

RESEARCH IMPACT

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RESEARCH FOR DISCOVERY AND IMPACT

At Newcastle University, we recognise the importance of research that is challenged and has demonstrable social, cultural and economic benefit. Increasingly, these impacts from research have been recognised by the UK government, those who fund research, and the public. As a result, there is now a clear expectation that universities will serve global society.

Businesses also recognise the value of research in universities, and we have many partnerships with commercial firms, both to help them to undertake R&D, and to ensure that the discoveries and innovations from our research are used to good effect in new products and services. These collaborations will be key if the UK is to reach its ambitious target of growing R&D spend from 1.7% to 2.4% of GDP over the next 10 years.

We are committed to our role as a world-class, research-intensive University. Our aim is to nurture excellent research and innovation that expands fundamental knowledge, addresses societal and global needs, supports sustainable economic growth and promotes health and wellbeing. We are also committed to training people who can contribute to the R&D demands of the UK economy.

In this edition of *Research Impact*, you can learn how our research is helping to address major global health issues such as diabetes and liver disease, how we're using virtual reality to help children with autism to overcome their fears, supporting people with dementia

by using technology to help them communicate with family members, and developing a new generation of prosthetics that behave more like a natural limb.

You can also find out how our experts are engineering solutions for more sustainable buildings and providing vital evidence that is influencing the way that governments and agencies around the world are protecting their cultural heritage, preparing for evermore extreme weather events and dealing with the problem of plastics pollution in our deepest oceans.

These are just a few of the research projects being undertaken by our brilliant staff and students.

Professor Chris Day
Vice-Chancellor and President

Read about our research impact and the latest news from Newcastle University at www.ncl.ac.uk/research



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We welcome enquiries about our research, opportunities for collaboration, and access to our commercial services, intellectual property and consultancy. Please contact our Business Development and Enterprise team at business.directorate@ncl.ac.uk



ENGINEERING FUTURE BIONICS

Our engineers are using computer vision to develop a new generation of prosthetic hands that enable wearers to reach for objects automatically.

There are over three million people living with upper-limb loss worldwide. Current prosthetic hands are controlled via myoelectric signals – that is electrical activity of the muscles recorded from the skin surface of the stump. Controlling them takes practice, concentration and, crucially, time.

Led by Dr Kianoush Nazarpour, Reader in Biomedical Engineering, Newcastle University's biomedical engineers are leading the way in the area of high-impact upper-limb prosthetics research, improving the design and effectiveness of existing bionic hands.

An example of the team's work is the globally unique 'hand that sees'. They have developed a bionic hand fitted with a camera that instantaneously takes a picture of the object in front of it, assesses its shape and size and triggers a series of movements in the hand. Using neural networks – the basis for Artificial Intelligence – the computer was shown numerous images of objects and taught to recognise

