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ISSUE 25 Thinking big!

ynette Barrett, Chief Executive Officer, tells us about the work of National Star (p 50), a charity and specialist further education provider. "We are a forward-looking organisation, and our teams are always looking for innovative projects that we can be a part of," she says – a progressive attitude shared by the many researchers featured in this issue.

National Star student Sam Vestey (p 4) is putting his vision for the future into action, leading a campaign to launch a more inclusive disability badge – one that moves away from the assumption that all disabilities are visible. He explains, "My end goal is to head off to the United Nations and get this new logo recognised as the international disability badge."

In the same spirit of looking ahead, we ran a teachers' focus group (p 86) with the aim of finding out what teachers like about our resources and what we can do to make them even more useful for teaching and learning. Our talk was incredibly positive, and the productive criticism we received has resulted in the new, slightly larger font size you will see us using from this issue of Futurum onwards.

As Sam's campaign highlights, how you present your message can make a profound difference! He says, "I might be aiming for small goals, but I'm thinking big!" As ever, so are we.

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Animations

As part of our free package of education resources, we include animations that bring many of the research stories to life: futurumcareers.com/animations Y

Podcasts

Featuring researchers talking candidly about their personal experiences, our podcasts are accessible, engaging and inspiring: futurumcareers.com/ stem-shape-podcasts

Socials

CONTENI

Research articles

- 08 How does the inner ear develop into a sensitive hearing and balance organ? Professor Andy Groves
- 14 Understanding haemophilia, one amino acid at a time Dr Jill M. Johnsen
- **18 How do hurricanes impact forest ecosystems?** Luquillo Long Term Ecological Research Program
- 24 How can creative arts help children cope with eco-anxiety? Dr Catherine Malboeuf-Hurtubise and Terra Léger-Goodes
- 28 Power to the people: how electrical engineering can empower the Navajo Nation Dr Peter Romine and Navajo Technical University
- **32** Building a better future: how can architecture help make a better world? Dr Lisa Landrum
- **36** Decolonising film festival research Professor Sheila Petty and Dr Estrella Sendra
- **40** Looking after performing artists' physical and mental well-being Professor Aaron Williamon
- 46 Can spooky stories engage people with history and heritage? Professor Dale Townshend and Dr Michael Carter
- 54 Boosting employment prospects for neurodiverse people through video game development Professor Leanne Chukoskie and
- 60 From school to university: how can students adapt better to change? Dr Jenna Gilchrist









Research articles

- 64 What makes nursing a dream career? Dr Kathryn Halverson
- 68 How can health and care support break the cycle of homelessness? Dr Michela Tinelli
- 72 Creating narratives of resilience with people affected by cancer Dr Laura Béres and Tracey Jones
- **78** Supporting pre-service teachers in kickstarting a mentally healthy career Dr Astrid Kendrick
- 82 Using creative arts to address children's eco-anxiety Dr Catherine Malboeuf-Hurtubise, Dr Catherine Herba and Dr Jonathan Smith

86 Teacher focus group

- 88 How can economists combat crime? Professor Tom Kirchmaier and Dr Magdalena Domínguez
- 92 Why is diversity important for productivity? Dr Grace Lordan, Dr Jasmine Virhia and Teresa Almeida
- 96 Can workplaces truly embrace LGBTQ+ inclusivity? Professor You-Ta Chuang
- 100 How is climate change affecting accounting and business? Dr Sanjay Banerjee
- 104 How to use Futurum resources

INTERVIEWS

- 04 "I want people to understand that you don't need to be in a wheelchair to be disabled, and you can't judge a person by their appearance." Sam Vestey, a 21-year-old student, has launched a campaign to make the blue disability badge more inclusive.
- 50 "Society has made great inroads, but there is still much that needs to be done to make society truly inclusive." National Star's vision is to have a world in which people with disabilities can realise their full potential as equal and active citizens. Chief Executive Officer Lynette Barrett tells us more.





Think Beneath the Surface

Sam Vestey is a 21-year-old student with a chromosomal condition called DiGeorge Syndrome. Having experienced discrimination for his non-visible disability at an early age, Sam has launched a campaign to make the blue disability badge more inclusive.

A more inclusive disability badge

The UK's Blue Badge scheme allows people with severe mobility problems to park close to where they need to



go. Currently, the blue badge, which can be displayed on car dashboards, features a wheelchair icon, which Sam believes is outdated and does not reflect the range of visible and non-visible disabilities. The new badge, designed by a student at St John's College in Brighton, shows two ablebodied people with a third person in a wheelchair and the wording: 'Some disabilities are visible. Some are not. Take care of each other.' Sam's campaign has already experienced huge success in his hometown: Cheltenham Borough Council, Cheltenham Business Improvement District (BID), Cheltenham Chamber of Commerce, Visit Cheltenham and The Cheltenham Trust are all backing his campaign.

In your experience, how common is it for people with an unseen disability to be challenged when using disabled facilities?

It's very common. When I was younger, I was a lot less physically disabled, and my disabilities were less visible. I used the disabled toilets as my legs would hurt if I waited in a queue for too long. People would question my mum or dad about why I needed to use the disabled toilets as I did not look disabled. We had the same problem when using disabled parking spaces. Because people couldn't see my disability, they didn't understand how much pain I was in and how fatigued I got. That's why I had a disabled blue badge.

What made you decide to start a campaign to raise awareness of hidden disabilities?

My experiences of people thinking I was not disabled enough to have a blue badge, or that I was stupid because of the way my voice sounds, made me want to start this campaign. I want people to understand that you don't need to be in a wheelchair to be disabled, and you can't judge a person by their appearance. That's why I've named my campaign Think Beneath the Surface. I also



want UK schools to provide more education about non-visible disabilities, so people can understand how their attitude can impact others.

Did you design the new badge?

No. The college I attend, National Star, is a specialist college for young people with disabilities (see page 50) and is part of Natspec, the membership organisation for specialist colleges. I did a presentation in front of hundreds of students from other colleges at a Natspec Student Voice Parliament. Natspec then ran a competition to come up with a design for a new blue badge logo. Lynette Barrett, Chief Executive of National Star and Chair of Natspec, and I chose the winner. It was designed by a student at St John's College in Brighton and shows two able-bodied people with a third person in a wheelchair. It also has the wording, 'Some disabilities are visible. Some are not. Take care of each other', which is a key message. A graphic designer then donated his time to turn the design into professional logo.

What steps did you have to take to get Cheltenham Borough Council and others to back your campaign?

In the summer of 2022, I contacted Sky News and, to the surprise of National Star and my parents, it ran the story. Marianne Sweet, Executive Communications and PR Officer for National Star, then started to work with me on my campaign. The story was picked up by the Press Association and BBC Radio Gloucestershire. Alex Chalk, MP for Cheltenham and now Justice Secretary, met me and is a great supporter of the campaign. He contacted my local MP, Laurence Roberston, who is also supporting my campaign.

Andrew Lansley, Innovation Manager at Cheltenham Festivals, the arts charity that hosts Cheltenham Jazz Festival and three other international festivals every year, heard about my campaign. My logo was then used at the Cheltenham Festivals last year. That was the first big breakthrough. The logo was also adopted by Sidmouth Folk Festival.

Then, Lindsey Holland and Michael Ellyatt from the Chamber of Commerce got in touch with me about how they could promote the campaign. Lindsey has a hidden disability, so she understands what I am trying to achieve. •

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I want people to understand that you don't need to be in a wheelchair to be disabled, and you can't judge a person by their appearance.



"

My end goal is to head off to the United Nations and get this logo recognised as the new international disability badge.



Sam with Laurence Robertson MP at the Natspec manifesto launch at the Houses of Parliament. Natspec, the membership organisation for specialist colleges, is calling for fair access to high quality further education for young people with disabilities and the opportunities to put their skills to work post college. © National Star

In September 2023, Cheltenham Borough Council, Cheltenham BID, Cheltenham Chamber of Commerce and Visit Cheltenham launched their campaign. One thousand window stickers were printed and distributed to local businesses to display in their windows. Regional BBC TV covered the launch, and there are plans to expand the campaign to other towns. Watch this space!

Did you expect to receive so much media attention?

When I first emailed Sky News about my campaign, I didn't expect to receive any media attention. However, looking back, I emailed them at the right time in the summer when there wasn't a great



deal of major news taking place, so I got lucky. With everything going on in the world now, you have to find the right time to get media attention. I've learned with Marianne that if you want to continue to get media coverage, you need to move your campaign on. It's unlikely that the media will cover the same story twice.

Where do you find the confidence to deal with the media coverage?

My disability affects my voice and how I speak, so I get quite nervous when speaking to an audience. Before coming to National Star, I would get very anxious. My time at National Star and leading this campaign have helped me gain confidence in speaking to people. It has also led me to going out more when I'm back in my hometown. I'm particularly confident when talking about my campaign because I am passionate about it. I can speak about it from the top of my head without any reminders or cue cards.

Are you hoping that this badge becomes officially recognised and used nationwide?

My aim is to slowly roll it out across the country with the help of the Government. My end goal is to head off to the United Nations and get this new logo recognised



as the international disability badge. The current disability logo, or as it is formally known, the 'international symbol of access', was designed in 1968. While, in my opinion, it's excellent, it's outdated and no longer reflects the legislation, introduced in 2019, that allows people with nonvisible disabilities to get a blue badge. For me, it creates a negative stereotype that only people in wheelchairs are disabled and that is profoundly not true.



Meet Sam

What are you studying?

At National Star College, I'm studying work outcomes. Before this, I was in a mainstream school where I gained my GCSEs, one A-level and a BTECH, a vocational qualification and A-level equivalent, but this was with 48% attendance. I missed a lot of my final year at school due to illness.

What do you hope to do after your studies?

I'm hoping to do a university degree in film studies or ICT at the University of Gloucestershire. My dream job is to be a film director.

What have you found most rewarding about this campaign?

The most rewarding thing I've found about this campaign is the overwhelming support I've had and the constructive criticism that people have given towards my campaign so I can take it on board and make it better. I've also been very surprised about how much support my campaign has got, and hearing other people's experiences has made me more determined to get the campaign rolling nationally and internationally.

What have you found most challenging?

The most challenging part of this campaign

was gaining the confidence to speak on camera. Because my disability affects my speech, I worry about people not understanding what I'm saying or making fun of my voice or my disability. Luckily, I now have very thick skin so that sort of stuff doesn't bother me too much. It mainly depends on how I'm feeling.

I've also had to get better at time management and listening to people. The confidence I've gained helped me on the National Star College ski experience to Andorra. It was a huge step for me to travel aboard with my peers and not with family. It was an opportunity to put my confidence and communication skills to the test and take myself out of my comfort zone.



"

The most challenging part of this campaign was gaining the confidence to speak on camera.

"

What advice do you have for young people who are passionate about a cause but aren't sure where to start?

I would start by talking to your parents or a teacher about it so that you can make it a project. And do your research. Find out what is out there and think about what you want to do. Your first objective may not be your end goal. I started my campaign wanting to immediately change the blue badge symbol, but it is an international symbol, so it's going to take time to build up that support and grow the movement. I might be aiming for small goals, but I'm thinking big!

How does the inner ear develop into a sensitive hearing and balance organ?

Our inner ears contain specialised hair cells that give us the ability to hear a range of sounds and to orientate ourselves in three dimensions. At **Baylor College of Medicine** in the US, **Professor Andy Groves** is leading a team of biologists to uncover how these hair cells develop as an embryo grows and how they have evolved in different organisms.

(;;;;) Talk like a ...

Cochlea — the spiral-shaped organ in the auditory system responsible for detecting sound

waves of different frequencies and

when a similar feature evolves

such as wings evolving in both bats

Gene expression — when

activated and results in a cellular function, predominantly the

Ion channels — proteins

that allow ions to pass through

genetic information (DNA) is

production of a protein

sending those signals to the brain

Convergent evolution

separately in different species,

and butterflies



6

Professor Andy Groves

Department of Neuroscience and Department of Molecular and Human Genetics, Baylor College of Medicine, USA

Fields of research

Developmental biology, evolutionary biology, genetics

Research project

Investigating the development and evolution of the inner ear

Funders

US National Institutes of Health (NIH), Hearing Health Foundation

he inner ear is composed of the auditory system (which houses the cochlea, responsible for hearing) and vestibular system (which houses sensory organs used for balance)," explains Professor Andy Groves, a developmental biologist at Baylor College of Medicine. Both systems contain specialised mechanosensory hair cells (named for the bundles of hair-like structures, known as stereocilia, on their surface) that convert vibrations into electrical signals, which the brain perceives as sound or balance information.

How do hair cells convert vibrations into sound and balance?

"Sound waves produce vibrations in the cochlea," explains Joel Nelson, a graduate student in Andy's lab. When someone listens to speech, the membrane on which their hair cells sit vibrates by 5 to 7 nanometres. "As the membrane is raised by the sound wave, hair cells are pushed upward and their stereocilia bundles bend and pull open ion channels," explains Helen Maunsell, another graduate student. The open channels let positive a cell membrane

developmental biologist

Mechanosensory cell

— a cell that converts mechanical movement into electrical signals that are perceived by the brain as a sensory response

Neurotransmitter — a chemical that, when received by a neuron, stimulates an electrical impulse

Stereocilia — hair-like structures on the surface of hair cells

Tunicate — a marine invertebrate, also known as a sea squirt

ions enter the cell, leading to the release of neurotransmitters which initiate the electrical signals that travel to the brain to be interpreted as sound.

Mammals can hear an amazing range of frequencies thanks to the varying flexibility of the cochlear membrane. The membrane vibrates to high frequency sounds at one end of the cochlea and to low frequency sounds at the other end. When the hair cells of different cochlear regions are activated, they transmit specific frequency signals to the brain in a code known as tonotopy.



Our sense of balance works on a similar concept. "The vestibular system has multiple sensory organs which detect forms of movement," explains graduate student Gwynna Fuller. "These organs contain fluid which, when we move, puts pressure on particular hair cells, causing the stereocilia bundles to bend and activate." This sends electrical signals which your brain interprets as the position or movement of your head.

How do hair cells develop?

As mammals develop in the womb, a simple piece of skin on the side of the embryo's head begins to fold in on itself and transform into the intricately complex structure of the inner ear. While the inner ear is forming, hair cells also begin to appear in highly specific patterns. Understanding how cells 'know' when to stop dividing to form the inner ear and to start specialising into hair cells is a key question for Andy's team of developmental biologists. The truth lies in understanding the cells' environment.

"We've discovered that some cells in the cochlea produce chemicals which disperse through the inner ear," says Andy. "These chemicals form a gradient, with highest concentrations close to the cell that produced them and lower concentrations further away. When another cell receives these chemical signals, the signal strength (based on concentration and, therefore, distance to origin cell) informs how that cell will develop. Cells that receive a medium dose turn into hair cells, and the chemicals also ensure hair cells are oriented correctly."

Cell development also depends on interactions between cell neighbours. "As hair cells develop, they send close-range

44

There are many genes whose function we don't yet understand.



77

signals to stimulate adjacent cells to become supporting cells," says Joel. "We discovered that if you disrupt these signals, the ratio of hair to supporting cells changes." These signals are disrupted if the genes controlling hair cell development are mutated. If the team can understand these developmental pathways and the genetic processes that guide them, they can help scientists address genetic causes of hearing loss.

How did hair cells evolve?

Andy's team is also interested in the evolution of hair cells. Squid and tunicates are invertebrates with mechanosensory cells which look like hair cells found in mammals. "Squid use mechanosensory cells to sense acceleration and gravity, while tunicates use them to detect particle flow when filter feeding," says Gwynna. "However, while these mechanosensory cells look similar to our hair cells, there is currently little evidence that they are molecularly related."

Did these mechanosensory cells evolve in our common ancestor? Or did they evolve separately in vertebrates and invertebrates - a process known as convergent evolution? Answering this is key to understanding our evolutionary past. "If these cells come from a common ancestor, it implies mechanosensory hair cells evolved around 600 million years ago!" says Gwynna. "If they evolved separately, then studying these convergent cells in different species will give us critical insights into different strategies for developing cells that function in similar ways."

How does the team study hair cells?

"There are many genes whose function we don't yet understand," says Helen. The team uses mice with mutant versions of these genes to observe what happens to hair cell development by activating developmental genes in the mature inner ear of mice to analyse how cochlear cells change. The researchers also extract the cochlear membrane from mouse embryos and grow these cells in the lab, where they can apply chemicals to interrupt signalling pathways and examine the developmental effects.

To visualise how hair cells develop in specific patterns, the researchers use highresolution microscopes to image these cells at different stages in the embryonic mouse cochlea. "We fluorescently label specific proteins in cochlear cells to observe how gene expression changes in hair and neighbouring support cells during development," explains Helen.

Like humans, mature mice cannot regrow damaged hair cells. The team is now exploring whether genes can be introduced into adult mice to re-stimulate hair cell development after the inner ear has formed. One day, it may be possible to 'regenerate' damaged or absent hair cells in people who wish to restore their hearing.

Student research projects

Joel, Helen and Gwynna are graduate students in Andy's lab, where they each lead their own research projects:

Joel Nelson My research focuses on understanding the genetic and molecular signals during inner ear development. I am interested in a specific gene that is expressed in developing mammal inner ears. Initially, the gene controls the development of the non-sensory structures of the inner ear. Later in embryo development, it controls the development of sensory structures, such as hair cells. I want to understand this dynamic difference. I collect inner ear cells from mouse embryos of different ages by dissecting the developing inner

ear from the rest of the embryo. I form a mixture containing individual cells using a specific solution, which I purify so that it only contains inner ear cells. So far, a lot of my work has involved optimising the process of purifying the inner ear cell population, and I have now developed a successful method. Once I have isolated inner ear cells from the mouse embryos, I sequence their RNA and analyse how gene expression changes as the embryo develops.



Helen Maunsell

I am studying the molecular drivers of craniofacial (face, head and neck) development. In vertebrates, this begins in early development and is responsible for the creation of the central nervous system (containing the brain and spinal cord), structural tissues (including bones and cartilage) and sensory organs (including the inner ear). Previous research in Andy's lab identified a gene that contributed to cranial sensory organ and nerve development. By removing this gene from mice, we found that embryos lacked an entire inner ear. I am now exploring how this gene influences the development of embryonic cells, in the hope of gaining insights into craniofacial disorders. I use mouse models and RNA sequencing to analyse the role this gene plays in guiding craniofacial development. By modifying mice so that expression of this gene activates a red or green fluorescent protein, I can visualise which cells express this gene in real-time. I am starting to identify exciting molecular differences within this cell population that suggest differences in how distinct regions of the head and neck form in development.



Gwynna Fuller I am investigating the molecular similarities and differences between squid and tunicate mechanosensory 'hair cells' and vertebrate hair cells. I want to understand whether all three organisms use the same genes during the development of their mechanosensory cells, or whether they have evolved unique strategies for making this cell type. To do this, I compare the genetic and RNA sequencing data from different species of mammals, squid and tunicates. It would take me years to look for similarities and differences in their genes if I did it by hand! Instead, I use computer-based bioinformatic techniques so I can compare huge datasets in a matter of hours. When I uncover genes that are present across species, I use molecular techniques to confirm whether they are expressed in mechanosensory cells. I have discovered that tunicate mechanosensory cells express a lot of similar genes as vertebrate hair cells. There is a lot more work to be done, but this discovery hints at the possibility that tunicate and vertebrate hair cells may be molecularly similar.

About developmental biology

evelopmental biology investigates the processes that define how organisms grow and develop. This involves understanding how cells divide and multiply, how they form organs and tissues, and how they become specialised depending on their position in the body.

"The fundamental question of developmental biology is: how does a single fertilised egg become an entire animal?" says Andy. A fertilised egg cell divides in two, then these cells also divide. The process continues until billions of specialised cells form a complete organism. "Precise control of development is important – we have hundreds of different types of cells in our body, and each must be produced in the right place at the right time during development," explains Gwynna. "You don't want liver cells growing in your brain!" As Andy explains, "When developmental processes go wrong, babies are born with birth defects. Developmental biology is key to understanding the molecular basis for how these defects arise."

"As developmental biologists, we have a lot of tools available for performing our research," says Joel. Some techniques, such as observing developing embryos under a microscope, have been used by scientists for hundreds of years. More recent developments, such as gene editing techniques, allow biologists to manipulate the genes in mice and explore how their development is impacted.

Pathway from school to developmental biology

At school, study biology to learn about development, genetics and evolution. Chemistry will also be useful as the molecular foundations of life (such as DNA and RNA) are chemical compounds, and physics will help you understand the mechanics of cell division.

Attend science events to discover current research projects and take part in science projects and fairs to develop your own research skills. Baylor College of Medicine runs the Saturday Morning Science initiative to introduce local students to STEM research and careers: www.bcm.edu/aboutus/diversity-equity-and-inclusion/programs/ saturday-morning-science

At university, a degree in biology, cell biology, genetics or biochemistry could lead to a career in developmental biology. Developmental cell processes are the blueprint for producing healthy organisms, so it will also be covered in fields such as immunology and cancer biology.

Coding is a critical skill for all scientists. Biologists must be able to analyse large datasets, so take computer science courses to learn to code.

Scientists also need communication skills to share their ideas and results, so practise public speaking and develop your written communication skills.

Explore careers in developmental biology

Developmental biologists work in research labs in academia (in a university) and industry (e.g., for a biotechnology or pharmaceutical company).

Andy and the team emphasise the importance of gaining research experience. Look for opportunities to help in a biology lab before, during and after your undergraduate degree. "Work in as many different labs as possible," advises Helen. "This will let you experience the different animals and research methods that developmental biologists use to address fundamental questions about how organisms take shape, and help you know if a research career is for you."

Andy's lab takes part in the Baylor SMART Program, which provides biomedical summer research projects for undergraduates: www.bcm.edu/education/graduate-school-ofbiomedical-sciences/degree-programs-andcertificates/student-development-programs/ smart-program

The National Institutes of Health runs the High School Summer Internship Program, where students spend the summer conducting research: www.training.nih.gov/research-training/hs







When I was younger, I loved playing with chemistry sets. My parents were both teachers, and my dad taught me about dyes and making enamel by melting coloured glass onto metal. I've also always been interested in music. Growing up, I played instruments, and I've been singing in choirs most of my life. I had a great high school science teacher who inspired me to become a biologist. He lent me biology books from his own student days, and we discussed them together. He was the first person to help me understand that biology and chemistry are intricately intertwined – all living things are composed of chemical building blocks.

If you talk to most scientists, they would never have predicted the path that led them to where they are now. In my case, my career has been shaped by a series of fortunate coincidences and lucky breaks. For example, many of my mentors were people who I initially met by chance. The questions and problems of developmental biology fascinate me. I'm happiest when I'm looking down a microscope at an embryo and trying to understand how it is put together and how it changes during development.

The inner ear is incredible, and hair cells are especially amazing in their sensitivity. They begin to respond to sound when their stereocilia bundle is moved by just the diameter of a hydrogen atom. This is like moving the top of the Empire State Building by one inch! It boggles my mind that evolution has produced cells that are so sensitive.



I've always been interested in art and nature. Developmental biology blends both – there is nothing more beautiful

both – there is nothing more beautiful than watching a complex group of cells work together to form the architecture of an organ.

My parents are both neuroscientists, so I grew up surrounded by science. Research was a common topic at the dinner table, and my parents would draw illustrations on napkins to explain their work to my brother and me.

My initial interest in human biology led me to study medicine, but then I realised that the clinical urgency of medical research inhibited the research questions that inspired me. I began to understand that my interest in biology stemmed more from curiosity and the conversations provoked by new findings.

I spent three years working at the National Institute on Deafness and Other Communication Disorders. I studied a gene that is expressed in developing inner ear hair cells but is no longer expressed by the time the animal is born. When our lab mutated this gene in mice, we observed a duplication of hair and supporting cells in the non-sensory portion of the cochlea, indicating this gene interacts with a key signalling pathway to regulate cochlea development.

I love the concept of developmental

biology – somehow, organisms have developed the cell types and molecular mechanisms to create their unique body plans, often using the same signalling molecules in different contexts. While I'm not religious, there's a magical quality to how everything settles into place.

When I'm not working, I love baking. I think there is something about baking (precisely mixing ingredients plus a bit of experimentation) that reminds me of lab work!



I've always wanted to be a scientist. My first dream job was to be a marine biologist because I loved everything to do with the ocean, then I wanted to be a lab analyst for the FBI, like my grandfather. Now, I hope to teach the next generation of scientists and share my passion for developmental biology.

Growing up in a small town and

attending a liberal arts college meant I didn't have many opportunities to get involved in research. However, during my undergraduate degree, I did a summer internship at the MD Anderson Cancer Center where I studied how fruit flies responded to pain. By exposing flies to different stimuli, I studied which proteins were involved in their response to pain. This was my first introduction to working in a lab, and it taught me a lot about what it takes how to become a researcher. I learnt to design an experiment, use specific instruments and troubleshoot when things don't work out.

I am inspired by the constant progress and innovation that occurs in science. I grew

up at a time when the largest scientific breakthrough was uncovering the human genome – which took years of research and millions of dollars.

Now, only a few decades later, we can sequence someone's entire genome within a couple of weeks for a few hundred dollars.

It is fascinating to consider how the complex and specialised inner ear starts out as just a thin line of cells. Thanks to remarkably precise chemical signalling, these cells develop to form all aspects of the auditory and vestibular systems. There is still so much we don't know about this process, so there is much more to study and analyse!



Growing up, I spent a lot of time reading. I loved spooky mysteries and elaborate fantasy worlds full of dragons. My love of reading and learning inspired me to follow my curiosity, which is probably one of the reasons I ended up becoming a scientist.

When I took my first undergraduate genetics class, I was amazed when I saw a chicken embryo for the first time. I was shocked to see just how tiny and delicate it was. This inspired my interest in research, so I joined my professor's lab to study how genes guide the complex development of an organism.

I spent a summer working at the Stowers Institute for Medical Research, where I studied the genes and regulatory elements in the genome that coordinate hair cell regeneration in zebrafish. This was an incredible experience which changed my perspective on research. Research projects bring scientists together from different backgrounds and levels of expertise to tackle questions, and I love being part of that environment.

l enjoy developmental biology because studying embryos gives you a glimpse into the history of life on Earth. The genome of every species represents millions of years of evolution, which has led to thousands of different genes across different species. Developmental biology allows you to watch the activity of these genes as embryos develop.

Every time I go to an amusement park, I'm reminded of the fun fact that our vestibular system is very important for our balance and very sensitive to movement. When you go on a roller coaster, you often feel dizzy even after the ride has stopped. This is because the fluid in your vestibular system is still moving, sending your brain conflicting signals.

The team's top tips

Be curious and always ask questions.

Reach out to people working on topics that interest you and ask if you can get involved.

Be open to new experiences and don't feel intimidated. Every top scientist was completely new to research once. **Remember, it is ok to make mistakes.** Most research ideas don't work out, at least at first. So pursuing a career in scientific research requires a deep love of your topic to sustain you through the setbacks.

Science is a social enterprise. Advances are made when scientists talk with each other, share ideas and data, and learn from mentors. Be sure to build your own network of friends, colleagues and mentors throughout your career.

Understanding haemophilia, one amino acid at a time

The hereditary blood disorder haemophilia B can have huge health implications, but it is still far from fully understood. At the **University of Washington** in the US, **Dr Jill M. Johnsen** is using the latest DNA sequencing techniques to dig down into the changes to one gene that lead to haemophilia B, examining the role of every amino acid within the protein it encodes. This will create a comprehensive 'map' of the gene, leading to an in-depth genetic understanding of the disease.



Dr Jill M. Johnsen

Associate Professor, Division of Hematology and Oncology, Institute for Stem Cell & Regenerative Medicine, Center for Cardiovascular Biology, University of Washington, USA

Field of research

Haematologyy

Research project

Using DNA sequencing to examine the role of every amino acid in protein coagulation factor IX, which affects the development of haemophilia B

Funders

US National Institutes of Health (NIH), Washington Center for Bleeding Disorders (WCBD), Hemophilia of Georgia, Octapharma

n very recent history, determining the sequence of nucleic acids in a gene – a process called DNA sequencing – was a long and laborious process. Now, however, technological advances have made the process astonishingly easier, offering a whole range of opportunities to study genes and genomes at a scale never before possible. "We now have a huge amount of sequencing data to analyse

Talk like a ...

haematologist

Coagulation factors — a family of proteins in the blood that help form blood clots to stop bleeding

Deep mutational

scanning – a method that uses high-throughput DNA sequencing to produce and assess many variants of a protein simultaneously **DNA sequencing** — the technique that determines the exact sequence of nucleic acids in a DNA molecule

Haemophilia — an inherited bleeding disorder where the blood does not clot properly. There are different types of haemophilia depending on the coagulation factor affected

to figure out which changes to DNA sequences are important to health," says Dr Jill M. Johnsen of the University of Washington. Jill's lab is working closely with Dr Douglas Fowler from the Department of Genome Sciences to examine how genetic mutations can lead to the bleeding disorder haemophilia B.

Coagulation factor IX

Haemophilia disorders stop blood clotting effectively. When a blood vessel is injured, cells called platelets gather at the site and initiate a complex chain reaction that involves a series of proteins known as coagulation factors. "Haemophilia B occurs when the body can't make enough coagulation factor IX (nine)," says Jill. "When we sequence the F9 gene responsible for making factor IX in people with haemophilia B, we often find DNA changes." However, it is difficult to be completely sure that these changes are the root cause of the disease, which has led Jill to undertake a thorough investigation of the F9 gene and the coagulation factor protein it encodes.

"Our project is testing the effects of changing the factor IX protein at every possible amino acid," says Jill. "This will tell us which changes affect the level of production of factor IX or lead to the production of factor IX that doesn't work normally."



Deep mutational scanning

Typically, testing the impact of a DNA change on a protein involves first creating a specific abnormal gene sequence and testing the effects of this abnormality of gene expression. However, there is a scaling issue with this method. "The factor IX protein is made of 461 amino acids, each of which could be changed by substitution with any one of the other 19 amino acids," explains Jill. "This means there are 8,759 different possible ways of changing just one amino acid in the protein." Testing each of these substitutions individually would take years and huge amounts of resources, so it is simply not practical.

With this in mind, Jill worked together with Doug to adopt a different method. "Deep mutational scanning looks at the function of a large number of DNA variants of a protein all at once," she says. "It's based on a technique called multiplex assay of variant effect, or MAVE for short." While MAVEs have been in use for some time, they have only been useful for proteins that stay within cells. Factor IX, however, is secreted from cells into the blood, which is where it performs its coagulation function. Therefore, Jill and her team designed a new MAVE method capable of examining secreted proteins. "This new method should work for many other secreted proteins, too," says Jill.

The library of variants

Jill's deep mutational scanning method is efficiently analysing the effects of

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If we have a specific DNA change found in a person with haemophilia B ... and find it led to a malfunctioning factor IX in our experiment, we can be sure that this change is causing haemophilia B.



mutating each single amino acid in the factor IX protein through substituting it with each of the other 19 amino acids used in the human body. "This will lead to a comprehensive map of the effects of all possible amino acid changes," says Jill. "This map will become a useful reference for anyone who wants to know the effect of a particular substitution or pattern of substitutions." Jill's team will also enter their results into a database called MAVEdb, which acts as an accessible resource for researchers around the world.

Most importantly, this will help join cause and effect. "If we have a specific DNA change found in a person with haemophilia B, and if we look up that change in our map and find it led to a malfunctioning factor IX in our experiment, we can be sure that this change is causing haemophilia B," says Jill. The team has now made a map that covers nearly all possible amino acid changes – and they are not stopping there. "Before factor IX is secreted from cells, it is modified in a process called gamma-carboxylation," explains Jill. "This modification is important for its clotting function, so we are creating a second map that covers how this modification is affected by changes to factor IX."

