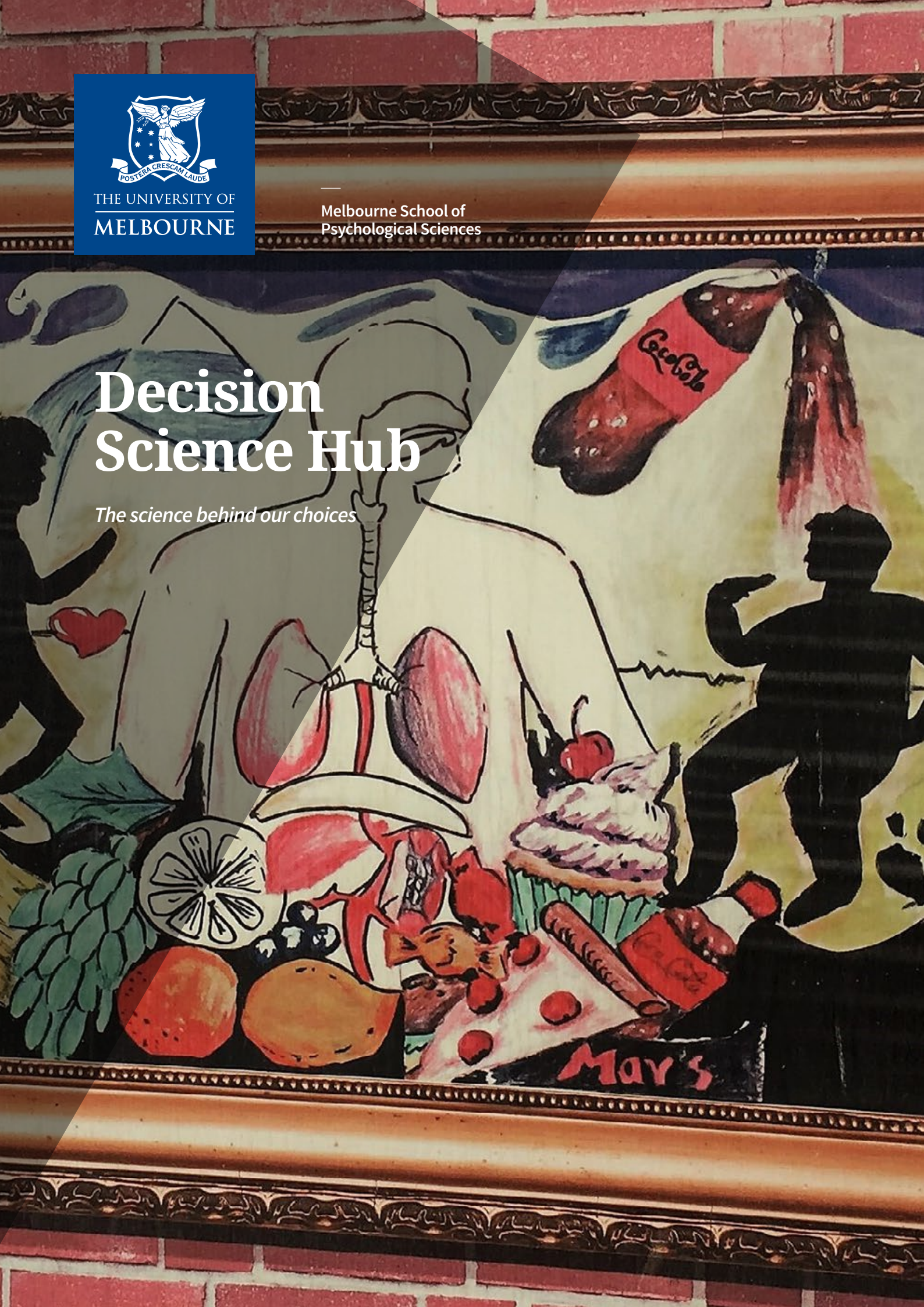
THE UNIVERSITY OF MELBOURNE

Melbourne School of Psychological Sciences

Decision Science Hub

The science behind our choices



WHAT IS DECISION SCIENCE?

