

# COMPLEX HUMAN DATA HUB

## THE SCIENCE BEHIND HOW WE MEASURE HUMAN EXPERIENCE AND BEHAVIOUR

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*From obesity to climate change to extremism, Australia faces diverse societal challenges that require a deeper understanding of human behaviour in order to address them. The Complex Human Data Hub (CHD Hub) is using technology and data to explore the broader dynamics of complex human behaviour. The aim is to produce actionable insights that will inform public institutions about how to design and implement effective behaviour change interventions in health, sustainability, national security and more.*

*The CHD Hub is, led by Director Professor Simon Dennis Deputy Director and Associate Professor Amy Perfors, is looking to study human experience and behaviour by combining psychological theory, sophisticated computational modelling and rich real-world data. Technologies such as smart devices, social media and the Internet of Things are making this more possible than ever before and the CHD Hub is uncovering fascinating insights about human experiences in today's world.*

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### OUR RESEARCH

Technological advancements are fuelling the our contribution to a new kind of psychological science that is tied to the real world. Computational modelling can be applied to better understand, explain and predict human behaviour. But what does this actually look like in action?

One example is Professor Dennis's research into understanding errors in human memory. This has been carried out with the objective of informing how police can ask better questions when interrogating suspects under inquiry.

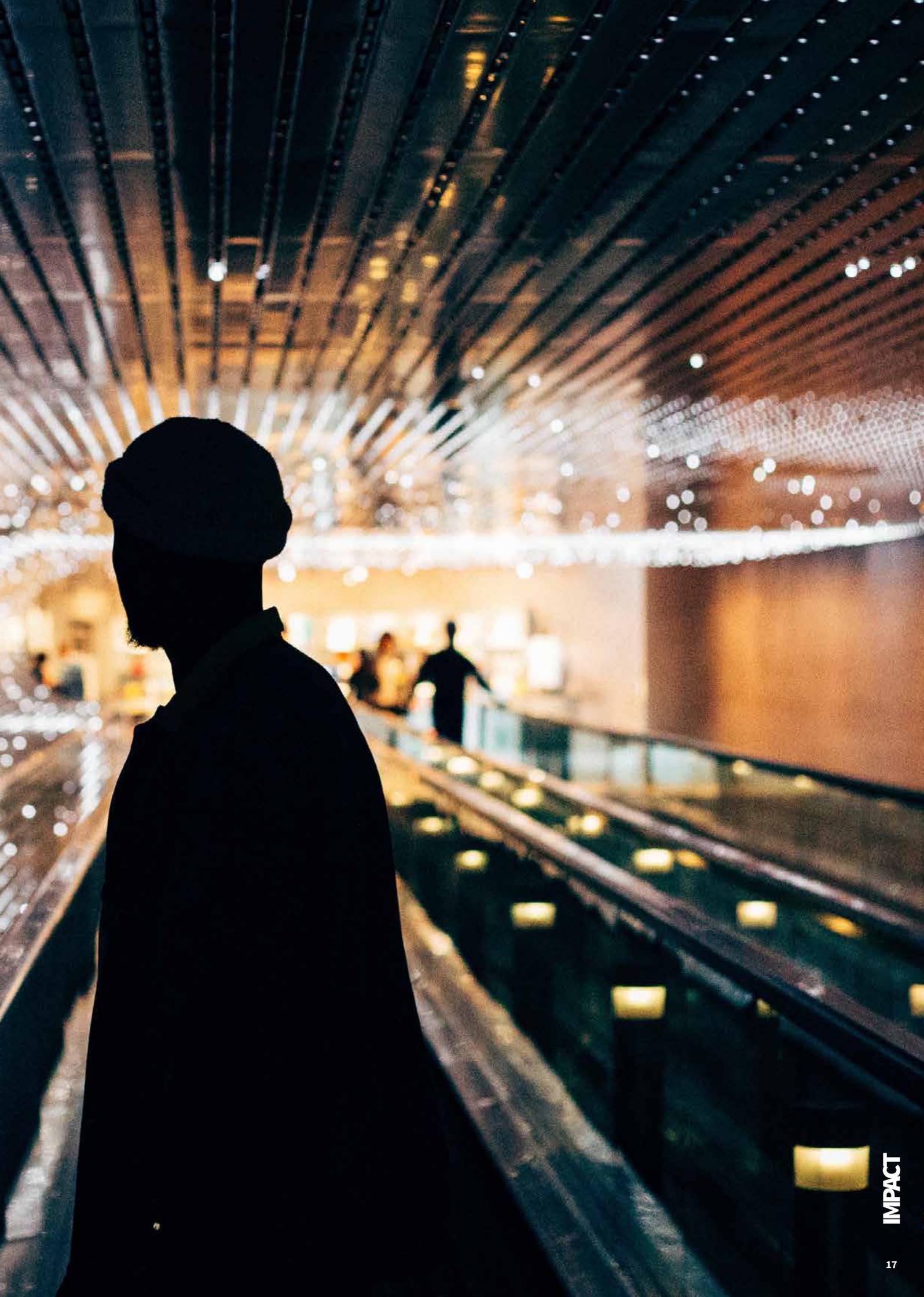
Professor Dennis has been involved in carrying out a study that collects GPS data from smartphones and cross references this information with how people respond when asked where they were at a certain time. Findings have shown that people are often a day or week off in their accuracy. The team is also collecting data to see if the nature of a person's sonic environment can affect their memory.

