



THE RESEARCH MAGAZINE FOR CARDIFF UNIVERSITY

CHALLENGE CARDIFF



**BBC Home Editor
Mark Easton questions
Professor Jonathan
Shepherd**

Fighting crime by numb8rs

Back from the Brink
Jonny Benjamin talks to
Professor Michael O'Donovan

Shaping a new city region
Dr Elizabeth Haywood challenges
Professor Gillian Bristow

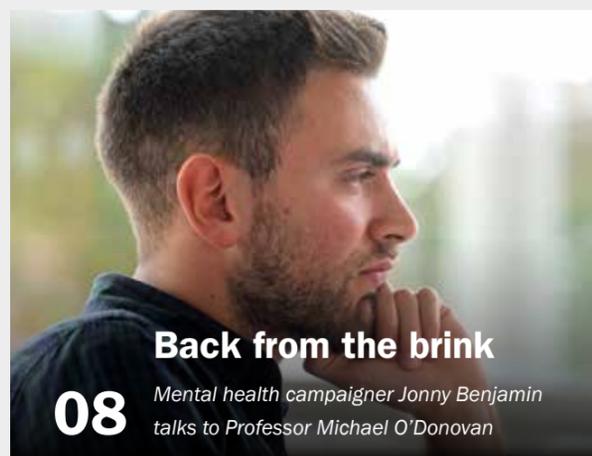
Contents

03 A welcome from the Vice-Chancellor

04 Research news

A round-up of our research highlights

Challenge Cardiff



11 Fighting crime by numbers

BBC Home Editor Mark Easton questions Professor Jonathan Shepherd

14 Changing the focus

Laura Tilley talks to Dr Maggie Woodhouse about her pioneering research into visual impairment

17 Shaping a new city region

Dr Elizabeth Haywood discusses city regions with Professor Gillian Bristow

20 Research impact

From conservation to economic policy, find out how our research is making an impact

24 What made me curious?

Sian Williams asks Professor Karen Holford what sparked her passion for engineering

26 Research Institute focus

Sustainable Places Institute

University's innovative vision for economic growth

Vice-Chancellor, Professor Colin Riordan announced an ambitious vision for innovation-led growth that will boost the Welsh economy, at the University's first Innovation Fast Forward Festival in October

[Read more 04](#)



Changing the focus

14



A selection of case studies on how research at Cardiff University is making a difference

Research impact [Read more 20](#)



Welcome to the first issue of Challenge Cardiff, the research magazine for Cardiff University. The magazine is unique in placing the users of research at its heart.

Whether it is mental health campaigner Jonny Benjamin challenging our world leading neurogeneticist Professor Michael O'Donovan on developments in the treatment of schizophrenia or Laura Tilley, a young woman with Down's syndrome, challenging Dr Maggie Woodhouse to help her read, the magazine gives the

users and beneficiaries of our research a chance to push us towards our next challenge.

It tackles many of the most pressing issues for Wales, the UK and the wider world. BBC Home Affairs Editor Mark Easton presses Professor Jonathan Shepherd on how his research into violence has helped to reduce crime. The University's role in building the city region's knowledge economy is put under the spotlight by former CBI Director Dr Elizabeth Haywood. The powerful drive to innovate, to change society, is evident in all the interviews.

What is equally fascinating is the power of curiosity underpinning

the urgent desire to use our research to better the world. Professor Karen Holford tells Sian Williams how her childhood fascination with the moon landings and Formula 1 ignited her passion for engineering, and how her ground breaking research is being used to ensure that bridges are lighter and safer.

The magazine also contains examples that show how our research is making a real impact in the wider world; from mathematical models that make lifesaving improvements to healthcare to a sustainable system for providing school food that has inspired the reform of policy across the UK.

Our research is helping to shape both our innovation and engagement agendas, and there is a brief introduction to the ambitious and exciting projects we are developing in these areas.

We hope you enjoy the publication and that you will take part in the project that is Challenge Cardiff. The magazine is accompanied by a series of films and podcasts on our website. Please contact challengecardiff@cardiff.ac.uk if you would like to challenge our academics on an issue that is dear to your heart.

Research news

University's innovative vision for economic growth

Vice-Chancellor, Professor Colin Riordan, announced an ambitious vision for innovation-led growth that will boost the Welsh economy, at the University's first Innovation Fast Forward Festival in October.

Around £300m will be invested in new buildings to bring his vision to life. This includes plans to build the world's first Social Science Research Park, which would be able to turn world-leading research into solutions to pressing problems facing society and the world.

Working in partnership with key stakeholders and investing in facilities and people, the University aims to become a magnet for enterprise, creativity and innovation for the Cardiff city region. Business cases are being developed for the proposed new buildings and are subject to the approval of the University's Council (its governing body).



Four planned new buildings

would transform a site on Maindy Road from a disused, former industrial space into a cutting-edge campus.

Social Science Research Park (SPARK)

The proposed first Social Science Research Park in the world would act as a magnet for national and international research leaders. It would increase capacity for postgraduate research and encourage a collaborative learning and working environment for creating, sharing and applying new knowledge.

SPARK will:

- Bring together existing centres of research excellence to work alongside other disciplines, businesses and the third sector to generate new ideas which are tested and evaluated over time and in situ
- Establish the University, the city and Wales as international leaders in the design, development and delivery of innovative, impactful, evidence-based social science research
- Strengthen the Welsh economy through increasing the role of research and development, boosting entrepreneurship and innovation across all sectors
- Create new employment opportunities in the private and third sectors.

Innovation Centre

The planned Innovation Centre aims to offer start-up companies high-quality, affordable space, advice and support on flexible terms so that they can grow and become independent. University spin-outs; staff and graduate entrepreneurs or local people with bright business ideas would all be able to access the Innovation Centre and benefit from its entrepreneurial environment.

The Innovation Centre will:

- Span the full breadth of innovation activities across all sectors
- Provide opportunities for students to embrace the innovation and enterprise culture as part of their educational experience
- House innovation and enterprise initiatives, events and workshops which showcase the inspirational, enterprising students and staff from across the University
- Offer our partners and collaborators the opportunity to co-locate with our researchers while developing their projects

- Facilitate inward investment in the city region by providing a 'landing' space for businesses while they explore opportunities in the area and look for suitable long-term premises
- Stimulate, support and exploit University research, raising the profile of the University, city and wider city region internationally as a location for successful technology innovation.

Translational Research Facility

The multidisciplinary research facility would support turning academic research and innovation into practical, real-world applications delivering benefits for society, healthcare, culture and the economy.

The facility will:

- Offer laboratory and office space to create a critical mass of researchers with a strong track record in translational research, positioning Cardiff as a leading UK centre for activity of this kind
- Enrich the academic environment through innovative research

- Allow development of enhanced training opportunities at undergraduate and postgraduate levels.

Research Institute for Compound Semiconductor Technology

Compound semiconductor technology has underpinned the operation of the internet and enabled emerging megatrends such as smart phone and tablet usage, satellite communications/GPS, direct broadcast TV, efficient solar power generation, advanced healthcare and ground-breaking biotechnology.

Cardiff University's proposed Research Institute for Compound Semiconductor Technology will:

- Be a unique facility in the United Kingdom to demonstrate and test the technology in realistic environments
- Provide cutting-edge facilities that allow for greater engagement with industry and excellent research and development
- Strongly position Cardiff to become the UK and European leader in translational research in this area.

GW4 Alliance

The GW4 Alliance was officially launched at the end of October, at an event at the Houses of Parliament.

The Alliance combines the intellectual capacity and physical resources of the four leading research-intensive universities in the South West of England and Wales: Bath, Bristol, Cardiff and Exeter. This year GW4 has granted £654,126 to 35 projects as part of its Building Communities programme, designed to build new, high-quality GW4 research communities or help existing collaborations build on their work and secure long term sustainable funding. The collaborative strength of the GW4 has already succeeded in attracting significant funding to train postgraduate researchers and bring the

brightest minds to the region. As well as hosting the largest National Environment Research Council (NERC) funded doctoral training partnership in the UK with nearly 200 studentships, GW4 was recently awarded £8m by the Biotechnology and Biological Sciences Research Council (BBSRC) for a Doctoral Training Partnership in conjunction with Rothamsted Research.



International partnership



The Vice-Chancellor, Professor Colin Riordan, has signed an agreement with the University of Leuven designed to boost research income, create new research collaborations and offer more opportunities for students and staff to study and teach abroad.

The Cooperation Agreement builds on existing academic collaborations with Belgium's largest university and, over the next five years, will

create more opportunities for students and the wider academic community to experience studying and teaching abroad.

In addition to strong academic ties the two Universities share similar systems of devolved government and unique cultural and linguistic identities.

The agreement is the first of two planned by the University to enhance Cardiff's reputation as a global university and put Wales on the international stage for its world-leading research.

NATO after the Wales Summit

From defence against cybercrime and maritime piracy, to Russia after Crimea and transatlantic cooperation in a post-Afghanistan age, the 'NATO after the Wales Summit' provided a forum to rethink how NATO should prepare for emerging challenges in an unpredictable future.

Following a welcome address, the conference was punctuated by five sessions, each dealing with a different global challenge: Maritime Security; Cyber Security; Smart Defence: Planning for the future, and NATO and the Transatlantic Partnership. 'The Future of NATO', the conference's keynote address took the form of a conversation between NATO Deputy Secretary General, Ambassador Alexander Vershbow, and Professor Ian Hargreaves from the School of Journalism, Media and Cultural Studies.