From healthy eating to addiction, from saving for retirement to saving electricity — decision-making is an ever-present part of our daily lives and a crucial component of many of today's most pressing problems. The study of decision-making also provides fundamental insights into how the mind moves from perceiving the world to acting in it.

Accounts of decision-making have stimulated debate and research for centuries, spanning across a variety of disciplines including psychology, economics, law, philosophy, sociology, politics, and more recently neuroscience, computer science and artificial intelligence.

Even seemingly simple decisions, such as deciding whether a person in the street is a stranger or an acquaintance, require our brains to conduct complex computations that draw on an enormous amount of information. Despite this complexity, humans and other animals are often able to make choices with astounding speed and efficacy, often in spite of imperfect or incomplete information.

On the other hand, in certain circumstances, we are prone to irrational or harmful choices. We prefer products that are "95% fat-free" to those that are "5% fat". Rare threats such as shark attacks or terrorist violence provoke greater fear than far more prevalent threats such as heart disease or traffic accidents. We tend to pursue small short-term gains that lead to large long-term harms, such as excessive gambling, drinking or shopping. Emotional states like anger or stress may influence how we make unrelated decisions about what we eat, or the speed at which we are driving.

The Decision Science Hub is an initiative supported by the Melbourne School of Psychological Sciences that provides an interdisciplinary platform for studying decision-making. We engage with partners from across different disciplines at the University of Melbourne, research institutes, government, the healthcare sector and industry.

Our research aims to answer fundamental and scientific questions about how our minds and brains solve decision problems, the circumstances in which we are prone to certain biases, or how we process basic perceptual information necessary to make decisions. In addition to pursuing the fundamental science of decision-making, our research investigates the decisions we make in our day to day lives. Many of the major chronic health challenges that Australia will face in the next 25 years, including mental health, obesity, addiction, cardiovascular health and cancer, involve a lifetime of implicit and explicit decisions. The same is true for the important personal life challenges, such as saving for retirement, buying a house, balancing career and family, or pursuing an education. Decision-making is also at the core of engaging with technology, for example, driving cars or flying planes, and at all levels of the institutions that are the major building blocks of our society – politic, markets, or the military. This understanding of decision-making at both a fundamental level and in applied settings will enable intervention strategies and innovations that deliver significant community benefits.

ENGAGE WITH US

We welcome community and industry participation and seek to enable our partners to leverage our expertise in decision science.

The Decision Science Hub is a highly active, collaborative, and internationally networked group of researchers who foster and lead rewarding partnerships world-wide.

Whether you are interested in sponsoring a research project, or forging a long-term strategic alliance, we'll help you launch a successful and rewarding collaboration with researchers who are leaders in their fields.


BRAMSHAW CP

OUR RESEARCH

The Decision Science Hub provides a platform to explore decision-making at all levels, from characterising how the brain represents the outcomes of our decisions, how public policy can support healthy choices, to improving decision technology.

DECISION NEUROSCIENCE LABORATORY

The Laboratory investigates the neural and cognitive mechanisms underlying perceptual, reward-based, voluntary and change-of-mind decisions, as well as preference formation, decision confidence, health decisions, decision errors, and related cognitive processes. Research in the Decision Neuroscience Laboratory examines decision situations in which people do not have clear preferences: How are decisions encoded in the brain? How do we make decisions when the choice options are equally likely or valuable? How do we change our mind? How does context bias preferences or judgements outside of the decision-makers‘ awareness? When do people prefer to sample information? We also investigate the cognitive and neural basis of health decisions and how we can encourage people to make better dietary decisions.

dlab.unimelb.edu.au

COGNITIVE NEUROIMAGING LABORATORY

The implementation of cognitive control by the human brain is critical to a range of everyday activities, and the failure of this mechanism is believed to contribute to the symptom profile of a number of clinical conditions.

