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THINK

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DIGITAL EDITION

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The inside out game

Artificial Intelligence is here. Our cover article interviews Prof. Georgios N. Yannakakis who brings a fresh view to the age-old question of AI taking over. Forget it. Think instead about a new social network of computers that are creative of their own right. Think as well how you might act like a computer. Yannakakis's ideas have helped create games that help children with dyslexia, soldiers with PTSD, and many other problems (pg. 15).

In another story, Cassi Camilleri interviews a team of engineers and cellular biologists who are trying to make better metal-on-metal hip implants (pg. 23). The engineers focus on making better hip-joint coatings, while the medical researchers ensure that the body reacts well to the upgraded implants. Safer, cheaper hip joints are in store.

Illegal drugs are a well-known if contentious social problem. Rarely discussed is the problem of prescription drugs used without consulting a doctor. All drugs have some sort of damaging side effect, especially if used inappropriately. Writer Marc Buhagiar investigates the extent of the problem in Europe (pg. 30).

On tapping research funds, Dr Vasilis Valdramidis talks about Horizon 2020 (pg. 8). In another opinion piece, environmental group fish4tomorrow talk about eating the right fish (pg. 9) and a student article also discusses fish (pg. 6). Other students are dipping their fingers in green chemistry (pg. 6). For alumni of the University of Malta, a new award has been launched. Who will you nominate? (pg. 47)

The University has to help all of Malta and all of Malta has to help the University. The country already contributes through taxes but Malta has never seriously invested in research. Without a research investment Malta's economy and cultural impact will always lag behind the World's and our best minds will always go abroad to find more satisfying jobs.

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COVER

Can the new kind of artificial intelligence be classified as creative intelligence? Computers are being programmed to create games to help people cope with stress, traumas and other difficult life situations. Image composite created by Jean Claude Vancell.

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students' THINKing

Lighter and Stronger Planes

Bonnie Attard

THE PRICE OF FUEL is a large cost burden on the aerospace industry. A lighter plane means cheaper flights, increased aircraft range, and less environmental pollution. Titanium alloys are replacing steel for components such as landing gear bearings and wing frames to reduce overall weight.

Titanium is still mainly used for static load-supporting structures such as landing gears, and seat and aeroplane frames mainly because, when sliding against other surfaces, the material wears down quickly. It is not ideal for moving parts such as bearings and gears. Hardening the surface can mitigate the problem but current techniques such as plasma nitriding are very expensive. Bonnie Attard (supervised by Dr Ing. Glenn Cassar, in a research collaboration between the Department of Materials and Metallurgy Engineering and the Technion Institute of Technology in Israel) has studied a more economically viable surface hardening process: Powder Immersion Reaction Assisted Coating (PIRAC) nitriding to protect titanium surfaces. The process is simple: components are immersed in an unstable nitride powder and heated in a furnace. The heat decomposes the nitrogen in the powder and forms highly reactive monatomic nitrogen. This reactive nitrogen is absorbed onto the titanium surface and reacts to form titanium nitride—a very hard ceramic compound at the surface that protects the component from being worn down during use.

In her research, Attard found that the PIRAC treatment significantly improved the dry-sliding behaviour of two titanium alloys Ti-6Al-4V (the most commonly used titanium alloy) and Timetal 834 (used in compressors for aeroplane engines) by forming a hard and very adherent ceramic surface layer. This treatment allows the components to handle prolonged usage of moving parts under high pressures. These treatments could increase the uses of titanium alloys in aircraft to reduce weight and cost.

This research was performed as part of a Master of Science in Engineering at the Faculty of Engineering, University of Malta. It is partially funded by STEPS (the Strategic Educational Pathways Scholarship—Malta). This scholarship is part-financed by the European Union—European Social Fund (ESF) under Operational Programme II—Cohesion Policy 2007–2013, 'Empowering People for More Jobs and a Better Quality of Life'. The testing equipment was financed by ERDF (Malta), Developing an Interdisciplinary Material Testing and Rapid Prototyping R&D Facility (Ref. no. 012).

Blood Families

Jeanesse Scerri

THALASSAEMIA is an inherited condition that causes a decreased production of haemoglobin. Haemoglobin is a protein found in red blood cells that transports oxygen in blood. Thalassaemia results from genetic mutations in genetic coding for the globin proteins in haemoglobin. If these mutations are inherited from both parents, they may result in severe anaemia requiring regular blood transfusions. In Malta, β-thalassaemia is the most common single gene disorder, with 1.8% of the population carrying a mutation in the β-globin gene.

Hereditary persistence of foetal haemoglobin (HPFH) is another inherited blood condition, this time with minimal detrimental health effects, in which otherwise healthy adults have naturally elevated levels of a foetal form of haemoglobin termed haemoglobin F (HbF). Interestingly, increasing the levels of this foetal haemoglobin in patients with thalassaemia reduces their symptoms, sometimes even eliminating the need for transfusions. Studying the genetics and physiology of HPFH individuals may therefore provide insight into new ways to increase foetal haemoglobin levels in thalassaemic patients.

Jeanesse Scerri (supervised by Prof. Alex Felice) optimised a technique to observe and measure HbF in single red blood cells of a family with HPFH. By using quantitative fluorescence microscopy, elevated levels of HbF were found to be caused by a small proportion of red blood cells having very high amounts of HbF, rather than by a large number of cells making small amounts of HbF. Microscopy and genetic data from family members were combined to find genes that influence the distribution of HbF within red blood cells of HPFH individuals. In the future, these genes may be targeted in patients with thalassaemia to potentially cure the disease.

The study shows that not every red blood cell is created equally; they are heterogeneous and individual red blood cells in the same person can have highly varied amounts of HbF between them. Traditional methods measuring the average HbF in a blood sample may therefore not show the whole picture. Cellular heterogeneity is becoming a hot topic in biological research, especially when it comes to other diseases such as cancer, where different responses to a particular drug are being observed not only between different patients, but also between different cells in the same tumour. Advanced techniques such as quantitative microscopy will be the essential tool in understanding the differences between cells that will help improve treatment in many diseases.

This research was performed as part of an Master of Science in Biomedical Sciences at the Faculty of Medicine and Surgery, University of Malta. It is partially funded through the Malta Government Scholarship Scheme (MGSS-PG).

Fast Fish, Slow Fish, Little Fish, Big Fish

Sarah Schembri

SEAGRASS MEADOWS support a diverse range of organisms. When this habitat is fragmented all species suffer. Fish that previously had large stretches of seagrass meadows to forage in would have to face the prospect of swimming to a different patch more often and this exposes them to predators. One of these species is that fish and chips staple, the cod (*Gadus spp.*), which as a juvenile uses eelgrass (*Zostera marina*) meadows as nursery areas in the North West Atlantic. A series of experiments were performed in 2009 at the Memorial University of Newfoundland, Canada in a tank with two fake grass patches. Researchers observed the gap crossing behaviour of juvenile cod when alone and in the presence of other cod. Then the data was analysed by Sarah Schembri (supervised by Dr Shaun Killen and

A Greener Chemical Pot

John Gabarretta

CHEMISTRY seems to inspire awe, scepticism, and mild disgust, followed by the utterance of something along the lines of 'that must be complicated'. Conversely, chemistry is an elegant science. One of the most elegant chemical reactions is the one-pot synthesis or multi-component reactions (MCRs).

MCRs are chemical reactions which make use of three or more molecules within the same 'pot' to create a more complex structure. At face value, this might sound unimpressive, but traditional chemistry takes much longer to carry out; one-pot synthesis is much simpler. Their 'simplicity' makes them much 'greener'. They save time and effort while providing very high yielding results with minor by-products. With a little thought and planning it is very easy to produce complex and functional molecules with much less effort than traditional methods, all in one pot.

John Gabarretta (supervised by Prof. Giovanna Bosica) sought to highlight the versatility and efficiency of the one-pot synthesis. His work focused on a reaction termed A^3-Coupling, standing for amines, aldehydes, and alkynes—the three basic starting ingredients—which produces structures called propargylamines: highly useful precursors to pharmaceutical compounds. Their structural backbone exists within a number of bioactive substances such as Rasagiline (used to treat Parkinson's Disease) and Dynemicin A (an antibiotic).

Green Chemistry is a more sustainable approach to industrial reactions.

Photo: Hans-Petter Fjeld (http://creativecommons.org/licenses/by-sa/3.0/)

Prof. Jason Matthiopoulos) using statistical models and turned into a computer simulation for fish movement in the tank.

Repeated simulations showed that fish grow bolder in crossing from one grass patch to another both when there are more fish present in the tank as well as when they are larger in size. However, the simulations allowed the researchers to distinguish a difference in this response; larger fish tend to be bolder and less decisive, they are quicker to leave the release patch but slower to enter the destination patch, while groups of fish tend to leave a release patch and swim quickly to the destination patch as a group. There was another difference. The total number of fish in the tank had an impact on gap crossing behaviour but not on the number of fish in the immediate vicinity. Juvenile cod communicate to coordinate their movement even at distances that seem relatively large compared to their size.

The conclusions drawn in this study could form the basis of hypothesis for larger studies, such as those to determine marine habitats that qualify for Marine Protected Area status. ●

This research is partially funded by the Master it! Scholarship Scheme (Malta), part-financed by the European Union—European Social Fund (ESF).

Gabarretta's work managed to make the A^3-Coupling reaction 'greener' in three ways. Firstly, the only by-product of the reaction is water, with all the other starting materials being incorporated in the final products. Secondly, with the help of a copper-based catalyst over 90% of the starting materials were turned into the final products in many cases. Finally, the reaction did not require any harmful solvents and the catalyst could easily be recovered and reused several times. A small library of nearly 20 compounds was amassed by varying the different starting materials with the synthesised examples being just a small fraction of the compounds possible through the reaction.

Overall the A^3-Coupling reaction in this study shows the flexibility of MCRs and their utility in ensuring efficient yet environmentally-friendly chemical processes ranging from food production to pharmaceutical products. ●

This research was performed as part of an Master of Science in Chemistry at the Faculty of Science, University of Malta. It is funded by STEPS (the Strategic Educational Pathways Scholarship—Malta). This scholarship is part-financed by the European Union–European Social Fund (ESF) under Operational Programme II—Cohesion Policy 2007–2013, 'Empowering People for more Jobs and a Better Quality of Life'.

An Untapped Funding Resource

Dr Vasilis Valdramidis

My research at the University of Malta would not have been possible without EU funding. Till 2020 the EU's research funding stream is the Horizon 2020 EU framework Programme for Research and Innovation (R&I). With an overall budget of €79 billion (in current market prices), it is a great opportunity for local researchers, the largest R&I programme ever, and focuses on three pillars: excellent science, industrial leadership, and societal challenges. The way it operates is that the European Commission will issue calls for proposals under different work programmes to attract entities from all over Europe and beyond to come together to propose research ideas for funding. Ideas are then evaluated and the top ranking proposals are funded.

Compared to its predecessor, the seventh framework Programme (FP7), the new Horizon 2020 has been simplified. Projects are managed with one single funding rate per action: up to 100% for research actions and up to 70% for innovation actions, with the exception of non-profit organisations such as the University of Malta which can also receive up to 100% of direct eligible costs. Indirect costs are reimbursed at a single funding flat rate of 25% of direct eligible costs. Another improvement is that the maximum time to grant the funds to applicants is capped at eight months after the call's deadline. Proposals are now evaluated as they are, without the possibility of further budget negotiations between the European Commission and the prospective consortium*. All publications from Horizon funded research need to be published in open access peer-reviewed journals that will make scientific findings more accessible.

These funds are extremely competitive but it is not impossible to be successful—even from Malta. One can only succeed if they try and try again. The international exposure and collaboration of successfully winning these funds helps academics develop independent research activities. These funds help support groups that can go beyond cutting edge research and receive international recognition.

> "The international exposure and collaboration of successfully winning these funds helps academics develop independent research activities"

I think that the main challenge in Horizon 2020 is to find the right consortia, topic, and call that best suit your research idea. Each member state should have the right structure to help in supporting, guiding and handholding applicants throughout the process.

The level of support provided by the University of Malta (Project Support Office and my faculty) and the Malta Council for Science and Technology has encouraged me to tap into various funding programmes and I have been successful in at least four EU projects from a *Marie Curie Career Integration Grant* and *FP7 - Capacities—SME* to *Erasmus+: Cooperation for innovation and exchange of good practices*. These brought the UoM around €500K in EU funding. This funding permitted me to develop a research group of Ph.D. and M.Sc. by research students, invest on expanding our research laboratory facilities and putting in the scene our group by participating to international conferences and workshops.

Familiarise yourself with this EU funding instrument and have a look at the Horizon 2020 Participant Portal:**http://ec.europa.eu/research/participants/portal/desktop/en/home.html.** It is worth it. ●

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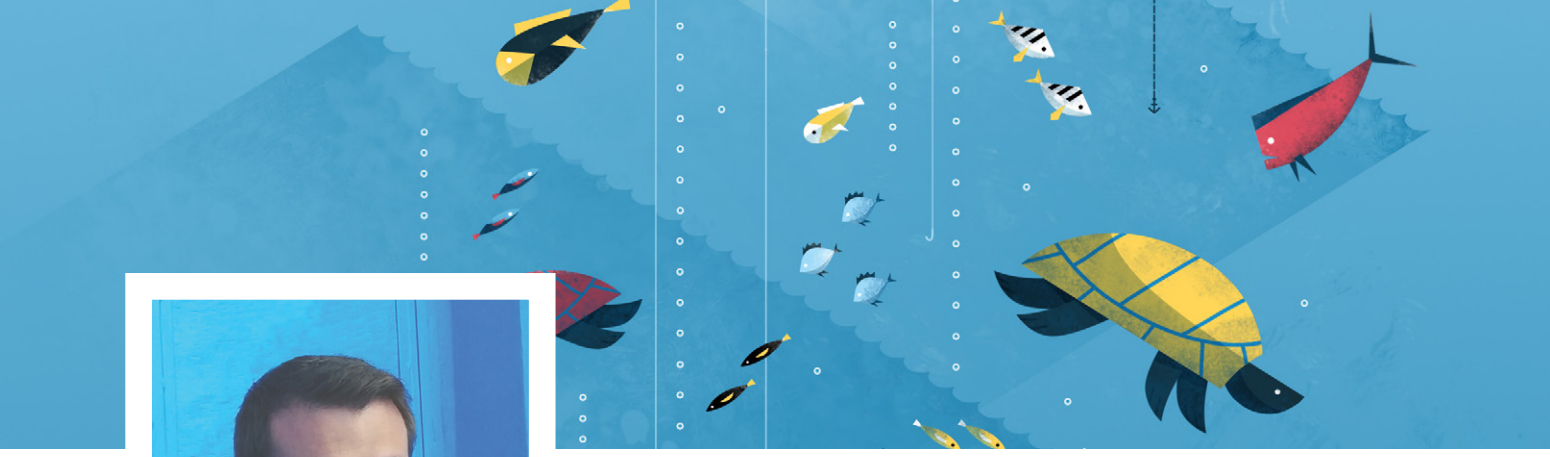
*financial features are provided by the project support team.



Let us fish4tomorrow

J.D. Farrugia

All over the world, governments and stakeholders are trying to cope with overfishing. Overfishing is when too much fish is caught which leads to an overall degradation of the marine ecosystem. It is the non-sustainable use of ocean resources.

The Mediterranean is one of the most severe cases of overfishing in the world. The former fisheries commissioner for the EU, Maria Damanki recently said that 90% of fish stocks in the Mediterranean are overfished. The fish are being caught in a way that will lead to their population collapsing. Species such as the Atlantic Bluefin Tuna (*Thunnus thynnus*) and Swordfish (*Xiphias gladius*) are in such a bad state that they are listed on the IUCN red list: at risk from extinction. The Dusky Grouper (*Epinephelus marginatus*), known locally as *Ċerna* is also endangered.

In 2010 University-based NGO, Greenhouse Malta formed a coalition to help tackle the issue locally. The result came to be known as the fish4tomorrow campaign. The aim is to create a culture of sustainable fishing and fish consumption in Malta. For the past four years fish4tomorrow has slowly built up a campaign based around scientific research, open communication with various stakeholders, and different plans to help solve the problem of overfishing in Malta.