Thinking bigger

The series of reactions that leads to effective blood coagulation is complex and involves many different proteins, so the team's work is not done. "We want to use our MAVE method to test other things that factor IX does, including how it binds to another coagulation factor called factor XI (eleven)," says Jill. "We've also started looking at other secreted proteins, such as coagulation factor VIII (eight), which is abnormally low in people with haemophilia A."

As well as working in the lab, Jill is a practising medical doctor. "I see people living with haemophilia in our clinic and help interpret their genetic findings," she says. "Being in the clinic helps us design research that better helps people living with haemophilia." Having this personal experience of haemophilia's effects on people's health and well-being lends added motivation to the team's lab work, as well as making sure that their work will directly benefit those with the disease. "Occasionally, our research has directly helped a person in our clinic," says Jill.

About haematology

aematology is the study of blood. It involves studying the causes, diagnoses, treatments and prevention of blood diseases, such as haemophilia. Like all medical sciences, recent technological advances are accelerating its rate of progress and discovery. Jill explains more about her field:

"Research in this field is rewarding in a number of ways.

We get to use cutting-edge technologies to answer interesting questions that have never been tackled before. We are advancing scientific knowledge in an area where people have been suffering, where better diagnoses, predictions and treatments will make a big difference to their well-being.

"Haematology is making unprecedented progress right now. We are generating a wealth of information and diving into it very deeply, down to the impact of individual molecules. Things are moving so fast that it's difficult to predict what will come next – but it will definitely be even bigger and more exciting, and I would not want to miss out.

"Haematology is about solving puzzles. We are gathering clues to figure out how things work, or don't work, in the blood. This takes strong critical thinking skills, which doesn't just involve STEM subjects. For example, a century ago some European royals suffered from a terrible blood disorder, but nobody knew what it was. It was only in 2009, using historical records and DNA sequences of recovered remains, that it was discovered that the royal family had haemophilia B. A diverse array of expertise was needed to solve the case."



As a practising medical doctor, Jill sees people in her clinic and is able to design research that better helps people living with haemophilia. © Marko Aliaksandr/Shutterstock.com

Pathway from school to haematology

Jill emphasises the importance of critical thinking skills for a career in haematology. At school, useful science-based subjects include biology, chemistry, mathematics and physics. Other subjects that can foster critical thinking include history, politics and literature.

At university, relevant degrees include biology, molecular biology, microbiology, biomedical sciences, medicine, genetics and biochemistry.

Explore careers in haematology

The University of Washington runs a number of local and global outreach programmes for high school students and young people: wish.washington.edu/community

The University of Washington also offers a variety of research and mentorship opportunities for undergraduates and graduates, including the Hematology Research Training Program (hemonc. uw.edu/education/hematology-researchtraining) and The Institute for Stem Cell & Regenerative Medicine's Research Experience for Undergraduates (iscrm.uw.edu/trainees/reu).

The American Society of Hematology has a useful career planner (www.hematology.org/about/ careers/planner), as well as many other resources for people at various career stages (www.hematology.org/education/trainees).

In the US, a haematologist earns an average of \$212,000 per year, according to Salary.com (www.salary.com/research/salary/recruiting/ hematologist-salary).





Meet

When I entered medical school, I planned to follow a career in infectious diseases. While in residency training, I took care of a young woman with a catastrophic blood clotting disorder. I was angry that we didn't have enough knowledge to help her – how could we not know? Around that same time, a new heart medicine came out that causes a rare clotting and bleeding complication, but patients were struggling to get a diagnosis. This made me certain that I wanted to work on these puzzles, so I changed my plans and trained in haematology.

Other people have shaped my career hugely. This includes patients, mentors, colleagues and my own trainees. One formative moment was when Doug Fowler and I were put in a room by Debbie Nickerson, a brilliant mentor and scientist, and she told us to work something out. We did – the factor IX project came directly from that incident. And as a fantastic side-effect, we've become great friends.

Eureka moments are rare and not like in the movies! My eurekas have come from a slow build-up, before everything snaps into focus. What keeps things exciting are the positive moments when experiments work, new ideas get traction, or we learn something new about a patient's condition. These make it very worthwhile.

I get to work with fantastic, smart, fun people doing amazing and interesting science. And best of all, it's all tied to better understanding the diseases that affect people that I care for in the clinic and in my personal life.

I hope to use the programmes we are developing to train more young people. I want to develop structures to support collaboration and sharing amongst researchers. I also want to invite the people affected by the disorders we study into the research process, to help us share our research back with the community.

Jill's top tip

Don't worry about reaching a point when you're 'done'. For a long time, I kept thinking I would be 'done' training. Jobs and pay become real, but you are never done. In this career, you are constantly learning and changing, as the science itself keeps on evolving. The cool part is you get to decide what you are going to be doing.

How do hurricanes impact forest ecosystems?

The island of Puerto Rico has diverse landscapes, making it a natural laboratory for ecologists. From mountain rainforests to coastal coral reefs, it contains a range of ecosystems that are teeming with life. The **Luquillo Long Term Ecological Research Program** and Luquillo Experimental Forest are based at El Verde Field Station in El Yunque National Forest. Here, ecologists are studying how and why forest ecosystems are changing, including how they respond to hurricanes and droughts.



WOULLO TO CONSTRUCT

Luquillo Long Term Ecological Research Program

El Yunque National Forest, Puerto Rico

Field of research

Ecology

Research project

Investigating how forests respond to disturbances, such as hurricanes and droughts

Funders

The Data Jam project and the scientific mentors have been supported in part by US National Science Foundation (NSF) grants: DRL-2049061 (The Learning Partnership); BSR-8811902, DEB-9411973, DEB-9705814, DEB-0080538, DEB-0218039, DEB-0620910, DEB-1239764, DEB-1546686 (LTER). Additional support was provided by the International Institute of Tropical Forestry, USDA Forest Service and the University of Puerto Rico. Any opinions, findings and conclusions or recommendations expressed in this material are those of the mentors and do not necessarily reflect the views of NSF, International Institute of Tropical Forestry or the University of Puerto Rico.

Talk like an ... ecologist

Biodiversity — the range of organisms in an ecosystem

Canopy — the uppermost portion of a forest

Ecosystem — the living and non-living components of an environment and the interactions between them

Forest morphology — the physical characteristics of a forest, including the size of trees and the shape of the underlying landscape

Hurricane — an extreme tropical storm characterised by strong winds and intense rainfall. The most severe hurricanes, classified as Category 5, have winds of over 253 km/hr (157 miles/hr)

Leeward — the side sheltered from the wind

Pesticide — a chemical used to kill pests

Prevailing wind — the usual wind direction

Resilience — the ability of an ecosystem to recover after a disturbance

ense green forests cover the mountains that rise from the sparkling blue waters of the Caribbean,

surrounded by white sand beaches and interspersed with vibrant towns. This is Puerto Rico, also known as *Isla del Encanto*, or Island of Enchantment, and it is easy to see how it came by this name. With lush rainforests, dark mangrove swamps and colourful coral reefs, the island is an ecologist's paradise. "Puerto Rico has a huge range of different ecosystems and incredible biodiversity," says Omar Gutiérrez del Arroyo Santiago. "It is a unique place to study."

A natural laboratory for ecology research

In the northeast of Puerto Rico, on the slopes of the Luquillo Mountains, lies El Yunque National Forest. This mountainous rainforest is the site of the Luquillo Long Term Ecological Research Program. Here, scientists study how the forest ecosystem responds to natural disturbances (such as hurricanes and droughts), legacies of human interference (such



as deforestation and dams) and climate change. Ecologists at Luquillo investigate all aspects of the changing ecosystem, from how droughts and hurricanes influence soils and vegetation, to how land use influences animal populations.

How do hurricanes impact soils?

Omar designed a research project to study the effects of drought on greenhouse gases and the abundance of nutrients in soils. "I installed sensors in experimental plots throughout the forest which continuously collected soil data, such as temperature, moisture content and pH, for three years," he explains. "Every few weeks, I visited the plots to collect soil and air samples which were analysed in the laboratory to determine their chemical composition."

While Omar had hoped to document how the soils in El Yunque responded to drought, Luquillo is a natural laboratory and conditions cannot be controlled. In September 2017, part way through Omar's research project, Hurricane Maria hit the island. This deadly storm devastated Puerto Rico, causing over \$90 billion of damage and costing almost 3,000 lives. This tragic situation meant Omar had an opportunity to re-frame the focus of his research.

"My sensors captured continuous data throughout the hurricane," Omar explains. "From a scientific perspective, it was very rare to have such detailed soil data before, during and after a hurricane." Thanks to his soil sampling campaign, Omar discovered that after Hurricane Maria there was a significant increase in soil nitrogen and iron. "Changes in nutrient concentrations



impact all the organisms in the soil," he explains. "For example, nitrogen is a key nutrient for plant growth, and the increase in nitrogen in the soil after Hurricane Maria likely promoted plant growth and enabled the vegetation to rapidly respond to the open canopy." Within a couple of years, soil chemistry had returned to pre-hurricane levels and vegetation was regrowing. The forest soil had recovered its function.

How do hurricanes impact trees?

Alyssa Brown is investigating how resilient the El Yunque forest is to hurricanes. "Resilience is a combination of resistance (how much damage the ecosystem receives during a disturbance) and response (the ecosystem's reaction to the disturbance)," she explains.

In September 1989, Hurricane Hugo

hit Puerto Rico. While it was of similar strength to Hurricane Maria (both were Category 5 hurricanes), Hurricane Hugo did significantly less damage to forests on the island. "Hurricane Hugo hit Puerto Rico in the same direction as the prevailing wind, while Hurricane Maria hit in the opposite direction," says Alyssa. "I want to know if this explains why many more trees were snapped by Hurricane Maria." If a tree is usually impacted by wind from one direction, Alyssa suspects that it will develop resistance to forces from that direction. This could mean that trees are better able to withstand hurricanes that blow in the same direction as the prevailing wind.

To test her hypothesis, Alyssa is collecting cores from the windward and leeward sides of trees growing in El Yunque. By drilling into the tree, she extracts a thin, pencil-like rod of wood. Back in the laboratory, she will examine the tree rings in the cores under a microscope to see if there is a difference in the cells on each side of the tree.

Professor Alex Sloan has investigated how trees with different life-history characteristics respond to stem breakage. In an experimental plot in the forest, he deliberately snapped trees' trunks and monitored how the trees recovered. "Many fast-growing species died due to this damage, indicating they have low resilience to damage while growing in the shade of canopy trees," he explains. "However, slow-growing trees were able to rebranch and regrow. This suggests these species are more likely to survive after they have been damaged by falling branches or high winds during hurricanes." **O**

How do hurricanes impact shrimp?

Hurricanes do not only impact the forest's vegetation. They also influence the wider forest landscape, as well as the animals that call El Yunque home. Dr Stefani Cruz Rosa started her research at Luquillo shortly after Hurricane Maria, when the forest was still recovering. "Hurricanes change the forest morphology," she explains. In addition to the extreme winds snapping branches and blowing trees down, the extreme rainfall causes streams to change course. "This forest is a dynamic and constantly changing environment," says Stefani. "I wanted to understand how organisms adapt to these natural changes." Stefani examined how shrimp were impacted by changing watercourses. She measured water flow rates in different streams and pools and collected shrimp from each location. "Some pools dried up completely when streams changed course, but some shrimp survived by moving to new ones," she says.

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This forest is a dynamic and constantly changing environment.

77

What else impacts shrimp populations?

Marla Valeria Santos-Crespo studies shrimp populations in rivers throughout Puerto Rico. "I'm interested in how land use surrounding rivers influences water quality, and how this affects shrimp populations," she explains. "I collect and analyse water samples and shrimp from rivers that are surrounded by different environments, and so are impacted by different activities." For example, the water in the Río Sabana river is relatively clean as it flows through the protected El Yunque forest, and it contains a healthy shrimp population. Río Piedras is polluted as it flows through the town of San Juan, and very few shrimp live in it. And Río Coamo is contaminated by pesticides as it flows through agricultural land.

"Shrimp are an important indicator of ecosystem health," explains Stefani. "If shrimp are missing, the ecosystem is not in balance." Marla is also investigating how the water quality impacts the shrimp themselves. She places shrimp in tanks containing different concentrations of pollutants and observes how this influences their behaviour, such as how they move and interact with other shrimp.

What else can we learn from El Yunque?

"I'm interested in how communities of species change after disturbances," says Professor Jesús Gómez. To study this, he evaluated how food webs among organisms living in the Luquillo Mountains were affected by Hurricane Maria. Jesús also conducted experiments to artificially lower the water level in streams to simulate the conditions of drought, then monitored how species responded. "I'm intrigued by how ecosystems adapt to climate change," he continues. "Long-term ecological research projects, such as those at Luquillo, allow us to observe how ecosystems have changed in the past, which helps us understand how they might change in the future."

As climate change continues, extreme weather events, such as hurricanes and droughts, will become more common and more severe. Ecologists, such as those who work in the Luquillo Long Term Ecological Research Program, are vital for helping us to understand how ecosystems will respond.



The Luquillo Data Jam

Data provide a powerful lens for viewing the world, but many people struggle to understand and interpret basic scientific data. In response, the US National Science Foundation highlights the need to reform statistics education and engage students in the practices of analysing and interpreting data. The Luquillo LTER ecologists featured in this article serve as mentors for high school teachers and students who participated in the Luquillo Data Jam. This initiative provides students in Puerto Rico with the opportunity to develop critical data analysis skills while conducting locally relevant real-world ecology research. Students explore, analyse and summarise long-term ecological data that has been gathered from El Yunque to answer their own scientific questions about environmental phenomena in the forest.

Learn more: schoolyard.lter.network

Pathway from school to ecology

Ecology is a branch of biology, but many other disciplines also are important for understanding ecosystems and protecting the environment. This means you can apply your personal interests to a career in ecology.

"If you're interested in computers, develop your coding skills as coding is an important tool for data analysis," says Jesús. "Knowledge of mathematics is key for statistically analysing data. If you like art, know that drawing is a very useful skill in science, because ecologists sketch the organisms they are studying in the field or lab. Writing and public speaking are also essential skills because scientists must be able to communicate their ideas clearly with nonspecialists. So, follow whatever subjects interest you – you will gain unique perspectives for studying the environment and they can all be applied to protecting ecosystems."

At university, a degree in biology, ecology, conservation or environmental science could lead to a career in ecology.

"In addition to studying ecology, take classes in other subjects," advises Alyssa. "Think about how these topics influence ecology and how ecology influences these topics."

Explore careers in ecology

The climate and biodiversity crises are major threats to the environment. "We need more ecologists to help understand how ecosystems are being affected," says Stefani.

While some ecologists spend their days observing or collecting wildlife in the field (or forest, ocean, desert...), others conduct experiments in the lab to explore how species react to environmental changes, or work with computers to build models and simulations of changing ecosystems.

"Ecology is a very diverse profession," explains Stefani. "Every day is different – one day I might collect shrimp in the river, the next I might analyse water samples in the lab, the next I might process data on the computer."

A career in ecology will not be a standard 9-to-5 job. For example, if you study a species that is only active at dawn, this might mean getting up at 3 am to walk many miles through a dark forest to observe the animal. "But if you are curious about nature, then this is a sacrifice worth making!" says Jesús.

If you do not want to, or cannot, participate in fieldwork, there is still a wealth of opportunities for a career in ecology. Increasingly, ecologists are using technology (such as satellite images) to gather data about ecosystems, and the discipline of statistical ecology uses statistics to answer ecological questions. These developments are creating accessible opportunities for anyone to contribute to conservation efforts.

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Top tips for getting started on a career in ecology

"Explore the ecology of your local area," says Alyssa. You do not have to live in the wilderness or go on exotic travels to observe ecosystems. "I grew up in the suburbs and always enjoyed finding wildlife in my neighbourhood. Urban ecology is devoted to studying ecology in cities."

"Immerse yourself in nature by visiting natural history museums and nature reserves," advises Marla. "Get involved with citizen science projects where the public record wildlife observations to gather data for scientific research studies." "Your mobile phone is a valuable tool," says Jesús. "Use it to find information about topics that interest you, and use apps such as iNaturalist (www.inaturalist.org) and eBird (www.ebird.org) to learn about the wildlife around you."

Volunteer with conservation organisations or environmental charities to gain practical experience and meet like-minded people. You could plant trees in a community forest, grow vegetables in a school garden, or clean up your local beach or river. "Volunteering opportunities will give you an immersive experience in ecology," says Omar. In Puerto Rico, the Environmental Sustainability Organization (www.opaspr. org/en) and the Department of Natural and Environmental Resources (www.drna. pr.gov) organise conservation projects.

Get involved with ecological research projects. "Reach out to university professors and ask if they have opportunities for high school students in their lab," advises Alex. "Whether you participate in data collection, data entry or data analysis, all experiences will be useful."

Meet the team



Marla Valeria Santos-Crespo

University of Puerto Rico

When I started university, I planned to become a medical doctor. But then, my biology professor invited me into the El Yunque rainforest. There, I fell in love with ecology. My experience of mentoring students has made me realise that I want to be a teacher. Initially, I wanted a government job that involved collecting data to give to communities to help them protect and maintain their rivers. But I really enjoy working with students and teaching them about ecology. I want to help people learn about rivers and ecosystems, and I hope to inspire the next generation of ecologists. We all depend on our environment, so we must all do our part to preserve it. We all have a responsibility to care for our planet. Whether or not you dream of a career in ecology, it is important that you take an interest in the environment and help to protect it. In Puerto Rico, we have been blessed with many natural resources, and I am passionate about protecting the biodiversity of our island.



Professor Jesús Gómez

University of Puerto Rico, Mayaguez

Watching nature documentaries sparked my curiosity about biodiversity. While at high school in San Juan, I volunteered with the Luquillo Long Term Ecological Research Program, which ignited my love of ecology. I enjoy mentoring young students who come to Luquillo. Young people show great curiosity about the forest, and they come up with thought-provoking questions and ideas about ecology.

My current research is investigating how to control the coffee berry borer. This beetle attacks coffee plants, reducing the quality and quantity of the coffee harvest. It is usually controlled by pesticides, but I am exploring biological control methods that are better for the environment.

We don't exist alone in a bubble – we're all part of a global ecosystem. Societies rely on natural systems and resources, and it is important to understand that what happens to the natural environment in one place can impact humans in another.



Omar Gutiérrez del Arroyo Santiago

International Institute of Tropical Forestry

Growing up, I spent a lot of time outdoors in the forests of Puerto Rico. My dad is a biologist, and my mom is an artist who loves being in nature; my family inspired my love of ecology. El Yunque National Forest is an oasis of protected land in a world of urban development and climate change. We must value and protect the huge ecological diversity we have in Puerto Rico.

While in high school and university, I volunteered in various forest ecosystems in Puerto Rico and the US. These experiences opened my mind to the range of ecology research being conducted, introduced me to new people and allowed me to explore new places.

I enjoy inspiring students to consider a career in ecology. My career is a combination of my interests in trees, soils and climate change. If you like spending time in nature, then a career in ecology will allow you to combine this with your other interests, while contributing valuable information that will help the environment and wider society.





Dr Stefani Cruz Rosa

Ana G. Méndez University

I have a very interdisciplinary background because I like many areas of science. My initial interest was in molecular biology. For my PhD, I studied the effects of pollutants on biological systems. Now, I teach classes about nutrition and health.

The health of an ecosystem is closely linked to the health of humans. If the ecosystem is unhealthy, so are we. It is vital to conserve ecosystems so that we can all enjoy good health. It is also important to understand that we are part of the ecosystem, not separate from it.

I enjoy the educational aspect of ecology, and I like translating my scientific research to non-scientific audiences. If scientists only share their results with other academics, then they won't have an impact on society. Instead, we must involve local communities in our work so that everyone can contribute to and learn from scientific research.



Alyssa Brown

Columbia University

I've always been interested in the natural environment. I studied landscaping and land management at university, which allowed me to apply my interests in a practical way. For one project, I investigated water-efficient alternatives to traditional grass lawns in Utah, which suffers from long-term droughts.

When I first visited Puerto Rico, I immediately fell in love with the people. It was the first time I'd been in a tropical environment, and I was curious about the new plants and ecosystems I saw. This experience inspired me to focus on ecology research. When I started my master's degree in ecology, I worried that my science background was much weaker than everyone else's. They had all taken so many more science classes than me, while I had studied business and design during my land management degree. However, I soon realised this was a strength, not a disadvantage. I had been taught to think differently and I could approach questions in different ways.



Professor Alex Sloan

University of Puerto Rico, Bayamón

I had a wonderful biology teacher in high school. Once, he brought in owl pellets for us to dissect in class. Owls can't digest the fur and bones of the animals they eat, so they regurgitate them as pellets. By dissecting these, we discovered what the owl had eaten.

Growing up, I had vision issues, but these disappeared when I used a microscope. It was so empowering to remove my glasses, adjust the microscope lenses and see tiny things in incredible detail. This freedom caused me to fall in love with biology.

I study the dry forest of southwest Puerto Rico, which is under threat from invasive species and fire. Despite being a dry forest, most native plants are not fire-adapted as naturally started fires are extremely rare. However, many introduced plants, especially invasive grasses, are fire-adapted and spread rapidly following fires started by humans.

How can creative arts help children cope with eco-anxiety?

As the climate crisis deepens, do you feel hopeful or hopeless about the future? In Canada, a clinical psychology research team is using creative arts to help children cope with eco-anxiety. Dr Catherine Malboeuf-Hurtubise, from Bishop's University, and Terra Léger-Goodes, from the Université du Québec à Montréal, are providing children with a safe space to explore their emotions through a creative outlet.





Dr Catherine Malboeuf-Hurtubise

Department of Psychology, Bishop's University, Canada



Terra Léger-Goodes

Department of Psychology, Université du Québec à Montréal, Canada

Field of research

Clinical psychology

Research project

Investigating how creative arts can help children cope with eco-anxiety

Funders

Social Sciences and Humanities Research Council of Canada (SSHRC), Ministry of Education of Quebec



ow do you feel when you think about climate change? Scared about what is happening to the Earth? Angry at politicians who are not protecting the environment? Or inspired by climate activists who are fighting for our planet? Whether you

Talk like a ... clinical psychologist

Climate activism — taking action to increase awareness of the climate crisis and to reduce its impacts

Climate change -

alterations in weather patterns (including global warming and more extreme weather events), driven by human activities

Climate crisis — climate change and its impacts on humanity and the planet

Eco-anxiety — the positive and negative emotions, thoughts and behaviours related to the climate crisis

feel hopeful or hopeless, all your emotions are valid responses to the climate crisis.

What is eco-anxiety?

"Eco-anxiety is more than a feeling of anxiety," explains Terra Léger-Goodes, a clinical psychology student at the Université du Québec à Montréal. "It is a complex experience of emotions, thoughts and behaviours related to the climate crisis." Not only do these include negative emotions, such as fear, anger, sadness and hopelessness, but also positive emotions, such as hope, gratitude and empowerment.

It is important to note that experiencing eco-anxiety is not a bad thing. It is a sign that you care for the environment. "Eco-anxiety is not a problem," emphasises Dr

Catherine Malboeuf-Hurtubise, a clinical psychologist at Bishop's University. "It is a normal response to a truly difficult reality." However, if eco-anxiety becomes overwhelming, it can have negative impacts on your well-being.

Young people are particularly aware of the climate crisis. Climate change has become a hot topic in recent years as its impacts are increasingly apparent, and, thanks to social media, young people today are wellinformed on global events. Youthled climate activism is pressuring older generations to adopt more environmentally friendly behaviours, as young people fight for their future, as well as that of the planet. However, while a lot of attention has been paid to the effects of ecoanxiety on teenagers, less has been focused on younger children.



Catherine and Terra's art intervention

Catherine, Terra and their research team have developed an art intervention to help young children cope with eco-anxiety. Their aim is not to reduce eco-anxiety, but to help children understand their emotions about the climate crisis. They lead art workshops in primary schools, based on different topics related to the environment, then use the artwork and artmaking process to initiate philosophical discussions about eco-anxiety. "The aim of the art intervention is not to make something aesthetically beautiful, but to engage in the creative process," explains Terra. "And the aim of the discussions is not to arrive at a right answer, but to explore the complexity of these issues, acknowledge how we feel about them and understand different perspectives."

The workshops use a range of different artforms, from painting and drawing to photography, sculpture and dance. For example, children are asked to draw the Earth in 50 years' time, build a landscape from LEGO[™] and take photos representing the beauty of nature. These activities then inspire discussions on themes such as whether change is exciting or frightening, how to protect the environment and what emotions children feel when they experience nature's beauty. "We try not to direct the discussion, as we want the children to lead the exploration of their emotions," says Catherine.

How can art and philosophy help children explore their emotions?

Catherine and Terra study clinical psychology, so why have they turned to art

"

Art and philosophy give children the tools to explore, name and express their emotions.



and philosophy to help children address ecoanxiety? "Art and philosophy give children the tools to explore, name and express their emotions," explains Terra. Art provides a non-threatening way for children to approach difficult emotions and allows them to visually express feelings they may struggle to put into words. As such, art creates a safe space for children to explore their reactions to the climate crisis. "Philosophical enquiry then encourages children to question the work they have created," explains Catherine.

How do children respond to the art intervention?

Catherine and Terra have run their art intervention in several primary schools, where it has been well received by children and teachers alike. The variety of activities means there is something for everyone. "Some children prefer painting and drawing, while others prefer photography or LEGOTM building," says Catherine. "By introducing different forms of art, we expose children to new experiences and allow them to nonverbally express themselves in the way most comfortable to them."

In one class of nine-year-olds, the

children most enjoyed using the cameras Catherine and Terra lent them to take photos of nature. "They were enthused to show their photos to their classmates and reacted with joy to seeing the photos their classmates had taken," says Catherine. "These photos then sparked profound discussions about climate change."

The aim is for children to use the artmaking process to explore their feelings of ecoanxiety. "It can take a while for children to reduce their expectations of producing a 'perfect' piece of artwork," says Terra. "But, once they do, they immerse themselves in the creative process and produce artworks that are usually very rich in colours and symbolic meaning." This also means Catherine and Terra do not give strict instructions for how to create a piece of art, as each artwork should be guided and inspired by the child's own experiences and emotions. For example, when asked to draw the Earth in 50 years' time, some children will draw the whole planet while others will draw a specific landscape. Some will spontaneously draw the deterioration of the Earth, while others imagine more hopeful futures. "This makes for very rich discussions," says Catherine. "We ask children to share what they have drawn, and why, which then leads to philosophical discussions about what it means for the Earth to change."

As the climate crisis continues, Catherine and Terra hope that creative arts will help children to identify, acknowledge and understand the often-difficult emotions they feel and inspire them to fight for a brighter future.

About clinical psychology

C linical psychologists provide mental healthcare to anyone who may need it. For example, they may help people dealing with stress, anxiety or depression, counsel couples having relationship difficulties, support grieving people who have lost a loved one, or help people process the effects of a traumatic experience. "Clinical psychologists have the privilege of exploring emotions with their clients, contributing to other people's well-being," says Terra. By staying up to date on psychology research and best clinical practice, clinical psychologists

offer the best possible care that is adapted to each individual person and situation.

Catherine specialises in children's clinical psychology. "I have a variety of roles, from performing assessments on children who may have learning difficulties, to providing parents with coaching on how to support their children to flourish," she says. Whatever clinical psychology path you choose to follow, you will have a rewarding career helping others improve their mental health and well-being.

Pathway from school to clinical psychology

At school, study psychology if it is offered. Biology, maths and your country's native language may be requirements for studying psychology at university, so check university entry requirements.

To become a clinical psychologist in Canada, you will need to complete an undergraduate degree in psychology, followed by a graduate degree in clinical psychology (either a research-focused PhD or clinical-focused PsyD). "It's worth mentioning that clinical psychology graduate programmes are highly competitive," warns Catherine. Learn more about how to become a clinical psychologist from the Canadian Psychological Association: cpa.ca/students/career/becomingapsychologist

Different countries will have different requirements for working as a clinical psychologist, so check what qualifications you will need in the country you hope to work in. You will probably need to complete a psychology degree that is accredited by the country's psychology body, followed by clinical training.

If you do not want to attend university, some countries offer apprenticeships that will allow you to train on the job, such as the UK's clinical associate in psychology programme: findapprenticeshiptraining.apprenticeships. education.gov.uk/courses/591

Explore careers in clinical psychology

"Talk to clinical psychologists and psychology professors to learn more about what a career in psychology involves," advises Terra, who also recommends reading widely to discover which aspects of psychology most interest you.

Clinical psychologists must be able to listen to other people and tune into their emotions. "If you are a sensitive person who empathises with other people's feelings, a career in clinical psychology is very rewarding as you can help other people and make the world a better place," says Catherine.

Read psychology articles written by Scientific American to explore just how broad the field is: www.scientificamerican.com/psychology

Find out more about careers in psychology from the Canadian Psychological Association (cpa.ca/careers/career-hub), the Australian Psychological Society (psychology.org.au/ psychology/careers-and-studying-psychology), the British Psychological Society (www.bps. org.uk/find-your-career-psychology) and the American Psychological Association (www.apa. org/education-career/guide).



As a child, I was sensitive to other people's suffering and asked lots of existential questions about life and death. As a teenager, I used creative writing to help me express emotions that I didn't feel comfortable voicing out loud.

Meet

Catherine

It took me a long time to realise I wanted to be a psychologist

- I wasn't ready to commit to a career when I started university. I enjoyed maths, so I studied for a degree in economics and took history courses alongside that. After deciding I wanted to be a medical doctor, I realised I was more interested in psychological health than physical health.

Through my clinical work and research, my aim is to alleviate people's suffering. I want to give children the space to ask existential questions, because adults often avoid talking to them about topics such as climate change and death.

I firmly believe that knowledge is power. So, to address my own eco-anxiety, I stay informed about climate change and acknowledge all the emotions (predominantly anxiety) I feel about it. As a mother, I work hard to stay hopeful for my children. I don't allow myself the possibility of giving up because I'm working towards building their future.



Children create LEGO[™] landscapes to explore their emotions about the environment



When I was younger, I wanted to be an actress. I enjoyed all types of art – including theatre, improvisation and dance, and I also liked painting, drawing, sewing and knitting (and still do).

My interest in clinical psychology began in my early teens

when I was involved in various theatrical plays. As I learnt to embody different characters, and to think, feel and act as someone else, I started asking questions about personality, 'normality', mental health and well-being. I took psychology classes in college, which answered some of these questions, but I had many more. I am now studying for a PhD in psychology because there are still so many questions left to answer!

I am always very grateful when children share their

experiences with me and talk about their emotions through art. I believe it's important to tell children that they are not alone with these emotions and that this is a normal and valid emotional response to their experiences. It is very gratifying to simply hear them say that this makes them feel better.

I have learnt to become attuned to my feelings, and not push them down. For example, when I feel angry, biking in a city full of cars, I look for other cyclists and feel grateful they've made the choice not to drive. But I let that anger exist, because it fuels the fire to keep me acting in my community. I also cope with eco-anxiety by talking to people who listen to my worries, and I paint, write in a journal and dance to explore what I am feeling.

Catherine and Terra's top tips for

coping with eco-anxiety

- Take time to identify your emotions about the climate crisis. Acknowledging what you and the world are going through is the first step in building a better future.
- 2. It can be hard growing up with an awareness of the climate crisis, but know that you are not alone experiencing the emotions you are feeling.
- 3. Share your feelings with someone you trust friends, family, a teacher or a professional psychologist.
- 4. Engage in artmaking as a way to explore your emotions.

Power to the people: how electrical engineering can empower the Navajo Nation

The Navajo Nation lies across more than 25,000 square miles of desert and scrubland in the southwest US. The Navajo People, or Diné as they refer to themselves, have long fought for self-determination. Through the **Navajo Technical University**, the Navajo have the power to educate their young people in accordance with their traditions, cultures and beliefs. However, a lack of Navajo engineering faculty means a lack of role models for engineering students. **Dr Peter Romine** has developed an engineering graduate programme to train Navajo engineers who will inspire the next generation.



