if the general rules of colonisation and immigration apply everywhere.'

Although they may be underachievers, preserving endemic species, even those that seem insignificant, is crucial due to the unique roles they play in maintaining healthy ecosystems. These species contribute to biodiversity, support food chains, and may offer potential benefits to humans in areas like medicine and agriculture. They help maintain ecological balance, and their loss could lead to unforeseen disruptions. Beyond their practical value, many species hold cultural significance and enrich the natural world's beauty. Ultimately, every species, no matter how small, is a vital part of the planet's intricate web of life, and losing them could have far-reaching consequences.

The evolution of endemic species spans millions of years, shaped by complex dynamics we are only just beginning to understand. Continued research by experts like Lanfranco and his team is essential to deepen our knowledge of these species and their ecological requirements. By refining our understanding of what constitutes species-poor environments, we can better inform and direct conservation efforts to preserve these unique and fragile ecosystems for future generations.

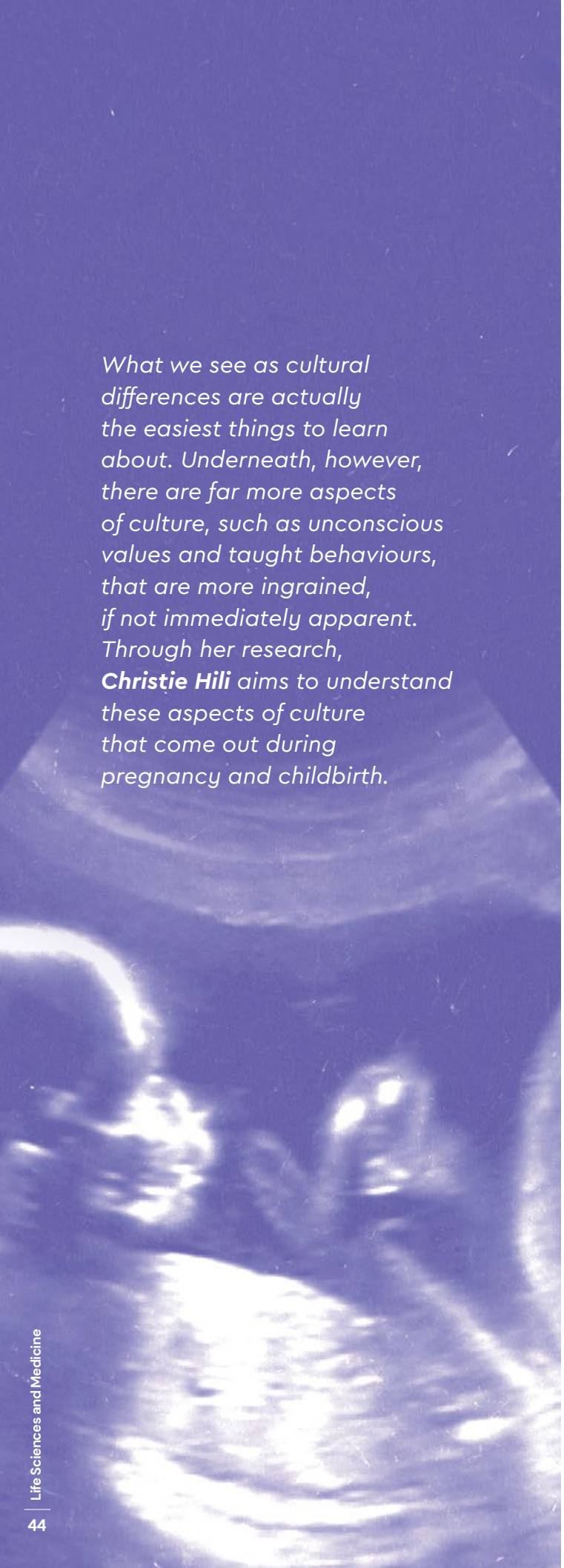
Further Reading

Camilleri, L., Debono, K., Ghose Roy, R., & Lanfranco, S. (2024). 'Diversity in Isolation: Dissecting the Drivers of Endemic Plant Richness on Mediterranean Islands and Archipelagos'. In Ž. Fišer, S. Lanfranco, N. Lončarević, A. Simmons, & C. Sánchez Romero (Eds.), *COST ConservePlants Final Conference: Book of Abstracts* (p. 20). European Cooperation in Science & Technology (COST). https://www.um.edu.mt/library/oar/handle/123456789/119020

