Dear Colleagues and Friends,

It is our great pleasure to welcome you all to beautiful Shoal Bay – a favourite destination for many Novocastrians, and one that we are delighted to be able to share with you.

Thank you for making the journey to join us for the 2016 offering of cognitive neuroscience in Australasia. We are looking forward to a great programme, and to hearing about your research.

With deep gratitude, we thank our keynote speakers for their long travel to our shores. We also thank our many sponsors, without whom we could not have hosted this event. Finally, the conference would not be possible without the many loyal ACNS researchers, as well as the ever increasing number of enthusiastic students who become our future cognitive neuroscientists.

On that note, we wish you all a wonderful few days in the Port Stephen’s area, relax and enjoy the Australasian Cognitive Neuroscience Society Conference 2016.

Frini Karayanidis and Juanita Todd
Co-Chairs of ACNS-2016
The 6th Australasian Cognitive Neuroscience Society Conference is hosted by the University of Newcastle. ACNS-2016 is being held at the Ramada Resort, Shoal Bay. The township of Shoal Bay is part of the larger Port Stephens and Hunter Valley areas.

Local Organising Committee

**Chairs:** Frini Karayanidis and Juanita Todd
Pat Michie
Alex Provost
Bryan Paton
Jaime Rennie
Hannah Keage, *University of South Australia, Chair ACNS 2017*
Paul Corballis, *University of Auckland, Chair ACNS 2015*

Conference Support Staff

Christine Torrance
Olivia Whalen
Aaron Wong
Maighan Hassett
Ariel Dunn
Rosemaree Miller
Bronte Speirs

Scientific Committee

Alison Fox, *University of Western Australia, Australia*
Ben Harrison, *University of Melbourne, Australia*
Marc Seal, *Murdoch University, Australia*
Alex Fornito, *Monash University, Australia*
Nadia Solowij, *University of Wollongong, Australia*
Ottmar Lipp, *Curtin University, Australia*
Steve Provost, *Southern Cross University, Australia*
Gina Grimshaw, *Victoria University, New Zealand*
Bruce Christensen, *University of New South Wales, Australia*
Michael Ridding, *University of Adelaide, Australia*
Social Events

ECR Social Events

**Thursday 24 November**

1:00pm  
Meet at Ramada Reception for a hike around the scenic Tomaree National Park.

8:30-11:00pm  
Port Stephens Country Club – No need to preregister; just turn up.

**Welcome Reception**

**Thursday 24 November  6:30-8:30pm**

The Welcome Reception will take place immediately after the opening address and first keynote speaker. This complimentary event will include a full BBQ buffet.

To facilitate catering, please use the buffet in the resort restaurant that corresponds to your dinner ticket.

**Poster Gala**

**Friday 25th November  6:30-8:30pm**

The conference will feature a single poster session in the Whitesands Conference Area. This event will include complimentary canapés and a cash bar will be available for drinks.

**Conference Dinner**

**Saturday 26th November  6:30-10:30pm**

The conference dinner will take place at Broughtons at the Bay (https://www.broughtonsatthebay.com.au/).

Broughtons is located on the top floor at d’Albora Marinas Nelson Bay, overlooking the pristine waterways of Port Stephens.

Tickets are $90 for a 2-course meal, canapés on arrival and one free drink. Limited number of additional tickets available. Please check at Registration Desk.

Information about transport to and from Broughtons will be provided.
Workshops

Early Career Researcher (ECR) Workshop
Thursday 24th November 9:00 am - noon

Sponsor: ARC Centre for Excellence in Cognition and its Disorders

The ACNS Early Career Researcher Day will take place on Thursday the 24th of November, from 9am to 12:00, with an optional hike around the beautiful Mount Tomaree from 1 to 3pm, and drinks at the Port Stephen Country Club to finish off the day.

The workshop will be focused on the nitty gritty of applying for ECR-related grants, such as the DECRA and NHMRC ECR fellowships, as well as the challenges involved in navigating the early years of one's career, such as balancing a busy research environment with personal commitments. The morning will feature individual researcher talks as well as a panel discussion. This workshop is ideal for those finishing up their PhDs or in the first few years of their postdoctoral career, but all who identify as early career researchers are welcome to attend. There will be multiple opportunities to network with others in a similar stage of their career, during the morning tea break, hike, or at drinks after the conference opening.

Confirmed speakers or panel members at the ECR workshop day will include

- Dr Ian Harding, (Monash University) NHMRC ECR fellow
- Dr Ann-Maree Vallence, (Murdoch University) NHRMC Peter Doherty Research Fellow
- Dr Suresh Muthukumaraswamy, (University of Auckland) (Rutherford Discovery Fellowship
- Dr Hannah Keage, (University of South Australia) NHMRC Mental Health Grant Review Panel and NHMRC ECR Fellow
- A/Prof Frini Karayanidis, (University of Newcastle) Australian Research Council (ARC) College of Experts

Mid-Career Researcher (MCR) Workshop
Thursday 24th November 1:00 – 4:00 pm

We are introducing an MCR workshop that will focus on pathways beyond ECR status. This workshop is targeted towards the transition from senior post-doc to junior faculty, and balancing research, teaching, admin, family etc. Emeritus Professor Pat Michie will moderate the brief presentations by researchers at various levels of seniority followed by discussions and input/questions from the audience.

Speakers & topics:
- Professor Jason Mattingley (The University of Queensland): What activities additional to your research should you engage in and which should you try to avoid?
- Associate Professor Frini Karayanidis (Newcastle University): Experiences of hiring academics: what are we looking for?
- Associate Professor Paul Dux (The University of Queensland): Starting a lab
- Dr Irina Harris (USyd) & Dr Hannah Keage (University of South Australia): Developing lectures without losing research momentum: is it possible?
- Dr Olivia Carter (University of Melbourne) & Dr Muireann Irish (UNSW/NeuRA): Decisions to make: moving between teaching-and-research and sole research positions.
- Dr Ann-Maree Vallence (Murdoch University) & Dr Nicolas Badcock (Macquarie University): Managing yourself, your grants, and other people.

Need more information?
Email Associate Professor Anina Rich:
anina.rich@mq.edu.au
(ANCS president & chair of the MCR organising committee)
On Saturday, we will launch of our new Equity and Diversity Policy, that has been developed by an ACNS working group chaired by Associate Professor Anina Rich (ACNS President) and Professor Jason Mattingley. A/Prof. Rich and Prof. Mattingley will give a brief presentation on the current state of ACNS in terms of gender equity, and an overview of the goals of the policy.

Professor Penny Jane Burke will then give a presentation and officially launch the policy.

Exploring Gender Equity

Professor Penny Jane Burke, Global Innovation Chair of Equity and Director of the Centre of Excellence for Equity in Higher Education at the University of Newcastle

Professor Penny Jane Burke has published extensively in the field including Accessing Education effectively widening participation (2002), Reconceptualising Lifelong Learning: Feminist Interventions (2007, with Sue Jackson) and The Right to Higher Education: Beyond widening participation (2012) and Changing Pedagogical Spaces in Higher Education (2016 with Gill Crozier and Lauren Ila Miaszek). Penny is Editor of Teaching in Higher Education and Access and Widening Participation Network co-Convenor for the Society for Research into Higher Education. Penny has held the posts of Professor of Education at the University of Roehampton, the University of Sussex and Reader of Education at the Institute of Education, University of London.

ACNS Equity Working Group:

Chairs: Anina Rich & Jason Mattingley
Working group: Donna Rose Addis, Olivia Carter, Paul Dux, Muireann Irish, Katherine Johnson, Hannah Keage, Melanie Murphy, Simmy Poonian

Please note that, this is a free but ticketed event. A sit-down lunch will be served in the Promenade room for delegates who have indicated that they want to attend the launch. Some tickets are still available. Please enquire at Registration Desk. Lunch for other delegates will be served in the Whitesands reception area.
Keynote Addresses

Keynote Speaker 1

Thursday 24 Nov - 5.30pm to 6.30pm

Dr David Strayer
Professor, Department of Psychology, University of Utah
Director for the Center for the Prevention of Distracted Driving

The multitasking driver: Why talking to your phone will drive you to distraction

Driver distraction is increasingly recognized as a significant source of injuries and fatalities on the roadway. In fact, naturalistic studies have found that up to 90% of the crashes involved driver distraction in one form or another. Driver distraction can arise from visual/manual interference, for example when a driver takes his or her eyes off the road to interact with a device. Impairments also come from cognitive sources of distraction when attention is diverted from safe operating the vehicle. In the latter case, the driver’s eyes may be on the roadway and their hands on the steering wheel, but they may not be attending to the information critical to safe driving. Concern over distracted driving is growing as more and more wireless devices are being integrated into the vehicle. Working with AAA Foundation for Traffic Safety, we developed and validated a metric of distraction associated with the diversion of attention from driving. Our studies show that the distraction potential can be reliably measured, that cognitive workload systematically varies as a function of the secondary task performed by the driver, and that many activities, particularly newer voice-based interactions in the vehicle, are associated with surprisingly high levels of mental workload. Using the new technology in the vehicle has unintended consequences that adversely affect traffic safety.

David Strayer is a professor of Cognitive Neuroscience in the Department of Psychology at the University. He received his Ph.D. from the University of Illinois@ Urbana-Champaign in 1989 and worked at GTE laboratories before joining the faculty at the University of Utah. Dr. Strayer's research examines attention and multitasking in real-world contexts such as driving an automobile. He has published over 150 scholarly articles in this area and for over a decade has focused on understanding driver distraction stemming from voice-based interaction in the vehicle. Dr. Strayer is a member of the Human Factors and Ergonomic Society, the Psychonomic Society, and is a Fellow of the Association for Psychological Sciences. In 2010, received the University of Utah Distinguished Scholarly and Creative Research Award.

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Keynote Speaker 2

Friday 25 Nov - 9.00am to 10.00am

Dr Rosalyn Moran
Senior Lecturer in Mathematical Neuroscience
Department of Engineering Mathematics, University of Bristol, UK.

Aging under the Free Energy Principle

The neurobiology of aging has, to date, focused on the idea that altered patterns of brain activity in older compared to younger adults during cognitive task performance is a result of compensatory mechanisms for a system under aging pressures. In this talk I will present an alternative view based on the Free Energy Principle, a theory of hierarchical empirical Bayesian inference in the brain (Friston 2013). Bayesian inference is a now ubiquitous framework used to inform the principles of perception, action and decision-making, accounting for how sensory information combines with our own prior beliefs about the world to shape brain activity and behavior. There are many ways that a brain could perform Bayesian inference and the hypothesized scheme under the Free Energy Principle posits a variational algorithm where posterior density estimation is recast as an optimization problem. In this guise the scheme becomes a predictive coding algorithm, with hierarchical structure and attribution of optimization dynamics to particular components of neuronal circuits. I will present evidence from neuroimaging studies of brain circuits (using dynamic causal models) that age-related connectivity changes are commensurate with long-term Free-Energy minimization. I will present work from sensory learning, memory and decision making paradigms that show that the neurobiological implementations of prior beliefs grow stronger in older brains.

Dr Moran’s research investigates how different neurotransmitters & neuromodulatory systems shape the dynamics of neuronal communication in human brain networks by developing Bayesian approaches to brain analysis namely - dynamic causal modeling (DCM). She is a co-author of the academic software package Statistical Parametric Mapping (where DCM is implemented) and serves on its faculty at courses internationally. She is Section Editor at Neuroimage: Clinical (Elsevier) with responsibility for brain connectivity and epilepsy. She is also a member of the Editorial board of Network Neuroscience: MIT Press (Associate Editor) and Computational Psychiatry: MIT Press. Her research is funded by the NIH and the NSF, from grants awarded during her tenure at Virginia Tech Carilion Research Institute.
Cognitive function tends to decline with increasing age. However, there is substantial variability in cognitive performance, such that some older adults show better maintenance of cognition. The Scaffolding Theory of Aging and Cognition (Park & Reuter-Lorenz, 2009) posits that individuals can make use of compensatory neural scaffolding in response to neural challenge in order to maintain cognitive performance. Moreover, the revised model (STAC-r; Reuter-Lorenz & Park, 2014) proposes that lifecourse factors may neurally enrich or deplete brain structure, function, and compensatory scaffolding. The Dallas Lifespan Brain Study (DLBS) and Synapse Project were developed to examine the effects of possible neural depletion and enrichment factors on the brain and cognition. One neural depletion factor that has been a major focus of the DLBS is amyloid deposition. Amyloid is a hallmark of Alzheimer’s disease and is present in around 30% of healthy older adults. Using the DLBS healthy lifespan sample, we have found that greater levels of amyloid are associated with impaired cognitive performance, cognitive decline, hyperactivation in the hippocampus, and decreased activation in frontal and lateral temporal regions. We have also examined the possibility of sustained mental engagement as a neural enrichment factor in the Synapse Project. This experimental evidence indicated that sustained new learning improved episodic memory in older adults. Moreover, engagement led to increased modulation of brain activity and increased neural efficiency in older adults. Although cognition generally declines with age, we show evidence that certain lifecourse factors can modify cognitive trajectories.

I joined the Park Aging Mind Lab at the Center for Vital Longevity in September 2014 and now serve as an Aging Mind Foundation Postdoctoral Fellow. I completed my doctoral training in the Cognition and Cognitive Neuroscience Area of the Psychology Department at the University of Michigan under the guidance of Dr. Patricia Reuter-Lorenz, investigating the consequences and mechanisms of directed forgetting in working memory. At the University of Michigan, I also worked with Dr. Rachael Seidler, using fMRI data to study cerebellar resting state functional connectivity in Parkinson's patients ON and OFF medication, and examining the effect of emotion on motor learning. Prior to my doctoral work, I earned a B.A. with Honors in Psychology and a minor in Biology from Scripps College in Claremont, California. I also completed a Summer Research Experience for Undergraduates (REU) program on the mind and brain at Colorado State University in Fort Collins, CO.
The “Information Age” frequently requires individuals to perform multiple decisions concurrently. Under such multitasking conditions, one must invoke cognitive control processes in order to manage capacity limited attentional resources. Of import, many psychiatric and neurological conditions, along with normal ageing, are associated with compromised functional capacity due to impairments in cognitive control (executive function). Here, I will present evidence from a range of cognitive neuroscience methods (e.g., fMRI, EEG, tDCS) to argue that cognitive control limitations occur because frontoparietal and subcortical (FP-SC) brain regions both serve a broad range of mental functions and are limited information processors. In addition, I will show that training improves multitasking ability by segregating tasks representations in FP-SC regions and that brain stimulation can lead to generalised training benefits for decision-making and multitasking by increasing the rate of evidence accumulation. Collectively, the results shed light on the neuro-cognitive mechanisms of cognitive control limitations and those that underlie the enhancement of associated operations.

A/Prof Paul E. Dux is a psychologist and neuroscientist who received his PhD from Macquarie University and then undertook a postdoctoral fellowship at Vanderbilt University. He is faculty in the School of Psychology at The University of Queensland, where he is currently an ARC Future Fellow. Dux leads a group that studies the cognitive and neural underpinnings of human information-processing capacity limitations in health and disease. Specific interests are the mechanisms of attention and the efficacy of cognitive training and how it changes the brain to improve performance. Dux has published widely, received several early career research awards and attracted funding from both the ARC and NHMRC.
Symposium 1 - NeuroEng: Computational Neuroscience and Neuromorphic Engineering

Sponsored by Compumedics

NeuroEng is a community and meeting place in Australia for researchers with an active interest in computational neuroscience and neuromorphic engineering. There is increasingly a great deal of overlap between the cognitive neurosciences and its more computational and engineering minded sister disciplines. With an aim to foster greater and more fertile collaborations between ACNS attendees and NeuroEng members this symposium will show case some of the exciting work being undertaken by Australian NeuroEng researchers as well as highlight some of the many ways in which we can collaborate.

Chair
Bryan Paton, University of Newcastle

Speakers
Michael Breakspear, QIMR Berghofer Medical Research Institute
Nonlinear models of large-scale brain activity

David Grayden, University of Melbourne
Minimally-invasive intracranial electrodes for brain-computer interfaces

Steven Wiederman, University of Adelaide
A spotlight on attention and prediction in the dragonfly

Paula Sanz Leon, University of Sydney
Neuroinformatics tools for simulating realistic brain activity

Symposium 2 - Neuroethics: When neuroscience meets society

Sponsored by the Australian Research Council Centre of Excellence for Integrative Brain Function

Advances in neuroscience are set to transform our understanding of human cognition and behaviour. They may change how we think about and treat people with behavioural or psychiatric disorders and challenge society's views of decision-making and judgments of moral responsibility. This symposium will cover a selection of these issues currently being examined in Australia:

• Will neurobiological explanations of mental illness reduce the stigma of mental illness and improve access to effective medical treatment?
• How will neuroscience change our judgments of moral or legal responsibility?
• Will cognitive neuroscience challenge our understanding of fundamental human concepts such as personality, identity and gender?
• How should society respond to the use of emerging neurotechnologies to modify cognition or predict behaviour?

Chair
Adrian Carter, Senior Research Fellow and ARC DECRA Fellow
Neuroethics and Policy Group, Monash Institute of Cognitive and Clinical Neurosciences, School of Psychological Sciences, Monash University, and
Director, Neuroethics Program, ARC Centre of Excellence for Integrative Brain Function

Speakers
Olivia Carter, ARC Future Fellow, Melbourne School of Psychological Sciences, University of Melbourne
The role of cognitive neuroscientists in the future of cognitive enhancement

Colin Klein, ARC Future Fellow, Department of Philosophy, Centre for Agency, Values and Ethics, and ARC Centre of Excellence in Cognition and its Disorders (CCD), Macquarie University
Delusions and conspiracy theories: cognitive neuroscience meets corpus analysis

Cordelia Fine, Melbourne School of Business, University of Melbourne
Sex and the City Brain: Rethinking sex, gender and adaptive traits

Nicholas Haslam, School of Psychological Sciences, University of Melbourne, Melbourne, Australia
Misery in the brain: The mixed blessings of neuroscientific understandings of mental illness

Paula Sanz Leon, University of Sydney
Neuroinformatics tools for simulating realistic brain activity
Invited Symposia

Symposium 3 - Recent advances in consciousness research

Sponsored by Sonoray

Consciousness research has recently emerged as a core topic in cognitive neuroscience. Among recent advances, four speakers will present their latest research from both empirical and theoretical studies, from sensory to cognitive processing. The topics include mental imagery, hallucination and dreams, as well as neural correlates of sub-conscious and conscious visual perception, which are investigated with multi-modal methodologies ranging from phenomenology, psychophysics and neuroimaging to computational and theoretical neuroscience. Following the presentations, we will have a panel discussion on recent progress as well as controversies on how to measure subjective consciousness with objective methods.

Chair:
Naotsugu Tsuchiya, Monash University

Speakers:
Joel Pearson, University of New South Wales, Australia
Seeing what's not there and measuring it
Jennifer Windt, Monash University
Questions & Challenges for Future Research
Marta Garrido, The University of Queensland
Detecting unseen change
Naotsugu Tsuchiya, Monash University
Empirical testing of integrated information theory of consciousness

Symposium 4 - Dynamic functional architectures of the human brain

Sponsored by Symbiotic Instruments

Recent advances in neuroimaging have shown that macroscopic functional brain networks reorganize spontaneously and in support of cognitive task demands. Capturing meaningful fluctuations in macroscopic network activity remains, however, a major challenge for modern neuroscience. Likewise, the functional relevance of such fluctuations for adaptive and maladaptive behaviour remains unclear. This symposium will bring together two internationally recognised experts in macroscale connectomics and two talented young researchers. Our speakers will discuss how network dynamics can be measured, linked to fundamental principles of brain function, and associated with behavior. The symposium will also highlight current advances and pitfalls in assessing dynamic changes in brain network activity across time and psychological contexts. Overall, this symposium will provide an introduction to a new paradigm aiming to assess the neural underpinnings of human perceptual and cognitive functions.

Chair:
Luke Hearne, Queensland Brain Institute

Speakers:
Luca Cocchi, QIMR Berghofer Medical Research Institute
Neural decoding of visual information varies with fluctuations in global network efficiency
Luke Hearne, Queensland Brain Institute
Dynamic brain modular architectures supporting higher cognition
Jessica McFayden, The University of Queensland
Dynamic causal modelling reveals a rapid subcortical route to the amygdala in visual and auditory processing
Andrew Zalesky, The University of Melbourne
Time-resolved connectomics
Awards

ACNS offers two types of awards:

1. Student Travel Awards

Sponsored by the ARC Centre of Excellence in Cognition and its Disorders (CCD).

Huge congratulations to our 10 Student Travel Award winners. Each will receive $250 to support their travel to the Shoal Bay. It was a very competitive year, with many fantastic applications submitted. Thank you to all those who applied. Our winners are:

- Alie Male, Murdock University
- Aimee Martin, The University of Queensland
- Amy Maddock, Victoria University of Wellington
- Daniel Feuerriegel, University of South Australia
- Elizabeth Thomas, Monash University
- Jonathan Robinson, Queensland University of Technology
- Julian Matthews, Monash University
- Noam Gordon, Monash University
- Manuela Russo, Queensland University of Technology
- Tijl Grootswagers, Macquarie University

2. Presentation awards

Sponsored by ACNS

Junior post-doctoral researchers and students are also eligible for oral and poster presentation awards. To be eligible for a presentation award, post-docs and students must be:

- A current student (PhD, Masters, Honours, undergraduate) or have graduated with a PhD in the last 12 months
- The presenting (first) author
- A current ACNS student member
- Registered for ACNS2016

Presentation awards will be announced on Sunday 27th November starting at 1:00pm, before the AGM.
## Poster Sessions

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<td>Manuela Russo</td>
<td>Domain specific processing or visual expertise? Exploring the neural mechanisms underlying face processing using electroencephalography.</td>
</tr>
<tr>
<td>47</td>
<td>Kiley Seymour</td>
<td>More than meets the eye: effects of task instruction on direct gaze biases in schizophrenia.</td>
</tr>
<tr>
<td>48</td>
<td>Leah Sharman</td>
<td>Coping through crying.</td>
</tr>
<tr>
<td>49</td>
<td>Maria Soloveva</td>
<td>The quality of visual information modulates response inhibition in the modified stop-signal paradigm.</td>
</tr>
<tr>
<td>50</td>
<td>Branka Spehar</td>
<td>Universal preferences and individual differences in aesthetics: An exploratory comparison between vision and touch.</td>
</tr>
<tr>
<td>51</td>
<td>Maria Viktoria Stuckenberg</td>
<td>Investigation of auditory processing differences with synchronous vs. asynchronous bimodal stimulation.</td>
</tr>
<tr>
<td>Poster #</td>
<td>Presenter</td>
<td>Article Title</td>
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</tr>
<tr>
<td>52</td>
<td>Jamesha Subachandran</td>
<td>Schizotypy and form perception through pooling: an application of the oblique superiority effect.</td>
</tr>
<tr>
<td>53</td>
<td>Philip Sumner</td>
<td>Semantic priming and self-reported thought disorder.</td>
</tr>
<tr>
<td>54</td>
<td>Eric Tan</td>
<td>Neurocognition and formal thought disorder in schizophrenia: do impairment profiles differ between symptoms?</td>
</tr>
<tr>
<td>55</td>
<td>Matthew Tang</td>
<td>Do repetition suppression and expectation have different effects on the fidelity of sensory representations?</td>
</tr>
<tr>
<td>56</td>
<td>Nicole Taylor</td>
<td>Habitual physical activity levels, the P300 and the significance of alpha power.</td>
</tr>
<tr>
<td>57</td>
<td>Christine Torrance</td>
<td>Cognitive improvement during stroke rehabilitation: Spontaneous recovery or practice effects?</td>
</tr>
<tr>
<td>58</td>
<td>Alba Tuninetti</td>
<td>Speech normalisation in EEG: an optimal paradigm?</td>
</tr>
<tr>
<td>59</td>
<td>Sreekari Vogeti</td>
<td>The effect of competition and adaptation on the amplitude of the event-related potential N170.</td>
</tr>
<tr>
<td>60</td>
<td>Grace Wang</td>
<td>The association between internet use and cognition: A pilot study.</td>
</tr>
<tr>
<td>61</td>
<td>Olivia Whalen</td>
<td>The role of infant and maternal factors on the early development of infant cognition.</td>
</tr>
<tr>
<td>63</td>
<td>Royce Willis</td>
<td>EEG Theta/Beta ratio, pro-environmental attitudes, and self-reported pro-environmental behaviour.</td>
</tr>
<tr>
<td>64</td>
<td>Aaron Wong</td>
<td>Replication and effects of practice using cued task-switching paradigm through evidence accumulation model: robust EZ diffusion.</td>
</tr>
<tr>
<td>65</td>
<td>Alix Woolard</td>
<td>The association of infant temperament and maternal pitch contours.</td>
</tr>
<tr>
<td>66</td>
<td>Katie Wykes</td>
<td>Individual differences in binocular rivalry across autistic personality traits.</td>
</tr>
<tr>
<td>67</td>
<td>Ashley York</td>
<td>Top-down modulation of onset capture by feature relationships, within and between feature dimensions.</td>
</tr>
</tbody>
</table>
### Day 1 | Thursday 24 November