Dr Christian Bueger, Reader in International Relations and the convenor of the programme

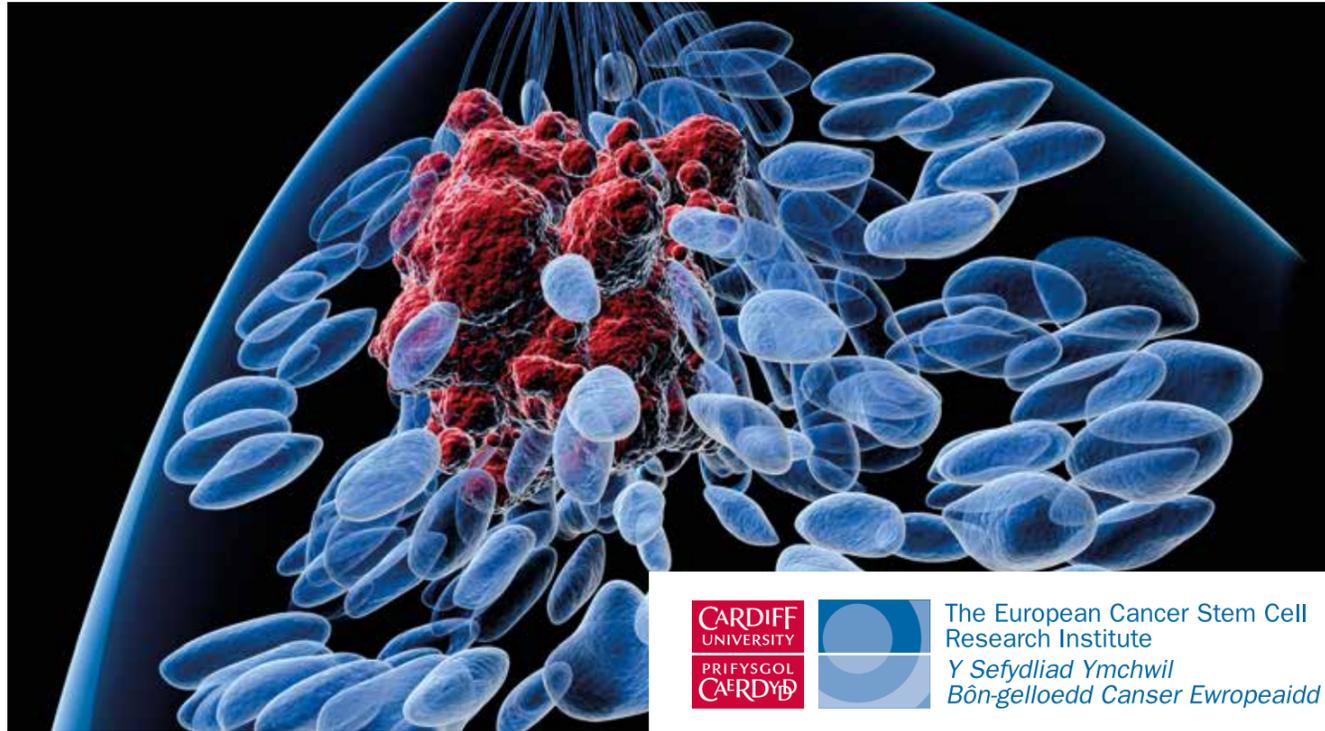
said, "to organise such an event in direct collaboration with NATO, and to have three deputy assistant secretary generals present, proves how fruitful the dialogue between academia and policy can be. International relations research can make a difference and illuminate what the challenges actually are."

Speakers included Director of Chatham House (Royal Institute of International Affairs) Dr Robin Niblett; NATO Deputy Assistant Secretary General for Emerging Security Challenges, Dr Jamie Shea; and Professor Mike Levi (Criminology). The debate was held in the historic Pierhead building in Cardiff.



Hannah Iqbal, a PhD student at the School of Social Sciences, was chosen to represent the United Kingdom at an international event for future leaders organised in conjunction with the NATO Summit. Representing 34 countries in North America, Europe, the Middle East, North Africa, and Asia, the young leaders were granted exclusive access to high-level leaders at the NATO Summit site. Hannah was also a panellist alongside the NATO special representative on Women, Peace and Security and spoke about issues directly related to her research on the experiences of women and young people who have fled violence and conflict and now reside in the UK.

Experimental breast cancer drug



CARDIFF UNIVERSITY
PRIFYSGOL CAERDYDD

The European Cancer Stem Cell Research Institute
Y Sefydliad Ymchwil Bôn-gelloedd Canser Ewropeaidd

Cardiff researchers are developing a novel compound known to reverse the spread of malignant breast cancer cells.

The vast majority of deaths from cancer result from its progressive spread to vital organs, known as metastasis. In breast cancer up to 12,000 patients a year develop this form of the disease, often several years after initial diagnosis of a breast lump.

In a recent series of studies researchers identified a previously unknown critical role for a potential cancer-causing gene, Bcl3, in metastatic breast cancer.

"We showed that suppressing this gene reduced the spread of cancer by more than 80%," said Dr Richard Clarkson from the University's European Cancer

Stem Cell Research Institute.

"Our next goal was to then find a way to suppress Bcl3 pharmacologically. Despite great improvements in therapy of early stage breast cancer, the current therapeutic options for patients with late stage metastatic disease are limited."

Dr Clarkson, senior lecturer in the School of Biosciences, joined up with researchers Dr Andrea Brancale and Dr Andrew Westwell from the School of Pharmacy and Pharmaceutical Sciences, to develop small chemical inhibitors of the Bcl3 gene.

Computer-aided modelling of how the Bcl3 gene functions inside the cell allowed the group to identify a pocket on the surface of Bcl3 essential for its function. By screening a virtual compound library for chemicals that could fit inside this pocket, using state-of-the-

art computer software, they identified a drug candidate that potently inhibits Bcl3.

The compound was then trialled on mice with metastatic disease. The resulting effect was that the drug completely inhibited the development of the mice's metastatic tumours.

With financial backing from Tiziana Pharmaceuticals, work is now underway to progress the compound to clinical trials. The aim is to develop a therapeutic agent capable of blocking metastatic disease in breast cancer and a variety of tumour types.

Cash boost for pancreatic cancer research

Pancreatic cancer charity Amser Justin Time, founded in 2008 by Welsh TV and Radio personality Shân Cothi has made a landmark donation in the fight against pancreatic cancer.

The six-figure sum will be paid over a period of two years to fund the work of a pancreatic cancer research associate at the European Cancer Stem Cell Research Institute.

Shân Cothi said, *"It's a privilege to be able to donate a six figure sum in Justin's name to further the research into pancreatic cancer. Pancreatic cancer has one of the lowest survival rates as a result of underfunding and lack of research. Hopefully our donation will make a difference."*

Shân lost her husband to pancreatic cancer in 2007 and as a result of her loss and her passion to fight the disease, she set up the charity in his name ('Amser' = 'Time' in Welsh).

Shân continued, *"We have been trying to identify a project aimed specifically at pancreatic cancer for some time and were thrilled when the opportunity arose to work in partnership with Cardiff University."*

Encounters with energy

Asking people to tell their own energy use stories is providing more clues on how to reduce the UK's energy demands, according to Cardiff University researchers.

Energy Biographies, an Economic and Social Research Council (ESRC) funded project led by Karen Henwood, Professor at the School of Social Sciences, aims to understand how energy demand reduction may be achieved by finding out how people's lifestyles and identities affect how they use energy.

Professor Henwood said, "Interviewing people about the ways in which their energy use has changed during

their lifetime, and how they expect it to change in the future, provides a novel way of making visible and tangible the many ways we have become dependent on easily-available power."

The key message of the study is how thoroughly patterns of energy use are 'locked in' to people's lifestyles and identities. People in the study, drawn from four separate sites including a large NHS hospital in London and an eco-hamlet in Wales, highlighted how far different ways of using energy are not just routine, but bound up with their desires, aspirations and emotional attachments. One participant in the study,

for example, who had moved with their family to rural South Wales from London, although keen on energy efficiency, saw patio heaters as a 'bad' but essential luxury that allowed them to create a convivial and hospitable atmosphere for old friends visiting from London.

"By understanding more about how and why people use energy over their lifetimes we aim to provide insights into the kinds of policy interventions that can help drive social change toward reduced energy usage across different communities and settings," Professor Henwood added.



Professor receives prestigious Chinese award



A Cardiff University professor has received China's prestigious Friendship Award – the nation's highest honour awarded to foreigners.

Professor Ralph Martin from the School of Computer Science & Informatics accepted his award from Ma Kai, Vice Premier of China, at a special ceremony held at the Great Hall of the People in Beijing.

This is the highest level recognition awarded by the

Chinese government to non-Chinese experts for their contributions to the country's economic and social progress. Professor Martin was one of 100 award winners from 25 countries, and was honoured for his outstanding academic contributions.

He was nominated for the award by China's top university for science and engineering - Tsinghua University in Beijing - where he is a Guest Professor in the Department of Computer Science and Technology.

Award for pioneering engineer who developed ultrasound



A pioneering University engineer who helped develop medical ultrasound scans says he is seeking further breakthroughs as he prepares to receive one of the highest accolades in the scientific community.

Professor Peter Wells of the School of Engineering, will be presented with a Royal Academy of Engineering award

that was first won by Sir Tim Berners-Lee, creator of the World Wide Web, in 2001.

He is currently involved in developing a new type of CT (Computerised tomography) scanning which is likely to be used for ultrasonic breast screening, and would particularly benefit younger women. He is also in the very early stages of trying to develop a much faster form of ultrasound scanning.

The medal is awarded to an engineer in the UK "whose sustained achievements have had a profound impact upon their engineering discipline".

His citation states: "Professor Peter Wells is one of the most well-known and highly regarded figures in the world of medical ultrasound. His outstanding and sustained engineering achievements in the medical applications of ultrasound extend continuously from the 1960s to the present day."



DURING THE MORNING RUSH HOUR, I PLANNED TO THROW MYSELF FROM WATERLOO BRIDGE.

