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Proceedings of Science in the House

5th Annual *Science in the House* Exhibition

David C. Magri[*1]

Celebrating its 5th anniversary, this year's *Science in the House* exhibition was a most memorable occasion. The event was held on Thursday 29th September at 11:00 am in the main foyer of the Parliament Building in Valletta. The event commenced with opening remarks from Prof. Alex Felice, chairman of the *Science in the City/European Researchers' Night* consortium followed by a distinguished list of speakers including Prof. Alfred Vella, Rector of the University of Malta, the Hon. Evarist Bartolo M.P., Minister for Education and Employment, and the Hon. Anġlu Farrugia M.P., Speaker of the House of Representatives, Parliament of Malta.

This year's event showcased a selection of research projects on neuroscience and brain research in addition to the regular compliment of posters from across various research disciplines. A set of four posters on the neuroscience theme presented research on the use of stereo-electroencephalography (EEG), the treatment of epilepsy with light, biochemical studies of autism and research related to depression, addition and epilepsy. These studies involve collaborations between Prof. Giuseppe Di Giovanni and colleagues from other institutions including Prof. Giacomo Rizzolatti, Dr Fausto Caruana, Prof. Vincenzo Crunelli and Dr Maria Cristina D'Adamo.

The University of Malta is fortunate to have a deep roster of neuroscience and brain research experts. Another column of four posters showcased projects by Prof. Neville Vassallo, Prof. Mario Valentino, Dr Ruben Cauchi and Prof. Richard Muscat on the discovery of new drugs for Alzheimer's and Parkinson's diseases, *in vivo* imaging of astrocytes, the use of genetically modified fruit flies for studying motor neuron disease and the study of neural brain function and oscillation, respectively.

New this year, biographical posters of 4 Maltese scholars from the past and present who have contributed significantly to the field of cognitive science and neuroscience were part of the opening ceremony. The biographical posters of Prof. Louis Vassallo (medicine), Prof. George Xuereb (pathology, former Rector), Prof. Edward de Bono (inventor of the concept of lateral thinking) and Prof. Ludwig Zrinzo (neurosurgery) were accompanied by the physical presence of Prof. de Bono and Prof. Zrinzo. Family members of the late Prof. Vassallo and late Prof. George Xuereb were also in attendance for the ceremony.

Representation of various research projects came from the Faculties of Science, Medicine and Surgery, Health Sciences and Economics, Management & Accountancy. Topics ranged from electromagnetic fields in medicine, evaluation of earthquake risk on the Maltese Islands, the economics and politics of household recycling, zebrafish as an animal model for studying bone diseases, novel hybrid optomechanical technologies, human foraging and attention, yeast cell cycle studies with aspirin and genetic studies of type II diabetes. In addition, this year the exhibition also included posters from four research-oriented organisations: Malta Life Science Park; Malta College of Arts Science and Technology (MCAST); Research, Innovation and Development Trust (RIDT) and the Malta Medicines Authority.

The exhibition remained on display for public viewing the following Friday and Saturday evenings for the *Science in the City/European Researchers' Night* and *Notte Bianca* festivals, respectively. The exhibition was left on display for the general public and parliamentarians for another week afterwards.

Science in the House is organised by the Malta Chamber of Scientists, the RIDT and the *Science in the City/European Researchers' Night* consortium and part funded by the EU Marie Skłodowska-Curie Action of the Horizon 2020 (H2020) Programme. More information can be found at www.scienceinthecity.org.mt or at www.facebook.com/ScienceInTheCityMalta.

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Figure 1: Guests during the opening remarks of *Science in the House* during the speech of the Hon. Evarist Bartolo. In the front row from left to right are Prof. Alfred Vella, the Hon. Anġlu Farrugia, Speaker of the House, the Hon. Helena Dalli and Prof. Alex Felice and the Hon. Chris Agius (second row to the right).

Figure 2: The main foyer of the Parliament Building showcasing the exhibition before the commencement of the 5th annual *Science in the House* exhibition.

2016 *Science in the House* Posters by Title and Contributing Researchers

1. Electromagnetic Fields in Medicine – Prof. Charles Sammut, Prof. Pierre Schembri-Wismayer, Dr Lourdes Farrugia, Iman Farhat, Julian Bonello
2. Evaluation of Earthquake Risk on the Maltese Islands – Prof. Pauline Galea, Dr Sebastiano D'Amico, George Bozionelo, Daniela Farrugia
3. Human Foraging and Attention – Prof. Ian Thornton, Marcello Gómez Maureira, Marthese Borg, Amanda Muscat
4. Zebrafish as an Animal Model for Studying Bone Diseases – Prof. Angela Xuereb, Dr Melissa Formosa
5. The Economics and Politics of Voluntary Household Recycling – Dr Marie Briguglio
6. Hybrid Optomechanical Technologies – Dr André Xuereb, Vittorio Peano
7. The Genetic Epidemiology of Type 2 Diabetes – Prof. Josanne Vassallo, Dr Nikolai Pace, Seham Eljali
8. The Cell Cycle is Crucial for Cell Survival and Death – Prof. Rena Balzan, Dr Gianluca Farrugia, Maria Azzopardi
9. Discovering New Drugs for Alzheimer's and Parkinson's Diseases – Dr Neville Vassallo, Stephanie Ghio
10. *In Vivo* Imaging and Monitoring Astrocytes in Health and Disease – Prof. Mario Valentino, Dr Christian Zammit, Robert Zammit
11. Genetically Modified Fruit Flies to Untangle Mysteries of Motor Neuron Disease – Dr Ruben Cauchi, Michelle Briffa, Rebecca Cacciottolo, Rebecca Borg
12. Brain Function and Neural Oscillations – Prof. Richard Muscat, Nowell Zammit
13. Decomposing tool action observation by sEEG – Prof. Giacomo Rizzolatti, Dr Fausto Caruana
14. Treating Epilepsy with Light – Prof. Vincenzo Crunelli
15. Autism Spectrum Disorder with Intellectual Disability – Dr Maria Cristina D'Adamo
16. Curing Depression, Addiction and Epilepsy – Prof. Giuseppe Di Giovanni
17. Malta Life Sciences Park – Dr Joseph Sammut
18. MCAST Water Research and Training Centre – Dr Alex Rizzo
19. Research, Innovation and Development Trust (RIDT) – Wilfred Kenely
20. Malta Medicines Authority – Prof. Anthony Serracino Inglott

Gratitude is extended to C. Camilleri & Sons for catering, Pierre Mallia, Director, House of Representatives, and Ryan Cutajar and Gianni Zammit of JugsMalta for logistic support, Siobhan Vassallo for the poster design, Angele Galea for assistance with the biography poster exhibition and individuals who contributed to the institution posters.