> 90% of fish stocks in the Mediterranean are overfished. The fish are being caught in a way that will lead to their population collapsing

Two years ago, the campaign launched a report and mini documentary, both entitled *25 Nautical Miles*. The report focused on the fisheries sector in Malta and researched people's consumption habits. The documentary aimed to introduce the people to the problem of overfishing and featured interviews with fishers, divers, restaurateurs, and the Director of Fisheries. Two years later, fish4tomorrow is now launching its second project also funded by the EU Youth in Action Programme.

Following the release of the 25 Nautical Miles documentary, many people grew concerned over the state of Mediterranean fish stocks and started to ask: "which fish can I eat?" The latest project tackles that question with the Quickfish guide. It contains 45 commonly consumed fish in the Maltese islands, in a wallet-sized guide, and rates them on a 3 point scale: 'recommended' (for eating), 'eat with caution' (in moderation), and 'avoid'.

University students from the Greenhouse Malta and fish4tomorrow team worked with scientists and local experts over a number of months to research and rate each fish species' level of environmental and social sustainability. Fish were rated on health of fish stocks, fishing method and its consequences, and any other environmental impacts of fishing, farming, importation, and so on.

Fish given three 'dots' are recommended for consumption. These fish are generally caught in ways beneficial for the fish stocks, the environment, the fishers, and society at large. With the fish with two 'dots' there were one or two issues with the way they are caught, produced, or brought to the local market. For these reasons, fish4tomorrow suggests that they are eaten in moderation. Fish with only one 'dot' are usually caught in ways which are detrimental to the fish stocks, other species, and the different ecosystems involved and are best avoided—they are overfished. ●

Check out fish4tomorrow's Quickfish guide at: **www.fish4tomorrow.com** *for the fish ratings of each fish species. Contact them on* **info@fish4tomorrow.com** *for a copy. You can also follow them on Facebook and Twitter.*

Illustration by wearegoat/Natasha Averyanova

LIGHT UP MY UNIVERSE

WHAT IS THE UNIVERSE MADE OF?
HOW WAS IT FORMED? HOW OLD IS IT?
WILL THINGS STAY THE SAME FOREVER?

The night sky is shedding its secrets as **Ian Fenech Conti** (Institute of Space Science and Astronomy) talks about his work measuring the most elusive matter in the universe

Ian Fenech Conti. *Photo by Jean Claude Vancell*

Till recently, our curiosity about the cosmos could only be mitigated by our imagination. Everything changed in the past century with the development of powerful telescopes that can peer into the early beginning of the Universe. Today's telescopes are starting to uncover its deepest and darkest corners.

Astrophysicists are faced with a major problem. Most of the known Universe cannot be seen directly. If we had to categorise all things that have mass and energy in the entire Universe—normal matter, like planets, galaxies, stars, dust, rocks, and gas—they only make up about 4% of the entire Universe. So what is the other 96% of the Universe made up of? There is no simple answer, however our current understanding has unravelled another two 'hidden' parts of the puzzle. These are called dark matter and dark energy, and are so named because we are not exactly sure what they are. To make matters worse we cannot see them directly and can only tell that they exist through their effects and interactions with normal matter.

One of the interplays we study between the invisible dark matter and normal matter is called Gravitational Lensing. The principle is simple and we see the lensing effect all around us. People wearing prescription glasses use it all the time. Light bends as it passes through glass; large celestial bodies with a huge gravity can also bend light.

A Lens on the Universe

Gravitational lensing works similarly to prescription glasses but is an effect of Einstein's theory of general relativity. All it means is that all matter, such as the Earth, stars, and galaxies, have mass and a gravitational field. The gravitational field of stars and galaxies causes light to bend as it passes close by. Naturally, the greater the mass of the object, the stronger the gravitational field and the more it causes the light to bend. Groups of galaxies clustered together end up acting like large lenses floating around in space, bending light as it passes by them. The lensing effect with stars and planets occurs also on smaller scales, for example around humans, but the bending effect is too small to measure.

In order to understand what dark matter is we need to look at the gravitational lensing effect on the largest of scales: galaxies and clusters of galaxies. Using modern telescopes, we take incredible images of the night sky that reveal thousands of galaxies. Every light ray that each one of those galaxies emitted had to pass through the Universe, sometimes for millions of light years, ending up all the way on Earth, inside our telescopes to form an image. On its way to us, the light ray had to pass by other galaxies and clusters which cause it to bend. However most of the bending or lensing effect is not an effect of normal matter but dark matter, that invisible stuff that contributes a huge 85% of the Universe's mass.

Dark matter is located wherever normal matter is, this means that it lies »

around and between galaxies and when we have a large collection of galaxies next to each other—a galaxy cluster, most of the mass comes from dark matter. The light passing by or through that cluster is lensed, predominantly due to the quantity of dark matter present. The amount of dark matter is not uniform in any given area, this means the lensing effect can be very strong in some places and very weak in others. So much so that when we look at the images we take of galaxies with our telescopes, some of them appear to have arced, stretched and disfigured shapes. This does not mean that the galaxy actually looks like that, but that the light ray was heavily lensed on its path to us, giving us a warped representation of what is really out there.

The shape distortion of galaxies happens because a galaxy is a very large object. Light rays that are emitted from one side of the galaxy pass through different regions of space than light that is emitted from the other side and it is the culmination of all this light bending that produces the final distorted shape we see. The gravitational lensing effect can sometimes be so strong that it produces multiple images of the same galaxy. Another interesting by-product of gravitational lensing is that it can act as a magnifying glass, increasing the visibility of distant galaxies that we would not have been able to see otherwise.

In these images, when we clearly see the galaxy shape distortions with just our eyes, the lensing strength is considered very strong. This means objects with a very large mass, such as a supercluster of galaxies, fell between the galaxy and us, causing the image we see of the galaxy to be very distorted. Here it is relatively easy to measure the lensing effect. The reality is that there aren't that many superclusters capable of producing strong lensing effects. Strong lensing is a very rare occurrence.

> “Groups of galaxies clustered together end up acting like large lenses floating around in space, bending light as it passes by them”

In order to realistically measure the dark matter distribution we need to be able to measure the weaker variation of gravitational lensing, which is significantly more common. Since normal matter and dark matter almost always coexist, it implies that to some degree a galaxy image we see from our telescopes is always partly lensed by dark matter. This mild variant of gravitational lensing is called weak lensing and only causes slight shape distortions of about 1%.

Measuring these minor shape distortions would allow us to map and understand the way dark matter is distributed throughout the Universe. The major problem here is that these variations are so weak that it is impossible to see and measure them with the naked eye. The key to all this is the ability to develop an accurate technique capable of measuring these slight variations.

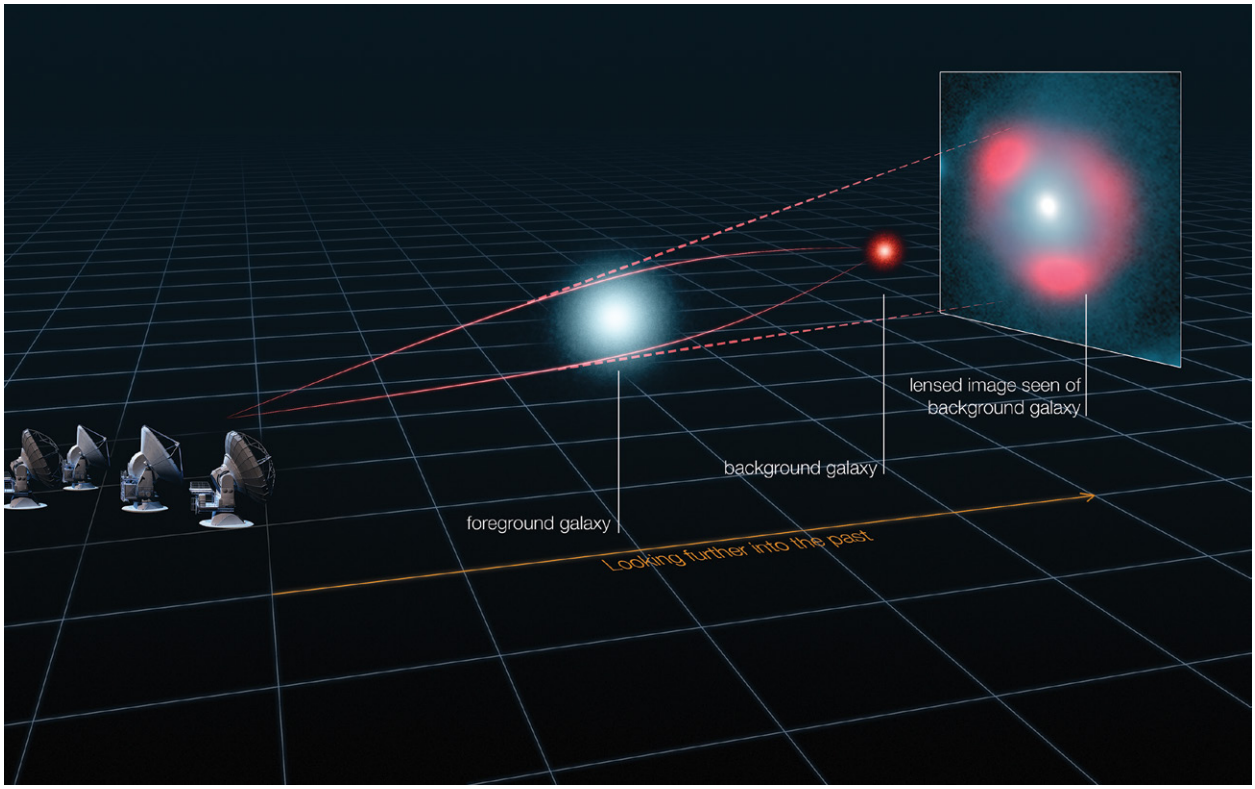
In practice, we do not need to know how much every single galaxy is lensed. The lensing effect can be averaged across a set of galaxies within the same neighbourhood. Of course, doing so means making a number of assumptions. The first assumption is that all galaxies tend be elliptical in their overall shape and the second one is that they all have

random orientations in the sky. Once we take these assumptions into consideration, we can start to apply statistical techniques that give us a good indication of the dark matter distribution for any given patch of sky.

Since we are dealing with such high levels of sensitivity it is crucial that the techniques we develop are robust and accurate. When we take an image of the sky there are a lot of external factors that make the processes of measuring the galaxy shapes much harder. Apart from gravitational lensing, a ray of light is also 'offset' by a number of secondary effects as it enters Earth and hits our telescopes. There are three main secondary effects, the first occurs when the light enters our atmosphere, here the light ray is refracted and bounces all over the place; the second is the effect of the telescope mirror that smoothens the image causing a slight loss in detail and information; the third is the effect of camera-shake, since a typical astronomical image is taken with a long 2-minute exposure, any camera movement causes blurring. These result in a 'dirty' image that needs refining.

Malta: cleaning up space images

Dark matter usually only contributes to a minute 1% shape change so images need delicate treatment to clean up accurately since a dirty image is useless. For an image to be useful it must only be distorted due to the gravitational lens and nothing else. Thus various techniques are needed to remove these secondary effects. This is one of the problems that we try to tackle at the Institute of Space Sciences and Astronomy (University of Malta). How do we go about removing these effects? First, we start off with an image that contains a large number of galaxies and stars taken by a telescope pointing somewhere at the night sky. We know that all the galaxies we see in the image are distant objects, meaning they have been subject to some amount of gravitational lensing. However the lensing signal is hidden behind the secondary effects, so the next challenge involves finding a way to separate the two. »



This schematic image represents how light from a distant galaxy is distorted by the gravitational effects of a nearer foreground galaxy, which acts like a lens and makes the distant source appear distorted, but brighter, forming characteristic rings of light, known as Einstein rings. An analysis of the distortion has revealed that some of the distant star-forming galaxies are as bright as 40 trillion Suns, and have been magnified by the gravitational lens by up to 22 times. ***Photo courtesy of ALMA (ESO/NRAO/NAOJ), L. Calçada (ESO), Y. Hezaveh et al.***

A colour composite image of the galaxy cluster CL2244-02 obtained with the VLT Test Camera at the UT1 Nasmyth focus. In addition to the prominent blue arc, produced by gravitational lensing of a galaxy, there are also notable, very red arcs, both closer to the centre and further out. They were only detected in the infrared image and are probably due to lensing of a much more distant galaxy. ***Photo courtesy of ESO***

While galaxies suffer both lensing and secondary effects, stars in the same image do not. Stars are much smaller than galaxies, being smaller means they emit less light and so they must be much closer to us than the galaxies. Visible stars come from our own galaxy: The Milky Way. These stars are too small and close to us to be affected by the gravitational lensing, yet are still affected by secondary effects. The stars in an image can be studied to determine which distortions are due to secondary effects and which due to gravitational lensing.

To speed things up, computer algorithms are used to automatically select stars. The program relies on the following assumptions. Firstly, that stars tend to be relatively bright and secondly, that light from stars is concentrated at a central peak. Stars are bright at the centre with very narrow edges, while a galaxy is less bright at the core and has broad edges of light. This classification technique separates the image into stars or galaxies.

Once we have extracted a catalogue of stars in our image, what's next? Stars are usually circular or elliptical in shape, so if we look at the stars and see that they are a different shape we know that in that area of the image there are certain secondary effects and distortions. The amount of secondary effects is not uniform and an image is degraded by different amounts and directions across it—called spatial variation. A good image needs a large number of spread out stars to model the degradation properly.

Using the stars as sampling points of the secondary effects, our algorithm then begins to look at each star's degraded shape and model it. The degraded stars we see in the images have complex shapes and it turns out that selection of the correct model is a very important choice. The approach we use is not constrained meaning that a degraded star shape can be virtually anything, from a simple elliptical shape to very complex geometric ones. This should allow the algorithm to make an accurate model of the way the secondary effects are distorting light in the image.

We now have a model of what the secondary effects look like at each star position. To remove these secondary effects from the galaxies in the image we have developed an algorithm that takes what we learnt above about how the stars are being distorted and applies them to the galaxies. Another triangulation algorithm figures out which of the nearby stars are best to use to understand the correct shape of the galaxy.

The algorithm then makes use of principal component analysis, artificial neural networks, and genetic algorithms to give us a best guess result on what we think the secondary effects are throughout the image. At this point we are able to remove all the secondary effects on any galaxy anywhere in the image. This process is repeated for each of the galaxies in the image, finally leaving us with an image containing clean galaxies, affected only by the gravitational lensing effect.

We only contribute to a small part of a long and complex process that ultimately ends up with... what? The truth is that we are not quite sure yet. We are trying to quantify something we do not quite understand. When we look at the way the Universe works when applied to the current models, things do not add up. It forces us to ask questions like "why do we get these weird galaxy shapes in our images?" and "why is the Universe expanding as it is?" By better understanding dark matter, we can answer these questions about the Universe that ultimately shed light on where we all come from.

I_COMPUTE
I_CREATE
I_AM

Creativity is a quality that we, as humans, think is ours alone. **Prof. Georgios N. Yannakakis** is creating computers that might have already taken this away from us. Computational creativity is here. His games are helping children be more creative, others to overcome dyslexia, and even combat bullying.

Words by **The Editor**

I am going to reveal a secret: I wrote this article like a computer. Or at least, that was how I felt after a chat with computational creativity and adaptive machine learning expert Prof. Georgios N. Yannakakis from the Institute of Digital Games (University of Malta). 'We [humans] do follow machine processes and algorithmic steps and are very creative'. A bold statement by Yannakakis. He goes even further, reasoning that philosophical thoughts that see humans as the only creative things are outdated. 'We should allow machines to be creative in their own right, and then judge on the outcomes and processes that they follow'.

Yannakakis' research revolves around two pillars. The first sees him and his team develop 'algorithms (computer programs that perform specific tasks) to understand how players behave, feel, and understand particular processes.' The users' data is used to form a mathematical model that can predict their behaviour and tailor the game for them. The second pillar takes this a step further with the game generating new content specifically for that person. A game could create new extremely challenging levels focused on anger. Forget mass production, Yannakakis' work is the ultimate individualist ideology as a force for good.

