inSCight

Inspiring stories from the Faculty of Science

ISSUE 15 | 2021

Finding solutions with science

Bringing back our oceans

Mussels making a difference

Cyberspace

Making it a safer place

How fresh is our air?

Find out what you're really breathing in

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Silver trevally fish (*Pseudocaranx georgianus*) feeding on krill near the surface, as a lone Fairy Prion (*Pachyptila turtur*) flies above. Mokohinau Islands, Hauraki Gulf. New Zealander Darryl Torckler is an award-winning underwater photographer.

Cover photo: Darryl Torckler

A word from the Dean

WELCOME TO THE 2021 edition of *inSCight*. This edition is themed around finding solutions with science. We will be exploring many of the ways in which research in the faculty has responded to global issues in the past year.

While COVID-19, and the way Science has stepped up to address the pandemic, has dominated headlines, notably via the contributions of Auckland Science staff such as Professor Dame Juliet Gerrard, Prime Minister's Chief Science Advisor, and COVID modellers Professor Shaun Hendy and Dr Dion O'Neale, there are many other issues that we have been helping to address.

Vital elements

The environment and our impact on it is one of the most pressing of those issues. The air we breathe and what's in it has been receiving much attention. Whether that relates to aerosol spread of COVID particles or other types of emission, Dr Joel Rindelaub from Chemical Sciences is at the forefront of research, as well as a practised science communicator. Professor Jennifer Salmond from Environment has also been looking at causes of urban air pollution and potential mitigation strategies.

Being an island nation, the health of our oceans is a paramount concern. Dr Jenny Hillman and her team in Marine Science have been working on green-lipped mussel restoration in the Hauraki Gulf – an ecosystem that was decimated by over-fishing last century. A by-product of successful restoration is that it will help reduce the amount of silt in our water, enhancing biodiversity; mitigate eutrophication; and could sequester large amounts of carbon, contributing to mitigating climate change.

In a different take on ocean health, Associate Professor Rochelle Constantine and PhD student Louise Wilson from Biological Sciences are researching sound pollution and creating a soundscape of the Hauraki Gulf. A by-product of COVID lockdowns has been the ability to understand what a noise-free ocean sounds like (see page four).

In this issue

"Being an island nation, the health of our oceans is a paramount concern."

Ingenuity and resolve

Our alumni are, of course, also very active in addressing global problems, and in this issue we highlight two of them, both former Biological Sciences students. Dr Anne Wyllie has been leading the Yale School of Public Health research team behind one of the most prominent saliva based Covid-19 tests. Neil Birrell is tackling issues of waste in his Hexacycle start-up, which is converting organic waste into a protein source for animal feed using the Black Soldier Fly. His PhD studies look at insects as food in New Zealand (see page eight).

While viruses have dominated headlines in recent times, bacteria and antibiotic resistance are also a constant threat. Hill Tinsley Medal recipient Associate Professor Frédérique Vanholsbeeck and her colleague Dr Cushla McGoverin, both from Physics, have been addressing this problem in a novel way by applying biophotonics to provide better food safety and antibiotic sensitivity testing (see page ten).

Creating opportunities to thrive

Closer to home, we are looking to address under-representation of Māori and Pacific people in Science via a new initiative, Ngā Motu Whakahī, which seeks to provide bridges between islands of learning to overcome some of the barriers to participation and progression that we have identified. And contrary to what you may have seen in the popular press and on social media, we have very active Mātauranga Māori research and engagement within the Faculty, as highlighted in our centrefold (see page 12).

Reaching out to potential students continues as a theme in Bioinformatics Masters student Sebastian Dunn's article describing his experiences at the MOTAT STEM Fair. Sebastian has built a Virtual Reality experience that teaches students about DNA. He is working to discover the best ways to communicate scientific concepts in this new 3D medium (see page 17).

Image: iStock/Enot Poloskun

Whether it's pipelines in the East Coast USA or District Health Boards, Banks, and the Stock Exchange here in New Zealand, cybersecurity is never far from the headlines due to the impact when it fails. Dr Danielle Lottridge from Computer Science has been looking at the human side of cybersecurity, including an interactive exhibition at Auckland Museum exploring data surveillance through facial recognition, and a recent address to the New Zealand Parliament. Dr Rizwan Asghar, also from Computer Science, has been focussing on cyber-attacks and cybersecurity (see page 14). I'd also draw your attention to the annual Gibbons Lecture series hosted by Computer Science, the most recent of which was themed *Dissolving the interface between humans and computers* and included a talk by Danielle. Recordings of these sessions are available online and can be found at cs.auckland.ac.nz/gibbons-lectures.

While health has been a common theme through the year, the contribution of exercise to wellbeing is something that has been highlighted during lockdowns. Our own Exercise Sciences Department has been active in this space. Dr Rebecca Meiring has been exploring exercise and chronic health conditions such as diabetes and neuromuscular disorders, while PhD student Ruhi Bajaj (joint with Business) has been researching wearable technology to aid preventative healthcare (see page 18).

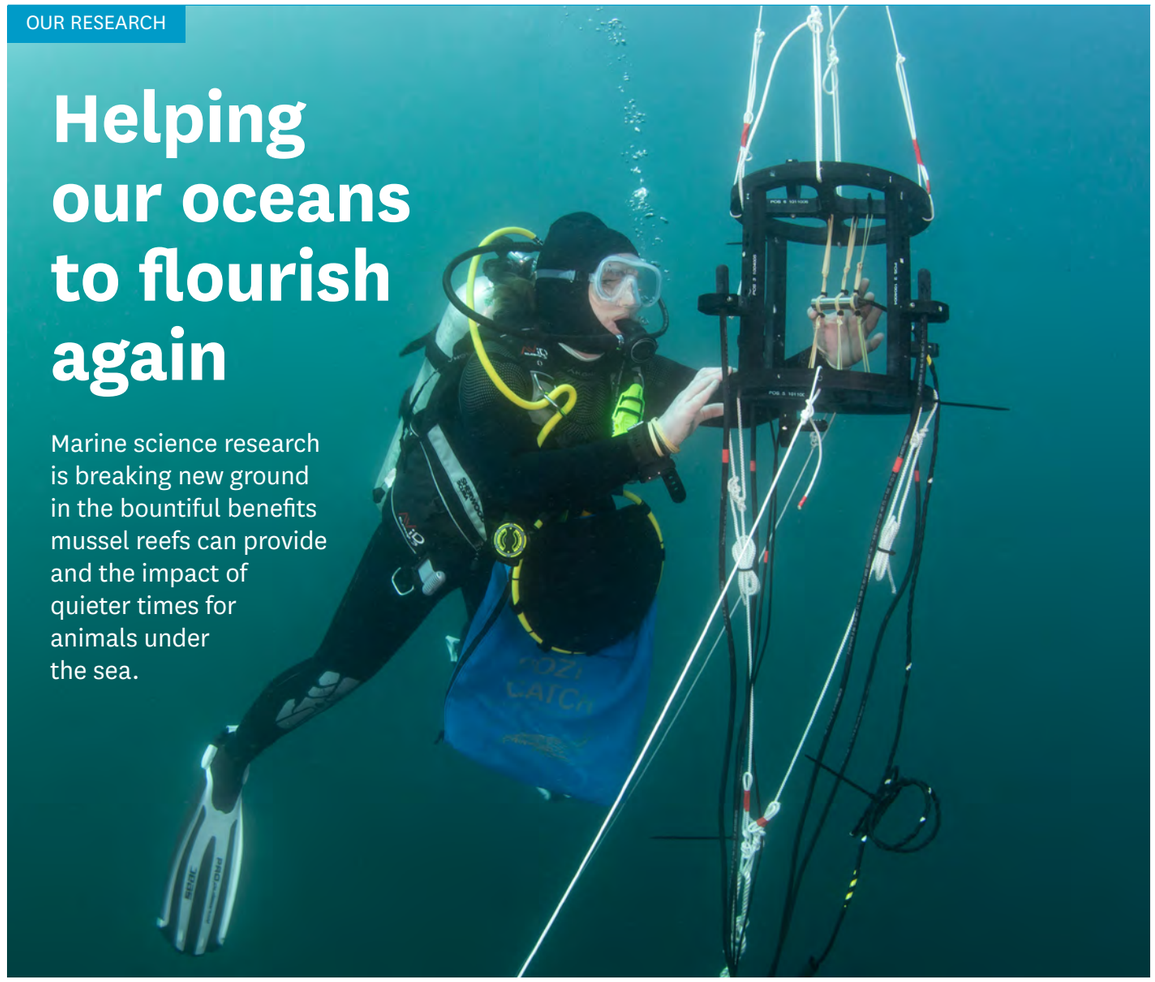
We round out this issue with a couple of student profiles and a thought piece by Professor Niki Harré from Psychology on human connections and the practice of love, ahead of her presentation on the same topic at TEDxUoA later this year.

As always, a wide variety of contributions from our diverse and impactful faculty. I do hope you enjoy it and that you and yours are surviving well in these unusual times.

PROFESSOR JOHN HOSKING
Dean of Science,
University of Auckland

Helping our oceans to flourish again

Marine science research is breaking new ground in the bountiful benefits mussel reefs can provide and the impact of quieter times for animals under the sea.



A PROPOSAL TO establish Ahu Moana conservation areas which are co-managed by mana whenua and local communities form part of the Government's new strategy to revitalise the Hauraki Gulf, and Faculty of Science researchers are leading the way by partnering with iwi to restore long lost mussel reefs.

For Institute of Marine Science Research Fellow Dr Jenny Hillman, collaborations with Ngāti Manuhiri in Kawau Bay and Ngāti Whātua Ōrākei in Okahu Bay are an opportunity to share knowledge and research about mussel restoration. "They're helping us to co-develop monitoring methods that anyone can then use to track how their restoration efforts are going."

