

FEARLESS RESEARCH



Insect vision influences robotic detection
and monitoring systems

RESEARCH ON THE RISE



External research income jumped 50% from two years ago and 70% from four years ago



Flinders ranked seventh in the country for National Health and Medical Research Council grants won by a university in 2021



Ranked 266 in the world (THE World University Rankings 2022)



\$34 million federal Department of Health contract



Construction began on the \$255 million Health and Medical Research Building



Launched our new \$2.5 million photo emission electron microscope

A close-up, high-resolution photograph of a child's eye. The eye is a striking, light blue-green color with a dark pupil. The surrounding skin is fair and has a soft, natural texture. The lighting is warm and focused on the eye, creating a sense of depth and intimacy. The background is blurred, emphasizing the eye as the central subject.

Forget them not

New rays of hope for children with childhood
dementia and their families

By Melissa Keogh

Every three days an Australian child is born with dementia – a group of rare genetic disorders that leaves families with a devastating reality.

Their children never grow up.

One Flinders researcher has dedicated her career to a particular form of childhood dementia – Sanfilippo syndrome. While Sanfilippo is rare, childhood dementia affects one in 2,800 children in Australia, making it as common as cystic fibrosis.

Professor Kim Hemsley is the head of the Childhood Dementia Research Group within the Flinders Health and Medical Research Institute. She and her colleagues, with collaborators at the University of Adelaide, have made an important discovery that offers a new way to monitor the effectiveness of treatments.

Studying Sanfilippo syndrome in mice, they've discovered that progressive lesions in the retina – the innermost layer of tissue in the eye – mirror the level of degeneration occurring in the brain.

“The retina is part of the central nervous system, just like the brain and the spinal cord, and we now know that the changes in the retina occur at a similar rate and start at a similar time to those appearing in the brain,” Professor Hemsley says.

“You can look at the retina much more readily than you can the brain, and you can use optical coherence tomography (OCT) which is something an optometrist does during a standard eye exam.

“We can use that image to tell us whether changes are going on in cells in the retina.”

The research group is now taking retinal imaging even further, hoping it can be used to indicate the success of treatment therapies to slow degeneration and prolong life.

Researchers around the world are working to develop potential treatments for children living with Sanfilippo syndrome, with gene therapy approaches currently under trial in Adelaide and overseas.

“The retinal imaging could be used to monitor disease progression in a child, but if they are given a therapy, we might also be able to monitor its effectiveness,” Professor Hemsley says.

“I'm hoping that if the scientific community knows about this data, the use of OCT can be incorporated routinely in clinical trials to determine therapeutic efficacy.

“If we had newborn screening, you might also be able to routinely schedule a baby who is suspected to have Sanfilippo syndrome for regular OCTs to see if there's any change going on, in a very non-invasive way.”

Caused by mistakes in genes, a child can only develop Sanfilippo syndrome if they inherit mutations in one of four different genes from both parents.

Classical symptoms typically begin to show around the age of five and can present as difficulties or delayed development in talking, reading, writing, walking and playing. This is followed by a progressive intellectual and bodily decline until the child usually passes away by their late teens or early 20s.

“The parents largely have no idea the risk of Sanfilippo is even in their family,” Professor Hemsley says.

“This is one of the main drivers for having newborn screening for this and similar disorders, because parents at the moment don't realise that they have a child with Sanfilippo until symptoms develop and they are diagnosed.”



**Professor
Kim Hemsley**

“It's quite a unique field and I feel very lucky to be involved. That interaction is most definitely what keeps me here.”

Over the past 20 years the Childhood Dementia Research Group – which was established at the Adelaide Women's and Children's Hospital before moving to the South Australian Health and Medical Research Institute – has made several significant contributions to the disease.

These include working with a large team of medical researchers in Adelaide and overseas to develop treatments; some failed, but some have provided important and promising outcomes.

One approach appears to stabilise disease in patients treated before two-and-a-half years of age.

Professor Hemsley says while we are nearing a time when the first treatment will be approved for children with Sanfilippo, it won't mean her work is done.

“One treatment will not be enough as many children will be unable to access it because of medical reasons as well as geographic and financial ones,” she says.

“So, with our collaborators, we are continuing to devise and test potential therapies for Sanfilippo and other childhood dementias to ensure that one day all children born with the disorder can be offered safe and effective treatment.”

Finding a ray of hope for families is what compels Professor Hemsley to keep striving for answers.

Unlike many neuroscientists, her research sees her interact not only with clinicians but also the children and their families – often the strongest advocates for awareness.

“It's heartbreaking watching the children disappear before your eyes,” Professor Hemsley says.

“It's hard to imagine how families who have Sanfilippo deal with it day in and day out. They're absolute heroes.

“It's quite a unique field and I feel very lucky to be involved. That interaction is most definitely what keeps me here.”

A microscopic view of brain tissue, likely stained with hematoxylin and eosin (H&E), showing various cellular structures and fibers. The tissue is predominantly orange and yellow, with some purple-stained nuclei. A prominent white, branching structure is visible in the upper half. An orange rectangular box is overlaid on the right side of the image, containing white text.

CRACKING THE CODE

TO UNLOCK
BRAIN DISEASES

By David Sly

Associate Professor Cedric Bardy is bioengineering live brain tissue to uncover the mysteries of incurable brain disorders.

A Nobel prize-winning scientific breakthrough that reprograms human skin cells into stem cells unlocked an opportunity for neurobiologist Cedric Bardy to bioengineer live human brain tissue in a petri dish.

His team in the Bardy Lab, based at the SAHMRI building in Adelaide, grow and age live brain cells from patients with complex neurological disorders to unlock the mysteries of such medical riddles as childhood dementia, Parkinson's disease and brain cancer.

"The work we are doing has the capacity to fast-track solutions for people with brain disorders," says Associate Professor Bardy.

"It is really exciting to be able to design and test solutions to help people. The stakes are high. Patients diagnosed with neurological diseases are often facing their most vulnerable life moment, and they desperately need better treatment options."

After pioneering experimental models of human brain tissue from patients in petri dishes for six years at the prestigious Salk Institute in California, Associate Professor Bardy was recruited by Flinders University and SAHMRI in 2017 to bring his innovative line of research to Adelaide.

Progress within the Bardy Lab marks the culmination of a whirlwind five years for the French-born researcher, whose approach to examine brain cancer and neurological disorders with patient-derived tissue has enabled an exciting pre-clinical research pathway and the hope of new translational opportunities.

Along the way, one of Associate Professor Bardy's great breakthroughs was creating a new type of culture medium that allows human neurons to survive and thrive in a laboratory environment – an entirely different medium to that which sustains animal cells and non-neuronal cells.

"Working with human cells rather than animal cells is very different and required the design of a whole new complex experimental model". He admits that he got stuck several times wondering how to arrive at the right solution.

"One challenge was that human neurons in the lab needs a medium comprising specific concentrations of more than 70 compounds to mimic the human brain functions, so finding the right combination was a bit like trying to crack a code with a million possibilities."

Without the resources or time to test every possible combination, Associate Professor Bardy started with calculated guesses, based on his detailed observation of brain tissue.

"I didn't get it right the first time, but after some effort we soon had a working formula."

He had invented BrainPhys, a neuronal medium that is now widely used to culture and mature active human neurons in vitro.

Associate Professor Bardy says it has provided the necessary key to unlock new possibilities across many areas of brain disease research – with the Bardy Lab researchers now simultaneously studying a form of childhood dementia, Parkinson's disease and brain cancer.

"We can look at the intricate function of brain cells and how they communicate with each other within a neural circuit that resembles the human brain," he explains.

With the recent boost of \$1 million in funds from the Michael J Fox Foundation, Shake It Up Foundation and The Hospital Research Foundation, resources are in place for a rapid acceleration of testing drugs on the laboratory cells before enrolling clinical trials.

"In Parkinson's disease, we've noticed the energy levels in cells taken from patients drop much quicker than those from healthy subjects of the same age," says Associate Professor Bardy. "Therefore, we are trying to come up with new and creative ways to restore the energy in those cells."

He is also seeing great progress with cells taken from 10 children with a form of early-onset dementia.

"We reprogrammed the skin cells from these kids into brain cells, which we can study in the greatest molecular and physiological detail in the laboratory without the ethical limitations of clinical research.

"We can see specific differences from the neurons of the kids with dementia compared to healthy kids of the same age. Our research team is now gearing up for swiftly testing which drugs could reverse this condition, without putting the patients at risk during the trials.

"For the brain cancer study, we have worked closely with local neurosurgeons for the last few years and examined brain and tumour biopsies from patients with about 15 months to live. Careful analyses of this tissue led us to identify a repurposed drug that appears effective in killing the cancer cells."

Associate Professor Bardy and his colleagues are working hard now to move this discovery from the bench to the clinic. If the repurposed drug works as well in patients as it worked in the pre-clinical model, it will save countless lives around the world.

A significant aspect of the Bardy Lab's progress is through using robotics to test drugs on the tissue samples, to increase the yield and speed but also ensure reproducibility of the results.



Associate Professor Cedric Bardy

"We can see specific differences from the neurons of the kids with dementia compared to healthy kids of the same age. Our research team is now gearing up for swiftly testing which drugs could reverse this condition, without putting the patients at risk during the trials."

In the past five years, the team has also worked with local material scientists to develop a new petri dish substrate which improves on the adherence of human brain cells. It maintains complex electrical connections between neurons, allowing a patient's brain to be modelled more accurately and therefore determine the best treatment with more certainty.

For Associate Professor Bardy, Flinders' research ethos and progress being made in this highly specialised area of research vindicated his decision to move to Adelaide – a city he had never previously visited.

He says a critical step is still ahead – ensuring that this innovative science is translated from the lab to the world.

"I really feel that I am racing against time with this research. I know that the deterioration of a child with early-onset dementia is so severe and irreversible, which makes it imperative to find solutions that can change these children's lives as soon as possible.

"I am constantly encouraged and inspired by our community and humbled by the resilience of people and their family facing terminal brain disorders.

"Am I satisfied? Never. I'm impatient but persistent. I know it's a slow process but every step forward matters and I am delighted with the progress we are making. We will not give up and we will make a difference."

Intestinal FORTITUDE



Starting at the mouth and working down to the tail, Erin Symonds has spent her 24-year research career focused on the science of the gastrointestinal system.

By Sarah Keenihan

It's important and urgent work. Despite a national screening program for bowel cancer, 5,000 Australians die from the disease every year.

At the Flinders Centre for Innovation in Cancer (FCIC), Associate Professor Symonds is finding new ways to identify and track bowel cancers so they can be picked up earlier and treated more effectively.

"Initially, I started working on breath tests to assess digestion, and then moved on to probiotics and food poisoning, nutrition and obesity, and the small intestine" she says. "Now I'm focussed mainly on bowel cancer, also known as colorectal cancer, a disease of the large intestine."

Of the 5,000 or more Australians who lose their life to bowel cancer, most are aged over 50, but increasing proportions are in their 20s, 30s and 40s.

Through a program of collaborative and clinically linked research at Flinders, Associate Professor Symonds and her team are developing new methods for detecting and managing bowel cancer.

"The work we do at the FCIC aims to improve clinical care pathways for bowel cancer patients," she says. "This includes primary prevention for people we know are at elevated risk of bowel cancer, and working with bowel cancer survivors to track their treatment and monitor cancer recurrence more accurately."

People are considered at higher risk of bowel cancer if they have a close family member who has been diagnosed, or if screening tests identify growths in their intestine known as adenomas, or pre-cancerous polyps.

Associate Professor Symonds and her research team were awarded a Medical Research Future Fund grant to identify bowel cancer biomarkers, molecules which accurately indicate the presence and size of a cancer.

"Currently the common way to monitor bowel cancers is with scans, which only provide visual information and involve the patient being exposed to radiation," she says. "We'd like to offer a safer and cheaper test; a biomarker that can detect the cancer directly."

The candidate biomarkers are fragments of cancer DNA that are found in a patient's blood.

"We've published a number of papers on this now, and the blood biomarker approach looks very promising as a tool for bowel cancer surveillance during and after treatment," Associate Professor Symonds says.

She is working on identifying comparable biomarkers for cancers of the oesophagus and stomach as well, for which there is no current screening test available, and that are typically only identified at relatively late stages of disease.

In addition, Associate Professor Symonds and her colleagues are conducting research that aims to assist doctors in prioritising which patients require colonoscopy most urgently. A colonoscopy is an invasive procedure, requires 24 hours of patient preparation and puts a large burden on the public health system. Around one million colonoscopies are performed each year in Australia.