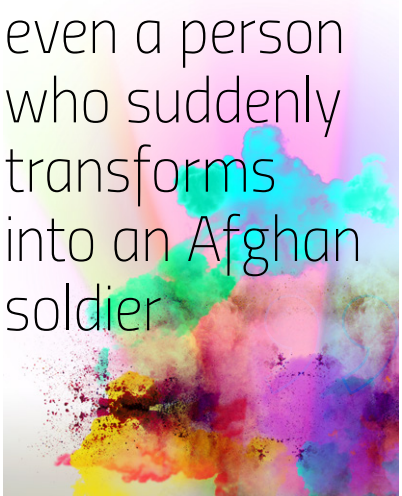
His tailor-made games are not being used to increase sales, even though he has researched commercial titles. Yannakakis has used his algorithms to create a tailor-made *Tomb Raider: Underworld* and *Super Mario* experience. Data from thousands of players helped identify different player types to allow game adjustments or generate new personalised levels. That research propelled him into the media limelight with coverage by the magazine *New Scientist* and blogs worldwide; the papers are still highly cited by researchers. His other research has helped soldiers recover from war trauma, resolve childhood bullying, overcome dyslexia, enhance creativity, and even rehabilitate physical injury.

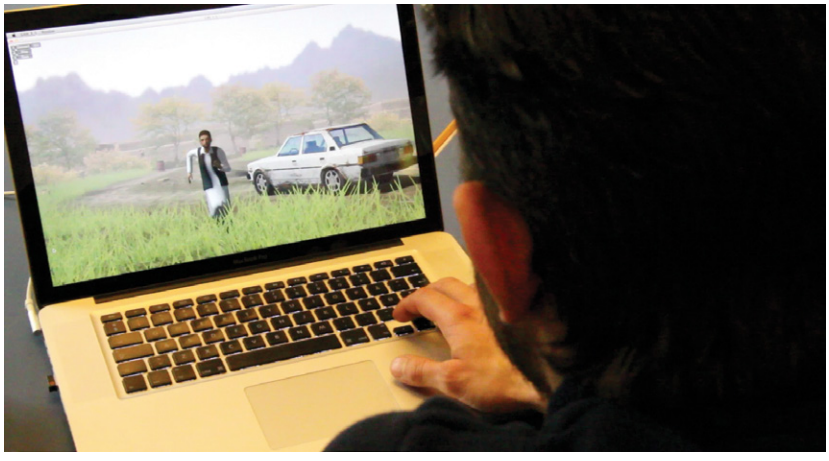
Games for Health

Wii fit, *Nike+*, fitness bands that monitor your every move, health has been digitised. Yannakakis has gone a step further with adaptive games for physical rehabilitation. His team worked with therapists in Denmark (before Malta, Yannakakis was an Associate Professor at the IT University of Copenhagen) to create rules for a ski slalom type game. The game 'understands where an injury might be, [...] how much weight you put on your left or right leg [measured using pressure mats] resulting in a patient's profile for their injury by tracking their knee'.

So let us take things to the next stage; how about a game that can cure the mind? Yannakakis developed a game that can be used by psychiatrists to help soldiers recover from post-traumatic stress disorder (PTSD). Enter *Startlemart*, which was designed to place PTSD patients in a stressful supermarket experience with the player trying to match their shopping list while dodging 'couples fighting, weird faces looking at them, [...] even a person who suddenly transforms into an Afghan soldier'. They measured stress using skin conductance. Conductance spikes whenever they see an Afghan soldier, but veterans have all gone through different experiences. Some might have 'heard bombs explode next to them, others children crying'. Each patient responds to a specific exposure therapy. 'I can give you (the psychiatrist) the stress profile of Edward (the patient) playing the game. According to my information Edward will be

“Dodging 'couples fighting, weird faces looking at them, [...] even a person who suddenly transforms into an Afghan soldier





Screengrabs from *Startlemart*.

maximally stressed when you provide this particular event at this moment. Do you (the psychiatrist) want to do that? Yes or no?' The psychiatrist can use the game to tailor treatment, affect the exposure therapy by maximising stress or minimising frustration, and then talk the patient through the experience.

The game was developed for one of the biggest clinics in Denmark. It was tested on patients to be used as a tool. The game was not designed to help patients deal with PTSD on their own. Unfortunately, due to the nature of research funds, the game has not been promoted to be used in other clinics; neither has it been monitored after it was released to see how well it is working or how it can be improved.

This problem with research funding troubles Yannakakis. '*Startlemart* was one of the most exciting projects. I interviewed these veterans, and the life they have had is horrible beyond any imagination. You would never have thought that these people live amongst us. Only 20 years old [and] their life is destroyed in several ways. They come back [from a war-zone] as different men. Their partners cannot tolerate them easily any more. They often get divorced. Their children are scared of them [and] cannot cry because their parent might get a panic attack. Most veterans are even afraid of driving. [...] If they overcome the problem, it's only after several years of good and effective therapy. [...] War shouldn't be there in the first place' but Yannankakis has found a way to help these veterans. Yet, *Startlemart* was not the only game about conflict.

Games for Education

Across Europe, around a third of children think bullying in schools is a problem. Bullying is one type of conflict that can scar children for life if it is not tackled properly. Yannakakis worked with other researchers at the University of Malta (Prof. Rilla Khaled and Dr Antonios Liapis) and with institutions around Europe to build a game that could detect conflict in a multi-player game for children called *Village Voices*.

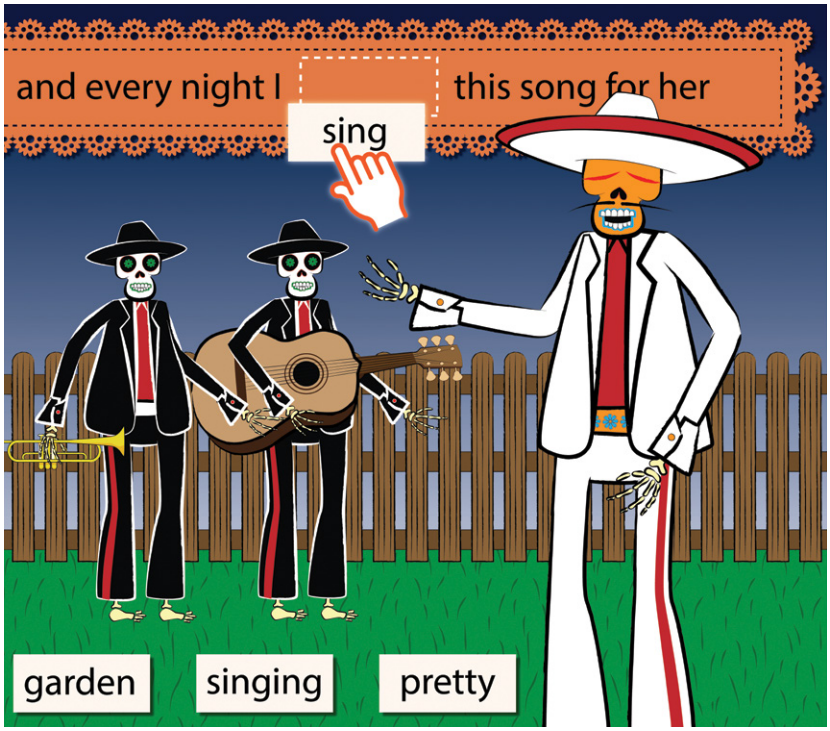
The game places children in different roles within a village. One child could be a carpenter and another a builder. They have to collaborate on certain jobs, while have the ability to steal and spoil »

Screengrabs from *Village Voices* (left), and *Words Matter* (right and bottom).

the plans of others. In the background, the game profiles the children and their interactions to enhance the conflict the students experience. The idea is that offline the children with a teacher about the conflicts they experienced in the game. In this safe environment the children would have learnt how to deal with conflict—a very clever, if unorthodox, approach.

The experts consulted did not know how to modify in-game conflict. The researchers had to use machine learning to create a conflict model. Any model needs data, so they studied several children playing the game and asked them to report how high they thought the conflict was in different situations. Then, 'statistical processes learnt the relationship [...] and in which sequence [to] predict [future] conflict. So you end up with a model you can trust.' The predictions of conflict reach accuracies of 80%. 'It's not great but sufficient.' The learning process of the machine was so successful that the game won awards.

Another game was developed, using a similar technique, to help dyslexic chil-



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> Across Europe, around a third of children think bullying in schools is a problem

dren between nine and eleven years of age. 'In *iLearnRW*, (the project behind the game *Words Matter*), we are not modelling the player, we are modelling the teacher instead.' A teacher normally guides a dyslexic child through a set of activities and modifies them to maximise the child's improvement in reading and writing. Yannakakis' team (especially Dr Hector P. Martinez) trained 'an artificial teacher on actual teachers' [pedagogy]' by turning nine well-known activities used by learning difficulty specialists into mini-games. The teachers then went through the game with the children they work with, picking out the best activities at specific difficulty levels according to each child's needs. Repeat this with dozens of teachers working with various children, throw in some artificial intelligence, and you have the best possible teacher model.

Words Matter is the first game built in-house at the University of Malta and designed to be a teacher on a tablet. Not every dyslexic child has access to the best specialists. With *Words Matter* the teacher is always there. The children have someone recommending what is best for them. The artificial intelligence behind this program creates a profile of the student that the real world teacher can see at any point to monitor the child's progress. The game can work on its own or with a teacher, and the system is highly accurate: 'this artificial tutor would be able to predict what [a real world tutor] would say in the eight or even nine out of ten cases, on average'.

In all these games Yannankakis develops the game module needed to learn how the user plays in order to adapt the game to that player. How is such a high accuracy reached? In *Words Matter*, set activities were carried out with dyslexic children, however the way they are incorporated is not standardised. 'Teachers tend to deviate from the book' to provide the best education to children who might get stuck. The teacher model was developed on the average best deviation the teacher would take in each case. Teachers do disagree on the best approach, but machine learning tools learn to predict a teachers' choice and find overlaps in teaching practices to predict the best possible approach. In this way, Yannakakis managed to build a highly accurate model. He keeps 'improving [his] algorithms as the years go by, by testing them on different domains'.

The game has impressed the Maltese Government. It is being incorporated into the One Tablet per Child project, along with other games produced by the Institute. The best part of this serious game is that it is fun. 'It's a really cool game because it carefully integrates the key learning objectives within a fun and [Khaled's] well-designed activity. It is a game that anyone can play whether they have dyslexia or not [....] which is the biggest success of any educational game: to stealthily engage people in learning activities.' I managed to play it at the Science in the City and Notte Bianca festivals and loved it. The game is inspired by the Mexican Day of the Dead celebration—an eerie and highly artistic vision. Apart from creativity in the games he creates, Yannakakis is trying to help others be creative through games. »

C2Learn Games: 4Scribes (left) and Iconoscope (right)

Games for Creativity

In 2008, a credit crunch turned into a recession, which transformed into a depression of the World's economy. Certain countries have bounced back but many Western economies are still struggling. Some think that a lack of creativity has led to sluggish economies that cannot adapt to new realities. Traditional education has no classes in creativity, with children needing to jump hoops to make it through the system until they reach University. Once they graduate, they suddenly have to be creative and 'think outside the box' to create a job that they love, is innovative, and helps the country's economy. Rather than this unrealistic approach, Yannakakis is trying to 'foster creativity in children with the *C2Learn* games'.

Within the games developed in the *C2Learn* project Yannakakis created models of players and measured their creativity. Yannakakis and his team drew inspiration from the philosopher 'Edward de Bono's lateral thinking [the UoM has an Institute dedicated to this great thinker] and they have split it into two main dimensions: the semantic (words) and diagrammatic dimensions (pictures).' They've designed games that tackle both aspects. 'We [consulted] pedagogues, creativity experts and teachers.' For picture-based creativity they came up with 10–15 basic shapes featured in the game *Iconoscope*. With squares, circles, triangles, and a few more shapes, hearts, sticks, chains, and other diagrams that convey ideas can be created. The children have to draw shapes depending on the given concept be it love, freedom, or others. So suppose a classroom is given the word 'love' to draw by the AI of the game and everyone draws a heart. The AI would find this uncreative: the class has failed. Students need to be able to convey the message of love [through a diagram] to half of the class and confuse the other half, and that requires creativity. Each child picks an assistant (the Mad Scientist, Typical Tom, Progressive Petra, Wise Oracle, or Chaotic Kate) and each one of these helpers has a particular AI behind it. For instance, the Mad Scientist comes up with very novel graphics. What is novel? [Novel is a diagram]

> We already use machines to be creative, I'm writing this article on a laptop as is the designer to create the magazine.


Prof. Georgios N. Yannakakis *Photo by Jean Claude Vancell.*

divergent from the current stream of thought'. The other AI assistants suggest pictures ranging from typical love diagrams (Typical Tom) to unorthodox ones (Progressive Petra) or just purely random (Chaotic Kate). The game's goal is for the children to draw various diagrams and link them to love; for example, an empty chair could represent love lost. What they want to achieve are 'entirely new associations that have not been historically made by other students or [the player]'.

In *C2Learn* 'the expert [model] is the actual player'. The AI machine would be creating a profile of every single player and pushing those who are sticking to clichéd diagrams to try out new ideas. 'AI searches for [diagrams] and sees what the features for love [for example] are, how many colours, shapes, and so on.' Then if a new student joins the class '[the computer] would say "let me give [them] something entirely novel, [different] from whatever has been generated over the last year, something that no other student has thought about under love." That suggestion could be super amazing or completely uninteresting, but we keep suggesting new diagrams constantly and let the student decide.' Yet Yannakakis still does not know 'how well this computational creativity intervention will be for human creativity'. The game is currently being piloted in several countries across Europe.

Apart from developing the creativity of humans, Yannakakis wants computers to be creative. Run a series of algorithms and out pops a new piece of artwork or, in the case of their latest project *AutoGameDesign,* a new game. 'That is a project that deals with automatic generation of games that are novel, unexpected, yet playable and fun.' Yannakakis envisages that one could set a constraint like: "I want a novel first person perspective game about fear which is playable" and the machine then creates such a game.' Novel here can mean 'completely different, or somehow atypical from what is already out there, or what [the computer created] in the past'. Through machine learning these computers will be able to invent new games.

AutoGameDesign is a first step towards having computers be creative in their own right. Yannakakis wants machines to 'surpass [themselves] from what they have designed so far. So you can let [the computer] design, [then it can assess how well it did and how creative it was], and how I, [the computer], can learn from that so that I can develop my artificial brain to create something more complex and unique from what I have been doing.' Yannakakis then continued to explain the concept of social computational creators. To create a game you could set up machines with different roles. One computer could evaluate and criticise the others, »

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another could be the music designer or level designer, or the perfect game tester. In this way you would have trained the computers 'to be creative and experts in their own field'. Yannakakis envisages a society of computers creating, then perfecting, that creation.

Terminator, *Blade Runner*, and *The Matrix* tend to enter our imagination when we hear these ideas, but Yannakakis is somewhat bored of these discussions. 'Artificial Intelligence is an overstated term for a very human-centric term for intelligence. [Artifical Intelligence] is not biological intelligence.' He sees a division of labour between humans and machines. After all, AI machines have already surpassed us in many tasks. No one can beat them at chess, or checkers any more. 'We shouldn't necessarily compare ourselves to machines [...] Humans and machines have different but particular capacities. There are harder problems for machines to solve than artificial intelligence. A harder problem, for instance, is artificial stupidity as intelligence naturally implies a logical process behind it. Stupidity can break any logical process.'

I, and Yannakakis too, do not think stupidity is the only realm that will be left for humans. But these new creative computers are challenging what creativity is. Also, what does it mean for a human being to be creative? We already use machines to be creative. I am writing this article on a laptop. So is the designer to create the magazine. 'Creative machines will be a tool to use. It is really up to us to which degree and in which context.' Some already exist and 'software tools already assist design.' Yannakakis thinks that we should exploit machines to do what they are good at, when humans sometimes are limited.

Yannakakis also reverses the concept of human and artificial intelligence being very different by seeing their similarity. 'Computational creativity formalises aspects of creativity [...] that could give us answers about human creativity. The particular way that machines operate and create could be relevant to how we operate and create.' We behave like machines. 'We sometimes follow machine processes and algorithmic steps and are very creative.' So I write like a computer, or the computer writes like me.

Could a computer become the editor of **THINK** magazine? Yannakakis thinks that one day it might, but it depends on a lot of factors. Human intelligence and artificial intelligence could be considered separately and the question I just posed is maybe unimportant to ask. What we should be doing is building computers that are better than us at completing certain creative tasks so we can focus on becoming even more creative on other levels. 'The machine could handle the level of detail you don't want to bother with and machines can be wonderful for concept generation or "what if" scenarios. Because they can rapidly search in huge databases and come up with really unexpected combinations of things and can—if you pose the right question—make you more creative.' Now all I need to do is convince Yannakakis to create an Edward-adapted writing module and perhaps turn me into a mathematical function in the name of creativity.