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.00 - 10.30</td>
<td><strong>Early Career Research Workshop</strong>&lt;br&gt;<em>Speakers:</em> Ian Harding, Ann-Maree Vallence, Suresh Muthukumaraswamy, Hannah Keage, Frini Karayanidis&lt;br&gt;<em>Sponsor:</em> ARC Centre for Excellence in Cognition and its Disorders</td>
<td>Sea &amp; Star Room</td>
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<tr>
<td>10.30 - 11.00</td>
<td><strong>Morning Tea</strong></td>
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<tr>
<td>11.00 - 12.00</td>
<td><strong>ECR Q&amp;A Session</strong></td>
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<tr>
<td>12.30</td>
<td><strong>Registration Desk Opens</strong></td>
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<tr>
<td>13.00 - 14.30</td>
<td><strong>Mid-Career Research Workshop</strong>&lt;br&gt;<em>Speakers:</em> Jason Mattingley, Frini Karayanidis, Paul Dux, Irina Harris, Olivia Carter, Ann-Maree Vallence&lt;br&gt;<em>Sponsor:</em> ACNS</td>
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<tr>
<td>14.30 - 15.00</td>
<td><strong>Afternoon Tea</strong></td>
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<tr>
<td>15.00 - 16.00</td>
<td><strong>MCR Q&amp;A Session</strong></td>
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<tr>
<td>17.00 - 17.30</td>
<td><strong>Conference Opening</strong>&lt;br&gt;<strong>Welcome &amp; Acknowledgement of Country</strong>&lt;br&gt;Frini Karayanidis &amp; Juanita Todd&lt;br&gt;<strong>Opening Address:</strong> Alan Brichta</td>
<td>WhiteSands Ballroom</td>
</tr>
<tr>
<td>17.30 - 18.30</td>
<td><strong>Keynote 1:</strong> Dr David Strayer, <em>University of Utah.</em>&lt;br&gt;The multitasking driver: Why talking to your phone will drive you to distraction.&lt;br&gt;<em>Chair:</em> David Crewther&lt;br&gt;<em>Sponsor:</em> UON Priority Research Centre for Brain and Mental Health</td>
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<tr>
<td>18.30 - 20.30</td>
<td><strong>Welcome Reception</strong>&lt;br&gt;<em>Sponsor:</em> University of Newcastle</td>
<td>Promenade &amp; Sandyfoot</td>
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<tr>
<td>20.30 - 23.00</td>
<td><strong>ECR Social Drinks</strong></td>
<td>Port Stephens County Club</td>
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### Day 2 | Friday 25 November

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
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<tbody>
<tr>
<td>9.00 - 10.00</td>
<td><strong>Keynote 2:</strong> Dr Rosalyn Moran, <em>University of Bristol.</em>&lt;br&gt;Aging under the Free Energy Principle&lt;br&gt;<em>Chair:</em> Michael Breakspear&lt;br&gt;<em>Sponsor:</em> QIMR Berghofer Medical Research Institute</td>
<td>WhiteSands Ballroom</td>
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<tr>
<td>10.00 - 10.30</td>
<td><strong>Morning Tea</strong></td>
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<tr>
<td>10.00 - 10.30</td>
<td><strong>Open Talks: A1 - Sun Room</strong>&lt;br&gt;<em>Attention, Sensation &amp; Perception 1</em>&lt;br&gt;<em>Sponsor:</em> University of Newcastle</td>
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<td></td>
<td><strong>Open Talks: B1 - Sea &amp; Star Room</strong>&lt;br&gt;<em>Motor Processes</em>&lt;br&gt;<em>Sponsor:</em> University of Newcastle</td>
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<tr>
<td>10.30</td>
<td><strong>Action- and context-based prediction-error signals interact at the P3</strong>&lt;br&gt;Bradley N. Jack&lt;br&gt;<em>University of New South Wales, Australia</em></td>
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<td></td>
<td><strong>Sustained attention as a predictor of antisaccade performance in schizophrenia</strong>&lt;br&gt;Elizabeth Thomas&lt;br&gt;<em>Monash Alfred Psychiatry Research Centre, Alfred Hospital and Monash Central Clinical School</em></td>
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## Day 2 | Friday 25 November

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker</th>
<th>Institution</th>
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<tbody>
<tr>
<td>10.50</td>
<td>Neural processing of visible orientations</td>
<td>Robert P. O'Shea</td>
<td>Murdoch University</td>
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<tr>
<td>11.10</td>
<td>Towards the development of psychosis biomarkers: Functional and structural brain networks in the continuum of psychosis</td>
<td>Lena Oestreich</td>
<td>The University of Queensland</td>
</tr>
<tr>
<td>11.30</td>
<td>Evidence for an effect of stimulus probability in the visual oddball paradigm with Fast Periodic Visual Stimulation</td>
<td>Daniel Feuerriegel</td>
<td>University of South Australia</td>
</tr>
<tr>
<td>11.50</td>
<td>Attention shifting performance in regular cannabis users following prolonged treatment with cannabidiol (CBD)</td>
<td>Nadia Solowij</td>
<td>University of Wollongong</td>
</tr>
<tr>
<td>12.10</td>
<td>Timing is everything: Context-based modulation of sensory inference.</td>
<td>Juanita Todd</td>
<td>University of Newcastle</td>
</tr>
<tr>
<td>12.30</td>
<td>Modulation of spontaneous eye blinks during the stop-signal task.</td>
<td>Ross Fulham</td>
<td>Newcastle University</td>
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<tr>
<td>13:30</td>
<td>The role of cognitive neuroscientists in the future of cognitive enhancement.</td>
<td>Olivia Carter</td>
<td>University of Melbourne</td>
</tr>
<tr>
<td>13:45</td>
<td>Delusions and conspiracy theories: cognitive neuroscience meets corpus analysis</td>
<td>Colin Klein</td>
<td>Macquarie University</td>
</tr>
<tr>
<td>14:00</td>
<td>Sex and the City Brain: Rethinking sex, gender and adaptive traits</td>
<td>Cordelia Fine</td>
<td>The University of Melbourne</td>
</tr>
<tr>
<td>14:15</td>
<td>Misery in the brain: The mixed blessings of neuroscientific understandings of mental illness</td>
<td>Nicholas Haslam</td>
<td>The University of Melbourne</td>
</tr>
<tr>
<td>14:30</td>
<td>A spotlight on attention and prediction in the dragonfly</td>
<td>Steven Wiederman</td>
<td>The University of Adelaide</td>
</tr>
<tr>
<td>14:30</td>
<td>Neuroinformatics tools for simulating realistic brain activity</td>
<td>Paula Sanz-Leon</td>
<td>University of Sydney</td>
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<tr>
<td>15.00</td>
<td>Panel Discussion</td>
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<tr>
<td>15.00</td>
<td>Afternoon Tea</td>
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**Symposium A1: Sun Room**

**Neuroethics: When neuroscience meets society**
*Sponsor: ARC Centre for Excellence in Cognition and its Disorders*

**Chair: Adrian Carter**

- The role of cognitive neuroscientists in the future of cognitive enhancement.
  - Olivia Carter
  - University of Melbourne

**Delusions and conspiracy theories: cognitive neuroscience meets corpus analysis**
- Colin Klein
  - Macquarie University

**Sex and the City Brain: Rethinking sex, gender and adaptive traits**
- Cordelia Fine
  - The University of Melbourne

**Misery in the brain: The mixed blessings of neuroscientific understandings of mental illness**
- Nicholas Haslam
  - The University of Melbourne

**Panel Discussion**

**Symposium B1: Sea & Star Room**

**NeuroEng: Computational Neuroscience and Neuromorphic Engineering**
*Sponsor: Compumedics*

**Chair: Bryan Paton**

- Nonlinear models of large-scale brain activity
  - Michael Breakspear
  - QIMR Berghofer Medical Institute

- Minimally-invasive intracranial electrodes for brain-computer interfaces
  - David Grayden
  - The University of Melbourne

- A spotlight on attention and prediction in the dragonfly
  - Steven Wiederman
  - The University of Adelaide

- Neuroinformatics tools for simulating realistic brain activity
  - Paula Sanz-Leon
  - University of Sydney

**Panel Discussion**

**Fast Talks A1: Sun Room**
*Sponsor: UON Priority Research Centre for Brain and Mental Health*

**Fast Talks B1: Sea & Star Room**
*Sponsor: UON Priority Research Centre for Brain and Mental Health*
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Chair - Muireann Irish</th>
<th>Chair - Bill Budd</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:30</td>
<td>Shepard tones test prediction: Amplitude of mismatch negativity is determined by the size of prediction error</td>
<td>Alicia Lawrinson&lt;br&gt;Murdoch University</td>
<td>Visual processing: conscious until proven otherwise&lt;br&gt;Tarryn Balsdon&lt;br&gt;University of New South Wales, Australia</td>
</tr>
<tr>
<td>15:40</td>
<td>An ERP study investigating memory-theory and predictive-coding of visual mismatch negativity (vMMN)</td>
<td>Alie Male&lt;br&gt;Murdoch University</td>
<td>See me, feel me: Do bodily-self cues affect visual-tactile asynchrony detection?&lt;br&gt;Robert Keys&lt;br&gt;Macquarie University</td>
</tr>
<tr>
<td>15:50</td>
<td>More than just a face: Expectations about person identity modulate the face-sensitive N170</td>
<td>Anne Overell&lt;br&gt;Queensland University of Technology</td>
<td>Local/global influences on attention orienting across the subclinical autism spectrum&lt;br&gt;Melanie Murphy&lt;br&gt;La Trobe University</td>
</tr>
<tr>
<td>16:00</td>
<td>Does sequence foreknowledge or concurrent task affect first impression bias in mismatch negativity (MMN)?</td>
<td>Jade Frost&lt;br&gt;University of Newcastle</td>
<td>Examining the symptomology network of ADHD: A new way to view ADHD symptoms.&lt;br&gt;Tim Silk&lt;br&gt;Murdoch Childrens Research Institute</td>
</tr>
<tr>
<td>16:10</td>
<td>Differences in first-impression bias patterns to spatially distinct monaural and binaural sounds</td>
<td>Kaitlin Fitzgerald&lt;br&gt;University of Newcastle</td>
<td>A shared autism and schizophrenia spectrum trait phenotype may be marked by increased glutamate/GABA ratio.&lt;br&gt;Talitha Ford&lt;br&gt;Swinburne University of Technology</td>
</tr>
<tr>
<td>16:20</td>
<td>Beyond brain decoding: Searching for information in the brain that also predicts behaviour</td>
<td>Tijl Grootswagers&lt;br&gt;Macquarie University</td>
<td>Are two brains better than one? Evidence of neural synchrony across co-actors in a visually guided movement task&lt;br&gt;Angela I. Renton&lt;br&gt;The University of Queensland</td>
</tr>
<tr>
<td>16:30</td>
<td>Electrophysiological response to duration deviants in Schizotypy</td>
<td>Roshini Randeniya&lt;br&gt;Queensland Brain Institute</td>
<td>Individuals with higher autistic-like traits show reduced face-inversion, but increased car-inversion effects in Saccadic choice tasks&lt;br&gt;Robin Laycock&lt;br&gt;RMIT University</td>
</tr>
<tr>
<td>16:40</td>
<td>Statistical Learning of Irrelevant Visual Information is Disrupted by Electrical Stimulation of Frontoparietal Cortex</td>
<td>Abbey Nydam&lt;br&gt;The University of Queensland</td>
<td>Decoding the nonconscious dynamics of thought generation&lt;br&gt;Roger Koenig&lt;br&gt;University of New South Wales, Australia</td>
</tr>
<tr>
<td>18.30 - 20.30</td>
<td>Poster Gala Session  &lt;br&gt;Finger food will be served; Cash Bar available</td>
<td></td>
<td>WhiteSands Ballroom</td>
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</tbody>
</table>
### Keynote Lecture 3: Dr Sara Festini and Michelle Farrell, University of Texas at Dallas

**Scaffolding of the Aging Mind: How Neural Depletion and Neural Enrichment Factors Affect Cognition**
*Chair: Anina Rich*
*Sponsor: UON Priority Research Centre for Stroke and Brain Injury*

### 10.00 - 10.30 Morning Tea

### Open Talks: A2 - Sun Room

**Attention, Sensation & Perception II**
*Sponsor: University of Newcastle*
*Chair - Olivia Carter*

#### 10:30
- **Distinct cerebellar contributions to cognitive-perceptual dynamics during natural viewing**
  - Vinh Nguyen
  - QIMR Berghofer

#### 10:50
- **Posterior parietal cortex, where working memory meets selective attention.**
  - Mojtaba Kermani
  - University of Melbourne

#### 11:10
- **Functional mechanisms encoding others direction of gaze in the human nervous system**
  - Colin Palmer
  - University of New South Wales, Australia

#### 11:30
- **Measuring the effects of attention to single fingertips using ultra-high field (7T) fMRI**
  - Alexander Puckett
  - The University of Queensland

#### 11:50
- **Early decision-related information predicts response times: a jackknifing approach for MVPA for ERPs**
  - Stefan Bode
  - The University of Melbourne

### Open Talks: B2 - Sea & Star Room

**Cognition & Decision-making I**
*Sponsor: University of Newcastle*
*Chair - Paul Dux*

#### 10:30
- **Multivariate pattern analysis of event-related potentials predicts the general desirability of objects**
  - William Turner
  - University of Melbourne

#### 10:50
- **Are cognitive processes facilitated by motor demands?**
  - Magnus Liebherr
  - Hochschule Fresenius - University of Applied Sciences

#### 11:10
- **A novel approach to characterising (relatively) complex decision-making using electroencephalography**
  - Dragan Rangelov
  - The University of Queensland

#### 11:30
- **Monoamine alterations in the dorsal striatum and behavioural flexibility in persistent neuropathic pain and acute stress**
  - David Mor
  - University of Sydney

#### 11:50
- **Goal-directed and habit-like modulations of stimulus processing during reinforcement learning**
  - David Luque
  - University of New South Wales, Australia

### 12:10
- **Functional gradients of prefrontal cortex organisation have corresponding oscillatory hierarchies**
  - Patrick Cooper
  - University of Newcastle

### 12.30 - 13.30 ACNS Equity Policy Launch and Lunch (Free, Ticketed Event)
*Sponsor: ARC Centre for Excellence in Cognition and its Disorders*
*Chair: Luke Hearne*  
*Chair: Naotsugu Tsuchiya*

#### 14:00
- **Neural decoding of visual information varies with fluctuations in global network efficiency**
  - Luca Cocchi
  - QIMR Berghofer Medical Institute

#### 14:00
- **From hallucinations to the imagination: Seeing what’s not there and measuring**
  - Joel Pearson
  - University of New South Wales, Australia

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*Day 3 | Saturday 26 November*
### Day 3 | Saturday 26 November

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker(s)</th>
<th>Institution(s)</th>
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<tbody>
<tr>
<td>14:15</td>
<td>Dynamic brain modular architectures supporting higher cognition</td>
<td>Luke Hearne</td>
<td>Queensland Brain Institute</td>
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<tr>
<td>14:30</td>
<td>Dynamic causal modelling reveals a rapid subcortical route to the amygdala in visual and auditory processing.</td>
<td>Jessica McFayden</td>
<td>The University of Queensland</td>
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<tr>
<td>14:45</td>
<td>Time-resolved connectomics</td>
<td>Andrew Zalesky</td>
<td>University of Melbourne</td>
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<tr>
<td>15:00</td>
<td>Panel Discussion</td>
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<td>15.30 - 16.00</td>
<td>Afternoon Tea</td>
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<tr>
<td>16:00</td>
<td>Attentional enhancement of event-related potentials in a multilingual dichotic listening task</td>
<td>Vivian Eng</td>
<td>University of Nottingham Malaysia Campus</td>
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<tr>
<td>16:10</td>
<td>Determinants of variation in rapid temporal processing ability: How do behaviour, function, and structure relate?</td>
<td>Jesse Bourke</td>
<td>University of Newcastle</td>
</tr>
<tr>
<td>16:20</td>
<td>Patterns of sedentary behaviour are associated with cognitive performance and cardiovascular disease risk in mid to late life</td>
<td>Ashleigh Smith</td>
<td>University of South Australia</td>
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<tr>
<td>16:30</td>
<td>Spontaneous Blink Rate in Anorexia Nervosa: Implications for Dopaminergic Activity in Anorexia Nervosa</td>
<td>Andrea Phillips</td>
<td>St Vincent's Hospital</td>
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<tr>
<td>16:40</td>
<td>Transcranial magnetic stimulation reveals distinct implicit learning mechanisms for first-order and second-order sequences</td>
<td>Gillian Clark</td>
<td>Deakin University</td>
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<tr>
<td>16:50</td>
<td>Separable effects of perceptual form and memory on hemispheric lateralisation during spatial memory tasks: An ERP study</td>
<td>Adam Bentvelzen</td>
<td>Macquarie University</td>
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<tr>
<td>17:00</td>
<td>Investigating the developmental course of letter recognition in the brain by varying typeface</td>
<td>Owen Churches</td>
<td>Flinders University</td>
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<td>Fast Talks A2: Sun Room</td>
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<td>Chair - Talitha Ford</td>
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<td>Chair - Paul Corballis</td>
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<td>Decoding dice and digits with Magnetoencephalography: How long does it take to access magnitude?</td>
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<td>Macquarie University</td>
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<td>Pushing attention to one side: Force field adaptation alters attentional processing in the healthy brain.</td>
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<td>University of Newcastle</td>
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<td></td>
<td>Rapid Adjustments of Frontoparietal Networks Underpin Proactive Cognitive Control</td>
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<td>Combinatorial processes of arithmetic and enumeration revealed by subset grouping.</td>
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<td>University of Melbourne</td>
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<td>Decoding voluntary decisions: perception of freedom is dependent on keeping your options open</td>
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<td>The University of Queensland</td>
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<td>Trigger Failure in the Stop-Signal Task Triggers</td>
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<tbody>
<tr>
<td>17:10</td>
<td>Cerebral compensation during motor function in individuals with cerebellar degeneration</td>
<td>Ian Harding, Monash University</td>
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<td>Necessity tamed: metacognition in the near absence of attention</td>
<td>Julian Matthews, Monash University</td>
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<tr>
<td>18.30 - 23.30</td>
<td>Conference Dinner</td>
<td>Paid Ticketed Event</td>
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<td>Broughtons at the Bay</td>
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### Day 4 | Sunday 27 November

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<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tr>
<td>9.30 - 10.00</td>
<td><strong>2016 ACNS Young Investigator Award: Dr Paul Dux, The University of Queensland</strong>&lt;br&gt;On the capacity limits of cognitive control and its enhancement: neural mechanisms and transfer&lt;br&gt;<strong>Chair:</strong> Jason Mattingley&lt;br&gt;<strong>Sponsor:</strong> ACNS</td>
<td>WhiteSands Ballroom</td>
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<tr>
<td>10.00 - 10.30</td>
<td><strong>Open Talks: A3 - Sun Room</strong>&lt;br&gt;Cognition &amp; Decision-making II&lt;br&gt;<strong>Sponsor:</strong> University of Newcastle&lt;br&gt;<strong>Chair - Tobias Loetscher</strong></td>
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<td>10.00 - 10.30</td>
<td><strong>Open Talks: B3 - Sea &amp; Star Room</strong>&lt;br&gt;Language, Learning &amp; Memory&lt;br&gt;<strong>Sponsor:</strong> University of Newcastle&lt;br&gt;<strong>Chair - Alex Provost</strong></td>
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<td>10:30</td>
<td>Do cannabis users show differences in brain activity for risk and reward related processing?  &lt;br&gt;Louise Curley&lt;br&gt;The University of Auckland</td>
<td>Morning Tea</td>
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<tr>
<td>10:30</td>
<td>Don’t get too excited: Higher levels of visual cortex excitability predict smaller visual working memory capacities&lt;br&gt;Rebecca Keogh&lt;br&gt;University of New South Wales, Australia</td>
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<td>10:50</td>
<td>Indexing Vascular Cognitive Impairment in the older population using event-related potentials&lt;br&gt;Hannah Keage&lt;br&gt;University of South Australia</td>
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<td>10:50</td>
<td>Distinct cortical contributions to recent and remote autobiographical memory retrieval - a longitudinal neuroimaging study in dementia&lt;br&gt;Muireann Irish&lt;br&gt;University of New South Wales, Australia</td>
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<td>11:10</td>
<td>Neurocognitive correlates of reduced thalamus volume in men who carry premutation expansions of the FMR1 gene.&lt;br&gt;Rachael Birch&lt;br&gt;University of New South Wales, Australia</td>
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<td>11:10</td>
<td>How do you take your language lateralisation: Two lumps or three?&lt;br&gt;Nic Badcock&lt;br&gt;Macquarie University</td>
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<td>11:30</td>
<td>Partial inhibition reveals age-related change during response inhibition in mid-to-late adolescents&lt;br&gt;An Nguyen&lt;br&gt;The University of Western Australia</td>
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<td>11:30</td>
<td>High-intensity Training Enhances Executive Function in Children&lt;br&gt;David Moreau&lt;br&gt;University of Auckland</td>
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<td>11:50</td>
<td>Neuroimaging white matter in attention/deficit-hyperactivity disorder: understanding impulsivity with diffusion tensor imaging&lt;br&gt;Fiore D’Aprano&lt;br&gt;The University of Melbourne&lt;br&gt;Murdoch Children’s Research Institute</td>
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<td>11:50</td>
<td>Using low-cost portable neuroimaging to detect receptive language ability in children&lt;br&gt;Selene Petit&lt;br&gt;Macquarie University</td>
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<td>12:10</td>
<td>Hierarchical Frequency Tagging reveals neural markers of predictive coding under varying uncertainty&lt;br&gt;Noam Gordon&lt;br&gt;Monash University</td>
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<td>12:10</td>
<td>Don’t judge a book by its cover - case of a minimally-verbal Autistic child with excellent receptive and productive language.&lt;br&gt;Alexandra Woolgar&lt;br&gt;Macquarie University</td>
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<td>12.30</td>
<td><strong>Working Lunch</strong></td>
<td>Promenade</td>
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<td>13.00 - 14.30</td>
<td><strong>Annual General Meeting</strong>&lt;br&gt;Includes:&lt;br&gt;Election outcomes &amp; new ACNS executive committee&lt;br&gt;Student and Post-doctoral awards&lt;br&gt;AGM feature event: Sharing insights from ARC and NHMRC panels, Hannah Keage, Frini Karayanidis, Jason Mattingley. Q&amp;A with ACNS members who have recently been on these panels.&lt;br&gt;Introduction to Australian Brain Alliance, Pat Michie&lt;br&gt;<strong>Promenade</strong></td>
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The 6th Australian Cognitive Neuroscience Conference
The majority of people are left lateralised for language processing: when completing a language task, the left hemisphere of the brain is more active than the right. Knowing this is important for surgical procedures to reduce seizures in epilepsy. It may also have implications for the development of language and reading. The methods and tools used to determine language lateralisation have been cross-validated and are considered to be reliable. However, there’s an anomaly when examining the distribution of language lateralisation collected with functional Transcranial Doppler Ultrasound (fTCD) and functional Magnetic Resonance Imaging (fMRI). fTCD produces laterality indices that are readily fitted by two Gaussian distributions: the majority of individuals are left lateralised and a small portion are right. fMRI produces laterality indices that are better fitted with three distributions - left, right, and bilateral. Here we report on two fTCD tasks that contrast easy and hard language production and reception. These tasks put the participants under significant pressure and return laterality indices consistent with the bilateral distribution apparent in fMRI. We question whether stress associated with the fMRI scanner introduces an artefact in some individuals. This may be an important consideration when examining individual differences in language lateralisation.