The aim of this research is to examine the psychological processes, and the neural mechanisms underlying them, which signal the requirement for implementation of greater cognitive control. This research involves the study of these processes in both healthy adults (across the lifespan) and a range of clinical groups.

psychologicalsciences.unimelb.edu.au/research/msps-research-groups/cognitive-neuroimaging-laboratory

VISION AND ATTENTION LABORATORY

Work in our Laboratory seeks to explain how colour, motion, and attentional mechanisms operate within the visual system. The Vision and Attention Laboratory employs a diverse range of approaches including behavioral psychophysics, computational modeling, and electrophysiology.

psychologicalsciences.unimelb.edu.au/research/msps-research-groups/vision-and-attention-laboratory

DECISION-MAKING & AFFECTIVE LEARNING IN EMOTIONAL CONDITIONS (DALEC)

This Laboratory focuses on those things that make us most like robots (i.e., algorithmic approaches to learning and decision-making) and least like robots (i.e., developing capacities for introspection and insight of self-concept via meditation research) - hence DALEC Lab. The DALEC Laboratory’s goals in this research are to understand the human condition and to use the understanding to mitigate maladaptive functioning and increase adaptive functioning.

Their key research areas include neurobehavioral basis and assessment of high-prevalence psychiatric disorders (i.e., anxiety, depression, substance use), and conceptualizations and implementations of mindfulness (especially in relation to high-prevalence psychiatric disorders).

psychologicalsciences.unimelb.edu.au/research/msps-research-groups/dalec-lab

PERCEPTION AND PHARMACOLOGY LABORATORY

The majority of the research in this Laboratory focuses on two questions:

- How does the brain‘s natural chemicals control complex behaviours, thoughts and perceptions?
- What are the factors that determine the contents of an individual‘s conscious experience?

They consider these questions both from the perspective of understanding the underlying neurobiological mechanisms involved and also in respect to the neuroethical issues associated with advances in neuroscientific knowledge and drug/technology development.

psychologicalsciences.unimelb.edu.au/research/research-initiatives/our-work/perception-and-pharmacology-lab

TIME IN BRAIN AND BEHAVIOUR LABORATORY

The Timing-Lab investigates time in the brain, from a neural, cognitive, and behavioural perspective. How does our brain function in real-time, despite its own internal processing delays? We use computational methods and neuroimaging techniques, particularly multivariate EEG decoding, as well as psychophysical and behavioural approaches, to study how the brain works over time.

timinglab.org

ATTENTION DYNAMICS LABORATORY

The Attention Dynamics laboratory is interested in the way infants, children, and adults focus and maintain attention on one task amidst a sea of choices. Their group uses a variety of neuroscience methods, including eye-tracking, response time, EEG, and behavioural analyses to further our understanding of these processes. They research the cognitive and physiological differences associated with developmental disorders, including Attention Deficit Hyperactivity Disorder (ADHD) and Autism Spectrum Disorder (ASD). They also examine how children in the classroom are able to concentrate and listen to the teacher, the association between everyday forgetful events and memory processes and the development of early attention and memory processes in infants.

psychologicalsciences.unimelb.edu.au/research/msps-research-groups/attention-dynamics-lab

GENES, BRAIN AND BEHAVIOUR LABORATORY

The Genes, Brain and Behaviour Laboratory focuses on understanding how our genes affect our experience of the world. The group uses a wide range of techniques spanning molecular genetics, cognitive neuroscience and psychology to investigate the genetic basis of behaviour and brain function. Their research examines normal variation between individuals, as well as disorders including autism and schizophrenia. By revealing the links between genes, brain and behaviour, they aim to cast new light on the architecture and development of the mind.

psychologicalsciences.unimelb.edu.au/research/msps-research-groups/gbb/gbb-lab

COGNITIVE NEUROSCIENCE LABORATORY

The Cognitive Neuroscience Laboratory study the behavioural and physiological responses to visual stimuli (msec reaction time, EEG, eye tracking, pupil responses) and the effects of electrophysiological stimulation on behavioural and physiological responses to visual stimuli. They model the relationship between visual input, and behavioural and physiological responses.

psychologicalsciences.unimelb.edu.au/research/msps-research-groups/cognitive-neuroscience-laboratory