"When patients present to a GP with symptoms and are sent for a colonoscopy, about 85% of them are found to have nothing of significant concern," Associate Professor Symonds says. "It would be really useful to be able to screen out this low-risk group."



**Associate Professor
Erin Symonds**

Photo credit: Flinders Foundation

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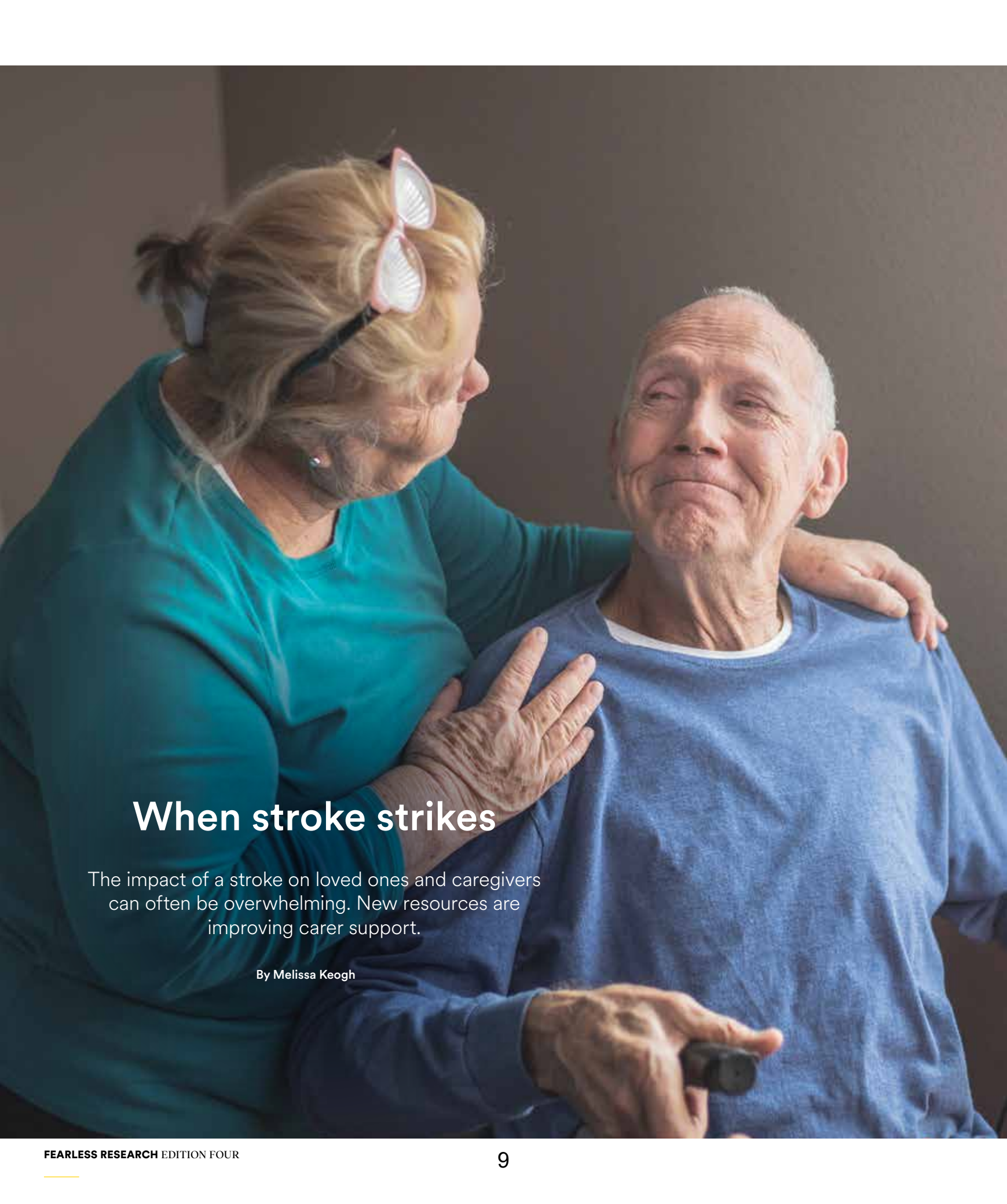
Funded by the National Health and Medical Research Council, this line of research focuses on identifying protein or DNA biomarkers of adenomas and bowel cancers in small stool samples. Associate Professor Symonds hopes that with further work, it could be used in a similar way to the current faecal screening test offered to Australians over the age of 50 by the Australian Government.

"The first stages of this work involve exploring which biomarkers hold the most promise, and then testing them using donated patient samples which we already have stored and ready to go," she says.

Much of Associate Professor Symonds' work is linked with a program called SCOOP (Southern Co-operative Program for the Prevention of Colorectal Cancer), which has been running in South Australia since 1999 to improve surveillance rates for people at increased risk of bowel cancer.

Her impetus is the knowledge that when bowel cancer is detected early, it's often treatable.

"Every time I hear about a person being diagnosed with bowel cancer, it's motivation for me to work harder, to try and make a difference," she says. "It's satisfying to be able to collaborate with the GPs and hospital doctors, to work with health economists, behavioural researchers and statisticians – all of these key people in making sure the work that we do as scientists is able to make it all the way to better clinical care for patients."



When stroke strikes

The impact of a stroke on loved ones and caregivers can often be overwhelming. New resources are improving carer support.

By Melissa Keogh



Almost half a million Australians are living with the effects of stroke, a health condition that attacks the brain and changes lives in an instant.

Stroke can happen to anyone of any age. Not only does it affect the survivor with damage to areas of the brain that can affect how they talk, swallow, see, feel, touch and move, it can also upend the lives of those around them.

Flinders researcher and physiotherapist Dr Elizabeth Lynch is investigating how to better support and upskill people who are transitioning to the role of an informal carer of someone who has suffered a stroke.

“Sometimes the stroke patient fully recovers but in others, the shift in the relationship between them and their loved one can be really confronting,” she says.

“Some couples go from being an equal partnership to only one person becoming the breadwinner and the other on a disability pension.

“Those sort of changes in the relationship can be really tough and tricky to navigate for both people.”

Alongside her team at the Flinders Caring Futures Institute, Dr Lynch is working with stroke survivors, support people and health professionals to develop new resources to help people cope with the often overwhelming and emotional load of caring for a stroke survivor.

The project is also aiming to improve systems within hospitals to better provide information to patients and their families.

Informal carers of stroke survivors can be parents, husbands, wives, partners, friends or family members. In an instant they can be forced to make decisions for their loved one around medical procedures, returning to work, organising finances, booking rehabilitation services and appointments or, in some cases, organising aged care services.

In a project funded by national charity organisation Stroke Foundation, Dr Lynch has developed a suite of resources including an online training module and videos of carers’ stories that share an insight into other people’s experiences and what to expect with their own.

The resources are currently being trialled at two hospitals, one in Adelaide and another in Perth, providing carers with access to correct and timely information.

Dr Lynch’s research also involves working with healthcare teams and hospital staff to improve how information is provided to patients and their families.

“In preparation for the videos, we did many interviews with carers and asked them what they would have liked to have known in the early days and weeks after stroke and what would they have done differently?” she says.

“Generally, carers don’t know what questions to ask, many people just wait to be told what to do and they



Dr Elizabeth Lynch

“Some couples go from being an equal partnership to only one person becoming the breadwinner and the other on a disability pension.”

trust the health professionals to tell them what they need to know.

“In talking to health professionals, we know that they do provide information to patients and carers, but often this is provided just once, and no-one checks if this information has been understood or remembered. Patients and carers in hospital are under a lot of stress, and they often don’t process information accurately or they can completely forget whole conversations.

“The online module and videos are there so that when someone comes to the ward with their loved one who has suffered a stroke, they have some tips on what sort of things to look out for, and tips on how to cope that they can look over as often as they like. It’s about helping carers identify their own learning needs and advocate for themselves to get the information they need.”

While strokes are often thought of as a health episode affecting older people, they in fact do strike at any age, although high blood pressure, being overweight, being inactive, smoking, high cholesterol, diabetes, and high intake of alcohol put people at greater risk.

“One in five Australians will have a stroke at some point in their life and one in three strokes occur in people under the age of 65, so these are people of working age and that is a big deal,” Dr Lynch says.

“It’s becoming more common for young people to have strokes, but we don’t have the services to meet their specific needs around returning to work, driving and managing a family. These needs are different to the needs of older people who may be nearing retirement or past working age and have different responsibilities in life.

“While we can’t change the turmoil that comes when a loved one has a stroke, we are striving to support carers to get all the information they need so that they and their loved one can live their best life possible.”



Surviving cancer

— it takes more than treatment

By Sarah Keenihan

Surviving cancer is a feat, but what happens afterwards? Research by the Flinders Caring Futures Institute is boosting cancer care.

Right now in Australia there are over 1.1 million cancer survivors – enough people to fill the seats at Adelaide Oval twenty times over. That’s a remarkable result in anyone’s language.

However, while the immediate risk of cancer is lowered by new and effective treatments, all these survivors still have complex health needs.

Matthew Flinders Professor of Cancer Nursing Raymond Chan runs a comprehensive and targeted program of research that supports the overarching health of patients who survive breast, prostate, blood and other types of cancer.

“Even when survivors may be described as cancer-free, many health challenges remain as a result of physical and psychosocial impacts of diagnosis and treatment,” says the much-awarded cancer care specialist. “My work is about improving the care, experiences and health outcomes for people living with cancer.”

Health changes that can result from cancer and treatments are diverse – pain, fatigue, physical disability, lowered cognition, memory loss, sexual dysfunction, cardiovascular issues and immunosuppression – and so Professor Chan’s research team is multidisciplinary. He admits his ambition to create positive change is high.

“As long as research has a chance of improving patient outcomes, we will focus on it,” he says.

One of Professor Chan’s core projects offers a care option for patients once they have completed the acute phase of any treatment – and he’s identified General Practitioners as playing a key role.

“When oncologists treat cancer patients it can involve exposing them to some pretty toxic treatments, such as chemotherapy and radiotherapy,” he says. “When patients are sent back into the real world but still suffer side effects, GPs are well positioned to help them manage and refer them to additional services such as physiotherapy, or nutritional support, or psychologists, or whatever else they need.”

Working within the structure of Australia’s existing public health system, Professor Chan has attracted funding from the National Health and Medical Research Council and the Medical Research Future Fund to establish and trial his programs. The model involves patients getting the best of both worlds – the acute cancer team and their general practitioners – to ensure their holistic needs are met. The approach was initially set up for breast cancer survivors but is now being expanded to include other types of cancer as well.

“For breast cancer, we worked with the McGrath Foundation across seven Australian sites to ensure that GPs and cancer care nurses deliver effective care for patients once their cancer treatment is completed,” Professor Chan says. “We’re now starting similar work for patients who have been treated for prostate cancer and lymphoma (a blood cancer), and with future expansion to support patients with lung, and head and neck cancers as well.”



**Professor
Raymond Chan**

“Even when survivors may be described as cancer-free, many health challenges remain as a result of physical and psychosocial impacts of diagnosis and treatment...”

The GP-centred care approach can also be adapted for managing patients with more unusual types of cancer. Professor Chan was recently awarded grant funding to create a program for patients with neuroendocrine cancers that form in glands and nerve cells in organs such as the bowel, pancreas, lung, skin or adrenal glands. Around 5,000 Australians are diagnosed with a neuroendocrine cancer each year.

“People diagnosed with neuroendocrine tumours are often younger than the average cancer patient and can struggle to work and maintain their quality of life,” Professor Chan says. “We’ve tailored our program to ensure GPs feel supported in managing these rarer types of cancers.”

In addition to running his own research program, Professor Chan is Director of the Caring Futures Institute at Flinders University.

“At the Caring Futures Institute, we focus not just on the traditional doctor, nurse and patient model of care, but also on enhancing self-care and their care networks,” he says. “We want to empower people to take control of their own, their family’s and their community’s health as much as possible.”

The work of 280 researchers at the Caring Futures Institute targets fundamentals of care, healthy start to life, disability and social inclusion, cancer care, cardiovascular care, healthy ageing and aged care, and palliative care, death and dying.

Professor Chan says he feels privileged to work in healthcare.


“I’m so lucky to work with a team of experts and offer each of them a focus so we can advance care of patients together,” he says. “Our research can really create positive change, and that’s such a strong motivation for me.”



EYE for *DANGER*

Tackling a devastating eye condition
that comes in many forms.

By Bill Condie



“We can catch Toxoplasma from the cat, but the more likely way to catch it is by eating your meat undercooked,” says Professor Smith.

Ophthalmologist Justine Smith has a message that may have you rethinking your taste for rare steak.