Dr Peter Romine

Head of Electrical Engineering, School of Engineering, Math and Technology, Navajo Technical University, USA

Field of research

Electrical engineering

Research project

Developing engineering programmes at tribal colleges

Funders

US National Science Foundation (NSF), Department of Energy (DOE), Department of Transportation (DOT), National Aeronautics and Space Administration (NASA)

oday, the Navajo Nation is the largest Native American Nation in the US, and Navajo Technical University (NTU) is the largest tribal college. Originally founded as a skills centre to train a workforce for the local coal mines and power plants, NTU now offers degrees ranging from construction technology to creative writing and from accountancy to animal science. In 2018, NTU became the first tribal college to earn accreditation from the Accreditation Board for Engineering and Technology for its degrees in electrical engineering and industrial engineering. In these courses, students

learn the practical skills to design and improve engineering systems.

How does NTU serve the Navajo?

As an educational institution, NTU has a significant role to play in empowering the Navajo. "Education was used as a

Talk like a ... Navajo electrical engineer

Colonisation — the settling among, and establishing control over, Indigenous Peoples and their lands

Decolonising — freeing a system from the effects of colonisation

Diné — the name the Navajo call themselves, often translated as 'the people'

Faculty — teachers and educators

<u>Graduate programme</u>

— a course list (e.g., master's or PhD) that students can take after completing an undergraduate degree

Self-determination — the ability of a person or nation to control their own life and affairs

Tribal college — a higher educational institution that serves a tribal nation



colonisation tool against the Navajo," explains Dr Peter Romine, Head of Electrical Engineering. As a tribal college, NTU is run by and for the Navajo. "NTU is decolonising education," explains Conrad Begay, an engineering student on NTU's new graduate programme. "Teaching is focused on taking care of the community through Diné philosophies and values, and it incorporates Diné culture and language."

Conrad expresses the significance of NTU by emphasising that it allows students to stay connected to their home and community, offering affordable education that keeps families together. Leranda Johnson, an NTU business graduate, notes that many young people can now gain higher education qualifications without leaving the Navajo Nation, thus fostering both personal growth and community development. By gaining qualifications at NTU, young people are being equipped with the skills and experience to find or create job opportunities without leaving the Navajo Nation.

How can electrical engineering empower the Navajo?

"Engineering is a tool for economic development," says Peter. "Training Navajo engineers and creating engineering jobs within the Navajo Nation will give young people the opportunities to stay and improve their local economy." This economic development will also help to

"

It is important that issues in the Navajo Nation are solved by Navajo engineers.



increase the self-determination of the Navajo Nation.

"It is important that issues in the Navajo Nation are solved by Navajo engineers, not by other people who come from outside the Nation," explains Candice Spencer, who recently graduated from NTU. "It is important that we develop leadership to solve issues we face and take ownership to raise the next generation of engineers." As more Navajo are trained up to be engineers, they will be a voice for the community to highlight how engineering can put power back into the hands of the Navajo Nation. "Navajo engineers are role models for the next generation," continues Candice. "They show us that we can also aspire to be engineers, serving our community while staying on the reservation."

What challenges still need to be addressed?

Despite its ability to provide top-quality higher education to the Navajo Nation, NTU is lacking one vital aspect: Navajo role models. "Currently, only one of the engineering faculty is Navajo," laments Peter. To address this, NTU developed the Electrical Engineering Graduate Program (MSEE) and is developing a PhD in Engineering, enabling Navajo students to stay within their communities while becoming qualified faculty. This will not only facilitate the emergence of role models but also inspire future generations of Navajo students to pursue engineering, thereby empowering the Navajo Nation and reinforcing their self-determination. In January 2024, NTU became the first tribal college to offer a Master of Science in Electrical Engineering. This programme is completely online and thereby accessible to everyone.

By providing a pathway for engineering students to progress to becoming engineering faculty, NTU will raise up a new generation of Navajo engineers. As Kashayla Smith, another recent graduate, says, "It is important for students to have role models we can identify with, so that we see engineering as a viable career path."

About electrical engineering at tribal colleges

ectrical engineering is the study, design and use of equipment and systems that use electricity. Electrical engineers are a vital part of the modern world as they design, build, improve and repair the electrical equipment that so many of us rely on. As we move deeper into the 21st century, our lives are becoming increasingly intertwined with technology, and we are ever more reliant on electricity in our day-to-day lives.

How are electrical engineers helping to fight the climate crisis?

Reducing our global dependence on fossil fuels involves generating electricity from clean, renewable energy sources. Electrical engineers are responsible for designing and developing the electrical technologies that can create this electricity from clean sources, such as solar, wind and geothermal, and efficiently transmit it so it can be used in homes and industries.

How can clean energy benefit the Navajo Nation?

In the past, coal mines and coal fired power plants provided jobs and electricity in the Navajo Nation. The local economy suffered when these mines and power plants closed, as many people lost their jobs and the Navajo Nation lost revenue from the coal mines and the power plants.

Peter hopes that the Navajo Nation will now build a new economy based on clean energy resources. NTU's electrical engineering programme has a focus on renewable energy as it aims to develop a workforce that is educated and trained to provide clean energy to the Nation. "Electrical engineering can help our Navajo People build solar farms to regain power on the reservation," says engineering student, Jordan Largo. "This will provide solar economic opportunity for our Nation."

The transition from coal to clean energy will not only benefit the local economy by providing new jobs, but also the local environment. Old coal and uranium mines still contaminate Navajo lands and waters. Moving to clean energy sources will allow the Navajo to meet their energy demands without harming the landscape and wildlife around them.

Pathway from school to electrical engineering

Mathematics, physics and computer science are important subjects to study at school, as you will learn the fundamental knowledge and skills behind electrical engineering.

At university, study electrical engineering or related disciplines such as electronics engineering or computer engineering.

Look for internships and work experience opportunities with electrical engineering companies or university departments. These are a great way to gain practical experience and make connections with like-minded people.

Contact people working in the field. Ask them what their job involves and what advice they have for getting started on a career in electrical engineering.

Explore careers in electrical engineering

Electrical engineers work on a range of topics, including power and energy, telecommunications and computing. As we are so reliant on technology, the demand for electrical engineers will continue to grow in the coming years.

The American Indian Science and Engineering Society (www.aises.org) provides information and support for Native students interested in science and engineering, including a college and career guide: www.aises.org/ students/star

The Institute of Electrical and Electronic Engineers (www.ieee.org) and the Institute of Engineering and Technology (www.theiet.org) have a wealth of resources for students and teachers from all backgrounds.



Meet students at Navajo Technical University



Thanks to new technologies, our world is changing constantly. Electrical engineering has taught me about a variety of electronics, their applications and how to think critically. Next, I will pursue a master's degree in electrical engineering so I can introduce the younger generation to the new era of electronics. I hope to continue the traditional way of learning in the new world of technology.



I love studying electrical engineering! I really enjoy creating electrical circuits and embedding programming in them. I am a student in the Electrical Engineering Graduate Program and, upon completion of my degree, I plan to pursue a faculty position.



I am studying electrical engineering and construction technology because I hope to find solutions to clean up the abandoned uranium mines that pollute the Navajo Nation and to improve accessibility to clean water and electricity on the reservation. Fighting these battles requires bright minds to help our leaders speak out about the research behind the struggles we face. I participated in a project to help our people who are suffering from the health issues of working in coal and uranium mines. At the time, Diné people did not know about the hazardous materials they were working with. Navajo engineers are now studying the safety precautions needed for handling such materials.

On the Navajo Nation, there are nearly 15,000 homes that do not have electricity and/or running water. With better access to clean water and electricity, we can build a stronger reservation for our people. NTU supports tribal sovereignty because, as Navajo engineers, we can light up the reservation to see a brighter future.

Building a better future: how can architecture help make a better world?

What leads to good architecture? How can we create environments that are not only functional, but also help people feel happy and meaningfully engaged in the world? At **Toronto Metropolitan University**, **Dr Lisa Landrum** is encouraging architecture students across Canada to not only create visionary architecture, but also push for visionary policies that promote social and environmental justice.





Dr Lisa Landrum

Chair of the Department of Architectural Science, Toronto Metropolitan University, Canada

Field of research

Architecture

Research project

Canadian Architecture Forums on Education (CAFÉ): empowering students and researchers in shaping the future of architecture and creating an architecture policy for Canada

Funder

Social Sciences and Humanities Research Council of Canada (SSHRC)

CAFÉ Collaborators

CCUSA - the Canadian Council of University Schools of Architecture CASA - the Canadian Architecture Students Association RAIC - the Royal Architectural Institute of Canada ROAC - the Regulatory Organizations of Architecture in Canada

Talk like an ...

Architecture policy — a set of principles and guidelines that encourage best practices in architecture, such as designing sustainable, inclusive places

Building codes — legal building safety standards

Built environment —

human-made structures and landscapes where people live, work and play

Environmental justice

 the right for everyone to have equal access to a healthy environment

Equity — the quality of being fair

Manifesto — a declaration of ambitious aims

Social justice — the right for everyone to have equal access to social opportunities

ave you ever considered how the buildings around you influence your quality of life? For example, natural light can improve your mood; you are likely to feel more positive in a bright room with large windows that allow sunlight to stream in, compared to in a gloomy room that only has one small window. And did you know that people are more likely to socialise if there are open common spaces with comfortable places to sit?

Architecture is all around us, but

we do not often appreciate just how much the built environment affects us. Based at Toronto Metropolitan University, Dr Lisa Landrum has been working with architecture students, academics and professionals to exchange ideas and design an architecture policy for Canada. This will promote the creation of buildings and spaces that foster emotional, cultural and environmental well-being.

What is an architecture policy?

While building codes are the legal



minimum standards that ensure buildings are safe and structurally sound, an architecture policy is more aspirational. "An architecture policy sets ambitious goals for creating more sustainable, equitable and inspiring communities," explains Lisa. "It can encourage all levels of government to improve the quality of life for everyone and protect the relationships we have with each other, with the land and with the world."

An architecture policy sets goals for positive, aspirational change, holds a country accountable for its responsibilities to both people and the planet, and promotes understanding of how welldesigned buildings can improve lives and repair the environment. It considers how the built environment affects daily life, and how architecture overlaps with social and environmental justice, by tackling issues such as affordable housing and sustainable buildings.

How can architecture be a tool for social and environmental justice?

"Architecture becomes a tool for social justice when design decisions foster dignity, hope, happiness and inclusion for everyone," says Lisa. "Architecture advances environmental justice by using sustainably sourced materials and renewable energy, adaptively reusing older buildings rather than demolishing them, respecting the land and local ecosystems, and giving more back to the environment than it takes." An architecture policy takes these considerations into account by providing guidelines and promoting best practices that encourage social, cultural and environmental well-being. "We need the help of everyone to achieve these goals," says Lisa.

Designing Canada's architecture policy

Many countries have an architecture policy, but Canada does not. Lisa is helping to change this. In 2019, she launched the Canadian Architecture Forums on Education (CAFÉ). CAFÉ involves all twelve of Canada's Schools of Architecture and encourages architecture students across the country to shape the future of Canadian architecture.

The forums provide a platform to elevate students' voices on critical issues facing the profession, such as equity in architecture. "CAFÉ encourages emerging and established architects to work together to reimagine the profession," says Lisa. "I hope the discussion forums compel better built environments, better policy and better understanding of how architecture impacts daily life."

To stimulate discussions about what a Canadian architecture policy should look like, CAFÉ conversations are centred around four main themes: place, people, prosperity and potential. "These four themes are prompts to help people think broadly about how the built environment relates to regional and personal identity, cultural practices and social values," says Lisa.

What has CAFÉ achieved?

The CAFÉ forums have empowered architecture students to share their visions for the future of Canadian architecture. "Several students who participated in the first CAFÉ discussions are now emerging leaders in the field," says Lisa. Outputs from the network are wide-ranging, including a national report setting out the vision of a Canadian architectural policy (www.roac.ca/future-of-architecture), an exhibition of manifestos from students sharing their dreams for the future of the built environment (www. architecturecanada.ca/manifestos), and a series of calls to action that will pave the way to this future.

"As a result of our work, I hope that young people will be inspired to pursue careers in architecture and that all people will contribute to building a better world, one that is more joyful and just for everyone," says Lisa. "And I hope architects, governments and the public will follow CAFÉ's calls to action." One such call is for the public to get involved in conversations about how architecture shapes their communities. In this way, communities will have a greater say in the built environment around them.

By promoting equity in architecture, CAFÉ will ensure that Canada builds a better future – one in which buildings are inclusive and accessible spaces of enjoyment, and where architects design solutions to social and environmental challenges.

About architecture

he architectural process involves reimagining what's possible and desirable," says Lisa. Architects combine art and science to not only create spaces that are functional and safe, but that are environmentally friendly, aesthetically pleasing and socially smart, helping people to live happier, healthier lives. "For example, a school is not just an array of classrooms," she explains. "A school is an environment to inspire young people, create communities and model future society." It is an architect's job to design places that will achieve this.

Architectural work involves listening to the needs of a client and community, researching the context of the site and understanding the ultimate aims of the project. "The best proposals come through collaboration," says Lisa. "The design process involves conversations, research, sketching, modelling and refining. Imagining what is best and helping others pursue positive and meaningful transformation is the most challenging, yet most important, part of being an architect."

Why should you consider a career in architecture?

"Architecture is our social body," says Lisa. "It wants to dance and sing, it needs our love and care, it longs to embrace humanity and celebrate life in all its magic and mystery. With a career in architecture, you can bring delight to others, make things that last for generations, and preserve cultural heritage. It is very rewarding and enjoyable to improve lives and bring about positive change."

Pathway from school to architecture

"So many subjects will help you succeed in architecture," says Lisa. English, physics and mathematics are typical entry requirements for university architecture programmes. Lisa also recommends studying art, to develop creative expression and an appreciation of design history, and practical classes in woodworking or mechanics, to gain experience of working with materials. Humanities subjects will help you understand people and cultures, creative subjects will fuel your imagination, and computer science will develop your digital modelling skills. She also recommends environmental science to learn about sustainability and climate action, and economics and business management to help you run an effective architecture business. "The most important skills for architects are imagination and compassion," says Lisa.

"Look around your neighbourhood and consider how its design impacts you," advises Lisa. "Get involved in community discussions about new developments. Sketch and draw, read and wonder."

The Royal Architectural Institute of Canada (www.raic.org/becoming-architect) has resources for students, a list of Canadian Schools of Architecture and information about how to become an architect, while the Canadian Architecture Student's Association (www.casaacea.org) connects students across the country.



Explore careers in *architecture*

Architects design buildings, settings and structures at different scales, so you could find yourself designing a new school, library, housing development or park.

Explore the work of architecture students at Toronto Metropolitan University: www.dasxhibitions.ca

Read about architecture news and examine new architectural designs: www.canadianarchitect.com

Get involved with CAFÉ to share your ideas about what architecture means to you: www.architecturecanada.ca/engage

According to Indeed, the average annual salary for an architect in Canada is around \$100,400.


Architectural science students at Toronto Metropolitan University © Bryana Jagdipsingh and Jake Levy



Many things inspired me to pursue a career in architecture. I had a great high school technical drawing teacher, and I studied history and the origins of architecture with encouraging mentors. The arts and big cities inspired me, and witnessing injustices made me appreciate how architecture can contribute to the fight against them.

I have also always loved theatre, and I am very interested in the interactions between theatre and architecture.

My PhD thesis studied the origins of architectural acts in early Greek plays, and explored the links between drama, democracy and philosophy. These plays highlight the emerging role of architects 2500 years ago and dramatise some of the ethical dilemmas that still face architects today.

As an architect, it is so rewarding to have a positive impact on people's lives and to make meaningful contributions to communities. Cities are built up over time. It's humbling and inspiring to positively impact a place, potentially for generations to come. As a teacher, it is most rewarding to watch students develop creatively and intellectually, gain confidence and become change-makers in the field.

One of my favourite architects is Michael Sorkin, who passed away in the early days of COVID. I admire his 'propaganda of optimism' and have felt invigorated by his visionary work and unshakable struggle for good. I had the privilege of being his student in an architecture studio that planted the seed of seeking joy and justice in architecture.



Architectural science students at Toronto Metropolitan University © Lisa Landrum

A career in architecture can be described in many ways: a good struggle; a beautiful challenge; serious fun; and a life worth living.

Lisa's top tips

- There are many ways to be an architect, so forge your own path.
- 2. Whichever path you choose, be curious, compassionate and courageous as you follow it.

Decolonising film festival research

African film festivals showcase the diverse wealth of cinematic talent from the continent. However, researchers who study these festivals are often influenced by colonial practices. **Professor Sheila Petty**, from the **University of Regina** in Canada, and **Dr Estrella Sendra**, from **King's College London** in the UK, are exploring how to contribute to decolonising film festival research.





Department of Film, University of Regina, Canada



Department of Culture, Media and Creative Industries, King's College London, UK

Fields of research

Film studies, creative industries studies

Research project

Decolonizing Film Festival Research in a Post-Pandemic World: developing a methodology to free film festival research from colonial practices

Funder

We acknowledge the support of the Government of Canada's New Frontiers in Research Fund (NFRF), [NFRFR-2021-00161].

This project has received ethics approval from The University of Regina Research Ethics Board: REB# 2022-057

Talk like a ... film researcher

Colonisation — the subjugation and exploitation of one nation or people by another

Cultural sovereignty having ownership of your culture

Curator — someone who carefully selects which films to show at a festival, and presents them both individually and as a coherent programme to festival participants

Decolonisation — freeing

something (e.g., an institution, activity or mind) from the effects of colonisation

Positionality — the social, cultural, and political context and lived experiences that define your identity

Reciprocal — giving back

Self-reflexivity — the critical examination of your own beliefs, perceptions, lived experiences and how they affect your actions

ilm festivals are inspiring cultural events, typically involving live screenings of cinematic works alongside discussion panels, workshops and parallel activities such as live music performances. However, like many aspects of society, film festivals are commonly influenced by the impacts of colonisation. This can affect how festivals are organised and framed, what films are shown and who is invited to speak during discussions. In addition, film researchers studying film festivals may have colonial biases which impact how they conduct their research.

Addressing these issues are Professor Sheila Petty, from the University of Regina, and Dr Estrella Sendra, from King's College London. They are leading a project that has developed a methodology to acknowledge colonial influences in film festival research and, importantly, to move away from them. "Our research is centred on African film festivals, not only due to our shared love of African cinema, but because we believe that all film festivals can learn from African film festivals," explains Estrella.

African film festivals

It remains rare to see films from the



African continent in mainstream cinema. "And yet, African films contain stories that resonate with the lives and dreams of so many people," says Estrella. "African film festivals expose us to stories that are rare to find in other spaces." The dearth of these stories on the global stage means that African people and communities are underand mis-represented in cinema, and that the global community has limited opportunities to learn about and value African cultures.

"Senegalese writer and filmmaker Samba Gadjigo often says, "When I watched the films of Ousmane Sembène, I felt proud of being an African." To me, this emotionfilled statement summarises what African films can do," says Estrella. "African film festivals promote culture and heritage and enable people to see themselves represented onscreen." In addition, film festivals act as an important stepping stone for independent films, providing them with the exposure needed to be shown in commercial cinemas or on streaming platforms.

In recent years, film festival organisers have started to question how festivals could be more representative of the different film cultures that exist around the world. "We noticed that some of the solutions were already present in smaller film festivals in places like Senegal," says Estrella. "What if, instead of suggesting that Africa has to catch up with the so-called West, we did it the other way round?"

Colonisation and decolonisation in film research

"Researchers who study foreign film festivals by observing them, gathering data and then returning to their own country without 'giving back' or meaningfully participating in the festival are using colonial practices, even if they don't realise it," explains Sheila. The same is true of filmmakers who, for example, document a community's cultural events without giving anything back to the community.

Breaking free of this trend involves being open to learning new ways of doing things. "Decolonising film festival research involves listening to and learning from the communities we work with," says Sheila. "It means building relationships and looking to communities to decide how they express their cultural sovereignty." Sheila points to the twin attributes of positionality and self-reflexivity researchers must acknowledge their privilege, account for this in the research process, and work to create inclusive environments that promote cultural diversity. "It takes time and commitment to decolonise systems that were not originally built for everyone," she says. "The process should be based on mutual respect and accountability."

Decolonial tests

In collaboration with film festival organisers and researchers, Sheila and Estrella have designed two decolonial tests, one for researchers and one for festival organisers, to encourage reflection about their practices and possible unconscious biases in the context of decolonisation of film festivals. "We have been privileged to immerse ourselves in different contexts which shape how decolonisation is interpreted, discussed and put into practice," says Estrella.

The test for festival organisers reflects on the strengths and limitations of the organisational process. "It provides the opportunity to discuss the social impact of festivals in the communities where they are located," says Sheila. For example, what insights can festival managers, curators, journalists and community leaders provide? What justice, equity, diversity and inclusion issues exist in the festival management and curatorial process? The test for festival researchers integrates self-reflection into the research process, helping researchers to question how their research is influenced by their own position within a colonial system. "It asks whether their practices are respectful and reciprocal, or whether they extract knowledge without giving back," says Sheila. For example, how do researchers communicate with festival organisers and the communities where festivals are based before, during and after the research process?

The team has been trialling their decolonial tests at African film festivals around the world: StLouis' DOCS (Senegal), the African Movie Festival in Manitoba (Canada), Vues d'Afrique (Canada), Mostra de Cinemas Africanos (Brazil), Film Africa (UK) and 'Women Creators of the Future', co-curated between the Festival Films Femmes Afrique (Senegal) and the Leeds International Film Festival (UK). Along the way, the questions are being refined and translated into multiple languages, providing a flexible toolkit for students, researchers and film festival organisers.

"Everyone involved in film festivals should develop respectful listening skills and be open to new ideas and experiences," says Sheila. "This is critical for understanding the goals of artists and artworks. Creating diverse and respectful spaces is a first step in decolonising practices."

About film studies

hile many films are created for our entertainment and enjoyment, they can also be powerful agents of change. Films introduce viewers to new ideas and have the potential to change perspectives and opinions.

Film is a form of art and an expression of culture. To make or study film, you therefore need to learn about art and culture. "It is especially important to learn about other cultures," says Sheila. "The best filmmakers are open-minded people with a deep knowledge and appreciation of the world around them that they attempt to represent through their films."

The study of film investigates how films are made, the artistic and creative techniques used, and their effects on the viewer. Studying film will give you a historical and contemporary understanding of all aspects of cinema and allow you to critically analyse films. "Develop your analytical skills by considering the role that film and cinema play in our lives," advises Sheila. "And develop media literacy. The ability to effectively analyse screen-centred content is critically important in today's globalised society."

Pathway from school to *film studies*

If your school offers classes in media or film studies, take these to learn how to read and deconstruct a film. In addition, study languages, literature and creative writing to learn how to read and write critically.

At university, pursue a degree in film, media or cinema studies. These will cover aspects of film such as film analysis, screenwriting, filmmaking technology and international cinema.

Sheila recommends taking any available courses in creative technologies, popular culture and creative writing. "Writing is an indispensable skill in the film industry," she says. "If you can write well, you can work in any aspect of the industry."

Explore careers in *film studies*

"Career options in the film industry are vast," says Sheila. "You could teach the history and theory of film, manage film archives, write film reviews as a critic, edit film magazines, organise film festivals or direct your own films."

Volunteering at local film festivals is a great way to gain practical experience and connect with people in the industry. For example, the Department of Film at the University of Regina in Canada hosts the student-run Living Skies Student Film Festival: www.livingskiesstudentfilmfest.com

Participate in film-related internships and summer schools to learn new skills. For example, in addition to promoting decolonial approaches to film and offering grants and equipment to student filmmakers, the Saskatchewan Filmpool Cooperative in Regina hosts a free summer youth programme: www.filmpool.ca/yfair

The National Film board of Canada (www.nfb.ca/ education) and the British Film Institute (www.bfi.org.uk/learning-training) offer a wealth of film-related opportunities for young people.

The University Film and Video Association is an international network of people interested in the film industry, including filmmakers, researchers, librarians and students. Student membership will enable you to connect with film professionals and attend events: **ufva.org**



A discussion panel at the African Movie Festival in Manitoba, Canada © Babatunde Onikoyi





As a teenager, I enjoyed art and media. I liked reading, watching classic black and white movies and painting landscapes.

I took a course on African cinema during my graduate studies in French-language African literature. I fell in love and never looked back! The creative, artistic and cinematic potential of the African continent is immeasurable. I am constantly discovering new films and directors with incredible stories to tell.

I loved attending the Panafrican Film and Television Festival of Ouagadougou in Burkina Faso during the 1980s and 1990s. The festival was a gathering place for filmmakers, critics and industry professionals at a time when many African filmmakers were exploring new genres and styles. The festival's atmosphere was very friendly, and I made many connections with people from all sectors of the film industry who have remained lifelong friends and colleagues.

My favourite film is Do the Right Thing (1989) by Spike

Lee. Lee's work explores controversial social and political issues, especially race relations. I consider Lee a film 'auteur', an 'author' of films who successfully moves between genres and between fiction and documentary, and is a brilliant screenwriter.

Sheila's top tip

Happiness in life comes from following your passion!



Q&A with Kofi Ofosu-Yeboah, as part of the Dine & View of his film Amansa Tiafi (Public Toilet Africa) at The Africa Centre during Film Africa in London, UK © Estrella Sendra



Meet Estrella

I've always loved live performances, such as festivals, theatre shows and music concerts. This interest inspired me to study cinema, but in five years of university, I was never shown a single African film. When I took a course on African cinema with Professor Lindiwe Dovey during my master's degree, it changed my life. I grew up in southern Spain, just a few kilometres from the African continent, but when I first watched *Black Girl* (1966) by Ousmane Sembène, it felt like I had found something that was missing from the portrayals of Africa I had seen in the media.

As a filmmaker, I produced the documentary Témoignages de l'autre côté/Testimonials from the other side (2011) about the experiences of Africans who had travelled to Spain in search of a better life. Most were Senegalese, so I codirected a follow-up documentary, Témoignages... «waa suñu gaal» (2016), with Senegalese journalist Mariama Badji which we produced with a Senegalese crew. My research is also focused on Senegalese films and film festivals. I feel very inspired when working with Senegalese artists – they are generous, approachable and humble, and have such a philosophical and mystical approach to art.

I've had many amazing experiences at film festivals around the world as an organiser, curator, jury member and researcher. Film Africa, in London, was the first African film festival I attended, and it was there that I realised the passion behind festivals and how they bring people together.

I love the work of Alain Gomis, and his film Félicité (2017) in particular. It is led by such a strong female character and has an unbelievable soundtrack and aesthetic approach. The first film of his that I watched was *Tey* (2012), so it holds a special place in my heart. Gomis has a fascinating sensitivity. His cinema is just magical, full of nuances for us to perceive and engage with.

Estrella's top tips

Do everything with your heart, be humble and acknowledge what people give you. Take time to think about what you want to achieve in life. Then it's a matter of figuring out how to make it happen. Changing our world is possible!

Looking after performing artists' physical and mental well-being

Careers in the performing arts are incredibly rewarding, but they also present a number of unique risks to performers' physical and mental health, ranging from repetitive strain injuries to performance anxiety. **Professor Aaron Williamon** heads the **Centre for Performance Science** at the **Royal College of Music** in London, where he also leads the **Healthy Conservatoires** network. He is investigating the physical and mental demands of performance and how performing artists' health can be best supported.





Head of the Centre for Performance Science, Royal College of Music, London, UK

Field of research

Performance science

Research project

Supporting the health and well-being of performing artists through a range of collaborative and interdisciplinary projects

Funder

UK Arts and Humanities Research Council (AHRC)

Musical Impact AHRC, grant ref. AH/K002287/1 Healthy Performer AHRC, grant ref. AH/T005602/1 HEartS PROFESSIONAL AHRC, grant ref. AH/V013874/1



n engaging music, dance or dramatic performance can be a highly emotional experience, for performers and audiences alike. Performance

is central to every culture around the world; many see it as integral to the human experience. Yet, until recently, few have investigated the science behind performance: what factors affect the quality of performance, how can performances be improved,

Talk like a ...

performance scientist

Conservatoire — an institution that trains performing arts students in performance and composition

Freelance — being selfemployed, working for someone who hires you for a job/project, rather than contracted to a permanent employer

Neurodivergent — differing in mental function from what is considered 'typical'

Performance science

— the multidisciplinary study of human performance (including music, dance and drama)

Town hall meetings

— a type of gathering where stakeholders can learn more about a relevant topic and contribute their own questions and suggestions

and how can the health and wellbeing of performing artists be maintained and enriched?

Professor Aaron Williamon is a performance science pioneer, most notably in his establishment of the Centre for Performance Science at the UK's Royal College of Music. One of the centre's landmark achievements has been establishing the Healthy Conservatoires network, which focuses on supporting and maintaining the health and well-being of performers in the short and long term. Issues such as the COVID-19 pandemic have created huge challenges for performers, so creating tools that effectively support their well-being has been a top priority.

Musical Impact and Healthy Conservatoires

"Musicians have long called for better prevention, treatment and support for playing-related physical and psychological problems," says Aaron. "In 2010, Conservatoires UK (CUK) initiated a series of 'town hall' meetings to explore how



to address these issues." These meetings eventually led to the creation of the Musical Impact project, which investigated the physical and mental demands of music careers. Musical Impact comprised three component studies that generated new knowledge and insights into the demands of music-making and the health problems that musicians encounter, as well as strategies to address these problems. "The project confirmed the need for radical change in the way that musicians' health is safeguarded and how musicians are trained to look after their own health and well-being," explains Aaron.

With these results in hand, the Musical Impact team created the Healthy Conservatoires network in 2015, which brings together members from conservatoires and other performing arts institutions both in the UK and internationally. "Healthy Conservatoires aims to inspire the creation of educational and professional environments that promote health and well-being," says Aaron. "The network provides a forum where members can engage with innovation and evidenceinformed practice, as well as access peer support to create and maintain healthy conditions for study and work."

Physical and mental demands

Any artistic performance demands some form of physical exertion – and to reach a professional level, hours and hours of practising this specific type of activity are required. This has the potential to lead to some very specific health problems.

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Healthy Conservatoires aims to inspire the creation of educational and professional environments that promote performing artists' health and well-being.

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"Performing artists' bodies are exposed to contorted positions and unnatural movements continously and repeatedly," says Aaron. "Unsurprisingly, this makes them vulnerable to musculoskeletal disorders and other physical problems, such as pain, weakness and numbness." These problems not only affect their health but can also affect their ability to continue performing - which can put their career at risk. "Existing research shows that playing-related musculoskeletal disorders are commonly experienced both by professional musicians and by music students," says Aaron. "International surveys report lifetime prevalence of playing-related musculoskeletal disorders in these demographics of between 39% and 87% - with most findings in the upper portion of this range."

A career as a performer can also pose specific psychological demands, which

can affect mental well-being. "Evidence suggests that performing artists suffer from chronic challenges with anxiety and depression, as well as perfectionism," says Aaron. "They also face acute challenges related to performance anxiety and self-doubt, leading to burnout and longterm health consequences." Typically, a performer's working life involves long rehearsal periods followed by a short but important time in the spotlight, where small mistakes have the potential to be perceived as critical failures. Maintaining a career that depends on this format can be mentally taxing. "On the other hand, musicians benefit from the many personal and professional rewards of a career in performance, and tend to report high levels of well-being, even in the face of career and health difficulties," says Aaron. This likely relates to the strong psychological benefits of making and listening to music as a creative outlet.

Supporting musicians' health and well-being

Healthy Conservatoires has agreed upon a number of factors that define how conservatoires can best support the performers with whom they work. This includes embedding health and well-being priorities within artistic and academic programmes, rather than considering them as a separate to core training. Professors and students alike are encouraged to embrace life-long habits that conserve or improve well-being while also enhancing performance – habits drawn both from previous research and **O**



the findings of institutions and individuals themselves, helping to develop personal systems for the preservation of health. "We provide diverse resources for support, acknowledging the holistic nature of health and well-being," says Aaron. "We encourage health and well-being as a collective endeavour, to be undertaken by everyone involved in the study and performance of music."