In another scenario, Associate Professor Perfors has been working with the University of Western Australia and Defence Science Technology Group to look at the way information is disseminated between people, as well as how and why group polarisation occurs. One of the key questions is to what extent social media drives such behaviour or if it emerges out of more general biases and real-world informational limitations. By studying group behaviour in a controlled lab environment and modelling it computationally, this research aims to better understand information sharing and apply the insights to real-world contexts.

### CHALLENGES

One of the greatest challenges that the CHD Hub faces is how to safely analyse and collect the data needed for its research. Information like GPS data and email addresses is very sensitive and needs to be handled differently than typical experimental data. While much of the research is conducted in a lab environment with people using computers and accelerometer devices, this data can't be stored on disks and needs to be safeguarded.

A key objective for the CHD Hub is to find ways of analysing this information without researchers actually seeing the data and imposing upon privacy issues. They have invested great effort in this issue. Professor Dennis has designed a special-purpose computer language (called Private) that permits this kind of access, and the team is engaged in dialogue with policy and legal scholars to ensure that it is used within an appropriate framework.



## OUR VISION

There is also an inherent challenge in analysing big data sets. Different models and computational infrastructures are needed in order for the CHD Hub to scale up. Pursuing this goal has led us to apply in collaboration with a number of national and international collaborative partners for a Centre for Excellence in Computational Behavioural Science, funded by the Australian Research Council.

The proposed Centre of Excellence will be formed in partnership with 17 other organisations including the University of Oxford, the Cancer Council Victoria and the University of Groningen in the Netherlands. The overall vision is to grow the field of computational behavioural science and build the research platforms and datasets on which it relies. By combining these tools with psychological theory and working closely with partner organisations, it will provide actionable insights for changing and understanding real-world behaviour. The outcome will ultimately inform government policies and contribute to the betterment of Australian society.