Neurogeneticist Professor Michael O'Donovan led the biggest genetic study of schizophrenia ever conducted, shedding new light on the biological cause of the condition. Mental health campaigner Jonny Benjamin, who lives with schizoaffective disorder, made the journey from London to Cardiff's MRC Centre for Neuropsychiatric Genetics and Genomics to find out what the findings mean. Here, Jonny recounts the conversation.

JB: It's been six years since that cold morning in London when a stranger pulled me back from the brink of suicide. Having for years lived with delusions, hallucinations and voices, a psychiatrist confirmed these experiences were not real and that they were in fact symptomatic of a condition called schizoaffective disorder.

The diagnosis crushed me. Without a known cure or hope for an effective treatment to manage my symptoms, my future seemed to evaporate before me. I found myself contemplating the unthinkable.

During the morning rush hour, I planned to throw myself from Waterloo Bridge. Thankfully, the kind words of a stranger drew me back from the edge and it's his words that have had the biggest impact on my recovery since then.

In the years following that day I've grown increasingly frustrated by the lack of progress in research to improve my condition, though in recent months I have become more hopeful, having read with interest the findings of a number of groundbreaking studies related to my condition.

Earlier this year, a global study involving a 300-strong team of neuroscientists, led by Cardiff University, analysed the DNA of over 80,000 individuals, and resulted in the discovery of over 100 genetic mutations linked to schizophrenia. I travelled to Cardiff to meet the project's lead researcher, Professor Michael O'Donovan, to find out what these mutations mean for me and whether they hold clues to a cure.

MOD: Despite 60 years of pharmaceutical research, the causes of schizophrenia remain obscure. Identifying these mechanisms is a critical step to understanding what drives the disorder.

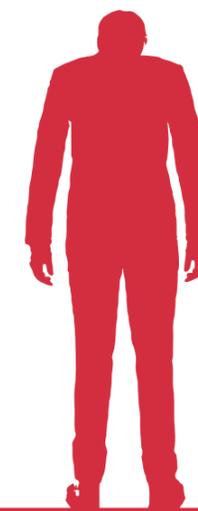
JB: As I have sought to understand my condition, I have certainly been aware that genes play a big part in schizophrenia. Although they are not the only factors, it is becoming clear that their involvement provides researchers with an opportunity to get a grip on how the disease is caused.

MOD: If specific genes that affect risk can be identified, like the ones we've discovered, researchers can then figure out what these genes do. If you



Back from the

THANKFULLY, THE KIND WORDS OF A STRANGER DREW ME BACK FROM THE EDGE AND IT'S HIS WORDS THAT HAVE HAD THE BIGGEST IMPACT ON MY RECOVERY SINCE THEN.



understand the enemy, which is the biology of the disorder, then it's easier to begin thinking about how you might develop treatment strategies that are different from the ones that already exist.

JB: Professor O'Donovan explained that risk genes are a window to what is going wrong in schizophrenia. They provide clues to what might be going on in the brain that leads people to hallucinate, hear voices, develop delusions, or feel, taste and see things that there is no explanation for in the real world. But the condition is immensely complicated.

He explained that schizophrenia is a diagnostic term that groups together people with a very wide range of symptoms and behaviours. No one individual shares their symptoms with another. It is certainly a lonely thing to endure and make sense of. It appears that in any one person many genes are involved and in different people, different sets of genes are involved.

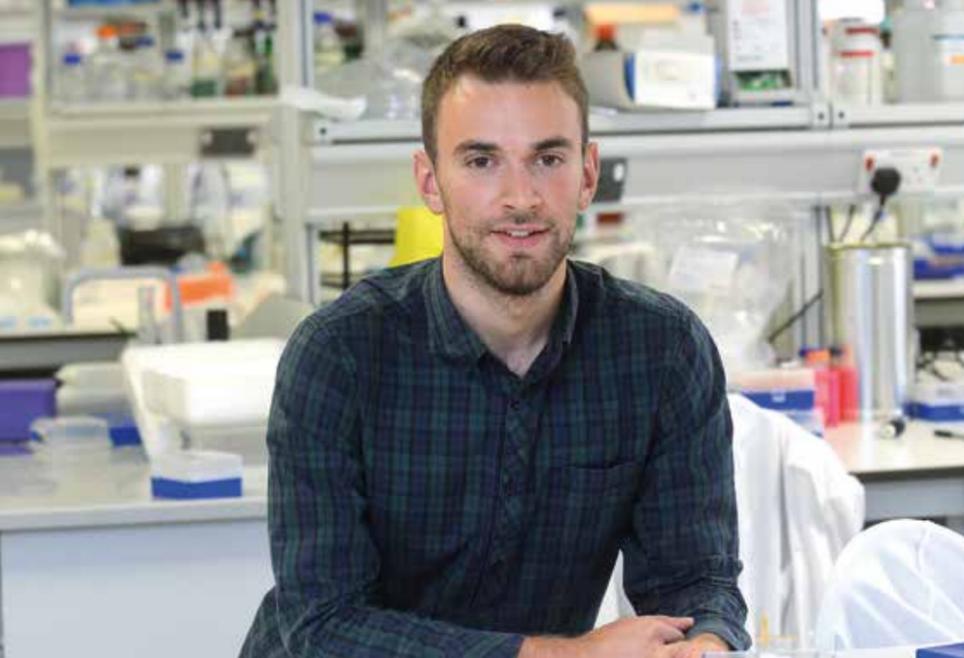
This has made linking specific genes to the disorder very difficult, which is why the Cardiff-led research had to involve

over 80,000 people to achieve enough statistical power to make enough links between one risk factor and the condition.

I am aware, however, that some factions of psychiatry feel that by emphasizing a biological difference between people with mental illness and those without, researchers are in some way contributing to patients' alienation and reinforcing perceptions of "otherness".

Professor O'Donovan insists this view is fundamentally flawed.

MOD: All disorders have at least some biological contribution, so I can't see how it's tenable to believe that your brain has no impact on how you think, feel and behave. Nevertheless there are a significant number of vocal commentators, including some clinicians, who think this. They say that schizophrenia is grounded in a psychological basis, but the truth is that psychology is often simply a different way of measuring the effects of biological change, which in turn is influenced not only by genes, but also by culture, learning and other environmental factors.



JB: Cultural attitudes to mental illness can certainly be unhelpful in influencing how people perceive and relate to schizophrenia research. In my experience these all play their part in reinforcing age-old ugly stereotypes that make fundraising for mental health research a lot harder than it ought to be.

Professor O'Donovan recalls his time as a medical student when cancer was stigmatised much in the same way schizophrenia is today.

MOD: We were given a little instruction book that said, when talking to patients, don't mention the word cancer. It gave us a whole load of euphemisms to use, and things not to talk about in front of the relatives - and that was the 1970s! We've come a long way since then, partly because there's better treatment, partly because of awareness raising campaigns. I hope that this will happen in schizophrenia, but cultures and attitudes do take a very long time to change.

JB: This certainly struck a chord with me. Society as a whole has not yet come to accept my condition. Despite this, I feel lucky that I have been able to come to terms with the way my mind works. Many do not. But if someone gave me the chance to have someone else's brain, without these symptoms, then I would surely take that opportunity.

Naturally, I still hold out hope for a cure and often wonder whether I'll see one in my lifetime. It's a point which Professor O'Donovan is quick to acknowledge, but he is keen to manage sufferers' expectations of the prospect of a 'miracle cure'.

MOD: I don't think there will ever be a single cure for schizophrenia. It is a diagnostic term for a multitude of conditions presenting unique symptoms in every case. Nothing we do here at the University, or to my knowledge anywhere else, is even plausibly likely to give anyone with schizophrenia a cure, but crucially what past and current research does allow is for people to control their symptoms and get on with their lives. I have no doubt that cures for some manifestations of the disorder will emerge but that won't be for another ten years, at least. I think what we will see before then, are improvements to symptom control.

JB: One of the most promising findings in Professor O'Donovan's latest paper is the identification of a link between schizophrenia and a brain chemical receptor called dopamine receptor D2 (DR2D). This gene is responsible for producing the very protein that is blocked by all the currently available, effective medicines. The discovery suggests proteins made by some of the other genes identified could also be therapeutic targets.

Even if these proteins don't turn out to be effective treatment targets, then at the very least the wealth of risk genes Professor O'Donovan and his collaborators have uncovered provide a foot in the door to achieving a better understanding of the disorder.

MOD: Many researchers, including me, are beginning to view what we call schizophrenia as an end-of-the-line condition that is actually the manifestation of a disease process that has taken place earlier. It's a bit like when someone has a heart attack, it is actually very difficult to repair the damage

it has wrought, but if you spot the symptoms of its development before it happens, it is quite possible to prevent it.

JB: This does encourage me. To think that doctors will be able to recognise schizophrenia's onset at earlier stages through diagnosis based on improved brain imaging or better ways of measuring psychology, combined with the insight of a patient's genetic risk, is surely good news. Professor O'Donovan certainly hopes that, armed with this knowledge, we could then stop the full-blown manifestation of schizophrenia from occurring and if we can achieve that, then it's legitimate to start using the word 'cure'.

Professor O'Donovan is quick to point out that without continued research you cannot effect informed change and what you're left with is unsupported theory.

MOD: When there is no knowledge, you have a vacuum which leaves the door wide open for all kinds of extreme views about schizophrenia's causes, treatments and origins. In the fullness of time, some views will be right, some will be wrong. But to determine which theories are right and which theories are wrong, we need to keep researching or things will never change.

JB: Not everyone who struggles with my condition can be saved from their lowest ebb by the kind words of a stranger. Professor O'Donovan is working hard to make sure they don't reach that point.