Funded by multiple donors including The Nature Conservancy, Foundation North's Gulf Innovation Fund Together (G.I.F.T.) and the George Mason Centre for the Natural Environment, Jenny's research aims to identify critical knowledge gaps and develop techniques to improve the health, productivity and resilience of coastal ecosystems that have been progressively stripped of mussel populations over the past sixty years.

The healing power of mussels

Since 2013, more than 150 tonnes of the green-lipped shellfish have been placed in the Hauraki Gulf and Marlborough Sounds in the hope that new beds will revive ecosystems by removing suspended sediments from water columns and encourage the return of marine life ranging from microscopic worms to large fish species.

World-first research conducted by Jenny and PhD student Mallory Sea has revealed that mussels enhance denitrification by filtering out harmful nitrogen – something which could help mitigate the worldwide problem of eutrophication. "Eutrophication can be really detrimental, and so showing that something like mussels can help with that is really important," says Jenny.

Carbon sequestration by mussels is also under the microscope, although Jenny says that building a conceptual model which includes how the molluscs breathe is very complicated because the carbon cycle interacts with the nitrogen cycle "and you're looking at all these multiple cycles happening at the same time".

PhD student Louise Wilson using hydrophones and an accelerometer to record how the soundscape changes as a boat passes by on the surface. Photo: Paul Caiger

In search of success

Restoring mussel populations is easier said than done. Farmed mussels donated by the seafood industry are a great source, but PhD student Al Alder found that juvenile wild mussels have greater survival rates than juvenile farmed mussels. But while juvenile mussels may be more efficient, they're also more vulnerable to predators like snapper and rays. Various forms of protection, including the use of coconut matting, fences and cages have been trialled but, as Jenny says, "that's hard on a large scale because you can't cage everything".

Additional research will hopefully identify new techniques to lay and monitor beds – especially given that mussels arrange themselves in different ways at different sites which consequently affects water flows and how sediment gets trapped.

Understanding 'what success looks like' is also part of the challenge, and the School

"The goal for all of us is to make the marine environment better and mussel restoration is only one step."

DR JENNY HILLMAN

of Computer Science is assisting Jenny and PhD student Sophie Roberts to look at different ways to map and model beds with affordable methods – like cameras – that community groups and iwi can use. "The goal for all of us is to make the marine environment better and mussel restoration is only one step," says Jenny.

Another Faculty of Science researcher who has welcomed the Government's new strategy to rejuvenate the Hauraki Gulf is School of Biological Sciences and Institute of Marine Science Associate Professor Rochelle Constantine, who studies large marine animals.

Proposed restrictions on commercial and recreational fishing and the extension of marine protection clearly acknowledge multiple stressors on the Gulf ecosystem, however Rochelle says the problem of noise often slips below the radar. "There are many layers of impact from people and one of them is acoustics, and it's not something that's often considered."

Building on previous research by Associate Professor Craig Radford at the Leigh Marine Laboratory, PhD student Louise Wilson is conducting a new study into the sound pollution generated by recreational boaties, who grew to a record 45 percent of the adult population in 2020.

Tuning into the Gulf

By placing hydrophones on the seabed and using shore-based cameras to match activity on the surface, Louise aims to create a 'soundscape of the Gulf' which differentiates between the long-term chronic sound from shipping versus the short-term impulsive and intermittent sound of small boats that manoeuvre and pass by at high speed.

"Smaller vessels usually produce higher frequency sounds and it's much more intense and also much louder," says Rochelle, pointing to the potential impact on many different species of fish and invertebrates, like crabs, lobsters, and molluscs, that produce and hear sound that might protect them from predators.

While different animals have different abilities to adapt, Louise points out that many species are "tied to the coast" – unlike larger animals that can move to avoid the impact. "Invertebrates and fish can't, they're tied to their habitat. They don't have the ability to move away from a stressor."

Silence is golden

While the impact of Covid-19 has increased recreational boating activities, the first major lockdown in early 2020 gave Louise a rare opportunity to establish a crucial baseline. "She had five weeks of basically silence," says Rochelle, "so we know what these reefs sound like when there's not lots of boats buzzing around and that is really exciting."

Without the boats, Louise says, "the range over which these animals communicate demonstrably increased" and knowing what those sounds are in the absence of boats "can help us really know what we should be striving for".

The research has been primarily funded by G.I.F.T, the Whitney-Chisholm Trust and Auckland Council, and Rochelle says the launch of the University's new purpose-built research vessel in late 2021 will aid researchers like Louise who need a good platform for diving.

It's also important, she says, to start having conversations about how to mitigate the amount of noise going into the water, including the possible use of electric boats.

"To have a functioning ecosystem, marine life needs to be able to see and they need to be able to hear. They need to be able to find food, find mates and live their best life. And I think as humans, we've really detached ourselves from thinking about how important this is."

To support vital research on shellfish restoration and fundamentally improve New Zealand's marine environment, visit: ***giving.auckland.ac.nz/shellfish***

PhD student Mallory Sea taking macrofauna cores (to look at the animals that live in the sediment) as part of the monitoring programme for the restored beds.

Gape sensors deployed on mussels on a restored mussel bed.

Waving goodbye to wood smoke and car fumes

Our researchers investigate what's really in the air we breathe and how we can make it cleaner and fresher in our urban areas.

Image: iStock/Sheryl Watson

THE WOOD BURNER crackles away merrily, spreading warmth throughout your home. Its smoke goes up the chimney and out of sight. But you may be breathing in this smoke after all. It can escape from your burner and into your living room. It can hang around urban areas as a low-lying haze, especially in winter. It may infiltrate your indoor air through open doors, windows and even ventilation systems.

Domestic wood burners are one of the main contributors to poor air quality in Aotearoa New Zealand, along with vehicle emissions. Smoke is made of particulate matter, explains Dr Joel Rindelaub from the School of Chemical Sciences. "These tiny particles hanging out in the air are terrible for you as they have a lot of carcinogens and cancer-causing compounds.

"There's a lot of this really high-risk particulate matter specifically with these combustion processes – they seem to form the smallest type of particles and the smaller they are the more dangerous they are."

Invisible pollutants

The smaller the particle the more dangerous it is to human health as it can travel further within our bodies. Particles less than 2.5 microns can get deep into the lungs, while nanoparticles which are smaller still can pass through the lungs and into the heart, ultimately reaching the brain, says Joel, who's focus lies in atmospheric chemistry. "Those happen to be three of the most important organs in your whole entire body. So once these particles get into your body, they can be transported anywhere."

Although New Zealand's air quality is relatively good by global standards, the country currently only regulates particulate matter 10 microns or less in size (PM10). But the Government is working on proposed amendments to the National Environmental Standards for Air Quality (NESAQ) which will target PM2.5, the smaller particles that can impact our health, and which is regulated in most developed nations already. Wood and coal combustion is one of the main sources of PM2.5 in New Zealand and so included in the proposed changes is a lowering of the emissions standard for all domestic solid-fuel burners to reduce PM2.5 in our air, particularly during the colder months.

Joel says it's an analytical challenge to understand the complexity of particles that are smaller than 10 times the width of your hair. His research looks at understanding some of the sources of air pollution that are occurring in New Zealand, that might not be on our minds, not only from outdoor activities such as fireworks but the quality of air in our homes, cars, and workplaces.

"People will be happily sitting around a bonfire for hours in the middle of the beach and not realise what is in the air they are breathing and that the reason their hair smells like smoke for the next week is because of toxic particles."

To find out what particles are in the air, he traps them using a filter system. "Much like a coffee filter will collect ground up coffee beans, our filter will collect tiny little particles suspended in the air. Once the particles have been collected, we can analyse them in the laboratory using mass spectrometry to understand their chemical compositions," he explains, often partnering with Auckland Council to measure the air quality at sites throughout Auckland.

"Previously, we have measured the air quality in West Auckland during Guy Fawkes celebrations and on Custom Street in the CBD leading up to the summer holidays. One surprising finding was the presence of illicit drugs (at low levels) in background urban air."

"Humans have done a great job of polluting the environment with our own synthetic creations."

DR JOEL RINDELAUB

Airborne microplastics

Joel is also co-supervising masters student Wendy Fan from the School of Environment, who is investigating whether microplastics are in the air. A grant from Maurice and Phyllis Paykel Trust enables Joel to study some of the inhalable microplastics and he helped Wendy with the chemical analysis of her rainwater samples.

"Everything that's in clouds or that becomes rain has been transported there from the atmosphere at some point,' says Joel. "And what we want to do is understand where it came from and why it's there."

They measured for the presence of microplastics using fluorescence microscopy and found microplastics present in the rainwater.

"So when it's raining on you, it's literally raining plastics," says Joel. "Humans have done a great job of polluting the environment with our own synthetic creations."

Using a cutting-edge technique called pyrolysis GCMS, they can identify the type and the exact amount of each plastic in the samples and are aiming for their paper to be published by the end of this year.

Reducing your exposure

Professor Jennifer Salmond from Environment is also one of Wendy's co-supervisors alongside Associate Professor Kim Dirks from Engineering, whom Jennifer has collaborated with to explore the pollutants people are exposed to as they move around a city.

Jennifer has always been intrigued by the link between human activities and the quality of the air we breathe and uses this knowledge to create mitigation strategies for urban pollution.

She is interested in thinking about how we can use low-cost instruments to measure exposure levels and effectively identify transient pollution hotspots in cities, not only to help individuals protect their own health but to inform the development of policy tools that can make a difference to population health.

"The low-cost instrument research has been a project for many years (funded by MBIE) and is ongoing as we enhance our techniques for auto-calibration using modelling and statistical approaches, as well as improving the instruments themselves," says Jennifer.

"For example, we are currently working with Mote Ltd to develop low-cost particle sensors which overcome some of the current limitations of commercial sensors for measuring specific particulates (such as very small black carbon particles and asbestos-like fibres)."