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HIPS ETERNITY

Cassi Camilleri

All over the world, hip replacement surgeries are on the increase. Provisional data from the hip replacement register at Mater Dei shows that, in Malta during 2014, 145 people needed their hips replaced while another 11 needed revisions to old implants. With costs that run into the thousands, the problem of faulty implants caught the eye of a local research team of engineers and medics. **Cassi Camilleri** finds out more about their work in solving the dilemma. Photography by **Elisa von Brockdorff**

The reality is simple. While we may now live in a world with advanced health practices that have blessed us with longer lives than ever before, the bible of health issues related to old age progressively continues to grow. The challenge continues to be finding new treatments to deal with the growing list of ailments.

Bone weakening in old age is a leading cause of disability. The degenerative arthritis of joints—osteoarthritis—is in the top ten most disabling diseases in developed countries. According to data from the World Health Organisation, 9.6% of men and 18.0% of women over the age of 60 display problems because of osteoarthritis. While age is the biggest determining factor for development of the condition, a European Commission report also points to other risk factors such as obesity, physical inactivity, smoking, excess alcohol, and injuries.

Treating osteoarthritis generally requires joint replacement. And that is where the issues arise. Replacing a hip joint has become relatively standard in the west; however, the disease's prevalence is fast becoming a problem. For Mr Ray Gatt, Head of Orthopedics at Mater Dei and a hip replacement revision specialist, this is a day-to-day reality. 'We have a five year waiting list at hospital of people needing hip replacements,' he states. 'This [statistic remains high] despite carrying out approximately seven replacements a week.' In fact, necessity has called for a new plan to be set in motion. As of last January (2015), 'we [started] a series of procedures in which a team of seven surgeons will be performing 28 replacements per week.' The figure excludes the procedures related to joint revisions because of dislocations, infection, or loosening for other reasons.

That is where the experts at the University of Malta come in.

The Four Horsemen for Hip Joints

Dr Joseph Buhagiar, Dr Bertram Mallia, and Dr Glenn Cassar, albeit separately, had all been carrying out research in leading UK universities related to surface engineering with the aim of enhancing the properties of metals. On their return to the Islands, the three soon established common ground between them. Later in 2013, Dr Pierre Schembri Wismayer came on board with the arrival of Malcolm Caligari Conti—the first MGSS [Malta Government Scholarship Scheme] funded Medical & Engineering interfaculty Ph.D. student.

> "the wear rate achieved on the 316L alloy was significantly reduced, nearly equal to that of the superior Co-Cr-Mo alloy"

Consequently, they began their work towards one goal: to construct an effective, cost-efficient hip replacement joint surface.

The work is threefold: starting with material characterisation, followed by corrosion and/or wear testing, and then moving on to biological testing. The aim of material testing and characterisation is to verify the material's strength, and corrosion and wear resistance. If the joint breaks or degrades it can release potentially dangerous metallic ions or debris in the human body. In-vitro corrosion testing involves placing the materials in saline solutions that mimic the body. Cows' serum is also used, with protein levels tweaked in order to more accurately simulate the joint inside a human body. This process also combines tribology (the science of wear, friction, and lubrication), corrosion, and cell work. Biological testing involves growing cells associated with bone, such as osteoblast cells, onto the material to ensure its biocompatibility and avoid harmful reactions after implantation.

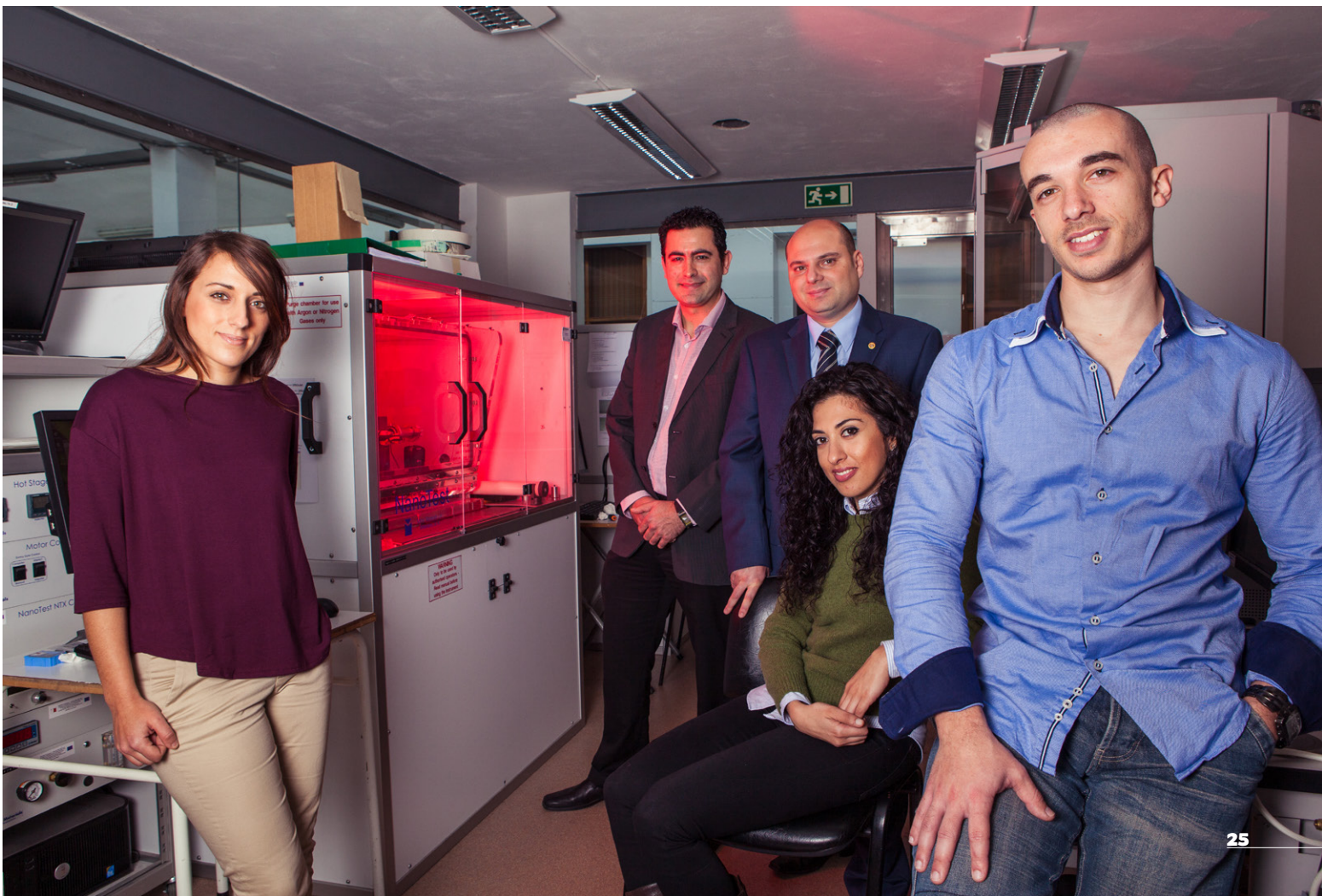
The initial idea was to have implants made up of an iron-chromium alloy called 316L stainless steel instead of the standard Cobalt Chromium Molybdenum alloy (Co-Cr-Mo). Stainless steel is resistant to corrosion and is cheap compared to Co-Cr-Mo, with the latter costing three times as much as the 316L due to it being the best metallic alloy in joint replacements. While

much cheaper, the 316L alloy wears down quickly.

The team want to keep making us of the less costly metal. Therefore, the only solution was to improve the surface. Thanks to contacts established by Buhagiar with Bodycote Hardiff GmbH (Germany), Mallia with Boride Services Ltd. (UK), as well as Cassar with Technion (Israel), each began modifying the surface of various combinations of metal alloys used in hip joints. The surface treatments used are called Kolsterising®, PVD, and PIRAC (see text box).

Because of the cost, the researchers test the material on flat and spherical pieces of metal (in tribology known as ball-on-flat). While this is not the geometry of an actual hip joint, Buhagiar explains the reasoning behind the decision: 'a joint simulator would require an investment of nearly a million Euro and multiple actual hip joints, each treated in a novel way, for every test. For now, the priority is gathering data across a number of material combinations and a ball-on-flat works fine for that purpose.'

The results of the first tests were impressive. With the Kolsterising® treatment, the wear rate achieved on the 316L alloy was significantly reduced, nearly equal to that of the superior Co-Cr-Mo alloy. Novel PVD coatings are being investigated to continue improving the performance of such alloys. 'I believe this in itself was something of an achievement,' explains Buhagiar, 'however because we did not top the »



wear rate of the actual Co-Cr-Mo, we couldn't boast about that improvement. It has to be better to make a real difference in the game.' The game is the international joint replacement market.

A dark past

Metal-on-metal hip implants have something of a sordid history. They have been taken off the market and shunned by the medical community.

The dramatic downfall of these implants came in the early 2000s with the release of the Articular Surface Replacement (ASR) joints, a brand of metal-on-metal prosthesis by DePuy, Johnson & Johnson's Orthopaedics division. ASRs emerged onto the market to rave reviews. They were deemed 'a godsend', says Gatt, but a dangerously high failure rate was riding on their coat tails. In fact, according to disclosed court documents, an internal analysis conducted by Johnson & Johnson in 2011, not long after it recalled the implants, estimated that the all-metal device would fail within five years in nearly 40% of patients.

Because of the ASR scandal, metal-on-polyethylene devices are now used more. But these devices also have ugly issues. Metal-on-polyethylene joints suffer from corrosion and wear much like any other device and wear particles end up being deposited in the joint. In many cases, the body starts to treat these particles as invaders, reacting to them as it would an infection. The body starts to attack them. That leads to the bone 'dissolving away', or osteolysis. This results in reduced stability and an eventual need for replacement. On the other hand, in the case of ceramics—either ceramic-on-ceramic joints or ceramic-on-plastic—a high cost and brittleness become a massive problem. There have been cases of chipping and fracturing, as well as squeaking while walking.

For these reasons, Buhagiar, Mallia, Cassar, and Schembri Wismayer continue to believe that metal-on-metal implants still hold much promise.

A Phoenix Can Rise

With seven more postgraduate engineering students contributing to the effort, thanks to local, industrial, and EU funding from THINK10K, Bodycote, STEPS and MASTER it!, work continues. Schembri Wismayer is currently overseeing the 'in vitro' testing as well as biological testing of the 316L, the Co-Cr-Mo, and the Titanium alloys. The good news is that for all the surface treatments, biocompatibility was sound. In fact, the cells grew better on the material which had undergone the Kolsterising® and PIRAC process. Surface-treated hip joints should lead to fewer problems in patients.

Naturally, difficulties continue to crop up. Both Schembri Wismayer and Buhagiar agreed that language proved to be an issue. 'While all students spoke English, there were times when understanding each other became a distinct challenge,' says Buhagiar. Engineers and medical researchers do not easily understand each other. They also had to adopt new work ethics. 'Students from engineering had to get used to a new modus operandi. Because cells are alive they could no longer put their work aside for the weekend. Continuous care is needed when the work depends

on living things' explained Schembri Wismayer.

In fact, the biological element of the project turns the idea of finding a suitable material for hip joints into nothing short of a mythical hydra. 'You tackle one problem and then you realise that this one problem you tackled might have negatively influenced another aspect and brought about another problem,' Mallia explains. 'This is why so much investment is required for this work', he adds. Cassar agrees, noting that the revoking of international funds for studies related to metal-on-metal implants was 'a distinct problem' because not only does it not 'solve the issue at hand,' but it also 'prevents us from ever trying to find a solution.'

There is no doubt about it—answers need to be found. As Gatt rightly points out, 'this financial problem is unsustainable.' On average, THR surgery costs €7,000 per patient while revisions, due to infections, to a single implant »

Treatments

Kolsterising® by Bodycote

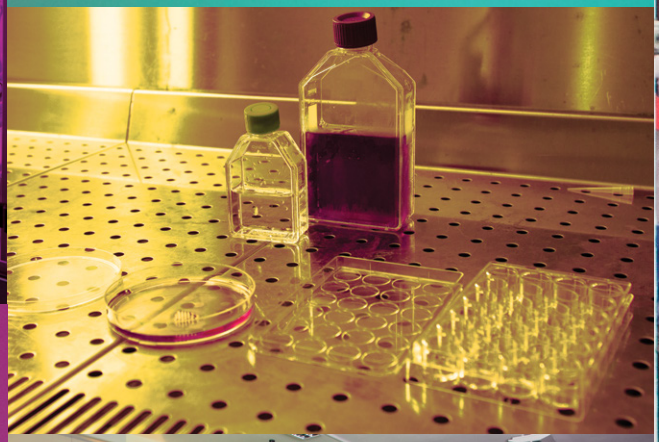
Kolsterising® is a branded treatment by Bodycote which improves the wear resistance of stainless steel parts through a pure diffusion process rather than by coating a surface. This results in excellent toughness and eliminates the risk of delamination or peeling. According to Bodycote, the surface hardness of stainless steel rises greatly thanks to Kolsterising®. The treatments need a low temperature and therefore do not compromise the corrosion resistance of the hip joint material.

Physical vapour deposition (PVD)

PVD is a vacuum deposition method used to deposit thin coatings on various surfaces, in this case hip joints. The coating method uses purely physical processes such as evaporation or sputtering of the source material with subsequent condensation.

Powder Immersion Reaction Assisted Coating (PIRAC)

PIRAC is a relatively simple nitrogen diffusion based process which has been proposed as a technique capable of considerable improvements in the wear and tear performance of ceramics and metals alike. It is considered efficient since it does not require intense heat and the materials needed are available to bulk buy at cheaper prices, making it much more cost-efficient than other processes.



> THR surgery costs €7,000 per patient while revisions to a single implant on one individual due to infection could cost anywhere between €75,000 and €100,000

could cost anywhere between €75,000 and €100,000 [...] sometimes considerably more depending on the case.' Suddenly, investing €900,000 on a hip simulator does not seem like such a bad idea does it? Potentially more importantly, however, is that the lack of doctoral funding is translating into something of a brain drain for engineering in Malta. Mallia outlines the predicament very clearly, 'you spend days and weeks and months transferring your knowledge to students, from undergraduate level onwards. A few good students go on to read for a Master's degree. You help them get a scholarship and they continue learning, training, and working on their own research. [...] You achieve momentum. Then, on graduation, your wish would be to keep that student to work on a Ph.D. and work on research. But that is not happening.' Cassar goes on to explain why that is. 'To retain these people you need a salary equal to industry. And that is not happening here. The reality is that few people at doctorate level can afford to stay at university full-time without a scholarship. The University of Malta and its students need attention from government. Some students reach astronomical levels when it comes to their research,' says Cassar, and these are the kind of people that need to be retained. It is about creating a critical mass of researchers who will work together to come up with the answers to the big problems, as in this case with hip joints.

The work being done by the team clearly shows how funds can be trans-

lated effectively into valuable output. The money invested in the laboratory and its ERDF-funded cutting edge equipment has put the department on the map. The team collaborate with international companies and research teams.

'Our work proves that we deliver,' concludes Cassar. 'We are already doing a lot with what we have. Can you imagine what we could do if we had the resources we need?' And until then, people continue growing older. ●

Seven M.Sc. by Research students and one Ph.D. student registered with the Faculty of Engineering, University of Malta contributed to this work. This research was funded by THINK10K, University of Malta Research Fund, Bodycote Hardiff GmbH, Boride Services Ltd., Technion - Israel Institute of Technology and the scholarship schemes: STEPS (the Strategic Educational Pathways Scholarship—Malta), MASTER it!, and the postgraduate MGSS (Malta Government Scholarship Scheme). These scholarships were partially funded by the European Union—European Social Fund (ESF) under Operational Programme II—Cohesion Policy 2007-2013, 'Empowering People for More Jobs and a Better Quality of Life'. The testing equipment was financed by ERDF (Malta), 'Developing an Interdisciplinary Material Testing and Rapid Prototyping R&D Facility (Ref. no. 012)', 'Enhancing Health Biotechnology Facilities at the University of Malta (Ref. No. 081)', and 'Strengthening of the Organic, Inorganic and Physical Chemistry Facilities (Ref. No. 309)'.