New Flagship Imaging Centre

Research into schizophrenia will benefit from a state-of-the-art research centre under construction at Cardiff University.

The new £44m Cardiff University Brain Research Imaging Centre (CUBRIC), set to become one of Europe's top facilities for brain imaging will co-locate world-leading expertise in brain mapping with the very latest in brain imaging and brain stimulation.

It will help researchers to understand not only the causes of disorders such as schizophrenia, dementia, Huntington's disease and multiple sclerosis, but provide important clues about how to develop more effective treatments to improve the lives of patients with these disorders.

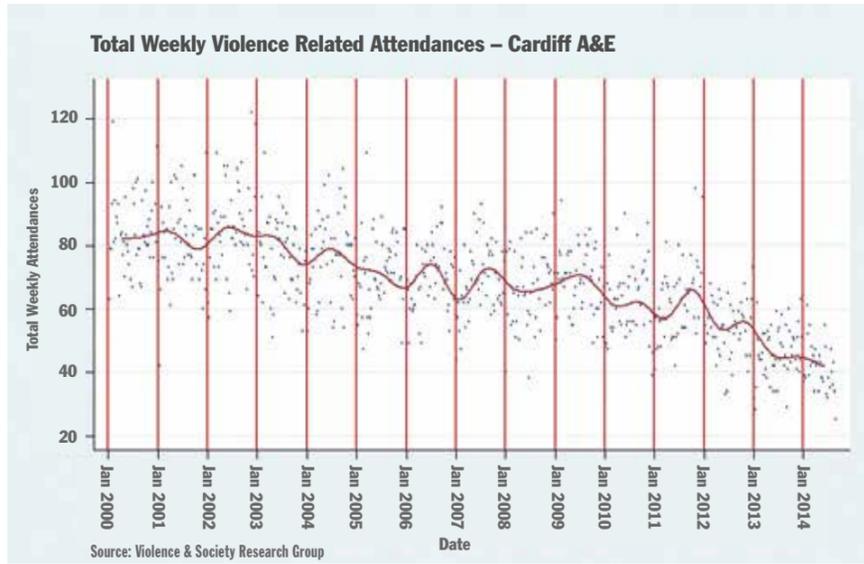


BBC Home Editor Mark Easton questions Professor Jonathan Shepherd on how his research into violence has helped reduce crime.



by num8rs

Good data lie at the heart of good research. Nobody understands this more than Mark Easton. As BBC Home Editor, he appears almost nightly on our small screens, using numbers to weigh the nation's top news stories. A respect for solid statistics underpins his journalism, from findings on the constitution to figures on migration. Earlier this year, his passion for quality data brought him 'head to head' with a like-minded exponent of evidence-based research. Professor Jonathan Shepherd, who leads the University's Violence and Society Research Group, pioneered the use of data from hospital accident and emergency (A&E) departments to pinpoint and tackle violent crime. The group's findings that serious violent crime has halved in a decade made Professor Shepherd's research a top national story. So, when the two met at New Broadcasting House, Mark began by asking what first kindled the pioneering dental surgeon's passion for studying violence.



JS: My interest was first prompted by observations when I was a trainee surgeon in Yorkshire in the early 1980s. I noticed that violence resulting in hospital treatment was concentrated in just a few licensed premises. It surprised me that violence hadn't been studied from a health/injury perspective. I thought this would make a fascinating topic for a PhD and so it proved. One finding in particular - that 75% of violence which puts people in hospital wasn't represented in police records - was a real shock and suggested that a rich seam of discovery and impact might be at hand, as the last 30 years have confirmed.

ME: When you first came up with the idea of gathering anonymised data from hospital A&E units to measure and reduce serious violence, did you meet with resistance from the police and Home Office?

JS: This idea followed logically from the finding that so much serious violence was not known to the police. Effective police and local authority prevention activity depends on knowing precise violence locations and times, and which weapon category was involved, so that these can be targeted. It took some time to engage the different agencies with the proposal that information from A&Es should be used for this purpose but there was no real resistance. To start with, I called a meeting of Cardiff police, health and county council representatives. South Wales Police carried out their own analysis and confirmed that

A&E was indeed a rich source of new intelligence. The next step was to carry out an experiment to find out if A&E data could make a difference by helping police pinpoint crime hotspots. After three years, this approach was formally incorporated into Community Safety Partnership work in the county in a sustainable way. Four years later, it was clear that Cardiff's approach of analysing the data and then targeting violent hotspots was resulting in lower rates of violence than in any of the other cities in its Home Office family of similar cities. The publications which followed, and the publicity which resulted from them, convinced national policy makers to adopt this programme, and implementation continues both nationally and internationally.

ME: Why are police statistics unreliable, and why has the Statistics Authority withdrawn its seal of approval? What's the best way to measure violence locally and nationally?

JS: Police records are an unreliable measure of violence because they largely reflect reporting by victims and the injured. However, many people don't report. This is often because they are afraid of reprisals, because they don't know who hit them - and therefore can't see what the police can do - and because they don't want their own conduct scrutinised too closely. There are also worries that once crimes are reported to the police, many are not recorded. Some offences have been "no-crimes", and the extent to which this happens varies across

forces. The Office for National Statistics has said that there might have been a gradual erosion in compliance with police recording rules, in part reflecting the need to demonstrate improved performance. Because of accumulating evidence of lack of objectivity, the UK Statistics Authority withdrew its seal of approval and recommended a thorough overhaul. New recording rules have since been published, including guidance that all reported crimes should be recorded. Worryingly though, in some forces, this has resulted in decreases in recorded offences - strongly suggesting that these new rules have not yet been implemented everywhere.

ME: Why have there been significant year-on-year falls in violence according to your data and the Crime Survey for England and Wales? What's driving this reduction? Is it behavioural or social change, or is it driven by wider economic or environmental change, like the banning of lead in petrol, for instance?

JS: It's easy to assume that there must be one or two major reasons for the year-on-year falls. But the reasons are likely to be many. Globally, evidence synthesised by Steven Pinker at Harvard and Manuel Eisner at Cambridge suggests convincingly that the oft-interrupted march of civilisation and increases in self-control over the centuries are macro-level explanations. Better government, especially but not exclusively in Western countries, is an important factor, and is manifest in many ways - including improvements in weapon and alcohol regulation; statutory partnership arrangements to tackle violence; better regulated, more trusted and evidence-based policing; more reliance on robust evidence in policy making and a host of situational interventions. The latter include CCTV, protective screens, toughened and plastic glassware in licensed premises, pedestrianisation of clubland areas and street lighting. Economic factors are likely to play a part too; steeper UK falls in violence since 2008 may reflect decreasing affordability of alcohol in the economic downturn, for example. Clear reductions in UK teenage pregnancy, drug misuse, alcohol misuse and violence among young people, helped along by better parenting and state responses to antisocial behaviour, support the self-control explanation.

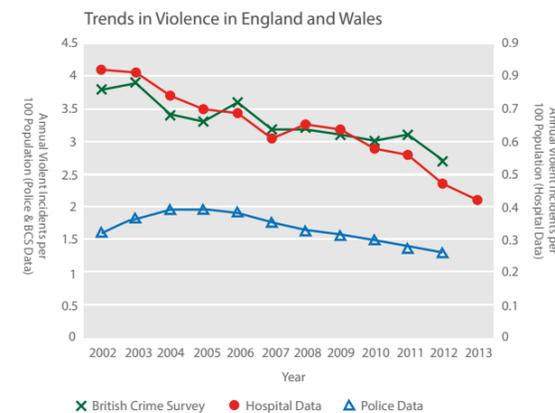


ME: So where do you go next with your research, and what are your long-term goals?

JS: Most of our current research portfolio builds on our previous findings. We have randomised trials under way of environmental health interventions in high violence pubs and clubs and of psychological interventions delivered in probation and dental settings designed to reduce alcohol abuse. We also have qualitative studies under way of vulnerability to violence of adolescents and violence caused by discrimination. We are evaluating the service impact and effectiveness of alcohol treatment centres and carrying out economic analyses of the influence of alcohol prices on violence. Our annual study of national violence trends is a fixture in the group's year. And our work has a strong knowledge-transfer theme exemplified by the establishment of the University's pioneering Police Science Institute and the adoption by government of our violence prevention, information-sharing "Cardiff Model". This is being rolled out in the Netherlands and the Western Cape region of South Africa and replication cities across the US have been identified. We have also contributed to legislation including the Crime and Disorder Act and

ME: But aren't your data really just a best guess?

JS: Our data are a scientific response to all the guesswork and uncertainty often associated with violence trends. Prompted by the obvious shortcomings of police records, and the contradictory messages from these on one hand and the UK Crime Surveys on the other, we decided in 1995 to set up the National Violence Surveillance Network, now comprising 117 accident and emergency departments across England and Wales, to triangulate measurement using health data. Annual reports have been published since 2000. The methods we use, which have been subject to repeated peer review and published in a range of journals, take account of population coverage and other potentially confounding factors. No measure is perfect of course, but this different perspective has brought clarity to trends; there is now no doubt that violence and the harm it causes have fallen over the past 20 years in England and Wales.



the Welsh Government's Gender Based Violence Bill. We have been instrumental in setting up the College of Policing and the Probation Institute - both new national standard-setting UK institutions at the centre of these key public services. My report for the Cabinet Office includes recommendations which help set an agenda for improving evidence ecosystems across public services. Our most important goal is, through the best science and advocacy, to maintain the current but fragile momentum towards less violence, and less harmful violence in Wales, the rest of the UK, and more widely.

ME: Finally, I'd be really interested to know whether improvements in healthcare have reduced homicide numbers?