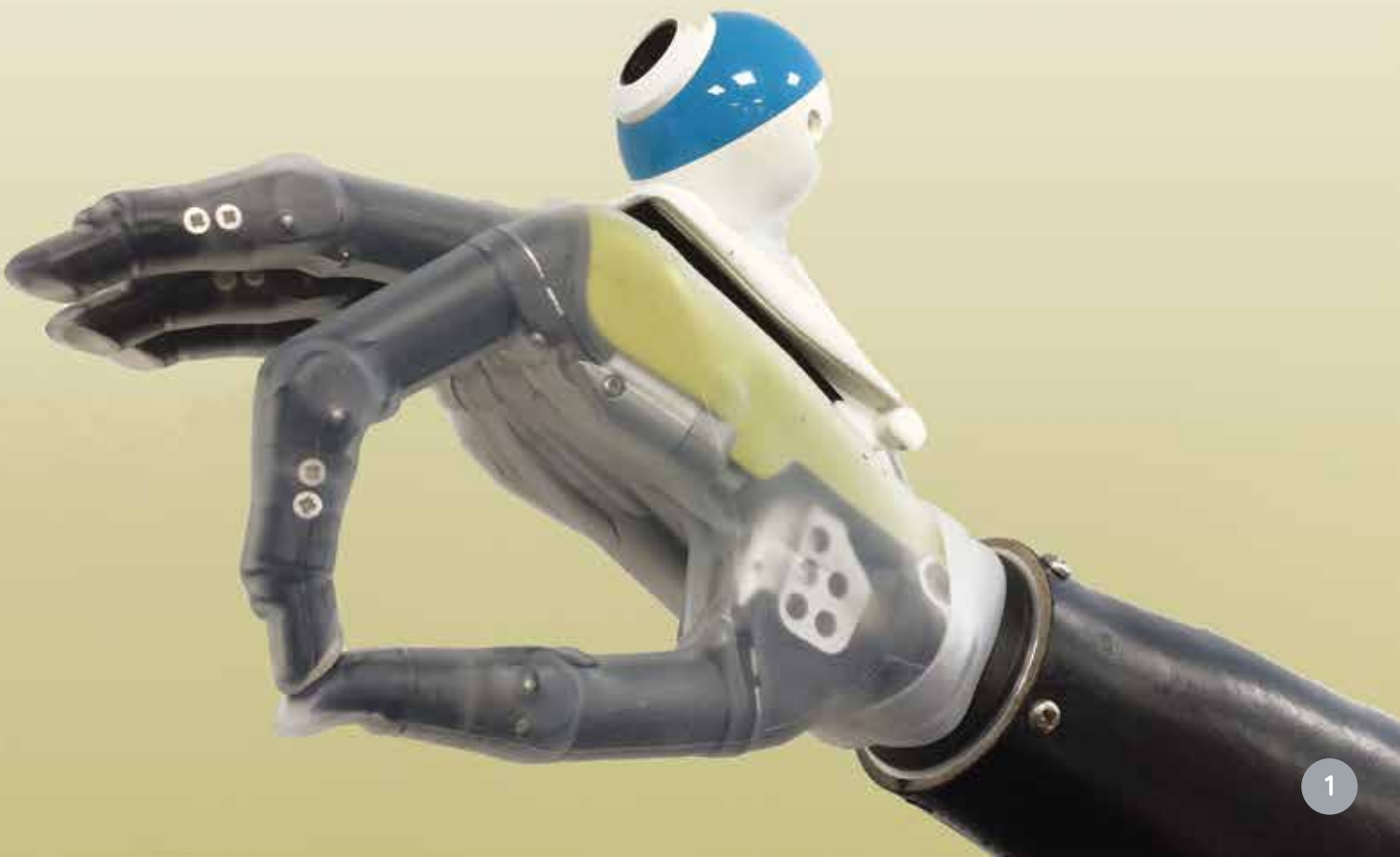
the 'grip' needed for different objects. The project won a Netexplo UNESCO Award in February 2018 and the IET William James Award.

The team's work, funded by a Healthcare Technology Challenge Award (2018–2023) from the Engineering and Physical Sciences Research Council (EPSRC), aims to develop novel algorithms and electronic technologies to utilise the flexibility of the brain in learning new skills.

A number of amputees have already trialled these innovations at Newcastle University. The team are working with experts at Newcastle upon Tyne Hospitals NHS Foundation Trust to test the 'hand that sees' and other methods with NHS patients.



<http://go.ncl.ac.uk/handthatsees>





'Substantial weight loss results in reduced fat inside the liver and pancreas, allowing these organs to return to functioning normally. What we're seeing from our trials is that losing weight isn't just linked to better management of Type 2 diabetes: significant weight loss could actually result in lasting remission.'

Professor Roy Taylor

Director of the Newcastle Magnetic Resonance Centre
at Newcastle University

REVERSING TYPE 2 DIABETES

Our findings on reversing Type 2 diabetes could benefit millions of people across the globe.

The World Health Organization estimates that, in just over a decade, diabetes will be the seventh leading cause of death worldwide. As well as causing serious long-term health problems, including impaired vision, blindness and amputation of the lower limbs and feet, diabetes is a major cause of kidney failure, heart attack and stroke.