Figure 3: Researchers Lourdes Farrugia (left) and Julian Bonello (second from left), Dr Leonie Baldacchino (middle left) speaking with Prof. Alex Felice (middle right), Hon. Anġlu Farrugia (second from right) and Prof. Charles Sammut, Dean of the Faculty of Science (right).

ELECTROMAGNETIC FIELDS IN MEDICINE

OBJECTIVES OF THE RESEARCH

High-frequency electromagnetic fields (EMF) are used to study the human body, in particular the water content in various tissues. Using EMFs we can distinguish cancer tumours from healthy tissue as the amount of water in tumours is higher than in healthy tissue. The difference in the amount of EMF energy absorbed by healthy and cancerous cells allows for therapeutic and diagnostic applications.

MAIN FINDINGS TO DATE

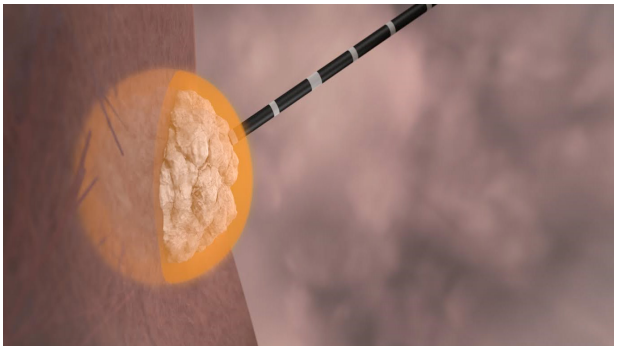
The electrical properties of liver, kidney and muscle tissue are dependent on the tissue age. A recent study showed that the properties of the liver measured in vivo can be estimated from ex vivo measurements. Liquids mimicking the electrical properties of different organs have been formulated.

SOCIO-ECONOMIC IMPACT

Computational and experimental methods have provided insight into the effect EMF has with different organs and tissues in the human body. This research could lead to the development of new medical devices and more effective treatments in oncology.

THE RESEARCH TEAM

The research is led by Prof. Charles Sammut of the Department of Physics in collaboration with Prof. Pierre Schembri-Wismayer of the Department of Anatomy, Dr Lourdes Farrugia of the Department of Physics and postgraduate students Julian Bonello and Maik Pertermann at the University of Malta.



ACKNOWLEDGMENT OF RESEARCH SUPPORT

The research is supported by the University of Malta and the European Regional Development Fund (ERDF) grants 018 and 310. The research group is involved with various COST Actions and collaborates with the National University of Ireland in Galway, the Energy and Economic Development (ENEA) in Rome and Supelec, University Paris-Sud in France.

EVALUATION OF EARTHQUAKE RISK ON THE MALTESE ISLANDS

OBJECTIVES OF THE RESEARCH

Historical and geological studies indicate that the possibility of serious earthquake damage to the Maltese islands is real. Our research aims to evaluate the threat and potential damage that could result from earthquakes. Using state-of-the-art seismic monitoring systems and virtual regional seismic networks, we are investigating known and newly-discovered tectonic features. New imaging techniques provide a way of determining the site-specific amplification of incoming seismic waves and hence the surface ground response. The data is used to generate realistic earthquake ground motion scenarios for risk-assessment purposes.

MAIN FINDINGS TO DATE

Our research has revealed that the frequency of earthquakes around the Maltese islands is much greater than previously thought. New instrumentation provides increased sensitivity for detecting tremors. We have also identified the role that clay layers have on site- and frequency-dependent seismic amplification.

SOCIO-ECONOMIC IMPACT

Through collaboration with the civil engineering community, this research will influence national strategies for designing and implementing improved construction guidelines for safe buildings that take into account the specific local geology. A holistic earthquake risk assessment will also provide important inputs to the insurance industry and Civil Protection.

THE RESEARCH TEAM

The research is carried out by the Seismic Monitoring and Research Group within the Department of Geosciences coordinated by Dr Pauline Galea with team members Dr Sebastiano D'Amico, George Bozionelos, Daniela Farrugia, and Dr Matthew Agius in collaboration with a number of academic institutions in Europe and America.

ACKNOWLEDGMENT OF RESEARCH SUPPORT

Financial support has come from the SIMIT project (B1-2.19/11, Italia-Malta OP 2007-2013); Endeavour scholarship; ERDF 310 (Expanding the Physics and Applied Interdisciplinary Research Capabilities at the Faculty of Science), COST Actions ES1401, ES1301, TU1208 and the University of Malta.

HUMAN FORAGING AND ATTENTION

OBJECTIVES OF THE RESEARCH

The objective is to use a novel approach to understanding how human perception and action is constrained by attention. Inspired by classic animal foraging research, we have developed a series of mobile phone apps that are used to collect data from diverse groups of human participants in a variety of settings. Here, we present some of our main findings and provide demonstrations of our tasks with particular focus on a new 3D scenario developed as a collaboration between the Department of Cognitive Science and the Institute of Digital Games.

MAIN FINDINGS TO DATE

Our studies suggest that human foraging is tightly constrained by attention. Search is flexible when individual items can be easily detected, but becomes more limited when viewing conditions deteriorate or attentional load increases. However, some individuals ("super-foragers") do not conform to this pattern. Their behaviour raises important questions about current theories of attention.

SOCIO-ECONOMIC IMPACT

Understanding and improving how we search has implications in many areas including consumer behaviour, medical image interpretation and airport security screening. We are constantly asked to divide our attention (e.g., talking and driving). Knowing when we can and cannot do this could save lives. How people control attention could shed light on several deficits that affect patient populations.