Camilleri, L., Debono, K., Grech, F., Bellia, A. F., Pace, G., & Lanfranco, S. (2024). Topographic complexity is a principal driver of plant endemism in Mediterranean islands. *Plants*, 13(4), 546. https://www.um.edu.mt/library/oar/handle/123456789/118850

PREGNANT CULTURE

Author: **Sarah Schembri**



What we see as cultural differences are actually the easiest things to learn about. Underneath, however, there are far more aspects of culture, such as unconscious values and taught behaviours, that are more ingrained, if not immediately apparent. Through her research, ***Christie Hili*** *aims to understand these aspects of culture that come out during pregnancy and childbirth.*

In 1976, the anthropologist Edward T. Hall described culture as an iceberg. He wanted to explain that what we see as culture – the clothes, the food, the festivities – is only the figurative tip of the iceberg. When you dip your head underwater, you see that culture features in most of our minor daily decisions and in our major ones as well. Culture is the way we live and the way we do things; it is intangible and ingrained. The bottom-of-the-iceberg aspects of culture might rise to the surface in moments of tension and high emotion, and what could be more fraught with tension and emotion than bringing new life into the world?

THE PERINATAL PERIOD

Christie Hili graduated as a midwife in 2012 and has always viewed her job as a vocation to care for the vulnerable. Keenly aware of societal issues and social injustices, she wants to challenge unfairness in the medical sphere. This is how Hili ended up doing her master's research on intimate partner abuse during pregnancy and her Ph.D. research on the perinatal (the

Christie Hili

period between getting pregnant until a year after birth) health outcomes of Maltese and migrant women in Malta.

Due to a lack of research in the area, Hili and her supervisors, Prof. Rita Borg Xuereb and Prof. Charles Savona-Ventura, decided that, for the second half of her Ph.D., she would conduct a qualitative study on the perinatal experiences of those in Malta, specifically migrant women from Sub-Saharan Africa and Eastern Europe. Hili made time to talk in detail and meet these women wherever they were most comfortable, giving her access and insight into those intangible aspects of culture that impact the perinatal period.

PREGNANCY PRIORITIES

The first thing that stuck out from Hili's conversations was the common experiences. All migrant women mentioned feelings of isolation due to physical separation from their family, friends, and support network. At the time of the study, these feelings of isolation were particularly intensified due to the travel restrictions in place to mitigate the spread of COVID-19. Stemming from this sense of isolation, all the women interviewed also talked about the importance of having their partner's support. These men's support (all the interviewees' partners were male) had an indispensable role as these women navigated the health system, the COVID-19 pandemic, and any other issues and challenges that came up during and after pregnancy. The immigrant women were also united in their praise for Mater Dei hospital, saying that it was clean, well-equipped, and often compared it more favourably to hospitals in their countries of origin. The good conditions of the hospital went some way in putting aside worries about safety, which naturally is a priority for every expectant mother.

PREJUDICE

Shockingly, but sadly unsurprisingly, all the migrant women also mentioned moments of xenophobia and racism experienced through the perinatal period, including from medical staff in the hospital. Even for Eastern European migrants, the colour of their skin was no shield as they experienced assumptions, unprofessional and hurtful comments, and worse service when they were not accompanied by a Maltese person – plus the classic 'go back to your country' remarks.

Sub-Saharan African women, in the meantime, also had to contend with false stereotypes that they all have large numbers of children which they do not put enough care into raising. They often had to contend with the lazy assumption that Black African women are a monolith when, in fact, they are individuals from a large continent with vast differences in their cultural backgrounds.

Hili believes that these hurtful and damaging incidents, which on at least one occasion, happened while the woman was giving birth, could be lessened with cultural competence training. This type of training is not officially provided to people working in the national health service, a glaring omission when considering the rapidly changing demography of the Maltese population. Hili insists that cultural competence needs to be a study unit in and of itself as it could make a huge difference in caring for patients with diverse backgrounds.

When it comes to care during and after pregnancy, many benefits could come from contextualising

Improving our health care service for the most vulnerable members of our society would undeniably have positive repercussions that everyone would enjoy. While this implies that some sectors of society only deserve excellent care because it would also benefit others, ensuring that everyone has the best chance of having a healthy pregnancy and safely giving birth is simply the right thing to do. That is reason enough.

the service we offer in Malta. For example, several Eastern European women were worried that they were not given an ultrasound scan every time they had an appointment during their pregnancy. They could not understand how the midwives and doctors knew the baby was well if they had not performed an ultrasound scan.