Type 2 diabetes has long been regarded as a chronic disease and one with a complex, obscure cause. However, research by Newcastle University's Professor Roy Taylor using innovative magnetic resonance methods has confirmed his Twin Cycle Hypothesis – that Type 2 diabetes is simply caused by excess fat within the liver and pancreas. In the liver, this fat causes a poor response to insulin and it produces too much glucose. In the pancreas, the fat inhibits insulin secretion. By clearly defining the cause of the disease, treatment can be planned to reverse the processes.

The research has established that people can reverse their Type 2 diabetes to the point where they no longer require medication. Importantly, the recent findings show that diabetes stays away providing that the excess weight is not allowed to reaccumulate.

Now, a trial is aiming to find an effective and accessible way to put Type 2 diabetes into remission for the long term. Results from the first year of the trial, published in late 2017, have identified that people in the first six years of Type 2 diabetes who follow a low-calorie programme with support from their GP can reverse their diabetes for at least a year.

The trial, DiRECT (Diabetes Remission Clinical Trial), found that almost nine out of 10 people taking part who lost 15kg or more put their Type 2 diabetes into remission. The study also found that almost half of those were still off all their Type 2 diabetes medication with normal blood glucose levels after one year.



<http://go.ncl.ac.uk/type2diabetes>



BUILDING A SMART FUTURE

Our experts are devising ‘smart’ bricks to improve sustainability in our homes and businesses.

An international project coordinated by Newcastle University will transform the places where we live and work. The €3.2 million Living Architecture project is developing ‘smart’ bricks which can recycle waste water and generate electricity.

The bricks extract resources from sunlight, waste water and air, and fit them together to create ‘bioreactor walls’. These walls can then be incorporated in housing, public buildings and office spaces. The project will transform spaces within buildings into biological computers that will create useful products from waste.

‘We are tackling the global challenge of sustainability by designing programmable ecosystems for buildings,’ explains Professor Rachel Armstrong, Professor of Experimental Architecture in the School of Architecture, Planning and Landscape and coordinator for the project. ‘This project brings together living architecture, computing and engineering. Our ‘living’ architecture contains tiny ecosystems of hard-working organisms that are performing particular useful tasks.’

By the end of the project, in April 2019, the bricks will contain microbial fuel cells, photobioreactors and synthetic consortia that are integrated into a programmable system of nutrient exchange. Robotically activated, each chamber contains a variety of micro-organisms specifically chosen to clean water, reclaim phosphate, generate electricity and create new detergents. The living cells that will make up the wall will be able to sense their surroundings and respond to them through a series of digitally coordinated mechanisms.

The project is being coordinated by Newcastle University and includes experts from the University of the West of England (UWE Bristol), the University of Trento, the Spanish National Research Council, LIQUIFER Systems Group and EXPLORA BIOTECH. The project has received funding from the European Union’s Horizon 2020 research and innovation programme.



<http://go.ncl.ac.uk/smartbricks>





ASSESSING LIVER DISEASE

Our researchers are leading an international research project to tackle fatty liver disease and save lives.

Non-alcoholic fatty liver disease (NAFLD) is estimated to affect up to one in three people. Tackling NAFLD is now a major public health challenge in many parts of the world as the condition is linked to a number of serious conditions including liver cancer, heart attack and stroke.

NAFLD is caused by a build-up of fat in the liver cells, which leads to inflammation, scarring of the liver and cirrhosis. This scarring can prevent the liver working properly, which is important for detoxifying harmful substances in the body, making vital nutrients and cleaning the blood. At present, many patients with NAFLD are not diagnosed until late in the disease process.

Newcastle University is coordinating a €34 million research project to look at new ways to diagnose those living with NAFLD. Liver Investigation: Testing Marker Utility in Steatohepatitis (LITMUS), brings together 47 leading international research partners, including international universities and global pharmaceutical companies to develop, validate and qualify improved biomarkers for testing NAFLD.

‘The availability of better diagnostic tests will help us to target care at an early stage of disease to the people who are going to be most severely affected,’ says Professor Quentin Anstee, Professor of Experimental Hepatology and Project Coordinator for LITMUS.