THE RESEARCH TEAM

The project is led by Prof. Ian Thornton of the University of Malta and Prof. Árni Kristjánsson of the University of Iceland, and assisted by two post-doctorate researchers based in Iceland, Ómar Jóhannesson and Andrey Chetverikov. In Malta, Francesca Borg Taylor-East, Elizabeth Camilleri & Isabelle Kniestedt at the Institute of Digital Games have developed a new foraging app.

ACKNOWLEDGMENT OF RESEARCH SUPPORT

Financial support for this project comes from the University of Malta, the Icelandic Research Fund (Rannís), the Research Fund of the University of Iceland, the Russian Foundation for Basic Research and the Saint Petersburg State University.

ZEBRAFISH AS AN ANIMAL MODEL FOR STUDYING BONE DISEASES

OBJECTIVES OF THE RESEARCH

Osteoporosis is a skeletal disease whereby bones become weaker and fragile resulting in increased risk of fractures. The disease can be caused by both lifestyle factors and genetic traits. Individuals with a family history of osteoporosis are prone to becoming affected at an early age. Using zebrafish as an animal model, the genes that cause osteoporosis are being assessed for their effect on bone development and cartilage formation.

MAIN FINDINGS TO DATE

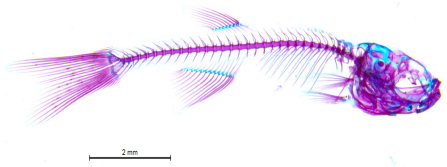
Around 80% of the zebrafish genes are identical to those of humans, making them a good animal model. Therefore, zebrafish can be used to study defects in bone and cartilage formation. Genetic studies on Maltese families with multiple affected members have led to the identification of new genes that are hypothesised to affect bone development.

SOCIO-ECONOMIC IMPACT

Genetic factors play a major role in the susceptibility to osteoporosis. Identifying these genetic factors could aid in the early diagnosis of osteoporosis and the development of personalised medicine. Preventive measures and early detection could prevent unnecessary suffering in high-risk individuals.

THE RESEARCH TEAM

The principal investigators are Prof. Angela Xuereb-Anastasi and Dr Melissa Formosa from the University of Malta. The research is conducted in collaboration with Prof. André Uitterlinden, Prof. Fernando Rivadeneira, Dr Annemieke Verkerk, and Prof. Rob Willemsen from the Erasmus University Medical Centre in Rotterdam.



ACKNOWLEDGMENT OF RESEARCH SUPPORT

The research is supported by the Malta Community Chest Fund in conjunction with the Research Innovation and Development Trust (RIDT).

THE ECONOMICS AND POLITICS OF VOLUNTARY HOUSEHOLD RECYCLING

OBJECTIVES OF THE RESEARCH

Municipal solid waste is a by-product of economic production and consumption. Its management and mismanagement incurs high capital and running costs, creates environmental and health impacts. A remedy imposed in several countries is a (polluter pays) tax on household waste disposal. However, the introduction or an increase in taxes is politically unpopular – sometimes stimulating illegal disposal. Communication campaigns to encourage voluntary cooperation could be a solution, although little economic research data is available in this field.

MAIN FINDINGS TO DATE

Our findings show that households are willing to recycle voluntarily. Household conditions (like space and time) and intervention characteristics (like convenience) stimulate voluntary uptake. We have discovered that political preferences influence household willingness to cooperate. When there is a negative sentiment towards the party in government, households are less willing to participate in government sponsored schemes.

SOCIO-ECONOMIC IMPACT

This research helps policy-makers and scheme-operators to increase household participation in recycling. Voluntary cooperation can cultivate public-spirited motives and lower the administrative, environmental and political costs of compliance. The finding that political preferences influence cooperation will result in better ways in which a public-good scheme is communicated to the public and help forecast uptake.

THE RESEARCH TEAM

The research team consists of Dr Marie Briguglio of the Department of Economics at the University of Malta and Prof. Liam Delaney and Prof. Alex Wood of the University of Stirling in the UK.

ACKNOWLEDGMENT OF RESEARCH SUPPORT

The research was conducted at the University of Stirling and part-funded by an Early Career Engagement Grant of the Scottish Institute for Research in Economics (SIRE) and PhD bursary from the University of Malta.

HYBRID OPTOMECHANICAL TECHNOLOGIES

OBJECTIVES OF THE RESEARCH

Hybrid Optomechanical Technologies (HOT) are a new kind of sensing and information processing technology based on light and motion. Scientists know that light, just like water emerging from a hosepipe, can push small things around. This concept can be used to control the motion of small objects with light and to measure their position very accurately. New devices will be developed that use light and motion to store or route information, or make extremely accurate measurements.

MAIN FINDINGS TO DATE

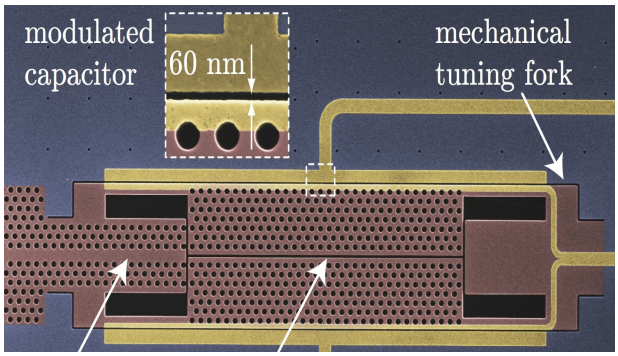
The consortium has demonstrated how to use tiny moving objects to produce diodes for light. Such devices allow optical signals to go in one direction from A to B, but not vice versa. These technologies may be used to amplify or process optical signals inside the computer chips of the future. We have built devices that demonstrate quantum entanglement in the vibrations of two microscopic drums. This will answer the question of why ordinary objects, like human beings, never seem to behave quantum mechanically, like being in two places at once.

SOCIO-ECONOMIC IMPACT

Completely new information processing technologies must be developed for computers to keep getting smaller and faster. Technologies using light instead of electricity are promising candidates. However, researchers are unsure how ordinary computer chips, which use electrical signals, can be developed to process light directly. HOT may solve this problem with new technologies that are faster and more energy efficient than those currently used today.

THE RESEARCH TEAM

The research team at the University of Malta consists of the Quantum Research Group within the Department of Physics in the Faculty of Science. The project is led by Dr André Xuereb. The project involves a consortium of 16 other institutions including several leading research team from European universities and four industrial partners (IBM, Hitachi, ST Microelectronics, and Thales SA).