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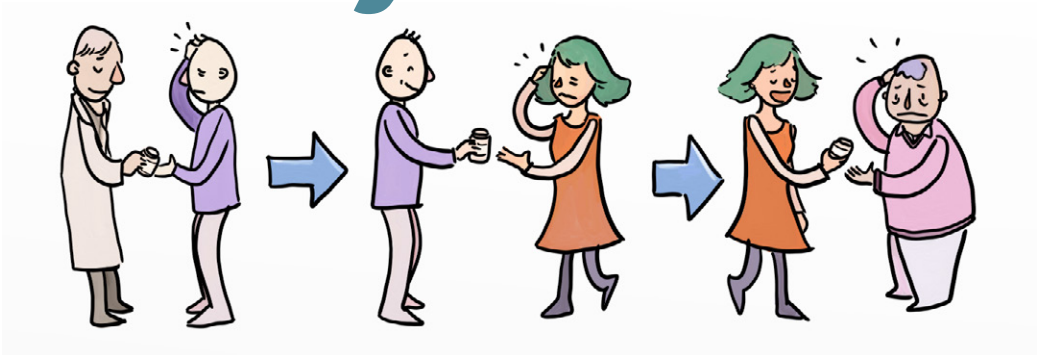
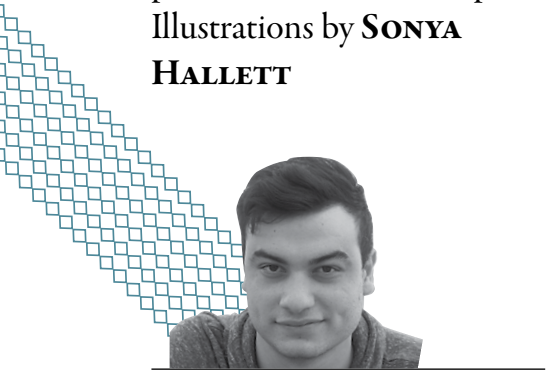
A pill for every ill?



In the US, non-medical use of prescription drugs is second only to marijuana. **Marc Buhagiar** meets up with **Prof. Marilyn Clark** to investigate just how dangerous this problem is around Europe. Illustrations by **Sonya Hallett**



Marc Buhagiar

Recently, Jane has been having problems sleeping. At work she is getting frustrated because she has been up all night and cannot focus. Jane speaks to her friend Sarah about her sleeping problems. Sarah, who is also an insomniac, gives Jane some sleeping pills that her doctor prescribed so Jane can finally sleep. Jane and Sarah are not real people, but this seemingly harmless action of a friend giving another friend prescription medication is a common phenomenon and can lead to many problems and complications. Prof. Marilyn Clark, a professor at the Faculty for Social Wellbeing (University of Malta), has coordinated research on the gender dimension of non-medical use of prescription drugs around Europe and the Mediterranean for the Pompidou Group, the drug policy arm of the Council of Europe. The research project collected data from 17 countries, including Malta, to explore gender and the non-medical use of prescription drugs.

'Essentially, this is a phenomenon which is becoming increasingly problematic all over the world. The drug field has, up till recently, focused primarily on illicit substances as well as alcohol and tobacco, but has somewhat neglected the use of prescription medications,' she explains. But what exactly is meant by non-medical use of prescription drugs? The Pompidou Group has adopted the definition developed by the Lithuanian Presidency of the Council of Europe in 2013 which defines it as the 'use of a prescription drug, whether obtained by prescription or otherwise, other than in the manner or for the time period prescribed, or by a person for whom the drug was not prescribed.' A doctor might have originally prescribed you the drug, but you might use it not as directed or for longer periods then directed. Clark explains there are a number of motivations and reasons for this. »

MEDICAL vs NON-MEDICAL use of PRESCRIPTION DRUGS

HAS IT BEEN PRESCRIBED TO YOU BY A DOCTOR?

Yes

No

ARE YOU TAKING IT AS DIRECTED?

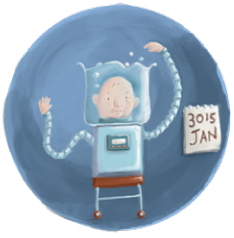
Yes

No

ARE YOU TAKING IT DURING THE PRESCRIBED TIME?

Yes

No



YUP, YOU'RE DOING IT RIGHT. CARRY ON!

YOU'RE DOING IT WRONG. STOP IT.

'You might be using the drugs in a way that's different. For example, the doctor advises you to take one before you sleep and you take three in the morning crushed with a glass of whisky. Or else, you're using them and they've never come to you from a doctor, or you're using them specifically to get high.'

The Pompidou Group study (**http://bit.ly/1AyU3P6**) is concerned with the use of psychotropic substances (chemicals that change brain function) namely opioids, central nervous system depressants, and central nervous system stimulants. But how can these drugs be dangerous if a doctor prescribes them?

The effects of illicit substances such as heroin and cocaine are well known and most people know to steer clear of them because of the adverse effects these substances have on the body. However, people seem to underestimate the potentially lethal side effects of prescription drugs, simply on the basis that they are found in pharmacies. 'People think "Oh ok, it's a prescription medication, then it shouldn't be so harmful",' Clark explains. They also fail to see that certain prescription drugs also have a lot in common with their illicit counterparts. 'Prescription medications are essentially, in their chemical composition and in their psychotropic effects, not radically different from illicit drugs. They may be a synthetic or semi-synthetic version of the natural substance that comes prescribed by a doctor, but that also lends them to use that is not medically prescribed because they have sought-after psychotropic effects. Today, drugs which are very powerful, such as Oxycontin (a narcotic analgesic) can be obtained legally from a doctor or illegally from the street, from your dealer,' she adds.

Prescription medications are essentially, in their chemical composition and in their psychotropic effects, not radically different from illicit drugs

In the United States of America, this phenomenon is well documented and it seems that the use of prescription drugs without a doctor's guidance seems to be alarmingly widespread. What the Pompidou Group is trying to achieve is to provide a snapshot of this phenomenon around the European-Mediterranean regions to see how policy can be formed regarding the non-medical use of prescription drugs with a specific emphasis on gender. Clark explains that in the United States, the non-medical use of prescription drugs is second only to marijuana in terms of prevalence, outranking hard drugs such as heroin and cocaine which have garnered a bad reputation. What is worrying is that certain prescription medication can be just as strong as heroin and cocaine. According to NIDA (the National Institute of Drug Abuse), opioid related overdose deaths have quadrupled in the United States since 1999 and, by 2007, outnumbered overdoses involving heroin and cocaine.

Whereas the USA has a clear indication of what is happening with prescription drug use, the same cannot be said for Europe. 'We wanted to see what monitoring practices were in place in the European countries because to know the extent of the problem, you need a very good monitoring system—you have to measure the phenomenon to be able to say that it is a problem.

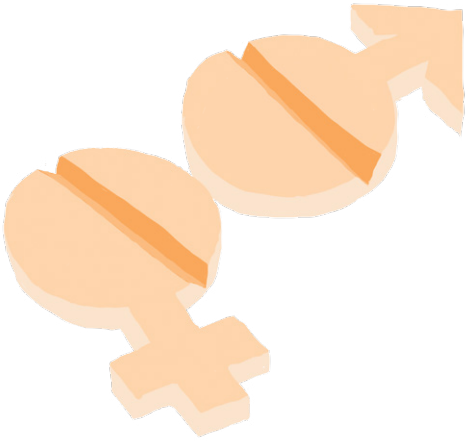
While the United States has a number of states, it is made up like one country, and they have one particular monitoring system, they define it in one way.' This is not the case in Europe as different countries have different legislative frameworks and consequently different prescribing and monitoring frameworks, which complicates things when it comes to collecting data.

The Gender Question

Who is at most risk? 'Generally, it appears to be a bigger problem for women but it depends on the type of drug. Sedatives and tranquillisers appear to be more popular amongst women while amphetamine use is more popular amongst men, especially younger men,' according to Clark. The American research and the European data show that there are big differences with prescription drug use when it comes to gender, which is why the Pompidou Group is focusing on the gender dimension.

Why are women more at risk? 'Women are more likely to be prescribed sedatives and tranquillisers than men are because, perhaps, it's more culturally acceptable,' explains Clark. Women seem to live much more stressful lives as they juggle childcare and career. Prescription drugs seem to be popular amongst women because their use is much more socially acceptable. They are less likely to be prosecuted for taking a prescription pill over heroin, which means non-medical use is harder to curtail. According to Clark, women seem to face more backlash for using illicit drugs over men because of societal norms. Prescription medication is also much easier to acquire than illicit drugs.

According to Clark, women also tend to enter their drug using career later in life, but reach the level of dependence much quicker. This has been termed the 'telescopic phenomenon' and means that the window for intervention is shorter for women. 'Prescription drug use amongst women increases with age.

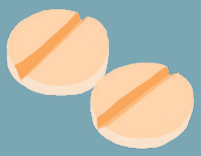


It goes up steadily and then it drastically increases in their 30s and mid-life,' she adds. The available data indicates that trauma from sexual abuse and interpersonal violence is a main contributor to the use of non-medical drugs for women. In fact, women seem to favour central nervous system depressants such as Valium and Xanax which calm and relax users.

Women do not seek professional help as much as men do when it comes to drug use, which is why the Pompidou's research project is also making recommendations to update policy to prevent and treat users. 'They don't go for treatment because women's lives present a lot of barriers to treatment. Especially if you're a mum and have children, if you present for treatment you're opening yourself up to a lot of enquiry and a lot of potential labelling and stigmatisation with the constant fear that "being an addict equals not being a good mum hence my children might be taken away"', she explains.

According to Clark, treatment also seems to be very male-oriented. The trend seems to be that most illicit drug and alcohol abuse happens amongst men. However, when it comes to prescription drugs, females register a higher use. This is something new to the drug field and awareness that women require specialised treatment services has only emerged since the late 1970s. Before that, usually only men sought treatment, perhaps because of social constraints imposed on women. Another possibility is that women might need their children with them when tackling their problem, or that they do not wish to seek treatment in the company of males, especially if the non-medical use of drugs was triggered by sexual abuse by men. »

Facts on drugs



The three major prescription drugs used non-medically are opioids, CNS depressants and CNS stimulants.

OPIOIDS

USES	PHARMACEUTICAL NAMES	SIDE-EFFECTS
Relieve pain. Reduce pain signals reaching the brain while also affecting the brain areas which govern emotion.	Vicodin (hydrocodone), OxyContin, Percocet (oxycodone), Kadian, Avinza (morphine), Codeine	Opioids can produce drowsiness, mental confusion, nausea, constipation and, depending on amount taken, reduce respiration and may even lead to death. Some people may also experience euphoria (which is why the drug is used non-medically). OxyContin (oral medication) can be snorted or injected, which might result in overdose.

CNS* STIMULANTS

USES	PHARMACEUTICAL NAMES	SIDE-EFFECTS
Treat ADHD (Attention-deficit hyperactivity disorder), narcolepsy, and sometimes depression. They increase alertness, attention, boost energy, blood pressure, heart rate and respiration.	Adderall and Dexedrine (dextroamphetamine) and Ritalin and Concerta (methylphenidate).	When used non-medically, people may experience feelings of euphoria. Stopping CNS stimulants abruptly after long-term use may result in withdrawal symptoms like fatigue, depression and irregular sleeping patterns. Repeated abuse may lead to aggression, paranoia, and psychosis. High doses may lead to an irregular heartbeat and soaring body temperatures, with a potential of cardiovascular failure and seizures.

CNS* DEPRESSANTS

USES	PHARMACEUTICAL NAMES	SIDE-EFFECTS
Benzodiazepines: Valium and Xanax are used to treat anxiety, stress, and panic attacks. Halcion and ProSom are sedatives used to treat sleeping disorders for a short period of time.	Valium (diazepam), Xanax (alprazolam), Halcion (triazolam) and ProSom (estazolam)	When using CNS depressants, a person generally feels sleepy. When used regularly, the person builds up a tolerance. If the user suddenly stops taking the drug, it can lead to withdrawal symptoms or a rebound effect resulting in seizures. Prolonged use may have life-threatening repercussions.
Non-benzodiazepine sleep medications: act similarly to benzodiazepines but with fewer side effects.	Ambien (zolpidem), Lunesta (eszopiclone), and Sonata (zalepon)	
Barbiturates: are less frequently used for anxiety disorders and sleep disorders. They have a higher risk of overdose when compared to benzodiazepines. However, they are used for seizure disorders and surgical procedures.	Mebaral (mephobarbital), Luminal Sodium (Phenobarbital) and Nembutal (pentobarbital sodium)	

*Central Nervous System

Although gender plays a pivotal role in determining who is mostly at risk of using prescription drugs without medical guidance, it is not the only factor. Other issues also intersect with gender such as age, class, employment, marital status, occupation, race, ethnicity, and sexual orientation. According to Clark, our local gender dimension is very well developed. 'We have specific women's clinics and we have a shelter that's specifically for women,' she said.

Chronic pain patients seem to be at risk of abusing prescription drugs because of the opioids they take to help soothe pain. When drugs such as Oxycontin, an opioid which can be swallowed, injected or crushed, are taken in the absence of pain, they register pleasurable effects in the brain which might lead to addiction. People who suffer from emotional pain might become dependent on central nervous system depressants which take the form of sleeping medication and anti-anxiety medication. People of different age groups are also susceptible to abusing prescription medication. These would include the elderly who are prescribed a multiplicity of prescription drugs, or highly stressed adolescents who take central nervous stimulants (ADHD and hyperactivity prescription medicine). 'They can be abused for cognitive enhancements, so you've got an exam and you want to stay up to study and you need to be sharp; or you've partied all night and you have something to do which requires focus,' Clark explains. Problem drug users also use prescription drugs to complement their daily use of illicit substances and people with mental health difficulties are also at risk as they are prescribed a number of central nervous system medications. Finally, health care professionals might also use prescription drugs non-medically as a form of self-treatment to cope with a multiplicity of problems such as stress, depression, and anxiety, to mention but a few.

The Pompidou Group's main challenge was collecting all the data from different countries and analysing it. Data for legitimate psychotropic prescription drug use was easy to gather and higher rates are registered for females in most of the countries surveyed. The data on the non-medical use of prescription drugs has a number of gaps. In Greece and Lithuania females register higher levels of use, which is not seen in Lebanon and Israel. Additionally, in Germany and Serbia, psychotropic fatal overdoses are higher for females than for males. The differences observed in the use of prescription drugs are not enough for clear documentation as comparisons cannot be easily made since there is no standard reporting system in Europe and the Mediterranean. Another problematic factor arises when General National Surveys do not clearly differentiate between 'medical use' of prescription drugs and 'non-medical use'. 'The study clearly indicates that we need to have a monitoring system that is the same for the whole of Europe so that we can make comparisons. [...] There's been a different measuring rod for you and a different measuring rod for me. This was the biggest problem that we encountered,' Clark explains.

On the other hand, with ESPAD (the European School Survey Project on Alcohol and Other Drugs), which surveys 16-year-old children, respondents are specifically asked if they have used prescription drugs without a doctor's consent. It asks about sedatives and tranquillisers: females use them twice as much as males.

Alarmingly, policy makers have not prioritised non-medical use of prescription drugs. 'Politicians and policy makers need to be aware that the problem exists and that they need to cater for it.' Without the right policies the problem cannot be tackled effectively.

> Politicians and policy makers need to be aware that the problem exists and that they need to cater for it

This type of drug use is gaining momentum around the world. Policy makers need to be sensitive towards the different treatments needed to curb people's addictions. 'The misconception that prescription drugs are not dangerous needs to change—just because a substance comes in a bottle with instructions, doesn't mean that it is any less dangerous than a substance bought on the streets. Granted, prescription drugs can improve our health when used correctly, but can also destroy it when abused.' ●

BLACK CORAL

R. J. Agius meets up with Prof. Alan Deidun to discuss a recent discovery of a smooth Black Coral underwater forest. Illustration by **Jean Claude Vancell**

The saying that mankind knows more about space than about the oceans may be clichéd but it does in fact hold a lot of water. While new discoveries are being made all the time—nightmare fish are found kilometres below the surface, the graveyard of ocean giants—it is easy to forget that our own backyard can hold its peculiar secrets too.

Off the southern coast of Malta, Prof. Alan Deidun and a team of scientists from Rome and Genova, have discovered a forest of Smooth Black Coral (*Leiopathes glaberrima*). The impressive coral (cnidarians) grow upright out of the seabed, preferring deep water and low silt levels, and can live as long as 4000 years. Their presence is considered an indicator of stability in deep marine environments.