In reality, excessive medicalisation (such as too many ultrasound scans) could be less safe for the foetus and the mother and so should be avoided when other means of examination are viable. However, this needs to be communicated clearly since not all patients are equally health literate or even literate. Seemingly complex medical concepts can and should still be communicated by, for example, using pictograms. Such resources and a practice of better communication would indubitably help not just migrant women but anyone who is pregnant and receiving care at the hospital.

POLICIES

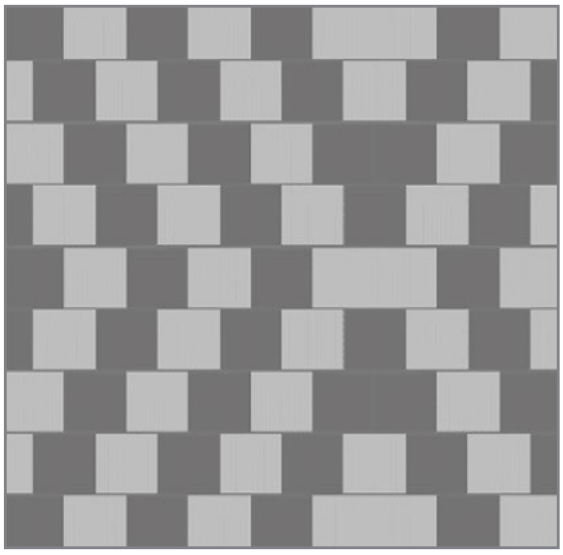
Many things could be done by the responsible authorities, Hili explains, starting from actively recognising pregnancy in the National Health Systems Strategy (2023–2030). Turning to the situation of migrant women, Hili points out the omission of health from the National Integration Policy. 'Any person living in Malta at some point will use the health service, and this could be an important point of integration, where they learn about the health services we offer and we learn about their culture, resulting in better care,' states Hili.

Hili's research is evidence that something must be done so that certain dangerous situations are avoided. For example, some Sub-Saharan African women had extreme reactions to the suggestion of a caesarean. In their home countries, caesareans can be a death sentence for the mother and baby, while in Malta, it is a fairly safe procedure. Religious beliefs that a baby is a gift from God intertwine with this reticence.

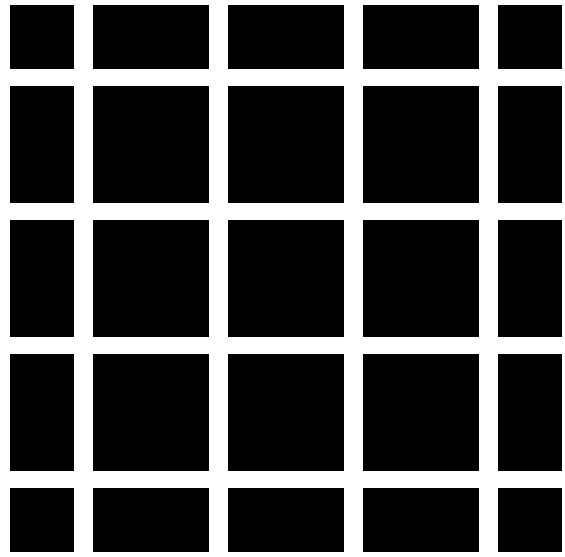
In Malta, it is also common to believe that babies are a divine and precious gift; however, the difference lies in the extent that medical procedures are seen as interfering with God's plan. As one Sub-Saharan African woman put it, 'if God gives me [a baby], He [God] tell me when to give birth.' However, reservations were eased when the safety of caesareans and the consequences of not having one (when this was required) were explained. The extra time spent clarifying facts at a crucial moment potentially makes the situation dangerous. Anticipation of such situations and quick understanding could make for a safer, less stressful birth for both mother and baby, as well as for the midwives and doctors assisting the birth.

Living together is not a passive act. We need to actively seek to understand each other, because understanding the source of our differences goes a long way toward solving issues of cultural clashes. This becomes especially apparent in important moments. Improving our health care service for the most vulnerable members of our society would undeniably have positive repercussions that everyone would enjoy. While this implies that some sectors of society only deserve excellent care because it would also benefit others, ensuring that everyone has the best chance of having a healthy pregnancy and safely giving birth is simply the right thing to do. That is reason enough.