ACKNOWLEDGMENT OF RESEARCH SUPPORT

HOT is supported by the Horizon 2020 programme of the European Commission. It builds on work supported through several private and public research initiatives, including the FP7 programme, and COST Action networks. We also acknowledge funding from RIDT and MCST.

THE GENETIC EPIDEMIOLOGY OF TYPE 2 DIABETES IN MALTA

OBJECTIVES OF THE RESEARCH

Type 2 diabetes is a metabolic disease characterised by high blood sugar levels in patients. The disease is a major risk factor for the development of cardiovascular disease and eventually death. The objective of our research is to explore the relationship between select genetic variants and the risk of diabetes. We examine DNA from new born babies as a reference and compare healthy senior citizens without diabetes to those with diabetes in the Maltese population. Patients from Malta and Libya are compared to explore the relationship between genetics and clinical traits.

MAIN FINDINGS TO DATE

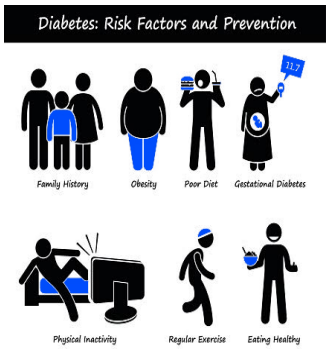
We have discovered that there are eight candidate genes consistently association with occurrence of type 2 diabetes in the Maltese population. These gene variants serve functional roles in inflammation, fat cell development and energy expenditure. Specific subgroups with diabetes were used for this study to identify any association between genetic makeup and body composition.

SOCIO-ECONOMIC IMPACT

The genetic findings could be potentially used for the early identification of individuals at risk of developing type 2 diabetes allowing for preventive measures and personalised treatment strategies.

THE RESEARCH TEAM

The research team consists of Prof. Josanne Vassallo and Prof. Alex Felice and researchers Dr Nikolai Pace and Seham Eljali of the Faculty of Medicine & Surgery at the University of Malta.



ACKNOWLEDGMENT OF RESEARCH SUPPORT

This work is part financed by the Strategic Educational Pathways Scholarship scheme grant and by the University of Malta.

THE CELL CYCLE IS CRUCIAL FOR CELL SURVIVAL AND DEATH

OBJECTIVES OF THE RESEARCH

The immediate objective of our research work is a better understanding of cell-cycle involvement in cell survival or programmed cell death. A number of genes which are involved in both cell survival and death have been identified, most of which play a role at cell-cycle checkpoints. Checkpoints ensure that one phase of the cell cycle is complete before a subsequent phase starts, thereby guaranteeing that the daughter cells are genetically identical to their parent cell. If checkpoints are non-functional, the cell cycle will proceed with damaged DNA, giving rise to defective daughter cells. We use yeast cells as experimental models of higher organisms to study aspirin's effect on oxidative stress and programmed cell death.

MAIN FINDINGS TO DATE

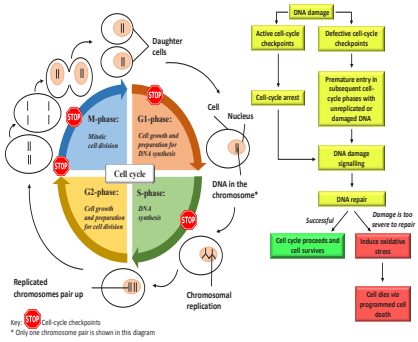
Our research team has observed that our redox-compromised yeast cells, which resemble cancer cells, die by programmed cell death in the presence of aspirin unlike normal, healthy yeast cells. Our studies to date showed key aspirin-induced differences in the physiology of the cells between these two sets of yeast cells.

SOCIO-ECONOMIC IMPACT

Aspirin is highly-prescribed to prevent cardiovascular events. However, its preventive anti-tumour properties are still not fully understood. Thus, our studies help to better understand the mechanisms by which aspirin distinguishes between cancer and normal cells and selectively targets cancer cells. The studies may allow for the development of better aspirin-like drugs or novel anti-cancer therapies.

THE RESEARCH TEAM

The research team consists of the project leader Prof. Rena Balzan, Research Support Officer III Dr. Gianluca Farrugia and Ph.D. student Ms. Maria Azzopardi. Institutions contributing to this research work include the Genomic's Core Facility at the European Molecular Biology Laboratory (EMBL) at Heidelberg, Germany and the Institute for Molecular Biosciences, Karl-Franzens University of Graz in Austria.



ACKNOWLEDGMENT OF RESEARCH SUPPORT

This work is part of project R&I-2015- 001, which is financed by the Malta Council for Science & Technology through the R&I Technology Development Programme.

DISCOVERING NEW DRUGS FOR ALZHEIMER'S AND PARKINSON'S DISEASES

OBJECTIVES OF THE RESEARCH

Alzheimer's disease (AD) and Parkinson's disease (PD) are devastating illnesses that are currently incurable. Combined they afflict around 8 million people in Europe: AD leads to severe memory loss (dementia) whilst PD results in uncontrollable tremors and slowness of movement. The objective is to discover new drugs for the prevention and/or treatment of these neurodegenerative maladies. Specifically, we seek to block a key molecular interaction between toxic aggregates and mitochondria, the so-called 'powerhouses' of brain cells.

MAIN FINDINGS TO DATE

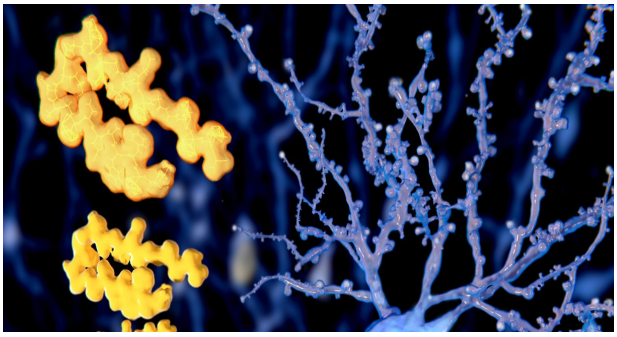
We have shown that toxic amyloid aggregates that form in the brains of AD/PD patients damage the mitochondria of brain cells by attacking a lipid molecule known as cardiolipin in the mitochondria's double-membrane. Furthermore, we have identified 3 naturally-occurring compounds and a marine plant extract that exhibit strong anti-aggregate activity for preventing mitochondrial damage.