JS: In several Western countries since 1900, advances in medical technology and emergency services have probably resulted in the survival of around half of those injured in violent attacks who would not have survived in earlier times. In addition to therapeutic advances, increased survival almost certainly reflects better ambulance services, proliferation of hospitals into non-urban areas, and the development of specialised trauma centres. When these centres are part of state-wide trauma care systems, they can increase survival across all injury categories by up to 40%. This finding is a foundation of the Royal College of Surgeons campaign for this integrated approach across the UK. But again, we shouldn't think of this factor in isolation or even as a contribution to homicide reduction at all in some countries where murder rates are highest. In Sao Paulo, Brazil, for instance, a city with a population around four times that of Wales, homicide rates fell by three quarters between 1999 and 2011 but in the poorest areas where homicide is concentrated, access to emergency vehicles is so bad that health service advances seem unlikely to be a major factor.

Laura Tilley was a young volunteer in Dr Maggie Woodhouse's pioneering study into the visual impairment of children with Down's syndrome. Earlier this year she returned to the University to ask Dr Woodhouse why she has problems with her sight and what more can be done. Tomas Barrett reports.

Changing the focus



Like the 160 other children with Down's syndrome who've since joined Dr Woodhouse's clinic, Laura's learning and social skills have improved considerably, thanks to the clearer vision afforded to her by bifocals. Now aged 19, she is a competent reader and studies Dramatic Arts at college.

LT: How was it that you came to work with people with Down's syndrome?

MW: It was completely by accident. My colleagues and I set up a Vision Clinic for children because we wanted to study lazy eyes and squints in young people. When we launched the clinic it got a fair bit of publicity, but we found that very few typical young people came to see us. Those who came to the clinic were mainly children with Down's syndrome and other disabilities that we hadn't really considered at the time. After a while we realised that children with Down's syndrome quite often have problems with their eyes and after that the size of the clinic just snowballed. Today we actually specialise in research and eye care for children with Down's syndrome and have gained an international reputation for the work we do. Children come to our clinic from as far afield as France, Ireland and Gibraltar. Their smiling faces adorn the walls of our clinic and remind us every day who we're working for.

LT: Why do children with Down's syndrome often have problems with their eyesight?

MW: The truth is we don't know the answer to that. Because of our research we do know what to do about problems with poor eyesight, but we can't say why there are problems in the first place. Children with your condition have an extra chromosome and therefore have plenty of extra genetic material, but we still can't pin down why that would affect your eyes and which particular genes are involved. It remains a mystery. Research is ongoing but the truth is we're not even close.

LT: Can you explain how bifocal glasses, like the ones I'm wearing, work?

MW: Bifocal glasses have got two strengths. I wear bifocals so I can show you with these (she takes off her glasses and hands them to Laura). Part of the lens at the top corrects short and long sightedness and puts my eyes in focus at a distance. Part of the lens at the bottom is more strongly focused to help me see things that are near. Most children don't need bifocals because their eyes can change focus really easily so they can home in very clearly on things that are near, using their ordinary glasses. But a lot of children with Down's syndrome can see things clearly at a distance but struggle to focus their eyes on things that are near, like reading a book or writing on lines. Bifocals are ideal for overcoming these challenges.

LT: Why do children with Down's syndrome learn differently to others?

MW: We know that children with Down's syndrome predominantly learn through their eyes and often have hearing difficulties. Correcting their vision with bifocals has been massively beneficial and gives children the best vision possible. Because of this knowledge, parents now work very hard to visually stimulate their children to learn, for example, by showing them words in proximity to the objects they're describing. They also now work much harder to teach their children to read, because they know which method works. As a consequence, when they reach school age, children with Down's syndrome are often ahead of their classmates in their reading ability. Because of my clinic's research, we now have a much better understanding of how people with Down's syndrome see so that we can instruct teachers and employers to make changes to the school and work environments to maximise people's learning potential, so that they're not held back by their vision.

LT: What have been the biggest challenges in your research and what have you done to overcome these challenges?

MW: The biggest challenge we face is recruiting enough typical children to our studies, to compare their eyesight with that of children with Down's syndrome. Most parents of children with Down's syndrome are very keen to help their children and others overcome problems around the condition so are very willing to join in with our research – recruiting children like you has never been a problem.





Shaping a new city region

Dr Elizabeth Haywood questions Professor Gillian Bristow on how her work is helping to address the twin challenges that confront the Cardiff city region: economic development and social inclusion.

LT: Are you planning any further research to improve the eyesight of people with Down's syndrome?

MW: Most of the children who joined our study in the early days of the clinic are now adults, like you, so what we're now interested in is how eyes and vision change when young people with Down's syndrome move into adulthood. We're currently looking at introducing contact lenses, to replace glasses, to children with Down's syndrome in order to further improve their sight. We already have one little boy called James, aged eight from Barry, who wears them – he's the first in our study. For other children to try wearing contact lenses we first need the full support of parents, given the difficulty even typical children find in putting contact lenses in and taking them out again.

LT: What other research is your clinic doing at the moment?

MW: We're currently looking at two conditions: Keratoconus and Nystagmus. The first condition is a distortion of the cornea, where a cone-like bulge forms in the eye to severely impair how a patient sees things. What our research hopes to determine is why it occurs more commonly in children with Down's syndrome and what about their cornea makes them more susceptible to it. Because we know there are treatments to prevent Keratoconus if we can intervene early enough, we need

to develop some diagnostic guidelines, which is actually quite difficult because the symptoms, in their early stages, are very hard to detect. The other condition we're interested in is Nystagmus. Put simply it's an involuntary toing and froing movement of the eyes which is also more common in children with Down's syndrome. To shed some light on this inexplicable phenomenon, we're planning a comparative study between typical children with Nystagmus and children with Down's syndrome living with the same condition. The findings, we hope, will show whether the cohort with Down's syndrome is experiencing exactly the same condition or something different and unknown.

LT: Can you talk about some of the most memorable moments of your career?

MW: What immediately springs to mind when I recall my most memorable moments is when someone like you, Laura, comes running into my clinic and gives me a big hug. That does it for me every single time! But other moments also stand out. For instance, when a parent has emailed me after I'd tested their children's eyes or given them some advice, and they've told me how much of a difference it's made to their child. Or the little boy who couldn't write on the lines in school, whose teacher I then instructed to make the lines bolder using black pen, which then made all the difference for the child. And there's the children, who, like you, have

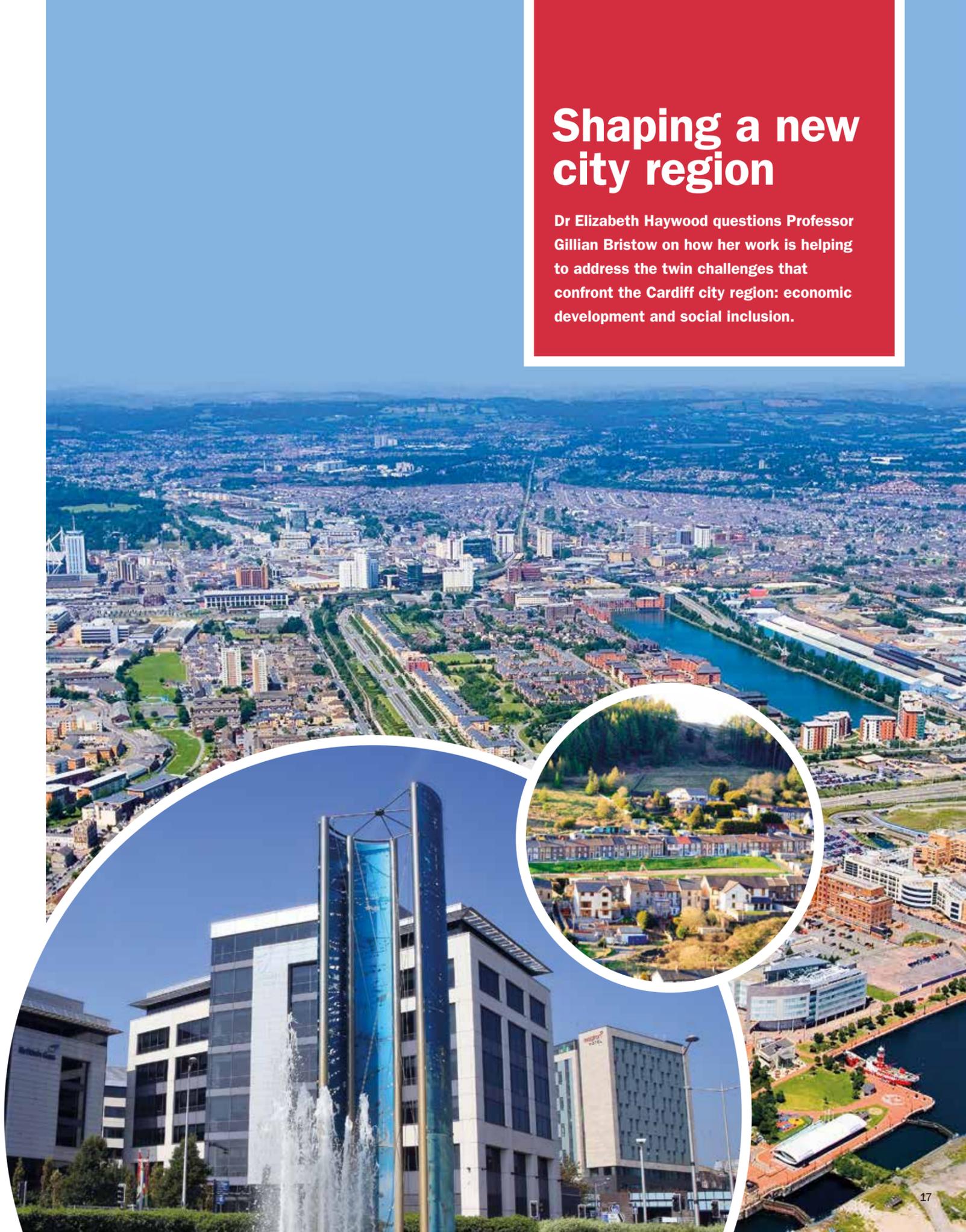
successfully taken to wearing bifocals and do things they couldn't do before. All these moments make my work so worthwhile.