Social and Behavioural Sciences



An example of the chessboard illusion



An example of the Hermann grid illusion

Author: **David Mizzi**

Take a look at the image on the left. Are the horizontal lines straight or wavy? How about the image on the right? Do you see ghostly, grey blobs at the intersections? Why do they disappear when you look directly at them?

Our brains, as it turns out, are not perfect little machines. Just like your old laptop, they will occasionally glitch and confuse us. However, while you probably want to throw your laptop out the window when that happens, you don't really get that feeling when you see an illusion. Instead, you might be pleasantly surprised or bemused.

But have you ever wondered why our brains do that? Why can't we tell if a line is straight or not? Why do we see ghostly grey blobs at the intersections of a grid? And why don't we freak out when we see these illusions?

'It's the context that makes them non-threatening. We can externalise it and say "It's a cool display," not "Oh no, my brain isn't working!"' explains Prof. Ian Thornton.

Thornton is a professor at UM's Department of Cognitive Science, which focuses on the scientific study of the brain and cognitive function. Its research combines linguistics, neuroscience, computer science, psychology, and philosophy to understand the workings of the human mind. Thornton, being both a computer scientist and psychologist, uses dynamic illusions to understand how the brain represents information that changes over time.

So, how do illusions work?

IT'S ALL AN ILLUSION

'Illusions are a glitch in the matrix,' says Thornton. 'The idea is that our brain is creating our experience of the world, and illusions give us an insight into the way we recreate the world.'

Let's take a look at the chessboard illusion with the wavy lines on this page. 'When you have black and white objects that are particularly organised, you get these massive distortions,' explains Thornton. The lines are actually completely straight – place a ruler and see for yourself. So, if the lines are actually straight, that means our brains are making the lines appear wavy. The illusion occurs

Prof. Ian Thornton
Photo by Prof. Noellie Brockdorff

because of an 'error' or 'glitch' when our brain processes the image. But this isn't a bug; it's a feature!

Let's take a step back for a moment and examine how we actively perceive the world. What we see or hear, for example, is our brain's interpretation or representation of the world outside us, not a simple copy of the world. 'We take apart the world that arrives at our senses, process it, and then rebuild it. We interpret the world and compute. With vision, some parts of the brain deal with colour, some with shape, some with motion, and they all work together to construct our final perception of the world. Illusions show us errors in these reconstructions. If we had a complete and faithful copy of the world, there would be no visual illusions,' explains Thornton.

For many of us, the idea is that we view the world as a series of still images or frames in quick succession. However, Thornton argues that our brain wasn't designed to work that way. 'The idea that we view the world as a series of snapshots, out of time, is fundamentally flawed. An image as something frozen in time is something humans have created. Our research is about putting time back into the equation,' he argues.

A GLITCH IN TIME

Think about playing catch. When someone is throwing a ball at you, your mind is doing dozens of incredible calculations at wicked speed. Part of these calculations include estimating the ball's trajectory and where it will land. Amazingly, your brain is also factoring in how long it is taking to make this calculation (typically about 100 milliseconds). So, your brain aims to predict where an object will be by the time the information is processed. However, this can also create some interesting illusions.

'If I show you something moving, a dynamic picture, and then a moment later I show you another picture taken a split second after, your mind will try to "fill in the gap",' explains Thornton. So, what happens if we take something like the chessboard illusion and put a moving object in front of it? Thornton's Rocking Line Illusion helps to illustrate just that (scan the QR code on the next page to see the illusion for yourself and follow along!).

The Rocking Line Illusion features a black rectangle moving horizontally across a series of uneven, white rectangles in the background. As you zoom out, making the display smaller, the line appears to tilt downwards and upwards as it moves. 'The illusion only happens when the line is small,' Thornton says. 'This gives us two clues. Firstly, when you're following the black rectangle, you're trying to

predict its movements. In trying to compute the average of where the black rectangle is, our brain changes the shape of the line so it appears to have a tilt. It seems to be some kind of limitation on our ability to interpret the shape.'

Even though we know that, in reality, the line is not wavy, our brain is still delivering that flawed information. Why does it do that, and what can it teach us about our brains?