An example where people have already benefited from mitigation strategies reducing pollution exposure is the introduction of a requirement for idling buses to turn off their engines at bus stops, says Jennifer. But even better, Auckland's red bus fleet became fully electric earlier this year, these are quieter and cleaner than the diesel buses and a step closer to electrifying Auckland's entire bus fleet which is likely to have a significant impact on air quality in the city centre.

She says there are low-cost aspects of urban planning that can make a difference to pollution exposure daily, such as separating pedestrian areas of a city from the vehicle areas. Pedestrians can also make small choices with a big impact, such as walking on the opposite side of the road from a queue of idling cars and distancing themselves from the exhaust fumes. Another is taking two steps back from an intersection crossing rather than waiting right on the curb. "Increasing your distance by even a meter or two can make a difference."

Professor Jennifer Salmond uses a hand-held particle sensor to measure air quality in urban areas. Photo: Elise Manahan

Dr Joel Rindelaub weighs out filters on the analytical balance to perform gravimetric analysis of aerosol mass loading. Photo: Elise Manahan

Clean, healthy cities

Joel says reducing pollution in New Zealand on a large scale comes down to two main factors. The first is to improve the build and insulation quality of housing so less heating is needed to enjoy a warm home. But equally important is increasing the use of cleaner heating sources such as ultra-low emissions wood burners or heat pumps.

The second factor is having more electric cars on our roads, says Joel. "We need to improve our vehicle fleet, so we aren't producing such high amounts of dangerous air pollution."

Jennifer says she would like to see healthier, sustainable cities. "I'd like to see a city that's a fun, clean, vibrant living environment. It's not noisy, it's not polluted. It's a happy, clean, healthy, and safe place where people enjoy to stop and mingle as well as commute through. It is possible to design and to modify cities to create these types of urban environments and what they're already doing down on Quay Street I think is really heading in the right direction."

Saliva – a game changer for Covid-19 testing

Biomedical Science alumna Dr Anne Wyllie is at the forefront of the global pandemic efforts, having developed a faster, more efficient and less invasive Covid-19 saliva test.

DURING HER SIX years at the University of Auckland Anne gained a Bachelor of Science, Postgraduate Diploma, and a Master of Science with a focus in cancer immunology.

She went to the Netherlands and completed a PhD in Medical Microbiology at UMC Utrecht and is now a research scientist at the Yale School of Public Health in the United States.

"Having worked to develop saliva as a sample type in my research leading up to that point," Anne says, recalling when the pandemic began, "I wondered if there was potentially a role for saliva to help overcome many of the challenges we were facing on a daily basis (the shortage of swabs, the need for trained healthcare workers to take the swabs, testing hesitancy and aversion from individuals not wanting to be swabbed)."

Anne and her research team started developing SalivaDirect in May 2020 and worked tirelessly to create the most sensitive test possible.

"In the end, we achieved a method with the same sensitivity as many of the other great polymerase chain reaction (PCR) tests out there, including the US CDC's own PCR test which requires a much more extensive (and expensive) test process."

How is the saliva testing going currently?

Testing itself is going brilliantly. A number of countries actually made it their sample type of choice very early on. In the US it continues to gain traction. Many labs and most patients prefer saliva testing to swab-based approaches.

What part of this research is most exciting to you?

It was so inspiring to find so many people across so many different sectors willing to come together as part of the pandemic response and openly share ideas, concerns, and resources. It has been incredible to see how quickly things can develop when so many people work together towards a common goal.

Why is testing for COVID-19 via saliva so important?

Overall what is most important, is that we have options. Saliva collection can be done using a wide range of simple laboratory plastic tubes and our work has also demonstrated that SARS-CoV-2 detection in saliva remains very stable at room temperature – and at elevated temperatures. This means you do not need cold chain transport so can have even greater benefit in low resource settings. Being able to self-collect can ease collection sites.

Thinking about circumstances in New Zealand I also think it could transform mass testing of people arriving into the country. A saliva collection kit could be at each seat on a plane, while masked, passengers collect saliva in their mouth, then quickly remove their mask to collect their sample in a tube in less time than many take to eat or drink, wipe down their tube and hands with a disinfectant wipe and drop it off in a collection box. This would make a much faster – and more affordable – way to test large numbers of arriving passengers.

Where do you see your career heading?

I hope to remain involved with advancing saliva as a diagnostic sample type to improve access to healthcare and to improve preventative healthcare, and along the lines of my previous research interests, to use saliva as a means to better understand how normal upper respiratory tract pathogens circulate through our communities and in healthy individuals before they cause disease.

What has been the highlight of your career so far?

While working with the NBA was definitely a surreal experience, I was recently at a conference which focused on lessons learned during the pandemic for getting children safely back to school and helping to ensure they could remain safely in school. Almost every speaker mentioned our work which I was in no way prepared for – I hadn't been fully aware of our impact until then. It was absolutely incredible to hear so many schools using saliva to successfully make a safe return to school, either by actually using SalivaDirect, or through lessons learned from our work.

Dr Anne Wyllie.

"It has been incredible to see how quickly things can develop when so many people work together towards a common goal."

What motivates you to make a difference in the world?

I'm not sure whether motivation is the right word, rather, our team has worked tirelessly the past year just from knowing what real world impact we could have and when you know there's a way you can help, it's not something you can easily turn away from.

Finally, tell us something about yourself that we can't learn by Googling you!

I actually met some of my best friends in my UoA laboratory classes! The BSc Biomed really brought together a wonderful cohort of students, a good number more I'm still in touch with and have loved to see where their careers post-UoA have taken them.

Tiny insects key to solving big problems

Biological Sciences alumnus Neil Birrell's Hexacycle start-up is putting organic waste to good use with the help of a certain fly, while his PhD research explores if other insects could become part of our future diet.

NEIL'S INTEREST IN the natural world was inspired by the many hours spent during his childhood, exploring rockpools and streams around Scotland and Northumberland.

Now he is halfway towards gaining his fourth qualification at the University, investigating insects as a food source in Aotearoa New Zealand for his PhD in Biological Sciences.

But before he returned to his studies, he created a start-up supported by the University's Centre for Innovation and Entrepreneurship (CIE) programmes.

"Hexacycle converts organic waste into insect biomass which can then be used as a protein source in animal feed," explains Neil. "This uses a species of fly called the black soldier fly, which has a remarkable ability to consume a variety of organic wastes.

"Insects as food and feed is a very recent field of research and there is so much scope to study.

"There is also a certain visceral joy in the idea of producing metric tonnes of maggots," he adds.

By chance, he mentioned his start-up to Ashok John in New Zealand, who had family in Kerala, India with large poultry farms. Feed costs were a large proportion of their overheads, says Neil and soon he was heading over to Kerala to establish Hexacycle there.

How does the treatment plant help the planet?

There are a few reasons: it diverts organic waste being dumped or going to landfill (where there are issues of leachates and methane); it provides a domestically produced source of protein that doesn't require productive farmland (it can be built in disused sheds and urban areas); and it also requires very little water or energy.

How is the second pilot plant in Kerala progressing?

The second plant in India is going well and in fact Ashok has been setting up a third plant earlier this year at another poultry farm. This poultry farm is in a very hot and dry location (compared to the hot and humid conditions of the first two plants) which is giving me plenty of biological problems to troubleshoot from afar.

How did you deal with the challenges in establishing a start-up?

There were so many challenges but thankfully there is a lot of great support at the University to help you overcome those challenges. The CIE has lots of great programmes and mentors to help students navigate their way around challenges.

Where do you see your company and career heading?

I've come to realise global production of black soldier fly meal is just a drop in the bucket in comparison to soya meal production. To become competitive and have impact there needs to be a sizeable increase in people growing black soldier fly larvae. To achieve this, individual farmers growing black soldier fly to supplement their income need to become prevalent rather than individual companies.

What has been the highlight of your career so far?

I'd have to say the friends I made in India who made me feel like a part of their family. I really hope they stay safe and well in the difficult circumstances at the moment.

What is your PhD research topic?

I am investigating the insects as food in Aotearoa. It's a varied and interdisciplinary topic that explores public acceptance of insects as food, what insects have been eaten in NZ, the reproductive biology and behaviour of our endemic longhorn beetle Prionoplus reticularis (huhu beetle), and metabolomics of the larvae (huhu grubs).

Neil Birrell. Photo: Abhilash Hatcheries, CC-BY

What motivates you to make a difference in the world?

I find insects (and all invertebrates) fascinating and getting to learn more about them whilst doing something useful is a great feeling.

Finally, tell us something about yourself that we can't learn by Googling you!

I really like Nicolas Cage movies. I've also eaten at least 20 different species of insects (including a giant hornet).

Black soldier fly (*Hermetia illucens*). Photo: Neil Birrell

Lighting the way with biophotonics

Researchers in biophotonics tell us how they are using fundamental science to create solutions that improve food safety testing and reduce antibiotic resistance.

YOU MAY NOT have heard of biophotonics, but you've probably used it in everyday life, such as when you have an eye test with an optometrist. It's an area of applied physics that uses light to understand biological systems.

Associate Professor Frédérique Vanholsbeeck (recipient of the New Zealand Association of Scientists' Hill Tinsley Medal in 2020) and Dr Cushla McGoverin, from the Department of Physics are part of the University's Biophotonics Research Group. They are also members of the Dodd-Walls Centre for Photonic and Quantum Technologies, a national Centre of Research Excellence operating across Aotearoa New Zealand. Together with colleagues in microbiology, engineering and other disciplines, they're working on a number of projects using light that could help solve some of the key problems facing societies at the moment.