Visual processing: conscious until proven otherwise
Ms Tarryn Balsdon, PhD Candidate
UNSW Australia
Prof Colin Clifford, UNSW Australia

Unconscious perception, or perception without awareness, describes when an observer has no phenomenal awareness of a stimulus yet their behavior or decisions are still influenced by that stimulus. Perception without awareness is often demonstrated by a difference in thresholds for tasks that do and do not require awareness, for example, a difference in the threshold for detecting the stimulus (requiring awareness) and the threshold for making accurate semantic judgments about the stimulus (based on unconscious perceptual evidence). Although a difference in thresholds would be expected if perceptual evidence were being processed without reaching awareness, the difference does not necessitate that this is actually occurring: a difference in thresholds may also have risen from confound factors in the measurement of thresholds, such as response bias, or because of differences in the tasks used for obtaining thresholds. Here we propose a different tactic for establishing perception without awareness: we ask instead whether the pattern of performance suggestive of perception without awareness could be obtained if the observer used only perceptual evidence that they were aware of in making their perceptual decisions. A backwards masking paradigm was designed based on previous experiments in the literature; using Arabic digits as target stimuli, with task difficulty being controlled by the length of time between target and mask. Performance was measured over three tasks: a detection task, a graphemic discrimination task, and a semantic discrimination task. Despite finding a significant difference in thresholds measured using proportion correct, and significant differences in observer sensitivity for each decision, modelling suggests that these differences were not the result of perception without awareness. That is, the pattern of performance could have been achieved even if the observer was only using conscious information to make decisions.

Distinguishing confounds from true meditation effects: Insights from auditory ERPs
Ms Lydia Barnes, Master of Research Candidate
Macquarie University

Recent studies provide evidence that meditation affects early auditory processing, as measured through auditory ERPs (Cahn & Polich, 2009). However, meditation effects in these studies are difficult to distinguish from experimental confounds introduced by unbalanced condition order and unequal task requirements in meditation and control conditions. Biedermann et al. (2016) reported N1 attenuation during meditation, compared to a mind-wandering control condition for novice meditators. In a series of studies, we investigated the role of meditation and experimental confounds in this design. Experiment 1 replicated the effect (d = -1.18). Experiment 2 tested whether mental state influences (high or low arousal) on repetition suppression were responsible for the effect. Eliminating the opportunity for mental state-induced differences in repetition suppression by reducing the inter-stimulus interval did not eliminate the effect (d = -0.97). Experiment 3 tested whether divergent tone-related instructions in the original experiment acted as a mediator of mental control in the meditation and mind-wandering conditions. Presenting uniform tone-related instructions for both conditions did not eliminate the effect (d = -1.27). Experiment 4 replicated the findings of Experiments 2 and 3 with reduced inter-stimulus interval and uniform instructions (d = -1.92). The N1 attenuated during the meditation condition (second condition) in Experiments 1-4, as in Biedermann et al. (2016). Experiment 5 reversed the order of the experimental conditions so that meditation occurred before the mind-wandering condition. N1 was attenuated during the control condition (d = -0.94). Thus, we conclude that N1 attenuation during first-time meditation, compared to a mind-wandering control condition, is an effect of condition order. These findings have critical implications for the design and interpretation of meditation and early auditory processing research.

Tuning attention to relative features affects early perceptual processes - behavioural and electrophysiological evidence
Dr Stefanie Becker, ARC Future Fellow
The University of Queensland
Dr Josef Schönhammer, University of Geneva
Prof Dirk Kerzel, University of Geneva
Dr Anna Grubert, Durham University

How do we select relevant information from cluttered visual scenes? A widely held belief is that we select important information by tuning attention particular elementary feature values of sought-after items (e.g., red, yellow). However, recent studies showed we often select a target item in a context-dependent manner, by tuning attention to its relative features, that is, to the features that the target has relative to other items in the surround (e.g., redder, yellower). So far, the evidence for this relational account is exclusively based on behavioral studies that do not allow safe inferences about early perceptual processes. The present study provides a critical test of the relational account, by measuring an electrophysiological marker in the EEG of participants (N2pc). In a first experiment, the target could be discriminated from the non-targets by its relative color, as the target and non-target color were always kept constant across trials with a relative account, we found that a pre-cue attracted attention only when it had the same relative color as the target (e.g., redder item), regardless of whether the cues had the same physical color as the target or not (e.g., orange or red). In a second experiment, we investigated whether attention can also be sufficiently biased to the exact target feature value (e.g., orange), by presenting the target in a randomly varying context. The results showed that in this condition, only target-matching orange cues elicited a significant N2pc indicative of attracting attention. Taken together, these results provide the first electrophysiological evidence that attention can modulate perceptual processes differently - in a context-dependent manner versus a context-independent manner, which results in marked differences in the range of colors that can attract attention.
Separable effects of perceptual form and memory on hemispheric lateralisation during spatial memory tasks: An ERP study

Dr Adam Bentvelzen, PhD/Master of Clinical Neuropsychology
Macquarie University

Dr Nicholas Badcock, Macquarie University
Prof Genevieve McArthur, Macquarie University
Prof Greg Savage, Macquarie University

Neuroimaging evidence for material specific hemispheric lateralisation during memory tasks (verbal: left; spatial: right) is usually assumed to reflect differences in the way materials are remembered. Material type and perceptual form are potentially confounded, however, due to a lack of precise stimulus control, but there have been surprisingly few investigations aimed at teasing apart these influences. Furthermore, while neuroimaging methods provide high spatial resolution in investigating hemispheric lateralisation, their low temporal resolution means that they struggle to detect very early perceptual lateralisation effects. In this vein, this study compared the effects of memory-related and stimulus-related processing on lateralisation during memory for different materials (verbal, spatial). Event-related potentials were measured in 20 healthy adults at parietal electrodes during recognition of previously learned verbal materials (letter triplets) and spatial materials (positional arrays) that differed in task-irrelevant perceptual form (standard: form reflected material to-be-remembered; hybrid: form controlled as verbal-spatial composite stimulus). The results showed that spatial memory and spatial form were independently associated with right-lateralisation of the N170 peak. Verbal memory did not show expected left-lateralisation. These findings support previously findings that spatial processing is right-lateralised per se and additionally suggest that right-lateralisation observed during spatial memory tasks is due to separable perceptual- and memory-related components.

Neurocognitive correlates of reduced thalamus volume in men who carry premutation expansions of the FMR1 gene.

Dr Rachael Birch, Lecturer
UNSW Australia

Dr Darren Hocking, La Trobe University
A/Prof Wei Wen, University of New South Wales
Prof Kim Cornish, Monash University
Prof Nellie Georgiou-Karistianis, Monash University
Ms Carolyn Rogers, Hunter Genetics
Prof Julian Trollor, University of New South Wales

Fragile X-associated tremor ataxia syndrome (FXTAS) is an inherited neurodegenerative disorder caused by premutation (PM) expansions of the Fragile X Mental Retardation 1 (FMR1) gene. Recent evidence suggests that thalamus volume loss is associated greater motor symptom severity in male PM carriers, but no study to date has investigated the relationship between thalamus volume and neurocognitive function in this group. This study investigated the relationships between thalamus volume and neurocognitive performance in 19 PM males (aged 26-80 years, 6 with FXTAS) and 24 controls (aged 26-77 years). Neurocognitive function was examined using measures of executive function (Behavioral Dyscontrol Scale), working memory (Letter Number Sequencing), information processing speed (Digit Symbol), and fine motor function (Lafayette Grooved Pegboard). PM males had significantly reduced thalamus volume (P(1,39)=4.418, P<.006), and demonstrated poorer performance on measures of executive function (F(1,39)=9.742, p=.003), working memory (F(1,39)=4.257, p=.046), and information processing speed (controlling for fine motor function, F(1,38)=4.772, p=.035), compared to controls. In PM males, reduced thalamus volume was associated with poorer performance on measures of executive function (r=.833, p<.001), working memory (r=.542, p=.025) and information processing speed (r=.545, p=.024), however the latter was no longer significant after controlling for fine motor function (r=.384, p=.142). No significant associations between thalamus volume and neurocognitive function were found in controls. Collectively, these findings provide the first evidence of associations between thalamus volume and neurocognitive function in male PM carriers. These findings have important implications for guiding future research exploring the use of sensitive measures to determine risk for FXTAS, track symptom progression, and the development of targeted treatments.

Early decision-related information predicts response times: a jackknifing approach for MVPA for ERPs

Dr Stefan Bode, Senior Lecturer / Research Fellow
The University of Melbourne

Dr Hannah Keage, University of South Australia
Mr Daniel Feuerriegel, University of South Australia
Prof Michael Nicholls, Flinders University
Dr Owen Churches, Flinders University

Recently, multivariate pattern classification analysis (MVPA) has been applied to spatially distributed patterns of event-related potential (ERP) data to predict the outcome of upcoming simple decisions. However, the extent to which such early information is directly translated into overt behaviour is an open question. The present study therefore investigated whether decodable decision-relevant information also predicted the timing of behavioural responses. For this, participants performed simple identity decisions, whereby two consecutively presented letters were shown in different rotation angle conditions, while the behavioural response (keypress) was recorded. Decision outcomes were predicted from spatio-temporal activity patterns before response execution using a moving-window support vector machine (SVM) MVPA approach. The first predictive time windows were identified at ~200-260 ms after presentation of the probe stimulus. Using a jackknife procedure, the change in average classification accuracy was then correlated with the change in average response times (RT) for each rotation angle condition when excluding each participant once. On average, decision-relevant information (as denoted by classification accuracy) started to significantly correlate with RT at 260 ms after the probe stimulus, peaking at ~400ms, which corresponded to the beginning of the response period. This suggests that when more information was represented in activity patterns during early time windows, decisions were made faster. These results show that MVPA for ERPs can reveal accumulation of information in the brain that is directly relevant for upcoming decision behaviour. Funding: ARC DECRA (DE140100350) to S.B.

Determinants of variation in rapid temporal processing ability: How do behaviour, function, and structure relate?

Mr Jesse Bourke, PhD (Clinical Psych) Candidate
University of Newcastle

A/Prof Juanita Todd, University of Newcastle
Prof Ulli Schall, University of Newcastle

Effective processing of rapid temporal cues in sound is essential for accurate perception of auditory stimuli, particularly for speech (Zatorre & Gandour, 2008). Poor rapid temporal processing (RTP) ability has been widely linked with disorders of speech and language processing (e.g., Cardy, Flagg, Roberts, Brian, & Roberts, 2005; Farmer & Klein, 1995). Todd, Finch, Smith, Budd, and Schall (2011) demonstrated that pre-attentive psychophysiological processing of RTP cues typically produces a right ear-advantage, depending on the individual’s behavioural ability to consciously discriminate RTP cues. A mismatch negativity (MMN) paradigm and gap detection threshold task (GDT) was used to measure behaviour and function respectively. Although neuroanatomical substrates of these effects have not yet been established, leftward structural lateralisations of the planum temporalis (PT) may be a potential determinant (Eimer, Hänggi, Meyer, & Jancke, 2012; Griffiths & Warren, 2002). In the present study we extended Todd et al.’s study by comparing behavioural and functional indices of RTP, with measures of the PT using structural and diffusion weighting MRI in a sample of 63 healthy participants (aged 18-46). Cognitive measures were also included. This presentation will focus on preliminary structural and cognitive relationships with RTP. For example, a positive correlation of leftward PT volume asymmetry with RTP ability.
was found. However, general strength of asymmetry (i.e., left or right) seems more strongly related. General processing speed and fluid intelligence also showed positive relationships with RTP. Overall, these findings affirm the potential neuroanatomical substrate of the relationship of behavioural RTP, and encourage integrative approaches to cognitive neuroscience.

**Nonlinear models of large-scale brain activity**

**Dr Michael Breakspear**

*QIMR Berghofer Medical Research Institute*

Movement, cognition and perception arise from the collective activity of neurons within cortical circuits and across large-scale systems of the brain. While the causes of single neuron spikes have been understood for decades, the processes that support collective neural behaviour in large-scale cortical systems are less clear and have been, at times, the subject of contention. Modelling large-scale brain activity with nonlinear dynamical systems theory allows the integration of experimental data from multiple modalities into a common framework that facilitates prediction, testing and possible refinement. This talk will review the core assumptions that underlie this computational approach, the methodological framework that fosters the translation of theory into the laboratory, and the emerging body of supporting evidence.

**Plasticity of the sustained attention network in ageing: a simultaneous tDCS-EEG approach.**

**Ms Māedhbh Brosnan**, PhD Student & Marie Curie Early Stage Researcher

*The University of Dublin, Trinity College & Monash University*

Dr Mahnaz Arvanégh, *University of Sheffield, United Kingdom*

Prof Ian Robertson, *Trinity College Dublin, Ireland*

Dr Paul Dockree, *Trinity College Dublin, Ireland*

While accumulating evidence suggests the right prefrontal cortex (PFC) plays a crucial role in sustained attention, whether this region can be targeted in older adults to improve age-related declines in this capacity has not been explored. We recruited 49 older adults (60-82 years) for two separate experiments and employed transcranial direct current stimulation (tDCS), a non-invasive brain stimulation technique, to increase activity in the right prefrontal cortex while monitoring sustained attention performance. In experiment one, performance was assessed using the Sustained Attention to Response Task (SART) and electroencephalography (EEG) markers of attention were monitored simultaneously with tDCS. During active relative to sham tDCS accuracy on the SART improved. Importantly, these benefits were task specific and were not observed on a modified version of the paradigm where reliance on sustained attention was reduced, while all other aspects of stimulus characteristics and the requirement for responses were held constant. Improvements in attention were accompanied by enhanced ERP markers of early visual attention deployment, stimulus selection and conflict monitoring over occipito-parietal and frontal scalp regions. Spectral analyses revealed an increased P1 response, with no sensitivity to emotion or spatial frequency modulated by the cross-modal valence of simultaneously presented images. To achieve this, the presented study used a six channel liquid diffusion olfactometer to present unpleasant, pleasant and neutral odours simultaneously with pleasant, unpleasant and neutral images from the International Affective Picture (IAP) database during an EEG recording. For each each trial participants rated both the pleasantness and intensity of either the odour or image. OERPs were averaged according to the rated odour valence to determine the influence of cross-modal valence on P3-2 amplitude. The results showed a significant effect of odour pleasantness on cross-modal image valence, where odour pleasantness ratings were significantly greater when pleasant images were presented than when unpleasant images were presented. Similarly, unpleasant odours rated as significantly more unpleasant when unpleasant images were presented. No significant effect was found for odour intensity indicating that the influence of cross-modal valence was specific to odour pleasantness. While ERPs where obtained to all odour stimuli, analysis of difference waves comparing odour and non-odour stimuli revealed no significant OERPs. These results are discussed in terms of the difficulty inherent in recording OERP responses due to poor time-locking for olfactory stimulation and the benefits of using measures of inspiration cycle and time-frequency analyses.

**Early cortical P1 ERP differences in high autistic tendency during fearful face processing.**

**Miss Adelaide Burt**, Student

*Swinburne University of Technology*

Dr Laila Hugrass, *Swinburne University of Technology*

Prof David Crawther, *Swinburne University of Technology*

Low spatial frequency (LSF) signals mediate rapid fearful face processing. In two separate experiments and employed transcranial direct current stimulation (tDCS), a non-invasive brain stimulation technique, to increase activity in the right prefrontal cortex while monitoring sustained attention performance. In experiment one, performance was assessed using the Sustained Attention to Response Task (SART) and electroencephalography (EEG) markers of attention were monitored simultaneously with tDCS. During active relative to sham tDCS accuracy on the SART improved. Importantly, these benefits were task specific and were not observed on a modified version of the paradigm where reliance on sustained attention was reduced, while all other aspects of stimulus characteristics and the requirement for responses were held constant. Improvements in attention were accompanied by enhanced ERP markers of early visual attention deployment, stimulus selection and conflict monitoring over occipito-parietal and frontal scalp regions. Spectral analyses revealed an increased P1 response, with no sensitivity to emotion or spatial frequency modulated by the cross-modal valence of simultaneously presented images. To achieve this, the presented study used a six channel liquid diffusion olfactometer to present unpleasant, pleasant and neutral odours simultaneously with pleasant, unpleasant and neutral images from the International Affective Picture (IAP) database during an EEG recording. For each each trial participants rated both the pleasantness and intensity of either the odour or image. OERPs were averaged according to the rated odour valence to determine the influence of cross-modal valence on P3-2 amplitude. The results showed a significant effect of odour pleasantness on cross-modal image valence, where odour pleasantness ratings were significantly greater when pleasant images were presented than when unpleasant images were presented. Similarly, unpleasant odours rated as significantly more unpleasant when unpleasant images were presented. No significant effect was found for odour intensity indicating that the influence of cross-modal valence was specific to odour pleasantness. While ERPs where obtained to all odour stimuli, analysis of difference waves comparing odour and non-odour stimuli revealed no significant OERPs. These results are discussed in terms of the difficulty inherent in recording OERP responses due to poor time-locking for olfactory stimulation and the benefits of using measures of inspiration cycle and time-frequency analyses.

**Training the Mirror System not to imitate: changes in proactive and reactive control processes**

**Ms Megan Campbell**, PhD Student

*The Queensland Brain Institute*

Ms Stacey Logan, *The University of Queensland*

Prof Ross Cunningham, *The University of Queensland*

The contentious issue of whether the mirror neuron system is innate or acquired continues to garner debate. This study extends our previous IMRI work which dissociated the engagement of proactive cognitive control for task-dependent modulation of mirroring. Using the same behavioural paradigm to measure the effects of sensorimotor training interventions on intentional and inciden-
tal imitation and counter-imitation. Pre and post-tests involved 2 tasks: an action imitation/counter-imitation task; and similar task with non-action stimuli manipulating low-level stimulus-response spatial compatibility rather than imitative compatibility. Both tasks also manipulated action preparation context (predefined vs stimulus-dependent). We compared three training interventions: counter-imitation (CIT, opposing action responses to action stimuli); imitation (IMT, performing the same actions as observed action stimuli); and spatial-incompatibility training (SIT, opposing button-press response to arrow stimuli, e.g. stimulus: right-ward pointing arrow; response: press left button). Behavioural performance indicated distinct effects of IMT and CIT on intentional senso- motoric responses, CIT leading to faster reaction times at post-test for mismatched actions, and removed the response-time facilita- tion effect of matched actions. IMT merely strengthened standard stimulus-response compatibility effect, with overall pattern across conditions conserved at post-test, only faster. Hence intentional counter-imitation can be trained to overcome existing stimulus-response pairings so that incongruent stimulus-response pairs become the default response. In ongoing work we use these training paradigms to examine neural correlates related to these changes in preparatory versus reactive control processes for modulating newly acquired action pairings. This work lends weight to the mounting evidence supporting the view that mirroring is acquired not innate, and hence malleable to experience and context.

Seeing the trees through the forest: characterizing selectivity in neural population codes.

A/Prof Thomas Carlson, Associate Professor University of Sydney
Mr Tijl Grootswagers, Macquarie University
Dr David Leopold, U.S. National Institute of Mental Health
Dr David McMahon, U.S. National Institutes of Health

Neuroscience has produced a variety of metrics aimed at characterizing the responses of neurons from single unit recording stud- ies and regions of interest (ROIs) from fMRI. Many of these metrics were developed in the context of univariate measures of neuronal activity (e.g., spike rates from single neurons, BOLD activation in ROIs). Over the past two decades, multivariate recordings of neu- ronal activity have become standard for the field, and there has been a corresponding development of multivariate methods for analysing these data. In the present study, we evaluated the efficacy of various measures of category selectivity to study neuronal activ- ity at the population level. We applied these measures to spiking activity in 36 neurons located in macaque's anterior fundus “face patch” in response to 2,500 individual object exemplars from 10 dif- ferent categories, including human and primate faces. We broadly observed that population activity was effective at distinguishing faces from other object categories (i.e., categorization); and impor- tantly, also distinguishing individual faces within the category (i.e., individuation). While most current selectivity metrics performed adequately in characterizing the categorical response, they over- looked the population's capacity for individuating exemplars within the preferred face category. Moreover, some metrics that pooled these two measures were effective in identifying components of the response produced both false positives (i.e., identifying non-preferred cat- egories as preferred) and false negatives (i.e., identifying preferred categories as non-preferred). To overcome the limitations of cur- rent selectivity metrics in the population context, we propose a new metric, “chirps,” that correctly parses both the categorization and individuation components of the population response.

The role of cognitive neuroscientists in the future of cognitive enhancement.

Dr Olivia Carter, ARC Future Fellow University of Melbourne

What would society look like if we had access to pills or devices that could safely and reliably improve our mood and cognitive abilities beyond normal function? There is nothing new about the desire for people to “improve themselves,” nor is it unique that there are products claiming to deliver this goal. But things are changing in the cognitive enhancement landscape with the rapid production, modification and online distribution of new technologies. This talk will provide an over- view of the existing international government initiatives established to identify and address neuroethical issues associated with cogni- tive enhancement. I will also summarise some of the neuroscientific research behind a range of currently available cognitive enhancing drugs and devices. Finally the talk will consider the existing discon- nect between the scientific research versus the claims of safety and efficacy in the popular press and supplier websites.

Human agency beliefs influence the neural processing of gaze during joint attention

Dr Nathan Caruana, Postdoctoral Research Fellow ARC Centre of Excellence for Cognition and its Disorders, Macquarie University
Dr Peter de Lissa, Macquarie University
Prof Genevieve McArthur, Macquarie University

Background: The neural mechanisms of social gaze processing are difficult to investigate using ecologically-valid experimental protocol because they can only be measured during online interactions. Method: We developed a virtual reality paradigm to simulate an eco- logically-valid interaction within a neuroimaging environment. Parici- pants played a cooperative game with an avatar, whom they believed was controlled by another participant but was, in reality, controlled by a gaze-contingent algorithm. On each trial, participants initiated joint attention towards a target. The avatar averted his gaze congruently (achieving joint attention) or incongruently (avoiding joint attention) with equal probability. We measured event-related potentials (ERPs) to the avatar's response to determine the neural time course of evaluating the achievement of joint attention. We also investigated the influence of agency beliefs on these ERPs in two further experi- ments. First, we manipulated the visual properties of the stimulus by replacing the avatar’s gaze with a non-active (Experiment 2). Second, we instructed participants that the avatar was controlled by a computer program, rather than a human. Results: Larger peaks were observed at centro-parietal sites, 350 ms (P350) after the onset of incongruent gaze shifts, compared to con- gruent gaze shifts. This P350 effect was absent when the avatar’s gaze was replaced with non-active arrows (Experiment 2), and when participants believed that the avatar was controlled by a com- puter (Experiment 3). Conclusions: These data reveal that the centro-parietal P350 may provide a neural marker for evaluating social outcomes from gaze, and that this neural process is influenced by whether participants believe they are interacting with an intentional human agent.

Dissociation of Reward and Effort Sensitivity in Methcathinone-Induced Parkinsonism

Dr Trevor Chong, NHMRC Neil Hamilton Fairley Early Career Research Fellow Monash University

Dr Trevor Chong, Monash University
Dr Valerie Bonnelle, University of Oxford
Miss Kai-Rin Veromann, University of Oxford
Dr Julius Juurmaa, University of Tartu
Dr Pille Taba, University of Tartu
Prof Masud Husain, University of Oxford

Methcathinone-induced Parkinsonism is a recently described extrapyramidal syndrome, characterised by globus pallidus and sub- stantia nigra lesions, which provides a unique model of basal ganglia dysfunction. We assessed motivated behaviour in these patients to establish whether they exhibit altered sensitivity to either reward or effort. A novel cost-benefit decision-making task was used to evaluate effort and reward sensitivity in six methcathinone-induced Parkin- sonism cases. On each trial, participants decided whether they were willing to allocate varying levels of physical effort for different levels of reward. The reward required to motivate individuals to exert each level of effort on 50% of trials established their reward indifference points. Patients required greater rewards than controls to motivate them to exert intermediate levels of effort. However, the correspond- ing analysis on effort indifference points showed that patients and controls were no different in the amount of effort they were willing to invest for a given reward. Importantly, these results were not due to motor differences between groups. These results show a dissociation between reward and effort sensitivity in methcathinone-induced Par- kinsonism. Pallidal/midbrain complex dysfunction appears to bias cost- benefit decision-making, causing patients to become less sensitive to rewards, while maintaining normal sensitivity to effort costs.
Individual differences within retinotopically defined primary visual cortex (V1) as a function of the autism-spectrum quotient.