BEHIND THE ILLUSION

'Illusions demonstrate the kind of mechanisms our brain uses to process and reconstruct our representation of the world,' explains Thornton. Illusions highlight the little quirks in our brains. These 'errors' or 'glitches' can shed light on how our brain processes information. 'After 150 years of scientific study of the brain, we still don't know certain aspects, like how the brain really stores information. We understand a lot about the brain on a molecular and neural level, but cognitive, not so much,' explains Thornton.

Illusions show us that our brain's processes aren't perfect. Something as seemingly simple as lines over a chequered background can befuddle our brains and tease our inner machinations. Yet, it is through these glitches that we can begin to understand how our brain operates. Perhaps it is within these distortions that we can unlock the mysteries of cognition!

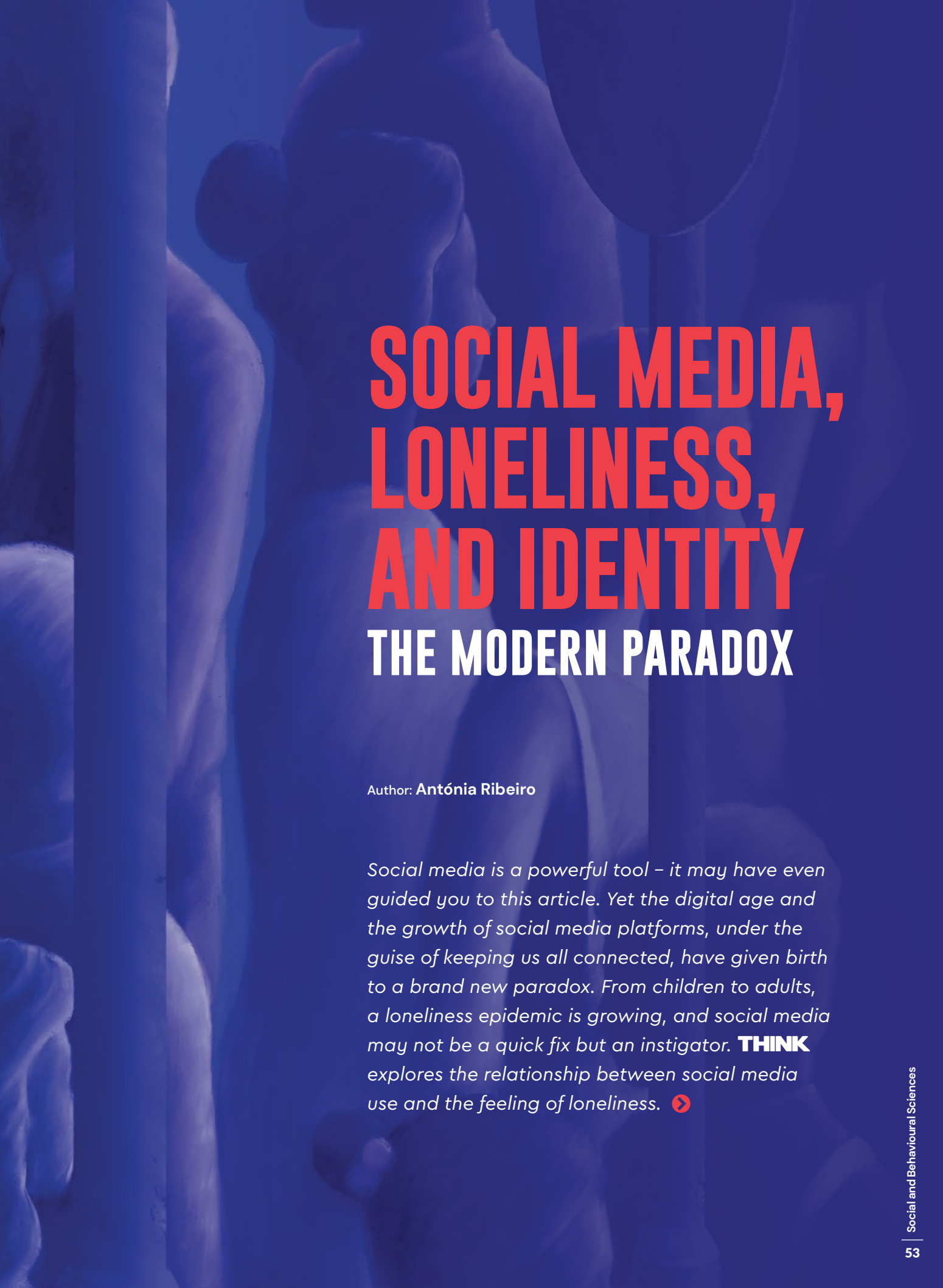
Scan the QR code to see the Rocking Line Illusion in action

maltacogsci.org/RLI

FUN FACTS

- Illusions aren't just for humans! Some animals, like primates and even certain mammals, experience the same visual illusions as we do, thanks to similar brain mechanisms.
- Not everyone sees illusions the same way! Just like some people are better at recognising faces, others are more sensitive to specific illusions, making the experience vary from person to person.