SOCIO-ECONOMIC IMPACT

Our research could result in the discovery of new therapeutic strategies for preventing or slowing the progression of Alzheimer's and Parkinson's disease. A new effective treatment could improve the quality of life of millions of patients, and alleviate the burden on caregivers.

THE RESEARCH TEAM

The research team is led by Dr Neville Vassallo in collaboration with Dr Ruben Cauchi of the Department of Physiology & Biochemistry and the Centre for Molecular Medicine and Biobanking of the University of Malta. Current team members are Dr Mario Caruana, Michelle Briffa, Angelique Camilleri and Stephanie Ghio. Past team members include research students Alison Gauci, Claire Zarb, Dr Johanna Neuner and Ulrike Ostermeier of the University of Munich, Germany.



ACKNOWLEDGMENT OF RESEARCH SUPPORT

The research has been supported by two RTDI programs from the Malta Council of Science & Technology (R&I-2008-068 'NEUROAMYLOID' and R&I-2012-066 'MODiFLY'). Additional funding has been provided by the University of Malta (PHBR-06) and the Faculty of Medicine & Surgery (MDSIN08-21).

IN VIVO IMAGING AND MONITORING ASTROCYTES IN HEALTH AND DISEASE

OBJECTIVES OF THE RESEARCH

Stroke is the third most common cause of death in men and the second most common in women according to the World Health Organization (WHO). In Malta 10.4% of all deaths were due to stroke. It is also the most common cause of severe disability with 1 in 4 men and 1 in 5 women expected to have a stroke by age 85. Current treatment options are extremely limited. Hence, there is a great need for new treatment strategies. Our goal is to better understand the mechanisms of astrocyte function in order to develop new treatments for stroke.

MAIN FINDINGS TO DATE

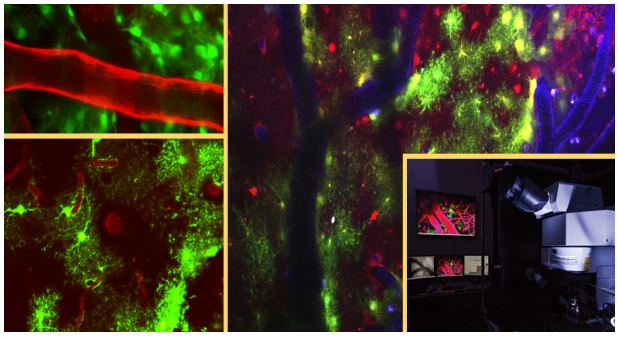
Brain function is maintained by an integrated system consisting of specialised cells called astrocytes. Contrary to published reports, we show that astrocytes are more vulnerable to injury than previously reported using new laser imaging techniques with improved resolution to study the brain *in vivo*. We have discovered that there are subclasses of astrocytes within the same region of the brain exhibiting different vulnerabilities to stroke.

SOCIO-ECONOMIC IMPACT

Despite major advances in prevention and rehabilitation, few neurological injuries are as debilitating as stroke. Our research is providing new insight into astrocytes and could result in more effective treatment.

THE RESEARCH TEAM

The stroke research team consists of Prof. Mario Valentino (Department of Physiology & Biochemistry) and researchers Dr Christian Zammit, Jasmine Vella and Robert Zammit in collaboration with Prof. Robert Fern and exchange students from the University of Plymouth.



ACKNOWLEDGMENT OF RESEARCH SUPPORT

The research is financially supported by the University of Malta Research and through collaborations with the University of Plymouth part-funded by the Research Councils UK.

GENETICALLY MODIFIED FRUIT FLIES FOR STUDYING MOTOR NEURON DISEASE

OBJECTIVES OF THE RESEARCH

Spinal Muscular Atrophy (SMA) and Amyotrophic Lateral Sclerosis (ALS) are motor neuron diseases that deprive patients of their ability to walk, eat or breathe. While ALS occurs in adults, SMA affects young children. Both SMA and ALS patients have a deficiency of the Survival Motor Neuron (SMN) protein that results in the death of motor neurons and the associated muscles. Using the fruit fly Drosophila melanogaster as a model organism, we are learning how the SMN protein works in the neuromuscular system of living organisms.

MAIN FINDINGS TO DATE

The SMN protein is involved in the assembly that cuts and pastes the cell's genetic instructions together. We discovered that disruption of this function leads to the collapse of the neuromuscular system of fruit flies in a similar manner to SMN deficiency. This breakthrough discovery implies that failure to correctly process the genetic blueprint for the production of functional proteins could be the reason for the neuromuscular deficits in SMA or ALS.

SOCIO-ECONOMIC IMPACT

Current therapies for SMA or ALS are based on boosting SMN protein levels. Broadening the therapeutic targets is essential for an effective treatment. Model organisms such as the fruit fly are key tools for the successful implementation of this strategy.

THE RESEARCH TEAM

The team is led by Dr Ruben J. Cauchi and postgraduate students Michelle Briffa and Rebecca Borg and undergraduate students Maia Lanfranco, Benji Fenech Salerno and Rebecca Cacciottolo in collaboration with Dr. Neville Vassallo's research group, the French National Centre for Scientific Research (CNRS) and the Institute of Cellular Pharmacology Ltd.

ACKNOWLEDGMENT OF RESEARCH SUPPORT

This research is supported by the University of Malta, the Faculty of Medicine & Surgery, and the Malta Council for Science & Technology (MCST).

BRAIN FUNCTION AND NEURAL OSCILLATIONS

OBJECTIVES OF THE RESEARCH

One of the most remarkable dimensions of humankind is the brain. The brain is responsible for both our normal healthy and unhealthy behaviour. This tempts one to ask the question: but how? The brain is composed of billions of 'micro' power stations, called neurons that generate complex electrical activity patterns. In our studies, we are attempting to understand behaviour and its abnormal facets in neurodevelopmental conditions, such as ADHD, by analysing the brain electrical activity called neural oscillations. This research will further our understanding of the neural basis that sub-serves ADHD, and provide insight into the therapeutic effects elicited by psychostimulant medication.