I suppose getting an OBE wasn't so bad either!

LT: Thank you, Maggie.

Around 1,000 babies in the UK are born with Down's syndrome every year. The condition occurs by chance during conception and is caused by the presence of an extra chromosome in the baby's cells. Of the 1,000, 600 babies will turn out to have impaired vision. Cardiff-born Laura Tilley was one of these babies.

Laura attended school in Cardiff but like so many other children with Down's syndrome her cognitive development was hampered by poor eyesight. In 2000, Laura's mother Jo heard that a new clinic in the School of Optometry and Vision Sciences was recruiting young children with Down's syndrome for research into their visual and general development and volunteered Laura on to the project. Laura attended the clinic for thorough eye examinations for many years, and, at the age of six, was given bifocal glasses, then a pioneering prescription and brainchild of Dr Maggie Woodhouse OBE.



When the idea of using city regions to boost economic performance in Wales was being considered, Welsh Government turned to a big hitter with serious business credentials to make it happen.

Dr Elizabeth Haywood, a former Director of CBI Wales, was chosen to lead an expert panel which concluded city regions should be created around Cardiff and Swansea. But she says the panel's work was hampered by a lack of hard economic data, a point she made in a series of challenging questions to Professor Gillian Bristow, who is leading a Cardiff University project to help shape the city region. The project, called City Region Exchange, will play a pivotal role in developing the city region, known as Cardiff Capital Region, which covers the 10 local authorities of South East Wales.

GB: One of the main aims of our project is to establish a robust evidence base to inform the development of the city region and support the socio-economic decisions of those within it. One of our first tasks will be to develop a solid baseline understanding of existing data sources and research evidence, and then identify any gaps which might be evident. We aim to build on, and bring together more effectively, the breadth of knowledge that already exists on data sources from individual researchers, research groups, centres and institutes that have been actively doing research on, in, or about the city region economy. We will also build on the University's engagement with key stakeholders – such as the Office for National Statistics and local governments – to better understand the data available and what our critical data needs are in relation to the city region's development.

EH: Cardiff was recently judged to have the best quality of living in the UK, yet in economic terms it fails to punch its weight. Research shows that while UK cities generally contribute over 60% to the region's Gross Value Added measure of the value of goods and services produced, in Wales it is only 33%. How will Cardiff University establish the obstacles to growth, and what milestones will you use to measure an increase from this low level?

GB: Clearly it will be important that our project better understands the opportunities and challenges that are manifest in the city region and how these are distinctively shaped by the uniqueness of the local and regional context. Understanding the nature and effectiveness of the economic relationships between the city of Cardiff and its neighbouring areas will be a critical focus for this project. We will provide knowledge of what has worked well in other city regions, for example, but we'll also engage across the Cardiff city region to identify key challenges and explore how the University might tackle them. Once this baseline knowledge is developed, we will draw on the different

skills and knowledge across the University to build focused projects, from business networks in key sectors to issues around skills development. Each project will identify indicators to track progress in relation to each issue.

EH: The increasing speed with which mid-level jobs are disappearing makes building a new knowledge-based economy an imperative – learning becomes the key element in the development of basic prosperity. What is Cardiff University's role in achieving this?

GB: The University undoubtedly plays a critical role in the development of a more knowledge-intensive city region economy, and is both a creator and consumer of knowledge. The University will contribute to the ideas, 'buzz' and creativity vital to the development of the city region. Mechanisms are being put in place by the University to enhance knowledge transfer and innovation for the local economy. One of the main rationales behind this project, and the University's other flagship engagement projects, is to develop the notion that knowledge transfer extends beyond science and technology to other sectors and issues. The University can and should be looking to enhance the role it can play in using its academic expertise in other areas for the benefit of the city region, including improving urban design, spatial and transport planning. In addition to this, of course, the University acts as a major source of graduates, providing skilled, knowledge-intensive labour for the local economy.

A graduate contributes between 20 and 48% greater productivity to the labour market over employees with lesser qualifications, and there is clearly a mutual interest between universities and the city region in developing highly skilled, employable people. The city region needs graduates who can transfer research-based knowledge into practice in the workplace, and with the skills to use new technologies or work with disadvantaged groups. Thus an important

aspect of this project will be to engage with others in examining key questions around the relationships between educational opportunities, education provision and student placement opportunities with local businesses, as well as skills deficits.

EH: I believe the University's four roles in the city region are to research and innovate, attract investment, provide skills, and contribute to its culture. I'd like to see the establishment of an observatory to conduct research on regional economics, better interaction with local government, and improved public services. An incubator for innovation, plus work experience or internships for all undergraduates in South East Wales, would really have a big impact on the success of the city region. Do you agree?

GB: I completely agree. The University plays a critical anchoring role for the city region through its potential to act as a major hub for linking local needs with external knowledge, people and investment. Many roles are already recognised as critically important by the University: the Cardiff Innovation System, for instance, builds on the University's innovation culture to attract enterprise, creativity and innovation to the city region. Also, the engagement projects, including the city region project, are one part of the wider engagement the University has with its locality. The city region engagement project will look beyond simply innovation, identifying areas where the University could both enhance its contribution to the city region, and build stronger networks of engagement with key stakeholders including the Cardiff Capital Region Board, as well as other Welsh Government, local government and business community representatives. We want to address the twin challenges that confront the Cardiff city region: economic development and social inclusion. Engaging with broad interest groups across the city region will be critically important in helping us identify projects and activities that will translate the opportunities provided by Cardiff's growth and development into wider opportunities for the South Wales Valleys hinterland.

EH: To what extent is Cardiff University's role a post-hoc, evaluation/monitoring one, and to what extent a proactive, leadership role?

GB: The University's role is a dual one. It has representation on the Capital Cardiff Region Board, set up to drive forward the city region and shape its agenda. The support unit established to assist the board is housed in the University, so the institution plays an important leadership role. The unit will evaluate and monitor the progress of the city region. The engagement project is separate and will provide and collate an independent and robust knowledge and evidence base to help inform the city region's development. It will have strong working relationships with the support unit to ensure it can, if needs be, provide important evidence in response to the board's needs, and benefit from engagement with stakeholders. However, the primary focus of the engagement project is to proactively engage with broader stakeholders across the city region to gather evidence and knowledge that will help inform key socio-economic decisions by all who have a role in shaping the development of the city-region.



Flagship engagement projects

City Region Exchange is one of the University's five flagship engagement projects, which were unveiled at a launch day in October with First Minister of Wales, Carwyn Jones, at the home of the Welsh Assembly. The other projects, listed below, focus on issues such as tackling poverty, boosting the economy, and improving health, education and well-being.

Community Gateway: Residents will work with the University as equal partners to bring innovative schemes to life that will benefit their community, starting in Grangetown, Cardiff. The team is keen to develop 10 schemes and wants to hear ideas from within the community itself.

Community Journalism: Communities lacking in access to local news will be supported to develop hyperlocal news websites. Some have already been set up, including in Rhondda and Cardiff.

The Phoenix Project: Focusing on sub-Saharan Africa, the proposed work will include everything from training medical staff and boosting communications, to strengthening local languages

and increasing maths skills among students. The University has teamed up with the University of Namibia, which will play a vital role in the project.

Strong Communities, Healthier People: This project focuses on health and well-being, initially in North Merthyr and the Butetown, Riverside and Grangetown areas of Cardiff. The areas have their own distinct history, geography, economy and identity, but they share similar levels of poverty and social and economic exclusion.

Research impact

Cardiff University researchers make a positive and lasting impact around the world by working across disciplines to tackle major global challenges.

Why gold is the key to a glittering future



The manufacture of complex materials, such as plastic, creates too much waste and not enough product. Researchers in the School of Chemistry, led by Professor Graham Hutchings, have been seeking ways of reducing harmful chemicals produced during catalysis.

Professor Graham Hutchings and his team, have discovered gold has the potential to save lives, improve health and clean up the environment. Gold is the best catalyst for the formation of vinyl chloride, the main ingredient for the production of PVC, and has the potential to replace an environmentally harmful mercury catalyst. Gold is also used as a catalyst to oxidise carbon monoxide

to carbon dioxide. This has potential to be used in natural disasters or domestic settings where carbon monoxide (CO) needs to be removed from the air.

Catalysis underpins an estimated 80-90% of all manufactured goods. It involves a material, which is not one of the reactants, speeding up a desired chemical reaction without the need for an increase in temperature.

Commonly used catalysts such as those containing mercury have proven wasteful, environmentally hazardous and even harmful to human health. Gold, scientists have discovered, is not only a viable alternative catalyst, but sometimes the best possible catalyst.

"The more we learn about this precious metal, the more I feel that society is ascribing the wrong kind of value to gold." Professor Graham Hutchings, Professor of Physical Chemistry

The research has led to a new process to produce vinyl chloride that does not use mercury. Two leading organisations have made substantial investments in developing the new catalyst, and the findings have been incorporated into the global policy debate around mercury and its risks to human health and the environment.



Conserving endangered species

The habitats of rare animals are at risk, including pandas in China and orang-utans and elephants in Borneo. By studying genetic data and mapping the behaviour of animals, researchers have taken a step towards saving the lives of some of the world's most endangered species.



Strategies to save rare animals are sometimes piecemeal and can lack data to show pressures on forest habitats. In Borneo, Professor Mike Bruford and his team gathered genetic and population data to show orang-utans would be extinct within 50 years, if there were no action to re-connect riverside forests.