The Strategic Professor in Eye and Vision Health at Flinders University researches a devastating condition called uveitis – an inflammation of the interior of the eye that is a common cause of blindness.

Uveitis is not one disease, Professor Smith, a clinician as well as a researcher, explains. Rather it is a group of diseases divided into the infectious variety, caused by pathogens including Ebola, dengue and Zika viruses, and non-infectious inflammation akin to diseases such as rheumatoid arthritis or multiple sclerosis, but in the eye.

There is even a uveitis that is a form of lymphoma that occurs in the eye and looks like inflammation that masks a cancer of the white blood cells.

But where does the rare steak come in?

The most common infectious uveitis is ocular toxoplasmosis caused by the parasite *Toxoplasma gondii*.

It is probably best known for being carried by cats, but the parasite can also be eaten by grazing animals such as cattle, sheep and pigs, and end up in our food chain.

“We can catch *Toxoplasma* from the cat, but the more likely way to catch it is by eating your meat undercooked,” says Professor Smith.

Repeated occurrences of *Toxoplasma*-induced inflammation of the retina can lead to permanent scarring and blindness.

Professor Smith’s recent research suggests the condition is more prevalent than we thought.

“Eye doctors know it’s common because they see it in their clinics, but other doctors don’t think it’s common because they don’t hear about it,” she says. “We wanted to show that it really was a common problem.”

She turned to the data from the Busselton Healthy Ageing Study (BHAS), a large multidisciplinary project investigating the causes of and risk factors for a wide range of conditions of public health importance in an ageing population.

Professor Smith and her team screened more than 5,000 eye photographs and estimated that one in 150 Australians has a *Toxoplasma* scar in their retina, making it surprisingly common for a disease of which few would consider themselves to be at risk.

The Professor’s other findings, though, suggest why.

“Separately, we did a project where we went down to the local supermarket looking for *Toxoplasma* in meat,” she says “We sampled lamb mince and found that, conservatively, 40% was positive and less conservatively, maybe two-thirds.

“So, you have to cook your meat.”

Alternatively, if you want to eat meat rare, Professor Smith advises to freeze it before you cook it, which is another way of killing *Toxoplasma*.



Professor Justine Smith

That’s the easy part as, once infected, there is no drug or vaccine that can eradicate the parasite.

“There are a lot of anti-microbials that will act against the parasite, but none of them are curative. Once you’ve been infected with *Toxoplasma*, you carry it for life like the herpes virus.”

However, Professor Smith says treatment can minimise damage.

“Part of the damage is the caused by the reactive inflammation inside the eye against the parasite, and so we treat patients with anti-inflammatories, usually corticosteroid-based drugs, along with the anti-microbials.

“We can inject them into the eye or give them to the patient by mouth.”

In the search for a better solution, Professor Smith used her myriad international connections to form a worldwide study group of almost 200 uveitis specialists to describe their approach to tackling ocular toxoplasmosis.

They published a paper this year, effectively providing a blueprint for how to manage the disease.

Back home, Professor Smith is working on the only study in the world using human eye tissue to study the mechanisms of *Toxoplasma* infection.

“At Flinders University, we have unique access to human eye tissue and we isolate different cells from that eye tissue,” she says. “That’s really important because humans have a different response and recognition system for the parasite than animals.”

Thanks to that work, we now have a good understanding of how the parasite gets into the eye, moves across the blood vessel walls, and infects retinal cells.

Meanwhile, she continues to research the human cost of the disease around the world, which may be more devastating than we thought. A collaboration with the University of São Paulo, Brazil, is leveraging the country’s big population to study a large cohort of patients.

“If you take all the patients that come to the clinic with ocular toxoplasmosis, a quarter of them are blind in one of their eyes,” Professor Smith adds, underscoring the importance of her mission.

Behave



yourself

Life is complicated, and as humans sometimes our behaviours undermine our health.

By Sarah Keenihan

Whether obvious dangers such as smoking, to more subtle ones such as not exercising enough, Flinders public health expert Professor Billie Bonevski is creating healthier societies by changing behaviours in high-risk communities.

“The beauty of public health is that rather than trying to influence an individual, you can have an impact across entire populations – you’re not just saving one life, but maybe millions of lives,” she says.

As Professor of Public Health at Flinders Health and Medical Research Institute, she manages a wide-ranging program of research that drives better health behaviours in Australians.

“We develop programs with a focus on the broad picture of what influences people’s decisions about their own health behaviours,” Professor Bonevski says. “We aim to increase awareness about health behaviour, and we develop support, resources and tools to make it easier for people to engage in healthy behaviours.”

Professor Bonevski’s work in the past ten years has particularly focused on high-risk populations, such as families with low incomes, people with existing mental health or drug and alcohol problems, and Aboriginal and Torres Strait Islander communities.

One success story is the Tackling Tobacco program, funded by the National Health and Medical Research Council and the Cancer Council NSW. Smoking is the leading preventable cause of disease in Australia, linked with 15 different types of cancer and conditions such as chronic obstructive airway disease.

“Our research showed that while general tobacco control programs had reduced smoking rates across the population as a whole, smoking rates remained high in certain subpopulations,” Professor Bonevski explains. “The next steps were to identify the drivers of smoking behaviours and the gaps in support, and then to develop very tailored programs to address the issues.”

Professor Bonevski says Tackling Tobacco works because it links provision of stop smoking support – counselling, free nicotine replacement therapy and referrals to the Quitline – with social services. Effectiveness has been clearly demonstrated using randomised clinical trials.

“The evidence shows we increased access to quit smoking support through bringing it together with housing support, financial support, drug and alcohol services, mental health services and Aboriginal medical health services,” Professor Bonevski says.

Tackling Tobacco has been rolled out by the Cancer Council NSW and is expanding to South Australia and other states.

Infant and family health can also benefit from behaviour change, such as the Growin’ Up Healthy Jarjums program Professor Bonevski is currently working on with Indigenous communities.

“Closing the gap for Indigenous Australians can be improved through working with Indigenous women, as they drive a lot of health behaviours in their communities,” she says.

To start the project, Professor Bonevski and her colleagues worked with five Aboriginal health services in NSW to survey Indigenous mothers of young children and ask them what they wanted and needed. Now, Healthy Jarjums consists of modules delivered through a smartphone app, with links to social media platforms to provide cultural and community connectivity.



Professor Billie Bonevski

“Closing the gap for Indigenous Australians can be improved through working with Indigenous women, as they drive a lot of health behaviours in their communities,” she says.

The modules cover adult issues such as nutrition, physical activity, alcohol, smoking, mental health and wellbeing and women’s business, as well as infant and child health information, including developmental milestones, vaccinations and sleep.

“Pre-testing of the modules shows high levels of acceptability in the Indigenous women, and we’re now going to conduct a big trial to formally assess impact,” Professor Bonevski says.

With the project initiated in NSW, Professor Bonevski has obtained funding from the Hospital Research Foundation to culturally adapt the program for Indigenous communities in South Australia.

Behaviour after a major health event can be critical to ensure good recovery and reduce the chance of another incident. Professor Bonevski received funding from the National Stroke Foundation to develop the Prevent Second Stroke program, and the National Health and Medical Research Council funded evaluation through a randomised controlled trial.

“Prevent Second Stroke is a secondary prevention program that aims to provide health behaviour modification strategies to people who have had a stroke and are at risk of having a second event,” she says.

An online program, it consists of modules that target diet, exercise and mental health.

“We had 400 people participate in the trial, and found people were really happy to use an online program and that users reported higher health-related quality of life than the control group,” Professor Bonevski says. “Our next step is broader implementation and scale-up of the program in a wider population, which we’re really well-placed to do at Flinders.”

Professor Bonevski says it’s satisfying to do research that is integrated with hospital care and community-based health services.

“Doing research that actually changes people’s health is a real privilege,” she says.



CHALLENGING THE SYSTEM

Improving Aboriginal and Torres Strait Islander
male health and wellbeing.

By David Sly

Aboriginal and Torres Strait Islander males remain the lowest users of primary healthcare services in Australia, with poorer overall health, higher rates of chronic disease and hospitalisation, and lower life expectancy.

Remoteness and socioeconomic disadvantage are frequently identified as contributing factors, but a Flinders University researcher contends that there's another element which needs to be tackled – changing how males are treated within the health system. Associate Professor Kootsy Canuto has made this the focus of his studies, and he has clear ideas of how it must progress.

Associate Professor Canuto was born and raised on the traditional lands of the Yidinji people and identifies as a Torres Strait Islander, belonging to his father's people, the Wagadagam clan of Mabuag Island. Now a Matthew Flinders Fellow working with Flinders Rural and Remote Health NT, based in Darwin, he's leading pivotal research initiatives, including a Medical Research Future Fund (MRFF) project to examine male social and emotional wellbeing.

"This is a critical challenge for Aboriginal and Torres Strait Islander males, who have the highest rate of suicide in Australia," he explains.

"The government has to appropriately resource primary healthcare services, especially Aboriginal Community Controlled Health Organisations and Aboriginal Medical Services, to meet the needs and wants of the Aboriginal and Torres Strait Islander men of their respective communities," says Associate Professor Canuto.

"Without the resources to develop, accommodate and evaluate the services and programs, no amount of advocacy, research evidence or anecdotal evidence will change the low utilisation of primary healthcare services by Aboriginal and Torres Strait Islander men.

Associate Professor Canuto is part of a team of specialist researchers at Flinders dedicated to Aboriginal and Torres Strait Islander people's health, which includes life partner Associate Professor Karla Canuto, and Deputy Dean of Rural and Remote Health Professor James Smith.

"There has been enough research done in this space to understand the problems; our research focuses on finding sustainable solutions and implementing them – but that's easier said than done."

"We know the barriers and enablers to meet the needs and wants of the Aboriginal and Torres Strait Islander men of their communities," Associate Professor Canuto says. "This is a structural and systemic challenge that needs to be tackled by those in power, but to ensure the sustainability of change, it must be supported appropriately with trained staff to create men's-only primary healthcare services."

He is working with Watto Purrinna Aboriginal Health Care Service (an Aboriginal Medical Service provided through SA Health) to provide Aboriginal and Torres Strait Islander males with a safe space to come together and enjoy a meal while they meet and build rapport with health service staff. This connection to build trust and exchange information is a crucial foundation, necessary for greater interaction between Aboriginal and Torres Strait Islander males with health care professionals to flourish.

Thanks to an NHMRC Investigator grant, a project called ETTA (Enough Talk, Time for Action) has enabled Associate Professor Canuto and fellow researchers to conduct the first of four iterations of qualitative interviews in Port Adelaide with Watto Purrinna staff and participants. These gatherings have not only enabled men from Aboriginal and Torres Strait Islander communities to connect with each other, but also built their confidence in discussing and requesting information or appointments to address health issues, whether it be seeing a GP, Aboriginal Health Practitioner or Social and Emotional Wellbeing Worker.



**Associate Professor
Kootsy Canuto**

“Without the resources to develop, accommodate and evaluate the services and programs, no amount of advocacy, research evidence or anecdotal evidence will change the low utilisation of primary healthcare services by Aboriginal and Torres Strait Islander men.”

"Unless primary healthcare services are resourced appropriately to develop, accommodate and evaluate the services and programs they deliver to the Aboriginal and Torres Strait Islander men of their community, no amount of advocacy, research evidence or anecdotal evidence will change the low utilisation of primary healthcare services by Aboriginal and Torres Strait Islander men," he contends.

The ETTA project is expected to be completed by December 2024, and Associate Professor Canuto says presenting the research findings back to the Watto Purrinna staff will enable the health service to keep improving its service delivery and increase the numbers of its successful interactions with Aboriginal and Torres Strait Islander males.

The findings will also allow Watto Purrinna to roll out similar engagement activities throughout the Northern Adelaide Health Network, and hopefully be adapted by other Aboriginal Medical Services and Aboriginal Community Controlled Health Organisations throughout Australia. "However, there must be a commitment from governments to follow through," says Associate Professor Canuto. "If a roll-out of services is not adequately and sustainably resourced, there's little that these services will be able to develop, implement and evaluate that can improve the numbers of men engaging with health services."

Associate Professor Canuto is also working with the Nauiyu Community in the Northern Territory and at Waiben in Zenadth Kes (Torres Strait Islands), co-designing social and emotional wellbeing programs for Aboriginal and Torres Strait Islander males – thereby developing a framework for other health services to follow in other communities.

This MRFF project ends mid-year 2026, when its assets will be available to all Aboriginal Community Controlled Health Organisations and Aboriginal Medical Services, and able to be modified to each community's own specific needs.