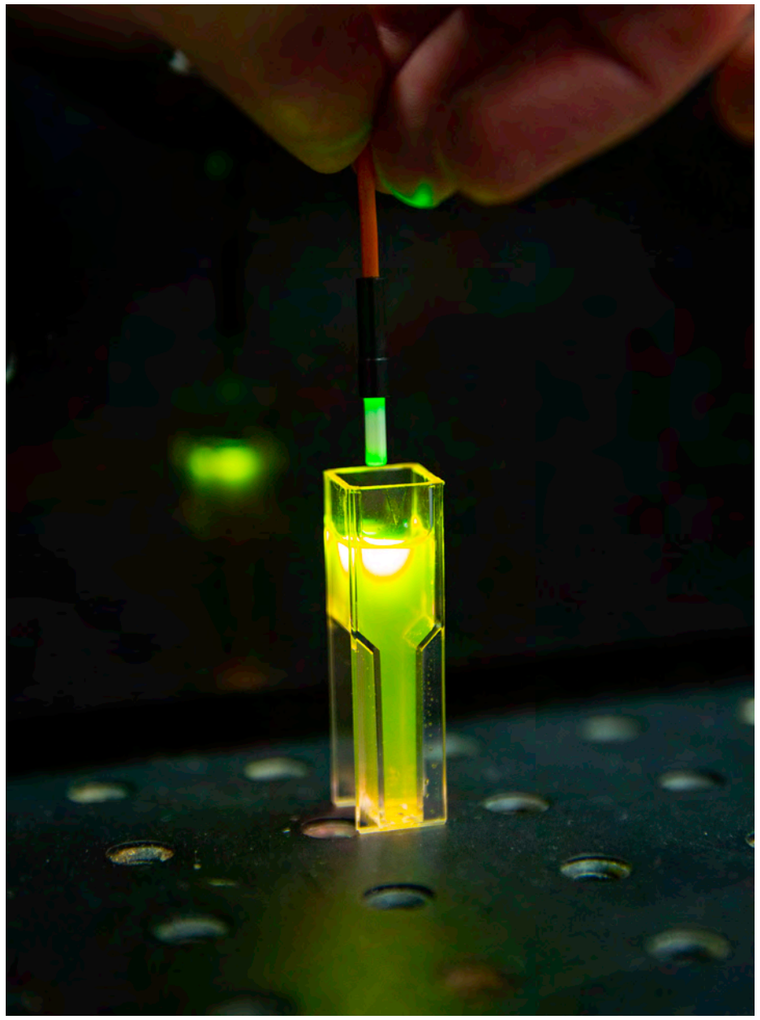
Food safety under the spotlight

Frédérique and Cushla first started collaborating on a project called FoodSafe, with the idea to upgrade the way meat is tested for bacteria. The process currently takes up to two days, so their goal was to find a cost-effective way of counting bacteria in near real time. They aim to achieve this with fluorescence spectroscopy, a technique that employs dyes and light to measure the fluorescence of molecules.

Using this tool, they have found a way to detect a high concentration of bacteria rapidly. Cushla explains: "What we have at the moment is good for applications where you use microbes to make a product, for example in pharmaceuticals, fermentation or making yoghurt. It's good for those high load applications. However, swab samples for meat or food safety applications in general need to detect low concentrations of bacteria, so we're halfway there."

The team are currently working on being able to count bacteria at mid and low concentration levels required for food safety testing in the food industry.

While they've been investigating the feasibility of using fluorescence spectroscopy for food safety, they've also learned a lot about the fundamentals of biophotonics that could be developed and applied to other settings. "While we pursue some very targeted research questions like 'Is the water potable?', we also learn a lot about bacteria and that allows a lot of fundamental science to occur," says Frédérique. "It's really good to maintain that pipeline between fundamental and applied research."



Fluorescence in action. Fluorescence is the process when a material absorbs light and emits light of lower energy. Here a rhodamine solution absorbs green light to emit yellow light. The phenomenon of fluorescence is used by the FoodSafe group to enumerate bacteria. Photo: Elise Manahan

Cushla agrees: "Just because you can't see what the application of fundamental research would be straight away, doesn't mean that it's not good research. Fundamental research and blue sky thinking has a function."

During the FoodSafe project, their team identified that the fluorescence spectroscopy method they used could measure concentrations of bacteria, but couldn't determine the species or whether bacteria are dead or alive. "The failure of the original idea is that we were detecting dead and alive bacteria alike," says Frédérique. But a new research idea spun out of this original 'failure'.

A lightbulb moment for antibiotic resistance?

Identifying whether bacteria are dead or alive is not easy. Different species thrive in different environments, some can 'play dead' or repair themselves when damaged, and others we don't know enough about yet to determine the conditions they thrive or die in.

Craig Steed, a PhD student within the Biophotonics Research Group, is currently looking at whether there are any changes in cells that can clearly signal that they are dying. This fundamental research could have interesting applications in health settings, particularly in the area of antibiotic resistance.

Frédérique explains: "What we really want is to develop a rapid test, so you can prescribe the right antibiotic straight away, thereby decreasing the chance of antibiotic resistance. For example, respiratory diseases can be hard to target due to the mix or load of bacteria that causes them. In our ideal scenario, you would take a sample, inoculate it with antibiotics and see which one works best.

"It would be a rapid test because you often want to start treatment and stop the patients' suffering as quickly as possible. This test could also be a good indicator to see whether bacteria have become resistant to a particular antibiotic."

Cushla and Frédérique stress they're not microbiologists, but are working closely with colleagues from the Faculty of Medical and Health Sciences at the University, particularly Associate Professor Simon Swift and Dr Julia Robertson who are affiliate members of the Biophotonics Research Group and lead the microbiology work.

"We're learning so much, not just in our field but also from our colleagues," says Frédérique. Cushla agrees that this collaboration has been great for "learning how to speak the same language. They learn a lot of physics and chemistry, and we learn a lot more about microbiology and medical practice."

Shining a light on osteoarthritis

Another tool in the Biophotonics Research Group's arsenal is optical coherence tomography (OCT), which uses light to capture 2D and 3D images. They have started a project with engineers and medical professionals to investigate non-communicable diseases.

Frédérique explains: "With non-communicable diseases, we don't really know why or when you contract them. I'm starting to focus on osteoarthritis. One of the big questions is how it starts, in the bone or in the cartilage? We're trying to understand how the disease develops to find a way of detecting it as early as possible. We'll also try to find the right proxy so we can detect it in a non-invasive way, and early enough to prevent patients suffering.

"At the moment we are at the stage where we want to understand the mechanism of degeneration. We're measuring the properties of cartilage and combining techniques to understand it better. We're using OCT to look at the structure, and spectroscopy to measure the composition. At the same time we'll compress the tissue and take measurements to better understand the biomechanics.

"Osteoarthritis is something that affects Māori people more than Pākehā, so later down the line we will have opportunities to involve and engage with communities."

Looking towards a brighter future

Frédérique and Cushla both agree that solving problems is one of their favourite things about science. Cushla says, "it's a puzzle. It requires a lot of thought. You come up with an idea. You think it will be obvious and fall into place and it doesn't."

They also agree that a lot of scientific solutions to global problems probably started out as a 'failed' piece of research.

> ***"A lot of research successes come from something that didn't work, so we need to have the time to investigate mistakes."***
>
> ASSOCIATE PROFESSOR FRÉDÉRIQUE VANHOLSBEECK

Frédérique thinks it's important to be honest about failure. "A lot of research successes come from something that didn't work, so we need to have the time to investigate mistakes. It's also good to remember that research takes time to develop – we don't have an exciting result every six months."

What's next on the horizon for Frédérique and Cushla? They're using the knowledge they've gained so far about light and bacteria to start a new project creating sensors for water safety testing. They'll also start involving industry and communities in refining solutions on their existing projects as they gather steam.

And with any luck, the next solution to a global problem could be one mistake away.

Associate Professor Frédérique Vanholsbeeck and Dr Cushla McGoverin assemble optical tweezers to allow for fluorescence studies of a single bacterial cell. Optical tweezers use light to hold in place and manipulate small particles such as a bacterial cell and therefore allow us to follow the same cell over time while changing the surrounding environment (e.g. media the cell is immersed in). Photo: Elise Manahan

Ngā Motu Whakahī

Raising our Islands

Building a thriving body of Māori and Pacific research students and research-active academic staff in the Faculty of Science.

THE FACULTY OF SCIENCE will be launching a pilot programme Ngā Motu Whakahī – Raising our Islands in 2022, a holistic and long-term initiative to nurture our future Māori and Pacific research leaders through targeted tuākana-teina cohort building.

Led by the Faculty's Kaiārahi, Jason Tutara, Associate Dean Pacific Sina Greenwood, and Associate Dean Research, Jan Lindsay, the programme aims to learn from the existing successful Tuākana Science Programme, which primarily focuses on teaching, to develop a new mentoring programme in the research space.

Aligning with the University's Strategic Plan to embrace values of equity and inclusion, Ngā Motu Whakahī will be an important vessel to grow the number of Māori and Pacific research students and research-active academic staff in the Faculty.

Using a navigation metaphor, the programme will be a journey between and across the following three 'islands', with waves connecting them:

Poipoia te kākano Through workshops and research projects, the first level will enable pre-university level Māori and Pacific participants (and their schools and families) to grow a strong foundation for a future in science.

Tairangatia Aimed at current Māori and Pacific students in the Faculty, the second level will build and foster a cohort of confident, connected and thriving students interested in research, through research scholarships and internships for undergraduates.

Pūtaiao Herenga Waka The third level will enable postgraduate research students and early career academics to flourish by providing them with clear pathways through academia and beyond, extending their journey to new horizons, whilst acknowledging community and family connections.

Te Painga Ngaru (The ripple effect) – The waves connecting our islands are symbolic of the actions we take to ensure that all students and research-active staff feel included and can thrive in their environment. This work is fluid, like waves, and the intention is that its effects will ripple throughout the Faculty and beyond towards transformative cultural change.

Patricia Clark

Ngāpuhi

Paewai Rangahau/Research Fellow – Ngā Motu Whakahī Programme

"In my role I am working alongside a Pacific colleague to scope the implementation of the Ngā Motu Whakahī Programme.