Dr Philippe Chouinard, Lecturer
La Trobe University
Mr Julian Vilsten, La Trobe University
Ms Alyse Brown, La Trobe University
Dr Oriane Landry, La Trobe University
Prof Sheila Cowherth, La Trobe University

Large-scale studies using magnetic resonance imaging (MRI) demonstrate thicker grey matter in early visual areas of the occipital lobe in people with autism spectrum disorder compared to typically developing people. However, it remains unclear if such variations in structure are present in the general population as a function of autistic traits. We performed MRI to determine if grey matter thickness in five early visual areas (V1, V2d, V2v, V3d, and V3v) correlates with the Autism-Spectrum Quotient (AQ) in twenty typical individuals (AQ range: 1 to 33, M = 14.3; Age range: 19 to 36; M = 27.3). Two T1-weighted structural scans with a voxel size of 1 mm3 were collected for each participant to allow for high resolution grey matter boundaries to be determined in FreeSurfer. Specifically, boundaries for each of the different visual areas were defined manually in each individual after superimposing their retinotopic maps obtained from functional MRI over an inflated cortical reconstruction of their brain. The average grey matter thickness for each visual area was then determined. Our analyses revealed that AQ correlated with grey matter thickness in V1 (r = .46, p = .042) but not the other visual areas (r < .30, p > .183) nor the overall cerebrum (r = .13, p = .580). From these results, we infer that the cortical structure of V1 differs as a function of autistic traits, which may shed light to numerous studies highlighting differences in visual processing in people with higher AQ scores.

Short interval intra-cortical inhibition and stop signal reaction time

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Prof Justin Harris, University of Sydney
Dr Evan Livesey, University of Sydney
Prof Alex Blassczynski, University of Sydney

Transcranial Magnetic Stimulation (TMS) provides a useful way of investigating inhibitory control, specifically when used to measure intra-cortical inhibitory mechanisms. A widely studied measure is short-interval intra-cortical inhibition (SICI), which is a reduction in a motor evoked potential (MEP) elicited by a TMS pulse that is immediately preceded by a weak “conditioning” pulse separated by a very short interval (2-5 ms). This reduction occurs due to the activation of inhibitory interneurons by the conditioning pulse. Although many studies have identified deficits in SICI in clinical populations characterised by poor behavioural control, studies have not yet determined whether SICI can indeed distinguish individuals who have good or poor behavioural inhibition. Accordingly, our goal was to determine whether there is a relationship between SICI and the latency for an individual to stop a cued response, measured as Stop Signal Reaction Time (SSRT). In our study, we compared MEPs evoked by single and paired pulse (3ms interval) TMS to measure SICI from the FDI muscle at rest. Participants (n=32) also completed the stop-signal task to obtain an estimate of SSRT. Results revealed a significant correlation between SICI and SSRT, such that those with longer SSRTs had weaker SICI (r = .47, p < .0001), which suggests that resting SICI may predict how quickly an individual can stop a response. Future experiments are planned to build on this by measuring SICI “online” during the stop signal task. After estimating SSRT in an initial phase, participants will complete the stop-signal task whilst receiving single and paired pulse TMS at fixed time points after stop signal onset. Stop signal onset will be adjusted according to each individual’s SSRT estimate in the initial phase. We will test whether the magnitude of SICI during the attempted inhibition of a response is weaker in individuals with longer SSRTs.

Investigating the developmental course of letter recognition in the brain by varying typeface

Dr Owen Churches, Research Fellow
Flinders University
Ms Rebecca Callahan, University of South Australia
Dr Scott Coussens, University of South Australia
Ms Jessica Hofmann, Macquarie University
Prof Mike Nicholls, Flinders University
Dr Hannah Keage, University of South Australia

Our group has previously found that in adults, visual letter form (ie. font) affects the processing of letters up to 600 milliseconds, a stage by which the abstraction of letter identity has already occurred. We sought to investigate this phenomenon in primary school aged children, an age during which there are great changes in reading ability. Thirty one right handed participants aged between 8 and 12 years took part in one-back task where letters were presented in easy to read typefaces (fluent stimuli) or difficult to read typefaces (diffluent stimuli). Task instructions necessitated that participants focused on letter identity rather than visual letter form. Event-related potentials were measured following each letter stimulus. Differences were found between fluent and diffluent stimuli in this sample. However, this was to a much lesser extent than that previously found in adults. The P3a component was found to be most sensitive to fluency in children. It showed an overall increase in activation for fluent stimuli over diffluent stimuli. This effect was additionally modulated by the relevance of the stimuli to the task, such that there was a greater difference between fluent and diffluent stimuli for non-targets than for targets. The absence of differences in earlier, visual ERP components, especially in the N1, in this younger sample likely suggests that font tuning is still developing at this age. And thus, pronounced and early differences only occur with greater visual expertise for fonts.

Transcranial magnetic stimulation reveals distinct implicit learning mechanisms for first-order and second-order sequences

Ms Gillian Clark, PhD student
Deakin University
Dr Jarrod Lum, Senior Lecturer of Deakin University

The serial reaction time task (SRTT) involves implicitly learning a visuospatial sequence. The learning that takes place on the task is thought to be supported by the cortico-striatal procedural memory system. However, there has been some debate over whether implicit sequence learning might be supported by different networks in the brain depending on the structure of the sequence. Using continuous theta burst stimulation (cTBS), this study investigated the effects of disrupting the procedural memory systems on the implicit learning of sequences.

In this study, 26 healthy adults were presented with two SRTTs that assessed the implicit learning of first-order conditional (FOC) or second-order conditional (SOC) sequences. In FOC sequences, a single position within the sequence predicts the next above chance levels. Processing FOC sequences is dependent on cortico-striatal networks. For SOC sequences, transitions between individual positions are at chance levels. It has been proposed these types sequences might be processed by the hippocampus supported declarative memory system. Before completing the tasks, participants received either sham or active cTBS to primary motor cortex. The active stimulation aimed to disrupt activity in the cortico-striatal procedural network. It was hypothesised that the stimulation group would show poorer learning of the FOC sequence than the SOC sequence, and that the difference in performance between sequence types would be larger for the stimulation group than that for the sham group.

In line with our prediction, the stimulation group performed significantly better on the SOC than the FOC sequence. The sham group showed no significant difference in performance between the two sequences. This provides evidence that processing FOC and SOC sequences might involve different neural networks.

The acute effects of nutritional supplements containing caffeine on human neurochemistry and alertness

Miss Carlee Cleeland, PhD Candidate
Swinburne University of Technology
Dr Matthew Pase, Boston University

While the abstraction of letter identity has already occurred, the impact on the processing of letters up to 600 milliseconds, a stage by which the abstraction of letter identity has already occurred. We sought to investigate this phenomenon in primary school aged children, an age during which there are great changes in reading ability. Thirty one right handed participants aged between 8 and 12 years took part in one-back task where letters were presented in easy to read typefaces (fluent stimuli) or difficult to read typefaces (diffluent stimuli). Task instructions necessitated that participants focused on letter identity rather than visual letter form. Event-related potentials were measured following each letter stimulus. Differences were found between fluent and diffluent stimuli in this sample. However, this was to a much lesser extent than that previously found in adults. The P3a component was found to be most sensitive to fluency in children. It showed an overall increase in activation for fluent stimuli over diffluent stimuli. This effect was additionally modulated by the relevance of the stimuli to the task, such that there was a greater difference between fluent and diffluent stimuli for non-targets than for targets. The absence of differences in earlier, visual ERP components, especially in the N1, in this younger sample likely suggests that font tuning is still developing at this age. And thus, pronounced and early differences only occur with greater visual expertise for fonts.
Neural decoding of visual information varies with fluctuations in global network efficiency

Dr Luca Cocchi, Senior Research Fellow
QIMR Berghofer Medical Research Institute

Background: Functional magnetic resonance imaging (fMRI) studies have shown that neural activity fluctuates spontaneously between different states of global synchronization over a timescale of several seconds. Such fluctuations generate transient states of high and low correlation across distributed cortical areas, resulting in changes in the network's capacity to support parallel transfer of information, and thus its processing efficiency. It has been hypothesized that periods of high global efficiency might facilitate the integration of information by specialised brain areas relative to periods of low network efficiency. Methods: In this talk I will discuss a recent study in which we tested the prediction that ongoing fluctuations of global neural efficiency varies the amount of stimulus-related information stored in specialised brain areas. I will describe how we used a linear decoder to discriminate patterns of neural activity elicited by face and motion stimuli presented periodically while participants undertook time-resolved fMRI. Results: Decoding was reliably higher during periods of high global efficiency than during states of low efficiency, and this difference was evident across both visual and non-visual cortical regions. Conclusions: Our results indicate that slow ongoing fluctuations in global network efficiency are associated with variations in the relative strength of local neural representations of distinct categories of visual stimuli. I will conclude my talk by highlighting the importance of understanding the impact of ongoing, stimuli-unrelated, global neural dynamics on specialised, stimuli-driven, neural processes.

Is reward-based cognition a specific impairment in bipolar disorder? A pilot study using set-shifting

Mr James Collett, Associate Lecturer
RMIT University

A/Prof Conrad Perry, Swinburne University of Technology
Prof Greg Murray, Swinburne University of Technology

Bipolar disorder is a mood disorder that may be aetiologically related to abnormalities in the behavioural activation system (BAS), a neurobehavioural system manifesting as reward sensitivity. Bipolar disorder is characterised by a range of cognitive deficits, however cognitive deficits are not specific to bipolar disorder. In the present study, we theorised that cognitive deficits in contexts involving reward stimuli might constitute a more specific impairment in bipolar disorder. Set-shifting, an indicator of cognitive flexibility, was used to test this prediction. A dimensional approach was adopted where a non-psychiatric sample (N = 118) were assessed for trait vulnerability to bipolar disorder using the 7 Up 7 Down Inventory. A contingency-shifting variant of the Iowa Gambling Task (CS-IGT) was used to examine set-shifting in the context of reward stimuli, whilst the Wisconsin Card-Sorting Test (WCST) was used to examine set-shifting with minimal reward cues present. Contrary to predictions, no correlation was found between trait vulnerability to bipolar disorder and either CS-IGT or WCST set-shifting. It is possible that cognitive deficits are largely non-specific to bipolar disorder, or that set-shifting deficits are a qualitatively distinct characteristic of bipolar disorder that are only testable within a clinical population.

Functional gradients of prefrontal cortex organisation have corresponding oscillatory hierarchies

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A/Prof Frini Karayanidis, University of Newcastle
Prof Francisco Barceló, University of the Balearic Islands

Extensive frontal networks enable top-down control over thoughts and behaviours. The prefrontal cortex (PFC) plays a critical role in guiding goal-appropriate behaviour, functioning as a major hub for facilitating higher order cognition. PFC can be functionally divided along a gradient of complexity, where simple, concrete associations are enabled by posterior portions of PFC and abstract, future-oriented goals engage anterior PFC. However, while there is consensus regarding spatial organisation of PFC, the neural mechanisms that underlie this gradient are incompletely understood. We utilised electroencephalography (EEG) to quantify underlying oscillatory activity as a functional mechanism of PFC engagement. Thirty-one participants completed a series of three top-down control tasks (oddball, go/no-go, and switch) while EEG was simultaneously recorded. To recruit PFC hierarchical organisation, identical sets of stimuli were presented across tasks (i.e., matched probabilities/perceptual features) with only task demands differing. That is, we manipulated task rule complexity associated with these stimuli to engage more distinct portions of PFC. Functional mechanisms associated with these tasks were characterised as average power across a broad frequency spectrum (2–30Hz). Our manipulation of hierarchical demands was successful. Simple task rules were performed faster/more accurately than complex task rules. Additionally, tasks that relied on posterior PFC and simple associations utilised lower-frequency power exclusively (i.e., delta, 2–4Hz and theta, 4–8Hz). In contrast, tasks relying on abstract rules (and anterior PFC) were associated with enhancements of these lower frequencies plus higher-frequency responses (i.e., alpha, 8–13Hz). The functional hierarchy of the PFC was found to have a corresponding frequency hierarchy. This map of control facilitating task demand appears to arise from a complex frequency landscape, sensitive to information-processing demands associated with current tasks/goals.

The magical number one-on-square-root-two: the double-target detection deficit in brief visual displays

Dr Elaine Corbett, Research Fellow
University of Melbourne

Prof Philip Smith, University of Melbourne

How limited representational capacity is divided when multiple items need to be processed simultaneously is a fundamental question in cognitive psychology. The double target deficit is the finding that, when monitoring multiple locations or information streams for targets, identification of two simultaneous targets is substantially worse than is predicted from the cost of divided attention alone. This finding suggests that targets and nontargets are treated differently by the cognitive system. We investigated the double target deficit in four different visual decision tasks using noisy, backwardly-masked targets presented for a range of exposure durations to test the theory that the deficit reflects a capacity limitation of short-term memory (VSTM). We quantified the deficit using a sample-size model of VSTM and two different models of the decision process: a signal detection MAX model and an optimum likelihood ratio model. We found a double target deficit in all four tasks which increased in magnitude for briefer displays. For shorter exposures the deficit was consistent with the capacity limits of VSTM, but for longer exposures it was diminished. We explained the exposure dependency using a competitive interaction model in which non-targets compete for access to VSTM at a slower rate than targets, allowing non-targets access to VSTM only when the exposure duration was sufficiently long. Our findings are supportive of two-stage models of visual search in which the most target-like stimuli are filtered into VSTM before the decision process begins.
The role of relative pitch in the active discrimination of complex sound patterns

Miss Nina Coy, Masters student
Leipzig University

Miss Maria Bader, Leipzig University
Prof Erich Schröger, Leipzig University
Dr Sabine Grimm, Leipzig University

The human auditory system shows the amazing ability to recognize complex auditory regularities even when absolute features undergo variability, such as when a melody is played in different keys. Thus, the melody is an invariant, defined by relative relations of specific auditory stimulus features, i.e. its Gestalt. By analysing behavioural performance and the event-related-potential (ERP), the current study investigated the role of absolute and relative pitch information in the active discrimination of complex melodic patterns. In a roving standard paradigm melodic patterns were presented for a certain number of times until a new pattern was introduced. Patterns within a stimulus train were either repeated identically (absolute repetition), carrying absolute frequency information about the pattern, or shifted in pitch (relative repetition), thus only relative frequency information was available to extract the pattern identity. Results showed that participants were able to use relative pitch to discriminate patterns, though they were less sensitive and took longer to behaviourally react to pattern changes when there was no absolute pitch information. The change-specific MN-components of the ERP, indexing a sensory memory comparison process, was elicited at approximately 216 ms after stimulus onset at frontocentral electrodes, irrespective of whether patterns were defined by absolute or relative pitch. Increased latencies but no differences in amplitudes of the N2 and P3b suggest that further processing is more demanding when, in the absence of absolute pitch cues, relative pitch has to be extracted. This is in accordance with recent findings on implicit auditory learning processes and suggests that a slowing of target selection rather than a slowing of the auditory change detection process causes the deterioration in behavioural performance in the absence of absolute pitch cues.

Red light reduces parvocellular, but not magnocellular components of non-linear VEP

Prof David Crewther, Professor Swinburn University of Technology
Ms Lalita Huggras, Swinburn University of Technology
Mr Thomas Verhellen, Swinburn University of Technology
Ms Caitlin Mallon, Swinburn University of Technology
Ms Eleanor Morrell-Earney, Swinburn University of Technology

Single cell studies demonstrate suppression of LGN magnocellular neural firing when red light is added to the surround of the receptive fields. Based on such observations, human studies have used red light to suppress contributions magnocellular responses in a variety of psychological tasks, including fearful face processing and reading. However, human studies have not directly addressed whether peripheral red light specifically suppresses M responses. Studies of the Wiener kernel components in non-linear VEP have shown the major components of the second order first slice (K2.1) and second slice (K2.2) waves are generated by the M and P pathways, respectively. Here we use non-linear VEP to investigate the effects of red and green surrounds on K2.1 and K2.2 responses to a central grey patch. Contrary to expectations, there was no effect of red surround on the K2.1 response. However, there was a significant reduction in the amplitude of the major K2.2 response. The effect was greater at high (70%) than low (10%) luminance contrast, consistent with parvocellular origin. Our findings call into question interpretations of psychological processes and suggest that a slowing of target selection rather than a slowing of the auditory change detection process causes the deterioration in behavioural performance in the absence of absolute pitch cues.

Do cannabis users show differences in brain activity for risk and reward related processing?

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The University of Auckland

Ms Carolyn McNabb, The University of Auckland
Mr Mohamad Al-Attar, The University of Auckland
Ms Phoebe Bint, The University of Auckland
Ms Tayla Bowers, The University of Auckland
Mr Jordan Hinton, The University of Auckland
A/Prof Robert Hester, University of Melbourne
A/Prof Bruce Russell, The University of Otago
Prof Ian Kirk, The University of Auckland
Mr Rohan King, The University of Auckland
Ms Justinn Cochran, The University of Auckland

Cannabis is one of the most commonly used illicit substances worldwide and has been associated with deficits in learning, memory and reward-related functioning as well as decision making. However, research on long-term cannabis use and decision making is limited compared to other substances such as alcohol and tobacco. To date, studies investigating brain activity associated with risk-based decision making have not typically dissociated probability of risk from magnitude of reward. In addition, research investigating brain activity based on feedback has been limited. This study aimed to determine if long-term cannabis users show differences in reward related behaviour in comparison to non-users using a novel task (the passive task) and electroencephalography (EEG). The task differentiated risk from magnitude of reward by modulating task difficulty based on speed of response. We were particularly interested in group differences at P300 and feedback related negativity (FRN), as these have been associated with the anticipation and feedback stages of similar tasks. Data were analysed using Brain Vision Analyser software. Data was compared with respect to their P300 and FRN responses at three electrode sites (Fz, Cz and Pz). Reaction time (RT) and ERP data were compared between groups using ANOVA in SPSS. The influence of previous outcomes on future RT was also assessed. Data analysis showed significant main effect differences between trial type and electrode position for both P300 and FRN. In addition, a significant difference (p<0.05) between cannabis users and non-users was found at FRN over all outcome types at Fz. No differences were found in RT. Cannabis users in this study demonstrated different patterns of activation related to risk and reward processing compared to non-cannabis using controls. This finding is in line with previous studies showing that chronic cannabinoid exposure can potentially affect reward related processing.

Neuroimaging white matter in attention/deficit-hyperactivity disorder: understanding impulsivity with diffusion tensor imaging

Miss Fiore D’Aprano, Student
The University of Melbourne/Murdoch Childrens Research Institute

Dr Timothy Silk, Murdoch Childrens Research Institute
Ms Sia Genc, Murdoch Childrens Research Institute
A/Prof Robert Hester, The University of Melbourne

Attention/deficit-hyperactivity disorder (ADHD) is a prominent neurodevelopmental disorder characterised by problems of inattention and hyperactivity/impulsivity that are thought to depend on white-matter connectivity between cortical regions. Given the prevalence and long-term ramifications of ADHD, the current study aims to examine the white-matter microstructure underlying impulsivity-characterising this phenotype categorically and dimensionally in a community-based sample. Using data acquired on a 3T Magnetic Resonance Imaging scanner, Diffusion Tensor Imaging was used to examine white-matter organisation in 47 diagnostically-confirmed children with ADHD, and 59 typically-developing controls, (overall sample mean age = 10.41, standard deviation = 0.47, 74 males). Participants completed a computerised Stop-Signal Task where Stop-Signal Reaction time (SSRT) provided an index of inhibition used to assess impulsive behaviour. White matter models were tested to examine structural connectivity within ADHD and controls, or between subtypes in SSRT or microstructural organisation. Dimensionally, greater white-matter microstructural organisation within the body and genu of the corpus callosum was significantly related to inhibitory control, pFWE > .04, but not to symptom severity or subtype. This relationship was not significantly different between ADHD and controls. Further investigation using multiple tests of inhibitory control and optimised assessment of white-matter will inform symptomatology, neuropsychology, heterogeneity, and neurobiology. Overall, this study found that inhibitory control...
was linearly related to white-matter organisation, and independent of ADHD diagnosis. This may suggest a dissociation between cognition and behavioural presentation-warranting models addressing aetiological heterogeneity. NHMRC project grant #1065835.

TMS investigation into the role of the left and right dorsolateral prefrontal cortices in control of emotional distraction.

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Dr Gina Grimshaw, Victoria University of Wellington

Emotional information is important and tends to be prioritised by our attentional system. Sometimes however, it needs to be ignored so that we can focus on our current goals. The Asymmetric Inhibition Model (AIM; Grimshaw & Carmel, 2014) proposes that the control of distraction from positive and negative distraction is lateralised in dorsolateral prefrontal cortices (DLPFC); with the right hemisphere supporting inhibition of positive distractors and the left hemisphere supporting inhibition of negative ones. We tested this assumption by means of theta burst (inhibitory) stimulation on the right and left DLPFC of 18 participants confronted with positive, negative and neutral distractors while they were engaged in a simple visual search task. Based on the AIM, we expected increased distraction by positive stimuli targeting the right DLPFC and by negative stimuli after stimulating the left DLPFC. Contrary to our predictions, although emotional distractors impaired search performance more than neutral ones, theta burst stimulation over the right or left DLPFC had no significant effect on performance compared with stimulation on a control site (i.e. vertex), and did not significantly decrease performance by comparison with a pre-test baseline condition. We discuss alternative explanations for this null effect.

Effect of maternal immune activation and sex on electrophysiological features related to schizophrenia

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Dr Lauren Harms, University of Newcastle
Dr Ross Fulham, University of Newcastle
Dr Aaron Wong, University of Newcastle
A/Prof Juanita Todd, University of Newcastle
Prof Deborah Hodgson, University of Newcastle
Prof Ulrich Schall, University of Newcastle
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Maternal immune activation (MIA) in response to gestational infection is a risk factor for the development of schizophrenia in offspring. Previous studies have shown that MIA in rats and mice, induced by the non-infectious viral mimic Poly(I:C), produces a variety of schizophrenia-like behavioural, cognitive and morphological alterations. However, it was unknown if MIA altered electrophysiology in rats. The current study therefore investigated the impact of MIA on two electrophysiological features altered in schizophrenia, gamma activity and mismatch negativity (MMN). Furthermore, our study aimed to determine whether this temporal expectation could be modified with repeated exposure to a delayed, self-initiated auditory sensation. Participants underwent electroencephalographic (EEG) recordings while undergoing a task where they pressed a button to produce a tone. The onset of the tone occurred either immediately after the button-press, or after a 100ms delay. Training comprised of repeated exposure to the delayed tone and, as a comparison, repeated exposure to the immediate tone. Pre- and post-training measures of the auditory-evoked response to the tone were assessed to determine the effect of training. In the pre-training phase, delayed tones evoked a larger N1 amplitude, compared to immediate tones. However, across two experiments, it was demonstrated that training to the delayed tone resulted in a reduction in N1 amplitude, such that there was no difference in N1 amplitude post-training between the immediate and delayed tones. This suggests that it is possible to modify the neural assumption that sensations follow immediately from actions.

Attentional enhancement of event-related potentials in a multilingual dichotic listening task

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In the traditional auditory dichotic listening task – designed to investigate selective auditory attention – two different messages are presented to subjects simultaneously and they are instructed to pay attention to one of the two sounds in each trial. This task has been extensively investigated, demonstrating that characteristics such as the pitch, rate, direction, and even the gender of the speakers can affect human ability to distinguish between the messages. When the task is performed with electroencephalography, early sensory probe-elicited event-related potentials (ERPs) are enhanced when presented on the same side as the attended stimuli, relative to the unattended side. In this project, we presented participants with two short stories simultaneously – one to each ear – in different language.
Evidence for an effect of stimulus probability in the visual oddball paradigm with Fast Periodic Visual Stimulation

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Dr Genevieve Quek, University of Louvain
Dr Hannah Keage, University of South Australia
Prof Bruno Rossion, University of Louvain

The experimental manipulations that produce visual oddball responses in the EEG are currently unresolved. Classical oddball designs confound effects of stimulus repetition and stimulus presentation probability. These designs also require long testing sessions for few useable epochs, limiting sensitivity to identify true effects. To determine the experimental manipulations (stimulus repetition and stimulus probability) that produce visual oddball responses we used a visual oddball paradigm with Fast Periodic Visual Stimulation (FPVS). In the stimulation sequences a single face identity was presented by sinusoidal contrast modulation at a rate of 6Hz (i.e. a base rate of 6 images/second). Every seventh face image (the oddball stimulus) was 20% larger in size and either the same or a different identity compared with the base rate faces. We manipulated whether the identity change was common (90%) or rare (10%) across sequences, through-out which participants monitored a central fixation cross for brief colour changes. EEG responses to each oddball stimulus type were quantified in the time and frequency domains. Larger responses in the frequency domain were evoked by rare compared to common oddsballs, the effects of which were largest when there was a face identity change relative to base rate faces. Common/rare comparisons in the time domain showed an occipitotemporal negativity 200-350ms from oddball stimulus onset resembling the visual mismatch negativity (vMMN). EEG habituation occurred across the sequences, but did not account for the observed time domain effects. These results indicate an effect of stimulus probability in the visual oddball paradigm which is modulated by face identity repetition. Our FPVS design shows potential as a shorter and more sensitive design for measuring the vMMN in healthy and clinical samples.