This work depends on carefully constructing ongoing relationships, which takes time – and progress has been hampered through disruptions caused by COVID-19, especially Associate Professor Canuto's work with health services in very remote locations. "It just reminds us that what we are trying to achieve is a very difficult process, but it is absolutely essential."



Culture and the sliding door moment

Family is the greatest
protection for young
Aboriginal lives.

By Bill Condie

When Luke Cantley was given the opportunity to join Flinders University and research Aboriginal child protection systems, he was keen, but thought it would put him on a steep learning curve. His previous research project had been in prisons.

“Unfortunately, very quickly, I learned that the reasons why we see over-representation of Aboriginal people in the prison system, and why there’s over-representation in the hospital system, are exactly the same with the child protection system.”

Ten times the number of Aboriginal and Torres Strait Islander children as non-Indigenous children are in care systems, with disastrous consequences for individuals, families and communities.

As a Research Associate, with the University’s College of Education, Psychology and Social Work, Mr Cantley is seeking a better way, one which works with Indigenous culture, rather than shying away from it.

“I’ve been talking to a lot of people over the past 18 months –practitioners and researchers, as well as people who have lived experience of being in the system,” he says.

“And the biggest thing that’s coming out of those conversations is that we must take into account culture as a protective factor in terms of child protection matters.”

Fracturing an Aboriginal child’s connection to that culture by plunging them into an incomprehensible and alien world can lead to a trauma with lifelong effects.

Mr Cantley is looking at ways of maintaining a connection to culture, connection to country, but most importantly, connection to family in ways which also keep children safe.

“If there’s an event that means a child is no longer safe within a family, then absolutely we must look at what we have to do to keep that child safe.

“But we need also to look at what networks are available. Are there other family members with whom we can place the child, so that they can remain safe and well, but within their own family?”

“Because we know family and culture are pivotal as a young person develops their own identity.”

Mr Cantley sees the high proportion of Aboriginal children in protection as another effect of colonisation, where systems have been set up without much thought for cultural differences and sensitivities.

“Across all the systems – prison, health, child protection – the reason for over-representation of Aboriginal people can be categorised across predominantly three major themes,” he says.

“They are the impact of colonisation, systemic racism and social determinants, such as access to housing, access to health services and opportunities to build health literacy to understand how to navigate systems. So we can see the systemic racism and colonial legacies are compounding.”

Mr Cantley’s own family connections are with the Gunditjmara nation of western Victoria. He didn’t set out to be a researcher. His early career involved working with Aboriginal people in different settings, such as the mental health system and how to return people to community living after an inpatient episode.

He moved to social housing where he learnt the importance of how having a decent roof over your head intersects with most other elements of wellbeing. And later work in primary health care showed him just how easily Aboriginal people could slip into homelessness after travelling to Adelaide to seek medical care.

His introduction to research was a study into the Aboriginal prison population, where people are stripped of their connections to country, culture and family.

“I was looking at what that would mean in terms of health outcomes, and that resulted in writing a model of care.



**Research Associate
Luke Cantley**

“Unfortunately, very quickly, I learned that the reasons why we see over-representation of Aboriginal people in the prison system, and why there’s over-representation in the hospital system, are exactly the same with the child protection system.”

“So that was a real introduction to research for me and it kicked off this massive realisation that as an Aboriginal Health Worker, I had been able to gain health outcomes at an individual level, but as a researcher I can begin to achieve knowledge and understanding at a population level, and start to work towards outcomes or implement strategies to tackle systemic issues specific to the Aboriginal community.”

He acknowledges change is not easy but the key, he says, is understanding that there are moments in people’s lives – especially young ones – where intervention is a sliding door moment.

“It means that they can avoid this whole trajectory they had been heading on, and they can follow a different path, even if it’s just slightly different, with a positive impact on their life as well as their families and community.”

THE MAKING OF MEN

Cultivating positive sporting club cultures for healthier men.

By Melissa Keogh



Whether it be tussles on the footy field, the swing of a cricket bat or the strain of a triathlon, sport has always been front and centre of Professor Murray Drummond's life.

Captain of the football and cricket teams as a teen in the late 1970s and early 80s, he “woke up thinking about sport and went to bed thinking about sport”.

“Sport was my life,” Professor Drummond says. “It offered me a way of expressing my identity.”

On the Mornington Peninsula south-east of Melbourne, scouts from an elite cricket training squad eventually spotted his swing and from there sprouted a promising future with the ‘gentleman’s game’.

But by the age of 19, the post-match change room shenanigans, a heavy drinking culture plus a badly broken nose eventually led him to walk away from the game he loved.

“I started to struggle with the (cricket) environment a little bit because I didn’t drink a lot, if anything,” he says.

“I was brought up to be respectful towards women and I was in an environment where the cricket subculture was quite masculinised.

“I moved away from it and became a triathlete. I became excited about triathlon because it was a new and emerging sport. I was heavily involved in that and competed in the Hawaii Ironman in my early 20s.”

Now in his early 50s, Professor Drummond is a father of two and has participated in several impressive sporting events over the years. It was these experiences that led to a fascination with gender and sport, and later pursuing a PhD in masculinity in men’s sport.

Educating others on the virtues of sport and exploring masculine sporting culture, gender, mental health and body image now forms the basis of Professor Drummond’s career as a research professor in sport, health and physical activity.

The Director of Flinders’ Sport, Health, Activity, Performance and Exercise (SHAPE) Research Centre is on a mission to challenge sporting environments to embrace difference.

“I’ve been arguing for the past 20 years that masculine sporting settings are not entirely healthy environments for young males,” he says.

“It (club culture) can certainly impact the way in which masculinity is socially constructed and it can impact mental health, the relationship men have with women, misogynist language, homophobic language, all those sorts of things.

“This notion of ‘boys will be boys’ and ‘whatever is said in the change rooms stays in the change rooms’ certainly needs to change.”

While sporting culture in Australia has progressed over the last few decades with some codes including Australian rules football changing to reflect general shifts in social attitudes and standards, much is still to be done, Professor Drummond says.

One area that requires a shift in thinking by young men is mental illness – a silent and often deadly problem.

“Mental health is still perceived as a weakness by young males,” Professor Drummond says.

“If we can change the way we see mental health issues within sporting clubs, which can be heightened or intense places of masculinity, then we’re going a long way to change the way in which we see and perceive mental health in broader culture.”



Professor Murray Drummond

“I’ve been arguing for the past 20 years that masculine sporting settings are not entirely healthy environments for young males,” he says.

“We (SHAPE) are working with clubs, presidents and boards to specifically identify people or champions of change with a club who can mentor young men around mental health.

Suicide is the leading cause of death for people aged 15-25 and the majority are male. Research also shows that while women are more likely to attempt suicide, men are far more likely to die by suicide.

The statistics for Indigenous males are worse. According to the Australian Bureau of Statistics, Indigenous men have twice the suicide rate of non-Indigenous men.

In his latest research endeavour, Professor Drummond is exploring how masculinised sporting cultures influence young Indigenous men’s attitudes and behaviours towards mental health.

With funding from the Freemasons Centre for Male Health and Wellbeing Research Alliance, he will work with colleague Professor James Smith throughout communities in the Northern Territory to interview local boys and men aged 12-25 about sport, masculinity and their experiences with mental health as well as broader issues associated with growing up as a male.

“We want to find out how sport shapes who they are now, but also how sporting clubs can impact their beliefs, attitudes and behaviours,” Professor Drummond says.

“Our research thus far has identified that sporting clubs for a lot of young males can be their second home. Why wouldn’t we use that captive audience?”

“We can’t just let that mentoring occur by chance.”

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How much do you need??

When brain matter affects money matters

People's vulnerability to fraud and financial scams may reveal more than just an assault on their savings.

By David Sly

Psychology researcher Dr Stephanie Wong has found that compromised financial capability may be a symptom of a less-known type of dementia that affects a surprising number of younger people.

“Frontotemporal dementia, a neurodegenerative condition affecting a person’s frontal lobes, can impair their reasoning and judgment, leaving them especially vulnerable to predatory financial scams, and I’m directing my research attention to find solutions,” says Dr Wong, who joined Flinders University in late 2021 as an NHMRC Research Fellow.

“There is no cure for frontotemporal dementia – no magic bullet via medication or pharmaceuticals – so it’s crucial to identify this condition early and establish appropriate support networks to help patients.”

To devise a clearer means of identifying changes in financial capability, Dr Wong is preparing a new type of financial skills test.

She repeatedly noticed financial vulnerability among dementia patients while doing clinical work as a neuropsychologist at the Brain and Mind Centre at Sydney University. Through examining rare and young-onset types of dementia, she found many patients with frontotemporal dementia who reported difficulties with their financial management skills – which was verified by their families and others as being uncharacteristic of their earlier behaviour.

“It kept cropping up in interviews with families that these people were very susceptible to scams, giving away large sums of money and being tricked into buying expensive things they didn’t need. One person had lost \$600,000, which had a serious financial impact on their life,” explains Dr Wong.

“This is very different to people with Alzheimer’s disease, who may be forgetting to pay bills or can’t work out amounts of change. People with frontotemporal dementia were gullible and susceptible to exploitation because they have difficulties with social cognition, such as interpreting different social signals from other people, or picking up subtle social cues such as reading people’s trustworthiness. It affects their abstract thinking and higher-level cognitive skills.”

Dr Wong’s investigation into the financial vulnerability of dementia patients began with a 2019 project grant from Dementia Australia. “It’s not easy. People may be reluctant to reveal their financial situations, or they may not think it’s relevant. Also, many people with the condition will deny that there is a problem – even though their carers and families recognise the decline from their previously capable selves.”

Dr Wong has tested more than 200 people, either with or without dementia, to build a robust test that will flag potential declines in financial capability and prompt more extensive neurological assessment. Involving a session with a neuropsychologist to administer the test, interpret the responses and provide feedback, it will hopefully be available during 2023.

In the meantime, additional grant funding from Ecstra Foundation, a Not-For-Profit organisation working with the National Financial Capability Strategy, is helping Dr Wong build a free, 10-minute mini-version of the financial capability test. The online mini-test will comprise about 15 questions targeted at older adults covering such financial tasks as handling cash, paying bills, budgeting, identifying scams and decision making, along with understanding legal and financial terminology.

When it becomes available in late 2022, the online mini-test will generate an automatic score and report card, itemising what people do well and what needs attention, with advice on where to obtain support.

Dr Wong believes that the test’s aim of promoting early identification and intervention can help ensure people’s long-term financial security, especially by prompting them to act early on creating wills, allocating Power of Attorney rights and agreeing to other financial restrictions appropriate to each person.



Dr Stephanie Wong

“It’s not easy. People may be reluctant to reveal their financial situations, or they may not think it’s relevant. Also, many people with the condition will deny that there is a problem – even though their carers and families recognise the decline from their previously capable selves.”

“Rather than taking away all their financial freedom, we could set tailored boundaries so that they are supported, but only in areas where they’ve been identified as needing help.”

While there is increased public awareness of the effects of Alzheimer’s disease, frontotemporal dementia is a less obvious condition and Dr Wong is concerned that many patients are slipping through the cracks. “Because of their relatively younger age, they often get misdiagnosed as having a psychiatric condition, or depression, and the delay between the onset of symptoms and diagnosis of this type of dementia is much longer,” she says.

“With a disease which has no cure, some people think it doesn’t matter if you get a diagnosis or not – but there are many things we can put in place early to ensure a better quality of life for that person living with the disease. Diagnosis is not a death sentence.”

Dr Wong is also studying how financial difficulties may relate to problems with other cognitive functions – memory difficulties, impaired executive functions such as problem-solving, and social skills. “Our cognitive abilities are so multi-faceted. It’s not as though one part of the brain is in charge of one particular skill. Many of our cognitive abilities are interrelated,” explains Dr Wong.

“If you think of financial difficulties as an outward symptom being driven by attention difficulties, or memory, or social skills, it can help us figure out what management strategies or interventions would prove most helpful. For example, we might find that supporting someone’s social skills could help them recognise signs of potential scams or untrustworthiness.”

Dr Wong is excited by the prospect of examining cognitive symptoms in an entirely different way. An example is a large US study that linked people’s medical records to their social security records, finding people with dementia were flagged as having difficulties with their bill payments and credit scores up to six years before their diagnosis.

She is keen to collaborate with banks, solicitors and financial institutions to help identify people’s financial capability at important turning points in their lives – such as when they retire, or when they take out a will. “By doing a simple financial health check, we could identify any erratic behaviour and introduce interventions that can help. Our aim is to help people identify any difficulties early on, so that an appropriate support network can be put in place.”