MAIN FINDINGS TO DATE

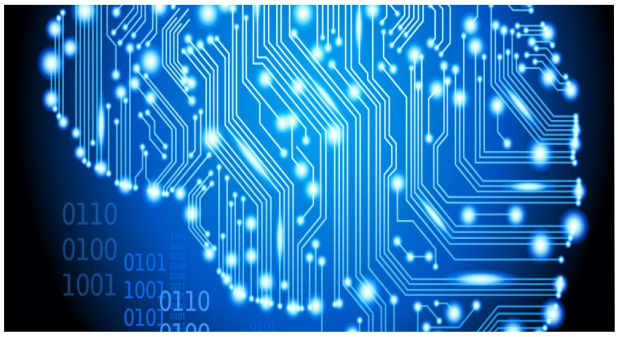
We have discovered that neural oscillations are crucial during mental process involved in understanding or the senses and that abnormal neural oscillation can distinguish between ADHD and healthy subjects. Furthermore, we have learned that psychostimulant medication improves the abnormal neural oscillations in ADHD.

SOCIO-ECONOMIC IMPACT

We envision that brain signals can be used as objective biomarkers to diagnose ADHD rather than 'paper and pencil' clinical questionnaires. In the future, brain signals may be used to assist practitioners in the administration of psychostimulant medication.

THE RESEARCH TEAM

The research team consists of Prof. Richard Muscat & Dr Nowell Zammit and colleagues at the Centre for Biomedical Cybernetics at the University of Malta.



ACKNOWLEDGMENT OF RESEARCH SUPPORT

The research is financially supported by the Department of Physiology and Biochemistry of the Faculty of Medicine and Surgery at the University of Malta.

DECOMPOSING TOOL ACTION OBSERVATION BY sEEG

OBJECTIVES OF THE RESEARCH

A fundamental goal of neuroscience research is to describe the dynamics of human cortical activity during cognitive tasks in real time. In this study, we employed stereo-electroencephalography (sEEG) – a high temporal resolution technique – in order to assess the neural activity of patients during tool action observation. We recorded the neural activity of 49 epileptic patients implanted with intracerebral electrodes, while they observed tool and hand actions. We assessed how different regions of the brain respond to the different events in the stimuli.

MAIN FINDINGS TO DATE

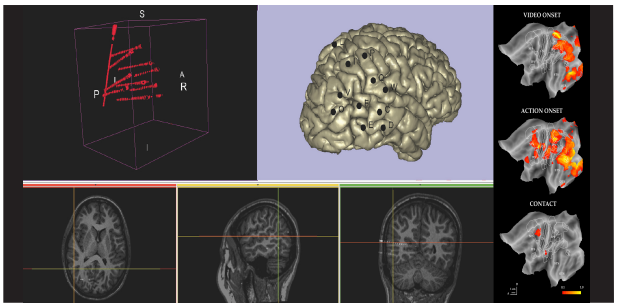
Observing tool action onset activated the action observation network but also, unlike hand action, a specific region in the left rostral inferior parietal lobule (aSMG). The final contact between the effector and the target object triggers activity in areas SII and premotor cortex.

SOCIO-ECONOMIC IMPACT

The absence of temporal resolution in imaging techniques has hindered the acquisition of four-dimensional maps of human neural activity. Here we show how monitoring the timing of cortical brain events during observation task allows for a better understanding of how the brain functions.

THE RESEARCH TEAM

This research team is led by Prof. Giacomo Rizzolatti, Dr Fausto Caruana and Dr Pietro Avanzini in collaboration with Prof. Giorgio Lo Russo, Dr Ivana Sartori, and Prof. Guy A. Orban affiliated with the Surgical Center for Epilepsy in Ospedale Niguarda, Milan and the Department of Neuroscience, University of Parma. Prof. Giacomo Rizzolatti is at the Department of Physiology and Biochemistry, University of Malta and at CNR Center of the University of Parma.



ACKNOWLEDGMENT OF RESEARCH SUPPORT

This research is supported by the Cariparma Foundation and a European Research Grant (ERC).

TREATING EPILEPSY WITH LIGHT

OBJECTIVES OF THE RESEARCH

Epilepsy is a widespread neurological disease affecting 1% of the world population (about 2000 people in Malta). Many epilepsy patients are resistant to traditionally drug treatments or suffer from serious drug-induced side effects. Therefore, novel therapeutic approaches are desperately needed for controlling epilepsy and improving patients' quality of life. This project is investigating whether a novel technique, called optogenetics, can be used to treat epilepsy. Optogenetics uses light of different wavelengths to either stimulate or block nerve impulses of neurons that carry light-sensitive proteins.

MAIN FINDINGS TO DATE

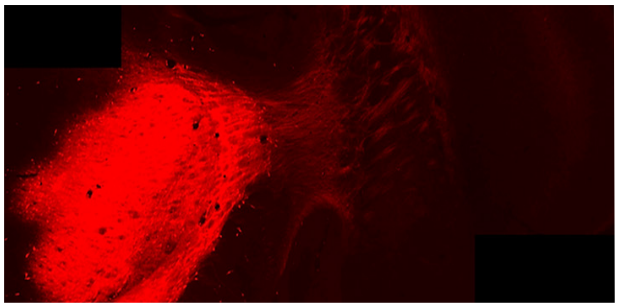
We have shown that a fibre optic implanted in the brain can deliver light pulses that block the abnormal activity of select neurons. We have developed a "closed-loop" system for controlling the flow of light impulses. Our prototype detects the brain electrical activity associated with an epileptic seizure within one tenth of a second. This "warning" signal is sent into the fibre optic and delivers a light pulse to the selected neurons. Preliminary results show that our prototype system is capable of stopping 100% of seizures without any external human intervention.

SOCIO-ECONOMIC IMPACT

Our research could result in an alternative treatment to brain surgery for epileptic patients who do not respond well to standard treatments with anti-epileptic drugs. Moreover, the new method could be useful for treating epileptic patients who have to stop taking anti-epileptic drugs due to adverse side-effects.