The team also showed the fragmentation of elephants' habitats forced them to forage further afield, leading to conflict with humans.

In China, Professor Bruford's techniques showed the giant panda population was larger than earlier estimates.

The two Borneo species action plans for orang-utans and elephants are helping Malaysia to meet its obligations under the Convention on Biological Diversity.

Rope bridges installed above river tributaries allow orang-utans to roam further afield. And the Danau Girang Field

Centre, set up to help manage the lower Kinabatangan Wildlife Sanctuary, is training Malaysian and international scientists in conservation techniques.

Cardiff's work on giant panda dispersal has influenced the Chinese strategy of guiding individual pandas to join the dwindling population in Xiaoxiangling.

A clinical basis for identifying child abuse

Ten years ago there were no evidence-based standards or clinical guidelines to inform clinical assessments of suspected child abuse or neglect. When cases went to court, clinicians were accused of misrepresenting the evidence and being instrumental in the wrongful prosecution of mothers for causing the deaths of their babies. Media and legal criticism led to a lack of confidence among clinicians working in child protection.



Researchers in the School of Medicine have developed the world's first research programme to provide the scientific basis for more reliable clinical assessments of child abuse and neglect. The team has completed 21 systematic reviews critically appraising the world literature relating to the recognition and investigation of child abuse, and published 28 peer reviewed papers.

Some of the most significant findings related to bruising and fractures. For example:

- it is not possible to age bruises in children accurately with the naked eye
- it is possible to age fractures within broad time frames
- rib fractures, fractures to the shaft of the humerus in infants and femoral fractures in non-mobile babies have a high probability of being caused by abuse.

This research programme was the first to provide the scientific basis for more reliable clinical assessments of child abuse and neglect. The research directly informed five national clinical

guidelines, the National Child Protection training programme and the first NICE (National Institute for Health and Care Excellence) guidance on child maltreatment.

ASSIST: A stop smoking schools trial



Smoking is the largest single cause of preventable illness in the UK. Over the last decade the number of adult smokers has fallen, although the number of teenage smokers has risen.

Evidence to show the success of anti-smoking programmes in UK schools was lacking until Professor Laurence Moore (formerly School of Social Sciences and DECIPHer) and Professor Rona Campbell (University of Bristol) developed the ASSIST programme, funded by the Medical Research Council.

The trial recruited peer-nominated students aged 12-13 as 'peer supporters'. They were taught how to intervene with their Year 8

peers in everyday situations to discourage smoking. Fifty-nine schools in South Wales and Bristol were randomly allocated either to continue with their normal smoking education programme, or to do so with additional peer supporter training. The trial demonstrated the peer supporters programme reduced the prevalence of smoking by 10%.

A new not-for-profit company, DECIPHER IMPACT was then set up in March 2010. The company gives materials, support and ongoing quality assurance to Primary Health Care Trusts in England and Public Health Wales.

Since 2010, more than 60,000 Year 8 students have taken part in ASSIST. Research suggests around 1,650 young people will not take up smoking as a result. If implemented UK-wide, it is estimated ASSIST would prevent 20,000 young people taking up smoking each year.

Treating locally advanced prostate cancer



Locally advanced prostate cancer affects 20,000 men per year in the US, and 4,000 men per year in the UK.

Previous studies in patients compared radiotherapy alone, and hormone therapy plus radiotherapy. Although these trials established a role for hormone therapy, they failed to establish the precise contribution of radiotherapy, and the result was uncertainty about the role of radiotherapy in such patients.

An international randomised clinical trial led by Cardiff University researchers sought to end the confusion by identifying whether combining hormone therapy plus radiotherapy improves the outcome for sufferers. The trial showed that combining radiotherapy and hormone therapy halves the risks of dying of prostate cancer.

The research highlighted the importance of radiation in the treatment of high-risk prostate cancer patients and clearly demonstrates its benefits. It showed that the standard treatment for these patients should now be hormone therapy plus radiation.

It is now a standard of care, enshrined in European and North American guidelines, that all such patients fit enough to receive it, should now be offered combined modality radiotherapy plus hormone therapy.

Seeing the science in space

Scientists working on the Hershel Space Observatory launched a public engagement programme to bring stories of science to school children, teachers, and international and UK media.



The campaign illuminated the University's scientific involvement in the Hershel Space Observatory, a €1bn astronomical satellite launched in 2009 and operated until 2013.

Herschel observed the Universe with three scientific instruments, one of which, the Spectral and Photometric Imaging Receiver (SPIRE), was

built by an international team led by the Cardiff Astronomy Instrumentation Group, School of Physics and Astronomy.

The public relations campaign run by the School, promoted inspirational scientists and provided up-to-date media materials, a schools programme and an outreach website to ignite media and public interest in the UK SPIRE team and the

Herschel Space Observatory.

SPIRE is a large multinational project (involving 18 institutes in eight countries, including six in the UK), with a total budget of around €90m. The project started in 1998 following approval by the European Space Agency. The Cardiff Astronomy Instrumentation Group came to lead the project to construct and operate

SPIRE, which was delivered to the Herschel Space Observatory for installation in 2007.

The programme took space science into schoolrooms across the UK, and provided exciting media insights into science and technology. In 2014, the SPIRE team was awarded the Royal Astronomical Society Group Achievement Award.

Using maths to save lives



Researchers sought to build and develop new mathematical models to unravel the complex reasons behind delays on hospital wards, cut waiting times and ultimately save lives.

The team from the School of Mathematics, led by Professors Jeff Griffiths and Paul Harper, engineered lifesaving improvements to healthcare systems. The team created and applied new mathematical models to health systems in England and Wales, enhancing a wide range of services through the study of patient queues and flows.

A simulation model was built at the University Hospital of Wales to study patient flows through the accident and emergency unit. In South London, the team's work helped markedly reduce the mortality of stroke patients. The research also drove net efficiency gains and better use of resources at two hospitals in South Wales.

The research helped save lives and cut costs. The models helped inform capacity planning,

shorten waiting times and improve efficiency at a new major trauma centre and the hyper-acute stroke unit at St George's Hospital in South London.

Modelling at the hyper-acute unit helped reduce the mortality of stroke patients by 60%. The new unit and stroke care service were rated as the best in the country by the National Sentinel Audit 2010 organised by the Royal College of Physicians.

Net efficiency gains of £1.6m per year were delivered in the emergency department at University Hospital of Wales in Cardiff. Patient care and hospital resources have also been significantly improved at Rookwood Hospital – a major neurological rehabilitation centre in South Wales.

Reforming school food



A study conducted by academics in the Cardiff School of Planning and Geography, sought to examine what was wrong with ways of providing school food in the UK.

Professor Kevin Morgan and Dr Roberta Sonnino proposed a more sustainable system, by drawing on experience in Europe and North America.

The study showed how the school food chain could be reformed by creating a better procurement system that linked local food production to local consumption.

The research has led to the transformation of school

meals in more than 4,300 schools. It has also inspired the reform of public policy at national and local levels across the UK. The research won the Economic and Social Research Council's (ESRC) Celebrating Impact Prize in public policy and has become a reference point for reformers all over the world.

It helped inform England's Food for Life Partnership, which transformed meals in thousands of schools. Food for Life is a five year programme established by the Soil Association in 2007. Funded through a £16.9m grant from the Big Lottery and involving four charities, Food for Life is the most transformative school food programme in Europe. It is being implemented in over 4,300 English schools, reaching over 500,000 children. In Wales, the research prompted the Welsh Government's reform of school food policy, Appetite for Life.

The UN World Food Programme has drawn extensively on the research to inform its own creative procurement programme, Purchase for Progress.



After the crash: influencing economic policy

Following the global economic crisis of 2007, there has been a focus on macroeconomic policies in the UK and wider European Community.

Researchers from the Julian Hodge Institute of Applied Macroeconomics at Cardiff Business School developed models that showed how a series of measures, for example, clear monetary rules which target inflation, could benefit the UK economy.

The team's models emphasise the need for clear fiscal planning, with limits on money supply growth to curb inflation. The team also identified key reforms in tax policy which, together, could lead to substantial benefits to the UK economy.

Professor Patrick Minford proposed the abolition of the top rate of income tax, the revenue loss from which he

demonstrated would be offset by broadening the base of taxation and by its positive effects on labour supply, innovation and productivity growth.

In 2012, Professor Minford was introduced by the Chair of the House of Commons Foreign Affairs Committee as "one of the most prominent economists advocating British withdrawal from the EU". Professor Minford went on to make direct reference to research findings highlighting the "considerable cost [of] being inside the European Union" as a result of its "protectionist" nature and specifically to the "3% of GDP" that would be gained by "moving to free trade".

The research has been used directly and indirectly, via MPs and intermediaries, to inform policy debates around such major issues as Britain's membership of the EU, as well as contributing to the wider public debate.

Precision performance

Performances of music from the 'long 18th Century' have lacked historical accuracy. Professor Robin Stowell from Cardiff University School of Music has sought to promote evidence-based 'period' techniques to enhance the understanding of musicians and audiences worldwide.

Professor Stowell was concerned that performances of music from that era lacked historical accuracy (e.g. fingering techniques, bowing styles, the application of vibrato and other expressive elements).

Through publications, talks, lectures and collaborations with conductors and performers, he has fired imaginations and illuminated practice. His work has influenced performers and conductors to revise their performance approaches and draw on the 'period' string techniques and style that he has promoted.