Challenging



Preconceptions

It's time for behaviour support practices that protect human rights and build better lives.

By Bill Condie

25

Two recent Royal Commissions shocked Australians by exposing the over-reliance on chemical and physical restraints to manage people's behaviour in disability and aged care settings, with evidence presented of aversive practices where people were physically bound and routinely medicated.

Both the Royal Commission into Violence, Abuse, Neglect and Exploitation of People with Disability and the Aged Care Royal Commission highlighted the need for alternative approaches to behaviour support that put people foremost and protect human rights.

Flinders University Disability and Community Inclusion researcher Dr Alinka Fisher is committed to building and promoting values-driven and rights-based supports using a Positive Behaviour Support (PBS) approach.

PBS might offer one solution to concerns regarding behaviour support practice in Australia, although there is significant work to be done to shift attitudes, build a capable PBS workforce and establish the systems required to support evidence-informed practice.

"PBS provides a framework to guide a very individualised and person-centred approach to behaviour support and is recommended internationally," says Dr Fisher.

"Challenging behaviours can have a significant impact on a person's quality of life – for example, their relationships, community participation and opportunities. They may also present risk of harm to the person and others.

"These behaviours might include physical or verbal aggression, property destruction and inappropriate social or sexual behaviour – but other behaviours like reduced initiation and apathy may also present significant challenges for the person and those providing support.

"We refer to these as 'challenging behaviours' because they challenge the service system to come up with an appropriate response...we are certainly not labelling the person as a 'challenge'.

Dr Fisher explains the importance of addressing attitudes and improving environments as a first step towards finding a solution.

"Sometimes those providing support may be quick to blame the person, as if their behaviour is a problem that needs 'fixing' – but this feeds stigmatisation around behaviour that is not accurate or helpful."

"Behaviour support plans are very much focused on systemic improvements – in fact, they are much less about changing the person's behaviour than changing the behaviours of support networks.

The origins and causes of challenging behaviour are many and varied. There may be organic contributors relating to behaviour change, for example mental health issues, brain injury or early-onset dementia.

As Dr Fisher describes, 'challenging behaviours' are the result of interactions between the person, their environment and broader systems. We need to understand this relationship to inform effective support strategies.

Often, she says, challenging behaviours can be a result of ineffective systems that do not adequately address a person's support needs, and then a person might express this unmet need through challenging behaviours.

"PBS is a holistic approach that emphasises preventative strategies. For example, if a person has an accessible and meaningful environment, and capable support networks, then this will have a significant impact on their quality of life and may prevent challenging behaviour in the first place."

Dr Fisher's research focuses on building and promoting PBS as a preventive, systems-wide and tiered approach to behaviour support.

"This is an important aspect of my research because often a person is referred to a behaviour support practitioner for specialist support before the most basic and rights-based systems and supports are even in place – those that create an accessible, predictable and meaningful environment. This isn't okay and is a really inefficient use of resourcing."

She is also focused on building the capabilities of families in providing effective behaviour support and is currently working with a team in NSW to examine the feasibility of a PBS family education program for adults with dementia. Another of her projects is developing and trialling a PBS training and mentoring program to build capabilities of aged care organisations in providing effective behaviour support to people with dementia.

This emphasises Dr Fisher's focus on educating families and building effective behaviour support systems from the ground level up.

Sometimes, she says, behaviour support practitioners are required to develop specialist and comprehensive behaviour intervention plans, but "we could better use resources if we had the foundations of good practice in place – reserving specialist behaviour support for where it's really needed".



Dr Alinka Fisher

"PBS is a holistic approach that emphasises preventative strategies. For example, if a person has an accessible and meaningful environment, and capable support networks, then this will have a significant impact on their quality of life and may prevent challenging behaviour in the first place."

While the practice of PBS has been around for a long time, it has gained momentum in Australia following the introduction of the National Disability Insurance Scheme (NDIS) in 2013.

"The disability service landscape has been shaped significantly through the introduction of the NDIS because it names and funds positive behaviour support. It has been a game changer," Dr Fisher says.

There are now thousands of PBS providers in Australia. However, there are some concerns regarding PBS policy and implementation funded by the NDIS, and a recognised need to upskill our behaviour support workforce.

"The NDIS Quality and Safeguards Commission is aware that work needs to be done," she says. "They have initiated some important work focused on improving the quality of PBS service provision". This includes two NDIS-funded projects that Dr Fisher is involved with – one intent on giving more voice to people around their behaviour support and helping them to understand their rights, and another to build the capabilities of behaviour support practitioners.

Although there appears much to be done in improving behaviour support in Australia, the work of Dr Fisher and her colleagues provides hope for all people to have better lives.



When home is no place

What does home mean to children whose parents have separated, or to those in state care? The answer has profound ramifications for their futures.

By Bill Condie

Around 20,000 divorces each year in Australia involve children, their young lives upended as their mother and father set out on separate paths.

When families change, what does this do to a young person's sense of home, or where they belong?

That question has intrigued Flinders University sociology researcher Associate Professor Kris Natalier ever since she worked with young people leaving the state care system.

"We were looking at their housing trajectories and as part of talking to those young people it became really clear that many of them had never had a sense of home, but they had a deep longing for one," she says.

"That started me thinking, 'where do kids feel at home?'"

It led to a project looking at what home meant for children whose parents had separated or divorced – children who potentially felt at home in two places. Or perhaps they lived across several houses and didn't feel at home in any of them.

First, she had to grapple with the question of 'what is home?'. The answer suggests that the old idiom 'where the heart is' may not be far from the truth.

"What it's not is bricks and mortar," says Associate Professor Natalier. "Fundamentally, it's people's connections with other people."

"We spoke to one young girl, for example, whose parents had separated and her mum returned to her family home. Her dad was living in a shed with one room and all four kids were there.

"But she loved it. She had lots of space to ride her bike, she was there with her siblings, she really, really loved her dad and felt happy with him. So he managed to create a home for these kinds of shared experiences, some really small, mundane things, but they felt connected."

A sense of home can also be born of routines that give a sense of control and wellbeing – the belief that you can rely on the same things happening over and over again, on a daily or weekly or even yearly basis.

"With one family, the kids and their mum watched MasterChef every evening after dinner, and the children described that as something that really made them feel at home. It was a shared experience even more important than shared rituals around Christmas or birthdays," Associate Professor Natalier says

"For another boy, his dad let him keep his Xbox in the lounge room and they would play together. It was hugely important for him because it showed him that he was welcome in his dad's space, and that his dad wanted to be there with him."

She says without that feeling of connectedness a young life can derail badly, reinforcing that home is important for a sense of security in the world around us.

"When we don't have home, it's really hard for us to build a sense of self or a sense of identity and a sense of place in the world," Associate Professor Natalier says.

Evidence suggests it can also be hard to build connections with other people outside the family. Statistically, children in state care are more likely to end up in juvenile justice and adult detention, far more likely to face homelessness, and far more likely to face drug addiction.



**Associate Professor
Kris Natalier**

"When we don't have home, it's really hard for us to build a sense of self or a sense of identity and a sense of place in the world," Associate Professor Natalier says.

"That's not only because they didn't feel at home, but that lack of security, that lack of belonging is going to intensify those risks and vulnerabilities," says Associate Professor Natalier.

With this in mind, Associate Professor Natalier is beginning a new project where she and a team of researchers will look at what home means for children and young people when they're in state care. They will be talking with children and young people living in residential care, as well as children in Aboriginal and non-Aboriginal kinship care, and kids and young people who are in traditional foster care. This research is being conducted in partnership with the Department for Child Protection, Life Without Barriers and Anglicare, South Australia.

"We are currently working with our Indigenous stakeholders to make sure that what we're doing can capture culturally specific ideas of home as well. Home tends to be discussed from a Western perspective; ideas about connection of country, spiritual connection, community connection, which are super-important for Indigenous kids, have been missed," Associate Professor Natalier says.

She hopes that the project will extend to groups who haven't had a voice in this space, to get an understanding of their experience.

"Then once we have that understanding, we can look at how we can use that to make life better. Once we understand how kids experience home, that could inform parents' thinking around how they organise their children in a divorce or separation.

"And if we understand the home needs for different groups of kids in state care it can inform how we support the people who care for them to do things that can actually help kids feel at home, letting them have some control over their space."

Solving the hunger crisis with dignity



By lifting the quality of food relief services in Australia, the Flinders Centre for Social Impact is tackling both hunger and poverty, empowering people in the process.

By Melissa Keogh

Professor Svetlana Bogomolova believes a good meal is like magic.

It's the glue that brings people together, gathers families around dinner tables every night, and is often a mark of celebration.

And that's not even mentioning the nutritional benefits.

"I love to eat food, I love to research food, it has healing powers to bring people together around a meal, support each other, feel included and have a good time," Professor Bogomolova says.

"Obviously, a healthy diet also has health benefits. Good food is the protective factor for many things that could go wrong in our bodies, and even our minds.

"I think food is like magic."

But what happens when food can't be put on the table? That's where food relief comes in.

Australia has various food relief models, from hampers filled with purchased and donated goods, to supermarket vouchers providing emergency relief, shared community meals and community pantries offering free or low-cost groceries.

According to Foodbank Australia's Hunger Report 2021, 1.2 million children are living in food insecure households.

More than 40% of parents in situations of severe food insecurity say their children go a whole day without eating at least once a week.

The objective of Professor Bogomolova's research is to reform the food relief sector "so people can find a pathway out of financial precarity and towards food security".

"Historically, the criteria to qualify for food relief have been a problem. That is the first and one of the most undignified moments in a customer journey in food relief – that you have to prove you're poor before you get support," she says.

"That undignified moment sends people emotionally back three steps.

It's at that most vulnerable point that Professor Bogomolova thinks there exists the greatest potential to transform lives through food.

As the Deputy Director for Flinders University's Centre for Social Impact (CSI), Professor Bogomolova is leading an Australian Research Council Linkage Project, Towards Zero Hunger. Working with service providers such as Foodbank SA, Anglicare SA and The Food Centre, policy makers Wellbeing SA and the Department of Human Services as well as community members and consumers, the project aims to lift the quality of food relief services in Australia.

The CSI team is working in partnership with providers of three kinds of food relief service delivery models – hampers, food hubs and social supermarkets – to co-design service improvements and new service delivery models, contributing to the sector-wide reform.

Food hampers filled with purchased and donated goods are designed to provide immediate practical relief, while the second model – food hubs – allow those in need to shop for free or low-cost groceries in a 'mini supermarket'.

Low-income families can access heavily discounted items with food vouchers while bread, fruit and vegetables are free.

The third model – the social supermarket – goes one step further.

"A social supermarket is like a local low-cost supermarket with wraparound services, supports and opportunities for social connection and engagement through food," Professor Bogomolova says.

"There is usually a café or space where you can sit down and speak with people who are in similar situations, or volunteers who can chat to you about other opportunities and services such as financial counselling or work-experience opportunities.

"It is about leveraging the moment of food insecurity as a window of opportunity to engage a person and offer them additional supports that addresses the root causes of their challenges, rather than just 'bandaging' by giving them food every week."



Professor Svetlana Bogomolova

"Historically, the criteria to qualify for food relief have been a problem. That is the first and one of the most undignified moments in a customer journey in food relief – that you have to prove you're poor before you get support," she says.

Recognising that different food relief models all have a place, Professor Bogomolova says the key question is "are we solving the food insecurity problem in Australia if all we are doing is just giving out food?"

"How do we use the emergency food relief moment to connect people to services, opportunities to build on their strengths, and create pathways out of poverty?" she says.

Professor Bogomolova says there are many reasons why people experience food poverty.

"Problems can spiral very quickly and very dramatically," she says. "When someone presents at an agency saying 'hey, I'm hungry, I need food', that moment is emotionally difficult because it is admitting you need help.

"What do we need as a sector is make sure that first point of contact is as supportive and as dignified as possible. That's where our research is making a difference."

REDEFINING THE SPACE WHERE LAW PREVAILS

When humans land on Mars, what law will apply? It's an important legal riddle that now reaches far beyond a science fiction plotline.

By David Sly





Increasing space travel – and Australia’s role as an emerging and significant player in space industries – means that Flinders University’s Professor Melissa de Zwart is engaged in exacting global legal debate to find the right framework for pioneering space law.

It marks a dynamic new chapter of academic work for Professor de Zwart, a thought leader in law and technology, with an international profile in the fields of internet law and the regulation of access to and use of outer space.

“In essence, both these areas of law look at rapidly evolving technology, and both have come about from predominantly military funding, so they have more in common than you would think. Both areas are also inherently international – they are not things that stop at any domestic border,” she explains. “I’m trying to understand where the human being sits in amongst all this technology.”