Healthy Conservatoires also draws upon the science surrounding performance health. "We employ evidence-based research and work with health and well-being professionals to ensure everyone has access to their expertise," says Aaron. "We believe in sharing the knowledge and experience gained throughout the performing arts sector, at the local, national and international levels." The network recognises the many facets that contribute to health and well-being, including emotional needs and regulation mechanisms, environmental stewardship, financial security, intellectual pursuits, a rewarding career, physical self-care, strong social networks and spiritual purpose.

The effort of putting these learnings into practice has paid dividends. For example, the Trinity Laban Conservatoire of Music and Dance is providing services to prepare students for the physical demands associated with performance, while the Royal Central School of Speech and Drama is developing equitable training practices to support the well-being of

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We encourage health and well-being as a collective endeavour, to be undertaken by everyone involved in the study and performance of music.

neurodivergent students. Elsewhere, the Royal Birmingham Conservatoire is helping its musicians develop their self-understanding through the use of Intelligent Behaviour Analytics[®], while the Royal College of Music's Creative Careers Centre is supporting young musicians in developing their career pathway alongside financial and social well-being.

Leadership for performance and health

The Healthy Conservatoires network has been vital for bringing together this vast pool of knowledge and advice and making it accessible to those who will benefit from it. "Many of our member institutions are small, specialist organisations that don't have the sufficient expertise or resources to build these systems alone," says Aaron. "Additionally, many of the demands of studying the performing arts are different from other areas of academia." This means that, to truly meet the needs of performers, the support network needs to be specific to the sector. Students of music performance practise their instruments several hours every day, are often examined when performing to live audiences, and careers often involve jumping between a limited array of opportunities. "Yet, there is also much to learn from related disciplines," explains Aaron. "Musicians can learn from dancers, dancers can learn from actors, actors can learn from circus artists - and vice versa."

Healthy Conservatoires members include stakeholders from all disciplines within the performing arts sector. "The network brings together performers, teachers, student support officers, human resource staff, administrators, employers, agents, union representatives and more," says Aaron. "We meet three times a year and target specific topics for discussion and learning." Topics have included exercise routines for performing artists, equality, diversity and inclusion in performing arts education, managing performance anxiety, and hearing protection, among others. And now, the network is spreading its learnings internationally. "We've supported the launch of sister networks in Australia and Mexico, with more to come," says Aaron.

About HEartS PROFESSIONAL

he COVID-19 pandemic hit the performing arts hard, and the sector is still feeling its effects. "The arts and culture sector was among the most disrupted during the COVID-19 crisis," says Aaron. "Performances, exhibitions and arts projects of all kinds were halted very suddenly." This affected the careers and financial security of many artists, most of whom work freelance or on short-term projects. "Millions of creative freelancers in the UK were unable to access government support schemes, leaving them to seek alternative employment to stay afloat," says Aaron. "Other forms of artistic engagement, including teaching, were also severely limited as many occupations ceased entirely or moved online." Between 2019 and 2020, for example, the music industry's contribution to the UK economy dropped by almost half.

HEartS PROFESSIONAL

To address the repercussions of the pandemic, Healthy Conservatoires launched the HEartS PROFESSIONAL (The Health, Economic, and Social impact of COVID-19 on PROFESSIONALs in the ARTs) project. "HEartS PROFESSIONAL investigated the impact of the pandemic on professionals in the arts and culture sector, providing knowledge, leadership and new ways forward where they are needed most," says Aaron.

The project addressed the pandemic's disruption of the sector through four strands of work. The first involved largescale surveys of the sector to understand where challenges lie and how they evolved throughout the pandemic. The second involved addressing these challenges through responsive follow-up studies with specific subsectors within arts and culture. "Thirdly, we identified and championed innovative responses through a series of multimedia case studies, made available as examples of good practice," says Aaron. "Finally, we examined the role of digital innovation and rapid design in helping arts and culture workers to interact and share good practice techniques."

Findings and outcomes

The project's surveys found high levels of depression, anxiety and loneliness among arts and culture professionals during the pandemic, as well as instances of severe financial hardship. When it came to finding solutions, respondents said that the three priority areas to strengthen were financial infrastructures, artistic communities, and future-proofed professional landscapes and training opportunities.

Drawing on these findings, the project has recommended the establishment of longterm funding models to support artists, allowing them to take creative risks, and to promote diversity in the sector. In terms of communities, it has suggested strengthening creative networks for freelancers, providing mentoring and guidance around building portfolio careers and protecting well-being. Its final core recommendation was to strengthen the representation of freelancers and grassroots organisations when making large sector-altering decisions, such as those made by the government during the pandemic. "The project's findings showed a clear pathway for supporting sustainable and progressive development within the arts and culture sector," says Aaron. "The aim is to promote the well-being of the people working in the sector, while also supporting the long-term financial health of the sector itself."

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We examined the role of digital innovation and rapid design in helping arts and culture workers to interact and share good practice techniques.

About performance science

Performance science involves the study of human performance – be it sports, music or acting, or performance of other specialist skills such as surgery or business management. It brings together a wide range of scientific disciplines, including physiology, sociology and psychology. "The study of performance offers fascinating insights into human endeavour," says Aaron. "Increasingly, new methods and technologies are allowing us to understand better how and why we perform, and what makes a great performance so compelling."

Aaron's work focuses on the study of music performance: when musicians play their instruments live, typically in front of an audience. This includes solo performances and in ensembles such as orchestras or choirs. "The multifaceted skills needed to perform well offer rich sources of information for researchers," says Aaron. "Music and its performance are deeply embedded in daily life worldwide, meaning that there is a wealth of information available for systematic study."

Performance Science at the RCM

The Royal College of Music (RCM) is a conservatoire, a school that specialises

in teaching the performance and composition of music. Aaron joined the RCM in 2000 and established the Centre for Performance Science (CPS) to analyse performances and understand the physiological and psychological processes behind performance. "The CPS aims to further our knowledge of the core processes and products of music-making and musical experience," says Aaron.

In 2015, the RCM joined forces with Imperial College London to establish a cross-institutional partnership in performance science. "The collaboration aims at tackling the major challenges of performance across a wide range of domains," explains Aaron. "Imperial College London provides expertise in areas such as medicine, engineering, the natural sciences and business."

The future of music performance science

Aaron predicts that music performance science may follow similar trends to those that sports performance science has experienced over the last three decades. In recent years, sports science has revolutionised sports, from helping top sportspeople hone their techniques to designing sports equipment that improves performance and athletes' longterm health. The rise of data-powered science, made possible by leaps forward in computational power, has accelerated these developments. Music performance science is already making big steps in this direction and has the potential to get results that enhance music performances, while also conserving the health and well-being of musicians themselves.

Augmenting music-making with science may seem at odds with the traditional interpretation of music as a wholly artsbased domain, where emotion, mood and other unquantifiable variables are key. However, Aaron and many other performance scientists are demonstrating its value to the discipline. "Music continues to take centre stage, but it is now a stage with multiple players with different vantage points, and sometimes radically contrasting perspectives," says Aaron. "Experimenting with and through these differences will, I believe, open fruitful avenues for study, new opportunities for musicians, and a fresh look at music itself."



Pathway from school to performance science

At school and post-16 years old, subjects such as biology, physics, mathematics, psychology and computer science can help set the stage for a career in performance science.

For university, Aaron recommends considering subjects such as psychology, physiology, data science, sports and exercise science, engineering and computer science, as well as music and the performing arts.

Performance science undergraduate degrees are also available, though most tend to focus on sports rather than music. Master's degrees in music performance science are available, notably from the Royal College of Music in the UK. Other postgraduate qualifications can also focus on specific aspects of performance science.



I started as a musician, playing the trumpet, but I have always had an interest in psychology. I have undergraduate degrees in both music and psychology and was able to combine the two for postgraduate studies when I moved from the US to the UK. After my PhD, I took up an academic post at the Royal College of Music, with an honorary fellowship in the Faculty of Medicine at Imperial College London.

Working in a conservatoire has shaped my career trajectory. Conservatoires focus on applied music making, which means my research prioritises practical outcomes for musicians, and it is highly interdisciplinary.

Films on performers' health and well-being

Healthy Conservatoires has produced a range of films for performers and organisations to use for sharing information, research and good practice in performers' health:

Research in performers' health

These films highlight the latest research from Healthy Conservatoires members investigating the health and wellbeing of performers:

www.healthyconservatoires.org/researchfilms

Specialist support for performers

These films help performers understand who is who among health specialists and how they can support performers' health and well-being:

www.healthyconservatoires.org/specialists

Guidance for healthy performance

These films summarise guidance and good practices across a range of challenges performers face: www.healthyconservatoires.org/guidance

Explore careers in

performance science

The Centre for Performance Science's website includes information about its research and engaging videos: **performancescience.ac.uk**

The Royal College of Music runs RCM Sparks, a learning and participation programme that engages with school students, especially from underrepresented backgrounds: **rcm.ac.uk/sparks/about**

The field of music performance science is new. A career in performance sports science, which is similar in many aspects, earns an average of £34,000 per year, according to Indeed.

Can spooky stories engage people with history and heritage?

The English countryside is littered with the crumbling remains of ancient abbeys and priories, many of which are supposedly haunted. Having previously investigated how the Gothic architecture of these medieval ruins inspired Gothic literature in the 18th and 19th centuries, Professor Dale Townshend, from Manchester Metropolitan University, UK, and Dr Michael Carter, from English Heritage, are using tales of the supernatural to engage the public with these heritage sites.





Professor of Gothic Literature, Department of English, Manchester Metropolitan University, UK

Field of research

Gothic literature



Dr Michael Carter

Senior Properties Historian, English Heritage, UK

Field of research

Architectural history

Research project

Using ghost stories to increase public engagement with English heritage sites

Funder

UK Arts and Humanities Research Council (AHRC)



tumbling out of the twisted undergrowth, you stare at the crumbling stone building that looms out of the shadows. Amidst fallen archways and toppled pillars, huge wooden beams lie decaying in the cold mud. A damp mist seeps from the cracked walls and lingers like a

💬 Talk like a ... | **Gothic scholar**

Gothic architecture — a medieval building style commonly used for religious buildings between the late 12th and early 16th centuries, characterised by pointed arches and ornate carvings

Gothic literature — a writing genre associated with horror, fear and the supernatural

Heritage — historic sites of cultural significance

Medieval — the 5th to 15th centuries, often referred to as the Middle Ages

Purgatory — a state of existence after death where souls must wait to be cleansed of sin before entering heaven

Reformation — a time of religious and political upheaval in the 16th century when the authority of the medieval Church was challenged, leading to a permanent division in Christianity between Catholicism and Protestantism

Revenant — a corpse that rises from its grave to haunt the living

Supernatural — used to describe something that seemingly defies the laws of nature, such as ghosts

Theological — relating to the study of God and religion

stagnant pool around the ruin. You rush through the rotting wooden doors that hang crooked on their hinges, and they creak slowly shut behind you. Heart racing, you stare around the dark ruin. You're just beginning to collect yourself when a ghostly hand suddenly grips your arm...

Whether huddling around campfires, cowering under blankets or hiding behind sofas, humans have always

had a strange fascination with ghost stories. Today, they are told to frighten and entertain, but in the past, they were used to inform and educate listeners about beliefs of life after death.

What can we learn from ahost stories?

"In the medieval period, ghost stories were often told and written down by monks," says Dr Michael Carter, a



historian at English Heritage. "These tales aimed to illustrate the progress of the soul in the afterlife, and the importance of praying for the souls of the dead on their passage from purgatory to heaven." Ghosts were thought to be souls in purgatory, waiting to be cleansed of the sins they had committed during life. Ghostly tales encouraged people to pray for these lost souls so they could continue their journey to heaven. "Ultimately, medieval ghost stories served moral and theological functions that showed the importance of preparing for death and the value of 'good works' such as saying prayers for the dead and distributing charity," explains Michael.

How did medieval ruins inspire Gothic literature?

As time passed, the religious landscape of England changed. With the Reformation, Protestantism replaced Catholicism as the dominant religion, Catholic ideas of purgatory were abandoned and monasteries were forcibly closed. After centuries of neglect, these grand abbeys and priories fell into disrepair, remaining only as symbols of death, decay and the supernatural.

During the Georgian and Victorian periods (1714-1901), these ruins of Gothic architecture became perfect settings for a new generation of ghostly tales, and the genre of Gothic literature was born. Characterised by an atmosphere of fear, suspense and the supernatural, Gothic literature is the realm of Mary Shelley's *Frankenstein* (1818) and Bram Stoker's *Dracula* (1897).

"Gothic literature was merely the continuation of ghostly, supernatural storytelling traditions that reached back to the medieval period," explains Dale Townshend, Professor of Gothic Literature at Manchester Metropolitan University. "Numerous Gothic writers of the 18th and 19th centuries set their novels and poetry in ruined religious houses. In doing so, they offered readers vivid and nightmarish visions of the ancient Catholic past that was imagined to have played itself out in these buildings."

How can ghost stories engage people with heritage?

Dale and Michael believe that the enduring appeal of spooky stories can capture the public's imagination. Using tales of ghosts who haunt religious ruins in the north of England, they are inspiring people to engage with English history and heritage. "We wanted to discover how we might employ the Gothic imagination to enrich modernday experiences of ruined architectural heritage," explains Michael. "We hope that our project engages audiences who might otherwise feel alienated from 'official' notions of history."

Dale and Michael's Revenants and Remains project took place at five religious heritage sites associated with the supernatural. For example, at Rievaulx Abbey, 12th-century monks were terrorised by a demonic visitor; numerous 14th-century tales tell of bloated corpses rising from the graves at Lanercost Priory to torment the living; and Ann Radcliffe, a famous 18th-century Gothic writer, imagined the ruins of Furness Abbey to be populated by ghostly friars.

Using ghost-themed guided tours and a series of creative workshops led by professional artists, Revenants and Remains aims to enhance the experience of tourists visiting the ruins through the lure of the supernatural. Rosie Garland, an award-winning novelist, led creative writing workshops at each of the sites. "In the same way that these Gothic remains inspired writers in the 18th and 19th centuries, Rosie encouraged participants to respond creatively and imaginatively to the ruins, and to create their own interpretations through the guiding lens of the supernatural," says Dale. Actor Robert Lloyd Parry performed M.R. James' chilling ghost tales within the ruins themselves. "Robert's performances brought the stories of each haunted location vividly to life, while highlighting the links between Gothic architecture and supernatural storytelling for a pleasurably terrorised audience," says Michael. And artist Sarah Sparkes, working with Photoworks, led photography workshops for local students, who were supported as they created their own ghostly photographic interpretations of the ruins and tried to convey a sense of the supernatural within their images.

How have people responded to the project?

"We've been nothing less than delighted by the response to the project!" says Michael. Drawing on Gothic and ghostly themes allowed visitors to discover aspects of the ruins that are rarely included in traditional histories, and participants commented on how the use of the supernatural increased their interest in the site's history.

"The Gothic mode has proved to be a particularly effective means of engaging young people in history and heritage," continues Dale. "As the photographs, poems, short stories and other creative outputs from the workshops indicate, the potential for ruins to inspire writers and artists today is as powerful as it was in the 18th and 19th centuries."

About *Gothic architecture and literature*

What defines Gothic architecture?

"In architecture, the term 'Gothic' initially implied that something was medieval and characterised by a certain roughness, wildness and even barbarity," explains Michael. The primary features of Gothic architecture (such as pointed arches, vaulted ceilings and flying buttresses) did not conform to the rules of Classical architecture from the Greek and Roman periods, which stated that buildings must have strength, utility and beauty. "Gothic architecture was seen as a systematic violation of the Classical ideals of symmetry, balance and proportion," says Michael. "And, in Protestant England, Gothic architecture was associated with Catholicism and its perceived primitiveness and cruelties."

What defines Gothic literature?

"In literature, the term 'Gothic' was used to describe a style of writing that turned its back upon the Classical laws of composition and which was associated with irregularity, roughness and imaginative excess," explains Dale. "One constant within this genre is a preoccupation with a dark and barbaric Gothic past that is characterised by a belief in the supernatural, to the extent that the term 'Gothic' itself came to serve as shorthand for the supernatural literature of horror and terror."

How can the 'Gothic' promote an interest in heritage?

As the Revenants and Remains project proves, there are many creative ways to engage people with history and heritage. Michael is an art historian who specialises in the architecture of monasteries in the north of England, while Dale is a literary critic with expertise in Gothic writings of the 18th and 19th centuries. "By combining the history of English ruins with insights from Gothic architecture and literature, we believe that our project has provided an exceptionally rich and illuminating approach to engaging people with English heritage."

Pathway from school to Gothic studies

At school, Gothic literature may be introduced in English literature classes, while elements of Gothic architecture may be covered in art and design classes. It would also be useful to study history to learn about the historical contexts in which Gothic architecture and literature arose.

At university, a degree in English literature, creative writing, architectural history, art history or history could be tailored to focus on Gothic elements.

"Read voraciously," advises Dale. "Read Gothic fiction, such as Charlotte Brontë's Jane Eyre (1847) and Emily Brontë's Wuthering Heights (1847). As you read, reflect on the role that architecture, either ruined or unruined, plays in the narrative."

In addition to reading, watch horror films and TV shows and consider how they rely on age-old associations between Gothic architecture and a sense of fear.

Visit heritage sites or ruins and respond creatively. "What story would you set there, and what role will the ruins play in your narrative?" asks Michael.

Explore careers in Gothic studies

A career in Gothic architecture could involve studying the historical significance of medieval ruins (like Michael) or preserving them so future generations can explore their heritage. Learn more about the work of English Heritage: www.english-heritage.org.uk

Similarly, a career in career in Gothic literature could involve studying Gothic texts (like Dale) or writing or performing them (like Rosie and Robert). Learn more from the Manchester Centre for Gothic Studies: www.mmu.ac.uk/english/ gothic-studies



Meet Dale

I've always been fascinated by the supernatural, and my earliest choices in literature reflected this. Despite being terrified by the prospect of the supernatural, I was strongly drawn to ghost stories as dark sources of pleasure. I now make a living from studying and teaching the material that excited me as a young boy.

My greatest sources of inspiration have been the mentors who have taught me English literature over the years, from primary school through to postgraduate university research. Literature has the potential to change lives, and those who teach it occupy a privileged position of responsibility and influence. I am still inspired by my past tutors who taught me how to love and appreciate all forms of literary expression. I also thrive on the research-related aspects of the job, and enjoy the challenge of tracking down rare facts, documents and manuscripts in archives and libraries around the world.

The Mysteries of Udolpho (1794), by Ann Radcliffe, is my favourite Gothic novel. Though she is not well known today, Radcliffe was one of the most successful Gothic writers of the 18th century. I love the story's preoccupation with Gothic architecture, especially the partly ruined and supposedly haunted castle in Italy that gives the novel its title.

It has been very rewarding to see the public's response to our Revenants and Remains project. I was particularly gratified to see how young people created their own fresh photographic interpretations of ruins through the lens of the supernatural. The Gothic certainly has the power to engage those who otherwise might feel alienated from national history and heritage.



This ghostly image was captured at Lanercost Priory © Photoworks, Amy Johnstone, Newcastle College



Meet Michael

My love of the history and architecture of monasteries was inspired by my Catholic upbringing and childhood visits to the ruins that populate the landscape of Yorkshire. These stirred my imagination and touched my soul.

I first encountered the ghost stories of M.R. James in my early teens, which contain elements of the medieval past, such as ruined monasteries. At school, I also studied Umberto Eco's *The Name of the Rose* (1980), a Gothic novel set in a 14thcentury abbey which provides fascinating gleanings about life in medieval monasteries.



After studying history at university, I got a job in the civil service. I spent almost 20 years writing patient information literature for gay rights organisations and HIV charities, which taught me many valuable skills, such as the ability to communicate with non-specialist audiences. At the age of 41, I decided to explore my true passion, so I returned to scholarship and started a PhD studying the art and architecture of medieval monasteries in northern England.

Kirkstall Abbey is my favourite Gothic ruin. Not only can you see how the architecture of the monastery developed between the 12th and 16th centuries, but the well-preserved ruins also provide a valuable source for charting how life in a monastery evolved over time. From an academic perspective, the ruins bring the life of medieval monks alive. From a personal perspective, my grandfather was the custodian of Kirkstall Abbey and I have many memories of childhood visits to the ruins. The ruins even have a ghost story – the last Abbot died heartbroken, and his spirit now haunts the Abbey museum!



"My disability is part of who I am, but it doesn't define me."

National Star's vision is to have a world in which people with disabilities can realise their full potential as equal and active citizens. **Lynette Barrett**, Chief Executive Officer of National Star, a charity and specialist further education provider, describes its impactful work and why its annual Leavers' Ceremony always has people crying tears of joy.

Why was National Star set up?

National Star opened in 1967 to offer residential courses and vocational support to enable young people with disabilities to gain skills to improve employability and become more independent. The charity started with 10 students at Ullenwood in Cheltenham, UK, which remains our main campus today.

We are an independent specialist provider and now provide education, personal development, accommodation, care and support to more than 450 young people a year. We have residential and day students at Ullenwood, as well as day education centres in Wales and Hereford. We also provide long-term living for 32 adults in four locations. Last year, the charity provided 811,197 hours of services to young adults with disabilities and learning difficulties.

In the charity's view, how far are we away from a world where people with disabilities can realise their full potential?

Society has made great inroads, but there is still much that needs to be done to make society truly inclusive. Young people with disabilities face challenges every day and those barriers can be physical and/ or psychological. In January, we had four students present on the main stage at Bett, a education technology show in London. I would like to quote Jaspar, one of those students: "My disability is part of who I am, but it doesn't define me. It is society which defines me by my disability. I long for the same respect and consideration afforded to anyone else." I couldn't say it better.

National Star is a recognised centre of excellence. What does this mean?

A centre of excellence is a specialised hub that shares best practice, expertise and innovation with other, similar organisations. National Star is a centre of excellence because we are a further education provider that has worked with young people (18- to 25-year-olds) with disabilities for 57 years. As mainstream colleges have become more inclusive, and are supporting young people with disabilities, it has meant that the young people attending National Star often have more complex disabilities or medical needs. While we are keen to grow, we do not want to do so at the cost of compromising the quality of our services and we are proud to share our wealth of expertise and skills with other education providers.

We are a forward-looking organisation, and our teams are always looking for innovative



National Star provides day and residential education across three different sites in England and Wales. © Thousand Word Media

projects that we can be a part of. Recently, for example, our physiotherapy team has been trying new equipment aimed at improving students' movement and physical fitness. Our technology team is working on our Find My Voice project, which enables students with electronic communication devices to have their own regional- and ageappropriate voice.

In what capacity does National Star work with schools?

We work with schools in a variety of ways, in particular those that have young people who may benefit from attending National Star. ational Star's multi-disciplinary teams work gether to enable students to achieve their rals. © Thousand Word Media

By working closely together, we ensure that students have a smooth transition in and out of mainstream education and can adapt to their new surroundings.

As part of the UK Government's EdTech programme, and alongside Balcarras School in Cheltenham, we have provided EdTech support and guidance to mainstream schools and colleges.

We also aim to establish new satellite education provision through partnerships with mainstream further education providers. Our students have worked with mainstream schools to deliver sports coaching or talks, which are about breaking down barriers about disability.

Can you explain how National Star uses EdTech and assistive technologies?

We aim to be innovative in our use of technologies, putting the students' needs first. National Star uses a range of assistive technologies such as augmentative and alternative communication (AAC) devices. Importantly, students actively participate in the assessment of the appropriate technology, while our Technology Innovation team find bespoke solutions for increasing levels of accessibility. The Technology



Innovation team engages with Parent Forums, the college's Student Union and Learner Voice (see Natspec's guidance on Learner Voice).

Our ongoing work with the UK Government's Department for Education is focused on the use of artificial intelligence in education and to produce guidance to support its use and development. In October 2023, we opened the Ingram Discovery Room, which is an assessment suite that uses Alexa SMART technologies. The room has SMART blinds, sensory equipment, lights, a fridge, kettle, windows and a vacuum cleaner. It provides an opportunity for students to explore this SMART technology and how it can help them be more independent when they leave college. **•**

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My disability is part of who I am, but it doesn't define me. It is society which defines me by my disability. I long for the same respect and consideration afforded to anyone else.



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No two disabilities are the same and it is important that we work with the individual to find the right solution.

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We also use technology to motivate students. For example, students learn about eSports in multimedia sessions and are involved in planning events, such as Bett earlier this year. For this show, they decided on the topics and were a key part of the planning.

Why is there a strong emphasis on the creative and performing arts and sports at National Star?

Our aim is to provide individualised personal development programmes to help young people develop and sustain personal skills. While we offer performing arts and sports, they are embedded through the curriculum. We use a multi-disciplinary approach, which means education, therapies, residential and nursing teams work together to enable the student to develop their potential.

We are privileged to work with young people with a range of complex needs. Some of them may aspire to get a job, learn to live with their peers or to independently drive a powered wheelchair. For others, it may be to learn to make choices for themselves and to take as much responsibility as they are able.



Can you provide some examples of the communication and life skills taught on the programme?

These vary from student to student, reflecting their needs and abilities. We support young people to find their voice. That may be verbal, or it may be finding different ways for them to communicate. Students use a wide range of communication devices, which they may operate with their eyes, hands, head or even feet. We had a student who communicated through the exhalation of breath, and we worked with her so that she could express her wishes and choices in this way. No two disabilities are the same and it is important that we work with the individual to find the right solution.

Why is teacher training and development an important part of National Star's offering?

One of the charity's aims is to improve the quality of education provision for people with disabilities and one way we can do that is to work with other organisations, schools and businesses. Our multidisciplinary teams have an incredible wealth of knowledge and expertise, which we share through a range of activities, including working in partnership with The Education and Training Foundation (ETF). ETF sets professional standards for improving the quality of teaching and leadership in the further education and training sectors.

Some of National Star's fundraising activities, such as firewalking and wing walking, are high-adrenalin activities and encourage participants to be brave! Is this intentional? High-adrenalin activities are often very successful as fundraising events, and participants are more likely to be sponsored to take part in something exciting, high-risk or physically challenging. These types of events, which push us out of our comfort zone to face a particular challenge, help people gain some understanding of the daily challenges faced by young people with disabilities. The things non-disabled people take for granted, such as, for example, making a cup of tea in the morning, can take huge amounts of concentration and energy for someone with disabilities.

Firewalking and wing walking are what can be termed 'bucket list' events - an experience or achievement a person would like to have done before they die. Both of these events leave the participant feeling that they have achieved something they may not have thought possible. Often participants have their own fears - fear of heights, fear of flying, etc. - so they get a great deal out of conquering those fears and supporting the charity.



© National Star

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If you ask any member of staff about what brings them the most job satisfaction, they will all say it is enabling students to achieve great things.

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Why are these fundraising activities so important?

The statutory funding we receive pays for the services and care we provide but the reason we have such high-quality facilities is due to fundraising. Through fundraising, we can provide the best possible facilities to enable students with complex disabilities to progress, grow and flourish, and to make the most of their time here at National Star. Fundraising also helps provide the necessary specialist equipment for delivering life-enhancing therapies and innovative technology that help a young person with complex disabilities become more independent. For example, our physiotherapy team have done some research into innovative equipment that helps improve students' fitness and muscle control. One of these pieces of equipment, a specialist cross trainer for people who use wheelchairs, costs almost £50,000. The only way we will be able to get that piece of equipment will be through fundraising.

What have been some of **National Star's proudest** achievements to date?

If you ask any member of staff about what brings them the most job satisfaction, they will all say it is enabling students to achieve great things. It could be something that may not seem like a big deal - for example, being able to go to the theatre and watch a pantomime - but something like this represents a huge achievement for the individual with a disability.

Students are at the centre of what we do and are National Star's greatest ambassadors. The four students who presented at Bett, for example, shared their stories and enabled people to understand how technology can be life-changing for people with disabilities. Sam's campaign to make the blue badge more inclusive (see page 4) exemplifies what we set out to do. Since his time here at National Star, Sam has grown into a confident young man who has a passion and a clear objective. What National Star has done is given him the support and skills to achieve his aspirations in life.

Every year, when students finish their time with us, we celebrate their successes at a Leavers' Ceremony. By the end of this event, no one has a dry eye.

What is the Learner Voice?

Natspec is a membership association for organisations that offer specialist further education and training for students aged 16 to 25 with learning difficulties and/or disabilities. It provides examples of different approaches to Learner Voice work: • Learner Councils/Student Unions

- Learner representation on governing bodies
- Learner involvement in college self-assessment processes
- Learner involvement in curriculum and transition planning
- Learner-led initiatives

Visit the website for more information: natspec.org.uk/resources/learner-voice

Find out more about **National Star**

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- nationalstar.org

Boosting employment prospects for neurodiverse people through video game development

Despite often having the potential to be huge assets to the workforce, people with Autism Spectrum Disorder often face discrimination and have difficulties obtaining and maintaining jobs. **Professor Leanne Chukoskie**, from **Northeastern University**, and **Professor Pamela Cosman**, from the **University of California San Diego**, in the US, are combatting this through a unique internship that champions the skills of neurodiverse interns and trains them how to negotiate the workplace.



Professor Leanne Chukoskie, PhD

Associate Professor, Department of Physical Therapy, Movement and Rehabilitation Science, Bouvé College of Health Sciences, Games Program, College of Art, Media and Design, Northeastern University, USA

Fields of research

Neuroscience, game design and development

Funder

US National Science Foundation (NSF): Future of Work at the Human-Technology Frontier



Professor Pamela Cosman, PhD

Distinguished Professor, Department of Electrical and Computer Engineering, Jacobs School of Engineering, University of California, San Diego, USA

Field of research

Electrical engineering

Funders

US National Science Foundation (NSF), Motorola Solutions Foundation, Foundation for Developmental Disabilities

Glossary

Autism/autism spectrum disorder — a developmental condition that typically involves impaired social communication and repetitive and restricted patterns of behaviour. Autism exists on a spectrum, meaning that different individuals with autism often present very different behaviours

Internship — a period of work placement where a trainee gains experience of a specific job role or industry **Masking** — in psychological terms, when a person conceals their natural personality to better conform with social pressures

Neurodiverse — a term used to describe the different ways in which people's brains work

Neurotypical — a term used to describe people whose brains function in a way considered typical by the wider population

eople with autism often find it difficult to integrate into the working world, facing challenges that neurotypical people might not even consider. Professor Leanne Chukoskie specialises in the intersection between neuroscience and game design and development and leads a pioneering internship at Northeastern University that aims to help people with autism spectrum disorder build their skills and access exciting opportunities in the workforce. She began this internship in 2018 with a grant from the San

Diego Foundation. Leanne and her colleague Professor Pamela Cosman, who now leads the University of California San Diego internship, won a four-year NSF grant to further develop the internship and related tools to help neurodiverse employees in tech.

Battling preconceptions

"Whether consciously or not, employers often prefer individuals who display polished social skills," says Leanne. "As this is an area where autistic individuals often have challenges, they can fare less well in



interviews." There is also a misconception that accommodating neurodiverse individuals can be expensive or timeconsuming, but Leanne says this is rarely the case. "Frequently, flexibilities offered to all employees accommodate autistic individuals effectively," she says.

Despite these prejudices, individuals with autism often have skills that can be highly useful to the working world. "The autism spectrum is broad, but there are certain peaks and challenges in ability," says Leanne. "Some of these peaks are the ability to detect patterns in complex situations and to be able to hold intense focus for long periods of time." Although these are highly desirable traits for most jobs, securing employment can be challenging for people with autism – and employers lose out as a result of this.