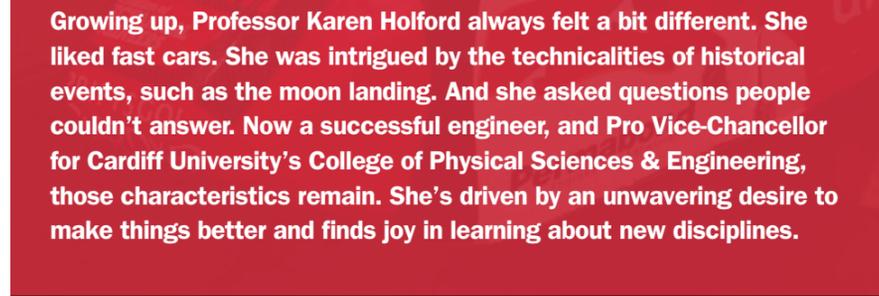
Professor Stowell's research advice has influenced a significant body of recorded orchestral work worldwide. His work has influenced the playing styles in commercial recording collaborations with Moldovan violinist Patricia Kopatchinskaja and American Jacqueline Ross.



What made me curious?

Sian Williams spoke to Professor Karen Holford about what sparked her curiosity and passion for engineering.

Growing up, Professor Karen Holford always felt a bit different. She liked fast cars. She was intrigued by the technicalities of historical events, such as the moon landing. And she asked questions people couldn't answer. Now a successful engineer, and Pro Vice-Chancellor for Cardiff University's College of Physical Sciences & Engineering, those characteristics remain. She's driven by an unwavering desire to make things better and finds joy in learning about new disciplines.



When I asked Karen to try to pinpoint what it was that first ignited her curiosity for science she took me back to when she was just seven. Sitting glued to the television as man first landed on the moon, Karen remembers thinking beyond the shiny instruments and futuristic images to question how exactly the astronauts got there. She also recalls a conversation that same year with her father about Concorde.

'I remember Dad calling me outside because Concorde was going to fly over. He explained that we might not see it but we would hear the sonic boom. That sounded so exciting to me but when I asked him what a sonic boom was he told me to look it up in the encyclopaedia. I was often asking questions that people couldn't answer.'

Unusually for girls of her age in the 1970s, Karen was a big fan of Formula 1. When she was 12 her

father and mother took her and her sisters to the British Grand Prix at Brands Hatch.

'I was a big James Hunt fan and was lucky enough to meet him in the pits and sit in his car. But rather than focusing on the glamour of meeting one of my heroes, I was also busy thinking about what it would be like to be an engineer and work on these fascinating projects.'

Karen's sense of curiosity and enthusiasm for science and engineering was not something shared by her classmates at school.

'At primary school I was very much seen as an oddity. At the time it was always boys that were seen as being good at maths and science. I can remember choosing to write a short story about Grand Prix cars and the headmaster commenting on what an odd choice of subject that was for a girl of my age.'

This sense of somehow being different stayed with Karen right through to secondary school when she recalls the careers advisor not knowing how to deal with a young girl wanting to study engineering and being actively discouraged from pursuing it as a career path.

So what kept her going? Well it's clear her father played a key role in her career development.

'My Dad had a garage so I was very practical and used to help him out regularly. He'd also worked in the design office at Gloster Aircraft Company so that sparked my interest in cars and aeroplanes. I very much admired my Dad, so his influence combined with my natural scientific interest and enduring curiosity kept me going.'

Surprisingly it was actually Karen's art teacher who helped her get to university and pursue her dream.

'None of my family had been to university before and nobody knew much about it. My art teacher told me I could get a graduate apprenticeship where they'd pay for me to go to university and work at the same time. She helped me apply for one and I got a place with Rolls-Royce, so that was where my career really started and they sponsored me to go to Cardiff University.'

The apprenticeship was a smart move by Karen and a move reminiscent of one of her great heroes, Baroness Platt of Writtle, who studied engineering at Cambridge in the 1940s but – as a woman – was not granted a full degree. She went on to have a distinguished career in engineering and politics. In the 1980s, Baroness Writtle spearheaded the Women in Science and Engineering campaign, a subject that's still very close to Karen's heart.

'While it's not so unusual now to see women in engineering, the stereotype still exists. Children's cartoons and television storylines portray engineers as nerds or introverts, who have no social skills and do boring, dirty jobs. People don't realise the rich wealth of talent that's needed in engineering and the huge range of opportunities that are there for you.'

So what needs to be done at an early age to break these stereotypes and encourage more people into engineering? Well, for Karen it's more than just a gender issue.

'The UK needs more scientists and engineers, whether they be women or men. And the public needs to be shown the impact engineering has on life. Society relies on technology more and more, and engineers enable us to have mobile phones, faster aeroplanes, solar power, wireless communication, food and water security. We need to be going into schools and explaining this: not just once, but every year. We also need to help parents understand that the career is a good one and more than that an exciting one that, enables you to travel the world and to work on some really, really brilliant projects. One example that's stayed with me is when I was at Rolls-Royce during the Falklands

War and I worked on stripping and rebuilding the Pegasus Engine, which powered the Harrier Jump Jet. Given the obvious time pressures we had to turn them over quickly and while I don't condone war, it was a really exciting time of my life in terms of engineering.'

Karen now spends her time managing her role as Pro Vice-Chancellor for the College of Physical Sciences and Engineering with her research into acoustic emission. Two distinct factors still drive her – that perpetual curiosity with her since childhood, and a strong desire to make things better, for individuals and society.

Her research into acoustic emission has seen the development of a technology that uses passive high frequency sensors, placed externally on the surface of structures such as bridges, to detect energy released from growing defects. This means that bridges that previously had to be manually inspected, resulting in safety problems and traffic disruption, can now be accurately monitored without the need for costly shutdowns.

She's now applying the same techniques to detect faults in aircraft structures, research that has the potential to revolutionise aircraft design and result in lighter aircraft.

As our discussion comes to a close Karen contemplates where she sees the future lying for her and for engineering.

'I've actually never been the sort of person that plans their future, I just seize opportunities. I'm very happy in my job at the moment, I'm only two years in so there's still so much more I want to achieve. As for the future of engineering there are so many discoveries yet to be made. I think we need to focus on solving the grand challenges of society, for instance energy. Few people realise the urgency of carbon release from fossil fuels. As an island, we've got so much potential for energy in our wind, waves and tides. If we can harness the power of today's computers along the way, then we can solve the big engineering problems of tomorrow.'

Sustainable Places Institute

The irreversible consequences of a changing climate and resource depletion are being felt across the world, in different ways in different places. In an effort to develop responses and solutions to these challenges of our time, Cardiff University founded the Sustainable Places Research Institute.

Launched in 2010, the £3.5m Sustainable Places Research Institute is a multidisciplinary Research Institute operating across all three colleges of Cardiff University. Its mission is to 'provide a new basis for sustainability science and, by pushing the disciplinary and methodological boundaries of traditional sustainability research, devise solutions

to the challenges presented by global environmental change'.

A team of ten Professors, including Institute Director, Professor Terry Marsden, have been brought together to act as Principal Investigators on a series of research programmes working with six Research Fellows and three Research Associates.

The Institute is now entering a second phase of development, which will consolidate and strengthen the interdisciplinary nature of its research programmes.

Links have been built both in the UK and further afield, and research is progressing in a range of locations around the world including: Canada, China, Brazil, Borneo, Finland and Germany.

Key developments at the Institute include:

- Theoretical and conceptual research linking different disciplines, including work on the emerging bio economy and place-based social and ecological systems
- Integrated methodologies for assessing impacts of policy, market and civic actions; and the development of more integrated and multidimensional approaches for assessing sustainable pathways of development
- Development of a series of longitudinal place-based laboratories, such as Cardiff city region, in which to conduct multilayered applications of sustainability research
- International and local collaborations and partnerships with academic institutions, including Bath, Bristol and



Professor Terry Marsden: "Our mission is to provide a new basis for sustainability science, to push the boundaries of traditional sustainability research and find solutions to these challenges of diminishing resources and a changing climate."

Exeter Universities and place-based organisations such as the Brecon Beacons National Park authority, and the Canal and River Trust

- The extension grant to take forward the Economic and Social Research Council (ESRC) funded Centre for Business Relationships, Accountability, Sustainability and Society (BRASS) agenda in the areas of: mobilities, food security, sustainable communities and ecosystem services.



Timeline Highlights:



Cardiff is selected as one of six cities in the UK to share in £1m of funding to be invested in improving food culture and support it on the journey to become a Sustainable Food City.

December 2013



The Brecon Beacons National Park Authority signs an agreement with the University to develop applied research in Wales to find solutions to environmental and rural issues.

March 2014



Professor Nick Pidgeon from the School of Psychology and Principal Investigator for Sustainable Places, is awarded an MBE in the Queen's Birthday honours for his services to climate change awareness and energy security policy.

June 2014



January 2014

A team of researchers based across the Institute and the School of Planning and Geography develop a model which measures the "DNA" of a city. The sDNA tool uses spatial design analysis to better understand urban form by taking into account the underlying street network design.



April 2014

Book launch of Sustainable Food Systems: Building a New Paradigm. A new book edited by Professor Terry Marsden and Dr Adrian Morley, explored the linkages between social science research and the evolving food security problems facing the world.



October 2014

Carl Sargeant, the Minister for Natural Resources in Wales announces that Professor Terry Marsden, Director of Cardiff University's Sustainable Places Research Institute, will chair the independent panel which will carry out the review of the governance arrangements for Wales' designated landscapes.



To find out more about the impact of our research go to

www.cardiff.ac.uk/research



KEEP IN TOUCH



@cardiffuni



facebook.com/cardiffuni



youtube.com/cardiffuni

To request a copy of Challenge Cardiff in large print format contact Laura Hodges on 029 2087 0298, email HodgesL1@cardiff.ac.uk

Comments and suggestions regarding Challenge Cardiff are welcome and should be sent to challengecardiff@cardiff.ac.uk

Cardiff University is a registered charity, no. 1136855

www.cardiff.ac.uk

Printed on 100% recycled paper, in line with the University's commitment to sustainability. www.cardiff.ac.uk/sustainability