As a leader of Flinders University’s Jeff Bleich Centre for the US Alliance in Digital Technology, Security and Governance, she is examining commercial and defence uses of outer space. “I’m interested in places where there is very little existing law, which require more legal thought on how we use these technologies for the benefit of humankind,” says Professor de Zwart. “We also have to understand what human behaviour can do to undermine legal regimes that have been put in place.”

Her work in the past decade has focused on assisting space industries, with South Australia being this nation’s home of start-up industries in the space sector. “Along with the rapid growth of space entrepreneurs, we are seeing so much new possibility happening quickly, on a global scale,” she says. “New Zealand wasn’t a member of the Outer Space Treaty, yet in 2016 it announced its first space launch company. Australia has only had a Space Agency since 2018, yet now there is Space Command within Defence.

“As a legal researcher and an intellectual property lawyer, I firstly have to understand where the technology is going. It’s a very interdisciplinary area to be working in, so I take my cues from industry. Lawyers are not running the show; they are there to assist the growth of industry and understand what its needs are.”

As a foundation for ongoing space law discussion, Australia and another 18 countries are part of the Artemis Accords with NASA, which describes a shared vision for principles that are grounded in the Outer Space Treaty of 1967. “This is a fascinating case study of how to bring together international partnerships,” says Professor de Zwart. “It’s in everybody’s interests that we get the rules right, and calibrated so that everyone wants to observe them.”



**Professor
Melissa de Zwart**

“What lessons do we learn from these ventures and what are the wider consequences of increased space tourism? We are asking whether we should regulate such activity and how we do it.”

It involves exploring hypothetical situations, such as mining on other planets – whether it be for water, or some type of fuel or resource – and asking how much is okay, under what terms is mining okay and what are the ethical and legal principles that have to apply. Another pressing question is defining a maximum number of low-orbit satellites before space becomes too congested and potentially too dangerous. Space tourism is also a consideration, in the wake of entrepreneurs Elon Musk, Jeff Bezos and Richard Branson initiating their own space journeys, outside of national space programs. “What lessons do we learn from these ventures and what are the wider consequences of increased space tourism? We are asking whether we should regulate such activity and how we do it.”

While law is a highly adversarial area, where polemic views are often stretched to extremes, Professor de Zwart says a collegiate view exists among international space law practitioners. “We all love space and we want it to be a domain that is open and successful. The last thing anyone wants is a war in space, or for the moon to become a site of international conflict, so we are focused on sorting out legal nuance. We all want to make this work.”

Professor de Zwart is especially optimistic about Australia’s emerging space industry. “This is something the nation can be really proud of – and we have enormous space expertise at Flinders University.” She points to Associate Professor Alice Gorman’s international renown as a space archaeologist, with other experts in space policy, ethics and regulatory legal experts within the College of Business, Government and Law. “This is only the beginning of the Australian space industry. It’s still growing and finding its way. We have a lot of very exciting work ahead of us.”



GETTING
the
MESSAGE

By Bill Condie

Vital wireless communications are at risk when nobody rules the electromagnetic waves.

Communications are vital to our modern world. Everything from our GPS navigation systems, to remote sensing in the intensive care unit, and firefighters' and police radios rely on the clear transfer of messages using electromagnetic waves.

But the more we rely on it, the less reliable it becomes. With more and more devices online, cluttered bandwidth puts clear communications at risk from both accidental and intentional interference. In particular, the threat of hostile jamming is easier than ever thanks to the online availability of cheap electronic devices.

"Clear communications is the biggest challenge we're facing, particularly as we go to the Internet of Things, where my fridge is going to talk to my oven," says Professor Sam Drake, Co-Director of Flinders' newly established Centre for Defence Engineering Research and Training.

"It's very easy to interfere with and the usable part of the electromagnetic spectrum is finite."

Professor Drake's research into the physical nature of electromagnetic waves, and how they are transmitted, focuses on Spectrum Security, ensuring that information transmitted is received by the intended recipients uncorrupted.

He is also concerned with locating illegal electromagnetic transmitters – a growing risk to our communications.

"Anybody with a little knowledge and very little equipment can give you a false GPS position, or just deny you a GPS signal," says Professor Drake. "GPS jammers are used by truck drivers to do their private delivery jobs without letting the company know. You can buy them on eBay, which will tell you that 'other buyers also were interested in mobile phone jammers, hurry only three left!'

"We have some devices in the lab that cost as little as \$600. They can interrupt signals everywhere from navigation systems, to broadcast radio, to Bluetooth."

Although the Australian Communications and Media Authority is very clear that using such devices is illegal with a potential fine of up to a million dollars, it is easy to escape detection.

So important is this territory that the military think of the spectrum in the same way that they view the land and sea – space that is to be controlled.

In civilian life, security and control of this space can be the difference between life and death.

"During COVID, particularly, intensive care units wanted to do a lot more remote sensing, which means wireless," says Professor Drake. "But in a hospital, we've got not only the sensors, but all sorts of signals from defibrillators, mobile phones, even the microwave nurses might use to heat up their lunch.

"We're going to get some accidental interference. Nobody's being malicious, but there are so many devices around and the spectrum is finite, they're going to start to interfere with each other.



**Professor
Sam Drake**

"The computer may decide, for example, to harness a particular frequency because it's not being used, only to find out too late that it's assigned to the fire alarm system, which only goes off once in two years or something. It means nobody's ever noticed the potential interference."

"And it's the wild west out there at the moment."

Diagnosing the problem is the easy part; finding a solution is much harder.

Some WiFi systems already actively manage how they use the spectrum, monitoring usage of bands and switching to the ones with less traffic.

"In the same way, you could do that with Bluetooth and other devices, but lots of other devices work on fixed bands," says Professor Drake. "And while we must have this sort of adaptive monitoring and control, if that's an automated system, it can create unforeseen problems.

"The computer may decide, for example, to harness a particular frequency because it's not being used, only to find out too late that it's assigned to the fire alarm system, which only goes off once in two years or something. It means nobody's ever noticed the potential interference.

"So, it's a complex space."

For now, Professor Drake and his team are analysing the spectra to build a 3D picture of the space to determine what – and the more challenging who – is occupying it.

"The 'who' can be hard," he says.

"The 'what' is okay. I know that there are signals transmitted at these frequencies, and they look like radar, or they look like radio. But I need to do a lot more to find out who's transmitted something – what's called specific emitter identification.

"I'm just concerned with the physical nature of the electromagnetic waves and how they are transmitted. We're not dealing with the content, just making sure our signals get through to where they are supposed to go, without interference or misinformation."

THE POWER



OF POLYMERS

The polymer batteries set to transform energy storage

By Sarah Keenihan

Chemistry is about what things are made of – it's the field of science that helps us understand how the molecular structure of materials determines their properties and applications. Flinders University chemist Dr Zhongfan Jia applies his expertise in molecules known as polymers to create new energy storage solutions for small and very large batteries.

Polymers are all around us. They make up the stretchy lycra in bike pants, the non-stick lining of frying pans and the hardy rectangles of Australian banknotes. Polymers exist in nature too, found in seaweeds, silk and wool.

At the molecular level, polymers all have something in common: they're made up of repeated individual units joined together like a string of beads. Though we can't see it with the naked eye, it's this structure that gives polymers their vital properties.

"Polymers are incredibly useful to us because they are strong, they can be made into different shapes, they are flexible and in general they are cheap to make," says Dr Jia, Senior Lecturer in Chemistry.

With his Flinders research team Polymers for the Environment, Energy and Catalysis, and national and international collaborators, Dr Jia works with both synthetic and natural polymers to create new molecules that solve problems.

"I love to explore and find out what things are made of and work out how the properties of molecules can offer useful applications for humans," he says. "It's fascinating to use my skills to create new materials that have never existed before and that can make our lives better in so many different ways."

Polymers can be very strong, which means they are exceedingly useful for making physical materials, such as packaging. However, polymers are incredibly versatile, offering features that can be applied for different types of product development too.

In Dr Jia's lab, they are developing polymers that can store energy and be used in batteries.

"Traditional batteries use metals such as lithium, cobalt and others, which are increasingly difficult to source through mining, and they present a risk to the environment when they enter landfill after use," Dr Jia says. "To provide an alternative, we are creating polymers that can replace the metals in batteries."

Batteries are made of physically separate components, namely cathode and anode. Chemical reactions where electrons flow from the anode to the cathode create electrical power. Nowadays, most batteries are rechargeable. An example is lithium-ion batteries which store electric energy as chemical energy when charging and convert chemical energy to electric energy when discharging.

"We have developed a metal-free battery by creating polymers that can be charged and used as replacements for the metals typically used for the cathode and the anode," Dr Jia says.

Dr Jia's metal-free battery is about the size of a USB stick, and it can be created in a coin shape as well. Once the metal-free battery was shown to work, Dr Jia set out to improve how much energy it could store.

"A normal lithium-ion battery has an output voltage of 3.6 to 4 Volt," says Dr Jia. "While most non-metal batteries could only deliver 1 to 2 Volt, we've been able to improve that up to 2.8 Volt in more recent work."

The polymer battery is also rechargeable, a core characteristic in demand for reusable consumer batteries.

Dr Jia's next challenge is to further increase the battery storage capacity and to transition to natural instead of synthetic polymers.

"Synthetic polymers are easy to work with and are useful for all sorts of applications, but they are typically made from petrochemicals," Dr Jia says. "And so an important part of our work focuses on natural polymers, as we'd like to be able to use these to replace synthetics in a wide range of applications."

The idea is to create a battery that is completely safe and biodegradable.



Dr Zhongfan Jia

"It's also wonderful to use my skills to create new materials that have never existed before and that can make our lives better in so many different ways."

"We're now working with polymers from materials such as seaweed, plant cellulose and starch to create a natural, non-metal battery, and for other applications as well," says Dr Jia.

On a much bigger scale, Dr Jia is also working on a redox flow battery. Redox flow batteries can be large, making them suitable for storing power from solar panels or other applications in green energy, industry and housing.

"Rather than being made of solid ingredients like smaller batteries, a redox flow battery is made of liquids," Dr Jia says. "It consists of two tanks of energy storage materials dissolved in liquid solvents set up next to each other, separated by a membrane."

Dr Jia aims to improve redox flow batteries by applying his expertise in polymer science. His first target is the size of the molecules that store energy.

"Currently, a major factor keeping the cost of redox flow batteries relatively high is the membrane separating the battery fluids, because it needs to be of very fine grade to stop the energy storage materials leaking from one side to the other," says Dr Jia. "We're designing polymers that can be used to store the energy and are of a large molecular size so a much cheaper membrane can be substituted for the expensive one."

Dr Jia is also refining the solubility of the polymers.

"We're making the polymers dissolvable in water, as this will make the battery much safer and more environmentally-friendly than using chemical solvents," Dr Jia says.

He hopes that one day home solar units can be connected to water-based, polymer-filled rechargeable redox flow batteries as a relatively cheap and safe way to store power.

Dr Jia's work is funded by the Australian Research Council and a range of industries interested in the potential of polymers. It's research that requires specialist equipment and infrastructure, and hands-on practical and analytical work.

"I am fortunate to have a range of different set-ups which enable us to make all polymers we are interested in," says Dr Jia. "Then we use Flinders University's analytical centre to assess how good we've been at making specific molecules, and a newly established electrochemistry lab to do all the functional testing for battery and other applications."

With batteries the most common form of household hazardous waste, growing by 20% per year in Australia, the annual waste they generate is predicted to exceed 100,000 tonnes by 2036 – making Dr Jia's quest for a safe and biodegradable solution not just important, but urgent.

ROBOTS THAT CAN 'SEE'

Insect vision influences robotic detection and monitoring systems.

By Sarah Keenihan

"We've now applied this knowledge to build automated visual detection systems that have even higher resolution than fly eyes - we're building on millions of years of evolution but without the same biological limitations."

Most computer engineers are a bit scared of biology – but Flinders robotics expert Associate Professor Russell Brinkworth embraces it. He has reverse engineered insect vision to create new capabilities in robotic detection and monitoring systems for security, defence and energy applications.

Associate Professor Brinkworth says the problem with robots right now is they can't make sandwiches.

Of course, lunch-making robots aren't a priority for his Autonomous Systems research team at Flinders University.

But the analogy of a robot constructing a meal is a useful one. Putting sandwiches together requires a way to see the world (vision), working with soft materials that come in irregular shapes, performing complex physical manoeuvres and making decisions on the spot about how to proceed.