COGNITIVE NEUROSCIENCE AND COMPUTATIONAL PSYCHIATRY LABORATORY

The research conducted by the Cognitive Neuroscience and Computational Psychiatry Laboratory is theoretically driven by ideas of Predictive Coding, a computational framework that posits the brain is a predictive, efficient and adaptive machine. The main goal of the group is to understand how the brain's circuitry implements these mechanisms, which enable them to make predictions about future events as well as learn about, and adapt to, the contingencies of a novel environment. Along with their work on typical cognition in healthy human individuals, their mission is to contribute to the understanding of mental illness, in particular to those conditions where predictive processes and brain circuitry are disrupted such as in schizophrenia and anxiety. To pursue this endeavour, the team use a combination of computational modelling, machine learning and brain imaging techniques such as magnetoencephalography (MEG), electroencephalography (EEG), and magnetic resonance imaging (MRI).

psychologicalsciences.unimelb.edu.au/research/msps-research-groups/C2NP/lab

OUR PEOPLE

DIRECTOR

Associate Professor Stefan Bode

Director, Decision Science Hub

Stefan is a psychologist with an interest in the neural and cognitive mechanisms underlying human decision-making. His research team investigates the neural and cognitive mechanisms underlying perceptual, reward-based, voluntary and change-of-mind decisions, as well as preference formation, decision confidence, health decisions, decision errors, and related cognitive processes. He is also interested in research questions related to behavioural change, emotion regulation and global health. His research integrates a variety of methods from experimental psychology, including reaction time experiments in the laboratory, cognitive modelling, response force measurements and other decision behaviour, as well as cognitive neuroscience, including functional magnetic resonance imaging (fMRI), electroencephalography (EEG), and transcranial magnetic stimulation (TMS). He has developed the Decision Decoding Toolbox (DDTBOX), a multivariate analysis toolbox for EEG data, that can be used to investigate the neural basis of decision-making and other cognitive processes.

sbode@unimelb.edu.au

MEMBERS

Professor Rob Hester

Deputy Director, Decision Science Hub

Rob's research examines the psychological and neural bases of executive functions, specifically self-control and performance monitoring. Rob is the director of the Cognitive Neuroimaging Laboratory at the Melbourne School of Psychological Sciences. The lab's research is focussed on how healthy people control their impulsive decisions towards rewarding stimuli. Similarly, they are interested in how they detect, and/or use negative feedback, to flexibly adapt their behaviour. They have also applied this research to examining dyscontrol and failures of error awareness in clinical conditions (such as drug dependence), where failures of control are central to the clinical symptomatology.

hesterr@unimelb.edu.au

Associate Professor Olivia Carter

Olivia is interested in the neurobiological factors that determine an individual's conscious experience. She heads the Perception and Pharmacology Laboratory within the Melbourne School of Psychological Sciences where the bulk of her research focuses on the impact of neurotransmitter systems on cognitive and perceptual function in healthy individuals. Clinically, her research focuses on altered cognitive and perceptual function in psychiatric populations. She also has an interest in neuroethics, particularly in relationship to cognitive enhancing agents and technologies.

ocarter@unimelb.edu.au

Professor Philip Smith

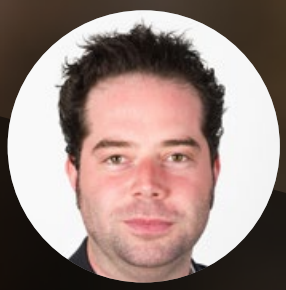
Philip is Professor of Quantitative and Mathematical Psychology and a former editor of the Journal of Mathematical Psychology. His research is concerned with the decision processes that are involved in translating perception into action. These kinds of decisions are ubiquitous in daily life. Deciding whether to stop or go when a traffic light changes and deciding whether a person in the street is a stranger or an acquaintance are two examples of the kinds of decisions we make rapidly and effortlessly many times a day. While they seem simple and effortless, these decisions are complex computationally and neurally. To solve the problem represented by the decision task computationally, the brain must be able to answer the questions: "what is it" and "what should I do about it?" This requires that processes of perception, attention, memory and decision making cooperate to form a representation of the external world and act on it to produce a behavioural response.