Sex and the City Brain: Rethinking sex, gender and adaptive traits

A/Prof Cordelia Fine, A/Prof University of Melbourne

To many, including many scientists, to say that a sex difference in human brain and behaviour reflects an evolved adaptation is to set limits on possible future male/female patterns of behaviour, and thus arrangements of social life. Although not always made explicit, a common assumption is that proximal mechanisms of genetic and hormonal sex, ultimately shaped by the differential reproductive challenges of ancestral males and females, create timeless, universal, and immutable sex-specific adaptations of brain and behaviour. In the past few decades, however, there have been major advances and conceptual shifts in evolutionary biologists’ conceptualisation of the evolution and development of adaptive behaviour, and in neuroscientists’ models and understanding of sexual differentiation of brain and behaviour. Considered together, these conceptual shifts have important and, to date, largely unexplored implications for thinking about sex, brains, and evolution.

Differences in first-impression bias patterns to spatially distinct monaural and binaural sounds

Ms Talitha Ford, Ph.D student Swinburne University of Technology
Prof David Crewwther, Swinburne University of Technology
Mr Richard Nibbs, Swinburne University of Technology

The phenotypes of autism and schizophrenia spectrum disorders are substantially overlapping both in the clinical and non-clinical population. This phenotype has been conceptualised as Social Disorganisation (SD). This study investigates whether differences in the excitatory glutamate to inhibitory alpha-aminobutyric acid (GABA) ratio exist between those with high and low levels of trait SD, as abnormalities in these neurotransmitters have been reported in both autism and schizophrenia. A low (n=18, 10 female) and high (n=19, 9 female) SD scoring group aged 18 to 40 years underwent resting state proton magnetic resonance spectroscopy (1H-MRS) for glutamate and GABA concentrations in a superior temporal cortex (STC) voxel. Reduced right STC GABA concentration (p = 0.004) and increased glutamate/GABA ratio was found for the high SD group; no group difference in left STC voxel was observed. This has been uncovered through modulation of the amplitude of mismatch negativity (MMN) which is elicited to unexpected deviations from established regularities in the environment. Traditional predictive coding accounts suggest that MMN amplitude will faithfully reflect the local probabilities of sounds at any given time, being largest to deviations of the most repetitive sequences. However the bias demonstrates a resistance to re-evaluation of initial tone roles via (1) reduced MMN to an initially repetitive sound when it later becomes deviant, and (2) no effect of sequence stability on MMN following a change from initial tone roles. Whilst widely replicated in pitch and duration processing, the aim of the present study was to investigate this effect in the processing of spatial location. Sixty-two participants were exposed to a variation of the previously used to show the bias, where where two tones alternated in the role of standard and deviant over multiple timescales and event-related potentials were recorded using electroencephalogram (EEG). Sounds differed only on localisation to the left or right of space, and the inter-aural level difference used to create this localisation was manipulated between subjects to give a monaural left-first deviant, monaural right-first deviant and binaural right-first condition. Whilst there was clear replication of both characteristic bias patterns in the binaural group, there were differences in the monaural groups. Patterns were partially present for the monaural group with a left sound as first deviant whilst in the right-first condition they were largely absent. The bias may be an even more complex phenomenon than previously believed, and may depend on the relative activation of alternative pathways from the left and right ears.

A shared autism and schizophrenia spectrum trait phenotype may be marked by increased glutamate/ GABA ratio.

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Dr Alexander Provost, University of Newcastle
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A/Prof Juanita Todd, University of Newcastle

First-impression bias in auditory processing refers to the observation that the initial context in which a sound is encountered has a lasting effect on future processing of that sound. This has been uncovered through modulation of the amplitude of mismatch negativity (MMN) which is elicited to unexpected deviations from established regularities in the environment. Traditional predictive coding accounts suggest that MMN amplitude will faithfully reflect the local probabilities of sounds at any given time, being largest to deviations of the most repetitive sequences. However the bias demonstrates a resistance to re-evaluation of initial tone roles via (1) reduced MMN to an initially repetitive sound when it later becomes deviant, and (2) no effect of sequence stability on MMN following a change from initial tone roles. Whilst widely replicated in pitch and duration processing, the aim of the present study was to investigate this effect in the processing of spatial location. Sixty-two participants were exposed to a variation of the previously used to show the bias, where where two tones alternated in the role of standard and deviant over multiple timescales and event-related potentials were recorded using electroencephalogram (EEG). Sounds differed only on localisation to the left or right of space, and the inter-aural level difference used to create this localisation was manipulated between subjects to give a monaural left-first deviant, monaural right-first deviant and binaural right-first condition. Whilst there was clear replication of both characteristic bias patterns in the binaural group, there were differences in the monaural groups. Patterns were partially present for the monaural group with a left sound as first deviant whilst in the right-first condition they were largely absent. The bias may be an even more complex phenomenon than previously believed, and may depend on the relative activation of alternative pathways from the left and right ears.
The speed of specifying the number of dots in a display (enumeration) is predictive of the time taken to add numbers (arithmetic). This relationship is the basis for theories about core numerical processes and the differences that may underlie differences in normal and poor arithmetic abilities. The strength of the arithmetic/enumeration relationship may depend on the degree to which specific arithmetic and enumeration tasks require the same combinatorial processes. Typical random dot displays are unconstrained in the number of subgroups that may be combined to achieve a numerical answer, whereas arithmetic tasks using double single addition are highly constrained - requiring combination of two items. We manipulated enumeration and arithmetic displays to make them equivalent in combinatorial complexity and determine if similar combinatorial processes underlie the arithmetic/enumeration relationship. Sixty undergraduates enumerated sets of dots and added numbers with totals from 1 to 16. Stimulus dots were arranged randomly (unconstrained combination) or grouped into four subsets (quadr combination). Addition displays comprised two Arabic numerals (constrained combination) or four Arabic numerals (quadr combination). As predicted the correlation between RTs for quad combination arithmetic/enumeration tasks was significantly higher than the correlation between RTs for traditional arithmetic/enumeration tasks. This suggests subset grouping and accrual in enumeration is a similar process to cumulative summation in symbolic arithmetic. Furthermore, systematic patterns of non-linear RTs for quad versions of arithmetic/enumeration task, as function of subset size, suggest the numerical similarity of subsets has an important influence on the integration of multiple quantities in computing answers.

Cognitive manipulations change the impact of first-impressions in sequence learning.

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First impressions are automatic beliefs that are formed quickly and are resistant to updating even when counter-evidence is available. Remarkably, the brain also forms a first impression bias based on initial exposure to sound information that alters later learning about sound. The brain is effective at using sound patterning to model, and therefore predict, the next most likely sound event given previous experience. The evolved-potential component mismatch-negativity (MMN) is elicited upon detection of any pattern-deviation and reflects a ‘prediction-error’. MMN amplitude is proportional to ‘certainty’ in underlying predictions; MMN is largest when patterns are stable. Using a ‘multi-timescale’ paradigm, we have shown that MMN does not faithfully reflect sequence stability but instead succumbs to a first-impression bias that is coupled to initial tone roles. In the paradigm participants hear two-tone sequences in which tones alternate roles of standard (p = .875) and deviant (p = .125). In unstable sequences, roles alternate every 2.4min (480 tones/block; 420-standard, 60-deviant). In unstable sequences, roles alternate every 0.8min (160 tones/block; 140-standard, 20-deviant). The bias refers to the observation that only MMN in the first stimulus configuration show the expected stability-modulation: stable > unstable. The primacy bias pattern did not occur when participants performed a demanding concurrent N-Back task (study-1) or were first informed about the sequence structure (study-2) before watching a silent movie. Our results are interpreted as evidence that engagement of higher-order brain areas is required to make predictions about patterning over longer timescales.

Modulation of spontaneous eye blinks during the stop-signal task

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Unlike reflexive eye blinks, spontaneous eye blinks are triggered rhythmically by a central generator which can be modulated by attentional processes. When participants perform visual tasks, blinks are suppressed immediately before an anticipated visual stimulus and re-emerge approximately 200 ms post-stimulus. Here we report novel findings showing modulation of the blink response by both response-elicitation and response-inhibition within the stop-signal paradigm. Within this task, participants must inhibit an ongoing pre-potent motor response when an auditory stop-signal is presented. Eye blinks were monitored in 195 healthy participants (18-25y) taking part in an EEG study within the Age-ility project. On go-trials, blink latency and response latency were largely independent; however there was an enhanced blink response 40 ms after a no-go response, which we suggest is associated with triggering of ballistic motor responses. On stop-trials, the auditory stop-signal suppressed blinks during a well-defined 150 ms interval on both stop-success and stop-failure trials. The data are interpreted to (a) suggest the stop process produces global rather than local inhibition; (b) support the primary assumption of the horse-race model of the stop-signal paradigm concerning the independence of the stop and go processes; and (c) provide direct evidence that stop signal reaction time variance is small relative to that of the go-process. Finally, stop-failure trials, but not go-trials, had a bimodal blink distribution following motor responses, possibly due to error monitoring processes. We suggest that the distribution of eye blinks provides novel data which is complementary to the response time distributions and ERP measures which have previously been used to develop cognitive models for this task.

Feedback loops in detecting (un)seen change

Dr Marta Garrido, Group Leader
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Detecting changes in the environment is fundamental for survival, as these may indicate potential rewards or threats. It is unclear, however, the extent to which conscious awareness is necessary for change detection. In this EEG study, we asked whether the awareness of a change was necessary to trigger a prediction error response in the brain. We found that, not only such sensory prediction error is elicited even in the absence of conscious awareness, but also it peaks earlier without than with awareness. Moreover, with Dynamic Causal Modeling we found that the networks underlying unconscious prediction errors engaged forward interactions between visual cortex, inferior temporal gyrus, and prefrontal cortex. Conscious prediction errors on the other hand, engaged feedback loops amongst these regions, with a specific top-down connection between prefrontal cortex and the middle temporal complex. Our findings demonstrate that unseen changes evoke prediction errors and provide a mechanistic explanation for how these might be generated in the brain. In addition, we show further empirical support for the notion of pre-attentional predictive coding mechanisms in the brain.

Characteristics and differences of somatosensory impairment post-stroke based on lesioned hemisphere.

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Ms Gemma Lamp, Florey Institute of Neuroscience and Mental Illness
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Aim: Impairment in sensation post-stroke is common with estimates ranging between 49 to 80%, however our understanding of the neural networks impacted and associations of severity of sensation impair-
ment are lacking. We aimed to examine changes in functional connectivity post-stroke and explore differences in connectivity that may be due to lesioned hemisphere.

Methods: In this study we examined tactile dysfunction using the Tactile Discrimination Test (TDT) and functional connectivity at rest between right handed healthy controls (n=14) and two right handed chronic stroke subgroups - those with lesioning in the left hemisphere (n=14) and the hemisphere damage (n=14). BOLD signal from four regions (left / right S1 / S2) was correlated with intrinsic voxel BOLD signal for all participants.

Results: Preliminary analysis showed spatially similar lesioning severity between the two stroke subgroups. Severe tactile dysfunction was observed in the contra-lesional hand. Functional imaging results showed a range of differences between the three groups, including expected intra and inter-hemispheric functional connectivity in contra-lesional region. The left lesioned group showed decreased functional connectivity in bilateral regions of the Dorsal Anterior Network while right lesioned participants showed both decreases and increased in functional connectivity in areas of the right Fronto-Parietal Network.

Discussion: These results suggest the importance of accounting for lesioned hemisphere when assessing change in functional connectivity linked somatosensory networks. Additionally, these results highlight the potential usefulness of resting state analysis to examine neural correlates of tactile dysfunction post-stroke.

Hierarchical Frequency Tagging reveals neural markers of predictive coding under varying uncertainty

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Dr Roger Koenig-Robert, The University of New South Wales
A/Prof Jeroen vanBoxtel, Monash University
A/Prof Nano Tsujiya, Monash University
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Understanding the integration of top-down and bottom-up signals is essential for the study of perception. Current accounts of predictive coding describe this in terms of the interaction between state units encoding expectations or predictions, and error units encoding prediction error. However, direct neural evidence for such interactions has not been well established. To achieve this, we combined EEG methods that preferentially tag different levels in the visual hierarchy. Steady State Visually Evoked Potential (SSVEP) at 10Hz, tracking bottom-up signals) and Semantic Wavelet-Induced Frequency Tagging (SWIFT at 1.3Hz tracking top-down signals). Importantly, we examined intermodulation components (IM) as a measure of integration between these signals. To examine the influence of predictions on the nature of such integration, we constructed 50-second movie streams using house and face images and modulated expectation levels for upcoming stimuli by varying the proportion of images presented in each trial. We found SWIFT, SSVEP and IM signals to differ in important ways. SSVEP was strongest over occipital electrodes and wasn’t modified by certainty. Conversely, SWIFT signals were evident over temporo- and parieto-occipital areas and decreased with increasing certainty levels. Finally, IM components were evident over occipital electrodes and increased as a function of certainty. These results link SSVEP, SWIFT and IM signals to sensory evidence, predictions, prediction errors and hypothesis-testing - the core elements of predictive coding. These findings provide neural evidence for the integration of top-down and bottom-up information in perception, opening new avenues to studying such interactions in perception while constraining neuronal models of predictive coding.

Neural correlates of filling-in using steady state visual evoked potentials (SSVEP)

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Dr Matthew Davidson, Monash University
A/Prof Naotsugu Tsuchiya, Monash University
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In perceptual filling-in phenomena, a peripheral target disappears from conscious awareness and is replaced by the surrounding image texture. Despite such disappearance phenomena having been studied using psychophysics, single unit neural recordings and imaging, the underlying system-level neural mechanisms remain largely unknown. Here we used the Steady State Visually Evoked Potential (SSVEP) and whole head Electroencephalography (EEG) to understand the temporal dynamics of these perceptual experiences. We investigated the spatio-temporal changes in frequency tagging activity during perceptual disappearance and reappearance, focusing on the interactions between targets and their surrounds. We compared these changes to those induced by the physical disappearance and reappearance of the same targets. Twenty-nine participants tracked the visibility of four targets simultaneously, presented on a 20Hz flickering background. Interestingly, targets simultaneously disappeared more frequently than would be expected based on reshuffled data, implying that the neural representations of separate targets and/or their surrounding background may interact over relatively long distances. Indicative of this target/background interaction, we found that the 20Hz SSVEP power of the frequency tagged background increased significantly during filling-in, and that this increase became larger as more targets disappeared. By contrast, physical target disappearances showed the opposite trend, as 20Hz power decreased over occipital sites. This trend implies that the 20Hz SSVEP may emerge in middle visual areas, similar to what has been reported for areas V3/V4 in previous fMRI studies. Our results suggest that distinct long-range neural mechanisms may operate under perceptual and physical disappearances, providing an avenue for future research.

Minimally-invasive intracranial electrodes for brain-computer interfaces

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Brain-machine interfaces enable control of prostheses for people with spinal cord injury, loss of limb and other movement disorders. Many sophisticated prostheses have been developed that provide many degrees-of-freedom of operation. However, to provide adequate input to these systems has so far required direct implantation of electrodes into the brain via open craniotomy. We have developed a passive stent-electrode recording array, called the "Stentrode", that provides a minimally invasive approach that avoids brain trauma by placing the electrodes within a blood vessel in the brain. We have so far demonstrated feasibility of chronically recording brain activity from within veins for up to 190 days in pre-clinical trials, and are now gearing up for human trials by early 2018. The Stentrode may also have application for other neurological conditions.

Beyond brain decoding: Searching for information in the brain that also predicts behaviour

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Dr Radoslaw Cichy, Free University Berlin
Dr Thomas Carlson, University of Sydney

An implicit assumption often made in the interpretation of brain decoding studies is that information is decodable from a brain region, then the brain is using this information for behaviour (but see Williams et al., 2007). In the present study, we sought to study the dissociation between “decodability” and neural correlates of behaviour. This was achieved by constructing spatially unbiased maps of where decodable information relates to behaviour.

We used a support vector machine classifier and searchlight analysis to first identify regions of the brain that could decode whether visually presented objects were animate or inanimate from two fMRI datasets (n=16 and n=15) that used (92/118) different stimuli. A second searchlight analysis was then performed on the same data, where the distance of individual exemplars to the decision hyperplane in each voxel sphere was correlated to human reaction times (RT) on an animacy yes/no categorisation task (n=50, collected on Amazon’s Mechanical Turk). The decoding and RT-searchlight maps were tested for significance at the group level.

In both datasets, we found decodable information along the entire ventral-temporal pathway. Regions that also correlated with RT behaviour were however restricted to inferior temporal cortex (ITC). These results support ITC’s important role in object categorisation behaviour, consistent with previous region-of-interest based findings (Carlson et al., 2014). Our results further show that our behavioural RT-searchlight method complements standard searchlight decoding analyses by differentiating between information that is merely decodable, and information that is more directly related to behaviour.

Potential (SSVEP) and whole head Electroencephalography (EEG) to understand the temporal dynamics of these perceptual experiences. We investigated the spatio-temporal changes in frequency tagging activity during perceptual disappearance and reappearance, focusing on the interactions between targets and their surrounds. We compared these changes to those induced by the physical disappearance and reappearance of the same targets. Twenty-nine participants tracked the visibility of four targets simultaneously, presented on a 20Hz flickering background. Interestingly, targets simultaneously disappeared more frequently than would be expect-
Cerebral compensation during motor function in individuals with cerebellar degeneration

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Motor planning, execution, and coordination rely on neural activity within interconnected regions of the cerebellum and cerebral cortex. Degeneration of the cerebellum, such as in Friedreich ataxia (FRDA), results in profound motor impairments. However, the impact of cerebellar damage on movement-related cerebral function remains unclear.

In this study, 25 individuals with FRDA and 33 healthy controls performed two finger tapping tasks concurrent with whole-brain fMRI. Self-paced uncued tapping involved tapping the index finger to the thumb at a rate trained prior to scanning. During unpredictable cued tapping, visual cues indicated a required tap of the index, middle, ring, or little finger with the thumb. Each task consisted of four tapping blocks of 24s, interleaved with 16s rests.

During self-paced finger tapping, cerebral hyperactivation in individuals with FRDA at the lower end of clinical severity and cerebral hypoactivation in those more severely affected was observed in premotor/ventral attention brain regions, including the supplementary motor area and anterior insula. Greater activation in this network also correlated with greater offline motor precision. This pattern of results is consistent with capacity-limited neural reserve, whereby mechanisms of functional compensation may operate early in the course of disease, but fail away with continued progression.

Cued finger tapping was also associated with cerebral hyperactivation, but in this case within dorsolateral prefrontal regions of the executive control network and superior parietal regions of the dorsal attention system. Poorer offline motor precision correlated with greater dorsal attention activations. These findings suggest that individuals with greater motor deficits may employ alternative task strategies that rely on higher-order brain regions.

These findings together provide evidence of compensatory cerebrocerebellar function during movement generation in individuals with cerebellar damage.

Structural networks associated with rhythmic motor control and temporal prediction: An individual differences approach.

Dr Bronson Harry, Post Doctoral Fellow
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Prof Peter Keller, MARCS Institute

Human interaction often involves the rhythmic coordination of actions across multiple individuals, such as in ensemble musical performance. According to the adaptation and anticipation model (ADAM), stable sensorimotor synchronization (SMS) relies on two processes; adaptive mechanisms that correct for asynchronies in a reactive manner, and predictive mechanisms that estimate the timing of upcoming actions via internal simulations. The present study examined the brain networks associated with adaptive and anticipatory processes with diffusion tensor imaging (DTI) and Tract Based Spatial Statistics (TBSS).

To quantify adaptive and anticipatory mechanisms, we fitted a computational implementation of ADAM to data collected from two SMS tasks. Estimates of adaptation were derived from a SMS task involving an adaptive virtual partner, wherein participants drummed in synchrony with an adaptive metronome that implemented varying levels of phase correction. Estimates of anticipation were derived from a task in which participants drummed in synchrony with sequences with constantly varying tempo. Differences in adaptive and anticipatory parameters were correlated with differences in functional anisotropy derived from diffusion tensor modeling. TBSS revealed a positive correlation between adaptation and FA in the arcuate fasciculus, suggesting that simple sensorimotor synchronization relies on white matter pathways mediating the coupling of auditory and motor cortices. Anticipation demonstrated a negative correlation with FA in the posterior corpus callosum corresponding to tracts connecting the temporal lobes bilaterally. This latter finding mirrors recent evidence that adaptation to meter changes in drummed sequences correlates negatively with FA in the posterior corpus callosum. Taken together, these present findings suggest that the processing of meter and aperiodic predictable sequences rely on communication between bilateral temporal lobes.

Dynamic brain modular architectures supporting higher cognition

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Background: Our capacity for higher cognitive reasoning allows us to understand abstract ideas and solve complex problems. Previous fMRI studies have shown that reasoning performance is positively correlated with task-induced neural activity in segregated functional networks (Gray et al., 2003). More recently, it has been proposed that widespread neural networks can rapidly and flexibly reconfigure their patterns of functional connectivity in response to complex cognitive tasks (Braun et al., 2015), but the importance of these dynamic reconfigurations in network topology for reasoning abilities is unclear. In this talk I will present a study where we assessed the hypothesis that links neural network reconfiguration and reasoning performance.

Methods: We collected functional MRI (fMRI) data using a 7T scanner while 50 individuals completed a non-verbal reasoning task, akin to Sudoku, at three discrete levels of reasoning difficulty (The Laterality Task, Birney et al., 2006). To assess reconfigurations in modular architectures, resting state acquisitions were completed both before and after the task. Results: Reasoning task performance was characterized by the fusing of subcortical and cortical modules. We found that these modular changes were coupled with changes in network efficiency. Conclusions: Our results suggest that the modular architecture of the human brain can be rapidly renegotiated in response to task demand, moreover, the subsequent changes in network efficiency were related to individual differences in reasoning performance.

Interlimb generalisation of Bayesian sensorimotor learning occurs in extrinsic coordinates

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A/Prof Paul Sowman, Macquarie University
Dr David Kaplan, Macquarie University

An emerging paradigm shift is currently underway in neuroscience involving the modeling of neural systems using the mathematical framework of Bayesian decision theory, and more significantly, treatment of the brain itself as a Bayesian machine. Recent work suggests that the brain represents probability distributions and performs Bayesian integration during sensorimotor learning, but the evidence remains inconclusive. In this study, we provide additional behavioural evidence concerning the representation of Bayesian sensorimotor learning. Using a novel variation of an interlimb generalisation paradigm involving a stochastic visuomotor perturbation (i.e., a distribution of visuomotor shifts with a fixed mean and variance), in which visual uncertainty (the likelihood distribution) was manipulated, we tested whether Bayesian integration occurs during sensorimotor learning and transfers to the other limb. Relatedly, we tested whether the representation of this learned visuomotor perturbation is encoded in an extrinsic or intrinsic reference frame. We found that learning transfers from one limb to the other only when the visuomotor perturbation is congruent in extrinsic coordinates. We also found that although the learned prior distribution transfers relatively rapidly to the untrained limb, information about visual uncertainty (the likelihood distribution) does not, indicating that the prior and likelihood are represented independently of one another. This study provides valuable information about the nature of the representations underlying Bayesian integration in sensorimotor learning and opens up intriguing paths for future investigation.
Non-linear VEP analysis of orientation selective surround suppression

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Mr Thomas Pham, Student of Swinburne University
Ms Violu Putri Permadi, Student of Swinburne University

The response of visual neurons can be suppressed by surrounding stimuli that fall outside of their classical receptive field. Suppression is stronger when the central and surrounding stimuli share similar features, such as orientation. Premature neurophysiological studies have shown that extra-classical surround suppression occurs for magnocellular (M) but not parvocellular (P) cells in the retina and LGN. Contributions from the M and P visual pathways in humans can be investigated noninvasively, with studies of contrast reversal (n=23). Functions demonstrating the first major K2.1 component and the second major K2.2 component are likely to be of M and P origins, respectively. Here we used non-linear VEP to compare the effects of parallel and orthogonal surroundings on responses to a central, contrast-reversing grating. To further investigate the origins of the K2.1 and K2.2 components, we recorded responses at both low (0.5 cdP) and high (3 cdP) spatial frequencies. Consistent with a magnocellular origin, we observed orientation-specific surround suppression (OSSS) in the first component of the K2.1 response, at low but not high spatial frequency. No OSSS was observed in the second major component of K2.2 response, however consistent with a parvocellular origin, the amplitude was greatly reduced at low spatial frequency. To our knowledge, this is the first study to use non-linear VEP to separate the M and P pathway contributions to OSSS.