"As part of the role, I enjoy engaging with our Māori and Pacific students and researchers within the Faculty of Science and seeing all the positive transformational work they are doing within the academic space.

"Personally, it's been really rewarding to see so many students I used to tutor in the Tuākana programme now undertaking postgraduate research that incorporates mātauranga Māori.

"It's really fulfilling to be involved in an initiative that will increase Māori and Pacific representation at all levels within the faculty and increase the recognition of knowledge systems outside of Western Science."

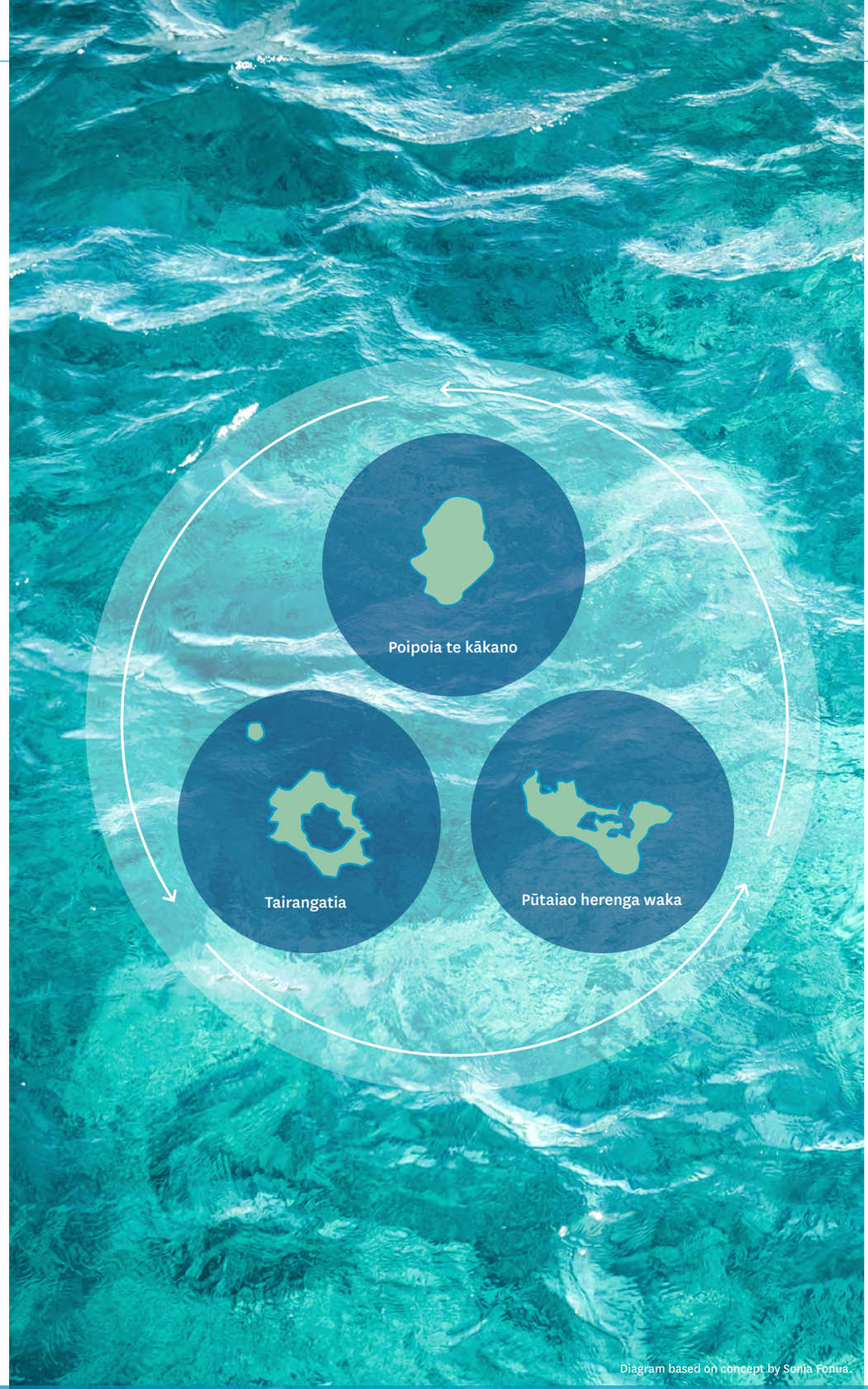


Diagram based on concept by Sonia Fonua.

NGĀ MOTU WHAKAHĪ

Hineatua Parkinson

Ngāti Patuwai,
Ngāti Hine, Whakatōhea

Kai Whakaako Mātai Hinengaro/ Kaupapa Māori Researcher

Member of Te Rōpū Hiko (Harnessing the Spark of Live), Taura Here Pūtaiao (Māori Staff in Science) and Māori and Pacific Psychology Collective

"My whānau, hapū and Iwi ground me and connect me to Te Ao Māori.

"Within my role as Kai Whakaako Mātai Hinengaro in the School of Psychology I bring Mātauranga Māori into my teaching and research.

"A key part of my work is enacting manaakitanga by nurturing and maintaining caring reciprocal relationships with staff, students and community.

"When people feel valued and safe they will reach out for help. Many staff have embraced aspects of Mātauranga Māori into their teaching and research. Many students have found and strengthened their connection to Te Ao Māori through learning.

"I am passionate about Rongoā Māori and the intersection with Psychology. There is scope for healing and wellness utilizing a harmonious approach.

"Another part of my role is Co-ordinating the Tuākana Programme within Psychology. I have an amazing team that hold to the core values of the programme; Tuākana-Teina (experienced students sharing their knowledge and expertise with less experienced students), manaakitanga and haumaru (creating a safe environment). It is challenging and rewarding supporting Indigenous students to flourish in academia. Nurturing the next generation of leaders is important and it begins with connection and relationship."

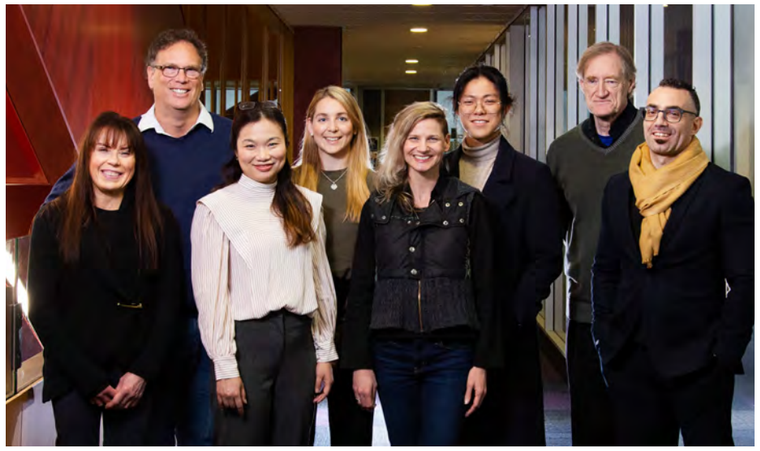
Making cyberspace a safer place

As our dependence on being connected to the internet grows, so does our need to protect our data and improve our resilience to cyber-attacks.

THE ONLINE WORLD is an environment dense with sensitive information, which inevitably attracts those who want to steal it for their own gain. Cybercriminals. Cyber-attack. Data breach. We see these words across headlines all too often and knowledge in the wrong hands can have disastrous consequences.

Two of our computer scientists are working on different research projects but are connected by a common thread, cyber-attacks.

Dr Rizwan Asghar's research has investigated which websites are vulnerable to cyber-attacks so that these areas of weakness can be addressed with better protection methods. Whereas Dr Danielle Lottridge's expertise lies in understanding how people interact with technology. Her research explores the human-system interaction of a type of cyber-attack, phishing, so people can be more resilient to such attacks with the support of better design.



From left: Dr Jude Buckley, Assoc. Prof. Paul Corballis, Assoc. Prof. Yun Sing Koh, Jacinda Murphy, Dr Danielle Lottridge, Sijie Zhuo, Prof. Robert Biddle and Assoc. Prof. Giovanni Russello. Photo: Dean Carruthers

Phishing: reeling in human error

Phishing attacks can be deployed in the form of an email scam. "A single successful phishing attack can completely ruin a company and can completely ruin an individual's life if they're being blamed for that," says Danielle. "It's tragic what can happen, and it can cost hundreds of thousands, if not millions of dollars."

Her research project looks at phishing susceptibility and how the problem of phishing can be approached in a way that's constructive, productive and is understanding of how situations can make people susceptible.

"I bring to it a systems perspective," she explains. "So as people, we tend to be very individual focused. If a problem happened, we usually point to a person and say, 'that's your fault'. Whereas we might be in a system that makes some people more prone to commit these errors than other parts of the system."

Funded by IBM, Danielle collaborated with an interdisciplinary team for the project which included Associate Professors' Giovanni Russello, Yun Sing Koh, and Paul Corballis, Professor Robert Biddle, Dr Jude Buckley, and PhD candidates Jacinda Murphy and Sijie Zhuo.

Jacinda, Paul, Jude and Danielle worked together with a financial institution to create a phishing simulation, which was emailed to over 4,000 employees. Then they observed two behaviours: the employees who clicked on the phishing links and those who recognised and reported the scam.

"This particular line of research really does benefit organisations and it's fantastic to be able to collaborate with organisations to do it," says Danielle.

The human element

So far, Danielle's team has found certain predictors for phishing, related to age, job type and the amount of training employees have done.

"One of the most mysterious ones is job type," she says, as one particular job type was more susceptible to phishing, and they are yet to understand the reason. "Is that job type receiving more email? Is it something inherent in the types of tasks that are related to that job?" says Danielle.