This is what makes constructing sandwiches more difficult than manufacturing automobiles, since cars are rigid and the parts consistent.

"I want to bring robots out of the lab and into the real world," Associate Professor Brinkworth says. "This means creating robotic systems that can operate in a dynamic environment, that can be flexible and that can respond to what's going on around them."

For defence applications, for surveillance, for self-driving cars and for tracking real-world natural phenomena, Associate Professor Brinkworth and his colleagues are creating new technologies and robotic systems that are autonomous and adaptable.

Their recent work has focused on creating systems that can detect changes in the environment, such as scanning for unauthorised drones at airports and military sites.

Current surveillance systems typically consist of high-grade cameras that collect visual information. Images are analysed by artificial intelligence trained to classify objects based on their appearance – distinguishing a drone from a bird, for example.

"But it's really resource intensive and relatively slow to scan the entire environment at high resolution all the time," Associate Professor Brinkworth says. "We've developed a system that operates much faster."

The key is an approach based on the biological reality of how eyes work. Low-grade vision is applied as a first-pass scanning tool (equivalent to peripheral vision that animals and insects use) and then the system shifts to higher resolution vision (known as foveal vision by biologists) once something new is detected.

"It's a much more efficient way to do surveillance," Associate Professor Brinkworth says.

Putting this new technology into action, Associate Professor Brinkworth has developed software that can be retrofitted to existing high-grade detection cameras to extend their capabilities.

"We've done simulations and real-world trials at Woomera in regional South Australia that show we're able to track drones out 50% further than other systems are able to do – so a detection system that worked over 2km can now operate at 3km," Associate Professor Brinkworth says. "This has real-world applications for perimeter defence and airport monitoring, where unwanted drone activity needs to be detected."

The system is incredibly robust, with three modes of detection built in.

"We can track drones visually, by their heat signature and by their sound, meaning it's very hard to evade this system," says Associate Professor Brinkworth.

Associate Professor Brinkworth's work is funded by multiple sources, including the Australian Research Council and the Department of Defence, with industry funding also on the horizon.

"I'm really excited about the possibilities of our scanning technology being applied to self-driving cars," Associate Professor Brinkworth says. "The ability to detect something moving in the shadows, and for the car to respond appropriately without needing the threat to be completely in front of the car in full light, that's what I think will really improve the safety of those vehicles."

Associate Professor Brinkworth is unusual in computer science circles, as he looks to biology for inspiration. Many robotics researchers shy away from biology, as it's seen as being too variable, with too many uncontrollable factors.

"Standard engineering approaches to autonomous systems involve making everything as static as possible," Associate Professor Brinkworth says. "Whereas biology is dynamic and highly non-linear – and these characteristics are actually really useful, and efficient, if you can apply them appropriately."

Associate Professor Brinkworth came to autonomous systems research after a PhD in neuroscience, with in-depth knowledge of how nerves work. His research to understand the intricacies of the visual system of flies has been instrumental in setting up his lab's current capabilities.

"Insect vision is relatively simple, and we can study flies to track the way visual information is processed from eyes to the brain," Associate Professor Brinkworth says. "We've now applied this knowledge to build automated visual detection systems that have even higher resolution than fly eyes – we're building on millions of years of evolution but without the same biological limitations."



**Associate Professor
Russell Brinkworth**

Understanding how eyes process visual information can also be applied to design detection systems that pick up erroneous sounds in a landscape, whether on land or underwater.

The work has also led to development of an automated system for tracking clouds in the sky.

Clouds are constantly morphing and changing, appearing and disappearing based on fluxes in atmospheric conditions. It's a characteristic that makes predicting cloud cover difficult, a big issue for solar energy providers who grapple with making power capacity and storage calculations based on varied exposure of solar panels to sunlight.

"Predicting cloud cover is important for improving the efficiency of our solar power generation systems – but currently cloud tracking is completely ignored or at best calculated at low resolution based on average data, which is often inaccurate for specific time frames," says Associate Professor Brinkworth. "In our system, we don't actually track the clouds, instead we track optic flow, which is the movement of motion energy across a scene."

In the same way that you use peripheral vision to pick up movement of a cat running across a road out of the 'corner of your eye', the automated cloud detection system picks up clouds as sudden changes in motion energy.

For all the projects Associate Professor Brinkworth and his team work on, one core task dominates: extracting useful information from noisy background data.

"For visual information, acoustic data and energy data, our job is to work out how to design a system that can detect meaningful changes," he says.

It's the same challenge our brains face every day.

"For us as humans, it's the unexpected thing that gets our attention," Associate Professor Brinkworth says. "Then we collect more information to decide whether we can safely ignore the change, or take some kind of action to address a threat. That's the kind of capability I'm aiming to replicate."

Green light for sustainable water solutions

Smart science is ensuring sustainable agriculture
and groundwater supply.

By David Sly

*“The big picture is about far more than
just efficient irrigation. It’s about the
ongoing health of a vital water system...”*



The future of Australia's water resources depends on smart science – especially to ensure the longevity of sustainable agriculture – and Professor Adrian Werner considers this foremost as he investigates improved groundwater system management in northern Queensland.

His focus is the Lower Burdekin Delta system (about 90km southeast of Townsville), Australia's largest artificial recharge scheme that is maintaining underground water reserves to support continued intensive agriculture in one of Australia's most productive sugarcane-growing areas.

"A significant part of this research will be to assess future climate and sea-level conditions on groundwater, especially the intrusion of saline water into aquifers and groundwater," says Professor Werner, a member of the National Centre for Groundwater Research and Training, based at Flinders University. "Aside from the relevance to local landholders, the outcomes will have great significance for other areas. For example, the successful deployment of artificial recharge to maintain the groundwater system holds important lessons for other water-limited parts of the country. This project will deploy instrumentation in the Lower Burdekin Delta using irrigated farms as outdoor laboratories."

The research to help sustain intensive agriculture through droughts and floods in the Lower Burdekin Delta is supported by \$897,000 in ARC Linkage funding, working with industry partner Lower Burdekin Water and a team of experts in groundwater, soil and hydrochemistry from three other research institutions. Professor Werner's role leading this group underlines Flinders' reputation as leaders in field-based investigations, laboratory-based experiments and computer modelling of groundwater.

The Lower Burdekin Delta is one of Australia's largest floodplain and delta systems, covering 1260 km² within the catchment of the Great Barrier Reef World Heritage area – a region that produces one-quarter of Australia's total sugar production and represents the largest irrigation area in north-eastern Australia.

The tropical climate presents farmers with significant challenges to ensure year-round water supply for irrigation, with very dry winters and then vast amounts of rainfall in concentrated downpours. With these farms located close to the coast, management of the system needs to ensure that irrigators avoid salty water that has the potential to reduce crop productivity and soil fertility. Overcoming this challenge requires careful operation of the artificial recharge scheme, which includes the injection of river water into pits to enable continued groundwater pumping. Professor Werner believes that increased efficiencies in water use can be achieved from the field measurements and experiments and computer models created through this project.

"Through collaboration with Lower Burdekin Water, we are hoping science can deliver improved water planning and management tools for the region,



**Professor
Adrian Werner**

including new benchmarks in adaptive groundwater management strategies for agricultural areas in Australia," he says.

To build specific knowledge of this localised system, Professor Werner needs to know how, when and where farmers are pumping groundwater and applying it to the land. "There are many lessons to be learned from the existing agricultural practices and water management approaches of the Lower Burdekin Delta because they don't have major water quality issues and they maintain certain efficiencies. If we apply better science to what they are already doing, it can only improve the way they are currently operating, and then we can pass on our accumulated knowledge to benefit other irrigation areas."

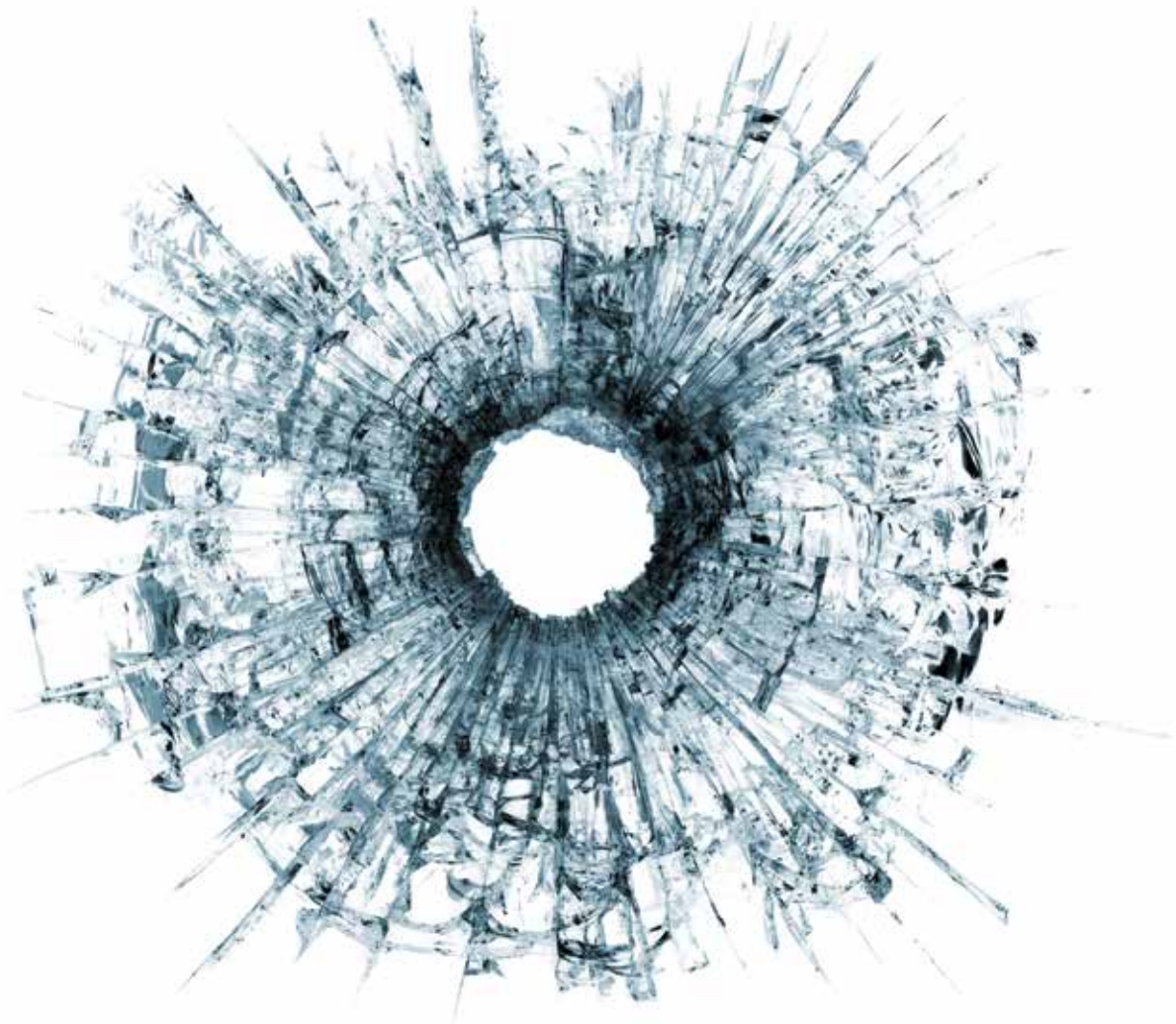
There are many shifting natural forces for the scientists to consider with this analysis, including rising sea levels, climate change and changing flows in the Burdekin River. To help them understand the delta's complexity, they will use a new state-of-the-art seawater intrusion model that will adopt a 3D representation of the coastal aquifer.

"Think of an aquifer as being like a bank account," explains Professor Werner. "If you make too many withdrawals, the groundwater drops, and if you put too much water into the aquifer, the mineral salt level leaches higher into the soil with the rising water. If contaminated water accumulates into the aquifer or discharges to sensitive ecosystems, it can lead to negative outcomes."

"The big picture is about far more than just efficient irrigation. It's about the ongoing health of a vital water system. It will interlock with other research that can provide a more cohesive environmental solution for intensive agriculture and irrigation areas, which can be applied to areas across Australia."

Professor Werner emphasises that this project must provide translational research from a multidisciplinary and consultative scientific approach. "The relationships between researchers, farmers and water managers are critical to the success of the project. We are hoping to develop a shared perspective of the longevity of the resource, so it's vitally important that the science makes good clear sense to the wider community of the region."

IDENTIFYING THE
INVISIBLE



It was once thought impossible to harness DNA from spent bullets, explosives and illegal drugs – but new forensic technology developed by Flinders University is transforming crime scene investigations.