25



SOCIAL MEDIA, LONELINESS, AND IDENTITY

THE MODERN PARADOX

Author: **Antónia Ribeiro**

Social media is a powerful tool – it may have even guided you to this article. Yet the digital age and the growth of social media platforms, under the guise of keeping us all connected, have given birth to a brand new paradox. From children to adults, a loneliness epidemic is growing, and social media may not be a quick fix but an instigator. **THINK** *explores the relationship between social media use and the feeling of loneliness.*

Many factors are contributing to the loneliness epidemic. Fast-paced lives organised around long work weeks, lack of support for family care, even difficulty in accessing leisure spaces – loneliness is a multi-factor problem that affects 24% of people over the age of 15 around the world.

THINK has previously reported extensively on loneliness at the university level, for the elderly during COVID-19, and even in dating with disabilities. As we explain in 'Only the Lonely', loneliness has long-term effects on our mental and physical health, relating to depression, high blood pressure, and the risk of stroke and heart disease.

In this article, we ask: how does loneliness relate to the digital world, and specifically, social media? On these platforms, the user is the product. Companies capitalise on your attention to sell you their products, and the platforms are designed to keep you focused, engaged, and addicted to the screen.

IT STARTED WITH FACEBOOK

When Christine Spiteri was an undergrad in psychology, Facebook was the new big thing. Quickly, Spiteri started looking at her class material through the lens of the digital world and developed a keen interest in the contrast between online and physical identities.

While smartphones were becoming ubiquitous, Spiteri was in the Netherlands studying media-mediated cultural changes. And while COVID-19 was in full swing, Spiteri started questioning how social media could be impacting isolation and loneliness during lockdown. It was with these experiences in mind that she started her doctoral studies in Psychology at UM under the supervision of Prof. Mary Anne Lauri.

Spiteri's research starts with an observation: 'There is a lot of talk about the effect of social media on mental wellbeing, but the relationship may not necessarily be a linear one – there are other factors that may affect how social media impacts people.' One factor Spiteri wants to test is personality. She focuses on the Five-Factor model of personality, which focuses on the Big Five traits: Openness (to experience new things and accept new ideas), Conscientiousness (persistence and organisation), Extraversion (enjoying outside stimuli, especially with other people), Agreeableness (prioritising other's needs), and Neuroticism (the tendency to respond to stress with negative emotions). According to Truity, the Big Five measure personality through these key dimensions, which are independent of each other and drive our behaviour. Spiteri uses this model to contextualise how people's predispositions affect their perception of loneliness while using social media.

The researcher also distinguishes between types of screen time in her research. Our daily life demands that we use our phones and computers all the time, yet using a calculator app is different from doom scrolling on Instagram. These different applications are likely to have different effects on our mental health. Aside from this, Spiteri warns that we should consider how 'our perception of screen time is usually lower than the actual time we spend on our devices.' As such, her research distinguishes between routine social media use (how much social media is integrated into our routines) and emotional use (the emotional investment in social media use, like feeling upset or disconnected when not online).

Finally, Spiteri hopes to see how social media impacts different age groups, specifically how younger generations interact and connect both in real life and through digital media. This becomes particularly urgent when we consider that Gen Z and younger generations have been exposed to social media platforms from an early (and very formative) age.

A QUICK GUIDE TO STUDYING LONELINESS

Spiteri's research uses what is called a mixed-methods approach. It includes quantitative (statistics-based) and qualitative (interpretation of answers and testimonies) data to create a narrative and reach conclusions about loneliness and social media use.

Spiteri first tackled the quantitative aspect of the research during the spring of 2022. She collected 591 answers to a questionnaire, which she spent the last year analysing. Her questionnaire uses standardised scales (definitive scales that accurately quantify behavioural, cognitive, or emotional processes) to prod on the

Christine Spiteri

respondents' feelings of loneliness, typical social media use, and their personality traits.