philipls@unimelb.edu.au

Associate Professor Katherine Johnson

Katherine is a developmental cognitive neuroscientist with an interest in attention and concentration. Katherine leads the Attention Dynamics laboratory. This lab uses a variety of methods to measure focus and attention control in infants, children, and adults. Her clinical research interests include measuring the cognitive and physiological differences associated with children and adults with Attention Deficit Hyperactivity Disorder (ADHD) and autism spectrum disorder (ASD) compared with typically developing children and adults. Katherine and her laboratory members are interested in examining the effects of exposure to nature on mental well-being and concentration, and the development of memory and attention in infants.

kajo@unimelb.edu.au



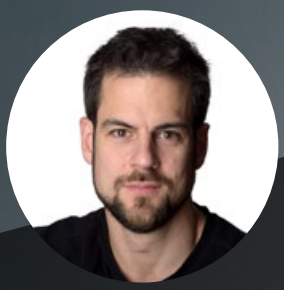
Dr Patrick Goodbourn

Patrick is a cognitive neuroscientist and geneticist. His research aims to understand how genes affect the structure and function of the brain, and how this in turn affects behaviour. His primary interests are in normal and disordered perceptual, psychomotor, and decision-making processes. Patrick's Genes, Brain and Behaviour Laboratory investigates the genetic basis of inter-individual variation in human visual and motor processing, incorporating both behavioural and electrophysiological assessments. He is also using gene editing in zebrafish to characterise the behavioural, physiological, and anatomical consequences of human genetic associates of visual abilities, particularly those also implicated in psychological disorders.

p.goodbourn@unimelb.edu.au

OUR PEOPLE

MEMBERS



Dr Hinze Hogendoorn

Hinze's primary research interests lie in visual time perception. In his laboratory, they study how time is encoded in the brain, and how the brain keeps track of time. They are especially interested in how the brain solves the computational problems that result from the fact that neural transmission and processing itself takes time.

hhogendoorn@unimelb.edu.au

Dr Nicholas van Dam

Nicholas's research interests centre on the use of cognitive neuroscience methods, decision science, and computational psychology/psychiatry to better understand and delineate high-prevalence symptoms across the spectrum from normal to pathological with a critical focus on value-based decision-making processes. His primary translational research objective is to advance the understanding of the clinical phenomenology and neurobiology of mood and anxiety disorders, as well as discrete domains that are commonly observed among these conditions (e.g., suicidality, approach vs. avoidance behaviours).

He aims to better understand these conditions (and the range of normal to abnormal behaviours that underpin them) through a combination of advanced psychometrics, experimental manipulation, functional magnetic resonance imaging (fMRI), and computational modelling.

nicholas.vandam@unimelb.edu.au

Dr Simon Cropper

Simon is a teaching and research academic in the area of human sensation and perception. He has worked in both physiology and psychology departments in the UK, Canada and Australia. His primary research interests lie in colour perception, motion perception, time perception and individual differences in perception and problem solving. Experimentally, he adopts behavioural and computational approaches and has a strong interest in durable rigorous methodology.

scropper@unimelb.edu.au

Dr Daniel Feurriegel

Daniel is a cognitive neuroscientist and Decision Science Research Fellow. His research program is focused on how our decisions are shaped by our prior choices and experiences, and how we regulate our decision making strategies following adverse or unexpected events. To investigate how decisions are implemented in the circuitry of the brain, Daniel uses neuroimaging techniques such as electroencephalography (EEG) and magnetic resonance imaging (MRI) in combination with computational modelling and machine learning. He is also interested in how our prior knowledge and expectations are encoded in the human visual system, and how we use this knowledge to rapidly detect strange or significant events in our environment. In addition to basic research, he is also involved in projects investigating how modifiable risk factors, such as malnutrition in infants or cardiovascular health in old age, influence our brain function and decision making.

daniel.feuerriegel@unimelb.edu.au

Dr Jason Forte

Jason is a cognitive neuroscientist interested in visual processing, numerical cognition and noninvasive brain stimulation. Jason's research utilises behavioural (msec reaction time), physiological (EEG, eye-tracking, pupil responses) and mathematical methods to examine and understand how we process visual and quantitative information. His research has also explored the effects (and non-effects) of non-invasive brain stimulation techniques such as tDCS.