Home to a vast but fragile ecosystem, finding coral in this area is interesting because Malta's waters were heavily exploited in the 1980s in a failed commercial exploitation attempt set up by government. The area is still significantly overfished. The first hint of the black coral occurrence was by a fisherman using long-line fishing who showed the finding to the local researchers.

Using a variety of tools to see what was hiding deep below the surface, Deidun and his team wanted to map the ocean floor just south of Filfla. Using a Remotely Operated Vehicle (ROV)—a type of robot—the team collated an array of data with high definition images and videos from a hull-mounted MultiBeam echo-sounder providing sonar feedback. This let them make a detailed map of the ocean floor.

Collecting that data ran into problems. Weather was one obstacle; the study took place in November, when winter and its high winds and rough waters had set in. Getting the ROV down to more than 250m is no mean feat either. 'The operational costs of surveying with an ROV at such great depths are considerable,' says Deidun. 'The available ship time of the research vessel ASTREA was narrow and had to coincide with acceptable sea conditions.' »

With some luck the team just managed the ROV survey in between bouts of bad weather. What they discovered was both an exciting scientific find and a stark reminder of what the area stands to lose if it sustains more damage.

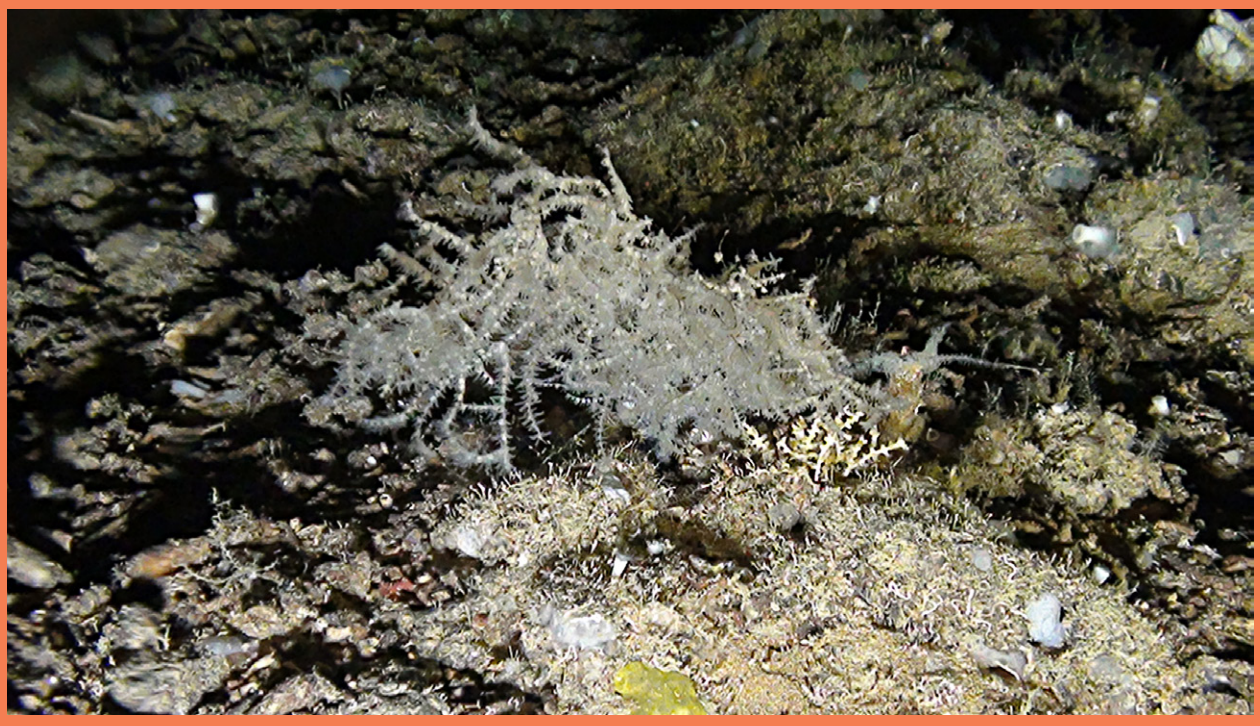
The survey discovered three zones at different depths. The biodiversity, hiding so close to our shores, is staggering, with dense outcrops of black coral rubbing aquatic shoulders with soft corals, anemones, sea urchins, crabs, and giant and stalked barnacles. The coral, reaching 100cm in height, also had larger neighbours: forkbeards, boarfish, blackbelly rose fish, a variety of perch species, scorpion fish, and three specimens of the rare Haifa grouper.

The ROV images showed pieces of fishing gear lying about this secret underwater garden. Littering the sea floor are orange cables and limestone blocks that are used to fish for dolphin fish (*lampuki*) through a complex contraption known as the '*kannizati*'. Long lines were also seen entangled in the upright coral colonies, smothering them, and the skeletons of dead corals often lay nearby, probably because of the damage caused by the fishing gear.

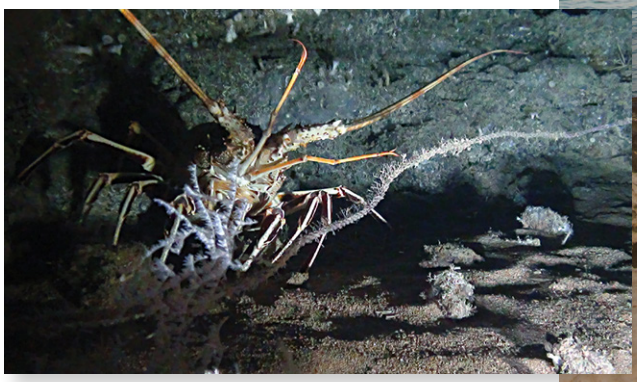
So what can be done to protect this hidden treasure? The team has proposed the extension of the existing Marine Protected Area between Ghar Lapsi and Filfla. It currently spans along the southwest coastline of the island. To protect the coral, this should be extended further offshore and include the deeper waters where this underwater forest has been found.

Extending this protected area demands change. Sea bed (benthic) fishing techniques are the main culprit. Fishing for dolphin fish often ends up with discarded equipment on the seabed. Limestone blocks are attached to cables, which are then used to keep palm frond rafts in place, attracting the fish to shelter beneath them.

> "What they discovered was both an exciting scientific find and a stark reminder of what the area stands to lose if it sustains more damage"



Black coral colony



Above: ***Bebryce mollis,*** **Spiny Lobster.**
Right: Prof. Alan Deidun ***Photo by Jean Claude Vancell.***

The fishing season for the popular fish lasts from mid-August to the end of December. That is a lot of limestone blocks and a lot of cables. This type of fishing ought to be prohibited or at best, regulated, within the extended marine protected area, though fishing off a moving vessel can go on unhindered. The biggest issue now is convincing people that this matters.

Fishing is part of Maltese culture and its economy. For fishermen this is their livelihood. Pushing through restrictions on fishing, and the subsequent loss of profit, will never be an easy task.

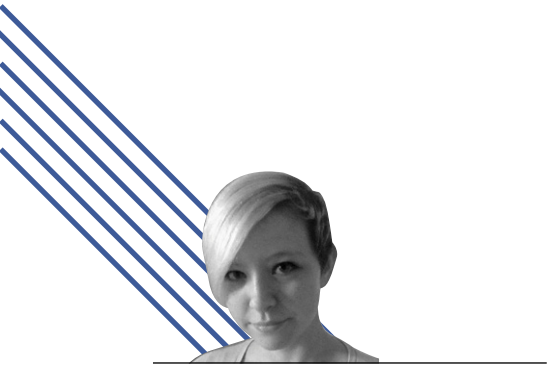
Prof. Deidun is sadly not optimistic. He calls the five existing marine protected areas 'toothless tigers' that exist only on paper. 'We believe that all these proposed measures will never see the light of day since implementation and enforcement of management measures out at sea are practically non-existent in Maltese waters.'

The current situation, he explains, is due to two main factors. 'Marine conservation enjoys a very low priority locally, both due to a general lack of appreciation of the living assets held within our waters but also due to the consistent opposition by a number of marine stakeholders (e.g. recreational fishermen) to any change to the status quo.'

The environment has always taken a back burner in local politics. But it is the tireless work of people like Deidun and his colleagues that provides the most compelling evidence for better, data-driven conservation. The field study that revealed the black coral forest was preliminary. More research is needed, both to further map the sea floor in the area as well as to determine just how much damage fishing and discarded gear has on sea life. The presence of black coral is a good sign—it would not thrive in an unstable environment. But humanity's mark is still clear, our responsibility is to keep the trash from damaging fishermen's livelihoods and our beautiful sea.

Unlocking the Secrets of the Ocean

Life in Malta is intimately linked to the sea that surrounds it. Throughout the years, countless Maltese poets have immortalised its beauty in verse. Dun Karm Psaila described it as the one constant on our ever-changing island: 'Fuq wiċċek biss, ja baħar, / żagħżugħ ta' dejjem, jgħaddu s-snin bil-mija, / bl-eluf u bl-għaxart elef, / u qatt ma jonqxu l-għelma tax-xjuħija'. But for **Prof. Aldo Drago**, the sea is anything but steady. As Malta's leading expert in the field of Operational Oceanography, he explains exactly why this force of nature must become a top priority in scientific study on our island



Cassi Camilleri

As the archetypal island nation, Malta has long held the potential to unlock the many secrets of the sea. And it has done so to great effect over the years, not for the sake of discovery alone, but as a way of improving life on our island. At its core, this is the mission behind operational oceanography, and the mission of Professor Aldo Drago.

Introducing Drago is no easy task. Listing the numerous influential boards across Europe which he is involved in is an undertaking itself, starting from the Intergovernmental Oceanographic Commission (IOC/UNESCO), to the International Commission for the Scientific Exploration of the Mediterranean (CIESM). He is also the Executive Secretary of MedGOOS (the Global Ocean Observing System for the Mediterranean). However, before embarking on his journey to bring Operational Oceanography to the mainstream, Drago's beginnings were much more humble. As a secondary school physics teacher, he sought to encourage younger generations to pursue science as a career. However, his passion for the sea kept him always on the lookout for a way to marry that passion with his career. His golden opportunity came when he joined forces with the Malta Council for Science and Technology. The Council agreed to help him pursue a Ph.D. in Physical Oceanography at the University of Southampton.

It was 1991 and back then, there was no one in Malta working on Physical Oceanography (the systematic measurement of sea conditions). With the departure of the British from the Island after Independence, practically all ongoing research projects were dropped as most of those in charge departed. The gaping hole they left behind remained empty for decades, until Drago stepped up to the plate. A sea level gauge in Mellieħa Bay was his first experiment and attempt at establishing systems to gather data about the sea around Malta. The Physical Oceanography (PO) Unit was born. With the new PO Unit came new hopes. Drago wanted to uncover the Mediterranean's characteristics and understand its movements. He wanted to track those movements and map them for future use. This could only be possible through the harvesting of vast amounts of data and that, in turn, meant Drago needed money—lots of it. With the Council backing him, Drago sought for help beyond home shores. 'Operational oceanography cannot be something we do on our own. When working on a map for a basic forecast for Malta, which includes values of sea currents and intensity, we need to create models. That means we need to link them to larger models. That is why the global community of researchers is so important.' Despite Malta not yet being a member of the European Union, the importance of what Drago was doing on the Island, and the data he was collecting, garnered him not just funding but the beginning of what would become widespread international recognition. That is not to say that the hard times were over. For many years, the PO Unit continued to be a one-man show. Not having a team meant the burden of the entire Unit weighed on his shoulders. Politics also became an obstacle. 'My work was not appreciated. There were times when I was almost suppressed,' says Drago.

In 1996, the change in government and subsequent replacement of board

What is operational oceanography?

Operational oceanography can be defined as the long-term, systematic measurement of meteo-marine conditions, such as the strength and direction of currents present, followed by their rapid interpretation and making them available to the public. This activity is not only crucial to our understanding of the Mediterranean Sea but also provides essential services.

Operational oceanography provides nowcasts, forecasts, and hindcasts which shed light on present, future, and past states of the sea. This data is then used to provide products such as warnings for coastal floods and storm impacts. It can also identify optimal sea routes for cargo ships, identify oil spills and create the appropriate response procedures.

These products are mainly targeted towards industrial users, government agencies, and regulatory authorities.

Physical Oceanography Unit

The PO Unit officially started in 1991 with Prof. Aldo Drago's doctorate studies in physical oceanography. Currently, the PO-Unit is part of the Faculty of Science.

The PO Unit dedicates itself to research in coastal meteorology, hydrography (the study of water bodies and how they change over time), and physical oceanography, with particular focus on the study of the Mediterranean's hydrodynamics (forces acted on and exerted by fluids) in the vicinity of the Maltese Islands.

Available within the PO Unit are gathering, processing, analysis, and management facilities for physical oceanographic observations. A dedicated portal has also been created in the form of CapeMalta (www.capemalta.net) which provides users with meteo-marine observations and forecasts in real time.

members, meant attitudes towards Drago's work changed. It was no longer held at such high esteem as different priorities vied for supremacy. Conflicts emerged. At the time, he was working on a major proposal for a national Marine Station worth two million Maltese Lira (over four million Euro). The project would have brought Malta up to speed with its marine research in a big way. Sadly, he had no choice but to watch on as years of work was wasted, deemed unimportant by those in power at the time. 'The Marine Station would have made a huge change. But we missed the boat in a big way,' says Drago.

Work went on and in 1999, when Prof. Drago finished his Ph.D., a major shift saw the PO Unit move from the Malta Council to the University of Malta. Now, the unit has grown to four members of staff. More importantly, the measurements of the waters around Malta continue to be taken. 'Our experience is a very positive one. The number of projects we have undertaken are unmatched by other faculties at University,' Drago states. More importantly, the work being done does not stop with the project. The real world applications they have mean that they are upheld and continued for as long as resources

last. The *Calypso* and *MyOcean* projects are two perfect examples of this.

Calypso was a 2-year project coordinated by Drago, working together with a consortium of partners from Malta and Sicily. Its goal was to set up a permanent and fully operational HF (High-Frequency) radar observing system which would monitor and record surface currents in the Malta Channel. In real time the radars, of which there were three located in Malta, Gozo, and Pozzallo, would record their direction and intensity on an hourly basis.

Ultimately, the collected data, combined to numerical models, served to support tangible applications. In the case of oil spills, the models help improve intervention scenarios. They also proved to be viable tools for search and rescue, security, safer navigation, improved metro-marine forecasts, and monitoring of sea conditions in critical areas close to ports. The data provided better management of the straits between Malta and Sicily.

This work was expanded upon through the MyOcean project. Currently in its third phase, the idea behind this project is to bring all the data acquired from satellite observation and site observation together as one open resource. This information will be made accessible to everyone. If people can use the data and apply it effectively, it could help boost the Maltese economy.

> “Operational oceanography is not just about research but also about business”

And that is where the Masters in Applied Oceanography comes in. The course is one of the first of its kind in Europe, offering students the chance to focus on operational oceanography and find their place within the network of roles available, a very wide spectrum of disciplines.

The broad aim is to train the next generation of professionals and see them make their way into a field which is now desperate for the injection of bright new minds, both on a local and an international level. The time has come to exploit the opportunities provided by marine research and technology.

Operational oceanography is not just about research but also about business. Drago sees budding entrepreneurs engaging with oceanography data in the future. ‘Their fresh perspectives will see them finding new applications for it, ones that those currently engaged in the field have not even dreamt of’, he says. When this happens, operational oceanography will finally access its own potential. Jobs will be created which would benefit the Maltese economy and

complement its service driven nature. It would tap into that natural inclination that people in Malta already have, one that Drago is certain the country would excel at.

Of course, operational oceanography becoming more mainstream does not guarantee success to every endeavour. The *Blue Ocean Energy* project is a case in point.

Because Malta is a country with practically no natural resources, the prospect of using the power of the sea to generate power is attractive even to the untrained eye. With *Blue Ocean Energy*, the project was created to quantify the wave resource potential around the Maltese islands, to determine if wave farms are viable locally. This could have revolutionised Malta and its operations. The major partner, Dexawave Energy, saw potential in using their converters to harness energy from waves.

But as the project ran its course, the results took a turn. While it emerged that there are areas in the South West of Malta which could be exploited for wave energy, the cost for photovoltaic energy plummeted. Everyone jumped on board and solar energy became a dominant trend. Wave energy was no longer a sustainable option. Its economic feasibility suddenly became unattractive, according to Dexawave's report.