"So instead of being focused on an individual and their susceptibility we now understand we're looking at groups of people." As a result, the company can consider customizing settings such as firewalling around those groups to shield them from phishing attacks more effectively. In the future, she envisions more dynamic design interventions, which are deployed in moments of greater susceptibility.

She says digital wellbeing also plays a factor. "If you haven't gotten enough sleep and you're stressed out, you may be more likely to fall for a phishing attack. So, we need to take care of our employees and there's yet another reason to care about their health because when people are doing well, that ultimately keeps the organisation safe."

How secure is online data?

As a cybersecurity expert, a broad theme of Rizwan's research is combating cyberattacks. "One key focus of my research is to investigate potential weaknesses in providing a secure communication channel over the internet," he says.

For the past five years, he has been collaborating with Computer Science colleague Dr Qinwen Hu on a research project focused on the security protocol HTTPS or Hypertext Transfer Protocol Secure – the familiar lettering you see at the start of your website URLs.

Rizwan and Qinwen investigated the HTTPS security level of the top one million domains listed by Amazon's web analytics provider, Alexa. Among the domains were banking, e-commerce, government, and education websites.

"We evaluated the domains by launching three large-scale measurements to assess the security risk of the current HTTPS configuration and track the historical changes in mitigating HTTPS vulnerabilities discovered since 1993," explains Rizwan.

"The main driver for this research project was to analyse whether domain administrators ignored the well-known security issues or patched them. This would suggest whether hackers can use those vulnerabilities or require more sophistications in mounting cyber-attacks."

Their research found that of these one million domains, five percent of the 720,000 HTTPS-enabled servers were still vulnerable to one or more known forms of cyberattack in 2018, although in 2020 they saw an improvement when it dropped to 0.01 percent.

"However, it is worth mentioning that 72 HTTPS-enabled servers are still vulnerable to one or more known forms of cyberattacks discovered in the last three decades," says Rizwan, pointing out that it took multiple years for these domains to fix many of those vulnerabilities.

"The lesson we can learn is attackers can get enough time to exploit such vulnerabilities."

Rizwan says these domains unfortunately still use out-dated security protocols, weak key exchange methods and even expired certificates.

"These are straightforward loopholes that can easily be addressed and there are already some patches and updates."

But now the nature of the attack is becoming more sophisticated. "So even if we ignore this aspect of whether the system is updated or not, the attackers are creating more sophisticated attacks," he says, such as using ransomware, as seen in the Waikato DHB case earlier this year.

Dr Rizwan Asghar and Dr Qinwen Hu. Photo: Dean Carruthers

Dr Danielle Lottridge with Dr Ethan Plaut. Photo: © Auckland War Memorial Museum Tāmaki Paenga Hira

"You either agree to the terms of service or you don't use the tool. This needs to change."

DR DANIELLE LOTTRIDGE

Protecting our data

The findings from this research project will help to provide a safer cyber environment. It will also enable organisations to protect their IT infrastructure from cyber-attacks which "can save businesses from catastrophic financial or even human loss", says Rizwan.

"In my opinion, New Zealand is seriously lacking a crisis management plan for dealing with cyber-attacks as we can see in the case of Waikato District Health Board. Also last year, we had attacks on the New Zealand Stock Exchange. I think this is where New Zealand should be having a proactive approach instead of a reactive approach to deal with cybersecurity or cyber-attacks."

Eyes on Tāmaki

It's one thing to protect yourself from cyber-attackers looking to steal data, but what about the data that we give access to freely? Danielle and University colleague's Dr Ethan Plaut from Arts and Dr Fabio Morreale from Creative Arts and Industries, collaborated with Auckland Museum to create Eyes on Tāmaki, an exhibition within the Tāmaki Herenga Waka: Stories of Auckland galleries.

Visitors can interact with a touchscreen that looks like a larger-than-life smartphone, putting themselves into the story with face filters and giving their opinion about regulation of facial recognition. The experience raises awareness around data privacy, facial recognition technologies and who is collecting and using personal information. The survey findings will be part of a paper the academics are working on around data privacy, which Danielle says could potentially inform municipal policy.

Consumers aren't offered much choice when it comes to data collection options, says Danielle. "You either agree to the terms of service or you don't use the tool. This needs to change."

As technology evolves and cybercrime no doubt along with it, research that strengthens our cybersecurity, uncovers vulnerabilities, and explores how we humans behave and interact with our computers and smartphones is vital in ensuring we are prepared to combat cyber-attacks and keep our online information and our communities safe.

Gibbons Memorial Lecture Series

Dr Danielle Lottridge presented her talk *Digital well-being: From human factors to mixed reality rehab* at the 2021 Gibbons Memorial Lecture Series.

The School of Computer Science began this annual lecture series in 2008, to present Computer Science research to the wider public and named in memory of Associate Professor Peter Gibbons.

View: cs.auckland.ac.nz/gibbons-lectures

Inaugural Pacific Research Symposium

The Faculty's first-ever Pacific Research Symposium will be held this November, an event to showcase our Pacific researchers and Pacific-related research in the Science faculty.

THE SYMPOSIUM WILL include research with Pacific communities, environments, technologies, plants, animals, oceans, lands, and skies, says Dr Sam Manuela, a senior lecturer in the School of Psychology.

"Furthermore, this research is being produced amidst wider conversations about what Pacific research is, highlighting the dynamic nature of this interdisciplinary field," he says.

"We aim to contribute to this wider conversation with a symposium highlighting the research of our Pacific postgraduate students and staff, and that of our non-Pacific peers conducting research relevant to the Pacific."

Speakers at the Symposium will include Professor Palatasa Havea from Massey University, presenting the opening presentation which gives an insight into his journey through academia. Schannel Van Dijken from Conservation International is the keynote speaker on the second day.

One panel session will explore what science research means to Pacific researchers and another panel will discuss Pacific research considerations (including methodologies, culture, and ethics).

> ***"...this research is being produced amidst wider conversations about what Pacific research is..."***
>
> DR SAM MANUELA

The initiative was organised by Associate Dean (Pacific) Associate Professor Sina Greenwood, Associate Dean (Research) Professor Jan Lindsay and their team: Dr Heti Afimeimounga, Dr Sam Manuela, Dr Sione Ma'u, Malia Puloka, Gustav Chu Ling, Taniela Lolohea, Morgan Meertens, Agnes Nun Toon-Tupou and from Faculty of Arts, Associate Professor Tamasailau Suaalii.

Associate Professor Sina Greenwood

The majority of research abstracts submitted to the event have been from Pacific postgraduate students, which highlights a growing group of Pacific researchers, says Sina.

"I also see the symposium as an opportunity to give visibility of our Pacific community in Science and provide motivation and a sense of identity to our Pacific students," she adds.

The team is working towards holding the event every second year in future and aspires to include staff across the University and extending into the community, which Sina says will "showcase our Pacific research to a wider audience of potential Pacific scientists".

Dr Sam Manuela

Maori and Pacific Scholarships Fund

To support our Māori & Pacific students to realise their academic dreams, visit: www.giving.auckland.ac.nz/maoripacificscholarships

Pulling apart DNA: learning molecular biology through a VR lens

Sebastian Dunn is a Science Masters student working with the School of Biological Sciences and the School of Computer Science.

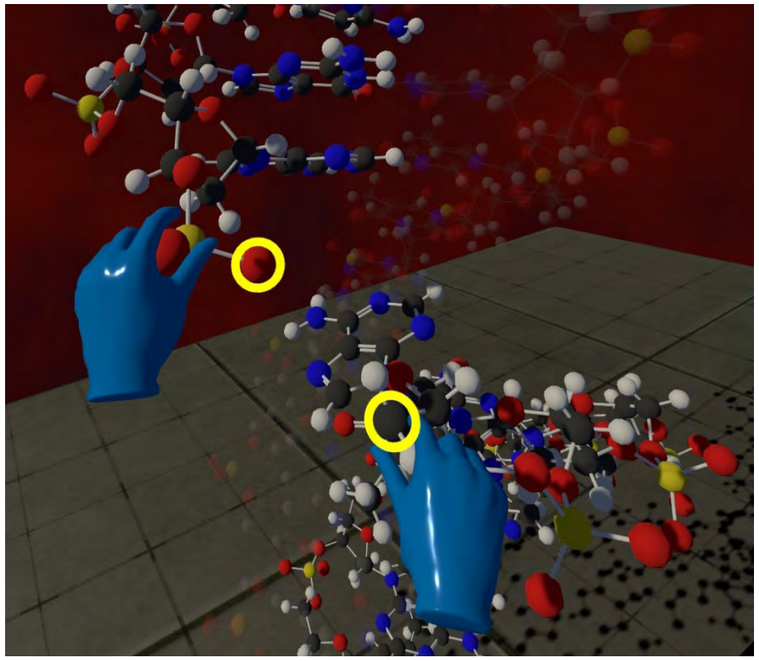
SCIENCE IS DIFFICULT. And it moves quickly. Each new generation of scientists enters an increasingly complex world, and they need to learn more information more quickly than ever before. This creates a constant need for innovation in science teaching. Luckily, it also creates new technologies we can explore to help solve this problem.

When I first learned biochemistry, molecules were stick figures on a textbook page. They were static and 2D, and electrons were dots that moved along arrows between them. From these pictures, and experience, I had to mentally create a model of the dynamic, 3D world of biomolecules. Every student needs a version of this model in their head if they want to succeed in biochemistry, and the challenge of creating it can vary hugely from student to student.

The goal of my research is to lower this barrier, helping other students reach this threshold of understanding more quickly. For my Masters in Science (Bioinformatics), I'm working with the School of Biological Sciences and the School of Computer Science to create a virtual reality experience that teaches students about DNA. Virtual Reality, or VR, lets us create interactive, 3D scenes that progress through time. It's a powerful way to teach students how molecules interact, and how those interactions are governed by their 3D structure.