jdf@unimelb.edu.au

Dr Simon Lilburn

Simon studies attention, memory, and decision making within the Vision and Attention Laboratory. He is particularly interested in how the measurement and precision afforded by examining low-level visual behaviour can provide a means of posing and answering questions about higher order cognitive phenomena, such as memory. The focus within his laboratory is on the construction of mathematical models which describe constraints within the visual system and the properties of decision making.

lilburns@unimelb.edu.au

Associate Professor Marta Garrido

Marta leads the Cognitive Neuroscience and Computational Psychiatry Laboratory at the Melbourne School of Psychological Sciences, at The University of Melbourne, and is Chief Investigator in the Australian Research Council Centre of Excellence for Integrative Brain Function. Marta received her PhD in 2008 from University College London and did postdocs at University California Los Angeles and back at University College London. In 2013 she moved to the Queensland Brain Institute, at the University of Queensland, on a Discovery Early Career Researcher Award where she later established her independent laboratory. In mid-2019 the lab moved to the University of Melbourne. Marta's team uses a combination of brain imaging techniques and computational modelling to understand the neural underpinnings of learning and decision making both in typical individuals as well as in people with psychiatric disorders.

marta.garrido@unimelb.edu.au

CASE STUDY

Would graphic warnings on unhealthy food make you think again?

A new study shows that health warnings on packaged foods can help us make healthier choices – but it's negative messaging that really drives the point home.

Strategically placed junk food on display at the supermarket checkout has little to recommend it to the smarter parts of our brains. But to our impulsive side, taste is all that matters. We may avoid the confectionary aisle but we have to pass through the checkout where our impulses can be overwhelmed by the lure of the sugar fix.

Decision Science Hub Director Associate Professor Stefan Bode says the checkout trick is just one of many 'environmental cues' that food companies use to market their products, from packaging to lifestyle messages and popular culture.

But how alluring would that chocolate be if the packaging was slapped with a picture of decaying teeth or a diseased heart?

New research by the Decision Science Hub and Cancer Council Victoria (CCV), published in both NeuroImage: Clinical and Appetite, suggests that just like warnings on cigarette packaging, when it comes to junk food – the more graphic and negative the message is the better. But they also found that positive imagery or negative text-only warnings can work too.

TACKLING RISING OBESITY

Rates of obesity worldwide have almost tripled since 1975. Around 13 per cent of adults are now obese the world over, and 39 per cent are overweight.

The epidemic is worse in richer countries (OECD) where nearly 20 per cent of adults are obese. Beyond hypothetical surveys there isn't enough research into what sort of food labelling would be the most effective.

Researchers developed a unique experiment where hungry patients received portions of food that matched their choices before and after viewing health warnings.

"Most of the research in this area is based on surveys where researchers ask people whether they think various messages would change their behaviour, but we know there can be a massive mismatch between people's intentions and their actual behaviour," says Associate Professor Bode.

COMPARING WARNINGS

The Decision Science Hub and Cancer Council Victoria research team recruited 95 participants who hadn't eaten for at least four hours to watch a screen-based experiment. Afterwards they could have a snack food that matched their preference.

Each participant was then shown colour pictures of 50 snack foods ranging from chips, chocolate bars and biscuits, to nuts, fruits, and vegetables. They were asked to rate on a scale how much they would like to eat each food at the end of the experiment.

Participants were then shown 10 health warnings from one out of five possible categories: text-only positive messages, text-only negative messages, positive text and graphic messages, negative text and graphic messages, and lastly, messages that only showed scrambled images and unreadable text as a control.

In reversal, they had to rate health foods in the same way. This was to see if the health warning had influenced their preferences. The research found that neither the control messages nor the positive text-only messages had any impact.

However, negative text-only messages, and imagery combined with positive text were both effective in encouraging people to revise their initial choice for a healthier option. But the strongest effect was observed for negative text combined with imagery. It was twice as effective in making people change their minds as the other messages.

To try and better understand what was going on in the brain when people evaluate foods after seeing health messages, the researchers also monitored participants' brain activity using non-invasive electroencephalography (EEG), in which electrodes are attached to the head.