Challenges in the workplace

Workplaces can have complex social rules that are rarely communicated directly. "Interpreting these rules can be quite challenging for autistic people," says Leanne. "Clarity with expectations and direct communication benefit employees with autism." Pamela points out that such clarity can actually be advantageous for all employees, helping to avoid misunderstandings or miscommunications. "For example, a manager spelling out the expected length and content of a report can be a lot more helpful than just asking for a 'progress report' with unclear parameters," she explains.

Many autistic individuals recognise that these workplace norms exist and work hard to comply with them. "This effort to fit in – called masking – can be exhausting," says Leanne. "It's like having an additional large task assigned to you every day." While neurotypical people might easily understand these norms – for instance around punctuality, appropriate clothing, playing music while working, or phone use during working hours – it can take conscious effort for neurodivergent individuals to detect and follow these unwritten rules. Leanne's team is piloting some tools that could make this process less draining – for instance, one subtly helps users to orient themselves better in meetings to demonstrate they are paying attention.

ReGame-XR Lab

The Rehabilitation Games and Extended Reality (ReGame-XR) Lab at Northeastern University, which Leanne leads, supported by her colleague Ara Jung, has recently expanded to The NeuroDiversity in Tech internship at the UC San Diego, led by Pamela. "The internship involves nine weeks of teamwork, with participants taking the roles of programmers, project managers, artists and designers," says Leanne. "All have the aid of a peer coach to collectively develop an educational or research-based video game." Prospective interns are chosen and allocated roles using written responses to questions around interests and experience in game design, as well as online interviews for which questions are sent in advance.

Mentoring opportunities form a key part of the internship. "Our coaches are trained to offer feedback, not only in aspects of game development but also in workplace norms and effective collaboration," explains Leanne. "They work closely with interns to support their individual needs." The internship can be intense at times, involving periods of stress as deadlines approach, but this challenge can help drive teamwork and provide experience of real-world workplace pressures.

Skills and successes

The internship imparts a mixture of hard and soft skills. "Hard skills involve learning how to use the Unity game engine, synchronising animations with sound, and quality assurance testing," says Leanne. "Soft skills involve clear communication, effective teamwork, mutual support, and contributing to the kind of workplace they want to work in."

This combination of skills helps interns develop their game project and contributes to their employment prospects down the line. "We see a lot of growth in our interns over the nine weeks," says Leanne. "We get especially excited when interns tell us that they won a competitive job after the internship." The internships also double up as valuable networking opportunities. Clients provide projects and work with interns, and the end-of-project showcase event introduces the interns' talents and commitment to the wider tech community.

Now, Leanne and Pamela hope to increase the support they can offer to interns. "We are seeking funding to extend the programme, so interns can build even more skills and get more projects on their portfolios," says Leanne. "We would love for this to dovetail with our own research, so that interns can go beyond design and development and get involved in the science behind the games."

About neuroscience

euroscience is the study of the body's nervous system, often focusing on the brain. Neuroscientists might study specific functions, mechanisms, developmental pathways and diseases of the nervous system. This includes holistic approaches that closely examine the link between the nervous system and our interactions with the world around us. Leanne explains more about her field:

"My work involves a lot of collaboration. In particular, I work with computer scientists, computer engineers and electrical engineers. Together, we can make better sense of the data collected using machine algorithms.

"The human brain is vastly complex. We are entering a stage of research where we are thinking less about the function of a particular area of the brain and more about how the system functions as a whole. This approach is giving us new ways to leverage the combination of brain imaging and behaviour.

"Research tools are becoming ever more sophisticated. We now have better tools to examine how two people's brains are synchronised when they are working well together. The concept of interpersonal synchrony demands a lot of interesting computation on top of the brain and behavioural data collection but gets us much closer to understanding how the brain functions during everyday interactions."

Pathway from school to neuroscience

Leanne emphasises that data analytics skills are becoming increasingly essential in neuroscience. This involves skills in mathematics, statistics and computer science, in addition to a strong biological underpinning.

At school and beyond, useful subjects include mathematics, statistics, biology, computer science and physics.

Undergraduate courses or modules that can lead to a career in neuroscience include biology, neuroscience, molecular biology, biochemistry and psychology.



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Northeastern University's Center for STEM Education offers a wide range of ways for young people to get involved in STEM projects, including summer schools, field trips and lab experience: stem.northeastern.edu

Northeastern University has co-designed summer job opportunities for low-income youth in the area, which includes work experience in a wide array of disciplines: impactengines.northeastern.edu/ia/ c2c/focus-areas/youth-development

The National Institute of Neurological Disorders and Stroke (NINDS) runs summer internship programmes for high school students to get involved in neuroscience research: research.ninds.nih.gov/employment-training/ ninds-summer-internship-programs-sip

According to Glassdoor, the average salary for a neuroscience researcher in the US is \$97,000 per year.



Meet Leanne

Growing up, I wasn't exposed to research in any way, so never considered research-focused careers. But I was always fascinated in why people thought, interacted and solved problems the way they do. This led me to the idea of becoming a psychiatrist, which sounded like a good fit for my early interests.

My excitement for research came from a work-study job in my first year in an infant virology lab. We were seeking to understand the causes of infant diarrhoea, which might sound disgusting, but was actually really exciting – every day you could discover something new that others hadn't seen before. I also loved the camaraderie in the lab and how senior students supported junior students' development. This experience was foundational in my path to becoming a researcher. I had a strange path to my current position. My PhD and early postdoctoral research were in systems neuroscience, but I realised that I wanted to focus more on studying questions impacting the human condition. At the time, a family member was diagnosed with autism spectrum disorder, and the questions around the best approach to caring for this child redirected my career toward autism research.

I attended the talk of a well-respected researcher and, boldly, approached him afterwards. I told him I had applied to his programme on autism, and that I didn't have much experience in autism but could contribute my systems neuroscience skills and a deep willingness to learn. My acceptance to the programme followed, and it changed the course of my career.

I then worked in autism-related research initiatives for over ten years. One research project involved a clinical trial for gaze-driven games for attention training, which could help some neurodivergent people. I have also been granted 'start-up' funds to create sensor-enabled games for research, which we called the Power of NeuroGaming (PoNG) Center. The existence of PoNG made the ReGame-XR internship possible. Looking forward, I am keen to focus more on social neuroscience. This involves looking at how the brain and people's behaviour change when people interact with each other. New behavioural and neural signal measurement tools are making these kinds of measurements more feasible. This is the kind of thing that makes up our everyday conscious experiences, yet we know remarkably little about it.

Leanne's top tips

- Get involved in research early on and find a mentor willing to guide you. It doesn't even matter what sort of research it is - mine was baby poop! It's more about learning the process and the skills involved, which will be useful regardless of the topic.
- 2. Take a 'multiple lenses' approach to a problem. Try to see a problem from different perspectives and different levels of analysis, which helps to consider a problem in a new and unique way.



Meet Pamela

As a kid, I loved building things like toy cities and marble machines. My dad was an electrical engineer and introduced me to coding when I was about six. But I also loved reading, writing and medicine, so it was hard to narrow down what I wanted to do! In the end, I chose engineering because of that joy of building things, but I've also been able to bring medical and creative writing aspects into my work.

During my education, I have had both awful and truly great professors and advisors. Such polar opposites helped show me that I could be a good teacher and mentor. My proudest career achievements involve my students, both the doctoral students who do research with me and the undergraduates in my courses. It makes me very happy when someone tells me that one of my classes inspired them to go into teaching, or when a former doctoral student got dozens of patents for her inventions. I am also very proud when something I create gets used in the real world.

My current research explores point

clouds. These are huge data sets of points in 3D space, which can represent detailed scene and object information. For example, self-driving cars use them to know where things are around them. I find the practicality of my research rewarding, and I love that I'm constantly learning something new. One year I'm involved in a project of colour restoration for underwater images, and the next, helping to make a home guidance system for physical therapy.

In the future, people will have all kinds of electromechanical devices within their bodies. These can help enhance our capabilities and our lifespan. Virtual reality and augmented reality will be part of everything, and electrical engineers will be designing those systems. Plus, the next generation of engineers will be working on a lunar station, an asteroid station and, eventually, a Mars station – with all sorts of exciting electrical devices!

I've written several fiction books for

kids. They introduce engineering and mathematics topics through fiction – who knew that error correction coding could help defuse a hostage crisis, for instance? I aim to write more, and the third book in the series should come out in 2024.

Pamela's top tip

Think of setbacks or failures as opportunities to learn and grow, not as reasons to give up. Some people are overly shielded from setbacks, so when they do encounter one, they think it's a sign they don't belong or they shouldn't be working on that project. Resilience and perseverance are important – embrace it when something doesn't go exactly right!



Meet Ara

Ara Jung

Administrative Researcher, ReGame-XR Lab, Department of Physical Therapy, Movement, and Rehabilitation Sciences, Bouvé College of Health Sciences, Northeastern University, USA

Field of research

User experience research

My background is in psychology. This stemmed from my fascination with the uniqueness of people's experiences during shared events. Although I've always enjoyed gaming, I never considered it as a potential career path – until I discovered roles related to games' user experience and research, and I realised my two passions could converge into a meaningful career.

The ReGame-XR lab stood out to me. It

harnesses games as virtual environments for research, allowing the capture of biometric data such as gaze or heart rate, which is challenging in a physical setting. I joined the lab, eager to contribute to this innovative intersection of psychology and gaming as a games user experience researcher. I also work as a lab administrative researcher and coordinate the lab's summer internship programme.

An 'epiphany moment' for me was realising the immense flexibility in career options. The rising demand for utilising games as learning tools across diverse fields would allow me to apply creative design skills and collaborate with experts from academia and medicine.

I lead the coaching element of the summer internship. Our coaching focuses on both hard and soft skills. We provide feedback not only on the quality of their work but also on improving communication and assisting participants in expressing their needs and intentions more clearly. We believe in modelling the behaviour we expect from participants, including fostering an environment where they feel comfortable sharing feedback with us.

I love witnessing tangible improvements in people's experiences through the iterative process of our projects. In my role as a researcher, conducting usability studies and identifying pain points has allowed us to enhance the quality of our data. As a coordinator, I love seeing our students and interns have a wonderful experience. Our interns report a significant increase in their confidence when seeking employment and a heightened belief in their ability to excel in a workplace.

For the future, I aim to build a process where user experience and research can be seamlessly embedded into scientific rigour. The combination of user experience and research and academic science is relatively new, but I believe the integration of user experience and research into the development of scientific tools and software can enhance the quality of research.

Ara's top tip

Network! Building connections is crucial in the games industry. Join online communities, share your thoughts, ask questions and consider attending real-world conferences and events. See networking not as a chore but an opportunity to genuinely engage with people, show interest in their work, and build meaningful relationships.



Pathway from school to *the game industry*

Ara emphasises the huge range of disciplines involved in the game industry and how important it is to learn about these disciplines so you can see what overlaps with your own interests: hitmarker.net/career-advice/thecomplete-list-of-gaming-jobs

Study the job postings for these positions to note what kind of skills and experience employers are looking for.

Ara advises, "Search through the International Game Developers Association's Special Interest Groups (igda.org/sigs) to join a group with people in the industry who share the same passion and values as you."

She also recommends joining the Games User Experience and Research Special Interest Group (grux.org/#2) to gain insights into the vital role of user experience and research in creating successful games.





Meet Pierre

Pierre Escaich Neurodiversity Talent Program Director, Ubisoft, Sweden

Field of research Neurodiversity

Working at Ubisoft is my first job - I've worked here for 25 years now! Video games became a passion for me because of the atypical creativity you find among its developers and players.

As Ubisoft's Neurodiversity Talent Program Director, my aim is to empower current and future neurodiverse employees by bringing them the support they need to realise their full potential at work.

Neurodiverse people bring a huge amount of skills to the gaming industry. These are skills that we need to develop innovative games: from high 3D visualisation skills to fine detail processing; from the ability to see the big picture to the ability to hyperfocus. We need to constantly think outside of the box to create fun games.

The power of neurodiversity can

be unlocked by adapting the work environment, so people can express and develop their talents and skills, while being respectful of everyone's individuality. It requires a skills-focused approach to management, bringing psychological safety to teams and actively valuing different ways of thinking, communication and problem solving.

Ubisoft supports the ReGame-XR

Lab because we are keen to encourage original initiatives that focus on promoting video game development among communities that are passionate but might feel excluded from the job market. Neurodivergent individuals have a lower access to the job market, despite their talents and skills.

We provide mentoring to the ReGame-XR Lab participants, sharing practical tips of how to experiment with and work through game prototyping. We also give advice about the recruitment process in the industry.

Supporting ReGame-XR Lab brings us great pride and motivates us to keep promoting both neurodiversity and video game development. All our mentors have a neurodiverse background and are passionate professionals. They are keen to share their knowledge with their peers and to show that you can be neurodiverse and pursue a meaningful career in the video gaming industry.

I am particularly proud of the collective achievement of having launched a dedicated neurodiversity initiative within Ubisoft, with an employee resource group of 500+ members across the world and a dedicated human resources talent programme to promote neuroinclusive good practices.

Ubisoft's goal is to be recognised as a leader in neuroinclusion at work. We hope to inspire others by providing trainings, tools and awareness of what neurodivergent people can contribute to industry.

Pierre's top tips

- 1. Follow your passion.
- 2. Try, fail and try again that is how we develop video games.
- 3. The video game industry needs all types of minds to develop enriching and innovative games. If you identify as neurodiverse, know you have a part to play in creating fun games.

From school to university: how can students adapt better to change?

Are you worried about leaving school or eager to start on the next chapter of your life? Whether you are anxious about moving away from home or excited to make new friends, times of transition commonly cause a range of emotions. At the **University of Waterloo** in Canada, psychology researcher **Dr Jenna Gilchrist** is studying how high school students adapt to life at university, and how techniques such as exercising self-compassion can help them regulate their emotions.





Dr Jenna Gilchrist

Postdoctoral Fellow, Self-Attitudes Lab, Department of Psychology, University of Waterloo, Canada

Field of research

Psychology

Research project

Investigating how students adapt during the transition to university

Funder

This research is supported by funding from the Social Sciences and Humanities Research Council of Canada (SSHRC)

tarting university can be a time of great excitement and challenge. Leaving home, moving to a new city, making new friends, managing your workload and schedule, and learning to cook for yourself are just some of the experiences you might face if university is your next step after finishing school.

"As students transition to university, they often experience a wide range of emotions," explains Dr Jenna Gilchrist, a psychology researcher at the University of Waterloo. "It's common to feel excitement, hope and joy about the new experiences

💬 Talk like a ...

psychology researcher

Emotion regulation — the ability to change your emotions

First-generation student — a student whose parents did not attend university **Self-attitudes** — the feelings, beliefs and evaluations that individuals hold about themselves

Self-compassion — treating yourself with care and kindness

that await, while at the same time feeling anxiety, fear and sadness due to the changes." These swings between emotional highs and lows have been likened to an 'emotional roller coaster' as students navigate the ups and downs of settling into university. "The ability to regulate these emotions is critical for students to adapt successfully to university life," says Jenna.

What is emotion regulation?

"Emotion regulation involves understanding and managing your emotions, especially when encountering new and stressful situations," explains Jenna. This ability allows you to deal with issues without being overwhelmed by how you are feeling, making you better equipped to

tackle challenges that come your way. In her research, Jenna is investigating whether practising self-compassion can help new university students regulate their emotions, settle into university life, and adapt to the pressures and mental stimulation of academic responsibilities. Being selfcompassionate means treating yourself in the same way that you would treat a friend – with kindness and understanding, comforting yourself when you feel down, and not holding yourself to unrealistic standards or expectations.

What happens if students cannot regulate their emotions?

If students become overly stressed or anxious, it can lead to them



having poorer mental health, getting worse academic results or even dropping out of university. Every year, over two million students enrol in university in Canada. However, about 15% of them do not continue beyond their first year. "The ability to successfully navigate the first year of university is a crucial factor in educational attainment," says Jenna, highlighting her motivation for studying how students adapt during the transition to university.

"Dropping out of university can lead to lower self-esteem, constrained career options and potential debt without the corresponding degree to enhance job prospects," explains Jenna. On a broader scale, high university drop-out rates can have economic and social impacts. Gaining university qualifications can promote social mobility, and a more educated workforce results in higher national economic productivity. From a university's perspective, a high drop-out rate negatively affects its reputation. "Addressing the causes of high dropout rates is therefore crucial for both individuals and society," Jenna adds.

How is Jenna studying emotion regulation?

To understand students' emotions as they transition to university, Jenna is asking students to keep a daily record of their feelings during their first semester at the University of Waterloo. Each day, every student involved in the study records the spectrum of emotions they have felt, whether happy, sad, stressed, anxious, grateful...

44

Adapting to the next chapter of your life is a process, so give yourself the grace to learn and grow at your own pace.

77

Jenna and her team will then analyse these diary entries using statistical models to look for patterns. "We expect to see that when students first arrive at university, their emotions are like a roller coaster, with significant highs and lows," Jenna explains. "As they adjust to their new life, these wild swings in emotion should calm down." If students can adapt, the fluctuations in their emotions should become less intense as they settle into university life. Jenna believes that students who practise self-compassion will adapt more quickly during the transition to university.

How will this research benefit students?

Jenna hopes universities will use her research findings to help new students

and support them as they adapt to university life. For example, if Jenna can identify when adaptation typically occurs, universities should create support systems to coincide with these critical periods. Most universities provide lots of activities and support for new students in the first few weeks after their arrival. However, Jenna suspects that many students would benefit from additional support later in the year or sustained support programmes. In addition, Jenna wants to encourage universities to provide self-compassion training for new students. This would teach students how to care for their emotional well-being, helping them to manage the emotional turbulence of settling into university life. Jenna also hopes to identify whether students from certain demographics (e.g., firstgeneration or international students) require additional support during the transition to university. If so, universities should develop specialised resources and support systems to target these students.

What can you learn from Jenna's research?

"As you transition out of high school, my advice is to embrace the journey with an open mind and a kind heart," says Jenna. "Practise self-compassion by allowing yourself to feel nervous or excited without criticism, speak to yourself with encouragement and supportive language, and recognise that you are not alone – many people around you will be facing similar challenges. Remember, adapting to the next chapter of your life is a process, so give yourself the grace to learn and grow at your own pace."

About psychology

sychology is the study of the human mind, its functions and behaviour. If you study psychology, you could find yourself exploring how people adapt to change, helping people work through the symptoms of depression or social anxiety, or researching conditions such as posttraumatic stress disorder (PTSD).

The study of self-attitudes

Jenna is a member of the Self-Attitudes Lab at the University of Waterloo, a group of psychology researchers investigating the beliefs and evaluations that people hold about themselves. "Our lab studies the way self-attitudes, like being critical or compassionate towards ourselves, influence the way we feel, think and behave," she explains. While Jenna explores how self-compassion can promote emotion regulation, her colleagues investigate topics such as how someone's view of their body image influences their eating behaviour and how someone's opinions of themselves influence whether they seek mental healthcare.

The joys and challenges of studying psychology

"The opportunity to uncover insights into human behaviour and mental processes is very rewarding," says Jenna. "Each study is like piecing together a complex puzzle of the human experience, which leads to findings that improve people's lives. Seeing the real-world impact of my research, such as helping students adapt to university life or devising strategies to enhance well-being, is incredibly gratifying."

Psychology research is not without challenges. The rigorous nature of the scientific process demands that researchers are meticulous at every stage, from designing a study to collecting and analysing data to reporting results. "Balancing the rigorous requirements of scientific research with the practicalities of working with human subjects, who can be unpredictable and diverse in their responses, adds complexity to our work," explains Jenna. "However, this demand for precision ensures our findings are reliable and valid and strengthens the integrity of our research."

Pathway from school to psychology

If your school offers psychology classes, take these to learn the basics of the field. Biology, mathematics and humanities subjects will also be useful.

Study psychology at university. If you want to be a psychology researcher, you will need to complete a master's or PhD after your undergraduate studies. To qualify as a psychologist, you will need to complete a graduate degree in clinical psychology that is accredited by your country's psychology body.

"Pursue a diverse educational path," advises Jenna. "Interdisciplinary study is key, as psychology intersects with many other disciplines." For example, biology will teach you about the brain, you will learn how to model complex systems in mathematics and computer science, and courses in economics and political science will illuminate social behaviours and decision making. Studying humanities will give you insights into human experience and ethics, and language classes are important because effective communication is a key skill in research. © Harbucks/Shutterstock.com

Explore careers in psychology

Psychology researchers, like Jenna, increase our understanding of human behaviour through scientific studies. In contrast, clinical psychologists are health professionals who help patients with mental health conditions.

"My advice for young people aspiring to a career in psychology is to immerse yourself in the field as much as possible," advises Jenna. "Keep up to date on the latest research by reading accessible psychology articles, connect with psychology professors through social media and get involved with psychology research by volunteering in a university psychology lab or participating in a research study."

Join your national psychology society, which will provide valuable resources and networking opportunities. For example, the Canadian Psychological Association has a career hub containing a wealth of information about getting started on a career in psychology: www.cpa.ca/careers/career-hub

Psychology Today translates psychology research into engaging articles written for a general audience: www.psychologytoday.com



My path to psychology was sparked by a fascination with understanding human thoughts and behaviours, particularly our emotional life. Emotions are universal and experienced by everyone, yet they hold such individual significance and offer a window into how a person views themselves and the world around them.

My own transition to university was a significant period of growth and learning. I recall a mix of excitement for the new experiences and independence, but also a sense of apprehension about the unknown. Having a strong support network really helped me and self-compassion served as an internal anchor during this time. It allowed me to approach struggles and difficulties with kindness and understanding. Initially, I faced many challenges, from barely passing my first cognitive psychology exam to getting constantly lost in a new city, to wondering if I had what it took to be successful. Looking back, it was a time of both emotional upheaval and profound personal development.

I'm proud to lead research on student adaptation as the

findings could significantly improve how students adjust to university life. I'm already collaborating with staff at the University of Waterloo to ensure any insights we gain from the study will be integrated into student support systems. We're dedicated to getting these findings out quickly, aiming to make a real difference to students' lives.

In the future, I would like to broaden the scope of this research to explore how we can support students during their transition out of university as they prepare to graduate. This period of change is often overlooked, but many students struggle as they leave university and enter the workforce or further education.

I'm also eager to take this research into high schools to help students prepare for university life ahead of time. By addressing adaptation issues proactively, we can equip students with the tools they need to thrive throughout their educational experiences and beyond.

Jenna's top tips

- 1. Stay curious. Always ask questions and seek to understand the 'why' behind human behaviour.
- 2. Find mentors who can guide you, offer advice and provide feedback on your work. Their experience can be invaluable in helping you navigate your career path.

What makes nursing a dream career?

In a world grappling with healthcare staffing shortages, exploring the exciting field of nursing has never been more crucial. **Dr Kathryn Halverson**, from the Department of Nursing at **Brock University**, Canada, shares insights into the challenges, rewards and opportunities awaiting the next generation of nurses.





Dr Kathryn Halverson

Department of Nursing, Faculty of Applied Health Sciences, Brock University, Ontario, Canada

Fields of research

Nursing education, transition to practice

Funders

Social Sciences and Humanities Research Council of Canada (SSHRC), Brock University

nursing educator

Ageing population — a higher percentage of people in a community getting older (65 years or above), leading to growing challenges in healthcare

Burnout — when an individual feels extremely tired, stressed and overwhelmed because of their work

Evidence-informed

practice — making decisions about healthcare based on the best available information, combining what doctors and nurses know with what has been proven to work well **Health inequities** — the unjust and avoidable differences in how healthy people are, often due to social factors (e.g., where they live, how much money they have, or their access to good healthcare)

Interdisciplinary

research — when experts from different areas, like doctors, scientists and other professionals, work together to study and solve problems

Nursing shortages — a

situation where there are not enough nurses to fill the available jobs in healthcare

n a world where healthcare is a key global challenge, nursing stands as a vital force. The nursing profession, which has always been key to successful healthcare systems, plays an important role in providing essential care during critical moments in patients' lives. The significance of nursing extends beyond the confines of hospital corridors – it is embedded in communities and homes and is an integral part of our society.

Nurses are the skilled professionals who

bridge the gap between medical expertise and compassionate support. They are the advocates for health and well-being, the empathetic caregivers, and the individuals who bring comfort and reassurance when it is needed most. Therefore, choosing a career in nursing is not just about filling a role; it is about embracing a profession that holds purpose and significance.

As the need for healthcare professionals grows, Brock University's Dr Kathryn Halverson highlights career opportunities in nursing, shedding light on its rewards, challenges and potential to shape the future of healthcare.

What is the current situation with nursing shortages?

Nursing shortages make it challenging for hospitals and other medical facilities to meet the needs of patients and maintain optimal healthcare standards. As the need for healthcare professionals grows, the critical role of nursing becomes increasingly apparent. "There is an urgent



need to recruit and retain nurses and other healthcare professionals to address staffing shortages across Canada," says Kathryn. "According to Statistics Canada, in the first quarter of 2023, job vacancies for registered nurses increased by 5,475 positions (a 24% increase) to 28,335 compared to the same quarter in 2022." This shortage of nurses is not just a problem in Canada; it is a global healthcare issue.

There are many reasons why these shortages persist globally. For example, the pressures caused by the COVID-19 pandemic, burnout among healthcare workers, and ageing populations have all contributed to the increased need for nurses. The significance of nursing cannot be overstated. Nurses play an important role in providing compassionate care and their commitment to healthcare serves as a source of hope, inspiring positive change and resilience in the face of challenges.

What are the qualities of a good nurse?

The qualities that define a good nurse extend far beyond medical and practical knowledge; personality traits are equally important. A truly outstanding nurse has a unique blend of compassion, resilience and adaptability. "People who are caring, enjoy teamwork and are comfortable with communication possess some of the qualities nurses benefit from," says Kathryn. Communication skills stand as a cornerstone, enabling nurses to create meaningful connections with patients and collaborate successfully within a healthcare team. They act as advocates, anticipating needs, and standing up for those who might feel a bit lost in the healthcare maze. Empathy is at the core

of what they do. They are good listeners, aiming to understand what each patient is going through without any judgment, and they respect the variety of values and life experiences people bring, trying to see things from the patient's viewpoint.

"As nurses work in so many unique areas with a variety of patient populations, the role demands different skills and attributes depending on the context you may find yourself working in," explains Kathryn. This is also why your adaptability and critical thinking skills can distinguish you as a good nurse. Nursing is a holistic profession, combining medical skills with empathetic communication, resilience, problem-solving and a constant desire to learn.

What are the rewards and challenges of nursing?

Nursing provides profound moments of fulfilment. It is not just a profession; it is a calling that combines scientific understanding with humanity. "A career in nursing can appeal to anyone who aspires to find a strong sense of meaning and purpose through caring for others, using evidence to inform practice, collaborating with other disciplines, and embracing science, technology and spirituality to advance health outcomes," says Kathryn. Nurses of the future will take on the role of advocates for social justice, working to address health inequities caused by social factors such as economic status and education.

However, even though the rewards are abundant, nursing can be challenging. "Nurses are expected to embrace evidence-informed practice and stay abreast of new and emerging information that may improve the health outcomes of the clients in their care," says Kathryn. "They are also challenged to quickly establish relationships and demonstrate compassion and cognitive flexibility in stressful and dynamic situations." From bonding with patients to embracing continual learning, nurses navigate a spectrum of challenges. Yet, each challenge becomes a unique opportunity for personal and professional growth, shaping them into compassionate and skilled healthcare professionals.

What does the future hold for nursing?

The road ahead for the next generation of nurses is full of promising prospects with the potential for research and education. As the demand for nurses continues to grow globally, the future holds exciting opportunities to make important contributions to healthcare. "Innovative and efficient training and mentorship programmes for nurses around the world will continue to be an important consideration for practice settings such as hospitals," explains Kathryn. The evolving healthcare scenario encourages a shift towards interdisciplinary research, promoting collaborations that extend beyond traditional healthcare areas. This forward-looking approach not only addresses the demand for skilled healthcare professionals but also pushes the next generation of nurses into a dynamic sphere where their expertise and contributions can span diverse sectors and fields of study.



Kathryn's career

Ms Turner, my high school guidance counsellor, had an early and influential role in my career. She convinced me to study nursing based on our conversations, my personality and her perception that I would thrive in a career that involved frequent contact with people. She saw something in me that I did not see in myself at the time. I trusted her and am glad that I did.

As an undergraduate nursing student, I was fortunate to have incredible nursing professors and clinical instructors who truly embodied the values integral to nursing. Their knowledge, professionalism, compassion and expectations inspired me to want to be the best nurse I could be, and in turn, to inspire others in the same way.

My transition from being a student to becoming a nurse provoked a sense of responsibility I did not always feel prepared for, and a frustration with systemic challenges I knew I didn't fully understand. I realised I had more to learn and that doing so may assist my ability to influence change. Pursuing further education in nursing led me to becoming an educator, which I found to be more rewarding than I had expected. As a researcher, I have chosen to focus on people's transition to nursing practice to help future nurses feel prepared for and supported during their early days as an independent nurse.

I look forward to having the opportunity to influence changes in education, practice and policy that reflect and respond to challenges shared by new graduates in their early careers as nurses. I will continue to engage in research that optimises academic-practice partnerships, while honouring and showcasing the voices and stories of nurses.

Kathryn's top tips

- 1. Have conversations with guidance counsellors and explore a variety of career opportunities in healthcare with those working in the field.
- 2. Develop teamwork, communication and leadership skills through extra-curricular activities, such as sports and voluntary or part-time work. These will help to prepare you for many jobs in nursing and beyond.

Pathway from school to nursing

"Prepare yourself for the study of nursing by establishing a strong foundation in science, mathematics and language," says Kathryn. "Developing relational skills in communication and seeking opportunities to listen and demonstrate compassion toward others will prepare you personally."

Kathryn recommends volunteering or working in a care setting such as a hospital or long-term care facility while studying. "Speak to nurses about their roles and experiences to gain valuable insight into the realities of nursing as a career."

Typically, nursing programmes provide a list of prerequisite courses necessary for entrance into an undergraduate nursing programme. "These often include biology, chemistry, English and mathematics. Every school is unique, so it is very important to look at the admission criteria for the nursing programmes you are considering applying to," advises Kathryn. As an example, here are Brock University's admission criteria: brocku.ca/programs/undergraduate/nursing/

Explore careers in nursing

To become a successful nurse, you need to be committed to a lifelong journey of learning. Some useful websites which provide the latest news on nursing include the Nursing Times(www.nursingtimes.net/ news), the Royal College of Nursing (www.rcn.org.uk/ news-and-events/news) and Nursing in Practice (www.nursinginpractice.com).

In addition to news websites, consider exploring reputable nursing journals such as the American Journal of Nursing (journals.lww.com/ajnonline/pages/ default.aspx) and the Journal of Nursing Education (journals.healio.com). These journals offer in-depth articles, research findings and insights into various nursing specialties.

"Brock University offers recruitment initiatives for nursing and other programmes welcoming Canadian and International students," says Kathryn: brocku.ca/applied-health-sciences/nursing

According to www.glassdoor.ca, the average salary for a nurse in Canada is \$75,000. Starting salaries and pay progression varies from country to country.



Meet Hudson

Hudson Trask, nursing student, Brock University



Meet Shabneez

Shabneez Xin, Registered Nurse, Home and Community Care Support Services, Ontario

Nursing piqued my interest because of the variety of opportunities it offers, from desk jobs to shift work to travel nursing, etc. It's a field that gives me the ability to obtain a university degree while also keeping my career options open. Whichever option I pursue, nursing will enable me to help people who might not be able to support themselves otherwise.

As a nursing student, it is important to look for opportunities outside of the school environment, such as clinical internships. I look for ways to be involved in my local healthcare community by joining local movements for healthcare improvement.

In the future, I would like to combine my love of helping others with my love for landscaping, nursing during the winter and landscaping during the summer. Not

While the science of nursing drew me in, the art of the profession is why I stayed. I was always intrigued by the rationale behind the care we provide, but the human aspect of connecting with patients and caregivers is where I feel most fulfilled.