As the research is still ongoing, the next stage is the qualitative aspect. By analysing the quantitative data, Spiteri will have a better grasp of the impact of social media use on loneliness. This will form the base for the qualitative analysis, which will complement the statistics with concrete stories about the impacts of social media use. In the qualitative stage of the research, Spiteri hopes to understand what makes people feel connected, what that means to them, and how social media shapes those perceptions.

SOCIAL MEDIA'S IMPACT CHANGES WITH PERSONALITY AND AGE

So far, the research has shown that there is a cyclical relationship between social media use and loneliness, and personality is an important factor. An anxious, fearful, or depressed person will likely have an increased perception of loneliness from frequent social media use. In contrast, people with a high score in extraversion or conscientiousness are less likely to report loneliness.

With regards to the type of screen time, productive time is usually correlated with better mental wellbeing. Additionally, people who report emotional use of social media have a higher ranking on loneliness.

Curiously, the data paints a different picture for elderly generations. According to one CNN article, 'only 17% of people aged 65 and older reported feeling lonely,' and Spiteri's research hints that social media use among older individuals may decrease loneliness. The elderly are also less emotionally invested in social media use and simultaneously may be more comfortable being alone since they didn't grow up with these technologies.

Why does social media seem to be increasing the feeling of loneliness, especially for people with high neuroticism? Spiteri believes this may be related to personality traits. Someone who is shy and introverted or is already feeling lonely may need more intimacy and have higher expectations for the level of connectedness they want to experience. Because social media cannot fully replace the intimacy of face-to-face conversation, these individuals may end up disappointed by social media use, which increases the previous feeling of loneliness.

HOW TO SURVIVE SOCIAL MEDIA

As such, it is important to find a balance between online and physical life, to think about the type of content we interact with, its purpose, and whether it meets our needs. Self-awareness and expectation management are key for health in the digital age. Spiteri hopes that her research will motivate people to better manage their social media usage and be mindful of its potential to affect their wellbeing.

Despite the impacts established in the literature and the results unveiled so far by Spiteri's research, she warns that it is incorrect to blame social media for all our loneliness issues. 'The fact that children don't have the freedom to play outside, elderly don't have space to talk with their neighbours. All of this could play into loneliness,' Spiteri points out. We need a systemic change that prioritises accessibility to community-centred outdoor spaces and unstructured time for children to play, be away from screens, and even have the chance to get bored.

Talking Trauma:
Intervention for Maltreatment

Author: **Maria Chiara Grech**

*'I think we often look at maltreatment as this huge, untameable beast that's out of our control' (**Estelle Zahra**). The maltreatment of children is an issue that everyone agrees should be prevented at all costs. Yet despite, or indeed because of, this importance, collecting the data and putting structures in place for actual, long-lasting solutions is challenging. In this article,* **THINK** *converses with a Ph.D. researcher who is actively doing just that.*

Estelle Zahra is no stranger to working with children with communication issues, having worked as a speech pathologist in various private and public sectors, including state schools. At UM, her ongoing study is being done thanks to a scholarship granted by Hill Ventures Group through RIDT. Zahra is supervised by Prof. Daniela Gatt from UM's Department of Human Communication Sciences & Disorders and co-supervised by Prof. Judy Clegg from the University of Sheffield. Zahra's previous academic achievements include a Master's Degree in Language and Communication, which she obtained through a dissertation that looked into the connections between language and movement. Zahra recalls thoroughly enjoying investigating this subject but says her Ph.D. research 'is fuelled by something completely different.' The study itself focuses on the language development of Maltese bilingual 5–8-year-olds with a history of maltreatment issues.

FALLING HEADFIRST INTO THE LITERATURE GAP

When asked about what exactly fuelled this somewhat drastic change, Zahra shares a personal story: 'In December 2020, shortly after my husband and I were married, we found ourselves meeting a social worker at Aġenzija Appoġġ, both keen to learn more about fostering. It was something we both wanted to do, and we were just looking for more information. A month later, we were sitting in on training sessions, and after that, we had social workers visiting our house. We ended up with a four- and a five-year-old living with us. I couldn't help but notice that there were patterns – linguistic errors – which I had never really seen in the clinic. I found myself thinking about the tools we use to assess kids in the clinic and knew, deep down, that if I were to suggest that a colleague assess them using these tools, their score wouldn't be indicative of

Estelle Zahra
Photo by Angela 'Giola' Cassar

speech and language intervention. And yet, they were still struggling to communicate basic narratives.'