Carrot Cake £3.50

CONTACT US

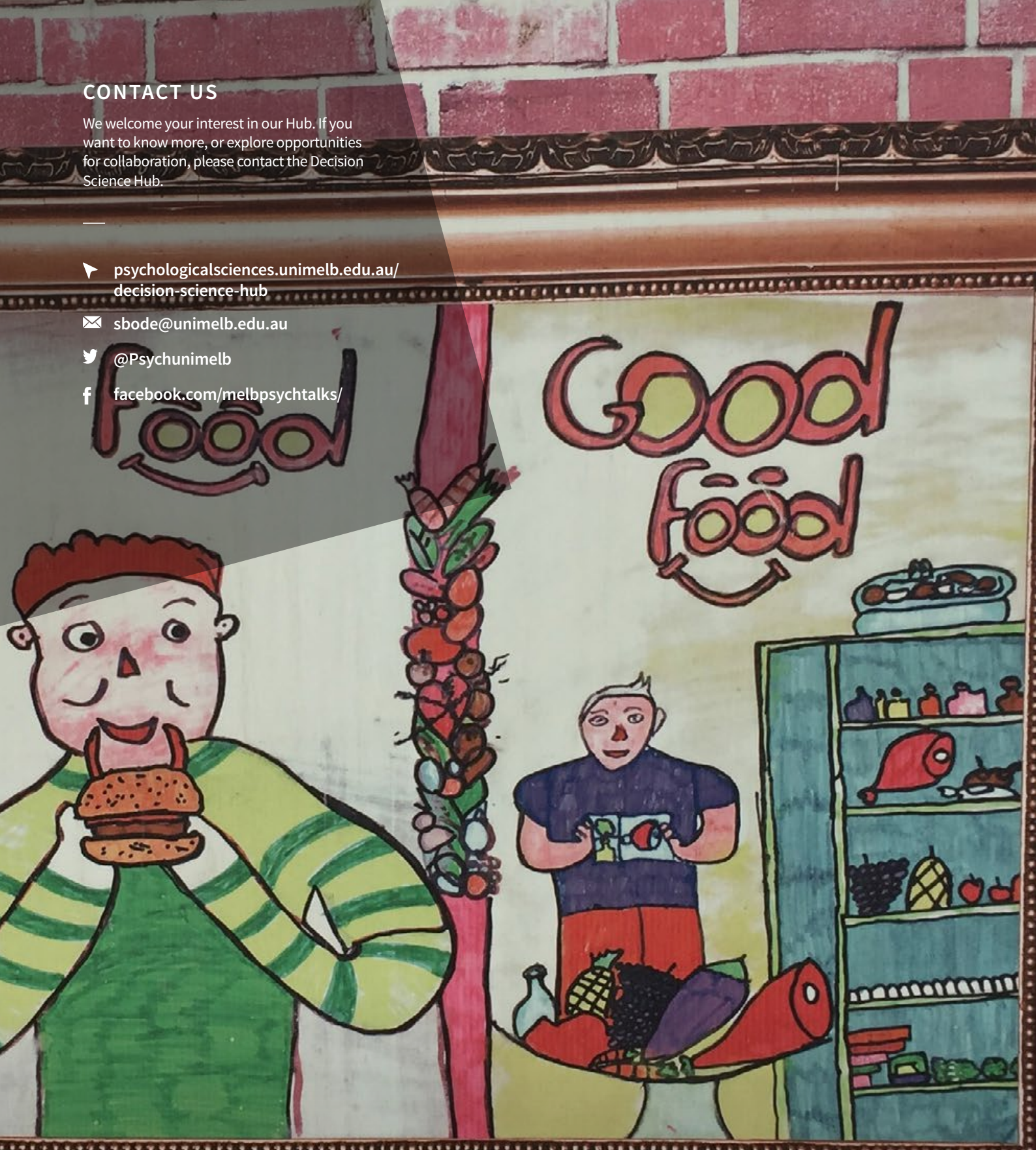
We welcome your interest in our Hub. If you want to know more, or explore opportunities for collaboration, please contact the Decision Science Hub.

psychologicalsciences.unimelb.edu.au/decision-science-hub

sbode@unimelb.edu.au

@Psychunimelb

facebook.com/melbpsychtalks/



THE UNIVERSITY OF MELBOURNE

CRICOS Provider Code: 00116K