I'm currently a case manager based in the community, coordinating home care and supportive living settings. I complete home visits with patients and work with other primary care and community partners. Each patient is like a puzzle, and my job is to find the right pieces to meet their goals. Working in the community allows me to meet patients and understand their everyday experiences. Helping patients navigate their daily lives is invaluable in keeping people out of the hospital. everyone wants to be limited to one career; many people experience burnout in one job. I believe that nursing gives me the opportunity to do both things I love.

My career goals are not set in stone. That is what makes nursing such a great field to study in; I can find myself while completing a meaningful and valuable degree. No matter where nursing takes me, I know it will provide a solid income and a career to be proud of.

Hudson's top tip

Take healthcare courses. Some high schools offer healthcare credits that count towards your high school diploma and will give you a taste of what nursing entails.

I'm also in graduate school studying

for a Master of Science degree and will eventually pursue a PhD, with the goal of becoming an educator and future researcher. There is so much we have yet to explore and improve within nursing, and I want a front row seat.

Shabneez's top tip

Find volunteering or shadowing opportunities in as many diverse settings as possible. I never would have considered home care but after having the chance to try it out, there's nowhere else I would rather be!



Meet Kiersten

Kiersten Ek, Registered Nurse, Neonatal Intensive Care Unit, Thunder Bay Regional Health Sciences Centre

Volunteering while I was in high school

taught me that helping others is something that brings me joy, and nursing is a career that offers so many different avenues to help others. I am a neonatal intensive care nurse working with newborn babies, and I am so grateful to have the opportunity to help parents navigate through the difficult time of having a newborn in intensive care.

I hope to one day get into an educational or leadership role within paediatric or neonatal nursing. I would love to help nurses achieve their full potential and feel confident in their careers and roles. I am currently working on my Master of Nursing degree to help me achieve these aspirations.

Kiersten's top tip

Explore as many nursing career paths as possible before entering nursing school. Not everyone is meant to do one kind of nursing; find what you are truly passionate about – it might be completely different from what you expect! Health and care economics

How can health and care support break the cycle of homelessness?

People experiencing homelessness often face significant health and well-being challenges, but accessing health and care support can be very difficult for them. **Dr Michela Tinelli**, a health and care economist at the **London School of Economics and Political Science** in the UK, is investigating how out-of-hospital care models can provide more meaningful care for people experiencing homelessness. Her research is contributing to data-driven decision-making that will improve these services.



(For the entire period 2021-23)



Dr Michela Tinelli

Care Policy and Evaluation Centre, London School of Economics and Political Science, UK

Fields of research

Health and care economics, evaluation, social care

Research project

Developing management resources to optimise out-of-hospital care models for people experiencing homelessness

Funders

UK Department of Health and Social Care (DHSC), National Institute for Health and Care Research – School for Social Care Research (NIHR SSCR)

Michela Tinelli (LSE) and Michelle Cornes (King's College London and Salford University) co-led the national programme of out-of-hospital care models for people who are homeless. The evaluation was funded by DHSC and the full team is acknowledged <u>here</u>. Michela was awarded a Developing Research Leadership Fellowship by NIHR SSCR to apply the discrete choice experiment technique to social care.



eople experiencing homelessness commonly face a range of health and social challenges," says Dr Michela Tinelli, a

health and care economist at the London School of Economics and Political Science. "For instance, exposure to the elements during rough sleeping

🖳 Talk like a ...

health and care economist

Data science — the collection and analysis of data to extract meaningful insights

Discrete choice

experiment — a quantitative research method for understanding people's preferences and decisionmaking processes, in which participants are asked to choose between hypothetical choices

Integrated management

dashboard — an interactive platform that allows a user to visualise a range of datasets and extract meaningful insights

Out-of-hospital care

model — any type of care not undertaken in a hospital setting

Stakeholder — anyone

who uses (e.g., patients, carers), provides (e.g., healthcare professionals, social workers) or commissions (e.g., local authorities, government departments) a service

Step-down services –

services for patients discharged from hospitals, typically integrating health and social care needs

results in increased vulnerability to illness." The stress of living on the streets, coupled with social isolation and discrimination, means that people experiencing homelessness are also vulnerable to mental health problems. Homelessness makes it much harder to access healthcare, education and employment opportunities, which compounds these problems.

This highlights the need for services that address these issues. "People experiencing homelessness need access to healthcare and mental health services, community clinics focused on the needs of the homeless population, and services to connect individuals with housing and employment opportunities," says Michela. Out-of-hospital care models play a crucial role in providing these services, and Michela is exploring how to optimise these models to provide the best possible care.

Out-of-hospital care models

Out-of-hospital care models provide health and social care services in the community, rather than in hospitals. For example, step-down services address the unique needs of people without stable housing by providing



transitional care facilities for people leaving hospital. Often, if a person experiencing homelessness is discharged from hospital with no further follow-up, they will remain homeless. Step-down services aim to address this. "The primary goal of step-down services is to provide individuals with a supportive environment that promotes recovery and stability," explains Michela. "This approach recognises the interconnectedness of healthcare and social factors for improving well-being and quality of life."

The importance of data science

Michela and her team used a mixture of qualitative and quantitative methods to evaluate out-of-hospital care models used in England. "We conducted qualitative interviews with people experiencing homelessness, healthcare professionals and other out-of-hospital care model stakeholders," she says. "These discussions allowed for in-depth exploration of personal experiences of and insights into the services." Quantitative methods included surveys of participants' experiences and analyses of outcomes (such as rates of readmission to hospital or return to homelessness) and service delivery costs.

Michela also used discrete choice experiments to understand what people experiencing homelessness want from out-of-hospital care models. These surveys asked participants to choose between two hypothetical situations, to understand their preferences and what trade-offs are acceptable for them. "For example, we asked how long people would be willing to wait to receive care in their own home, compared to receiving care immediately in temporary accommodation," explains Michela.

Data science methods such as these will help to inform the rollout of services that cater directly to the needs of the community. For instance, the discrete choice experiments uncovered some interesting results. "Unsurprisingly, participants strongly expressed their aversion to returning to rough sleeping, compared to accessing step-down services," says Michela. "By synthesising their preferences, we deduced that the ideal care service model encompasses a housing support worker visiting the participant's own accommodation three to four times a week, for a duration of ten to twelve weeks." Crucially, this suggests that a stable, private living arrangement - having their own flat, rather than living temporarily in a hostel - makes people experiencing homelessness more likely to access health and social care services.

Michela's results suggest the impacts of out-of-hospital care models are strongly positive. "We collected data from 1,254 homeless patients, many of whom experienced improvements in quality of life and felt they were treated with dignity and respect through these services," says Michela. "Only 7% returned to rough sleeping after accessing step-down services, compared to around 77% before these services existed."

Developing dashboards

Using the insights gathered from her results, Michela developed integrated management dashboards to serve as tools for out-of-hospital care model stakeholders. "The objectives of these dashboards include monitoring the performance of out-of-hospital care models, assessing the quality of care received by patients and optimising the allocation of resources," says Michela. The interactive dashboards allow users to visualise data through clear and customisable presentations. "They empower the monitoring and evaluation of current events, allowing for immediate action based on present insights (what is happening now) instead of relying on published reports with outdated data (what happened in the past)," she explains. "The dashboards provide actionable insights for stakeholders. They facilitate datadriven decision-making to enhance the effectiveness of out-of-hospital care for people experiencing homelessness."

There is strong support for the integrated management dashboards as operational and management tools. Stakeholders report they are useful for enhancing evidencebased decision-making. Michela is now in conversation with local health and care providers around England to provide the dashboards to out-of-hospital care model stakeholders throughout the country.

From research to policy

Thanks to the data science research of health and care economists such as Michela, services and national policies will improve the health outcomes for people experiencing homelessness. "Our analysis offers practical guidance for policy development," says Michela. "It informs policymakers where to focus their efforts and resources to align with the preferences of those accessing and implementing these services." Furthermore, these results will help to optimise out-ofhospital care model services, improving quality of care and tailoring support to those in need. "Our outputs will support decisionmaking for the health and well-being of the population at the national level."

About health and care economics

he field of health and care economics investigates how to allocate health and care resources in the most effective way possible. Michela explains more about her field:

"Health and care economists investigate the allocation, distribution and utilisation of resources in healthcare systems. They aim to understand the economic aspects of health and care delivery, alongside the impacts of health policies and interventions. Health and care economists may investigate different models of healthcare financing or evaluate the cost-effectiveness of healthcare interventions.

"Researchers in my field contribute to shaping decisions that directly impact people's well-being. The field tackles pressing societal issues, including healthcare accessibility, affordability and the equitable distribution of resources. Working in the field is very rewarding as it provides opportunities to make meaningful and positive differences in people's lives. My job satisfaction comes from knowing that my work directly aligns with societal well-being and the improvement of healthcare systems.

"Health and care economics draws on insights from economics, public health, policy analysis, data science and social sciences. This interdisciplinary approach provides a dynamic and diverse work environment, and addressing health and social care challenges requires collaboration among many stakeholders. This includes researchers, healthcare professionals, policymakers, community organisations and individuals. Together, we can inspire a commitment to collective solutions."



Pathway from school to

health and care economics

At school and beyond, Michela recommends studying mathematics (especially statistics), economics, biology or health sciences, and psychology to gain quantitative and data analysis skills and to learn about human health and behaviour.

At university, a degree in economics, public health or public policy could lead to a career in health and care economics. Michela recommends taking classes in health economics, econometrics, statistics, health policy analysis, health services management, global health and ethics in healthcare.

Explore careers in health and care economics

Health and care economists may work as researchers for universities, governments or healthcare organisations, or they may apply their work as policymakers to improve health and social care.

1183

164

Michela recommends seeking internships or work experience in healthcare organisations, research institutions or government agencies. "This opportunity will allow you to make a meaningful contribution towards their work, while preparing for your GCSEs or A levels," she says. Talk to your school careers adviser about the possibility of work experience. You can send your CV to Michela (**m.tinelli@lse.ac.uk**) if you are interested in gaining hands-on experience with her team or working with the Care Policy and Evaluation Centre at the London School of Economics and Political Science (**www.lse.ac.uk/cpec**).

The International Health Economics Association (www.healtheconomics.org/resources) has a wide range of teaching and learning resources, as well as career and mentorship opportunities, while the School for Social Care Research blog (www.sscr.nihr.ac.uk/blog-posts) contains articles on a range of health and social care topics.


Legend (Category): Criminal Justice Costs Emergency Care Housing Mental Health Other Healthcare costs Social Care

After establishing out-of-hospital care (OOHC) models, local authorities have lower costs for criminal justice, emergency care, housing and mental healthcare for people experiencing homelessness

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Meet Michela

I've always had a curiosity for mathematics, economics and health science, which laid the foundation for my interest in health and care economics. Growing up, an awareness of societal issues and a concern for the well-being of others manifested in a desire to improve the delivery of healthcare. Early experiences in college sparked a passion for research and knowledge creation – I wanted to create something new that nobody else had done before.

I originally studied pharmacy and spent time working as a pharmacist (both in a lab and as a community pharmacist). Pharmacy offers the opportunity to directly improve people's health and well-being by providing medication-related expertise. The scientific aspects of pharmacy, such as the effects of pharmaceuticals on the human body, aligned with my interests in chemistry, biology, and how genetic engineering can optimise the production of pharmaceutical compounds.

I soon switched from pharmacy lab work to applied research (in health and care) because I was deeply passionate about improving healthcare systems. I wanted to make a concrete positive impact on public health by addressing societal challenges. I wanted to connect with different stakeholders to help them optimise services and gain better outcomes for patients and society.

My mum, husband and daughter all suffer from asthma, and their health issues inspire me to make positive changes to healthcare systems. I believe that better health and care services must be tailored to the needs and preferences of individuals. More broadly, my passion for health and care economics is rooted in genuine concern for the well-being of communities and society as a whole.

My hobbies depend on the season. I enjoy ice skating in winter, wakeboarding in the summer, and cooking all year round!

Michela's top tips

Be passionate about what you do, keep going even when it's tough, be open to new ideas and opportunities, and always have fun!

Creating narratives of resilience with people affected by cancer

The psychological toll that accompanies living with cancer can be immense. To aid the mental well-being of people affected by cancer, **Dr Laura Béres**, from **King's University College at Western University**, and **Tracey Jones**, from **Wellspring London and Region Cancer Support Centre**, in Canada, successfully sought research funding for the development of the Journey Through Words programme, which uses the practices of narrative therapy and narrative medicine to help foster stories of resilience and hope in people with cancer and their families.





School of Social Work, King's University College at Western University, Ontario, Canada

Fields of research

Social work practice, narrative therapy, spirituality, critical reflection on practice



Executive Director, Wellspring London and Region Cancer Support Centre, Ontario, Canada

Field of research

Anthropology

Research project

Journey Through Words: Narratives of the cancer journey – fostering resilience within members of a creative writing group

Funder

Social Science and Humanities Research Council (SSHRC) Partnership Engagement Grant, Canada

social work researcher

Group therapy — a form of psychotherapy where a small number of people meet and discuss their problems together, with the guidance of a therapist or cotherapists

Narrative medicine — a

discipline initially developed to support medical students in maintaining their empathy with patients through close analysis of literature and the use of creative writing. Over time, doctors began to suggest the use of creative writing for their patients in order to assist them in expressing themselves

Narrative therapy — a form of counselling and community work that centres people as the

knowledge-holders of their own lives, creating distinctions between people and their problems and helping people create more constructive narratives that focus on their strengths and preferred ways of living instead of focusing too much on the problem narrative

Social work — a form of work carried out by trained professionals that aims to help people, groups and communities with social disadvantages and personal problems. In some countries, like Canada and US, registered social work professionals are also permitted to provide psychotherapy if they have received sufficient training and ongoing professional supervision

he direct treatment of physical illness lies at the heart of medicine, but to nurture people's long-

term well-being, medical care cannot stop there. Terminal or chronic diseases can have a heavy impact on people's mental health. It can be easy to lose hope or to focus only on the pain associated with the disease. This applies not just to people with these diseases, but also to those who care for them, such as family and friends.

A way of helping people to improve

their mental well-being is by helping them change their perceptions of their lives and be mindful of which of their experiences with the disease they dwell on the most. The Journey Through Words programme aims to do exactly this, applying the twin practices of narrative medicine and narrative therapy in group sessions using creative writing techniques.

Narrative therapy and narrative medicine

The narrative therapy approach was first developed in the 1980s and is



now used in a multitude of therapeutic contexts. "Narrative therapists are aware that the stories people tell about themselves shape how they think about themselves and how they act," says Laura. "Narrative therapists aim to assist people in exploring events in their lives that they have previously not put into words, and which might offer some openings into preferred storylines for themselves." Narrative therapy enables people to distance themselves from the label of a diagnosis and feel more like a person who happens to be living with a disease. It can guide people to focus on the parts of their life story that have helped them develop their resilience and which can continue to support them.

Narrative medicine differs to narrative therapy in that it was initially developed for training medical students, rather than as a therapeutic method. However, the approaches are similar in their understandings of the importance of narratives in people's lives. Medical students and doctors recognised how therapeutic it was for themselves to engage with creative writing, and they began to suggest others could benefit from it. The process also assists medical professionals in listening more deeply to a person's whole story, beyond a focus on illness.

The origins of Journey Through Words

Journey Through Words came about when four undergraduate medical students contacted the Wellspring London and Region Cancer Support Centre. "Keen to support people living with cancer and their carers, they enquired whether they might be able to offer a creative writing

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Narrative therapy enables people to distance themselves from the label of a diagnosis and feel more like a person who happens to be living with a disease.



group influenced by narrative medicine, and Tracey, the Executive Director of the centre, reached out to consult with me as a professor who has taught narrative therapy to social work students for many years" says Laura. "Together, we set the wheels in motion to apply for and, thankfully, receive research funding." The team Laura built comprised people from different professions, including students of both medicine and social work. "The project provided an invaluable opportunity to work together and learn from one another," she says.

After discussing the overlaps between narrative therapy and narrative medicine, the newly-assembled team felt it was best to combine the two approaches. This was principally because narrative therapy goes beyond listening to people telling their illness stories; it helps them focus on other events in their lives that can go towards constructing storylines to better their mental well-being. "Narrative therapy insists that services do not overly focus on the problem storyline (based on the sadness and pain related to their diagnosis and treatment) but encourages time spent on preferred storylines, on what is sustaining people," says Laura.

Narrative therapy sessions

Since setting up the programme, several group sessions have been run for members of Wellspring. Each session consists of therapists meeting with the group of people affected by cancer for ninety minutes once a week, for six weeks. "Each session starts with a brief check-in, followed by a description of that week's theme," says Laura. "Group members are then given a carefully-crafted creative writing prompt, and have twenty minutes of silent writing to address it." Afterwards, group members are invited to share their experience of writing and what they wrote, if they want to. This is followed by a group discussion.

Rather than ignoring or diminishing group members' sadness and worry about their illnesses, these sessions try to focus on what has kept them going each day, thereby constructing a more positive storyline of resilience. "Narrative therapists are primed to be curious and to ask questions about how people have kept going despite their problems," says Laura. Narrative therapy conversational 'maps' are used to provide guideposts for the therapist to ask questions to ensure they stay focused on what has been most helpful for the person with cancer in maintaining hope in their lives despite the worries and side effects of cancer treatment. 😜

The value of group discussions

Narrative therapy is often done oneon-one, but Laura believes that, in this context, it is best combined with group therapy. "Group therapy theory argues for the connection and support offered by group settings," says Laura. "In sharing their creative writing in a therapeutic context, themes of hope and resilience are reinforced and supported by others in the group." Nevertheless, there are challenges to this approach. "Since Wellspring offers many drop-in groups, assessing people's readiness to commit to six weeks of a group session was not the usual approach at the centre," explains Laura. "The fact that people had to register without us having the chance to speak individually with them ahead of the group starting meant it was sometimes challenging

to maintain continuity. Supporting the movement towards a preferred storyline could be challenging if a member missed too many sessions. There was also a risk of undermining the connection between members."

Despite these challenges, the group adapted and has seen strong positive outcomes. "I found it particularly rewarding to see group members show awe and surprise about how meaningful their own and others' writing was," says Laura. "It was wonderful to hear of their stories of resilience, friendships, connections and hope that kept them going." The group members connected with one another quickly and were soon comfortable to share vulnerable moments of their lives – which the team believes was accelerated through the creative writing aspect. "For me, participants' resilience also seemed to have a sense of the spiritual," says Laura. "For some, this meant going to church, while, for others, it meant walking in nature or watching the birds in their gardens."

The programme has led to real benefits for group members' well-being, and its outcomes have been the subject of two conference presentations. The team has also put together an open-access facilitator's handbook drawing on the lessons learnt through the sessions. It hopes these dissemination methods will lead to more social service and medical facilities taking up their own Journey Through Words programme.



S ocial work focuses on practice-based work with individuals and communities, through to academic study of social theories – and everything in between. However, in each area of social work, the common factor is a consideration of the 'person in environment'. Social work careers promote positive social change and development, at the individual, community and regional level. Laura explains:

"Social work is a broad field. It covers direct practices like counselling, as well as community practices, policy development, and child protection work. It's possible to pursue research in social work in any of these areas with a focus on philosophy, practice theory development or building the evidence base behind different practices.

"This broad scope has allowed me to shift my focus as elements of my practice evolve. Recently, I have enjoyed researching how to better teach skills of critical reflection in practice, so that students are more able to sustain these skills after graduating and throughout their careers.

"The ecological crisis is the focus of a new area of important research in social work. Many young people are experiencing ecoanxiety, and social workers and therapists are being called upon to support them, while also contributing to practices that will ensure a just and sustainable future.

"Other contemporary issues in need of ongoing research developments include the traumas of war, relocation, poverty and homelessness. Loneliness is another area of research that has arisen significantly in the last decade, especially since the COVID-19 pandemic. I predict that the rise of artificial intelligence in society will bring its own research needs for social work. Anything that is happening socially or environmentally will impact individuals and will, therefore, be relevant to social workers, research and education."



Meet Laura

After completing a BA in psychology, I pursued a Master's in Social Work (MSW). I realised it would be an efficient route to provide counselling, and from the first course, it felt like the right field for me. I appreciate social work's focus on the 'person in environment', which allows us to consider the impacts of family and society on individuals.

A woman I was counselling told me she read romance novels to learn how to behave so her husband would not beat her. She thought that being the 'perfect heroine' would mean he wouldn't be angry with her. I realised I had heard many people talk about their engagement with popular culture, and I began to realise that media held a powerful message about the romanticisation of abuse.

My MSW had not prepared me to deal with this, so I pursued a PhD in critical pedagogy and culture studies. Here, I came across narrative therapy, which I realised would give me a way to assist people with protecting themselves from harmful but powerful social ideas.

While I was working in direct social practice, the concept of mindfulness became more widespread. I began to explore links between therapy and spirituality, including relationships with different cultures. This has been immensely rewarding. Many Canadian academics are committed to decolonising our practices, and spirituality provides a bridge for connection to Indigenous communities and others.

The publication of my latest book was a proud moment for me. It is entitled The Language of the Soul in Narrative Therapy: Spirituality in Clinical Theory and Practice and brings together many of my areas of interest. I expect my next book will be about everyday spirituality, and I have a couple of research projects underway that will contribute to this book.

Laura's top tips

- Discover what helps you feel the most authentic. If you feel drawn to training in counselling or social work, begin by volunteering in settings where you can try out some skills and see if you are truly passionate about this area.
- 2. There are so many areas of specialisation available. Always keep an open mind and look out for new opportunities.



My field of expertise is anthropology – the study of human cultures and societies. I have studied marginalised groups for many years, and working with people living with cancer has yielded some fascinating research. I am invested in improving the lives of these people and their caregivers.

Working as an educator in healthcare has shaped my

perspective in life. I have worked in neurology (which focuses on conditions related to the nervous system) and oncology (the treatment of cancer) for over two decades. One of my most impactful jobs, with the Brain Tumour Foundation of Canada, involved working with children and adults who faced a terminal diagnosis, where treatment wasn't possible. This taught me to understand what hope meant in their eyes. It doesn't always mean a cure; sometimes, a peaceful death is something to hope for. This reshaped my way of thinking permanently.

Every day looks different in my job. I might meet with various board committees to report on our community work, meet staff members to support their work, and have discussions with community partners and volunteers. I also oversee two office locations, so I'm always busy!

One of my proudest career moments was organising retreats for young adults with cancer. It allowed them to connect with each other and understand that they weren't alone in their experiences. I remember a games night on our first retreat that involved so much laughter, I felt my heart could burst. It was the most beautiful thing I had ever witnessed. I knew I was making the impact that I had always dreamt of.

While working for Wellspring, I aim to contribute as much as I can to the development of support and resources for underrepresented groups. This includes more work with young adults, men, and minority groups such as our Indigenous communities. We recognise that our current Wellspring model isn't one-size-fits-all, and we're always looking for creative ways to be inclusive and meet the needs of our communities. I'm grateful to be a part of this movement.

Tracey's top tips

- 1. Take an interest in what is happening around you. Try to improve any situation. There are a lot of not-for-profits in need of great leadership from people with kindness, empathy, an interest in learning, and engagement with the people they serve.
- 2. Humility and the vision to see beyond the immediate is essential.



Leah Getchell

Research Assistant, Journey through Words programme / MSW student Can-SOLVE CKD Network, Vancouver, Canada

When I was in my last year of high school, I went on a social justice trip to the Dominican Republic. I knew from that point on that I wanted to be 'of service' to my local and global community. Since then, I have followed a few different career paths. I recently came back to my social justice roots and pursued my Master's in Social Work (MSW).

My mom was a professional storyteller. From a young age, I was surrounded by stories and understood their power. Before applying for the MSW programme, I helped co-create the 'Storytelling for Impact' module for Can-SOLVE CKD, a national research community bringing people with lived experience of kidney disease and kidney donation together with researchers, healthcare providers and policymakers. That's where I met Laura and learnt more about narrative therapy.

I have co-facilitated the programme at Wellspring twice now. I also assisted with the development of the facilitator's handbook. It's always challenging to facilitate a group using a new framework, especially as my prior knowledge of narrative therapy was purely academic. I began participating in the writing tasks myself, which helped me make stronger connections with what participants shared and relate it back to our therapy practices.

Facilitating the Journey Through Words programme has been very rewarding. I have learnt the practicalities of narrative therapy and its power in helping people focus on resilience, hope and life goals, rather than always returning to their challenging experiences. I have also discovered how creative writing, particularly the engagement with metaphor, can bring out emotions or ideas that would otherwise remain hidden. We hope that others will use the facilitator's handbook to run their own creative writing programmes. I have just completed running the programme for another organisation I worked with called Grounded Roots, Open Wings (GROW), where we deliver pre- and postnatal (before and after birth) care for families. I intend to use the programme for years to come.

I'm in my third career right now! I completed my MSW in my mid-40s. I hope this next phase of my career will allow me to support individuals and families within a healthcare setting, as well as in my private therapy practice.

Leah's top tip

There isn't one 'right' path. Though I thought about a career in social work during my 20s and 30s, I enjoyed meaningful jobs in other sectors. Follow your heart, listen to your intuition, and eventually you'll get to exactly where you're meant to be - even with some twists and turns along the way!

Pathway from school to social work

Laura recommends a broad educational basis for pursuing a career in social work. At school, relevant subjects might include psychology, biology, statistics and English, though many others can also lead to a relevant degree.

Relevant degrees at university include social work, psychology, sociology and anthropology. Courses focused on child and youth work, social justice and peace can also be highly relevant. The quickest route into social work is through a Bachelor of Social Work degree, with which you can practise entry-level social work. Many other positions require a Master's of Social Work.

Explore careers in social work

The Canadian Association of Social Work has a useful webpage (www.casw-acts.ca/en/what-social-work) describing the different types of social work and career paths to get there.

Laura notes each Canadian province has its own professional social work body; checking their websites can help you understand what social work looks like in that province (e.g., the Ontario Association of Social Workers - www.oasw.org/ Public/Public/Home.aspx). Other nations have their own associations that you can find.

According to Talent.com, the average social worker salary in Canada is around CAN \$67,700.



Valerie Johnston-Way

Program Manager, Wellspring London and Region Cancer Support Centre, Ontario, Canada



Amandi Perera

Schulich School of Medicine and Dentistry, Western University, Ontario, Canada I always wanted to get into a helping profession of some kind. I found that social work offered a lot of flexibility in areas of focus. In my position at Wellspring, I get to use my education in social work alongside my experience in recreation to help those affected by cancer in my community.

As Program Manager at Wellspring, I supervise students from Kings University College. I helped the students develop this project, bringing along my knowledge of social programmes and the types of structure that would work best for Wellspring members. I had never developed a programme completely from scratch before, and it was certainly challenging at times, but very rewarding!

A lot of great work has come out of this partnership. The programme is positively assisting those living with cancer in our community. At Wellspring, we will continue to make sure the resources are available for anyone interested in leading their own programme, and to offer the programme at no cost for our members. I feel very privileged to be working at Wellspring and thoroughly enjoy the work that I do.

Valerie's top tips

- Life is too short to do something that isn't fulfilling. Find something you are passionate about, that interests you, and that supports your growth and development.
- 2. Self-care and a work life balance are essential for you to be successful; you can't help others if you are not helping yourself.

Personal experiences with healthcare, plus the continuous learning and problemsolving aspects of medical practice, led me to seek a career in medicine. I want to support people during vulnerable periods of their lives, and it is a career that will allow me to engage with people's life stories, which aligns with my interest in the humanities.

I heard about the Journey Through Words programme through a medical student group on social media. I felt drawn to the intersection between the humanities and health, as well as the creative writing component. I have always enjoyed writing and worked as an editor-in-chief for a university publication, among other involvements.

I created new creative writing prompts, aligning them with narrative therapy themes and introduced writing tips.

also led one series of sessions alongside Leah and assisted with the creation of the handbook. Before getting involved, I had little exposure to narrative medicine or narrative therapy, so I spent a lot of time reading and learning from my team members. Watching participants engage with the process and hearing how they benefitted was a key highlight. I also enjoyed the learning experience and sharing our work at the Canadian Association of Health Humanities conference, which could potentially lead to others implementing similar sessions.

While I don't yet know which medical specialty to pursue, I am leaning towards those involving long-term engagement with people. I hope to continue learning about narrative medicine and therapy so that I can integrate it into practice.

Amandi's top tip

When you enter a time-consuming degree or job, it's easy to let your other interests take a backseat. Try and find ways to prioritise them and even connect them to what you are doing. I think it can end up multiplying the passion you have both for your career and other interests!

Supporting pre-service teachers in kickstarting a mentally healthy career

Teaching is a highly rewarding but also highly challenging career. Ensuring that pre-service teachers avoid compassion fatigue and burnout, both through their own self-care and through accessing support resources, is the mission of HEARTcare. **Dr Astrid Kendrick**, of the **University of Calgary** in Canada, believes that the HEARTcare resources that she helped formulate can set pre-service teachers on the path to a truly rewarding teaching career.

Teacher

CPD





Dr Astrid Kendrick, Ed.D

Director, Field Experience (Community-based) Academic Director, Outreach and Professional Learning, Centre for Well-Being and Assistant Professor, University of Calgary, Canada

Field of research

Education

Research project

Creating and collecting resources to support pre-service teachers' well-being in the workplace

Funders

Social Sciences and Humanities Council of Canada (SSHRC), Alberta Teachers Association, Alberta School Employee Benefits Plan (ASEBP)

eaching is one of the oldest professions and often seen as a vocational calling, preparing the next generation to find their place in the adult world and contribute to societal progression. Teaching also has the potential to be a taxing occupation. "While teaching can be a highly rewarding career, working with children and youth can be very stressful and difficult at times," says Dr Astrid Kendrick of the University of Calgary. "In order to create a safe, warm and caring school environment, teachers need to express genuine care and develop effective relationships with their students." Astrid studies the interplay between teacher and student well-being, and how teachers can be supported at every stage of their career – from preservice to retirement.

A teacher's role

While teaching at its most fundamental level is about the sharing of subject-specific knowledge, a teacher's duties go far further. "While teachers play an integral role in developing a child's intellectual abilities, they must also be attuned to all six dimensions of health for the students," says Astrid. "This includes their social, mental, emotional, intellectual, environmental and physical health." Incorporating such a holistic approach into the classroom involves teachers using the curriculum to create opportunities for students to develop their interpersonal relationships, regulate their emotions, make healthy lifestyle choices, and be stewards of their environment.

Accounting for all these factors in the classroom is a big ask for teachers, but Astrid believes it is a vital part of facilitating students' development. "Teachers create the classroom conditions that can help their students flourish – or falter," she says. "For example, attuning to children's mental health might involve using assessment techniques that, while rigorous, do not unnecessarily push students' stress levels beyond their ability to cope." To put such considerations into practice, students could sit several lower-stakes exams spread throughout the year, rather than one high-stakes exam at the year end, for instance.

The emotional demands

As part of ongoing research, Astrid ran a research study that asked teachers to list the three emotions they display most commonly at work, and the three emotions they are most likely to conceal. "Overwhelmingly, survey respondents selected 'joyful', 'cheerful', 'energetic' and 'mildly frustrated' to describe how they felt they should appear at work,' she says. "Anger, sadness and frustration were the emotions they hide at work." Participants' principal reasoning for concealing these emotions was to ensure that classroom environments felt safe and caring for students.

This highlights the emotional labour faced by teachers: suppressing their own emotions to help students' health. "The term 'superficial acting', coined in 1983 by Arlie Hochschild¹, describes when teachers feel compelled to display emotions that they don't feel – to pretend they are joyful or energetic, for instance,"



says Astrid. "Ongoing superficial acting is associated with emotional burnout and disassociation." Over time, teachers may disassociate their actual self from their professional self to act in a way they feel is acceptable in the classroom.