By David Sly

It's now possible for people to be identified from DNA traces taken from objects that previously could not be read accurately – including fired cartridge cases, detonated explosives and manufactured illicit drugs – thanks to a high-precision portable testing system. The breakthrough is set to have sweeping international ramifications for supporting the success of criminal prosecutions.

“We can see cells on these items through our system, then use a microscope to pick the cells off an item, put them in a tube, analyse the DNA and generate a profile – and no-one else in the world can do that. It's a game changer,” says Professor Adrian Linacre, Chair in Forensic DNA Technology at Flinders University.

Until now, crime scene investigators applied swabs to surfaces where they presume DNA will be deposited, but without knowing for certain because DNA is not visible to the human eye. These samples are taken to laboratories, where they are subjected to an extensive laboratory procedure to isolate then quantify any DNA. It's a costly, laborious process that can take up to three hours to obtain results – and a vast majority of swab results come up negative. One state police force estimates it spends about \$7.5 million a year on swabs where no DNA was present.

New research driven by Professor Linacre and his team at Flinders University allows investigators to see exactly where DNA is located in an instant, using dye sprayed from an aerosol canister at a crime scene for an instantaneous identification of deposited skin cells.

“We can spray an item or area with the DNA-binding dye, see cells light up, and then be confident that the sample we will collect actually contains DNA. DNA becomes visible in five seconds, thanks to an inexpensive and portable fluorescence digital microscope, which allows easy viewing even in ambient light at an investigation scene. Then we take the swab away for more serious analysis to make an accurate DNA profile.”

The inspiration for this new system came to Professor Linacre three years ago, when he made a thumb print on a glass slide, applied dye and, through a powerful microscope linked to a computer, he could see illuminated skin cells on the screen. In this moment, he realised that testing for DNA could be done on site with portable devices rather than in laboratories – saving great time and money, and increasing the success rate of DNA profiling.

This discovery will have global implications in an emerging science that first recorded DNA profiles generated from touched objects in 1997. The 13-person Flinders University team – which also features chemistry expert Professor Paul Kirkbride – is now recognised as a world leader in this type of DNA research. Their 17 published research papers during the first half of 2022 verify their exciting initial findings and underline the legal validity of the new system to support effective crime investigation.

Professor Linacre's trademark rigour was developed during 17 years of crime scene investigations in Glasgow, and has not waned since commencing his research career with Flinders in 2010.



**Professor
Adrian Linacre**

“It's a very significant piece of the larger forensic puzzle,” he says. “Our work brings closure. It's a relatively immediate science. Each piece of research leads us through another door – and onward.”

“We can't afford for any of this to be wrong or have errors. These can't just be bright ideas. The research results have to be peer reviewed and irrefutable. It has to stand up in a court of law,” he says, noting that the Flinders team has been teaching the system to crime scene investigators from the NSW and WA police forces, and attracted recent international attention from Finland Police.

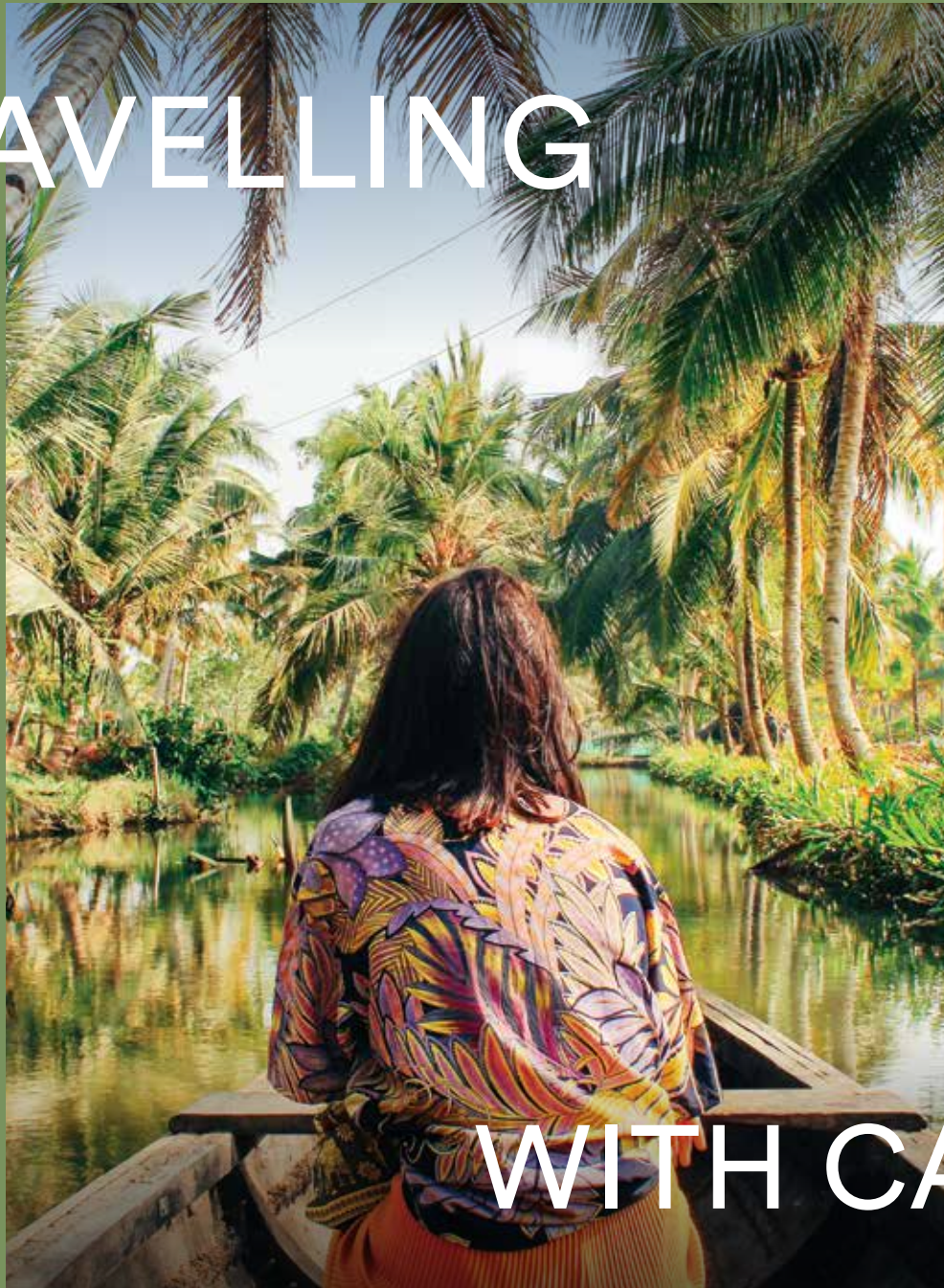
Professor Linacre's team is now researching the so-called shedder status of different people, measuring the propensity of a person to shed skin cells and deposit their DNA. Three grades of shedders have been identified, from heavy shedders depositing many cells with every touch, to very light shedding. Rigorous testing has also shown that a person's shedding status is consistent across all parts of their bodies (from both left and right hands, for example) and does not change over time.

“To identify someone's shedder status is another means of more accurately identifying a DNA profile that will be able to stand as irrefutable evidence in court.”

Professor Linacre is also confident of unlocking information about secondary DNA transfer to trace the history of DNA on an object and identify specific timelines of when each deposit was made, leading to positive identification of people in exact locations at specific times.

“It's a very significant piece of the larger forensic puzzle,” he says. “Our work brings closure. It's a relatively immediate science. Each piece of research leads us through another door – and onward.”

TRAVELLING



WITH CARE

Building a sustainable and resilient tourism industry

By Bill Condie

We don't have to destroy the places we love to create a sustainable tourism industry, but making it happen can be complex, requiring customised solutions for sustainability and resilience.

"It's all about having the right tools and knowing how to use them," says Dr Laura Lesar, Senior Lecturer at Flinders University, who has embraced that challenge for her entire career.

Tourism is the largest industry in the world. It touches every continent, but it can degrade the very natural, social and economic environments that feed it.

When the global tourism industry slammed to a halt at the beginning of the COVID-19 pandemic, it devastated many lives and businesses reliant on the income brought in by travellers. However, it also provided a breathing space to take stock of the impact the industry was having on some of the world's most beautiful and culturally valuable places.

Now, as tourist numbers are returning to pre-pandemic levels, few would disagree that it is in everyone's interests that the industry minimises its negative impacts while maximising positive contribution to the environment, communities and local economies – that is at the heart of sustainable tourism. Translating sustainable tourism into practice is the hard part, and the focus of Dr Lesar's research.

Her expertise is in the quality control tools that assist businesses to implement sustainability in practice.

"Perhaps the best-known examples of these tools are certification programs," she says. This involves businesses implementing a prescribed set of sustainable practices and successfully completing an independent audit.

Certification is just one of the many tools available. Other tools, such as the Global Reporting Initiative, can help businesses disclose their impacts on the environment, society and economies as part of their environmental, social and governance (ESG) reporting.

There are also tools that help businesses to build capacity for sustainability, such as sustainability training programs for employees. Many tools are accessible for any business, such as best practices, which can be as simple as installing energy-efficient light bulbs.

Through industry consultation and extensive review of sustainability practices internationally, Dr Lesar has identified more than 100 tools that businesses can use to translate sustainable tourism principles into practice.

"This is important because we can mix and match these tools to create a customised 'tool mix' for businesses, and industry is showing preference for these solutions as opposed to a one-size-fits-all model," she says.

Dr Lesar has built her expertise through multi-disciplinary study and hands-on industry experience.

Her journey began in the United States where she was an environmental studies major at the University of California, Santa Cruz. Her major emphasis was sustainable development, or 'sustainability' as we refer to it today. Specifically, she examined ecotourism as a vehicle for sustainable development.

"I was interested in development that is environmentally, socially and economically responsible. Sustainability for any business means minimising the negative impacts on people, planet and profit, while maximising its positive impacts."

After building expertise in sustainability, she knew she needed to develop parallel expertise in the business of tourism. That led her to complete a Master of Science in Travel Industry Management at the University of Hawai'i.

"And that's where I started looking beyond ecotourism to the broader concept of sustainable tourism," she says.

"I became very interested in the practical tools that translate sustainability into business practice. And that really set my trajectory."

She then worked in a sustainable tourism consultancy and served as an auditor for a sustainable tourism certification program, learning the nuts and bolts of tool design.

This passion brought her to Australia, where she completed her PhD in Sustainable Tourism at Griffith University, Gold Coast. After that, Dr Lesar served as Assistant Professor at the University of Hawai'i specialising in sustainable tourism, embracing localised challenges.

"Pre-COVID, Hawaii was experiencing many challenges associated with over-tourism, where visitors outnumber residents, and residents perceive that the impacts of tourism are negatively impacting their quality of life," she says.

When global travel virtually stopped during the pandemic, it provided space to assess how the industry was impacting some of the world's most environmentally and culturally valuable places. This underscored the dual imperatives of business sustainability and resilience.

With this perspective front and centre of her work, Dr Lesar joined Flinders University as Senior Lecturer.

She is now building on her previous work by developing innovative methods for producing a 'tool mix' for business sustainability and resilience, customised to the unique needs of each business.

She has partnered with Gemtree Wines, a local winery internationally recognised for its sustainable tourism practices.



Dr Laura Lesar

"Pre-COVID, Hawaii was experiencing many challenges associated with over-tourism, where visitors outnumber residents, and residents perceive that the impacts of tourism are negatively impacting their quality of life," she says.

The company is facing challenges common to the industry in South Australia and the rest of the country.

"Closing the national borders was a significant impact, of course. And the wine industry is facing many of the same challenges as other businesses, whether it's rising costs of exports or fuel," she says.

In this climate, tourism can be a vehicle for good.

"If we look at wine business, we can think of it as consisting of three core components. There's grape-growing, the winemaking and tourism. That means three different ways to gain revenue to help them stay financially afloat."

"Tourism may help, in some cases, offset some of the losses the difficult trading conditions are bringing," says Dr Lesar.

With Gemtree, she is refining a methodology for creating customised, place-based sustainability solutions. This has produced a set of tools ideally suited to Gemtree's unique needs, and a roadmap for its phased implementation.

"Once we've finalised the implementation of the tool set, then we will performance optimise it," says Dr Lesar.

"I could not be more excited to be working with a third generation McLaren Vale winery. They have been an incredible company to work with."

While Dr Lesar's work has global implications, she also highly values the localised, positive impacts of her research.

"As researchers and scholars, we want to come up with place-based solutions for the community, to make our part of the world just a little bit better."