During this time, Zahra also recalls thinking back to her university days and how, in the few times the topic of language development in children with maltreatment histories came up, 'it was always spoken about in the context of neglect: that in any neglectful situation, one would expect that language exposure would be limited or inadequate, and once they are in a setting where language exposure is adequate, we should eventually expect to see them "catch up". We never really spoke about the actual effect of the maltreatment itself; it was always like this kind of "catching up" exercise.'

This led Zahra to discover that maltreatment in relation to language development was being discussed in academia, but there were a lot of questions that remained unanswered. Seeing that the issue had very much become a part of her life, she decided to try to answer them herself.

THE QUESTIONS THAT NEED ANSWERING

Since the majority of research in this area revolves around preschool age or adolescence and early adulthood, Zahra chose to focus on the specific age range of 5–8-year-olds. A point of interest for Zahra was the narratives in the various studies she read. She recalls, 'As I was reading more research, often children with a history of maltreatment either find themselves with a social worker who's carrying out some sort of investigation or, in worse circumstances, in adolescents when things would have already gone south.' Zahra further elaborates that these investigations would often be done to decide whether child protective services needed to be involved or, even in the situation of adolescent studies, whether or not there needed to be incarceration during investigations following alleged delinquent behaviours.

Zahra's investigation aims to look at linguistic profiles that may or may not present specifically at 5–8 years of age and to propose a working model that will facilitate collaborative practices in the child's best interests. For more accurate results in such an under-researched area, Zahra intends to have a comparison group of children with no history of maltreatment, 'to compare not necessarily performance, but linguistic profiles: what kind of grammar they use, what kind of errors they're making, how long their narratives are, how their narratives are structured, so on and so forth'.

Part of the reason why gathering data around this subject is so complicated is that there is no clear

reason why maltreatment affects language development. 'Every child reacts differently to maltreatment – same event, completely different response. There is also evidence for a neurological component. When someone goes through a stressful situation, they release stress hormones. In typical contexts, a person is able to regulate these emotions, and the stress hormones stop being released. But in the event that an adverse situation is somewhat chronic or extended, the stress hormones are going to be fired for a longer period of time to the point where the brain learns that this is the way it needs to function. This, in turn, can have a neurotoxic effect on the brain, quite literally changing the structures it's developing. But unless you're mapping out the brain neurologically, it would be difficult to account for these factors with clear certainty.'

Zahra also considers Malta's bilingual context, analysing the effect of maltreatment on both the Maltese and English languages. Although her research so far is preliminary, Zahra has already observed that the effect of maltreatment may be greater on the child's second language.

THE DREAM

Her study looks into what Maltese professionals in the area of language development understand by the idea of trauma-informed practice, and whether or not it is being used. Zahra's primary aim lies beyond simply helping these children 'keep up' with their peers in terms of academic milestones: 'It is an idea we are letting go of, and instead, we're moving toward a reality with more neurodivergent acceptance, where these children can be seen as individuals rather than "what they should be".'

The final and most important point in her study is that in all maltreatment cases, 'early intervention is key.' In fact, in a lot of cases, by the time child protective services are called, most of the damage has already been done, and in those cases where language difficulties have persisted into adolescence without adequate support, the children are more likely to fall into the 'school-to-prison pipeline'. Zahra concludes with, 'The implications are massive. The sooner a number of professionals are involved, the earlier we can see the signs and prevent harm from happening. That's the dream I guess.'

And what a dream it is! As a fellow student, I would like to thank Estelle Zahra. Allowing one's academic journey to have an influence on one's personal life and vice versa is not a boundary everyone is willing to cross, especially not on such a delicate subject.

L-Università ta' Malta

UM RESEARCH EXPO 2025

SAVE THE DATE

28 MAY 2025

VALLETTA CAMPUS

APPLICATION DEADLINE

Scan the QR code to submit your abstract by **31 January 2025**

UNIVERSITY OF MALTA RESEARCH EXPO 2025

At the University of Malta Research Expo 2025, UM researchers can showcase their research activities to the wider UM community, facilitate the sharing and cross-pollination of ideas, and celebrate their successes thus far! It also incorporates the traditional Doctoral School Symposium – allowing us to also celebrate the up-and-coming research of doctoral students.

Submit your application and join us!


B3
B4
B5

UM
RESEARCH
EXPO
2024

THINK