Despite these challenges, respondents also highlighted that these displays of positive emotions were normally genuine. "They often felt joy when a lesson went well, the students learned the content, and they received acknowledgement and validation from the school or government inspectors," explains Astrid. "These experiences sustained them through difficult times, providing the drive to continue teaching." Yet, such positive experiences were in worryingly short supply. Respondents suggested that difficult times were outnumbering the positive times, leading to a growing sense of suffering among teachers.

First experiences

As part of their training, pre-service teachers engage in classroom teaching practicums. Typically, these practicum placements are their first experience of teaching first-hand and are formative experiences in shaping their approach to teaching and career aspirations. "Before entering the teaching profession, people rarely understand the background work and ongoing professional learning necessary to maintain an engaging, safe and caring classroom environment," says Astrid. This behind-the-scenes work constitutes a major part of a teacher's workload, but Astrid

believes that pre-service teachers may have misconceptions about what it entails. "For instance, pre-service teachers may think that teaching is an ideal profession for a parent, as they will have the same holiday breaks as their children," she says. "However, any additional caregiver responsibilities add to one's emotional and mental workload, which can make providing emotional support to students even more difficult." Astrid also highlights the amount of planning necessary for a career in teaching - not just daily lesson plans, but also yearly, weekly and back-up plans to support student learning through unexpected changes or incidents common in schools.

Compassion satisfaction, stress and fatigue

Compassion involves being able to understand and empathise with the feelings of others and acting to help relieve the suffering that others feel. This action can bring its own emotional benefits. "A person experiences compassion satisfaction when they effectively relieve suffering in another person," says Astrid. "For teachers, this satisfaction is built through their connection to students, feeling that their teaching is important and valued, and teaching in a subject area in which they have expertise."

However, teachers do not always feel this sense of satisfaction. "Creating a compassionate classroom culture requires that teachers are able to notice, feel and act to relieve perceived suffering of their students," says Astrid. "Many students face mental health and social problems that go well beyond typical teacher training and their scope of practice." If teachers feel unable to help relieve students' suffering, they can experience compassion stress, a type of secondary traumatic stress. Depending on the nature of the suffering of the student, a teacher may experience compassion fatigue, which can interfere with their own feelings of empathy to others' suffering or apathy to students' health needs.

Compassion stress and compassion fatigue are occupational hazards experienced by those working directly with people experiencing a crisis or traumatic event. "In educational settings, crisis work can involve leading students or colleagues through a distressing event such as a fire, violent classroom incident, or a pandemic," says Astrid. "Trauma work is provided when a teacher listens to a student or colleague who speaks about a traumatic event - a bereavement, or neglect or abuse, for instance." Unlike other frontline professionals, such as social workers or healthcare personnel, teachers are not specifically trained to provide crisis or trauma work, yet both are frequent occurrences within schools. This highlights the critical need to equip teachers with the tools to support students and their colleagues while simultaneously looking after their own health and well-being. 🕤

¹ (https://www.ucpress.edubook/978 0520272941/the-managed-heart)

The danger of burnout

Sustained heavy workloads – in volume and emotional burden – can lead to burnout. The World Health Organization identifies the categories of symptoms as physical and mental exhaustion, cynicism and lack of acknowledgement, and depersonalisation². "In education, depersonalisation has the greatest impact on the well-being of children and youth," says Astrid. "They will feel the effects of being in a classroom with a teacher who is unable to show they care about them as individuals needing support and compassion." Astrid's research suggests that mid- and late-career teachers feel the symptoms of burnout and compassion fatigue the most intensely. "Mid- and late-term teachers are vital to the profession as they provide mentorship, leadership and institutional memory for their colleagues and communities," explains Astrid. "However, survey participants in these categories suggested they felt ignored and were not getting the support they needed to stay in education." Losing these experienced teachers has many negative consequences including disrupting continuity and stability for schools and students. Pre-service teachers also lose access to valuable insights and effective teaching practices from long-serving staff members. Teachers need to be supported at every stage of their career, creating an environment where compassion fatigue and burnout are minimised and the positive aspects of teaching careers, such as compassion satisfaction, are made more possible.

² www.who.int/news/item/28-05-2019-burnout-an-occupational-phenomenon-internationalclassification-of-diseases



HEARTcare planning

HEARTcare planning is a framework to help pre-service teachers understand and find the resources available to help them tackle the challenges that a career in teaching can entail – and support their students in the process. "HEARTcare planning helps individuals identify and access interventions during times of stress and distress," she says. "It consists of five main elements that, together, provide a framework to promote well-being for educational workers."

The five elements are: scHool – workplace and relationship systEm – pedagogy, responsibility and policy individuAl – personal learning, self-care and identity pRofessional – expert help educaTional worker – community and unique work

scHool

Every school has a unique and specific teaching and learning culture. "In general, a psychologically safe workplace promotes a sense of belonging for all community members, has open and transparent communication that gives space for respectful disagreement and collaboration, and respects its most valuable asset: teacher, student and leadership time," says Astrid. Prioritising collective wellbeing and collective compassion is at the heart of establishing a positive school culture.

Pre-service teachers can offer a unique perspective on school cultures, entering as an outsider with a fresh and potentially unbiased approach to teaching. "However, pre-service teachers have little influence on overall school culture, as they are only part of the community for a matter of weeks and will be assessed by their partner teacher and principal at that school." This is not an ideal context for challenging established cultures, as it can risk their relationships with staff and affect their assessment success. Generally, preservice teachers also lack the knowledge of what changes would improve the school's culture.

HEARTcare planning suggests a more introspective approach when faced with a non-ideal school culture. "Pre-service teachers can reflect on what they perceive as problematic practices in their practicum school and consider how their actions might help create a more productive environment," Astrid says. She recommends that pre-service teachers focus on struggling students, and what resources are available to help them support their students. She also suggests looking at stress management techniques used by their mentor teachers and accessing the best support and professional development opportunities. "A pre-service teacher could share learning opportunities and resources for teacher wellbeing with their partner teacher or principal, being constructive rather than critical," says Astrid.

systEm

A school's environment is also heavily influenced by its place in the wider social and governmental system, including the rules and regulations that are placed on it. "Pre-service teachers should spend time reading the local and national governmental legislation that impacts their work," says Astrid. "The expected scope of work, conduct and competence required of teachers is very clearly defined in both legislative and case law."

The HEARTcare planning framework recommends that pre-service teachers become familiar with relevant teacher organisations and unions that can offer support and help clarify teachers' responsibilities. "Additionally, their practicum supervisors, university professors and student associations can provide immediate responses to questions about the educational system," says Astrid.

individuAl

Even with the most rigorous support system in place, individuals need the agency to do what they need to do to feel well and cope with stress. "Time is by far the most valuable resource, so pre-service teachers should identify the priorities for their time," says Astrid. "Setting time aside each day to do an activity that supports one of the six dimensions of health can help them manage their workplace stresses more effectively." Implementing HEARTcare involves setting a daily goal that can be achieved within 10 to 20 minutes, and to adjust this goal if it becomes impractical. "Healthy habits are often built incrementally over time, so starting with small daily goals is better than setting a big, long-term goal," says Astrid.

Self-care practices can include meal planning, scheduled physical activity, listening to relaxing music on the commute, and spending time with other

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Feedback, growth and learning are at the centre of moving from a pre-service to an in-service teacher.



pre-service teachers to build community. "Because each person's self-care needs are different, there is a wide range of resources to explore," says Astrid. "We recommend that pre-service teachers seek out evidence-based and researchtested resources and supports, rather than trendy or expensive 'wellness' activities that are not proven to actually reduce stress."

pRofessional

Seeking professional support is an important part of any career. "Pre-service teachers should ask their university instructors and other advisors for information about available well-being programmes and services," says Astrid. "They should also investigate if there are benefit plans available to them." It may be that therapeutic intervention is required, and many therapists, psychologists and psychiatrists charge patients according to their income.

Astrid also highlights that proactively researching options for benefits and healthcare ahead of needing them can prove prudent. "The worst time to navigate the often-complex healthcare and benefits systems is when a person is already in a state of distress," she says. "Having a prior professional connection removes the stress of seeking help." Furthermore, visiting professionals before problems magnify can help to identify and address sources of distress before they become a major issue. "For teachers to maintain a safe and caring classroom, they cannot wait to access help until their symptoms are severe and overwhelming their ability to cope," says Astrid.

educaTional worker

Working in education can be simultaneously fulfilling and depleting, with both rewards and challenges impacting the daily life of a teacher. "Recognising that pain and suffering exists within their own and students' lives, and not trying to create a toxically positive classroom by avoiding or ignoring the challenges these present, is an attribute of compassionate and caring educators," says Astrid. "Through this acknowledgement, the teacher has the agency to potentially change the immediate conditions related to the problem."

Pre-service teachers may not have much immediate authority in terms of facilitating large-scale improvements, so Astrid advocates for looking at the long-term. "Schools and classrooms are complex and constantly changing environments, and systemic problems can feel overwhelming or impossible for a single person to influence, especially for pre-service teachers," she says. "But, being at the start of their career, preservice teachers have time to make the changes necessary to make education better for their future students."

HEARTcare goals can include investigating areas for collective action, such as participating in curriculum reviews, joining local teacher organisations, and advocating for equity and funding for public education. "Simple actions or one-time advocacy is rarely enough to make large-scale or sustainable changes," says Astrid. "Progress involves sustained and passionate efforts by multiple interested actors, such as government officials, parents and business interests, to take hold."

At the heart of these efforts is humility from early-career teachers, to remain open to learning more about the structures surrounding teaching, and hard-won resilience from mid-late career teachers, who continue to show up and care for their students and colleagues. "Feedback, growth and learning are at the centre of moving from a pre-service to an in-service teacher," says Astrid. "The preservice stage is one of the few times that someone has access to mentoring from an experienced professional." Pre-service teachers are, by definition, still studying - and there is always more to learn about how to be effective and engaging in one's teaching.

Using creative arts to address children's eco-anxiety

Teacher **CPD**

As the climate and biodiversity crises worsen, predictions about the future are becoming increasingly gloomy. This has a profound effect on people's mental health, especially children. A team of Canadian researchers, including **Dr Catherine Malboeuf-Hurtubise, Dr Catherine Herba** and **Dr Jonathan Smith**, are exploring how creative arts can help children address eco-anxiety and equipping teachers to better support their students' climate concerns.





Dr Catherine Malboeuf-Hurtubise

Department of Psychology, Bishop's University, Canada

Fields of research

Child clinical psychology, child mental health, psychology of the arts, philosophy for children, existential psychology



Dr Catherine Herba

Department of Psychology, Université du Québec à Montréal, Canada

Fields of research

Developmental psychology, child mental health, parental mental health



Dr Jonathan Smith

Department of Preschool and Primary Education, Université de Sherbrooke, Canada

Fields of research

Educational psychology, social psychology, teaching and classroom management practices

Glossary

Collective action — shared action taken by a group of people to achieve a common goal

Competence — a person's sense that they have an effective impact on their environment

Eco-anxiety — the positive and negative emotions, thoughts and behaviours related to the climate crisis

Radical hope —

acknowledgment of the painful realities facing humanity without giving up, while holding onto the belief that a better future is possible

Self-determination — the ability of a person to take control of their own life and to act of their own will and in accordance with their values of what is important

co-anxiety is a growing phenomenon with potentially profound psychological effects. A team of Canadian researchers has assembled to develop and test methods that schools can use to

address eco-anxiety in their students – not to diminish it, but to help children understand their thoughts and emotions about climate change and translate them into positive action. Through creative arts and philosophical enguiry, the team is empowering children and teachers alike to address eco-anxiety and its effects on mental health.

What is eco-anxiety?

"Eco-anxiety refers to any lived experience – be it emotions, thoughts or behaviours – related to an awareness of climate change and the corresponding uncertainty of the future. This may include anger at political inaction, feelings of individual helplessness or hope for a brighter future," explains

Research project

Using creative arts to help children address eco-anxiety

Funders

Social Sciences and Humanities Research Council of Canada (SSHRC), Ministry of Education of Quebec



Dr Catherine Malboeuf-Hurtubise, a clinical psychologist and professor at Bishop's University. "It's really important to understand that eco-anxiety is not a problem, but rather a normal response to a truly difficult reality."

Everybody experiences eco-anxiety in a different way. "While some people are not really concerned about climate change, others are very much so," says Dr Catherine Herba, a professor of psychology at the Université du Québec à Montréal. "People react in different ways to the climate crisis. For example, some take action while others feel hopeless." There are concerns that eco-anxiety is affecting mental health, especially for young people – which indicates the need for intervention.

Eco-anxiety in children

While there is a fair amount of research into eco-anxiety in teenagers, there is little focus on younger children, which prompted the team's research. "We explore eco-anxiety in children to understand whether they experience eco-anxiety, and if so, how they experience it," says Dr Jonathan Smith, a professor of education at the Université de Sherbrooke. The team encourages teachers to open discussion spaces for their students, providing an opportunity for those experiencing eco-anxiety to speak up and explore their concerns.

Through such efforts, the team found that, in general, young children have a good knowledge of climate change and its consequences, gleaned from sources at school, through the media and from discussions with parents and friends¹. "This awareness is linked to emotions, such as sadness for humans and animals that are suffering, anger towards polluters and the inaction of previous generations, and fear for their own future," says Catherine Malboeuf-Hurtubise. "However, they also experience hope and connection with others, through taking collective action and the knowledge of technologies that can help mitigate the consequences."

Why is eco-anxiety difficult to address?

Eco-anxiety can often be hidden, and even parents may not realise that their children have feelings about climate change. "Children tend to cope by avoiding the issue, which is not very adaptive in the long run," explains Catherine Herba. "We suggest that parents and teachers bring conversations about climate change and eco-anxiety into the home and classroom and encourage children to act in meaningful ways at home and school." Catherine suggests encouraging children to spend time in nature, watch documentaries and read children's books on climate change. Parents or teachers can then prompt discussions of the themes and concerns that arise to build an appreciation of ecoanxiety while also addressing its mental impacts.

One challenge that both parents and teachers often face is that they do not feel well-equipped to facilitate discussions on topics that are causing children distress, worrying that such conversations may add to their anxiety – but avoiding or playing down the issue can make things worse. "If an adult doesn't acknowledge a child's emotional response to climate change, then the child doesn't feel heard and feels their emotions and thoughts are not validated," explains Jonathan. "Saying that 'everything will be fine' does not validate a child's concerns."

The importance of addressing your own eco-anxiety

Before you can facilitate discussions about climate change and eco-anxiety as a teacher, it is important that you explore your own experiences and emotions about the issue. "Reading up on the topic, cultivating self-care, finding your own meaning, and building a constructive and radical hope can help equip you with the tools needed to help your students," says Catherine Malboeuf-Hurtubise. "Without this prior work, it's difficult for teachers to accompany children on their own journey of understanding their eco-anxiety."

The team emphasise that eco-anxiety is an understandable reaction to the modern world and efforts should focus on helping children cope with eco-anxiety, rather than reducing it. "We want to facilitate effective and positive coping strategies that can be linked to positive action," says Catherine Herba. "These strategies include self-care, grieving, recognising and engaging with our emotions, and finally, empowerment to action."

1. Léger-Goodes, T., Malboeuf-Hurtubise, C., Hurtubise, K., Simons, K., Boucher, A., Paradis, P. O., Herba, C., Camden, C., Généreux, M. (2023). How children make sense of climate change: A descriptive qualitative study of eco-anxiety in parentchild dyads. PLoS One, DOI: 10.1371/ journal.pone.0284774



A creative arts intervention for eco-anxiety

To help address eco-anxiety in children, Catherine, Catherine, Jonathan and their colleagues have developed an intervention combining creative arts and philosophical enquiry, which aims to improve children's well-being and mental health by allowing them to explore their emotions related to eco-anxiety. During the eight-to-ten-week-long programme, the team visits classrooms weekly to lead art workshops and initiate philosophical discussions related to the themes of climate change and eco-anxiety.

"It is well-known that making art can help children develop critical thinking skills for their emotions and thoughts," explains Jonathan. "Using creative expression as a catalyst for group discussions, we address themes such as emotional reactions to climate change, the beauty of nature, our responsibility for nature, the awe-inspiring power of nature, taking care of ourselves and the planet, and citizen engagement."

The importance of philosophy

In addition to encouraging children to create artwork inspired by these themes, the team also encourages philosophical enquiry. "The contribution of philosophical enquiry with children before, during and after the artistic process is related to art's benefit on youth mental health," explains Catherine Malboeuf-Hurtubise. "It encourages children's questioning and introspection related to the art they create, helping them put the intuitive process of artmaking into words." This combination of philosophy and art provides children with the space to explore any doubts they have around the creative process, such as performance anxiety and fear of judgement from others. "We are evaluating one hypothesis about whether the combination of art and philosophical enquiry has a greater impact on children's well-being, mental health and self-determination than either activity on its own," explains Catherine Herba.

The importance of using different media

When delivering the art intervention in classrooms, the team employs various artistic media, with the aim of ensuring there is something that appeals to everybody. "Some children prefer fine arts, such as painting or drawing, while others prefer photography, sculpture, building with LEGOTM or dancing," says Jonathan. "By introducing different forms of art, we allow children to open themselves to new experiences, express themselves nonverbally, and permit them to use whatever art form best suits them to explore their feelings about the climate crisis."

How do children respond to the intervention?

While the team's research project to scientifically evaluate the impacts of their art intervention is

still ongoing, preliminary results are promising. "We conducted a pilot study with a class of nineyear-old children, during which our combined intervention of art and philosophy was wellreceived by the students and their teacher," says Catherine Malboeuf-Hurtubise. Students reported that the topic of climate change was important to them and that they wanted to understand and explore their eco-anxiety. "The children most enjoyed the photography activities as they had fun using cameras to take photos, were enthused to share their photos with their classmates, and reacted with joy to seeing their classmates' pictures," says Catherine Herba. "The teacher also noted that the photography activities sparked the most profound discussions on climate change."

After the intervention, the children reported increased psychological satisfaction in several aspects. "Overall, the art intervention fostered the basic psychological need for self-determination in children, namely through the freedom to choose which discussions to pursue, and because they found the themes important to them," says Jonathan. "They also reported satisfaction in the psychological need for competence, as they were able to overcome challenges around speaking in front of the group, and felt they were becoming better at their chosen art media as the weeks went by."

Advice for teachers

C atherine, Catherine and Jonathan emphasise that while addressing students' eco-anxiety can feel daunting, they believe the outcomes will be well worth it. "Schools are an important space where children should not be shielded from the reality of climate change, but be given spaces for emotional expression and collective action," explains Catherine Malboeuf-Hurtubise. "As a teacher, you are in an important position where you can discover the concerns of children and help address them."

While collective action should be encouraged, the team notes that this should be in partnership with self-care and emotional expression. "There is a danger that people can experience 'activist's burnout' when they don't take sufficient self-care measures," says Catherine Herba. "Young people should learn how to identify their limits so they don't become overly anxious and burnout, and how to act in a meaningful way without getting overwhelmed. The same also applies to teachers." Embracing the idea of 'radical hope' can help – accepting the painful realities facing humanity while still holding onto the belief that a better future is possible and taking action to imagine and work towards this future.

Adoption of this approach can be assisted through emphasising how seemingly small individual actions can collectively add up to a big impact. Schools can be a powerful place to actively demonstrate that positive change is possible. "Schools should be models to show children that society is making changes for their future," says Catherine Herba. "This can be through measures such as composting, reducing single-use plastics and creating green spaces." The team has noted that gardening is growing in popularity in schools, which can help children form a closer relationship with the natural world. "Teachers are always on the lookout for new knowledge and trends in educational practice," says Jonathan. "They can facilitate the changes that can help children cope with eco-anxiety and feel empowered to take action."

Meet the team



Dr Catherine Malboeuf-Hurtubise "I've been asking existential questions for as long as I can remember - I was 'that' child! Climate change is an existential threat that children must cope with, and I want to provide children with a safe space to do so. My expertise in existential psychology helps children navigate big questions, and I foster children's selfdetermination in accordance with their values. These efforts can help children become flourishing and active members of their society."

Dr Catherine Herba "I'm interested in children's socioemotional development, including early risk factors for internalising difficulties, such as anxiety, and externalising behaviours, such as aggression. I've also always been interested in how the wellbeing of a parent can be linked to the well-being and development of their child. I'm interested in the relationship between parents' own eco-anxiety and that of their children, and how parents respond to their children's concerns."

Dr Jonathan Smith "I study the quality of school adjustment to fit the needs of students, and how the influence of school and classroom factors affects the experiences of children. I'm also interested in how eco-anxiety affects children's approaches to learning, and how interventions can be designed to help children manage their eco-anxiety."

Futurum teacher focus group – let's chat!

At **Futurum Careers**, we pride ourselves in producing free resources that help teachers to motivate students. We know teachers are incredibly busy, and we design our resources with the intention of supporting them in the invaluable work that they do. However, it has been a while since we had the chance to spend quality time with teachers to ask them what they think of our resources. So, on a recent Saturday morning, in a cafe somewhere in the southwest of the UK, we met a group of teachers and got chatting over coffee.

What do teachers like about our resources, and how are they using them?

Julie, a university lecturer, and Adrian, a KS4 (grades 9 & 10) and KS5 (grades 11 & 12) teacher, kicked off our discussion. Immediately, they highlighted the organised and contemporary look of Futurum brochures. Adrian likes our articles for extension and enrichment tasks for his students, adding he is happy for his learners to use them independently. Julie particularly likes how the articles emphasise the researchers' passion and innovation as a way to raise students' aspirations and encourage them to read more academic articles.

Jen, a KS3 (grades 6 to 8) to KS4 teacher and school leadership team member, told us her school is dedicating tutor times to preparing their year 10 (grade 9) students to apply for and ready themselves for work experience placements. Jen teaches at a school that has reading as a priority for both



academic skills and reading for pleasure. She sees Futurum resources as helping teachers meet both of these aims by providing students with knowledge of careers and stimulating reading materials. Sophie (KS3 and KS4) explained that as a subject teacher, she is expected to link her subject to careers and to provide her appropriate resources to help her students learn more. Maggie, a KS3 to KS5 teacher with experience of leading careers, recognises that our resources enable teachers to meet this need (as set out by the Gatsby Benchmarks in the UK).

All our teachers highlighted the challenging content of our brochures. Our resources aim to get students thinking at a deep level and to consider the wider implications of the research and field they focus on. Some students may need more teacher support than others to work through our articles; the activity sheet 'talking points' provide a good tool for students to consolidate their learning and for teachers to assess their students' understanding.

Words such as 'engaging', 'stretching' and 'versatile' peppered our conversation, and

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Words such as 'engaging', 'stretching' and 'versatile' peppered our conversation...







it was agreed that Futurum resources can be used in subject classrooms, tutor time, PSHE (personal, social, health and economic education), careers sessions and at home. But, we are as self-reflective and ambitious as we want students to be, and we needed productive criticism...

What could we be doing better?

Maggie and Sophie were concerned about accessibility, telling us our font size was too small. Yes, our Pdf articles can be zoomed in on when read online, but what if students do not realise that, and what if our overall design could benefit from an adjustment? We have listened, and from this issue of Futurum onwards, you will notice a slight font increase in our articles – subtle enough to ensure the content of our resources is not affected, but significant enough to remove the 'density' our teachers were apprehensive about.

Julie emphasised how useful PowerPoints are for teachers, as a brochure is not quite the right format for the teaching and learning taking place. A fair point and one we are pleased to be addressing with our growing library of resources to add to our brochures. The range of Futurum podcasts, careers PowerPoints, animations and translations is increasing all the time – and it is important we keep telling you about them!

Join the conversation

From assemblies to online quizzes, from alumni visits to work experience placements, it was great to hear from our teachers about the range of careers activities going on in schools. And, of course, hugely rewarding to hear how Futurum is playing its part.

We would love to hear about how careers are taught in your school and how you are using Futurum resources with your students. Email us at info@futurumcareers.com and let us know.

Let's keep chatting!

Sign up to our newsletter to receive the latest education and careers resources: futurumcareers.com/sign-up



How can economists combat crime?

How can economists help police forces to better assign their police officers onto the streets, thereby providing a better service to the public? In the Policing and Crime Research Group at the London School of Economics and Political Science, UK, Professor Tom Kirchmaier and Dr Magdalena **Domínguez** are using approaches from the field of economics to investigate crime and improve the efficiency of police departments.





Policing and Crime Research Group, Centre for Economic Performance, London School of Economics and Political Science, UK

Field of research

Crime economics

Research project

Using economic methods to combat crime and improve policing

Funder

UK Economic and Social Research Council (ESRC)



hy do some people turn to crime? How does crime impact society? And what improvements could police

departments make to reduce crime? In the Policing and Crime Research Group at the London School of Economics and Political Science, Professor

💬 Talk like a ... crime economist

Criminology — the study of crime and criminal behaviour

Cyber crime — criminal activities carried out on computers or online

Demographic — a characteristic of a group or individual, such as age, gender, etc.

Econometrics — using statistical models to understand data patterns and quantify different phenomena

Economics — the study of how people use and consume resources and respond to incentives

Incentive — something that encourages someone to do something

Money laundering — putting money made from illegal activities into legal sources of income

Recession — a period of economic decline, often accompanied by high unemployment rates

Sociology — the study of the social lives and interactions of humans

Tom Kirchmaier and Dr Magdalena Domínguez are hoping to answer these questions by investigating crime from an economic perspective.

"In the Policing and Crime Research Group, we study the full spectrum of questions around the causes and consequences of crime and the impacts of policing," says Tom, who leads the group. "Our research covers areas as wide-ranging as how to prevent domestic abuse, the role of gangs in violent crime and money laundering, and how best to prioritise police resources."

Can econometrics predict policing needs?

Knowing when and where to deploy police officers is key to addressing and deterring criminal activity. Tom has built an econometric model to help predict policing needs. "Econometrics uses statistical methods to forecast future trends from historical data," he explains. "In this case, it involves gathering data on past crimes to anticipate how much police work will be needed in the future."

Tom collected data from the entirety of England and Wales, including



crime statistics (such as when and where previous crimes occurred), demographic information (such as population density and age profiles), economic factors (such as unemployment rates and the area's economic services), seasonal variations (such as hours of daylight) and the influence of specific events on previous crime (such as concerts or sports matches).

By comparing how different factors correlated with the occurrence of crimes in the past, Tom built an econometric model to predict how these factors might influence crimes in the future. "In other words, given any specific situation, what do we expect to happen in terms of crime?" he explains. "Once we have these predictions, they can be used to assign police resources more effectively." For example, if a football match will be held on a dark winter evening in a part of town with high unemployment rates, what level of police presence will be required? How would this compare with during the middle of a working day in a sparsely populated area of town that has a large elderly population? "This model helps police departments to enhance their efficiency by better allocating existing resources and addressing potential crime occurrences more effectively," says Tom.

Can data analysis combat organised crime?

"Organised crime groups are structured criminal organisations that engage in illegal activities for financial gain," explains Magdalena. This typically makes them more dangerous and harder to tackle than individual criminals working alone. "Organised crime groups have extensive networks and may often be involved in

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By combining economics, criminology and sociology, we can better understand why crimes happen and find smarter ways to prevent them.



serious crimes, such as drug dealing, money laundering and cyber crime."

Magdalena uses economic methods to understand how organised crime groups operate and how police can prevent them. "I use quantitative methods, such as econometric models and network analyses, to analyse numerical data in a structured and statistical manner," she explains. "For example, I quantified the effects of mass arrests of gang members in Barcelona, Spain, on future criminal activity." Magdalena found that, following these mass arrests, not only were the arrested criminals less likely to commit further crimes, but that crime rates also fell among their peers who were not arrested. "It seems that mass gang arrests have spillover effects that indirectly contribute to a further reduction in crime," she says. "However, I also found that some key gang members were not arrested, indicating that the policy could have been designed better to achieve an even larger crime reduction."

Getting the full picture

The study of crime has traditionally taken place through a sociology lens to understand the social, societal and human factors that make crime more or less likely. While crucially important for understanding crime, sociological approaches sometimes miss an important element - quantifying incentives. The economic situation of an individual or community can make a big difference to the likelihood of crimes being committed. For instance, a recession may lead to a lack of job opportunities, which in turn may cause some people to feel that crime is their best option for securing an income. If caught, having a criminal record can then make it even harder for that person to get a job, causing them to return to crime. Understanding how much these factors matter is crucial for policy design.

However, economic factors do not exist in isolation. Many social factors, such as peer influence, education level and mental health support, can also contribute to an individual's decision to commit crimes. This highlights the importance of combining the quantitative approaches of economics with the typically more qualitative approaches of sociology and criminology. "By combining economics, criminology and sociology, we can better understand why crimes happen and find smarter ways to prevent them," explains Tom. "This mix of ideas helps us see how society works, why people do what they do, and how different social and economic factors contribute to crime."

The work of crime economists, such as Tom and Magdalena, is crucial for reducing crime, improving policing, and building a safer society for everyone.

About crime economics

conomics involves the study of decision making, including economics applies these concepts in the context of illegal activity. Crime economists study everything from the economic value of illegal trading to the financial consequences of crime to the economic impact for individuals caught up in the criminal justice economic prospects, how likely are they to return to crime?

"We use economic frameworks and quantitative methods to understand the incentives, behaviours and impacts associated with criminal activities," explains Tom. "This helps with resource allocation for crime prevention, effective policymaking, and understanding the

Applying the well-trodden approaches from economics in the people to pursue illegal activities. "We pay attention to the costbenefit analyses that people make when deciding whether crime is 'worth it'," explains Magdalena. "We use numbers to measure how these decisions can be influenced to make crimes seem less worthwhile." These cost-benefit analyses can also be applied to police resourcing, helping police departments understand where money and effort is best directed to prevent crime.



Pathway from school to

"At school, studying maths, economics, psychology and sociology will help build a foundational understanding of crime economics," advises Tom.

"At university, a degree in economics, criminology, statistics or public policy will offer more in-depth knowledge," recommends Magdalena. "In addition, take data science courses to learn about quantitative analysis and data management."

Tom and Magdalena emphasise the importance of complementing your academic studies with practical research experience through internships and networking with professionals.

Explore careers in crime economics

The Royal Economic Society (www.res.org.uk) runs a campaign called Discover Economics (www.discovereconomics.co.uk), which aims to change perceptions around economics and attract more students from under-represented groups. Efforts include free school workshops and the Young Economist of the Year competition.

Tom and Magdalena suggest seeking internships with organisations involved in crime research or policymaking. This could include the National Crime Agency (www.nationalcrimeagency.gov.uk), local police departments, think tanks and research centres.



Meet Magdalena

Maths was always my favourite subject at school. I also enjoyed reading and spending time with friends, but I didn't like studying natural science subjects, and I was never much of a sports person.

My career in crime economics came about by chance. I studied economics at university in Uruguay, but there were no courses on the economics of crime. However, while I was working as a research assistant, I got involved with a project studying the societal costs of crime. I realised this was a dynamic field where my research could have real-world impact.



I am very proud to have obtained my PhD, for which I investigated crime networks. A PhD requires a great deal of effort and determination. This can go unnoticed in academic circles, but I believe we should celebrate all achievements more.

Studying crime economics is interesting because there is still so much to learn. There are lots of research questions to answer, massive room for collaboration with public agencies and policymakers, and the potential to drive evidence-based change in society.

Magdalena's top tips

Work hard and consistently, don't be shy to reach out to people, and trust in yourself. You're probably doing much better than you think!



Crime economists help improve the efficiency of police departments



At school, I enjoyed studying physics and economics. I have also always loved being in the mountains at any time of the year.

Conducting crime economics research gives me purpose in life. The police show enormous interest in our work which highlights the need for this research to help society. Collaborating with police departments is very rewarding because, by using the data they share, we can tackle questions that would otherwise go unanswered.