‘It will help us develop more effective medical treatments for NAFLD and to run the clinical trials that the regulatory agencies need so that they can licence these medicines to be prescribed by doctors.’

Newcastle University’s Vice-Chancellor and President, Professor Chris Day, who is an internationally leading liver specialist, has been part of the research team. He said: ‘The project gives us real hope of making significant advances in the diagnosis and treatment of this increasingly common and often devastating disease.’



<http://go.ncl.ac.uk/liverdisease>

BRACING FOR CLIMATE CHANGE

Our researchers are using climate change models to identify future changes in flooding, droughts and heatwaves affecting European cities.

A landmark study has shown that, from 2050–2100, the incidence of extreme weather will exceed previous predictions.

Using projections from all available climate models, the team published three possible futures: low, medium and high impact scenarios. In each scenario, the study of 571 cities predicted a worsening of heatwaves, increasing drought conditions and an increase in river flooding.

‘Our analysis provides, for the first time, comparable information for different impacts and cities that can be used to prioritise national and European research investment on impacts of climate change,’ says Dr Selma Guerreiro, Researcher in Hydrology and Climate Change and lead author of the study. ‘However, they should be complemented by site-specific assessments for detailed design and planning on how cities adapt to climate change.’

The study identified a likely increase in heatwaves across Europe, with predictions that Stockholm and Rome could see the greatest increase in actual numbers of heatwave days. Elsewhere, Prague and Vienna could see the greatest increase in maximum temperatures during future heatwaves, with increases of as much as 8°C to 14°C in some central European cities.

Changes in droughts and floods vary between the three scenarios. In the low impact scenario (the ‘optimistic scenario’), drought conditions intensify in southern European cities whereas river flooding worsens in cities in the North West, including Paris. While for the high impact scenario, almost every European city could see worse droughts and floods.

Lisbon and Madrid are among the capital cities most likely to face increases in the frequency and magnitude



of droughts, while Athens, Nicosia, Valletta and Sofia are among the top cities for predicted increases in both drought and heatwaves.

Of the European capitals, Dublin, Helsinki, Riga, Vilnius and Zagreb are likely to experience the most extreme rise in flooding. For the high impact scenario, several European cities could see more than 80% increases on peak river flows, including Santiago de Compostela, Braga and Derry/Londonderry.

‘We are already seeing at first hand the implications of extreme weather events in cities in Europe and around the world,’ says Professor Richard Dawson, Director of the Centre for Earth Systems Engineering and co-author and lead investigator of the study. ‘This research highlights the urgent need to design and adapt our cities to cope with these future conditions.’

‘Our analysis shows that most cities have considerable changes in more than one hazard which highlights the substantial challenge cities face in managing climate risks.’

Dr Selma Guerreiro



<http://go.ncl.ac.uk/extremeweather>



SAFEGUARDING THE PAST

Our experts are protecting cultural property around the world and preserving unique archives.

Newcastle University's Professor Peter Stone OBE is leading efforts to protect cultural property and heritage in zones of armed conflict around the world. Professor Stone has been a tireless campaigner for protecting monuments, archaeological sites, important artefacts and works of art from destruction and looting, culminating in his appointment as UNESCO Chair in Cultural Property Protection and Peace in 2016.

'Cultural properties are more than simply bricks,' explains Professor Stone. 'Conflicts in Afghanistan, Iraq, Libya, Mali and Syria have seen the looting of museums and unnecessary damage to significant archaeological sites and places of heritage. Such destruction has a significant impact on the wellbeing of local communities and frequently leads to the escalation of conflicts.'

Professor Stone's article, 'The 4 Tier Approach to CPP (cultural property protection)', has provided a model for

non-governmental organisations, international military and policymakers. 'While individual officers usually understand and fully accept the importance of cultural heritage, its protection during conflict has not, until recently, been high on their agenda,' he says.

In September 2017, after 15 years of campaigning by Professor Stone and others, the UK government ratified the 1954 Hague Convention for the Protection of Cultural Property in the Event of Armed Conflict, its Protocols and the Cultural Property (Armed Conflicts) Act 2017.