Distinct cortical contributions to recent and remote autobiographical memory retrieval - a longitudinal neuroimaging study in dementia

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Dr Sharpary Hsieh, Brain and Mind Research Centre
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Compromised autobiographical memory (ABM) retrieval is well established in dementia, attributable to degeneration of a core memory brain network. It remains unclear, however, how the progressive spread of atrophy through large-scale functional brain networks impacts ABM retrieval across life epochs. To this end, we conducted a longitudinal study of recent and remote ABM using the Autobiographical Interview in Alzheimer’s disease (n=11) and frontotemporal dementia (n=13), and contrasted their performance with healthy older Controls (n=23). Patients were re-tested approximately one year following their initial visit and underwent repeat ABM testing and structural brain imaging. Linear mixed modelling neuroimaging analyses were used to explore disease-specific cortical changes driving ABM alterations over time. At baseline, ABM was globally impaired in Alzheimer’s disease relative to Controls, with no evidence of significant deterioration following up. Notably, however, cortical thinning of lateral temporal regions was associated with memory performance at follow-up in Alzheimer’s disease. This association was further qualified on the behavioural level by robust correlations between semantic processing and ABM integrity at follow-up. In contrast, frontotemporal dementia patients demonstrated relatively preserved recent memory at baseline in the context of impaired remote memory. At follow-up, however recent memories were disproportionately disrupted in the frontotemporal dementia group, attributable to cortical thinning in posterior brain regions, including the lingual gyrus bilaterally and right posterior cingulate cortex/precuneus. Our findings offer new insights regarding the potential time-specific role of discrete cortical regions in modulating recent and remote ABM retrieval and provide novel evidence regarding the fate of personally salient memories with disease progression in dementia.

Nice and Slow: Measuring the sensitivity and aesthetic preference of naturalistic stimuli varying in their amplitude spectra in space and time

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Prof Colin Clifford, University of New South Wales
A/Prof Branka Spehar, University of New South Wales

Background: The 1/f^a amplitude spectrum is a statistical property of natural scenes characterising a specific distribution of spatial and temporal frequencies and their associated luminance intensities. This property has been studied extensively in the spatial domain, whereby sensitivity and aesthetic preference overlap and peak for slopes within the natural range (a=1.2). However, little is known about sensitivity and aesthetic preference to these statistical properties in the temporal domain. It is unknown whether sensitivity and aesthetic preference would be highest in response to a natural distribution of temporal frequencies (a=1.2), and whether they closely match across a range of slopes. Methods: To address this, a 4AFC task was used to measure sensitivity and a 2AFC task was used to measure aesthetic preference across a wide range of spatial (0.25, 1.25, 2.25) and temporal slopes (0.25, 0.75, 1.25, 1.75, 2.25). Stimuli with shallow temporal slopes move rapidly (i.e. 0.25), whereas stimuli with steep slopes move slowly (i.e. 2.25). Results: In both tasks, a significant effect was found for temporal slope variations, however the effect of spatial slope was non significant. Interestingly, sensitivity and aesthetic preference did not closely overlap. Sensitivity was highest for the most natural temporal slope in our stimulus set (1.25), however preference was highest for a temporal slope of 2.25. Discussion: While the sensitivity of the visual system is highest for our intermediate spatial stimulus (1.25), which is most abundant in nature, the slowest moving stimulus (2.25) seemed most preferred. A potential reason for these results might be related to the significance of these signals in evolutionary terms. Consider the cases of waves slowly vs. rapidly crashing on a beach or fast vs. slow animals. In both instances the slowest option is often the safest and preferential, which may be the reason for this deviation in sensitivity and aesthetic preference.

Action- and context-based prediction-error signals interact at the P3

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The human brain makes predictions about upcoming sensory input in at least two ways. First, it predicts sensations that result from actions producing them: Self-generated sounds elicit smaller neural responses than externally-generated sounds. Second, it predicts sensations based on past experience and context: Frequent sounds elicit smaller neural responses than infrequent sounds. The theory is that predictions prepare sensory and associative cortices to receive and ‘explain away’ sensory input, meaning that less cortical activation is required to process predicted sounds than unpredicted sounds; that is, sounds that elicit prediction-error. We set out to study the relationship between brain signatures of action- and context-based prediction-errors by measuring event-related-potentials (ERPs) to sounds that orthogonally varied in production (self- vs. externally-generated) and probability (frequent vs. infrequent). Consistent with previous research, we found that the N1 indexed action-based prediction-error signals and that the mismatch negativity (MMN) indexed context-based prediction-error signals. At the P3, we found that action- and context-based prediction-error signals interacted: Self-generated, infrequent sounds elicited the P3 whereas externally-generated, infrequent sounds did not. Using standardized low-resolution brain electromagnetic tomography (sLORETA), we found that the action- and context-based prediction-error signals interacted during the time range of the P3, they have discrete neural sources. We conclude that prediction and prediction-error signals are the common computational principles underlying action and perception.
Vascular disease is the primary modifiable risk factor for late-life dementia. A current focus is understanding the clinical trajectory of cognitive impairment with a vascular origin: from no impairment, to Vascular Cognitive Impairment (VCIND), a form of Mild Cognitive Impairment, to dementia. This study aimed to investigate cross-sectional associations between cardiovascular risk burden, cognitive performance (Addenbrooke’s Cognitive Examination/ACE-III) and ERPs during an executive function task. A total of n=77 (56% female) adults between 50 and 80 years of age completed a graded difficulty n-back task – 0, 1 and 2-back – from which ERPs were calculated. Cardiovascular risk was characterised using multiple standardised tools: Exercise and Sport Science Australia Pre-exercise, Framingham, and Cardiovascular Risk Factors Aging and Incidence of Dementia (CAIDE). Mixed-effects modelling showed that the early P1 and N1 components were not associated with cardiovascular risk burden. The P3 component was significantly attenuated in those with high cardiovascular risk across all difficulty levels (i.e. no interaction between cardiovascular risk and difficulty). Increasing age and a lower ACE-III score also predicted attenuated P3 responses, with smaller effect sizes than cardiovascular risk. A significant interaction between ACE-III and cardiovascular risk burden showed that increased risk associated with attenuated P3 amplitudes more so for those with better cognitive performance; in fact, there was no relationship in those under the Mild Cognitive Impairment threshold. Findings indicate that cardiovascular disease and risk factors are independently associated with attenuated P3 responses recorded during an executive function task, a domain known to be first affected in VCIND. This relationship was most pronounced in those with pre-clinical impairment, the period in which we need to implement and track preventative interventions for dementia.

Don’t get too excited: Higher levels of visual cortex excitability predict smaller visual working memory capacities

Miss Rebecca Keogh, Post-doctoral Researcher University of New South Wales

Despite the rich detailed sensation many of us feel when remembering visual scenes, our visual memory is severely limited, with individuals only being able to remember, on average, 3 items, however these estimates vary considerably with individual capacity limits ranging from 1-5 items. Exactly what drives these individual differences in visual working memory (WM) capacity at a neuronal level remains unknown. Recent neuroimaging research has indicated that the early visual areas are used to hold low-level sensory information in mind when completing WM tasks. Conversely, higher-level regions, such as the frontal and parietal areas, are thought to be involved in general task demands rather than representing low-level visual information in mind. Most research into individual differences in WM has assessed high-level attentional cognition. Here we aimed to investigate how individual differences in the functionality of low-level visual areas might also drive the widely observed differences in WM capacity limits. To do this we first measured the levels of visual cortex excitability (using magnetically induced phosphene thresholds (TMS)) and correlated this with an individual’s WM capacity. We found there was a negative correlation between visual cortex excitability and an individual’s WM capacity; that is the less excitable an individual’s visual cortex was, the more items they could hold in mind. Next we manipulated the excitability of visual cortex using anodal and cathodal transcranial direct current stimulation (tDCS). We found that increasing visual cortex excitability (anodal tDCS) resulted in poorer performance on the WM task, whereas cathodal stimulation resulted in a slight increase in performance. These findings provide both correlational and causal evidence that the excitability levels of the visual cortex may regulate the number and quality of items an individual can hold in mind.

See me, feel me: Do bodily-self cues affect visual-tactile asynchrony detection?

Mr Robert Keys, Graduate Student Macquarie University

Bodily-self perception is essential for interacting with our environments, and successfully tracking our own bodies. Research into this area has implications for our understanding of multisensory processes, and clinical populations, such as schizophrenia and autism spectrum disorders, who have altered experiences of the bodily-self. Bodily-self perception relies on multisensory cues, such as the plausibility of viewed body form and orientation, as well as spatially and temporally congruent multisensory inputs. Previous research shows that particular bodily-self cues influence spatial aspects of visual-tactile processing. These cues can also modulate the temporal processing of visual-proprioceptive information - for example, individuals are more sensitive to asynchronies between seen and felt movements when viewing a plausible hand orientation. One hypothesis for this interaction is that bodily-self cues directly modulate multisensory processing, and that bodily-self cues have a general effect on multisensory temporal processing. Here, we investigated whether this temporal modulation in bodily context cues occurs for visual-tactile perception. In two experiments, we manipulated bodily-self cues (viewed hand orientation and multisensory synchrony) and employed a two-interval forced-choice task to measure asynchrony detection thresholds. Participants detected asynchronies between an LED flash and a tap on the middle finger. We used Bayesian analyses to test evidence for the hypothesis that plausible bodily-self cues increase the sensitivity for visual-tactile asynchrony judgments, compared to implausible cues. Calculations of the Bayes factor were all < 1/3, strongly suggesting that bodily-self cues do not affect visual-tactile temporal accuracy. This indicates that bodily-self cues do not lead to a general improvement in multisensory temporal processing, and that previously found effects might be particular to movement and spatial processing.
Conspiracy theorists are often compared to patients who suffer from clinical delusions. Conspiracy theorizing does seem to involve serious breakdowns in rationality. Yet it is not obvious that conspiracy theorists form a homogenous group, and selection bias may ensure that we encounter only the most committed and least socially adept conspiracy theorists. We attempt to get a more nuanced picture by looking at a large sample of comments from the conspiracy forums at reddit.com. Using a combination of network analysis and topic modelling, we explore similarities and differences between conspiracy theorists of various stripes, showing (among other things) the unexpectedly high numbers of casual conspiracy theorists, the persistent role of racism in generating and maintaining conspiracy theories, and the differing epistemic concerns, motivations, and doxastic attitudes between enthusiastic and casual conspiracy theorists."

Decoding the nonconscious dynamics of thought generation

Dr Roger Koenig, Postdoctoral fellow
University of New South Wales

Dr Joel Pearson, University of New South Wales

Much of economics, psychology and neuroscience have focused on thought dynamics and how they control our behavior, from individual moral choices to the irrationality of market dynamics. However, how much of our thoughts we actually control when we feel we make deliberate choices remains unknown. Here we show that the content of thoughts can be decoded from activity patterns as early as 11 seconds before individuals report having made the volitional thought. Participants freely chose which of two differently oriented and colored patterns to think about visually. Using functional magnetic resonance imaging and pattern classification methods we consistently classified the contents of thoughts using activity patterns recorded before and after the thought was reported. We found that activity patterns were predictive as far as 11 seconds before the conscious thought, in visual, frontal and subcortical areas. These predictive patterns contained similar information to the responses evoked by unattended perceptual gratings and were evident in individual visual areas. Interestingly, neural information present before the decision was associated with the vividness of future thoughts, suggesting that preceding nonconscious sensory-like representations can impact the content and strength of future conscious thoughts. Our results suggest that thoughts and their strength, can be biased by spontaneous nonconscious perception-like representations, advancing theories of free will and models of intrusive and repetitive thought production.

Meta-analysis of touch studies reveals laterality effects in activation of secondary somatosensory cortices

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Brain regions involved in processing somatosensory information have been well documented through lesion, animal, and more recently, neuroimaging studies. While functional neuroimaging studies characterise responses related to somatosensory processing, a synthesis of this knowledge is currently lacking. Further in-depth knowledge of the regions involved in somatosensory-related tasks may also be confounded by motor influences. Our Activation Likelihood Estimate (ALE) meta-analysis sought to quantify brain regions that are involved in the tactile processing of the individual right (RH) and left hands (LH), with the exclusion of motor-related activity. The majority of studies (n=36) only measured activation for RH touch stimulation, and these were separated into those which conducted whole brain analysis (n=25) and those which examined specific regions of interest (ROI; n=11). Brain activation associated with RH stimulation (whole brain) studies revealed large clusters in left somatosensory cortex (S1) and bilaterally in somatosensory area two (S2). In contrast, RH whole brain studies indicate the importance of taking into consideration bilateral activation, particularly in S2. Due to the small number of studies which examined LH stimulation (n=5), preliminary analyses only revealed one small cluster within the right (S2). These findings highlight the importance of S2 activation in touch stimulation, particularly the role of right S2 across both hands. The implications of this lateralised pattern of somatosensory activation for further research and for possible differences in right and left hemispheric stroke lesions are discussed.

Shepard tones test prediction: Amplitude of mismatch negativity is determined by the size of prediction error

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The mismatch negativity (MMN) is an automatic brain response to perceived irregularity in the auditory environment. It is greater negativity in the event-related potential (ERP) occurring approximately 100-250 ms after the onset of an irregular, deviant tone compared to that from a standard, or standard tones. We aimed to test whether the MMN could occur when the standards changed on every trial in a predictable way and whether the size of the MMN is dependent on the magnitude of difference between the predicted tone and the deviant. We presented 20 participants with discrete Shepard scales created from 12 equally spaced Shepard tones. In half of the blocks, the Shepard scale descended continuously, in the other half it ascended continuously. We then randomly violated the scale with four kinds of deviants. Two had their base frequency between those of the preceding and the next, predicted standard (we call this the NSA condition), with one being farther from the predicted (Dev1) and the other being closer to the predicted (Dev2). The other two had their base frequency between those of the next, predicted standard and the standard after that (we call this the NSA condition), with one being closer to the predicted (Dev3) and the other being farther from it (Dev4). We found larger MMNs to deviants more different from the predicted tone, confirming that prediction is important in generating the MMN. We also unexpectedly found larger PNS MMNs than NSA MMNs, needing further exploration.

Individuals with higher autistic-like traits show reduced face-inversion, but increased car-inversion effects in saccadic choice tasks

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Individuals on the autism spectrum are reported to exhibit impairments in face processing, including identity recognition and emotion processing. One aspect of typical face processing reported to be impaired in autism spectrum disorder (ASD) is the face inversion effect in which recognition of inverted faces is more difficult in individuals with normal development, whilst there are usually no inversion effects for other object categories. Although some studies have documented reduced face inversion effects in ASD, this has not been well replicated, with many studies in fact finding the typical inversion effect in ASD populations. We employed a saccadic choice task requiring participants to make a saccade towards one of two pictures of natural scenes containing a target, presented left and right of fixation. Across four tasks, the target to be detected was either a face or a car with the second photo consisting of a neutral tractor picture, with all pictures presented either upright or inverted by 180 degrees, in a factorial design. Two groups of non-clinical participants with either higher or lower levels of autistic-like traits completed the tasks, with saccade onset times directed towards targets compared between groups and task conditions. A three-way
Early feedback from frontal to occipito-temporal cortex during visual word recognition

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Previous studies have shown that skilled readers can rapidly differentiate visual words from symbol strings; differences in the evoked responses become apparent by about 200 ms after stimulus onset. A recent MEG study further found that during the early stages of visual word processing, activity in the left inferior frontal gyrus (left IFG) exerts a stronger top-down influence on the left ventral occipito-temporal cortex (left vOT) for real words than for meaningless symbols (Woodhead et al., 2014). However, questions remain about the nature of this top-down influence, specifically whether it reflects lexical-semantic or phonological effects. The aim of the current study was to shed light on this question using dynamic causal modelling (DCM). Fifteen adults participated in a MEG experiment in which they viewed four types of visual stimuli: real words (RW), pseudowords (PW), consonant strings (CS) and false fonts (FF). Six nodes including bilateral IFG, bilateral vOT and bilateral primary occipital cortex (OCC) were chosen in the DCM analysis. Through the specific contrasts of RW vs PW (lexical-semantic effect), PW vs CS (phonological effect) and CS vs FF (low-level letter effect), we were able to examine the nature of the early top-down influences. The results showed that within 200 ms after stimulus onset, the connection from left IFG to left vOT was stronger for RW than for CS and for RW than for PW, indicating that both lexical-semantic and phonological information are implicated in the top-down influence from the left IFG to left vOT. These results add to our understanding of the nature of high-level feedback effects during the early stages of visual word recognition.

Interpreting the amplitude of auditory signals through visual cues to sound source distance

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Many studies in auditory cognitive neuroscience examine the consequences of variations in the properties of sound waves reaching the ear. However, few studies relate such properties to the physical environment. Here, we consider the implications of the dependence between the amplitude of the signal reaching the ear and the distance between the sound source and the listener. The theory of loudness constancy proposes that the loudness (perceived intensity) of a sound at the ear demonstrates some invariance to this attenuation of sound amplitude over distance. Here, we investigated whether loudness constancy could be generated solely through the presence of visual cues to the distance of the sound source. In a series of three experiments, participants performed a psychoacoustic task in which they judged the relative loudness of two consecutively presented pure tones. Delivery of each tone was accompanied by the visual presentation of a computer-generated scene with a frontally-presented loudspeaker at a particular distance (7.5m, 15m, or 30m). Distance of the cognitive task via various monocular cues. We find that the prediction from loudness constancy, that the point of subjective loudness equality would correspond to different amplitudes for tones perceived as being emitted from sources at different distances, was not supported. Instead, the participants performed the task in a manner consistent with the amplitude at the ear. Future research is required to clarify the situational factors that control the expression of loudness constancy. Such knowledge is vital to the interpretation of auditory research, particularly in cases where variations in amplitude responses are associated with clinical conditions.

Are cognitive processes facilitated by motor demands?

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We often walk around when we have to think about something, but suddenly stop when we are confronted with a highly demanding cognitive task, such as calculating 1540*24. While previous neurophysiological research, investigated cognitive control during walking (Kok, 2001), the motor task effect is specific to one-legged stance and a later positivity (350-500ms P3). Statistical analysis of the early time window registered a motor x cognition interaction [F(1,19)=5.83, p<0.027]. Resolution of this interaction revealed an effect of the cognitive task in the one-legged stance motor condition [F(1,19)=4.32, p>0.05] that was not present with a motor-cognitive interaction [F(1,19)=5.83, p=0.027]. While the influence of the cognitive task-difficulty (in the P3) is in accordance with previous studies (Kok, 2001), the motor task effect is specific to one-legged stance (cf. no effects for running, Gramann et al., 2010). The motor-cognitive interaction found in P2, leads to the suggestion that the more complex motor task (one-legged stance) facilitates cognitive task performance.

Walking reduces spatial neglect: An eye tracking study

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Background: Spatial neglect is a common consequence of stroke. Neglect behaviour is typically exacerbated by increased task demands. It was thus anticipated that the addition of a secondary task requiring general attention (walking) would worsen performance on tests of spatial neglect. Here, however, we report a patient in whom neglect was considerably reduced when performing a visual search task while walking. Methods: A SMI Eye Tracker Glasses were employed to quantify eye movements of a 55-year old stroke patient with right brain damage. The patient, who displayed marked signs of left-sidemed neglect in paper-and-pencil measures, performed a visual search task on a computer screen (single-task) and while walking (dual-task). In the dual-task, the patient was required to detect targets placed along the ward corridors while walking a circular course. In order to assess neglect behaviour, an exploratory quotient was calculated by dividing the number of saccades to the left visual field by the number of saccades into the right visual field. Values > 1 indicate more saccades towards the right side, whereas values of 1 suggest a symmetric exploration of the left and right sides of space. Results: The exploratory quotients for the computer and walking visual search tasks were 1.23, 4 and 2.1, respectively. The walking quotient was thus more than 60 times smaller than the computer quotient. The much smaller quotient indicates a substantial increase of saccades to the left and, consequently, a significant reduction of neglect behaviour in the dual-task relative to the single-task visual search conditions. Conclusions: Contrary to expectations, walking reduced symptomatics of spatial neglect. Several explanations for why a presumably more taxing task ameliorated neglect will be discussed. For example, this patient may have suffered from left spatial neglect for near but not far space.
Goal-directed and habit-like modulations of stimulus processing during reinforcement learning
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Dr Tom Beesley, University of New South Wales
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Animals and humans rapidly learn how to act in order to obtain rewards. Such reinforcement learning is supported by two different systems: A goal-directed system which represents outcomes and their values separately, and a habit system which caches the value of the stimulus-response association (S-R). This latter S-R representation leads to fast (but inflexible) responses given detection of the relevant stimulus. Recently, it has been shown that perceptual processing of stimuli predicting reward is automatically prioritized once they are associated with high value rewards, even when rewards are no longer available. It has been proposed that such reward-related modulation of stimulus salience is conceptually similar to an ‘attentional habit’. Recording event-related potentials in humans during a reinforcement learning task, we show strong evidence in favor of this hypothesis. Resistance to outcome devaluation (the defining feature of a habit) was shown by the stimulus-locked P1 component (from 130 to 200ms), reflecting activity in the extrastriate visual cortex. Analysis at longer latencies revealed a positive component (corresponding to the P3b, from 550 to 700ms) sensitive to outcome devaluations. Thus, distinct spatio-temporal patterns of brain activity were observed corresponding to goal-directed and habitual values. These results demonstrate that cortical responses to both cached and current reward value occur in the same learning episode, suggesting that reinforcement learning engages both attentional habits and goal-directed processes in parallel.

Motivation enhances suppression of irrelevant emotional distractors.
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Prof David Harper, University of Wellington
Dr David Carmel, University of Edinburgh
Dr Gina Grimshaw, University of Wellington

Our attention is biased towards emotional stimuli, which are often useful for survival and reproduction. But sometimes we must ignore emotional things when they are not relevant to current goals. Using effective cognitive control to ignore distractors is cognitively taxing, so we will only exert the extra effort if it seems ‘worth it’, for example if distractors are frequent and expected, or if we are sufficiently motivated to do so. Motivation reduces distraction from neutral and negative images. However, it is unknown whether motivation can encourage suppression of positive distractors, which are themselves rewarding. To determine how motivation influences suppression of positive, negative and neutral distractors, we had participants complete a simple perceptual task while attempting to ignore centrally-presented, task-irrelevant images, which could be intact or scrambled. Intact images were either positive (erotic scenes), negative (mutilations) or neutral (scenic people). To elicit motivation, one group received a monetary reward for fast and accurate task performance, while a control group received no performance-based incentive. Overall, both negative and positive images were more distracting than neutral images, as reflected by slowing of responses on trials with intact relative to scrambled distractors. Crucially, the greater distraction from emotional images was attenuated in the reward condition – reward reduced distraction from both negative and positive images equally. Despite the rewarding nature of positive images, motivation can help us to ignore positive distractions.