## OUR FUTURE

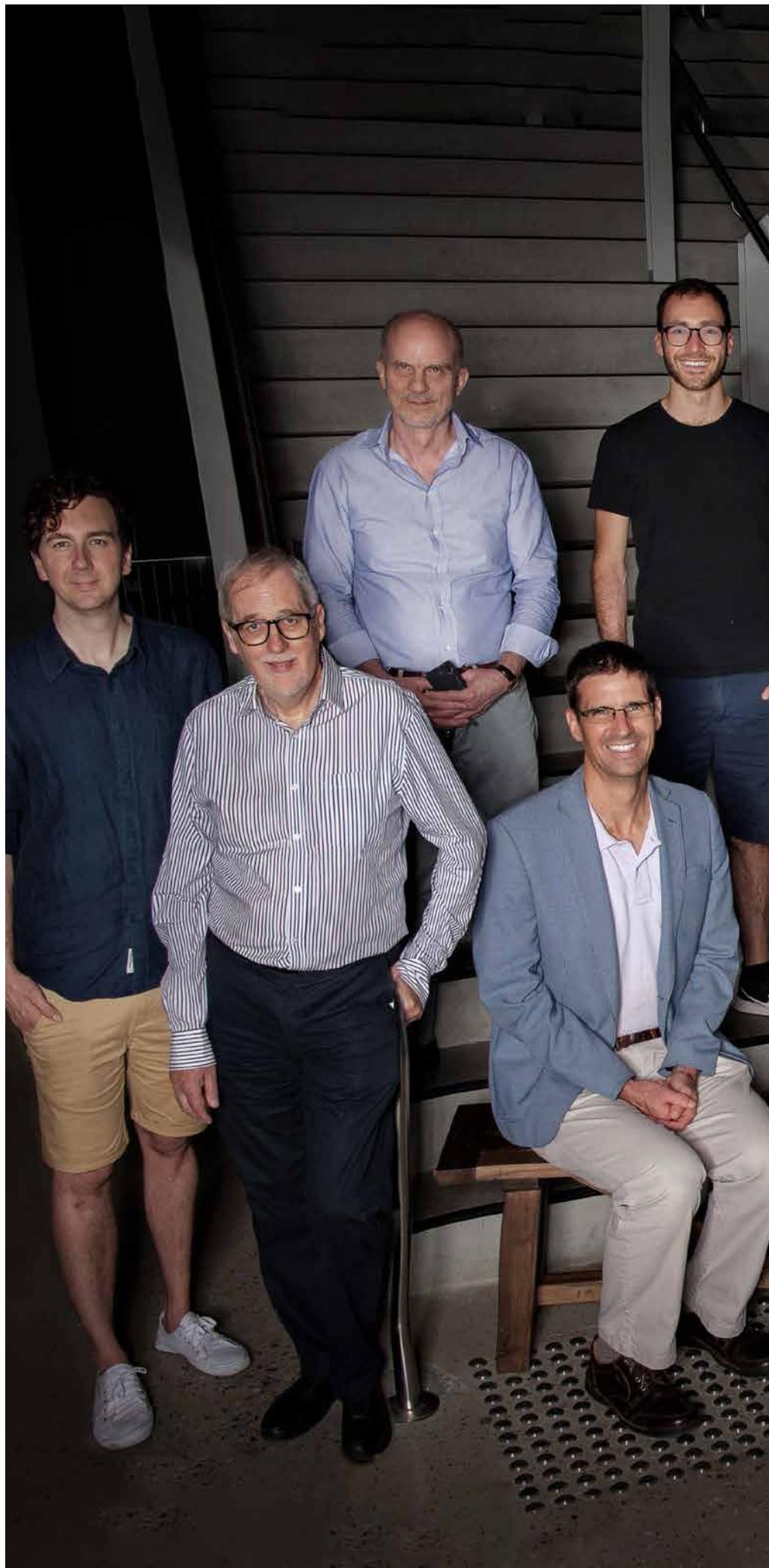
The CHD Hub sees many positive opportunities on the horizon. At the end of 2018 we ran the inaugural CHD Hub Summer School designed to give the next generation of psychological scientists the technical training they need for success. Over 70 students from around Australia and the world attended and we plan to run it again in subsequent years. CHD Hub also runs regular seminars and we have seen strong growth in our staffing profile, including:

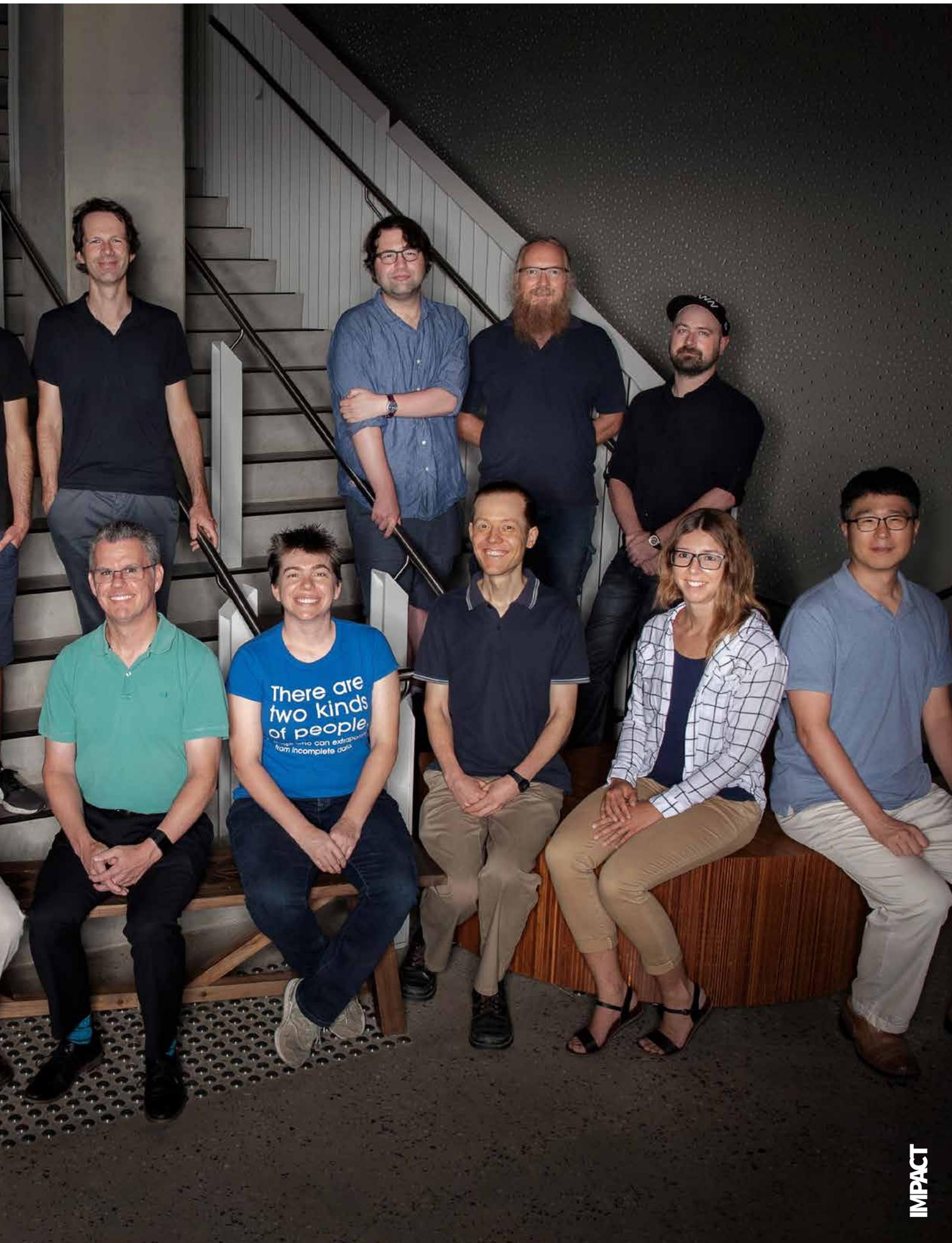
- Dr Johan Koskinen, a Social Network Researcher from the University of Manchester
- Dr Mirko Uljarevic, Developmental Disability expert from Stanford University, and
- Associate Professor Charles Kemp, from Carnegie Mellon University in Pennsylvania.

The work of the CHD Hub is extremely important and valuable and advancing technologies are boosting the scope of their research more and more. There is huge potential in this area, advancing the ability of the psychological sciences to explain, explore and influence how people respond in complex real-world environments.