Prof. Drago finds the silver lining in every project. With *Blue Ocean Energy* it lies in the fact that if in the future another group wants to tackle wave energy once more, a considerable amount of work has already been carried out.

The future looks bright for the field and new opportunities continue to arise. While the proposal for the Marine Station was scrapped in the 90s, Drago is now working with MEPA (Malta Environment Planning Authority) to make that long-overdue project a reality. Dr Alan Deidun, who lectures at the PO Unit, echoes the dire necessity of such a facility. His published research

emphasises how the Mediterranean Basin is lagging behind in the implementation of crucial marine policies, despite the various ecological, socio-economic, and geopolitical conflicts at play. As a result, he says, 'this situation has also had a negative impact on national legislation in the various littoral states [zone between sea and land] as regulation [...] has remained piecemeal and fragmented.'

This situation needs to change. As a member of the European Union, Malta now has to get in line with the Marine Strategy Framework Directive. The country needs to monitor the environment and ensure the health of its coastal seas. While MEPA do not have the means to carry out these operations, the PO Unit and its work will make it possible to kick-start the endeavour. Planning is firmly under way to set up the much-needed infrastructure.

Additionally, while the *Calypso* project may have officially ended in October 2013, the work done has been duly noted. As a result, there is a possibility that a boost in funding could see the project being revived. Another High-Frequency radar could possibly be added in Sicily, bringing the total number of radars to four and increasing geographical coverage for surface current measurements, meaning there will be more data available for maps and modelling.

Drago likens the current state of this field to the computer's early days. 'When the computer was first invented, nobody knew how many applications it would have, how important and how entrenched it would become in our day-to-day lives. I believe the same can be said for Operational Oceanography'. ●

FURTHER READING

- Deidun, A. , Borg, S. and Micallef, A.(2011) *'Making the Case for Marine Spatial Planning in the Maltese Islands',* Ocean Development & International Law, 42: 1, 136 — 154

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ALUMNI talk

Robots: science fiction to science fact

Dr Ing. Raphael Grech writes about his love affair with the robot world from *Wall-E* to the MIT Lincoln Laboratory in the USA

DYSON are mostly famous for their vacuum cleaners but they also invest heavily in research, design and development. At the company, I am an Advanced Robotics Algorithms Engineer, working on robotics research and development of robot consumer products, and have just finished working on a new state of the art robot vacuum cleaner involving robot map building, computer vision, and navigation techniques.

My interest in robotics dates back to when I was still a very small child. My first exposure to robots was through Japanese cartoons such as *Mazinga Z*, *Goldrake*, and *Transformers*, reinforced by science fiction movies such as *I Robot*, and *Wall-E*. When I started my engineering degree I realised that designing intelligent machines was far harder than that depicted in movies. This challenge led me to chase a career in robotics research and strive to turn science fiction into science fact.

I obtained my first degree from the University of Malta in Electrical and Electronics Engineering back in 2001. I held positions at Methode Electronics Malta Ltd. and Carlo Gavazzi Malta Ltd. Responsibilities included the design, development and commissioning of automated robot systems, product management, and leading the industrialisation of products developed within the research and development department.

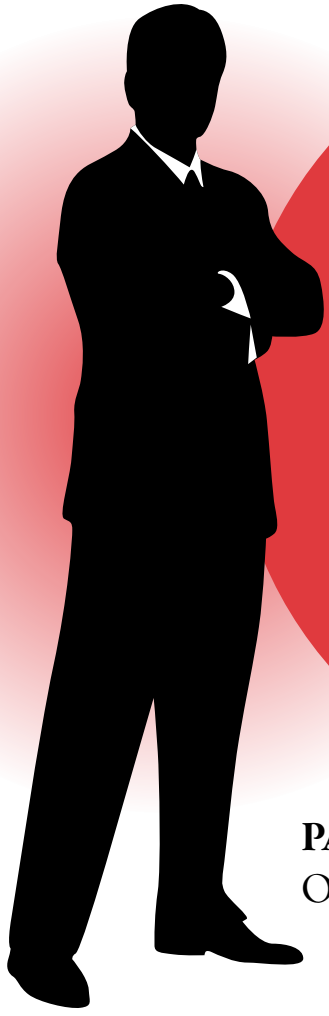
I also read for an M.Phil. in Mobile Robotics (University of Malta) on a part-time basis which I completed in 2007. In this study I researched and developed a robust control method for a wheeled mobile robot navigating in an unstructured environment to track a specific trajectory whilst also avoiding obstacles. Apart from various computer simulations and mathematical models, this work involved the design and building of the robot.

In 2009 I decided to relocate to the UK. I started reading for a Ph.D. in Multi-Robot Vision. It focused on robot sensing using cameras and computer vision. I developed a model which makes robots capable of handling visual information captured from cameras, then filter, and store only the relevant information in an adaptive and dynamic memory that tries to mimic human performance. By the end of it we had a fully autonomous team of robots capable of collectively surveying, learning, and sharing salient visual information of the environment even without any prior information.

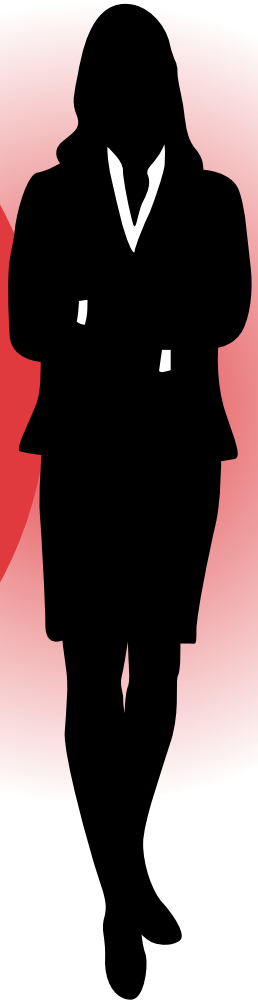
This work has proven a hit and I have presented my work in several international conferences, including at the MIT Lincoln Laboratory, part of the US Department of Homeland Security. I also interned at AIST (Advanced Institute of Science and Technology) in Japan, the birthplace of one of the most human like robots to date: HRP-4C.

Robotics is a very new engineering branch. It can be quite demanding with steep learning curves, but I have found it an exciting field that needs more young minds to meet its challenges.

To follow Dr Ing. Grech's work see:
www.raphaelgrechphd.blogspot.com



Who is the University of Malta's Most Outstanding Alumnus?



PATRICIA CAMILLERI writes about a new Outstanding Alumni Achievement Award. Who would you nominate?

THE UNIVERSITY of Malta produces many of Malta's top professionals who excel both at home and abroad. Some are remembered through paintings, such as the superb portrait by Edward Caruana Dingli of Sir Themistocles Zammit—a revered University alumnus. But how many more important and influential alumni have contributed to the good of the country yet remain unremembered or under-recognised?

The University of Malta is about to change this by offering current alumni, and all University of Malta staff members and registered students the opportunity to put forward the name of an alumnus or alumna who they think has used their education and career for the good of society in Malta or abroad.

The chosen Awardee could be, for example, a well known businessman who built up a company that not only contributes to the economy but who has used the business to assist others—someone who has gone that proverbial 'extra mile'. The Awardee could equally be someone unheard of locally, but who has contributed to research with benefits to society worldwide. The Awardee's actions need to fulfill the ethos of the Outstanding Alumni Achievement Award (OAAA), as explained in the regulations.

The Committee of the OAAA looks forward to receiving nominations and feels sure that its challenge will be the '*embarras de choix*'. Living alumni of the University of Malta number around 30,000. In 2014 alone there were 3308 graduates. The University's oldest living alumnus is 96 and graduated with a B.Sc. in 1937. Choosing one outstanding alumnus will not be easy.

Successful nominees will be honoured guests at a University reception and s/he will be presented with a specially designed commemorative pin and a certificate. The Awardee's name will also be inscribed on a list of all those who receive the Outstanding Alumni Achievement Award. The OAAA plaque will be placed in a prominent position on campus. Current staff of the University of Malta are not eligible for the award.

The deadline for nominations is 15 April 2015, with further information at: **www.um.edu.mt/alumni/oaaa** or contact Patricia Camilleri on 2340 3080.

Who do you know that deserves this award? ●

www.um.edu.mt/alumni/oaaa

Placing Cultural Research on the Map

Graziella Vella
for the Valletta 2018 Foundation

The Valletta 2018 Foundation recently started a five-year research study to evaluate and monitor the European Capital of Culture (ECoC) project in Malta. The process combines both quantitative and qualitative approaches to collect data that will be communicated to the general public and interested stakeholders. This research will provide feedback to help fine-tune or correct the Foundation's operations. The process aims to provide a local model for research in culture and the creative sector in order to encourage more cultural research after 2018.

Through consistent, accessible, and comparable research the study has five main categories. The *cultural and territorial vibrancy* research theme will evaluate the success of the Valletta 2018 cultural programme and Euro-Med collaborations. The *governance and finance* topic aims to understand the investment and management in Valletta 2018 and the related impact on Malta's creative sector. The *community inclusion and space* topic assesses the impact of Valletta 2018 cultural and infrastructural regeneration on various community groups. The *tourist experience* sector aims to evaluate the changes in visitor profile, tourist expenditure and visitor perception as a result of Valletta 2018. With the final theme being *the Valletta brand* itself, the brand will be studied to evaluate how well, or not, the Foundation is communicating with its stakeholders, and the public perception's to Valletta 2018.

The Valletta 2018 Foundation sees this research as essential to successfully implement ECoC in Malta. A Steering Committee has been set up comprising a number of Government of Malta entities and up-and-coming researchers who will be responsible for carrying out research structured around the five key thematic areas as outlined above. The Foundation wants to promote a sense of collaboration between different entities and sharing resources. The baseline studies will be carried out throughout 2015, with research continuing until 2019. The research outcomes will be communicated on a regular basis. ●

www.valletta2018.org

Photos by Elisa von Brockdorff and Tomoko Goto, courtesy of The Valletta 2018 Foundation.

GAME REVIEW

by Costantino Oliva

Captain Toad: Treasure Tracker

Developer: Nintendo
Platform: Wii U

It's a *Mario* game, but you can't jump. By working around this apparently unsolvable limitation, the designers stretched level design barriers to find new, creative solutions to navigate space.

The main character, Captain Toad, is cute and clumsy in a typical Nintendo fashion. After countless guest appearances in dozens of games, the little mushroom is now ready for his first solo adventure. Unfortunately, the large, heavy backpack he's carrying during his explorations prevents him from jumping. Also, he's unable to perform any standard attack. A great difference from the arsenal of fireballs and triple jumps *Mario* games normally feature.

With all these hindrances, it's the levels that make this game interesting. They resemble little doll's houses you can peek into by rotating the camera to observe all the details and possible interactions. Just like a snow globe, they encourage playful interaction. Ultimately, the game's best aspect is the physical connection between controls and space.

Captain Toad is an exercise in game design that proves that sometimes less is more. Discovering the little surprises in each level is a joy. Be prepared for a pleasurable experience, but don't expect a competitive challenge. ●

FACT or FICTION?

Can we become zombies after death?

by Alexander Hili

Yes, hypothetically we can be transformed into brain loving zombies. A scary answer to a scary question.However, before going out to buy a chainsaw to cut those zombies in half please be aware that a human zombie has never existed.

The rest of the animal kingdom isn't so lucky. Different types of fungi, parasites, and pathogens have altered the life of other organisms and transformed them into zombies. One of the most graphic examples is *Leucochloridium paradoxum*, a tapeworm which has been observed to infect and take control of snails. After inserting itself into the snail's body, the tapeworm slowly spreads and concentrates in its eye stalks making these look like tasty green caterpillars. In turn this makes the snail more eye-catching for hungry birds that are an intermediate host for this parasite. If that is not gory enough just wait for the zombie part. The flatworm makes the snail do its bidding by exposing itself during daylight. By staying on the highest leaves pulsing the eye stalks making them look like tasty morsels ready for the picking by the hungry birds above.

This case is not unique. There are other species which are known to be zombified: ants, flies, crickets, and others. At the time of writing no fungus, parasite, bacteria, or virus has been found to infect and transform humans. Till then there is no need to get your zombie-proof chainsaw and sawn-off shotgun. ●

Send your questions to think@um.edu.mt and we'll find out if it's the truth or just a fib!

FILM REVIEW

by Noel Tanti and
Krista Bonello Rutter Giappone

Housebound

Film: Housebound (2014)
★★★★★
Director: Gerard Johnstone
Certification: R
Gore rating:

Noel: I wasn't expecting this. I had gathered that *Housebound* was the latest horror fans' darling but besides that I knew next to nothing about it. The trailer gives a dishonest portrayal of film. I thought it was going to be a psychologically brutal home invasion film with ghosts. Which it is, but there's a lot more to it.

Krista: I love the way it slips from supernatural to psychological horror to whodunnit to the Peter Jackson brand of exploding head gore, associating itself with that strand in New Zealand's horror legacy. It also made me laugh out loud at some points.

N: It does its share of genre-hopping. Besides the ones you mentioned, there are whiffs of crime procedural, sitcom and even soap opera. It's a true compendium of different genres. I must admit though that I found it a bit jarring at first. However, once I realised what it was going for, I just sat back, relaxed and enjoyed it.

K: There was little originality in it but the way it brought all those tropes together and had fun with them was exhilarating. This film finds the tone that Adam Wingard's *You're Next* (2011) was straining for.

N: I thought of Peter Jackson too. And Baz Luhrmann, two Australasian directors with a (former) quirky aesthetic that is quintessential to them. However in *Housebound* it was not exploited to its fullest, perhaps to make the film more palatable to a general audience. I found it a bit gimmicky.

K: I thought the probation officer/amateur paranormal investigator succeeded in being quite likable. But yes, I get what you mean about 'gimmickry' or quirkiness. For example the oddball paranormal investigators—from *Poltergeist* (1982) through to James Wan (*Insidious* (2010) and *The Conjuring* (2013)). I did enjoy that he wasn't just an adjunct in this though, but had a more active role. He was a comic character, played partly through his mix of enthusiasm and naïveté.

N: What about the house itself? It was my favourite character in the film.

K: I found the economical and inventive use of space fascinating. The claustrophobia, and the sense one gets that the house is larger than it appears to be. Large enough to be a recovery house or potential B&B (alternative plot-points in the film). And the in-between spaces, like narrow conduits in a maze, that don't always quite add up. We get glimpses of bits, never a whole. And those clues that its past may have been

more 'Arkham Asylum' than family Bed and Breakfast—not entirely subtle hints, like the huge portrait of Freud on the wall.

N: I didn't like the drug addiction angle. I found it spurious and unnecessary, unlike in the remake of *Evil Dead* (2013) where the addiction was an honest-to-god proper narrative device.

K: I barely registered the drug angle.

N: I would go for a 3.5 rating but I think Ed (the ed.) doesn't allow us halves.

K: 4.5 out of 5. Unfortunately, I don't think it deserves a 5. But I'd be happy with a 4.

N: Deal.

TECH OPINION
by Matthew Cesareo from the Gadgets team

Is new tech killing social interaction?

msn, hi5, and Myspace started the social media trend. Facebook turned it into a frenzy with over 1 billion people signed up. This could be, perhaps, it is because facebook enjoyed the birth of smartphones and super-fast mobile Internet making the service available virtually anywhere.

But with such facilitated tiny, portable devices, I can't help but think that these innovations have hindered social interaction. I mean, yes, one might argue that you can now find your great uncle Larry from Australia and communicate with him whilst sipping a coffee at the Sliema Waterfront. Then again, is that what people are using facebook for? All I can see are people stuck to their devices posting images of food and statuses about how happy they are, whilst ignoring their significant other sitting across the table who, incidentally, is doing the same thing.

Go to a restaurant and all you can see are people glued to their phones. Families sit silently around the table on tablets or mobiles, ignoring the fact that they are wasting their precious life playing Candy Crush, or browsing funny cat photos.

As time goes by, things will become worse. Smart clothing, smart jewellery, and smart appliances hit the shelves late this year—you can actually get a facebook-ready fridge. Are these actually necessary? In five years time, people will spend less time going outside or travelling, and spend their lives living a fictitious virtual life in a bid to boost their ego.

I don't mean to sound like a grumpy old man, or like the guy from the Pepperridge Farm advert, reminiscing over simpler times. Truth be told, when I was young I used to be glued to my consoles—the Sinclair and SNES (Super Nintendo Entertainment System)—but I always made sure to spend proper time with my family and friends, and enjoy the great outdoors.