In the VR experience I've created, the student starts in a biology lab and then shrinks (from their perspective) all the way down to subatomic size. They end up in the nucleus of a cell where they find a stretch of DNA they can pick up, pull apart, and put back together again. The purpose is to give the student an intuitive sense of the scale of DNA, and then help them learn how the 3D structure of DNA leads to its function as an information storage molecule.

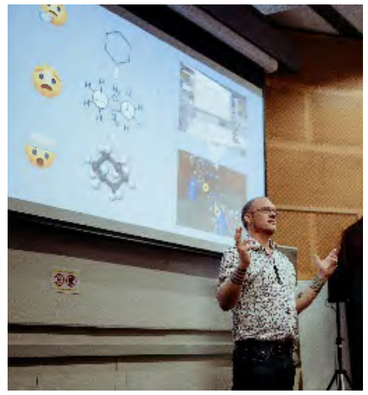
The other big advantage of VR is it's fun. It's new. It's exciting and engaging. And it turns out it's a great way to get people interested in science too. Working on this project at the University of Auckland has given me the opportunity to incorporate outreach activities into my Masters. I've made a version of my experience that doesn't need any prior DNA knowledge, where you can smash up the piece of DNA with a baseball bat and learn about the different subunits. We've shown it at the Rotary National Science and Technology Forum, the MOTAT STEM Fair, and school outreach events. It's a big hit with young people and stimulates a lot of conversation about DNA and science.



Learning about DNA through virtual reality. Photo: Courtesy of Hands-on DNA

My project is a transdisciplinary effort that uses lessons from molecular biology, computer science, and pedagogy. The direct purpose of this project is to create better educational tools for the next generation of biologists, but the long term goal is to discover the best ways to use VR to teach. VR is a new medium that we've only just begun to explore properly. I want to uncover the hidden strengths of VR for education, and help future students learn complex concepts that I took years to fully understand.

Written by **SEBASTIAN DUNN**



Sebastian Dunn presenting his thesis in three minutes. Photo: Anna Vasilyeva-Bycroft

Unlocking wearable tech for healthy living

Data from wearable devices could be put to good use, not only in preventative healthcare but also for managing chronic conditions.

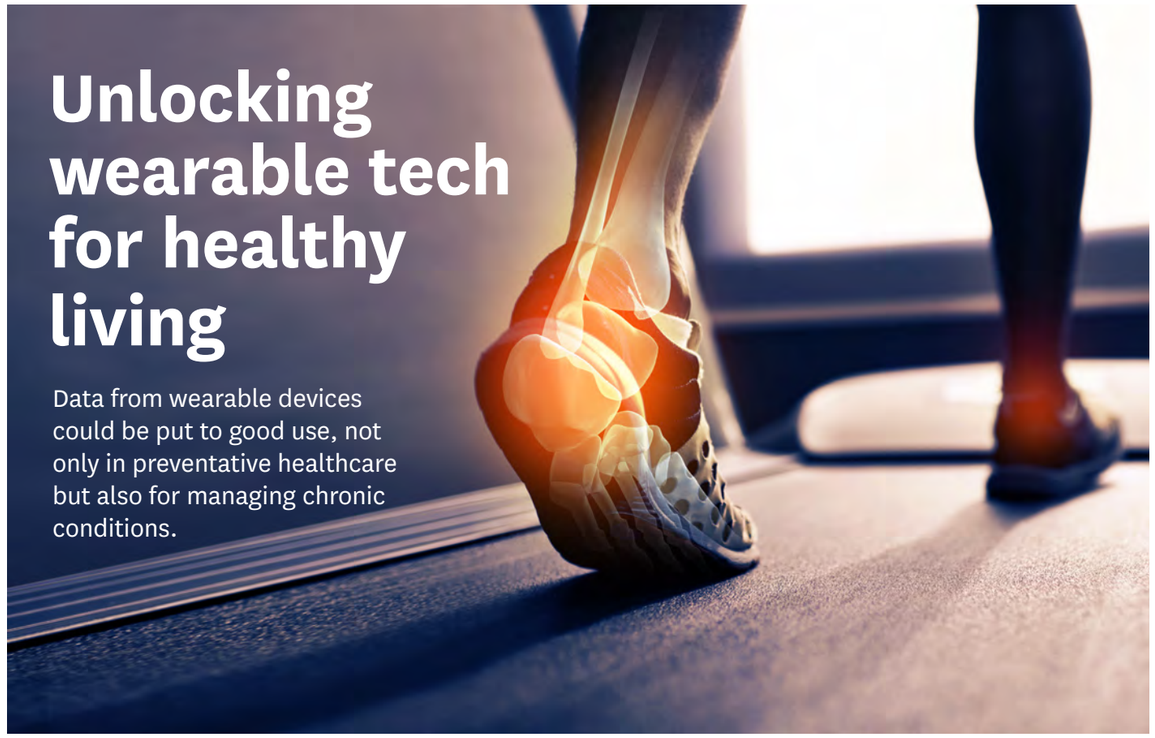


Image: iStock/Yuri Arcurs

WEARABLE DEVICES could be at the forefront of a health revolution that enables the medical profession to monitor an individual's health in real time, to promote healthy behaviours that prevent chronic health conditions.

The fact that only seven percent of 5–17-year-olds meet Ministry of Health guidelines of at least one hour of moderate to vigorous activity per day, indicates a looming health crisis and it's something that Faculty of Science researchers are hoping to mitigate with projects that shift the focus from treating sickness to maintaining wellness and good health.

"We all know exercise is good for us, but half of the world's population doesn't do enough of it," says Department of Exercise Sciences lecturer Dr Rebecca Meiring. "So, what we're now trying to do is look at combining behaviour change therapy with exercise to optimise changes in physical activity behaviours for the individual."

One step at a time

Rebecca's current work aims to encourage people living with chronic conditions such as osteoarthritis, the neurological movement disorder cervical dystonia and cardiovascular disease to improve their quality of life by moving more – whether it's getting out of a car, walking to the shops, or simply climbing a flight of stairs.

As part of their assessment, participants are fitted with a wearable device called an accelerometer which measures activity 24/7 over the course of one week, to provide an accurate picture of both activity and sedentary behaviour patterns over the course of a day.

Rather than suggest standardised exercises or perhaps going to the gym, Rebecca looks to target habitual activity behaviours like daily walking or housework using a behaviour change technique called 'motivational interviewing' which allows people to autonomously determine their readiness for change.

"Nobody's going to change a person's behaviour except themselves," says Rebecca. "It's got to be feasible for them, because if it's feasible then it's sustainable. And that's really important because we're talking about long-term change and long-term maintenance of healthy behaviours."

Because each accelerometer can gather as much as 40 gigabytes of data, Rebecca is collaborating with data scientists at Australia's La Trobe University Business School to analyse the information and develop algorithms that help easily visualise and predict energy expenditure in day-to-day-activities.

Tapping into a world of wearables

Whether the research outcomes can be scaled up for potential use by the medical profession remains to be seen, however another research project involving commercially available wearables could potentially lead to a more proactive – rather than reactive – approach to exercise and health.

Under the joint supervision of Rebecca and Associate Professor Fernando Beltrán from the University of Auckland Business School, PhD student Ruhi Bajaj is looking into whether the data generated by smart devices like Apple watches and Fitbits could help prevent chronic diseases.

"Can we do something with the humongous amount of data coming from these devices and tap into its potential?" asks Ruhi, who says that while many people wear the devices, their data is not being put to complete use.

To share or not to share

Privacy is an obvious issue, so Ruhi has surveyed people about their willingness to use wearable devices and to share personal health information with health providers – something that many already do on social media platforms.

"We all know exercise is good for us, but half of the world's population doesn't do enough of it."

DR REBECCA MEIRING

From Ruhi's perspective, the benefits of clinicians being able to monitor data continuously and remotely in real-time is obvious. "The clinicians themselves can proactively tell people that there is some health anomaly which is detected and why don't we take some measures to prevent things getting worse from this?"

The next phase of research is to enlist the support of the Ministry of Health and District Health Boards to access electronic health records to develop and evaluate a prototype application for remote health monitoring. "If both data sources are combined, and if that data is being presented to clinicians and monitored in real-time, then it is possible to detect a health anomaly," says Ruhi.

Wearable technology has already proven its worth in Rebecca's research where the accelerometers can be posted out to people in remote locations to avoid the trouble and expense of travelling into her Newmarket clinic. They also tend to be more accurate than questionnaires, as people tend to over-report their activity and under-report the amount of sedentary behaviour.

Relationships matter

Looking ahead, she believes that personal wearables could also support better clinical services by using remote behaviour monitoring to ensure adherence to exercise over the long term. "It offers us the opportunity to follow up with people who come to our clinic for exercise rehabilitation and check up on them occasionally and support them if physical activity or exercise drops off."

Ministry of Health guidelines recommend 150 minutes of moderate to vigorous exercise per week, but Rebecca says that goal doesn't suit everyone – especially those suffering from chronic conditions – and hopefully her findings will contribute to a modification of the guidelines to incorporate low intensity activities that reduce sedentary behaviour.

An important aspect underpinning Rebecca's research, and in striving to embed Treaty of Waitangi principles in her studies, is the formation of relationships with the participants in her research. These relationships form the basis of being able to understand behaviours, evoke an individual's idea of what change looks like for them, and challenge people to modify their activity.

"It's about using my expertise to learn more about my participants and to be able to get on a journey together and say, 'let's work together to see what's possible for you in changing your activity'."

Funding for the wearables research is derived primarily from internal University of Auckland grants, and the cervical dystonia project also has additional support from the Maurice and Phyllis Paykel Trust.

Given that many people don't take their health seriously, Ruhi hopes that her work will bring about a change in lifestyles. And for Rebecca, it's also about "the little victories" like a message from a participant that simply says, 'I need to watch how much time I spend in sedentary behaviour'.