THE RESEARCH TEAM

The team consists of Prof. Vincenzo Crunelli in collaboration with Prof. Giuseppe Di Giovanni of the Department of Physiology and Biochemistry, Faculty of Medicine and Surgery, University of Malta), Dr Adrian Attard Trevisan (AAT Research Ltd., Malta) and Dr Magor Lorincz (University of Szeged, Hungary) and post-doctoral researchers Drs Gabriele Deidda, Francois David and Gergely Orban and PhD students Liad Baruchin, Maria Vella and Francis Delicata.



ACKNOWLEDGMENT OF RESEARCH SUPPORT

This work is supported by a European Union research grant and MCST project grant (R&I-2013-014) "Closed-loop Serotonin Optogenetic Stimulation with EEG recording to Suppress Epileptic Seizures: A Therapeutic Device".

AUTISM SPECTRUM DISORDER WITH INTELLECTUAL DISABILITY

OBJECTIVES OF THE RESEARCH

The objectives of our research are to uncover disease causing mechanisms and potential therapies for several channelopathies. Recently, we uncovered a distinct ion channel-dependent disease characterized by ASD/ID, epilepsy and motor impairment. We are studying a large number of these patients, characterizing their phenotypes thoroughly and, analysing the presence of mutations in some inwardly-rectifying potassium channel types By using advanced electrophysiological, biochemical and confocal microscopy technologies, we will investigate the effects of mutations on channel activity, protein trafficking, calcium signals, astrocyte\neuron interaction and test drugs that are expected to ameliorate the symptoms.

MAIN FINDINGS TO DATE

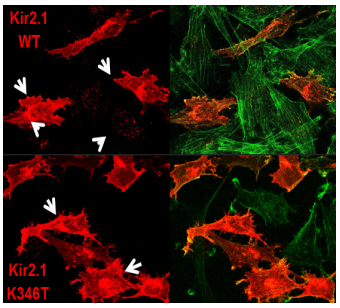
The genetic mutations in Kir2.1 and Kir4.1 channels and their molecular consequences have been partially clarified by our research team, which has provided new insight into the pathophysiology of both ASD/ID and epilepsy. By altering the channel properties, the identified mutations emerge as potentially deleterious for the functions of astrocytes and neurons in the brain.

SOCIO-ECONOMIC IMPACT

The outcome of our research is to transfer the knowledge and technology to clinical practice in order to advance diagnosis and improve cost-effectiveness. Families at risk will greatly benefit from our investigations as medical practitioners will help them preventing this channelopathy and sudden deaths, planning future pregnancies, predicting the clinical course of their affected child and getting the right therapy.

THE RESEARCH TEAM

The research team consists of Dr Maria Cristina D'Adamo (co-ordinator of the project) in collaboration with the University of Malta, and Dr Federico Sicca from University of Pisa and Dr Elena Ambrosini from the Istituto Superiore di Sanita, Rome. Scientists from Boston Children's Hospital of the Harvard Medical School have recently joined our team.



ACKNOWLEDGMENT OF RESEARCH SUPPORT

This research programme is currently funded by the University of Malta and Fondazione Cassa di Risparmio di Perugia, Italy.

CURING DEPRESSION, ADDICTION AND EPILEPSY

OBJECTIVES OF THE RESEARCH

Brain diseases can affect anyone. One in three Maltese citizens and about 1 billion people worldwide suffer from some form of mental condition or disease. Depression, addiction and epilepsy, in particular, are amongst the most challenging public health issues in the 21st century. We are using electrophysiological behavioural and neurochemical approaches and animal models to study better understand the pathophysiology of these brain diseases with the aim of identifying new drug targets.

MAIN FINDINGS TO DATE

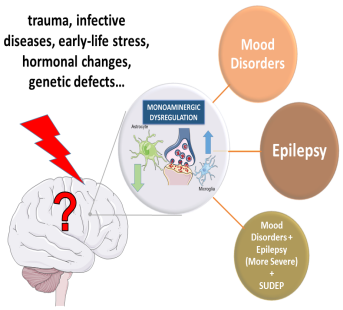
We have discovered one of the mechanisms involved in the antidepressant activity of the recreational drug Ketamine and that an area of the brain known as the Lateral Habenula is a potential new target for nicotine cessation therapies. In addition we found that marijuana, alcohol and cigarette smoking during childhood can induce long-term pathological brain changes as they become in adults. Lastly, we have discovered that increasing the levels of cannabinoids and serotonin can be used to treat epilepsy.

SOCIO-ECONOMIC IMPACT

Neuropsychiatric disorders have a high economic burden on society due to the debilitating health conditions. Although multiple therapies are currently available, most of patients are resistant to drug treatment. Our aim is to understand the direct neurobiological mechanisms involved in neuropsychiatric disorders, which will help us develop more efficacious treatments patients worldwide.

THE RESEARCH TEAM

The research projects are led by Prof. Giuseppe Di Giovanni of the University of Malta in collaboration with Dr Massimo Pierucci, Dr Roberto Colangeli, Dr Gergely Orban and Dr Gabriele Deidda and research students Francis Delicata, Maria Vella and Norbert Abela of the University of Malta; Prof. Vincenzo Crunelli and research exchange students of Cardiff University; Dr Maurizio Casarrubea, Prof. Arcangelo Benigno and Prof. Giuseppe Crescimanno of the University of Palermo and Dr Adrian Attard Trevisan of AAT Research Ltd.



ACKNOWLEDGMENT OF RESEARCH SUPPORT

The research is supported by the Malta Council for Science & Technology (R&I-2013-014), the University of Malta and the COST action CM1103. UK students are supported by ERASMUS plus.

MALTA LIFE SCIENCES PARK

Malta Life Sciences Park promotes research and development to spur the growth of the Life Sciences Sector in Malta. MLSP offers 8000 m^2 of offices and laboratories in a stimulating environment for knowledge-intensive companies. MLSP also supports and encourages commercial growth and success amongst its tenants by offering business and financial advice as well as assistance for technology development and internationalisation.

AAT

MENTE is a medical device developed to remove unwanted Delta and Theta brainwaves associated with autism. The device uses neurological data to create an inverse feedback signal using a state-of-the-art circuitry and noise-cancelling technology to suppress excessive Delta and Theta activity. This system is intended for children. The technology has been developed by Dr. Adrian Attard Trevisan and his team.