An ERP study investigating memory-theory and predictive-coding of visual mismatch negativity (vMMN)
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Murdoch University

Dr Urte Roerber, Murdoch University
Prof Robert O’Shea, Murdoch University

The visual mismatch negativity (vMMN) is a brain signature of pre-attentive change processing usually tested with an oddball task. In the oddball task, there is a regular series of stimuli—standards—and occasionally an irregular stimulus—a deviant. By recording the electroencephalogram (EEG), we typically see greater negativity in response to deviants compared to the standards from about 150 to 400 ms after onset—the vMMN. There are two prominent theories about the vMMN’s origin: one is that the series of standards establishes a memory trace and the deviant is different from the memory trace, requiring extra processing. Another is that the series of standards generates a prediction and the deviant yields prediction error, requiring extra processing. To discriminate between these two theories, we presented a series of static Gabor patches (120 ms, ISI: 680 ms), with each new Gabor rotated by 30 degrees from the previous. This continued until interrupted by a deviant rotated by 10, 20, 40, or 50 degrees (i.e., 10 or 20 degrees different from predicted, either less or more). According to memory theory, no vMMN would be expected from this task, because standards change according to a rule to allow predictions. Preliminary analysis suggests that opposite to our prediction from memory theory we found that deviants less than the predicted orientation yielded different voltages from deviants more than the predicted orientation. We conclude that predictive coding gives a better account of our results than memory theory.

Cognitive remediation improves executive functions, self-regulation and quality of life in residents of a substance use disorder therapeutic community
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Ms Joanne Lunn, We Help Ourselves
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Deficits in executive functions (EFs) are common in substance use disorder (SUD) populations and hinder treatment. Recent research has trialled neuropsychological interventions to remediate EFs. We previously found that 50% of residents in SUD therapeutic communities had been hospitalised for head injuries and this was a significant determinant of cognitive impairment. The current study aimed to establish whether cognitive remediation improves EFs and self-regulation in an ecologically valid sample of residents attending SUD therapeutic community treatment, including those with past head injuries and psychiatric comorbidities. Controlled sequential groups design with all residents (N = 33, all female) receiving treatment as usual (TAU). The first group (n = 16) completed four weeks of cognitive remediation (CR) and the second, TAU only (n = 17). Outcome measures assessed post-intervention included performance-based EFs, Behavior Rating Inventory of Executive Function - Adult Version (BRIEFA), self-regulation and quality of life. CR relative to TAU significantly improved inhibition (Color-Word Interference Test; F = 4.29, p = 0.047), inventory-based assessment of EFs (BRIEFA Global Executive Composite; F = 6.38, p = 0.017), impulsivity (Barratt Impulsiveness Scale; F = 4.61, p = 0.040), self-control (Brief Self-Control Scale; F = 5.53, p = 0.026) and quality of life (Quality of Life Enjoyment and Satisfaction Questionnaire - Short Form; F = 7.68, p = 0.010). These findings suggest that CR improves EFs in a heterogeneous sample of residents in therapeutic community SUD treatment. Future research may explore the possibility of tailoring CR interventions for various SUD subgroups.

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How does knowledge affect attentional capture vs. dwelling and awareness? Evidence from EEG and eye movements.

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Attention can be guided by the inherent salience of an object (bottom-up saliency) or the goals of the observer (top-down knowledge). Contrary to the prevalent view that attention is top-down biased to specific feature values (e.g., large, red, feature similarity view), recent studies have shown attention can be biased to relative features of a target in a context-dependent manner (relational tuning). However, previous studies focused mainly on implicit measures of attention (e.g., RTs, eye movements). The aim of the present study is to examine the effects of top-down (relational) tuning on overt (eye movements) and covert attention (N2pc in EEG), as well as awareness. In a visual search task, participants had to find a pre-defined colour target among several non-target items, and ignore an irrelevant distractor. To distinguish feature-specific from relational tuning, the colour of the distractor systematically varied such that it matched either the exact target colour (e.g., bluish green) or its relative colour (e.g., blue). In two different experiments, the attentional capture by the distractor was assessed by eye movements to the distractor or the N2pc in the EEG. To index awareness of the distractor, participants were asked to report its location on a small portion of trials. The eye movement results revealed that target-dissimilar distractors that matched the relative colour of the target (e.g., blue) captured attention and the eyes most strongly, whereas target-similar distractors held attention for longer. The N2pc component mimicked these findings, reflecting more capture by relatively matching distractors, but elongated dwelling on target-similar distractors. Awareness depended both on the initial capture of attention and dwelling on the distractor. This study highlights the importance of the context in determining top-down tuning of attention, which in turn influences orienting of attention, distraction, and our awareness of stimuli in the environment.

Reduced willingness to expend effort for reward in obesity: Link to weight loss outcomes

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Objective: (1) To compare willingness to expend effort for rewards, predict adherence to weight loss treatment. Methods: 73 participants completed the Effort Expenditure for Rewards Task (EEfRT). Of those 73 participants, 42 excess weight young adults took part in a 3-month weight loss treatment after completing the EEfRT. Generalized Estimating Equations (GEE) models were used to compare the healthy-weight, overweight and obese groups in the EEfRT. Logistic regression models, including the proportion of hard-task choices for each reward probability condition as predictors (12, 50 and 88%), were conducted to longitudinally predict attrition in the treatment. Results: Obese young adults were significantly less willing to expend effort for high magnitude rewards compared to overweight participants (p<0.05). Willingness to expend effort for uncertain rewards (50% probability) distinguished between completers and dropouts in the weight loss treatment (p<0.02). Considering compared to their overweight counterparts, there has been diminished motivation to expend effort for obtaining high magnitude rewards. Less willingness to expend effort for the most uncertain rewards predicts poor adherence to weight loss treatment.

Necessity tamed: metacognition in the near absence of attention

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Whether conscious perception requires attention remains a topic of intense debate. Directing the focus of top-down spatial attention to a demanding central task, the dual-task literature has repeatedly demonstrated that the discrimination of certain complex stimuli can be achieved in the near absence of attention while perceptually simpler items are severely impaired. However, it remains unclear whether accurate discrimination of these unattended, complex stimuli is accessible to consciousness or just a product of unconscious processing as in blindsight. We addressed this issue by developing a novel, dual-task paradigm incorporating confidence ratings and an adaptive staircase procedure. With minimal training, subjects achieved equivalent task performance for face-gender discriminations performed under single-task or dual-task conditions. Further to this, gender-discrimination accuracy correlated with trial-by-trial confidence ratings, an indication of above-chance metacognitive accuracy, confirming conscious awareness of gender despite little or no top-down spatial attention. In contrast, the discrimination of simple coloured disks was significantly impaired with metacognitive accuracy dropping to chance even in a partial-report condition. Our findings demonstrate the first evidence that discrimination of face-gender in the near absence of attention is consciously accessible.

Dynamic causal modelling reveals a rapid subcortical route to the amygdala in visual and auditory processing.

Dr Jessica McFayden, Centre of Advanced Imaging, Brisbane

Background: Since the discovery of a rapid, subcortical pathway from the thalamus to the amygdala in rodents, it has been theorised that a visual equivalent might exist in the human brain. This proposition has been met with much controversy but computational modelling has begun to shed light on the existence and potential functional role of such a pathway. Methods: I will present a series of magnetoencephalography (MEG) studies that employed dynamic causal modelling to investigate how visual (McFayden et al., in prep, Garvert et al., 2014) and auditory (Garrido et al., 2012) are transmitted along subcortical and cortical pathways to the amygdala. In these studies, participants made gender judgements on emotional and non-emotional faces. In the auditory study, participants also heard expected and unexpected tones. Results: Collectively, these experiments demonstrated that the discrimination of certain complex stimuli can be achieved in the near absence of attention while perceptually simpler items are severely impaired. However, it remains unclear whether accurate discrimination of these unattended, complex stimuli is accessible to consciousness or just a product of unconscious processing as in blindsight. We addressed this issue by developing a novel, dual-task paradigm incorporating confidence ratings and an adaptive staircase procedure. With minimal training, subjects achieved equivalent task performance for face-gender discriminations performed under single-task or dual-task conditions. Further to this, gender-discrimination accuracy correlated with trial-by-trial confidence ratings, an indication of above-chance metacognitive accuracy, confirming conscious awareness of gender despite little or no top-down spatial attention. In contrast, the discrimination of simple coloured disks was significantly impaired with metacognitive accuracy dropping to chance even in a partial-report condition. Our findings demonstrate the first evidence that discrimination of face-gender in the near absence of attention is consciously accessible.

Rapid adjustments of frontoparietal networks underpin proactive cognitive control

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Mr Patrick S. Cooper, University of Newcastle
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Dr W. Ross Fulham, University of Newcastle
Prof Patricia T. Michie, University of Newcastle
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Background: Since the discovery of a rapid, subcortical pathway from the thalamus to the amygdala in rodents, it has been theorised that a visual equivalent might exist in the human brain. This proposition has been met with much controversy but computational modelling has begun to shed light on the existence and potential functional role of such a pathway. Methods: I will present a series of magnetoencephalography (MEG) studies that employed dynamic causal modelling to investigate how visual (McFayden et al., in prep, Garvert et al., 2014) and auditory (Garrido et al., 2012) are transmitted along subcortical and cortical pathways to the amygdala. In these studies, participants made gender judgements on emotional and non-emotional faces. In the auditory study, participants also heard expected and unexpected tones. Results: Collectively, these experiments demonstrated that the discrimination of certain complex stimuli can be achieved in the near absence of attention while perceptually simpler items are severely impaired. However, it remains unclear whether accurate discrimination of these unattended, complex stimuli is accessible to consciousness or just a product of unconscious processing as in blindsight. We addressed this issue by developing a novel, dual-task paradigm incorporating confidence ratings and an adaptive staircase procedure. With minimal training, subjects achieved equivalent task performance for face-gender discriminations performed under single-task or dual-task conditions. Further to this, gender-discrimination accuracy correlated with trial-by-trial confidence ratings, an indication of above-chance metacognitive accuracy, confirming conscious awareness of gender despite little or no top-down spatial attention. In contrast, the discrimination of simple coloured disks was significantly impaired with metacognitive accuracy dropping to chance even in a partial-report condition. Our findings demonstrate the first evidence that discrimination of face-gender in the near absence of attention is consciously accessible.

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Cognitive control refers to a number of processes that facilitate goal-directed adjustments of behaviour such as overriding autonomic responses, set-shifting, and updating working memory. These processes occur in the prefrontal cortex, a region of the brain that is particularly active during tasks requiring cognitive manipulation. The prefrontal cortex is involved in various cognitive processes, including decision-making, planning, and inhibitory control. Dysfunctions in cognitive control are associated with a number of neurological and psychiatric disorders, such as ADHD, schizophrenia, and depression. The prefrontal cortex is composed of a number of different brain areas, each with its own unique function. For example, the dorsolateral prefrontal cortex (DLPFC) is involved in working memory and planning, while the ventromedial prefrontal cortex (VMPFC) is involved in social cognition and decision-making. These areas are interconnected through a network of neurons, allowing for coordinated activity during cognitive tasks. Understanding the neural mechanisms underlying cognitive control is crucial for developing effective interventions for individuals with cognitive control impairments.
The 6th Australian Cognitive Neuroscience Conference

**Local/global influences on attention orienting across the subclinical autism spectrum**

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Ms Annie Agnus, La Trobe University
Ms Grace Christou, La Trobe University
Ms Gokce Erkocu, La Trobe University
Mr Saxon Goold, La Trobe University
Mr Simon John, La Trobe University
Ms Claudia Nguyen, La Trobe University
Ms Jessica Schepis, La Trobe University
Ms Penny Trueman, La Trobe University
Ms Clare Wilson, La Trobe University
Prof Sheila Crewther, La Trobe University
Dr Robin Laycock, RMIT University

Individuals with Autism Spectrum Disorder as well as subclinical populations with higher autism-like traits (AT) are reported to demonstrate a local bias in visual processing. Assessment of such processing typically requires explicit attention to global and/or local information. We used a sub-clinical adult population with higher or lower autism-like traits to first detect anomalies in explicit local/global processing using Navon letter stimuli, and secondly to determine whether involuntary reflexive processing of local/global compound arrow stimuli would differentially orient spatial attention.

The Navon task required participants to detect whether a target letter was present or absent from congruent or incongruent stimuli. Targets were present at either local, global, or both levels. The Arrow Cueing Task used congruent and incongruent hierarchical arrow stimuli pointing left or right. A Posner cueing paradigm was utilised with participants responding to a simple target appearing left or right of a previously presented cueing arrow after 250ms or 750ms SOA. Participants were informed that cue validity was uninformative.

The Navon Task revealed greater local to global interference in the High- compared with the Low-AT group, whereas there were no group differences in global to local interference. For the Arrow Cueing Task a cueing effect for congruent arrow cues for the 750ms SOA was observed, with the High AT group remaining susceptible to reflexive arrow cueing effects in this condition. No group differences were observed for incongruent arrow cueing. Although higher autistic traits were associated with a greater local bias during explicit global target identification, this did not transfer to reflexive local/global processing differences in the cueing task. Instead, the larger cueing effect for congruent arrows at 750ms SOA for the High-AT group may indicate a slower capacity to override exogenous attention processes with top-down control.

**Biases in perceiving gaze vergence**

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Dr Colin Palmer, University of New South Wales
A/Prof Yumiko Otsuka, Ehime University, Matsuyama, Japan
Prof Colin Clifford, University of New South Wales

The perception of another’s gaze is an important cue in social interactions, wherein the focus of their gaze can indicate an object of interest or potential danger in the environment. The vergence of the two eyes (i.e., their convergence or divergence) provides information about the distance of this object of fixation from the person. In the present study, participants viewed synthetic faces with varying degrees of eye vergence. Our first experiment examined whether observers had a bias for perceiving a particular vergence of gaze, and whether this was influenced by gaze direction. A second experiment further investigated this bias by manipulating stimulus uncertainty, realised by adding dark glasses over the eyes of the face stimuli. Results showed a significant bias for a particular vergence of gaze and fixating at closer distances, especially when their gaze was directed downwards and under conditions of uncertainty. The overall bias to perceive gaze as convergent may reflect the predominance of convergent over divergent gaze in everyday social interaction. That downwards gaze is most likely to be perceived as convergent might reflect the implicit knowledge that when someone’s gaze is averted downwards there is a higher probability of fixating on an object close to themselves. These findings have significant implications for our understanding of social vision and how our visual system operates when faced with perceptual uncertainty.

**Partial inhibition reveals age-related change during response inhibition in mid-to-late adolescents**

Mr An Nguyen, PhD Student
University of Western Australia
Dr Jonson Moyle, Princess Margaret Hospital
Dr Allison Fox, University of Western Australia

Evidence from neuroimaging supports the protracted development of brain regions involved response inhibition. However, few studies have examined the development of response inhibition during the transition from adolescence to adulthood. In this study, we used an error-sensitive go/no-go task that allowed us to detect when participants initiated, but did not complete, their response to nogo trials (partial inhibitions). We compared task performance and the N2 and P3 elicited during successful and partial inhibitions between mid-to-late adolescents (N = 26, M = 15.57, SD = 0.90) and adults (N = 24; M = 21.17, SD = 3.52). The results showed that adolescents made more errors on nogo trials compared to adults, and within the adolescent group, the proportion of errors on nogo trials decreased with age. In the ERPs, we observed significant group differences in the latency and distribution of the N2: The N2 peaked later adolescents and showed a broader scalp distribution. Furthermore, N2 peak latency on successful inhibitions was significantly associated with the proportion of errors on nogo trials and age in adolescents. No significant group differences in the overall amplitude or magnitude of the N2 and P3 effects were observed, and both groups showed a similar response during partial inhibitions. The ERP data suggests that the observed performance differences were due to an increase in the speed and efficiency of conflict monitoring processes as opposed to improvements in response inhibition.

**Distinct cerebellar contributions to cognitive-perceptual dynamics during natural viewing**

Dr Vinh Nguyen, Research Scientist
QIMR Berghofer

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Introduction: The contribution of the cerebellum to motor learning and coordination is very well known. In recent years, increasing evidence from clinical and cognitive neuroscience research has supported an emerging view of the cerebellar involvement in cognitive and affective processes. The exact nature of this involvement, however, is far less understood than the motor function of the cerebellum. In particular, putative functional subdivisions and specific cognitive functions are not known. Methods: Twenty right-handed participants underwent a resting-state fMRI session, followed by a naturalistic fMRI session - freely viewing a short drama in its entirety. We used both data-driven and hypothesis-driven methods to identify cerebellar regions that are consistently engaged during the naturalistic condition. We then examined functional role of these identified...
cerebellar regions during this dynamic perceptual and affective process and characterised their connectivity with the cerebral cortex.

Results: We found that distinct clusters at the posterior and inferior cerebellum are reliably engaged in this dynamic perceptual and affective process. These cerebellar regions show significant relevance to visual salience and unexpected turning points of the movie - an intriguing parallel to the cerebellar motor function in signalling predictive error in motor behaviour. We further demonstrated robust and dynamic functional connectivity of these distinct cerebellar regions to prefrontal and posterior parietal cortices.

Conclusions: Our results demonstrate that distinct functional subdivisions of cerebellum are robustly engaged in real-life cognitive processes, playing specific roles through a dynamic interaction with higher order regions in the cerebral cortex.

A systematic review of the effects of transient ischaemic attack on resting-state and task-based electroencephalography

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Cerebrovascular events involving a disruption of blood supply to the brain and are a leading cause of disability and death globally. In 20-40% of cases, a minor non-disabling cerebrovascular event known as a transient ischaemic attack (TIA) occurs before a major disabling stroke. Furthermore, 10 to 15% of patients diagnosed with a TIA have a stroke within 3 months, with half occurring in the first 48 hours. Studies have found cognitive impairment post TIA, however, findings are variable. Although present data suggests there are cognitive deficits post-TIA, the inconsistencies in methodology, patients’ characteristics and findings makes the precise nature of the relationship elusive. The current review of the literature will inform the direction of future longitudinal study which will investigate the occurrence of post-TIA deficits. We expect to inform development of a new protocol to investigate neural, affective, cardiovascular and demographic factors that are associated with different cognitive profiles and cognitive pathways in older adults who have experienced a TIA.

Tracing the neural transforms of rhythm in the human auditory system

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Neurons in the auditory system synchronize their responses to rhythmic sound inputs. This coupling or entrainment is thought to facilitate rhythmic movement, which is often timed with respect to a regular pulse-like beat and higher-order metric structure, as in music. How the human brain performs the transformation from continuous changes in acoustic features into perceptual metric units remains unknown. Here, we recorded neuroelectric activity generated at both cortical and cerebellum levels of the human auditory pathway elicited by rhythms of different metric complexity. One rhythm had a regular beat marked by periodically occurring sound onsets (physically salient beats), while the other was a relatively complex and syncopated rhythm in which some beats were marked by silence instead of sounds (physically less salient beats). The simple rhythm was additionally played four times faster, thus at the upper limit for beat and meter perception, to test the effect of tempo on the neural transforms. We found that the difference between brainstem and cortical representations of the rhythms depended on the complexity of the rhythm. There was a significant difference for the complex rhythm, characterized by increased amplitude at meter-related frequencies in the cortical responses as compared to the brainstem responses, while no difference was observed between brainstem and cortical representation for the simple rhythm. Moreover, the cortical encoding was restricted to a frequency range corresponding to the musical tempo (~<5 Hz), while the brainstem encoding did not exhibit such a lowpass function. Our findings demonstrate a critical transformation in the neural encoding of rhythms between auditory brainstem and cortical structures, providing new insights on the emergence of high-level perceptual representations of rhythms and of rhythmic movement entrainment in humans.

Statistical Learning of Irrelevant Visual Information is Disrupted by Electrical Stimulation of Frontoparietal Cortex

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The ability to learn novel and complex behaviours has a long been linked with functions of the prefrontal cortex (PFC). In recent years, work using non-invasive brain stimulation has provided evidence that the PFC contributes causally to learning, decision-making, and the effects of training on performance (Filmer, Mattingley, & Dux, 2013; Filmer, Mattingley, Marois, & Dux, 2013). This work has predominately focused on explicit forms of learning that involve goal directed behaviour or instructed training. Yet, much of what we come to know about our environment is acquired incidentally and without instruction, by way of implicit statistical learning. For example, individuals can learn to predict a target location based on the visual context, in which it is most likely to appear - a phenomenon known as contextual cueing (Chun & Jiang, 1998). Implicit statistical learning has been conceptualized as an automatic process that relies on neural substrates that are distinct from those involved in acquiring explicit knowledge, such as medial temporal lobe structures. However, neuroimaging studies have suggested areas in PFC and posterior parietal cortex (PCC) may play a role in implicit statistical learning for visual information. Here, we delivered anodal (excitatory), cathodal (inhibitory), or sham transcranial direct current stimulation (tDCS) to the left PFC and left PPC online, while participants undertook a contextual cueing task. Cathodal stimulation of both PFC and PPC disrupted the learning of contextual information, relative to the sham condition. These findings causally implicate frontoparietal regions in implicit statistical learning of visual context information, suggesting that these regions are involved in both implicit and explicit forms of learning.

Towards the development of psychosis biomarkers: Functional and structural brain networks in the continuum of psychosis

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The mismatch negativity (MMN) is an event-related potential component, which is evoked in response to surprising or unpredictable events. The auditory MMN is consistently reduced in patients with schizophrenia and healthy individuals at high-risk for psychosis who transition to clinical psychosis. The first aim of this study was to investigate whether the reduced MMN is also present in healthy individuals with varying degrees of psychotic experiences. The second aim was to explore the relationship between the functional and structural brain networks involved in the manifestation of the auditory MMN. Electroencephalography (EEG) and diffusion magnetic resonance data were collected from 100 healthy individuals with varying degrees of psychotic experiences. An EEG was recorded while participants listened to sounds sampled from a Gaussian distribution and simultaneously performed an incidental working memory task. MMN was extracted by comparing responses to outliers and means. Individuals with a high quantity of psychotic experiences exhibited significantly reduced MMN response compared to individuals with a low quantity of psychotic experiences. The functional brain networks activated during the auditory MMN, revealed by source reconstruction, are structurally connected via auditory white matter pathways, namely the arcuate fasciculus, the inferior occipito-frontal fasciculus and the aslant, all of which have been reported to be disrupted in schizophrenia. These results suggest that the auditory MMN might be a promising biomarker for identifying individuals at risk for developing psychosis who might benefit from prophylactic treatments. Additionally, the findings from this study indicate that functionally connected brain networks that are active during the generation of the auditory MMN are structurally connected via white matter pathways.
Neural processing of visible orientations

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One key feature of what we see is orientation. For example, a set of vertical lines looks very different from a set of horizontal lines. Moreover, when we present such sets of oriented lines to each eye, three qualitatively different experiences ensue: For identical orientations in each eye, we see one set of lines despite two sets being delivered to the eyes—binocular fusion. For small orientation differences between the two eyes, we see one set of lines that are tilted towards us in depth—stereopsis. For large orientation differences between the two eyes, we see one of the component set of lines for a second or so, then we see the other, then we see the first, then the second, and so on, for as long as we care to look—binocular rivalry.

What early brain processing is associated with such experiences? We measured the electrical activity of the brain to 200-ms presentations of two sets of lines, either one to each eye (dichoptic) or both to each eye (dioptic), with a range of orientation differences, from 0 deg to 90 deg in 18-deg steps. Event-related potentials yielded two components from electrodes over the occipital cortex:

• A positive deflection 100 ms after the onset of the lines (the P100) whose amplitude increased with dichoptic orientation difference but whose amplitude was constant with dioptic orientation differences.

• A negative deflection 170 ms after the onset of the lines (the N170) whose amplitude increased with dichoptic orientation difference but whose amplitude was constant with dioptic orientation differences.

We conclude that these two components reflect processing specific to binocular vision, the first assessing the suitability of the viewed orientations for fusion and stereopsis, the second preparing for the experience of binocular rivalry.

More than just a face: Expectations about person identity modulate the face-sensitive N170

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The N170 ERP is considered to index structural encoding of faces (stimulus driven, bottom-up processing), prior to identity recognition, which is influenced by higher order cognitive factors. The face N170 is not generally seen as an index of identity recognition or considered to be cognitively penetrable. Here, we sought to test this conception of the N170, building on studies using contextual manipulation. By manipulating a patterned sequence of different, ambient images of familiar facial identities, we created an expectation about identity—this expectancy was breached by infrequently presenting a different identity. There were three levels of the visual stimulus condition: Frequent Regular, Infrequent Regular and Infrequent Random. Brain activity was recorded with EEG over occipitotemporal areas. Participants (N=19) were healthy adult volunteers. It was predicted: (1) that in a pattern based on facial identity, an identity shown Infrequently and Regularly would elicit a larger N170 than one shown Frequently and Regularly; and (2) that a facial identity shown Infrequently but Randomly would elicit a larger N170 than both Frequent Regular and Infrequent Regular identities. Hypothesis 1 was supported: N170 response to Infrequent Regular stimulus was larger than to Frequent Regular, F(1,19)=7.96, p=0.011. Hypothesis 2 was partly supported: N170 to both Infrequent Regular and Infrequent Random was larger than to Frequent Regular, Mdiff=1.23µV, 95% CI [0.41, 2.05]; Mdiff=1.24µV, 95%CI [0.56, 1.91], but there was no difference between Infrequent Regular and Infrequent Random, suggesting periodicity was not a factor driving the response. This is important because it supports an inference, contrary to the orthodox view, that in the N170 time interval, the brain is processing information sufficient to distinguish identity (recruiting top-down processes) not just encode facial form (bottom-up processing).