Dr Rebecca Meiring and PhD student Ruhi Bajaj. Photo: Elise Manahan

Wearable technology could be a useful tool in preventative healthcare. Photo: Elise Manahan

Leadership through service

Conjoint degree student La-Teish Brown chose to study science and law for a specific purpose – to protect sacred spaces from coastal erosion.

Ko Ōperu te maunga,
Ko Reporua te awa,
Ko Ngāti Porou te iwi,
Ko Ngāti Rangi te hapū,
Ko Reporua te marae,
Ko La-Teish Meri Maureen Brown
tōku ingoa.

La-Teish Brown, Ngāti Uepōhatu, Ngāti Porou, Te Aitanga a Māhaki, Apia & Papa Sataua. Photo: Henry McMullan

FINAL YEAR Science/Law student La-Teish Brown selected Ecology and Environmental Science as her science specialisations.

"Raised in Tāmaki Makaurau, I have always returned to my whānau and whenua, in Te Tairāwhiti, where my identity and whakapapa is inextricably linked to the land," says La-Teish.

"My beautiful marae sits adjacent to the ocean and river. Over the years, I have become increasingly aware of the erosion slowly eating away at the whenua, which will soon disturb the resting place of my nanny Te Horowaitai and whānau at Reporua marae."

Spurred by her concern of potentially losing these sacred spaces, she chose a science degree to learn the impacts of environmental issues and how to solve them.

"I also felt that having a Bachelor of Laws would enable me better insight into the legal systems and policies that would facilitate needed changes to ameliorate the loss of this precious taonga."

During her studies she received the Prime Minister's scholarship award for Latin America. This enabled her to spend a month in Brazil learning indigenous history, rights, and environmental sustainability efforts with fellow tauira.

"A personal learning that I was able to identify with was the shared devastation and ongoing impacts of colonisation on Brazil's indigenous people. It was heartening to witness their resilience and selflessness despite ongoing adversity and their ambition to retain their languages, stories and traditions."

La-Teish says along her academic journey she has enjoyed sharing kōrero and values the teachings of her fellow tauira and kaiako.

"Feeding off their enthusiasm, passion, and purpose for pursuing their discipline has inspired me on my journey."

After graduation, she intends to undertake a diploma to fully immerse herself in te reo Māori, tikanga Māori and mātauranga Māori.

"This will allow me to reclaim my language for my whānau to develop my understanding, communication, and ability to work with my people and serve them in the future."

Following this, she has an important goal to pursue.

"My dream job would incorporate an iwi-based role that contributes to real and positive change to benefit Māori, Pasifika and other indigenous peoples recognising the value of indigenous models, which are ecologically sustainable and have been tested over generations."

Outside of her studies, La-Teish took part in the KPMG's 2021 Kiwa mentoring programme and also served an internship with the Ministry for Primary Industries.

"Both these experiences allowed me to gain valuable insight into both the public and corporate sectors," she says.

"My Samoan heritage values tautua, a tradition that recognises the pathway to leadership is through service. Participating as a tutor for the Tuākana programme for the School of Environment and serving as an executive member of the Nesian Indigenous Science Student Association (NISSA) has allowed me to support the cultural and social wellbeing of other Māori and Pasifika students."

She adds, "I am also involved in organising and participating in research involving our whakapapa, cultural history and recording this information for posterity."

However, La-Teish stresses that her achievements are a result of the love and support of her collective.

"My Tīpuna have set me on my path, and my parents Matuhara and Judy, are my pou (my support, strength and stability). They have inspired and nurtured my growth, investing in my dreams and aspirations."

Professional teaching fellow Phil Kane's support also helped her through some challenging times.

"Many people have contributed to my journey; Arohanui ki a koutou kātoa."

Bringing new ideas to life in the healthcare sector

Pharmacist Amy Lee embarked on a Bioscience Enterprise degree to work on healthcare projects with a positive global impact.

FOR MASTERS student Amy Lee, the sciences have always been where her fascination lay. She was especially drawn to the health sciences because of their biological, chemical, and social aspects.

"Seeing the difference that healthcare professionals make in patient outcomes and how a meaningful conversation and medicine can help to change someone's life," says Amy, is what inspired her to study a Bachelor of Pharmacy (Honours) at the University, from which she graduated in 2018.

With her degree in hand, she embarked on a career as a pharmacist. While she enjoyed the ability "to create a positive impact in the local community and educate patients on how to maintain and improve their health", she aspired to work on more innovative projects with a positive global impact.

She realised that her passion was in bringing "new ideas to life, especially in the science and healthcare industry".

"Throughout my undergraduate studies, I developed an interest in innovation and entrepreneurship," Amy recalls.

So in 2020, she decided to embark on a Postgraduate Diploma in Bioscience Enterprise. This unique programme brings science and business together, providing students with industry networking opportunities as well as teaching them about finance, intellectual property, and commercialisation.

"Through the programme I have been able to use my healthcare knowledge and experience in many innovative and exciting ways."

Amy has gone from strength to strength in her studies and cites being able to contribute to research projects and volunteering ventures throughout her time at university as a highlight.

"I have been fortunate to be involved in research projects that can provide commercial value which is an area that I have a keen interest in."

She also says that the hands-on experience has enabled her to build a strong foundation for her career.

Amy is now working towards her Master of Bioscience Enterprise thesis on commercialising digital health interventions, whilst also working for a health software start-up.

After she graduates, she wants to continue being "involved in projects that help start-ups and small organisations achieve their business goals", combining her passion for healthcare and innovative technology.

"Working in healthcare has made me passionate about helping others to achieve their healthcare goals and now with my learnings from work and my studies, I aspire to help others achieve their business goals."

In the future, Amy sees herself in a leadership role where she has the freedom to work with many different passionate people, helping them bring their ideas to life and facilitating their learning and development.

Her aspiration is "to be able to give back to others, like my current mentors, colleagues, and friends".

"Through the programme I have been able to use my healthcare knowledge and experience in many innovative and exciting ways."

Amy Lee. Photo: Charlotte E. Johnson

The practice of love

Love is arguably one of the most precious elements of the human experience and can appear in many forms. Psychology Professor Niki Harré explains generalised love and how it can enrich our world.

TEN YEARS AGO, I started a research project that involved asking people what they consider of "infinite value". Things of infinite value were defined as that which is sacred, precious, or special, of value for its own sake; that which makes the world truly alive. People were told they could offer anything they wished including, but not limited to, emotions, relationships, parts of the natural world, objects, or qualities. To date, I've asked thousands of people what they consider of infinite value; 1,080, all within Aotearoa, were part of a formal research project.

The word cloud shows the offerings of these 1,080 people. As you can see, the single most common word is "love". Some of those who offered love explained that they weren't just talking about love of particular people, but an orientation towards the world as a whole. We could call this "generalised" love. It is hard to articulate an orientation of generalised love precisely – or to know if people are experiencing it in the same way – but it seems to include a sense of wonder, deep appreciation for what is, and extreme benevolence – wanting the best for everything. When we are "in love" in this sense, we are fully present to the moment, the place we are in, and the people we are with.

Practising this kind of love then, involves openness to what is happening and the potential to be transformed by it. It is, I suggest, an orientation that can help us have the cross-sector, cross-culture, cross-community conversations we need to respond to the wicked problems we face, including climate change and material inequality. But how exactly do we "do love"?

Well, for a start, we try and listen to other people with genuine openness. The aim here isn't so much respect – which involves a polite distance, but compassion – trying as best we can to learn about and understand the situation, motivations, fears and hopes of the other. A sign that you've got somewhere is that, at the end of the conversation, you feel as if you aren't quite the same person you were before. If you've just been driven further into your corner, something is amiss. A powerful way to set up conversations that help people listen with compassion is through structured storytelling. This invites each person to talk about their background, experiences, values, the people they are close to, and their hopes for the future. After each person has spoken, those listening reflect back some of what they have heard and how it is similar and different to their own lives.

From there you can move to discussing contentious issues and making collective decisions with the sense that you are connected, and everyone has something to offer.

While it is likely almost everyone has experiences of generalised love, translating these into practice is not easy. As many religious traditions teach, the practice of love is a discipline. It is about going beyond the impulse to defend your position and assume harmful intent in those whose arguments you find abhorrent. It involves patience, courage, confidence and, ideally, a social environment that values genuine engagement. As educators and participants in public life we would do well, I think, to foster these skills and create the social environments that enable the practice of love to flourish.

PROFESSOR NIKI HARRÉ
School of Psychology

Niki will be talking on The Practice of Love at TEDxUoA 2021: Past, Present, Pause. This year's TEDx asks if we are in a once-in-a-lifetime turning point on which our future depends. For more information on the event, please follow the official TEDxUoA Facebook page at **https://www.facebook.com/TEDxUoA**

Professor Niki Harré. Photo: Dean Carruthers

Infinite values offered by 1,080 people in Aotearoa. Note the word cloud was produced from coded data, a related research article can be found here: https://doi.org/10.5964/jspp.v5i2.742.

Visit: *Niki's home page: https://unidirectory.auckland.ac.nz/profile/n-harre*

Read: *A free manual on structured storytelling and other exercises for helping people work together. http://www.infinite-game.net/manual*

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2022 Alumni and friends events

University of Auckland events are always stimulating and entertaining, as well as a chance to catch up with friends and network with new people. There are mainstay events such as the annual Distinguished Alumni celebrations and the Golden Graduates lunch, plus Alumni and Friends receptions in various centres and smaller, informal gatherings led by alumni. In these unusual times we are finding many ways to connect and engage online as well.

Update your email address and we'll make sure you stay informed of upcoming events and opportunities. **alumni.auckland.ac.nz/update**

If you update your email and postal address by **31 December 2021**, you'll go in the draw to win one of five Samsung Galaxy smart watches.

Or watch our 2021 Raising the Bar Home Edition talks and view/listen to other alumni content at **alumni.auckland.ac.nz/recordings**

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