Find out more:

[psychologicalsciences.unimelb.edu.au/research/hubs/chdh](https://psychologicalsciences.unimelb.edu.au/research/hubs/chdh)







## HOW DATA AND SENSORS CAN SHOW US HOW OUR MINDS WORK

As our mobile devices integrate more and more seamlessly with our lives, data about us is being recorded – for better or worse.

Our devices have become catalogues of our lived experience. From the palm of our hands, our phones can track where we are, who we're in contact with and what we're observing from our environment. They can even monitor the quality of our sleep.

When data collection is protected by privacy control, it promises to uncover new information about how we think, learn, use language and recall memories. It also allows us to better understand and treat mental illnesses.

Researchers within the CHD Hub aim to bring together psychological science and computer science, along with mathematics, to collect and harness data about how we live and think. They're exploring the ways to harness this technology so that we can learn about the ways our minds work.

In doing so, CHDH seeks to produce actionable knowledge and technology that can help us understand human behaviours across a variety of fields, from national security to sustainability.

### ANALYSING OUR OBJECTIVE EXPERIENCE

"There has never been a better time to be a psychological scientist", says Professor Simon Dennis, "We can now start to capture people's objective experiences in a real way."

The CHD Hub are using smart phones to track the lives of participants living with bipolar disorder to better understand, monitor and even predict depressive and manic episodes.

At a time when advances in neuroscience and imaging are revolutionising our knowledge of how the brain works structurally, Professor Dennis says the emergence of real time sensing and 'big data' is a revolutionary tool. Because instead of only giving us a view of our minds from the inside, he says it offers an unprecedented look at what is going into our minds from the outside. This data can show us how we live and think.

### MOVING BEYOND THE LAB

Previously, psychologists have been limited to understanding their clients through clinical testing and consultations. Given the environment where these interactions take place, it's difficult to accurately capture a person's lived experience. Feedback can be stilted or unreliable due to the artificial surroundings of a lab, with clients often forgetful or telling researchers what they think we want to hear. Some conditions are even associated with forgetfulness, such as bipolar and schizophrenia, further complicating this model.

Experience sampling like this isn't new, but 'wearable sensing' takes it to a whole new level. The advantage of sensors is that they allow passive experience sampling, which means that the data isn't compromised by the person wearing it having to stop and act. They can just be themselves.

In a system developed by Professor Dennis and IFTTT, an activity tracker is being used by people living with bipolar via their mobile devices. The app will indicate if the participant isn't sleeping and uses GPS to show that they leave the house. Intermittent microphone can even indicate that they haven't spoken to anyone. Each of these factors may signal a manic episode.

For legal and privacy reasons, audio is limited to intermittent grabs and is scrambled so the researcher only knows whether someone is speaking, not what they're saying. Similarly, researchers are only able to see that emails, text messages and phone calls have been logged – they don't have access to the content.

### **SENSORS AND SOCIAL MEDIA**

Associate Professor Amy Perfors, is leading another project about sensors and the monitoring of online social behaviour through platforms like Facebook and Twitter.

Associate Professor Perfors says that "by knowing what an individual's actual experience is, we will be able to model how people interact in order to understand what makes them decide to talk to someone, what they decide to share with someone, what they learn from each other, what social structures lead to knowledge exchange... We can delve into some deep questions."

In combination with experience sampling, social media platforms can create a rich stream of data that can be aggregated and mathematically modelled to draw out patterns. This data is valuable for researchers who are interested in how people interact socially and acquire and use language.

### **USING DATA FOR GOOD**

"People are social and we create each other's environments and culture. [Our tools] can capture the input that is shaping our behaviour and will eventually enable psychologists to better understand how it all happens," Associate Professor Perfors says.

Our mobile devices know us intimately. If this data can be harnessed so that we can know more about the ways we behave and think, we'll be able to understand our interior lives like never before. The researchers at the CHD Hub are dedicated to using their discoveries for good, translating them into action to affect real change in our communities.