Since being appointed UNESCO Chair in Cultural Property Protection and Peace, Professor Stone has continued his work on a global scale. He is also collaborating with UNESCO World Heritage Sites to investigate how sites can be used as tools for peace, in addition to working with governments across the globe, including in Peru and Australia.



'As events in Europe, the Middle East and across the world change, the archive continually takes on new and unexpected significance.'

Dr Mark Jackson

Globally significant archives

Newcastle University is home to a unique archive of letters, diaries and photographs by explorer and archaeologist Gertrude Bell. Bell was an extraordinary British woman who travelled the world as an archaeologist, mountaineer and explorer before World War I. She subsequently became a diplomat and had a unique role in the British administration of Iraq during the creation of the state in the early 1920s.

The archive was recently recognised by UNESCO as a collection of global significance. The memories preserved in the archive are of worldwide significance because of the places she visited.

Containing almost 10,000 items, the archive provides a record of the people and cultural contexts from multiple ethnic and religious groups living through the transition from

the Ottoman Empire of the late 19th century, to the period of the establishment of the modern Turkish, Syrian, Iraqi, and Jordanian states. Bell's personal perspective on the transitional period from the Ottoman Empire before World War I until 1926 provides a unique, irreplaceable insight into the formation of the Middle East and Bell's instrumental role in that process.

'The archive represents a priceless and unparalleled source of documentary heritage for a very important period of societal change at the end of the Ottoman Empire and the creation of the modern Middle East,' explains Dr Mark Jackson, Senior Lecturer in Archaeology and Manager of the Archive. 'It is an internationally important memory of the contribution of an extraordinary woman to the contemporary world.'

The archive is one of only a handful in the UK to be inscribed into the International Memory of the World Register, and is one of only two UK university-held collections to feature in the Register.



<http://go.ncl.ac.uk/past>



MAKING CONVERSATIONS COUNT

Our experts are using digital toolkits and apps to improve communication between people living with dementia and their loved ones.

It is estimated that some 50 million people around the world are living with dementia. Dementia is caused by a breakdown of the connections in the brain. Symptoms of dementia often include memory loss, difficulty in concentrating and problems communicating, which can impact upon the way in which people interact on both sides of a conversation. This can contribute to huge strains on patients, their families and care providers.

DemTalk is a web-based toolkit that brings together experts, family members and people living with dementia. Developed with support from Alzheimer's Society UK, DemTalk is helping to improve communication for people with dementia, with the team developing advice packages and technology such as websites and phone apps.