BOARD GAME REVIEW
by David Chircop

27th Passenger

Designers: Christos Giannakoulas, Manolis Zachariadis
Publisher: Purple Games
Game Rating: ★★★★½

I THOUGHT I hated deduction games. A friend of mine had purchased *The Resistance* and we played it till kingdom come. Everyone loved it, except me. It was too much a social exercise and too little a game. This is not necessarily bad, it just made the game extremely different with different groups, and it didn't work with some of them. I assumed that this was true for all deduction games; *27th Passenger* proved me wrong.

27th Passenger is about a group of assassins on a train. They all want to kill each other, but not the civilians. Of course, all players have a disguise ranging from a tough gangster to a sweeter schoolgirl.

27th Passenger starts off the same way as a standard fare deduction game. The player is dealt a card and assigned a personality; a personality which must remain hidden for as long as possible while trying to find out the opponents. Personalities come out with a few details: who you are (*the nurse* or *the cardsharp*) and your description (your scent, your appearance, and the way you speak). Each card has a unique combination of those three, and you use a paper with all the combinations (not unlike *Cluedo*) to try to find who your opponents are, and assassinate them before they assassinate you.

Players can find out about their opponents by carrying out investigations. The player hands the set of 'scent cards' to the person they would like to investigate and the person being investigated returns the cards with the correct scent card on top, revealing which of the scents applies to him or her. The same applies to the other descriptive qualities, such as the way you look or speak. Investigations can be countered using disguise cards or playing an action that disallows investigation.

One of the most exiting moments of *27th Passenger* is when players have collected enough information to be able to attempt an assassination. More often than not, an assignation is played by more than one player in the same turn, which means they must announce the character they would like to assassinate simultaneously. If they name a player character that player is out, if they get it wrong and 'kill a civilian', they are eliminated themselves instead. This gives assassinations a certain amount of weight. Many times though, you would have gained enough information from one player to be able to kill him, but you don't, because you know that he has been investigating the player who has been investigating you. So you wait, until your target conveniently eliminates the only player who knows enough about you to kill you, and then you rid yourself of him—eat your heart out Brutus.

27th Passenger is an approachable yet satisfying deduction game. Since last October I've played this game more than any other game. The game allows for a social experience, with plenty of banter and table talk, but with enough mechanisation to accommodate a larger variety of groups. It's familiar yet fresh, relatable yet challenging. I went to the game convention *Essen* last year hating deduction games, but three games called *Alchemists*, *[redacted]*, and *27th Passenger* changed my mind.

27th Passenger is a delightful game, enjoyable with almost any sort of group—as long as you can handle a little stab in the back, or two. ●

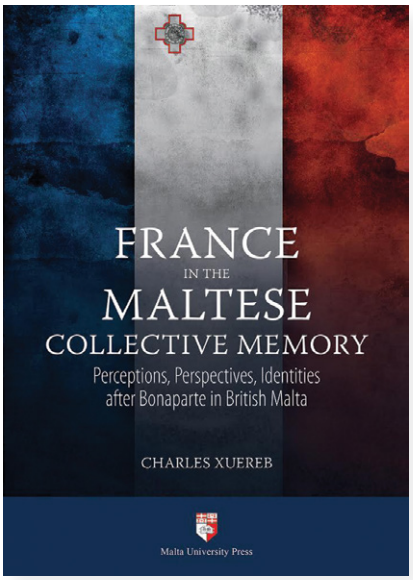
BOOK REVIEW
by The Editor

France in the Maltese Collective Memory

Perceptions, Perspectives, Identities after Bonaparte in British Malta

Charles Xuereb

Quill rating:



IN 1798, Napoleon Bonaparte invaded Malta. He pillaged its churches, stole the Knights of St. John's (the previous rulers) treasures, which he never returned, and forcibly conscribed the Island's men into the French military machine. In response, the Maltese revolted. That is the story my schoolday history books taught me. Dr Charles Xuereb paints a very different picture, and it's based on cold hard facts.

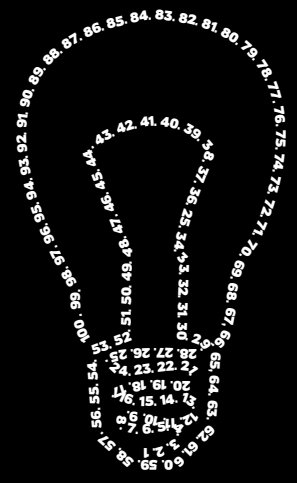
The truth seems much sadder. Before 1798, Malta had three rulers: the Knights, the Curia (Catholic institution), and the Inquisition. The city folk prepared Malta for the French takeover and the knights did not resist, conflict was minimal and the Grandmaster was handsomely relocated to France. The Curia realised the economic and power loss due to French rule and encouraged the countryside to revolt. Then they used British protectionism to ensure the safety of their assets. Both parties rewrote history.

The book is based on Xuereb's doctoral research, which is unfortunately its main failing. Although having a good style of academic writing with enough humour to keep readers engaged, the book needed a more extensive rewrite. It still comes across as an academic study with little narrative uniting the book chapters. The reader also needs to know the historical background of the Maltese Islands making the book challenging.

While at times a tough read, it is captivating. Let's take a look at September 1798, the peasant revolt started in Mdina while Maltese notaries commissioned by the new republican government (the majority of whom were Maltese) were auctioning off church items. Apparently, Maltese insurgents lynched over 60 French soldiers, cut them open, then cooked and ate their livers. Their women and children were also killed. Maltese French sympathisers either had to eat human liver or faced death. After this horrific incident the peasants circled the built-up harbour region of Malta, and more brutality followed. Two young boys and a lady were brutally killed when leaving the besieged area for vegetables, while a French soldier was beheaded for eating a fig, his head left on a spike. Xuereb postulates that these events were orchestrated by mercenaries in the employ of the religious and merchant leaders to tie the hands of the peasantry. After such brutality there was no going back.

According to some sources, the two-year siege left around 20,000 men dead and the country six million scudi poorer (around £500,000—a lot of money back then). When the Maltese insurgents finally overthrew the French, the British did not pay any dues or allow them to enter the city. The Maltese were not involved in the signing over of the Island to the British empire around a decade later neither. The Curia also forgot the fallen. Conversely, Bonaparte had insisted Maltese leaders are present at the signing of Malta to France in 1798. The history books still do not laud the sacrifice of the Maltese peasants, but normally exalt how Malta was saved and protected by the British Empire.

Xuereb's study has strong implications for Malta's love affair with its previous colonial rulers, while suggesting a readjustment of its attitude towards the French—after all the Order had several French knights who ruled for around 300 years. *France in the Maltese Collective Memory* is an important read, be prepared to open your eyes and mind.



100 WORD ideas to change MALTA

A Comic Education

by RYAN SCICLUNA

In classrooms comics can be used as a complimentary tool to students' studies. They allow students who find textbooks boring to have a combination of text and images as an aid. Comics also make lessons more interactive. Graphic Novel Library Malta is trying to do that by promoting them in classrooms around Malta and Gozo. Using comics and pop culture to educate on various topics will engage children who are difficult to reach. GNLM wants libraries to start collecting the medium to encourage students to read something they can relate to. ●

Get in touch with GNLM on: www.facebook.com/GraphicNovelsLibraryMalta
gnlmalta@gmail.com

[Don't] THINK!

by Dr Ġorġ Mallia

CYCLING FOR CHILDREN WITH CANCER

Wilfred Kenely
CEO, Research Trust (RIDT)

When two years ago a group of cyclists decided to raise funds for research in breast cancer, few thought that this was going to be the beginning of a new chapter in Maltese philanthropy. For the first time a group of people decided to raise money for a new cause in Malta that had never featured in the long list of established worthy projects. They raised €55,000—much more than their original target. The funds are financing a Ph.D. scholarship in breast cancer research through RIDT (the Research Trust of the University of Malta). The challenge was repeated in 2014 with even better results—€80,000, again going towards a second Ph.D. scholarship in the same area. ALIVE Charity Foundation has chosen cancer research as its objective, and has committed itself to keep this spirit going on a long-term basis.

Fuelled by its success and with ambitious targets in mind, for the 2015 challenge it has joined forces with another NGO, Puttinu Cares, to raise funds for research in cancers affecting children. The cycling challenge will cover over 1,000 km and will see 45 cyclists pedal through seven countries in Europe, starting from Liechtenstein in the Alps and ending in Sutton, UK, where Puttinu Cares has been offering support to sick children being treated there. The funds will be donated to the RIDT to be utilised in cancer research to benefit children.

Dr Pierre Schembri Wismayer from the Department of Anatomy has led a research team in cancer research at the University of Malta for several years. They focus on cell differentiation and the use of natural derivatives. 'Once a cancer has spread, there are three things which can protect the body against cancer cells. These are viruses, certain chemicals found in blood, and the immune system.'

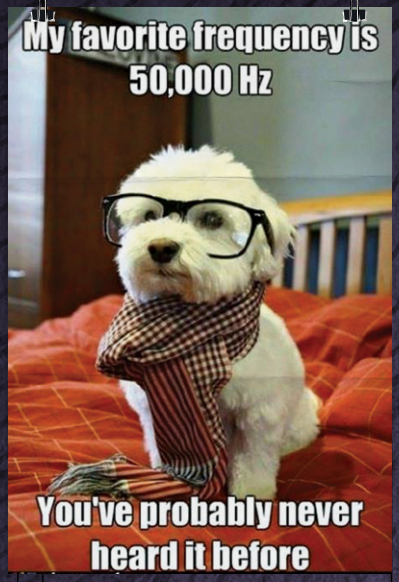
'The Department studies all of these ways to target cancers, primarily in young people and children. Differentiation therapy uses non-toxic chemicals to make cancer cells grow old and die. Cancer cells unfortunately have a youthful elixir that means they never stop dividing and growing. The therapy also uses safe viruses and the body's own immune system to help attack a cancer which has spread and is unoperable' explained Schembri Wismayer. His team will investigate brain and bone cancer which are common in children.

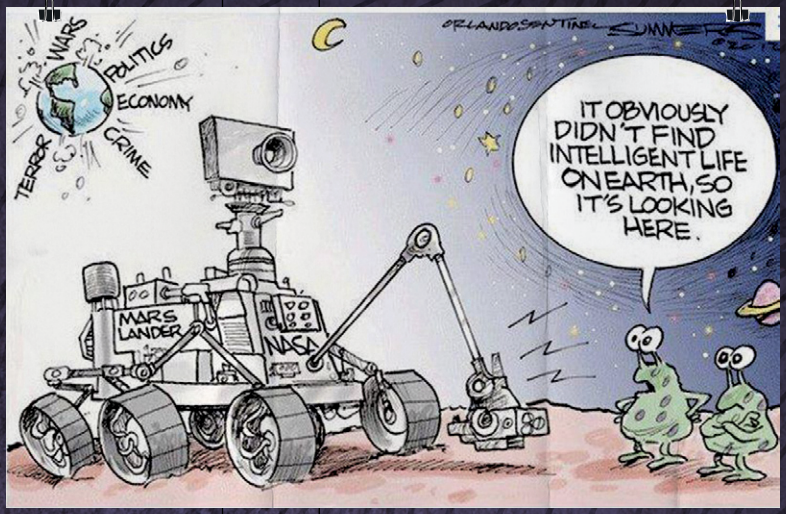
The initiative is also being supported by the Malta Community Chest Fund and by the President of the Republic. During her speech at the launch of this year's challenge, H.E. Marie Louise Coleiro Preca appealed for society to support the ALIVE 2015 Challenge so that more home-grown research can be funded to benefit Maltese children and children worldwide.

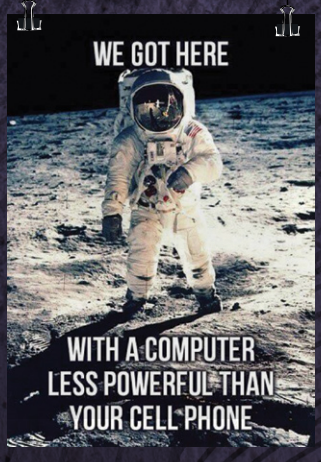
The ALIVE Charity Foundation is a living testimonial that research should be considered as a philanthropic cause. It has sent a clear signal that society is responding to our call and is putting its money in research through its generosity. This does not imply that the burden of research funding should be shouldered solely by society through its philanthropic endeavours. It remains primarily the role of governments to invest strongly in research. This investment will in turn contribute to the country's economic development. Society should be there to supplement this investment, not to substitute it.

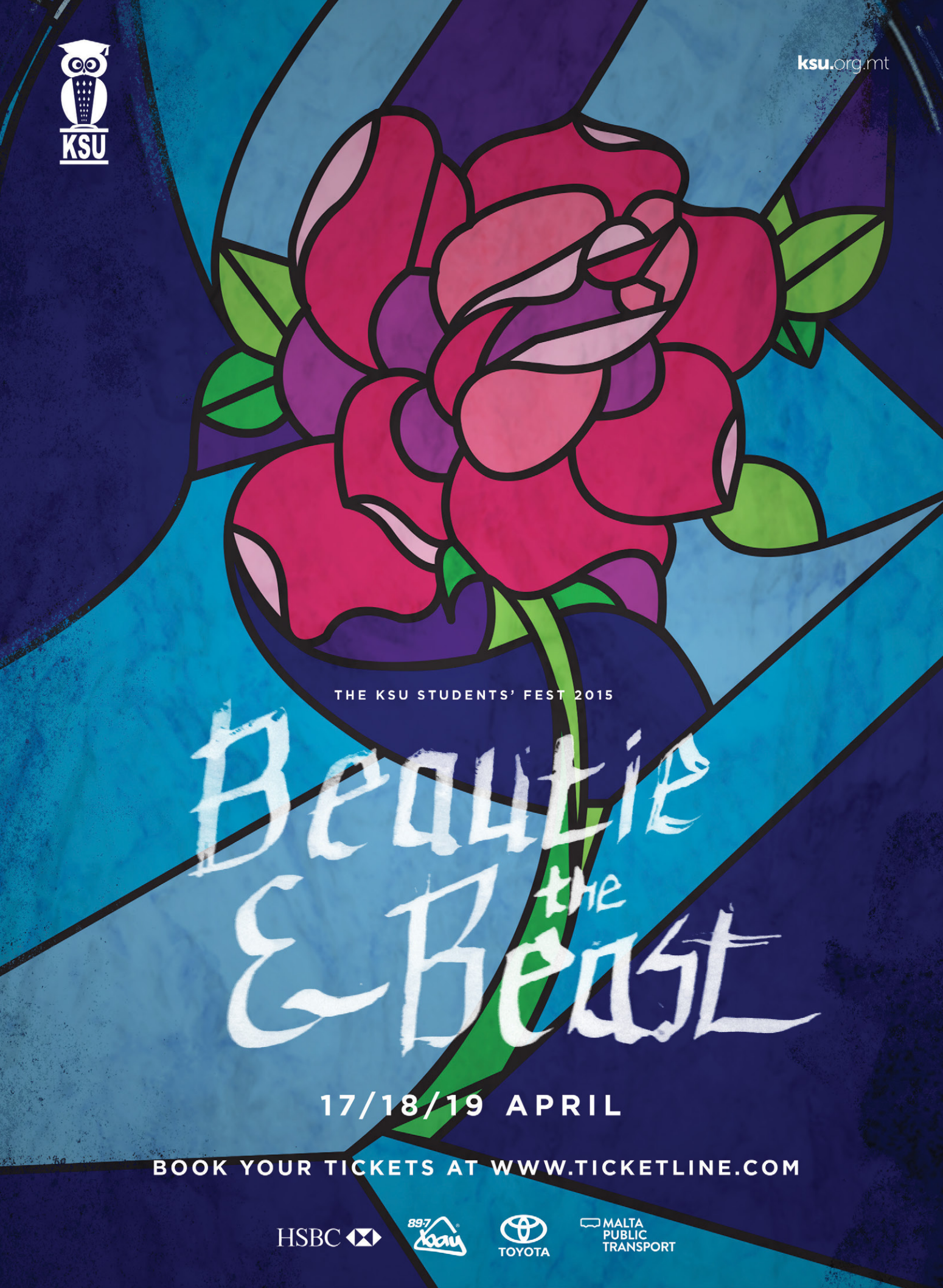
MEME

culture genes





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