Crime economics is fascinating in so many ways. It is also very rewarding to be able to make a real difference in the world. Our work helps make the police service more effective, while also understanding and tackling the root causes of crime. This will make life better for everybody in the long run.

As the Director of the Policing and Crime Research Group, I am very proud to have helped build an effective and impactful research team. Our work has a host of academic achievements and is improving the practices of police services around the world.

Tom's top tip

Don't just work hard - work smart too!

Why is diversity important for productivity?

Of the top 100 companies in the UK in 2023, only ten were led by women. And only four were led by a person of colour. There are many reasons for this concerning lack of diversity in senior management positions, including a lack of opportunities for people from under-represented backgrounds at all stages of their educational and career journeys. At the **London School of Economics and Political Science**, **Dr Grace Lordan** is leading the Diversity and Productivity project, where researchers, including **Dr Jasmine Virhia** and **Teresa Almeida**, are working to prove the importance of diversity for increasing productivity.



Dr Grace Lordan

The Inclusion Initiative, London School of Economics and Political Science, UK

Field of research

Behavioural science

Research project

Diversity and Productivity from Education to Work: Exploring the relationship between diversity, inclusion and productivity

Funder UK Economic and Social Research Council (ESRC)

Dehavioural scientist

Behavioural science — the study of how people behave

Diversity — the range of differences among people e.g., differences in age, gender or education

Inclusion — a way of integrating everyone's diverse skills, knowledge and abilities and empowering them to engage and contribute

Neurodiversity differences in how people's brains work **Productivity** — how consistently and efficiently a person completes tasks and reaches goals

Socioeconomic status

— a person's social and economic position in relation to others, based on factors such as how much money they make, their parents' occupations and their education

Thematic analysis — a

scientific method to identify themes that emerge from data

he UK faces a significant diversity challenge," states Dr Grace Lordan, who leads the Diversity and Productivity project at the London School of Economics and Political Science. Individuals from under-represented groups encounter barriers when they try to access and excel in high-productivity career paths, leading to a lack of diversity in the workforce. "In addition," she continues, "the UK lags nearly 20% behind its competitors in terms of productivity." Grace believes that addressing the diversity issue is key to solving the UK's productivity problem.

The leaky pipeline

Dr Jasmine Virhia and Teresa Almeida are behavioural scientists on the Diversity and Productivity team, and they refer to the problem of the 'leaky pipeline'. The nation's education and employment systems can be thought of as a hosepipe – instead of water flowing through the pipe, people are flowing through the system from school to the workforce. However, in the same way that a leaky hosepipe results in less water coming out the end than went in, talent is lost as people 'leak' out of education and employment systems.

"People from under-represented groups face inequalities in terms of access to skills and productive careers paths," explains Jasmine. "These inequalities start early and widen through a person's life." For example, if someone lacks opportunities



to build skills while at school, they will be less likely to end up in high-productivity jobs. This will then mean they have fewer opportunities to advance their career later in life. As a result, people from underrepresented groups are often prevented from reaching their full productive potential.

The Diversity and Productivity project

The Diversity and Productivity project is a collaborative research venture led by The Inclusion Initiative, where researchers investigate the obstacles that lead to the loss of diverse talent through the UK's 'leaky pipeline'. The project is focused on different aspects of diversity, including demographic diversity (e.g., gender, race, socioeconomic status, etc.) and health diversity (e.g., neurodiversity, people with physical disabilities, people with mental health conditions, etc.). Team members from universities around the UK are studying all stages of educational and career journeys, including how education pathways differ for diverse individuals and when diverse talent is lost on the pathway from early career workers to senior management positions. Jasmine is uncovering the barriers individuals face to their productivity and Teresa is exploring how diverse teams promote productivity.

Asking questions

Jasmine is interviewing a diverse range of individuals working in different professions around the UK. She hopes to understand more about the barriers they have faced in their educational and career journeys, and the factors that influence their productivity at work. "We ask participants about their job history, what productivity means to them and what support they have received throughout their career," Jasmine says. "We also ask for specific examples of when they have felt most and least productive at work, as this provides detailed insights into what enables and prevents productivity for diverse individuals." Jasmine then uses qualitative research methods, such as thematic analysis, to identify what themes and topics are commonly mentioned by participants.

Conducting experiments

Teresa is conducting behavioural experiments to explore how the diversity of a team influences its productivity. "Diverse teams of five people come together in our virtual lab to solve fun tasks," Teresa explains. "These tasks require people to work together, voice different opinions and think outside the box." Some teams are given hints on how to ensure they are working inclusively, and Teresa is interested to know if this promotes the team's creativity and productivity. Teresa and a team of behavioural scientists then analyse the participating teams' performances by scoring how creative, unique and useful their solutions to the tasks are. "We want to know how teams prompted on inclusive working compare with unprompted teams, and we want to see how diverse teams compare to non-diverse teams," she says.

What have Jasmine and Teresa discovered?

The interviews have shown that who you work with can significantly impact your productivity. Being surrounded by diverse individuals has a positive effect on experiences at work. "Organisations need to make commitments to fostering inclusivity and equity," says Jasmine. "It's important that people from under-represented groups have equal opportunities to develop their skills and for their voices to be heard."

Teresa is still conducting her behavioural experiment so does not yet have results to analyse. "However, we have seen that when people come together to work on their creative tasks, they are committed to doing a good job and seem to enjoy themselves," she says. "This suggests that diverse teams are engaged and motivated."

How will this research improve diversity and productivity?

The Diversity and Productivity project aims to show how diversity improves productivity and to identify practical ways in which companies can promote inclusive working. If concepts such as inclusion can be translated into behaviours, then individuals and workplaces can take action to ensure that everyone can bring their knowledge, ideas and perspectives to the table. As Grace says, "We want to use behavioural science to find solutions that make workplaces more equal, open and innovative!"

About behavioural science

Behavioural science research provides valuable insights into human behaviour, decision-making and motivation," says Jasmine. "It offers a foundation for designing effective solutions to real-world problems." Behavioural scientists identify the factors that influence the choices, decisions and behaviours of an individual or group. This then allows researchers and policymakers to develop strategies and interventions that are tailored to address real-world issues. For example, behavioural scientists contribute to public health initiatives by exploring how people will respond to specific health policies

Analysing data to understand behaviour

Behavioural scientists use quantitative (non-numerical) research methods to gather and analyse data relating to people's behaviour and perspectives, and quantitative (numerical) research methods to gather and analyse statistical data. In the Diversity and Productivity project, researchers used a wide range of techniques, from qualitative interviews and surveys asking about workplace experiences to quantitative reviews of company records that report the characteristics of employers. By analysing information about when workplace inclusion initiatives were introduced to a company and comparing this with records of a company's productivity, the team can determine whether changes in productivity were due to improvements in diversity and inclusion, or other factors.

"The combination of both qualitative and quantitative data gives us a rich, multilayered understanding of our research questions on how diversity and inclusion affect productivity and creativity in the workplace," says Teresa. "We couldn't get the complete picture without blending these research approaches together into our toolkit and analysing the different sources of data to uncover insights."

Pathway from school to behavioural science

At school and beyond, study maths and statistics to develop numerical and data analysis skills, study psychology to learn about theories that exist in the field and develop your critical thinking skills.

Some universities offer degrees in behavioural science, or the subject may be covered during a degree in psychology, management or economics. Aspects of data science, statistics, sociology, anthropology, social policy and neuroscience all contribute to behavioural science research.

Learn more about studying behavioural science at the London School of Economics and Political Science:

www.lse.ac.uk/PBS/Study

Teresa and Jasmine recommend reading books such as Thinking, Fast and Slow by Nobel prize-winning economist Daniel Kahneman and Predictably Irrational: The Hidden Forces That Shape Our Decisions by Dan Ariely.

Explore careers in behavioural science

In addition to conducting academic research, many behavioural scientists work in policymaking, where they contribute to improved healthcare, education, social and environmental policies.

Behavioural scientists may also work in marketing or behavioural therapy, or for governments or non-profit organisations.

"There are many ways in which insights from behavioural science can contribute to positive change in society," says Teresa. "Behavioural scientists study everything from how to improve environmental outcomes to how we engage with robots."

The United Nations provides information about the importance of behavioural science for fulfilling its mandates to tackle inequality: www.un.org/en/content/behaviouralscience





I've always been interested in solving puzzles and problems. I think this made me curious to understand why people do the things they do. Growing up in Portugal, I was motivated to explore further afield and learn about other cultures, people and ideas, which drove me to study in the UK.

During my undergraduate degree in international

management, I took courses in decision-making, negotiation and game theory. This was the first time I had explored an entire scientific field devoted to understanding human behaviours and choices, and these courses inspired me to study a master's in behavioural science.



I enjoy bringing knowledge from different disciplines to answer behavioural science questions. I also love applying this knowledge to a real-world issue that really matters – diversity and inclusion. It is satisfying to test our research to ensure it is helping people and making a positive impact. As an eternally curious person, it's very rewarding to think about new ways to solve real-world problems.

I'm excited to be part of the Diversity and Productivity

project because increasing workplace inclusion through behavioural interventions aligns perfectly with my passions. Diversity drives innovation, but it takes deliberate changes to unlock the creative potential of people from all backgrounds. It's been an incredible opportunity to work with other researchers from different disciplines and see how they approach their research questions – I now know a lot more about psychology, data science and economics than before.



Meet Jasmine

I've always had varied interests. I enjoy spending time outdoors, playing sports, painting and playing musical instruments. At school, I most enjoyed humanities subjects (English, history and geography), so people are often surprised that I pursued a scientific career.

My undergraduate degree was in English literature

and linguistics, during which I developed strong written communication skills. I then studied a master's in neuroscience and linguistics, where I began linking my humanities knowledge to science topics. This background gave me an interdisciplinary approach to solving problems and conducting research. However, I hadn't studied maths since I was 16, so I had to engage in a lot of creative independent learning to develop my numerical and statistical skills. For example, I took part in psychology and neuroscience experiments to learn about their design, then explored how this translated into testing for statistical significance. I then did a PhD in cognitive neuroscience, conducting experiments to test people's behaviour in a brain scanner. I had no previous experience in computer programming or the physics behind neuroimaging, so this was another huge learning curve!

The Diversity and Productivity project has allowed me to develop my qualitative research skills. I have enjoyed broadening my skill set as, before this, most of my behavioural science research used quantitative data. Learning from experts in the team, as well as the huge range of people I have interviewed, has been a great opportunity. Knowing that our research could positively impact people's lives and careers is a great feeling.

Teresa and Jasmine's top tips

- 1. Be curious and always ask questions. Science is all around you, so be imaginative about how you immerse yourself in it.
- 2. Read widely about whatever topics interest you.
- 3. Develop your numerical skills and critical thinking. These are key for analysing data and questioning assumptions.
- 4. Consider how different subjects link together. How could you combine your different interests in your studies and future career?

Can workplaces truly embrace LGBTQ+ inclusivity?

Based at **York University** in Canada, **Professor You-Ta Chuang** is exploring intricate LGBTQ+ workplace dynamics and addressing key aspects such as the impact of organisational policies, the pervasive issue of microaggression and the role of activism in fostering a truly inclusive work environment.





Professor You-Ta Chuang

Professor of Management, School of Administrative Studies, York University, Toronto, Canada

Field of research

Organisation management theory

Research project Investigating LGBTQ+ inclusivity in the workplace

Funder

Social Sciences and Humanities Research Council of Canada (SSHRC, grant #890-2021-0032) Talk like an ...

organisation management theorist

Heteronormative a societal assumption that heterosexuality is the norm or 'default' sexual orientation

Heterosexism — systemic discrimination or prejudice against non-heterosexual orientations, reinforcing the idea that heterosexuality is superior or more valid

LGBTQ+ — lesbian, gay, bisexual, transgender, and queer/ questioning, with the plus symbol indicating inclusivity of other sexual orientations and gender identities

Microaggressions -

subtle, often unintentional, discriminatory behaviours that marginalise individuals based on characteristics such as gender or sexual orientation

Organisational policies

— rules set by an organisation to govern behaviour and practices

magine a workplace where everyone feels accepted, valued and understood. While this should be the norm, evidence highlights a disheartening reality: various groups in society face unfair stigmatisation in the workplace. Among these, perhaps one of the most profoundly stigmatised groups has been the LGBTQ+ community. Despite progress in societal attitudes, the workplace remains a battleground for LGBTQ+ individuals striving for acceptance and equality. Even though global acceptance of homosexuality has seen an upward trend in the past two decades, a study by The Canadian Press published in 2022 indicated that 65% of

LGBTQ+ employees in Québec, Canada, had experienced workplace discrimination in the previous five years. This contrast between the increased tolerance towards LGBTQ+ individuals in broader society and the workplace reality highlights a significant disconnect that demands attention.

Professor You-Ta Chuang, Professor of Management at York University, opens a window onto the challenges faced by LGBTQ+ individuals in the workplace. From decoding the impact of organisational policies to navigating the nuances of microaggressions, his research uncovers crucial insights that influence the development of an inclusive work environment.

How important are organisational LGBTQ+ policies?

Organisational policies are a set of rules established by a company to guide how it operates. These policies cover a wide range of areas, including employee behaviour, workplace conduct, and the overall culture within the organisation. They serve as a framework to ensure that everything is fair and follows the law.

These policies have profound influence on the experiences of LGBTQ+ employees at



work. "Legislations, sometimes ambiguous and in contradiction with one another or across local and national levels, can be subject to varied interpretation," says You-Ta. For example, before 2020, there was no legal protection at the federal level in the US against discrimination based on sexual orientation. This legal gap allowed different US states to set their own requirements, reflecting a patchwork of policies that affected the degree to which LGBTQ+ employees received equal treatment in different regions.

"Quite often, the state only indicates the minimum requirement that organisations need to comply with," says You-Ta. "Therefore, the extent to which organisations will embrace equal treatment of LGBTQ+ employees is subject to their management's political ideology and willingness to create a truly inclusive work environment." Some organisations with more progressive political ideology actively adopt LGBTQ+ friendly policies, demonstrating a commitment to diversity. However, some organisations with more conservative political ideology may only meet minimum legal requirements, possibly perpetuating discrimination. Consequently, the lack of a standardised approach highlights the crucial role organisational policies play in determining the extent to which LGBTQ+ individuals are valued and protected in their professional environments.

What role do LGBTQ+ activists play in challenging workplace norms?

LGBTQ+ activists play a pivotal role, actively working to fight discrimination

and fostering more inclusive workplace environments. "Our research shows that LGBTQ+ employee activists work with people who are more open-minded or supporters of LGBTQ+ and have more power and influence in their organisations to acquire resources to advocate for equal treatment," says You-Ta. In doing so, they not only confront discriminatory practices but also collaborate with like-minded individuals in influential positions to promote equality.

Activists work hard to reshape workplace dynamics. "LGBTQ+ activists also take various opportunities to educate employees and managers to help them understand varied forms of discrimination and microaggressions and their effects on LGBTQ+ employees," explains You-Ta. Their dedication extends to supporting LGBTQ+ rights through various approaches, from openly challenging discriminatory policies to subtly expressing their identities. It is through these combined efforts that LGBTQ+ activists contribute significantly to fostering environments where individuals can thrive.

How do microaggressions affect LGBTQ+ employees?

Microaggressions convey negativity towards individuals based on their sexual orientation, gender identity or expression. "Examples of microaggressions include assuming sexual orientation based on appearance, not inviting LGBTQ+ employees to social gatherings, assuming each employee is heterosexual, or expressing negative or hostile comments toward LGBTQ+ populations," explains You-Ta. These sometimes seemingly insignificant actions can contribute to a hostile workplace culture if left unaddressed, creating an environment where LGBTQ+ individuals may feel marginalised or excluded. "More specifically, microaggressions prevent LGBTQ+ employees from participating fully in the workplace and undermine their identities," says You-Ta. These acts are rooted in heteronormative assumptions and workplace cultures that do not value LGBTQ+ identities. You-Ta based his research on workplaces in Canada and Taiwan. Despite these countries' progressive and LGBTQ+ friendly reputations, his studies uncovered high frequencies of microaggressions experienced by LGBTQ+ employees. These were proven to be more detrimental than explicit discriminatory policies, affecting identities, well-being and job performance. Consequently, LGBTQ+ employees, confronted with microaggressions, tend to hide their identities, further promoting a culture of silence.

However, despite challenges, there may be a silver lining. "Fortunately, microaggressions sometimes trigger LGBTQ+ employees to stand up against interpersonal discrimination to fight for changes in workplace heterosexism," says You-Ta. Addressing microaggressions requires a holistic approach, including diversity education, safe spaces and channels for voicing concerns. Despite direct supervisors' crucial roles, LGBTQ+ individuals, especially transgender employees, often receive inadequate support, exposing inclusivity gaps. Achieving truly inclusive workplaces demands real commitment to diversity and inclusion at all levels. 😜

What impact do LGBTQ+ policies have on workplace experiences?

"In the past, organisations hesitated to implement LGBTQ+ friendly policies due to concerns about costs and backlash from anti-LGBTQ+ social groups," says You-Ta. Recent realisations debunk these fears, as studies indicate these policies enhance productivity, well-being and trust in management. "However, the impact of organisational LGBTQ+ friendly policies on employees is often dependent on how employees interpret the reasons why their employers implemented the policies," explains You-Ta. It is important that policies are implemented to benefit people, not just for image enhancement or legal compliance. While LGBTQ+ friendly policies can boost job satisfaction and performance, for them to really work, the organisation must be truly committed to equality. Policies put into

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As we move forward, it is vital for organisations to recognise that a genuine commitment to diversity extends beyond policies...



place just for appearance or to 'tick a box' may not produce real benefits. In contrast, organisations actively incorporating policies into daily operations, fostering LGBTQ+ participation in corporate functions and sponsoring events demonstrate a genuine commitment to equality, potentially leading to more positive impacts on employees.

Thinking about the future

"My current and future research tries to understand the conditions under which LGBTQ+ employees would stand up to change discrimination and microaggressions in the workplace," says You-Ta. "Importantly, to truly embrace equal treatment for LGBTQ+ employees, all employees need to buy into the idea of diversity, equity and inclusion". Only through this unified effort can workplaces truly become inclusive environments, fostering the well-being and success of LGBTQ+ employees. As we move forward, it is vital for organisations to recognise that a genuine commitment to diversity extends beyond policies; it involves cultivating a culture where everyone feels valued, respected and empowered, regardless of their sexual orientation, gender identity or expression.

About organisation management theory

rganisation management theory is a multifaceted field centred on exploring the intricacies of human behaviour within organisational structures. Researchers investigate why individuals, from employees to managers to senior executives, behave the way they do within an organisational context such as their



workplace. "I am always curious about why people do what they do," says You-Ta.

This discipline navigates the ever-evolving landscape of organisational challenges, requiring adaptability to changes in societal values, emerging technologies and environmental concerns. Consequently, organisation management theory plays an important role not only in structuring businesses but also helping leaders make important decisions. "I find doing research in organisation management theory rewarding because it answers my curious questions and stimulates more curiosity," says You-Ta. The field is fascinating because it empowers professionals to actively participate in or react to global changes.

"Faced with ever-rapid changes in our world (such as changes in societal values, the emergence of artificial intelligence, changes in geopolitical landscape, and climate changes), there are lots of research opportunities to understand how



organisations either actively participate in or passively react to these changes," explains You-Ta. Research opportunities lie in understanding successful strategies for navigating these changes and how they affect things like leadership, organisational structure and workforce dynamics. This knowledge can help organisations become more resilient in the face of challenges. **Pathway from school to** organisation management theory

"Organisation management theory is about the interplay between people, organisations and society," explains You-Ta. "Subjects such psychology, sociology, economics and political sciences are very helpful".

Reach out to local businesses, non-profit organisations and research institutions that align with management and organisational theory. They might offer internship opportunities or the possibility of shadowing professionals in the field.

Pursue a bachelor's degree in sociology, business management or economics. Specialised courses like organisational theory and business operations would be very valuable.

Explore careers in organisation management theory

"To pursue a career in organisation management theory, you need to have critical thinking skills and curiosity about human behaviour and business operations," explains You-Ta.

"Reading daily business news such as the Financial Times (www.ft.com), the Wall Street Journal (www. wsj.com), the New York Times (www.nytimes.com/ international), Fortune (fortune.com/tag/u-k), and the Times (www.thetimes.co.uk) can be very helpful," says You-Ta. These sources provide a comprehensive understanding of current business trends, economic analyses and global affairs. Reading articles on these platforms can expose you to diverse perspectives, industry insights, and real-world applications of organisation management theory.

"Articles from the Harvard Business Review (hbr.org), the California Management Review (cmr.berkeley.edu), and the Sloan Management Review (sloanreview.mit.edu) can also sharpen your critical thinking skills and advance your knowledge," says You-Ta.

Indeed.com provides a career guide for different types of management theory: www.uk.indeed.com/careeradvice/career-development/management-theories





Meet You-Ta

What inspired you to become an organisation management theorist?

Before getting into organisation management theory, I was trained as a clinical psychologist and provided psychological counselling for six years. I also worked in a big corporation for two years and helped my parent's family business for several years. As I am always fascinated by human behaviour and how people interact with each other, I was intrigued by organisation management theory when doing my graduate studies and decided to pursue it as my career.

What experiences have shaped your career and research?

One of the most important eureka moments I'll never forget occurred during my second year of undergraduate studies. I was fascinated by very interesting materials taught by my professor, Nai-Wen Kuo. In one lecture, she explained why some people don't see objects on their left side. It is not because they don't want to pay attention to the left. It is because their impaired cognition made them neglect the left. It opened my eyes to human behaviour and made me realise that there are different factors leading to the same behavioural outcomes. This makes the understanding of human behaviour both challenging and intriguing. Since then, I have been interested in exploring diverse human behaviours and interactions in different contexts.

What are your proudest career achievements?

So far, my career has been quite smooth, without many hiccups! I have published research in prestigious management journals and received good teaching evaluations. I especially enjoy and am proud of having the freedom to do what I want to do.

What are your aims for the future?

My goals for the future are to produce more impactful research, on LGBTQ+ issues in particular, and to help organisations create more LGBTQ+ friendly, truly diverse and equal work environments.

You-Ta's top tips

- 1. Be sensitive and curious about your surroundings.
- 2. Always ask why and how things happen.
- 3. Read broadly to gather diverse perspectives.

How is climate change affecting accounting and business?

Climate change is creating unprecedented risks for businesses around the world, which is making investors nervous. A key way that businesses can address this anxiety is through disclosing how they impact, and are impacted by, climate change. **Dr Sanjay Banerjee** of the **University of Alberta** in Canada is researching how businesses are going about this, and what this means for future policy and regulation.





Dr Sanjay Banerjee

Associate Professor, Alberta School of Business, Department of Accounting and Business Analytics, University of Alberta, Canada

Field of research

Accounting, climate risk

Research project

Climate disclosures: how companies' physical climate risks impact their investor demands and voluntary disclosures

Funder

Social Sciences and Humanities Research Council of Canada (SSHRC), Canadian Academic Accounting Association (CAAA), CPA Canada

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nderstanding how companies are responding to the threat of climate change is of huge interest to investors, regulators and policy makers. Based at the University of Alberta, Dr Sanjay Banerjee collaborates with Dr Vikas Mehrotra, Dean and Professor of Finance at the University of Alberta School of Business, and Dr Rajesh Vijayaraghavan, Assistant Professor at the University of British

Talk like an ...

accounting researcher

Capital — wealth in the form of money or assets

Carbon tax — a tax on the usage of fossil fuels and/or greenhouse gas emissions

Climate disclosure — the sharing or publication of climaterelated information related to a business, such as climate risk assessments and mitigation plans

Climate risk — the potential for the impacts of climate change to have negative consequences

Investor — a person or organisation that gives money towards a certain business or project, with the expectation of receiving a profit from the investment at a later date

Machine learning — a type of artificial intelligence that uses algorithms to imitate the way that humans learn and perform certain tasks more accurately over time

Shareholder — any person or organisation that owns shares in a company

Shares — the subunits of a company's capital/stock

Stock — the sum of a company's shares

Columbia Sauder School of Business. The team studies accounting and its relationship with climate. Sanjay, Vikas and Rajesh's research is uncovering what factors influence companies to investigate and voluntarily disclose the level of climate risk they face, and what this means for the wider world of finance and policy.

Climate risks

"Climate change presents two types of risks to businesses: physical risks and transition risks," says Sanjay. Physical climate risks refer to the direct effects of the changing climate, such as drought, wildfires, hurricanes or sea level rise. These can all affect businesses through damaging their production lines or stores, disrupting supply chains, or impacting the daily life of their workforce. Transition risks refer to the uncertainties around the transition to a low-carbon economy. "For example, companies may have



to pay higher energy costs if carbon tax policies are introduced, or they may make investments in new unproven green technologies," explains Sanjay. "Some businesses, such as coal and gas companies, will have reduced demand for their products."

Almost every business in the world will be exposed to at least some of these risks, so predicting and planning for the future is essential. "These costs already impact us today. It's estimated that large climate disasters cost the US between \$300 to \$500 billion every five years," says Sanjay. "Companies are, therefore, developing strategies to avoid or minimise these losses."

Climate disclosure

Businesses rely on investors to provide the capital that keeps their operations running. This means that they listen closely to investors' wants and needs to keep them happy. "Investors are increasingly demanding climate disclosure, which involves companies calculating and sharing the level and type of climate risks that they are exposed to," says Sanjay. "This helps investors decide the value of the company and whether they should invest."

Sanjay, Vikas and Rajesh are investigating how investors' demands impact companies' decisions to make such disclosures, and if so, which type of disclosure outlet they use. "There are two outlets that are most often used for voluntary climate disclosure," says Sanjay. "The first involves working with CDP, a charity formerly known as the Carbon Disclosure Project, which asks companies to disclose their climate risk and their strategies to fight climate change. The second involves the companies themselves publishing climate-related information in their corporate social responsibility (CSR) reports.

Analysing the approaches of thousands of companies is no easy task, so the team has recruited the help of machine learning algorithms. "We have potentially hundreds of thousands of documents to examine, and machine learning helps us do this faster and with fewer mistakes," explains Sanjay. "For example, the algorithms can potentially search for words or phrases related to climate risk, using sources ranging from financial reports, social media posts and telephone call transcripts."

What affects climate disclosure?

The team has already uncovered some interesting findings. "We found evidence that companies in which the largest investment companies (BlackRock, Vanguard and State Street) have ownership are more likely to make voluntary climate disclosures via CDP than via corporate social responsibility reports," says Sanjay. "The same is true for companies that are top emitters of greenhouse gases." In fact, in 2023, CDP Global reported that 746 institutional investors with a collective \$136 trillion in assets requested companies to disclose via CDP.

Separate research finds several other factors that can influence climate disclosure. "Companies are more likely to make voluntary climate disclosure if the company is large, if its investors are climate-conscious, or if it received climate-related shareholder proposals," says Sanjay. There is growing incentive for climate disclosure, as investors see the value in such forward planning and will value the company's stock higher, leading to more investment.

In the real world

The team's findings are of significant interest to both the public and private sector. "Our findings will inform investors, regulators and companies about how investors' demand for disclosure influences companies' decisions," says Sanjay. "For instance, if investor demand is found to have insufficient impact, then regulators may have to step in to make climate disclosure compulsory."

There is an ongoing debate about whether companies' climate disclosures should be voluntary or mandatory, and these results will help inform this discussion. "Even though investors are asking for disclosure, companies are not always responding," explains Sanjay. "So, regulators around the world have started stepping in to make climate disclosure mandatory."

Looking ahead, Sanjay wants to learn more about the types of climate risk businesses are facing. "Our research did not differentiate between the two types of climate risk," he says. "The next step for us will be to take a deep dive into physical climate risk – a topic with only limited research so far." It is only recently that models and datasets have grown sophisticated enough to perform this research, and Sanjay is excited to see what it reveals.

About accounting research

ccounting involves the recording and organisation of business' financial transactions. Accounting research examines these practices and how they affect the wider world. Sanjay's work involves examining businesses' accounting practice and how these relate to business behaviour, policy, regulation and societal trends. He explains more about his field and why accounting has a bigger impact on our everyday lives than we might realise:

"I love to understand the 'why' behind the 'what'. For example, why does a manager behave in a certain way? Why don't companies disclose their climate risks as much as their investors demand? Why does a regulator make a certain policy decision? Why did the stock price of a company fall after a new regulation? I also love to have the freedom to choose what I want to investigate.

"There remain a lot of unknowns about the financial effects of climate change. Understanding investors' demands and how companies and regulators are responding to them is vital.

"Machine learning and artificial intelligence (AI) are transforming the field of accounting, and will continue to do so. Accountants today and those in the future need to understand these. Already, big accounting firms are investing in training their employees in these areas, as AI is likely to set new trends in the future.

"Accounting doesn't have to be dull! It influences society in ways that, typically, we don't realise. Investors' decisions to invest depend on companies' financial reports, which are audited by accountants. If this isn't done properly, there are real-world impacts: investors will not feel confident to invest in companies, and, with a lack of investment, people might lose their jobs, a relative might lose part of their pension, for instance. Accountants are vital for investors to have trust in companies."



Pathway from school to accounting research

Sanjay emphasises that a career in accounting research can be approached from a range of different directions. He says you should be comfortable with numbers, be meticulous and precise, practise clear and concise writing, develop soft skills, and stay up to date with technology.

For a career in accounting, useful subjects to study at school and beyond include mathematics, statistics, English and sciences.

For a career in accounting practice, a professional licence in chartered (public) accountancy is needed. At university, a bachelor's degree in business with a major in accounting can be helpful but not necessary. A bachelor's degree in any discipline can be a starting point for someone to pursue a career in accounting, as long as they complete a certain number of credit-hours of accounting-related coursework and pass the professional licensing exam.

For a career in accounting research, a licence is not needed; rather, a PhD in accounting is the right qualification. A bachelor's degree in any discipline, including business, economics, engineering, mathematics and science, can be useful.

Explore careers in accounting

The University of Alberta has a wide variety of outreach initiatives, which you can learn about in this report: www.ualberta.ca/communityengagement/media-library/reports-to-thecommunity/2022-23-report-to-communityenglish.pdf. You can also learn more about the Department of Accounting and Business Analytics, where Sanjay works: www.ualberta.ca/accounting-business-analytics/ index.html.

CPA Alberta (www.cpaalberta.ca/Become-a-CPA/High-School-Students) and CPA Ontario (www.cpaontario.ca/become-a-cpa/high-schoolstudent) provide information for high school students about careers in chartered accountancy and offer scholarships, ambassador programmes and events.

In Canada, a chartered accountant makes an average of CAN \$80,000 per year, according to **Talent.com**.



I never originally intended to pursue a career in accounting. My undergraduate degree was in aerospace engineering, and I later worked on missile design and in a variety of other industries. It was only while studying for my PhD that I found two courses especially interesting – and both focused on accounting.

Before, I had subscribed to the common perception that

accounting is boring. These two courses showed me otherwise. One, led by Professor Chandra Kanodia, covered how to develop models to understand and predict how accounting information impacts managers' and investors' strategic decision making. The other, by Professor John Dickhaut, looked at testing the predictions of these models by conducting experiments in the laboratory.

The publication of my first paper after my PhD was a proud

moment. It was published in 2016 in an accounting journal and covered the banks' response to the 2008 financial crisis. We did some experiments in the laboratory to understand how people make decisions, and we uncovered interesting findings – sometimes providing people with more information can lead them to make bad decisions.

Much more work is required to mitigate climate risk right

now. Even though there's a lot of talk, we still need much more research and action. Another emerging area of interest to me is cryptocurrencies, which are currently subject to very little regulation. I want to study these areas in more detail – and to design a course on sustainability accounting, too.

Sanjay's top tips

- To be a good accountant you need to like numbers, precision and computers. But more than that, a diverse set of interests and experience of industry can help a lot.
- 2. It's never too late to begin a career in accounting research - in fact, diverse experiences can help. My own career path was far from direct!
- 3. Always remain curious.

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