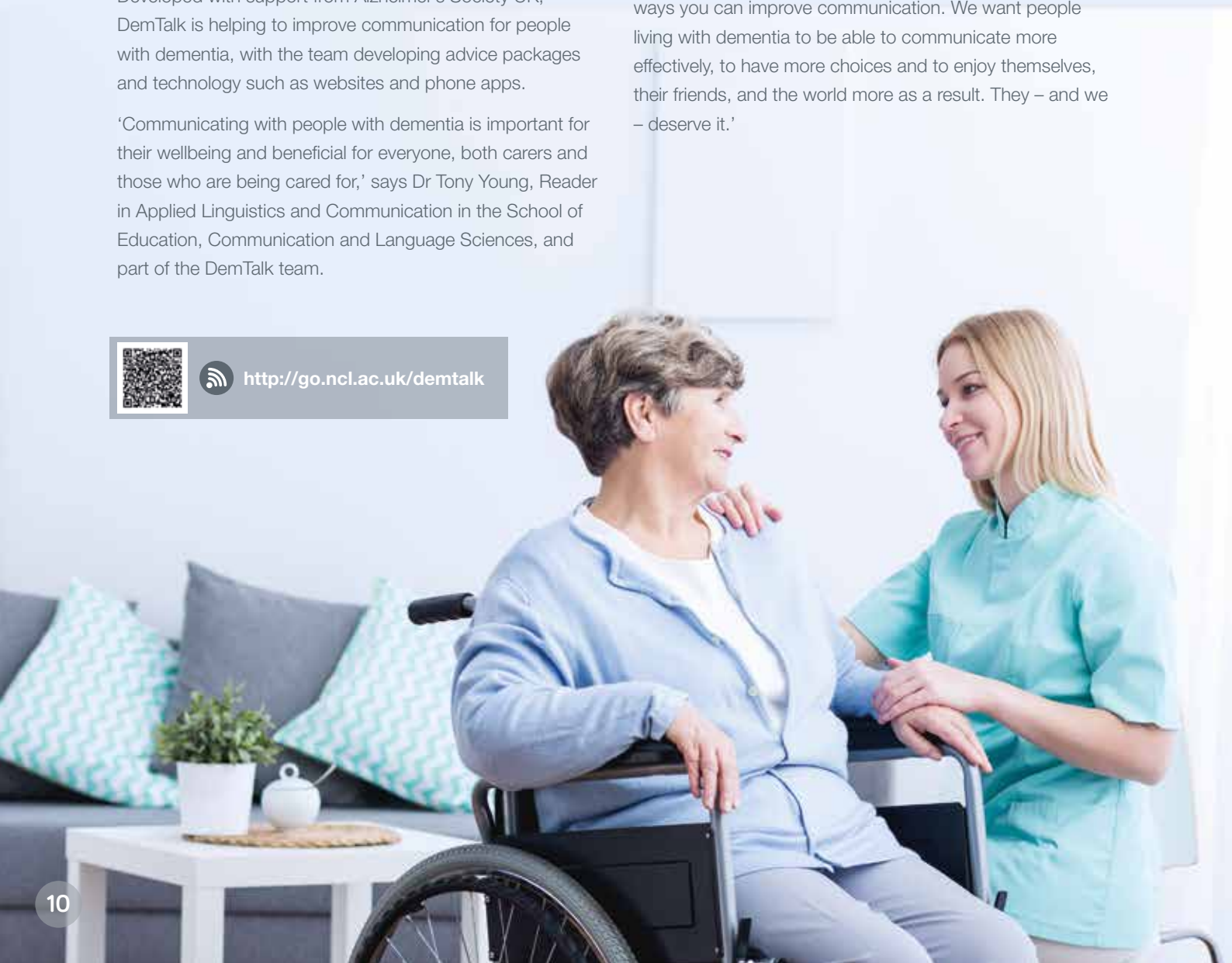
'Communicating with people with dementia is important for their wellbeing and beneficial for everyone, both carers and those who are being cared for,' says Dr Tony Young, Reader in Applied Linguistics and Communication in the School of Education, Communication and Language Sciences, and part of the DemTalk team.

Most recently, the team have developed a smartphone app for young people who have difficulty talking to older relatives or friends with dementia. The Ticket to Talk app was developed following a project where researchers worked with young people who had personal experiences of dementia. Most participants reported communication breakdown, frustration and lack of confidence in caring for their relatives but cited 'young person friendly' information being hard to come by.

'We put together the DemTalk toolkit to show the different ways you can improve communication. We want people living with dementia to be able to communicate more effectively, to have more choices and to enjoy themselves, their friends, and the world more as a result. They – and we – deserve it.'



<http://go.ncl.ac.uk/demtalk>





RESCUING OUR OCEANS

Our researchers are shaping global understanding on how plastics threaten our seas and ecosystems.

An estimated 300 million tonnes of plastic are littering our oceans, with recent findings revealing that plastics have now reached the deepest chasms of our oceans and are also being ingested by the animals that live there.

Using unique lander technology designed at Newcastle University by Dr Alan Jamieson, our researchers are discovering new species and shaping global understanding on how plastics and other pollution threaten our seas and ecosystems.

Most recently, the Newcastle team have tested samples of amphipods found in the ultra-deep trenches that span the entire Pacific Ocean – the Mariana, Japan, Izu-Bonin, Peru-Chile, New Hebrides and Kermadec trenches.