ELTY FOOD

A collaboration of highly experienced food specialists is establishing a database of properties of local food products which forms the basis of their intrinsic food research. They offer laboratory services including food chemistry analysis and pesticide residue level analysis. Elty Food helps the food producer with recipe development to ensure that his product is safe and healthy. The effort is being led by Ms. Jeanette Cameron.

MELISSA

A medical device this is being developed and commercialised that is clinically effective to treat wounds. The device is based on the healing properties of Maltese honey which has been clinically tested in Switzerland. Work now includes innovative methods to fine tune the formulation and ensure consistency of the device. The technology was developed by Mr. Ray Sciberras.

MALTA LABORATORIES NETWORK

The collaboration effort in the Network has seen the introduction of the Touch-DNA methodology where epithelia skin cells are used for DNA identification. This methodology is opening up a world of possibilities which links perpetrators' clothing to crime scenes. The Malta Police Crime Scene Investigation utilise the locally based accredited BioDNA Laboratory services. This technology implementation is being led by Dr. Marisa Cassar and Inspector Charlot Casha and their teams.

RESOLVE

A novel solvent recycling machine is being designed and developed for industry to recycle solvent waste. The project funded by MCST RTDI 2014-026T and led by Dr. Stefan Mohnani is intended to be energy efficient in order to make it commercially viable.

MLSP is a Malta Enterprise project that was partially funded by ERDF 199 and ERDF 331 (ERDF 2007-2013).

ENTERPRISING WATER SOLUTIONS

OUR MANDATE

The MCAST Water Research and Training Centre was established in 2013 to provide a national focal point for the research and skills related to the themes of potable water, grey water and sea water/coastal waters. The Centre works in close collaboration with MCAST's Centre for Agriculture and the Institutes of Applied Sciences and Engineering & Transport.

OUR VISION

Malta has the lowest water resources index and the highest water competition index in the whole of the Mediterranean basin. It is thus imperative that Malta be at the forefront of water technology and in the research and development of complex water systems. The MCAST Water Research and Training Centre focuses on water enterprise, aiming to embody the application of creative ideas and innovation to practical solutions in the fields of potable water and grey water. Research and innovation within this Centre focus on the themes of water systems control, water efficiency and innovation and water quality enhancement.

OUR ACHIEVEMENTS

Main research thrusts of the Centre are targeted at grey water micro-solutions, apparent water loss control and the descaling of water. As an example, an innovative grey water micro-system is being run by the Centre in collaboration with Alter Aqua, to study the effects of specifically treated drains water on the growth of plants in a green-roof setup. Recent results indicate that various indigenous plants can be grown in a micro-environment with this 'dirty' water. Another research initiative has focused on innovative magnetic technologies for the descaling of water within commercial treatment plants.

WATER PARTNERSHIPS

The water research is strongly supported by a number of EU and local funding grants such as the ERDF funding of the Centre's laboratories, lead partnership in a Horizon2020 project focusing on water utilization in agriculture, and local funding from MCST Fusion and the Global Water Partnership. The research is run by a team of MCAST lecturers, scientists, engineers and undergraduate students. A high level of collaboration exists with CIWEM, the IWA, CIHEAM, Cranfield University, the WSC, and SEWCU.

RESEARCH, INNOVATION AND DEVELOPMENT TRUST (RIDT)

OUR MANDATE

The Research Trust of the University of Malta (RIDT) was established in 2011 as a key component of Malta's efforts to bolster investment in research and development on a national level. RIDT was set up specifically to engage with the community and encourage its various sectors to embrace the emerging need of supporting research at the University of Malta.

OUR VISION

Malta's future, like any progressive nation's lies in the ability to innovate and discover new aspects of human development. Investing in Malta's future is akin to investing in each and every citizen's future. RIDT has embarked on a new path, where individuals, businesses and organisations dare to dream of a new way forward for Malta in a unique partnership across public, private and social sectors.

OUR ACHIEVEMENTS

In the few years since its inception, RIDT has attracted broad ranging support from a number of sectors, thereby providing a tangible and much needed impetus for high-calibre R&D projects across various faculties and departments within the University of Malta, be it projects in engineering and technology, physical and life sciences, medicine, humanities, social sciences and the arts.

The Maltese community has responded to our appeal by financing a number of research initiatives including PhD scholarships in cancer research, a programme in kidney research, a nation-wide survey on diabetes, industrial research, studies in economics, osteoporosis, digital marketing, ICT and linguistics.

See more on our website: www.ridt.eu

THE UNIVERSITY OF MALTA MOBILE DENTAL CLINIC

This novel community project reaches out to all sectors of society including the underprivileged, the institutionalised, schools, orphanages and the homebound. While providing oral health advice and dental care, the project collects epidemiological data relating to the Maltese population. This project has been achieved thanks to the support of a number of corporate entities through RIDT.

MALTA MEDICINES AUTHORITY

OUR MANDATE

The Medicines Authority is a science and health oriented competent authority based on the values of quality, innovation, people and integrity. Our mission is to protect and enhance public health through the regulation of medicinal products and pharmaceutical activities.

OUR VISION

Our vision is to be a centre of excellence in advancing effective and innovative regulation and promoting quality and scientific rigour in the work we do. We strive to be a best in class regulator for the benefit of patients and stakeholders. We endeavour to be an internationally recognised, efficient entity and promoter of people development and sustainable growth.

ACHIEVEMENTS

Safe, Efficacious and Quality Medicines for the Benefit of the Patients

- Over 5300 medicinal products registered, with over 450 products having been registered between January and August 2016.
- Top 5 position in the EU in the assessment of generic medicines at centralised level and assessing over 250 medicinal products as Reference Member State.
- Establishment of Medicines Intelligence and Access Unit.

Effective and Innovative Regulation

- Conducting EU Good Manufacturing Practice Inspections in India, China, Serbia and Ukraine, establishing Malta as a hub for the pharmaceutical and life sciences sectors in Europe.
- First agency to deliver joint scientific advice with another Member State so as to facilitate accelerated access to medicines.
- Collaboration with the MEB of the Netherlands to start outsourcing part of its assessment work to Malta.

Achieving Results through People, Good Governance and Innovation

- Introduction of the Medicines Authority International Traineeship Programme and over 30% of employees carrying out studies at Masters and Doctoral level.
- An established and certified Quality Management System.
- Relocation to the strategic and scientific environment of the Malta Life Sciences Park leading to cost savings.