‘The results were both immediate and startling,’ says Dr Jamieson, Senior Lecturer in Marine Ecology. ‘This type of work requires a great deal of contamination control but there were instances where the fibres could actually be seen in the stomach contents of the creatures as they were being removed.’

Working with the BBC as part of *Blue Planet II* and with Sky for their Ocean Rescue campaign, the Newcastle team have helped raise awareness of plastic pollution and the impact it is having on our planet.

Some five trillion pieces of plastic currently float on the surface of our oceans, but it is where they end up that is more concerning, explains Dr Jamieson. ‘Litter discarded into the oceans will end up washed back ashore or sinking to the deep-sea,’ he says. ‘There are no other options.’

Once the material sinks to the underlying deep-sea habitats, opportunities for dispersal become more and more limited. ‘Deep-sea organisms are dependent on food raining down from the surface which in turn brings any adverse components, such as plastic and pollutants, with it,’ says Dr Jamieson. ‘The deep-sea is not only the ultimate sink for any material that descends from the surface, but it is inhabited by organisms well adapted to a low food environment and which will often eat just about anything. Isolating plastic fibres from inside animals from nearly 11 kilometres (7 miles) deep shows the extent of the problem.’

‘The number of areas we researched, and the thousands of kilometre distances involved, shows it is not just an isolated case – this is global. Understanding what this means for the wider ecosystem will be the next major challenge.’



<http://go.ncl.ac.uk/oceans>

IMMERSIVE THERAPY

Our specialists have developed virtual worlds to help children with autism overcome their fears and phobias.

Autism can affect a child's learning and development, often resulting in impaired social and communication skills and many children also have fears or phobias which can be very distressing but are often overlooked.

Our cutting-edge technology is helping children with autism overcome their fears and phobias. The Blue Room is a specially designed 360 degree seamless screened room with no point of external reference. It was developed by a Newcastle University team alongside innovative technology firm Third Eye Technologies and is being offered through Northumberland, Tyne and Wear NHS Foundation Trust.

Accompanied by a psychologist, the child enters The Blue Room and is surrounded with audiovisual images representing the real world. Within this virtual environment, the child can comfortably investigate and navigate through various scenarios using digital controls, but remain in full control of the situation.

'Currently the main treatment for fears and phobias is cognitive behavioural therapy,' says Dr Jeremy Parr, Clinical Senior Lecturer in the Institute of Neuroscience, who leads the team. 'But that often doesn't work for a child with autism as it relies on them being able to use their imagination.'

The flexibility of The Blue Room means that scenes can be gradually built up in complexity and noise level. This allows a graded exposure and an element of control that cannot be achieved in real life. Scenarios include boarding a bus, crossing a bridge and interacting with a shop assistant.

'Children with autism can find imagining a scene difficult, but by providing it physically in front of their eyes we can sit alongside them and help them learn how to manage their fears,' says Dr Parr.



<http://go.ncl.ac.uk/theblueroom>

RESEARCH-INFORMED TEACHING

Newcastle University has a long history of excellence in learning and teaching.

We are committed to providing students with an education for life, equipping them with the knowledge and skills that will last a lifetime, and that are relevant and useful to life and the world around them.

Students at Newcastle benefit from studying in a research-intensive environment. Working alongside academic leaders in their field, our students are able to evaluate and recognise how their own work responds to present and future challenges.

Our students benefit from high-quality teaching facilities. Recent significant investment in technology-enhanced learning and the provision of modern study spaces is ensuring that we provide our students with the best possible learning experience. The success of our approach is reflected in consistently high rates of student satisfaction in both the National Student Survey and the International Student Barometer.

The excellence of teaching at Newcastle University was recognised in 2017 with the award of Gold, the highest status in the TEF (Teaching Excellence Framework), a UK government assessment of the quality of teaching in universities. The TEF panel judged that Newcastle University delivers consistently outstanding teaching, learning and outcomes for its students, of the highest quality found in the UK.

Our students are highly employable too, with 82% in graduate-level jobs six months after graduation, and the University consistently ranks among the top 20 higher education institutions targeted by employers in 'The Graduate Market' report, produced by High Fliers Research.



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