Functional mechanisms encoding others’ direction of gaze in the human nervous system

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The direction of others’ gaze is a strong social signal to their intentions and future behaviour. Pioneering electrophysiological research identified cell populations in the primate brain that are tuned to specific directions of observed gaze, but the functional architecture of this system is yet to be precisely specified. Here, we develop a computational model of how others’ gaze direction is flexibly encoded across a population of sensory channels. We incorporate the divisive normalisation of sensory responses—a computational mechanism that is thought to be widespread in sensory systems but has not previously been discovered in the context of social vision. We demonstrate that the operation of divisive normalisation in the gaze system predicts a surprising and distinctive pattern of perceptual changes following sensory adaptation to gaze stimuli, and find that these predictions closely match the psychophysical effects of adaptation in human observers. These results reveal the functional principles that govern the neural encoding of gaze direction, and support the notion that divisive normalisation is a canonical feature of nervous system function. Moreover, this research provides a strong foundation for testing recent computational theories of neuropsychiatric conditions in which gaze processing is compromised, such as autism and schizophrenia.

Resting state functional coupling between the ascending synchronising system, limbic system and the default mode network

Dr Bryan Paton, The University of Newcastle

Default mode network (DMN) function has been implicated in perceptual, learning and memory function. Understanding the causal role of the DMN in these processes will provide insight into healthy function and the dysfunctions seen in dementia and psychiatric illnesses. In the case of both episodic and autobiographical memory processes, electrophysiology in animals suggests theta band oscillations are the intrinsic mechanism for their orchestration. Theta oscillations are primarily controlled by the ascending synchronising system, a set of sub-cortical nuclei found in the pontine tegmentum and basal forebrain. We show, using rapid fMRI resting state data, for the first time, a causal link between the ascending synchronising system and the DMN. Nodes of the DMN, including the hippocampus and parahippocampal gyrus are linked at the network level with the sub-cortical structures responsible for fundamental memory processes. Our cross-validated approach, using ICA decomposition, seed based connectivity and dynamic causal modelling provides critical support for the role of theta oscillations in memory function and coordination.

From hallucinations to the imagination: Seeing what’s not there and measuring it

A/Prof Joel Pearson, University of New South Wales

Cases of visual awareness without a corresponding stimulus occur in special conditions, such as pathological hallucinations, dreaming, mental imagery, synaesthesia and some illusions. Hallucinations can also be perceived as sweeping waves of visibility that occur when exposed to full field lumiance flicker. However, a primary problem with such percepts is the inability to objectively measure the ‘hallucinated’ content. Here, I will talk about new methods to objectively measure two different types of visual phantom perception: mental imagery and flicker induced hallucinations. Using perceptual methods, we have shown that visual phantoms of non-retinal origin can be local in visual space. These phantoms undergo adaptation and priming, are linked to visual cortex anatomy, and can even be bistable. These new methods provide novel tools to investigate the constructive nature of visual awareness in function and dysfunction.
Structure-from-motion and lightness perception: understanding the interaction between lightness and high-level motion

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The visual system’s ability to estimate surface lightness (perceived reflectance) is a multi-stage process which is thought to involve cortical areas associated with the ventral visual pathway. The perception of 3-D shape information is critical for such lightness estimation, with previous studies demonstrating that multiple cues to 3-D shape can inform lightness judgements. Our study investigated whether human observers were able to use 3-D shape information from a high-level motion cue to inform judgements of surface lightness. Participants (N = 44) completed a visual psychophysics procedure consisting of a brightness matching task in which they adjusted the brightness of a patch in one region of the stimulus until it was perceived to match the brightness of a different patch. The results from our experiment demonstrated that participants were susceptible to a brightness illusion regardless of the availability of 3-D shape information provided by a high-level motion cue. This result has implications for our current understanding of lightness perception, suggesting that high-level motion cues are not integrated during lightness processing. Additionally, these results raise the question of whether visual pathways have the potential to interact to facilitate lightness perception.

Using low-cost portable neuroimaging to detect receptive language ability in children

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Can some children understand more than they can demonstrate? Mounting anecdotal evidence suggests that some minimally-verbal (i.e. non-speaking) children with autism have preserved language comprehension that is not apparent using conventional tests. We aimed to develop a non-invasive neural test of spoken language comprehension in individual children using a portable EEG device. We developed two child-friendly paradigms that manipulated the semantic congruency of spoken language. The first paradigm used sentences with meaningful versus anomalous completion (e.g. “She wore a necklace around her neck” versus “She wore a necklace around her milk”). The second paradigm consisted of forward-associated or unassociated word pairs (e.g. “row-boat” versus “row-pen”). In groups of participants a larger N400 event-related potential is evoked by anomalous sentence completions relative to correct completions, and by unassociated word pairs relative to associated word pairs. For a screening task, the N400 needs to be reliably detected at an individual level. We therefore tested for the N400 in 31 children aged 6 to 12 years (N=16 for the first paradigm and N=15 for the second paradigm). We recorded simultaneously from a traditional research-grade EEG system, and from a portable low-cost EEG system (Emotiv EPOC+©), consisting of a wireless, easy-to-setup headset. The results from the two EEG systems were similar. At the group level, for both paradigms, we replicated the typical N400 findings in the literature. At the individual level, we detected a statistically significant N400 effect in up to 43% of the children. Although this is a relatively low rate, and the absence of an N400 effect would not necessarily mean an absence of comprehension, if a child did show a significant N400, we could infer hidden language comprehension, making this a promising start. This study was funded by the CDD Neural Markers Training scheme.

Spontaneous blink rate in anorexia nervosa: implications for dopaminergic activity in anorexia nervosa

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A number of neurobiological mechanisms have been proposed to contribute to anorexia nervosa (AN), including dopaminergic function. The dopaminergic system plays an important role in eating behaviours, motivation, cognitive flexibility and reward; behaviours which are also disturbed in AN. The aim of this study was to utilise spontaneous blink rate (SBR) as a non-invasive measure of central dopaminergic activity in AN, and to examine the effects of cognitive load on this measure. 24 females with AN and 21 healthy individuals undertook two tasks: a fixation task and a prosaccade/antisaccade/no-go saccade task. AN participants demonstrated lower SBR than controls over both tasks. Further, both groups had significantly lower SBR during the saccade task than the fixation task. The findings suggest reduced central dopaminergic activity in AN, particularly striatal D2 activity, which may be related to the disturbances in eating behaviours present in this group. Further, the findings suggest that dopamine agonists, which increase dopaminergic activity, may be beneficial in the treatment of AN rather than dopamine antagonists which are often advocated for the illness.

Differences in neural oscillations for optimal movements and goal attainment when observing others actions

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When we observe others’ behaviour it is thought our brain makes predictions about their actions and intended goals. It currently remains unclear which aspects of the action sequence, i.e. the goals, grip type or optimal interactions between the two, are indexed by changes in neural activity through alpha and beta oscillations. In this study, we investigated the temporal profile of the oscillatory response to others’ actions, in relation to grip type, goals and optimality. In an EEG study patients were presented with videos of an actor interacting with an object (a box), where the type of grip (power/precision) was varied with the intended goal (open/light). To create observations where goal attainment was reached using optimal or sub-optimal grip types. Cluster-based permutations revealed early differences in the action sequence for occipital beta in electrodes contralateral to the observed movement initiation. Differences in grip type were also found in ipsilateral occipital alpha after the grip was clearly observed and the actor was interacting with the box. Activity related to optimality revealed differences in contralateral fronto-central electrodes for beta (230ms to 330ms after goal onset) and middle frontal electrodes for alpha (400ms to 645ms after goal onset). Finally, activity for goals showed two significant clusters late in the action sequence, with differences in alpha in contralateral parieto-occipital electrodes (550ms to 900ms after goal onset), and differences in beta in fronto-central electrodes beginning over 1 second after goal onset. Our findings indicate the test profile when observing others involve processing of movement information early in occipital areas; with optimal interactions between goals and grip types being indexed in sensorimotor areas soon after goal onset, and activity related to goals occurring late in the action sequence.

Modelling Distraction

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The 6th Australian Cognitive Neuroscience Conference

The healthy aged and persons with schizophrenia often exhibit deficits in attention control possibly linked to an inability to monitor the environment and filter out irrelevant stimuli. Relevance filtering can be assessed using the mismatch negativity (MMN) component of the auditory event related potential as an index of proficiency. MMN occurs when an unexpected change in sound patterning is detected. Larger MMNs have been linked to attention switches that result in poorer and/or slower responses on trials associated with MMN elicitation. Consequently, it has been proposed poor relevance filtering inferred from smaller MMN in healthy aged and in persons with schizophrenia could be indexed on such tasks. Participants made tone length discriminations, either short (100ms) or long (250ms) while the tone pitch randomly varied between standard (700Hz - 75%), low pitch deviant (613 - 12.5%) or high pitch deviant (1560 - 12.5%). In both young (n=23, > 35yr old) and older (n=19, 60-70 yrs) groups of participants we collected EEG whilst participants completed this distraction experiment in addition to a neuropsychological battery (e.g. CPT-IP, WAIS subtests, MOCA). Preliminary analysis confirms slower and more error-prone performance on deviant trials compared to standard, demonstrating the distraction effect. Data also confirms distraction effects from and more error-prone performance in older adults and more pronounced distraction by deviants despite significantly smaller MMN amplitude. Additionally, the data was fit using a behavioural evidence accumulation model, the linear ballistic accumulator that enable extraction of latent variables relevant to decision making processes. Parameters of this model will be reported and ultimately formally linked with features of the neural data. Results confirm that MMN amplitude links to distraction effects may be confined to young healthy adults. The model fitting results provide a baseline to compare to the expected patient group results.

The challenge of heterogeneity in Autism Spectrum Disorders (ASD): Characterizing differences in monozygotic twins concordant or discordant for ASD

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Autism Spectrum Disorders (ASD) are neurodevelopmental conditions associated with deficits in social communication, social interaction, and restricted and repetitive behaviours. To date, the search for predictive neurobiomarkers remains challenging and obscured by inconsistent or incompatible findings. Although brain abnormalities have been identified in ASD, there is much disagreement on the regions implicated or direction of alterations. Monozygotic twin study designs are a powerful solution to investigate heritability of ASD phenotypes and understanding, the effects of genetic and shared environmental factors. The present study investigates brain structure and function in a Victorian cohort of monozygotic twin pairs between the ages of 5 to 18, discordant or concordant for ASD. We use Magnetic Resonance Imaging (MRI) to measure within-twin-pair differences in brain structural morphometry, structural connectivity and resting-state intrinsic functional connectivity. To ensure replication and generalizability of findings, the Autism Brain Imaging Database Exchange (ABIDE-II) with MRI and phenotype datasets from 557 ASD singletons and 587 typical controls will be used to validate results. Analysis of resting-state functional MRI data using the Network-Based Statistic approach found a single subnetwork associated with nonverbal intelligence (size=940, p-FWE=0.0044) in singleton males with ASD (n=26, ages 8 to 13 years) that was not present in matched typical controls (n=24). Preliminary findings suggest that nonverbal intelligence in males with ASD may be associated with an atypical intrinsic connectivity subnetwork despite intact cognitive test performance. This highlights the need to account for effects of heterogeneity that could explain between-group differences unrelated to symptom severity. We propose the co-twin control design as an effective method to control for variation in the analyses of brain-behaviour relationships in atypical populations.

Measuring the effects of attention to single fingertips using ultra-high field (7T) fMRI

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Attention is able to modulate the neuronal processing of sensory information. For example, visuospatial attention acts by modulating responses at retinotopically appropriate regions of visual cortex. Much less, however, is known about the processing associated with attending to other modalities of sensory information. One reason for this is that visual cortex is relatively large and hence easier to access non-invasively using fMRI. With high-resolution fMRI, however, it is now possible to access smaller areas such as primary somatosensory cortex. Here, we combined a novel experimental design and high-resolution fMRI to measure the effects of attention to tactile stimulation in S1.

Data were acquired on a Siemens MAGNETOM 7T scanner. Anatomical images were collected using an MP2RAGE sequence with 0.5mm resolution. Functional data were collected using a 3D-EPI sequence with 0.8mm resolution. Tactile stimulation was delivered via a piezoelectric stimulator. There were two main experimental conditions: sensory and attention. During the sensory condition, four fingertips on the right hand were stimulated sequentially to map the somatotopic organization of the fingertip representations. During the attention condition, attention was swept across the fingertips under constant sensory stimulation of all four fingertips. The attention condition elicited phase-encoded responses along the postcentral gyrus that were strikingly similar to those elicited by the sensory condition indicating that attention modulates S1 in a somatotopically appropriate fashion. Importantly, this modulation was measured by the level of the cortical representation of individual fingertips, and our results provide clear evidence of fingertip-specific attentional modulation. The ability to make such detailed measurements provides an unprecedented opportunity to examine the neural mechanisms underlying somatosensory attention, and how these processes influence human somatosensation.

Electrophysiological response to duration deviants in Schizotypy

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Auditory mismatch negativity (MMN) has been indicated as a potential biomarker for psychosis proneness given its consistent reduction in patients with schizophrenia and individuals at high-risk for psychosis, compared to healthy controls. Schizotypy is a term, which describes healthy individuals with psychotic-like experiences who possess an underlying vulnerability for schizophrenia. The current study aimed to identify if there are differences in the electrophysiological response elicited by auditory oddball paradigms between individuals who score high on a measure of schizotypal traits compared to individuals who scored low. 50 participants were recruited and grouped into High Schizotypal (n=24) and Low Schizotypal groups (n=26) based on their score on the Prodromal Questionnaire (Loewy et al., 2007). Participant’s EEG was recorded while they underwent an auditory oddball paradigm with a concurrent visual task. Spatiotemporal analysis of whole data using an analysis of covariance (ANCOVA) revealed main effects of surprise and deviant type, and a significant group*deviant type interaction. There was neither a main effect of group nor an interaction group*surprise, that is no differences in the MMN between Low Schizotypy and High Schizotypy groups. However, our findings suggest that auditory oddball paradigms with longer duration deviants have the potential to be further explored with larger schizotypy samples to identify biomarkers for psychosis proneness.
A novel approach to characterising (relatively) complex decision-making using electroencephalography

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Quantitative models of decision-making permit accurate prediction of human behaviour. Recent electroencephalography (EEG) studies have linked two components – the CPP and the N2b – to decision processes. Importantly, our findings indicate that the CPP and the N2b are two components of complex decisions. Here we aimed to characterise (relatively) complex decisions using EEG indices of decision-making (the CPP and the N2b). Further, we tested whether cognitive load affects complex decision-making. Finally, we measured participants’ response precision, that is, how similar the observed and the correct responses were, instead of response speed and accuracy. Participants (N = 36) monitored a stream of moving dots that changed colours every 2s, and memorized the motion direction of the target-coloured dots. Twice per trial, the dots had a target colour, and participants reported the average direction of the two target motions. To vary cognitive load, either one colour or two colours served as targets in different trial blocks. Behavioural analyses revealed that responses were a better match to the second target motion than the first. The response precision was similar for one and two target colours, suggesting that participants were able to concurrently maintain attentional sets for two colours. We observed strong N2b and CPP components both to the first and the second target which, consistent with behaviour, did not vary with cognitive load. Taken together, our results reveal that individual components of complex decisions closely resemble simple decisions. Importantly, our findings also suggest that complex decisions exhibit unique dynamics – here in the form of a recency bias – which would not be captured by simpler decision-making paradigms.

Decoding voluntary decisions: perception of freedom is dependent on keeping your options open

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It has been proposed that the perception of freedom of choice is driven by the opportunity to choose alternative plans of action. This study investigated how the perceived freedom of choice and the underlying neural correlates change depending on the ongoing maintenance of a choice and the availability of options. In this (fMRI) experiment, participants freely chose between left or right doors in a virtual environment. After advancing up a corridor, cues at the halfway point indicated whether one or both doors remained open. When both doors were open, participants were free to either keep or change the initial decision (alternative action available), while a closed door forced participants to select a particular door (no alternative action available), which either matched their choice or required a change of decision. We found that trials in which both actions remained available were rated as significantly freer than forced choice trials, and congruent choice trials were rated as freer than changes of decision. Multi-voxel pattern analysis revealed that upcoming choices could initially be decoded from visual cortices, followed by motor cortex at the halfway point. In the free choice conditions, additional clusters in the precuneus were predictive of choice. For congruent choice trials, the availability of the other door could be predicted from right dorso-lateral prefrontal cortex, the frontopolar cortex and right inferior frontal gyrus. These results suggest that regions related to self-referential processing, uncertainty and option selection were recruited to maintain flexible action plans for free choices, while forced conditions resulted in a fast translation of choices into specific motor plans. The subjective feeling of freedom appears to depend not only on making an unconstrained initial choice, but moreover, on the ongoing opportunity to change one’s mind. Overall, this suggests that the perception of freedom is strongly related to keeping our options open.

Are two brains better than one? Evidence of neural synchrony across co-actors in a visually guided movement task

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In everyday life, it is often necessary for individuals to coordinate their actions with others to achieve common goals. Relatively little is known about the neural processes underlying such joint actions. Here we tested whether joint actions might involve coupling, or synchronisation, of brain states between co-actors. Pairs of participants used joysticks to manoeuvre a computer cursor to one of eight visual targets while we recorded neural activity using electroencephalography. In separate, randomly interleaved trials, participants were cued to perform the movement task either individually or jointly. Critically, throughout the experiment, participants were physically separated and thus not able to observe one another’s movements directly. The cursor and visual targets flickered at unique frequencies, thus evoking unique steady-state visual evoked potentials. To test for evidence of neural synchrony, we employed a combination of time-frequency analyses, cross-correlations and deep neural network machine learning techniques. Cursor movements were faster and more direct under joint control than individual control. Additionally, joystick displacements were more highly correlated during joint control than individual control, indicating behavioural coupling. Moreover, neural activity between participants within each pair was more correlated under joint control than individual control conditions, consistent with neural synchronisation. For the joint control condition, neural coupling was stronger for movements that successfully hit the target than for those that missed. Remarkably, neural coupling under joint control was even present before movement onset, suggesting synchronization was initiated during the early stages of motor planning.

Pushing attention to one side: Force field adaptation alters attentional processing in the healthy brain.

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Prof Stephan Riek, University of Queensland
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Unilateral spatial neglect is a major cause of disability after stroke, and is characterised by an impaired capacity to attend to one side of space. Sensorimotor adaptation to optical wedge prisms is a promising treatment for neglect but it remains unclear precisely how prism adaptation improves attention in neglect patients. For example, it is unknown whether prism effects rely on the experience and correction of visual errors, or upon subsequent adjustments of the motor plan. Here we asked whether changes in spatial attention can be induced by a remapping between intended movement direction and motor commands in the absence of a visual mismatch. We used event-related potentials (ERPs) recorded using electroencephalography to determine whether visual spatial attention is affected in healthy adults by adaptation to force fields that push movements to one side. Thirty-eight healthy subjects performed a Posner spatial cueing task before and after they made 300 reaching movements to a target aligned with the body midline. A velocity-dependent force field pushed the hand either leftward (n=19) or rightward (n=19) during each reach. Critically, the field was introduced gradually, so that participants implicitly learned to apply time-varying compensatory forces to one side of space without experiencing substantial deviations in movement trajectory. Adaptation boosted attentional orienting responses (N1 ERP component, time-locked to the cue) toward the side of compensatory hand forces, and impeded attentional disengagement (P1 ERP component, time-locked to the target) from that side. The results indicate that remapping between motor commands and intended movement direction is sufficient to shift attention, despite the fact
that neither the hand nor the visual feedback were ever displaced from the body midline. These data from healthy adults provide new insight into the potential mechanisms of prism therapy, and open avenues for new treatment approaches for neglect.

Brain oscillations and connectivity in ASD: insights from atypical sensory and perceptual processing?

Prof Gina Rippon, Chair of Cognitive NeuroImaging
Aston University
Mr Robert Seymour, Aston University
Prof Klaus Kessler, Aston University

Based on the application of new techniques using contemporary measures of brain synchronisation and invoking the coupling of both high and low frequency bands, we have proposed a new model of atypical cortical connectivity in ASD. This model has developed from the observation that both hyper- and hypo- sensory and perceptual processing characterise the ASD profile. This would impact on both feedforward and feedback cortical pathways and affect normal predictive coding mechanisms, the downstream consequences of which could manifest as “the world changing too fast for a miswired brain”.

We have tested this model using a simple sensory processing paradigm. Data were collected from N=7 ASD participants and N=10 controls, using a 306-channel Elektro Neuromag Magnetoencephalography (MEG) system. Phase-amplitude coupling (PAC) between high-frequency gamma-band and low-frequency alpha-band activity was calculated as a measure of local dysregulation. Feedforward/feedback connectivity profiles were calculated using Granger causal techniques. Separate measures of alpha and gamma band activity showed no differences between ASD and controls, but there were marked differences in PAC, with a much more variable profile for the ASD group. This was associated with an atypical feedforward/feedfeedback profile in the ASD group, dominated by increased feedforward connectivity in the gamma band and reduced feedback connectivity in the alpha band. These early findings indicate that such measures offer a promising way of characterising connectivity profiles in the ASD brain which could be consistent with emerging neurocognitive models and with the extremely heterogeneous symptom profiles typical of the condition. This research is supported by the Wellcome Trust and the Dr Hadwen Trust. Robert Seymour is supported by a cotutelle studentship from Aston University, UK and Macquarie University, Australia.


Mr Jonathan Robinson, PhD Student
Queensland University of Technology
Prof Michael Breakspear, Queensland Institute of Medical Research
Prof Andy Young, University of York

A recently established index of prediction errors in visual perception offers a means to investigate the processes underlying the formation of perceptual predictions. In two EEG experiments, we investigated the potential Bayesian-like parameters determining the reassessment of predictions. We manipulated the visual stimuli, both in terms of accumulated prior evidence, and disparity between present data and prior evidence. To achieve this, we present a rapid sequence of highly controlled images that form rigid rotation trajectories. Each sequence has a final image transition that is either predictable (conforms to sequence trajectory) or unpredictable (violates sequence trajectory). To investigate prior confidence, we adjusted the number of images (3/5 images) in a sequence prior to the unpredictable image. To investigate the changes of disparity between data and priors, we adjust the extent to which the final image violates the context trajectory (small violation: change in the size of final transition; large violation: reversed trajectory). To ensure that difference between conditions group only be attributed to the context created by the sequence and not merely low-level difference between images, trials were organised such that identical final image transitions occur in each condition and no single stimulus is repeated within a sequence. As with previous work, we found significantly large N170 amplitudes for all unpredictable final stimuli.

Additionally, we find a greater N170: 1) based on the number of priors; a greater error signal to greater accumulated evidence; 2) depending on the size of violations, a greater error signal for larger violations that are contrary to the established trajectory. Further, a sequential decrease in the N170 occurs with each image presentation. We conclude support for a Bayesian-like function of signaling prediction errors, which serves as a means of efficiently refining the accuracy of predictions in visual perception.

When stochastic rules are not deterministic enough: An MMN study

Dr Urte Roeber, Senior Lecturer
Murdoch University
Prof Erich Schröger, University of Leipzig

One of the pre-requisites for flexible and adaptive behaviour is our brain’s ability to encode regularities in the stimulation and to detect events that violate them. From hundreds of studies we know we can test this ability with sounds that violate a rule inherent in the recent auditory stimulation, because we typically find the mismatch negativity (MMN) component of event-related potentials (ERP) elicited by such sounds, even when they are not attended. Apparently, the system underlying MMN is of remarkable intelligence, because it not only detects simple rules such as stimulus repetitions but also complex abstract rules such as contingent, serial relationships between the stimuli. However, all previous reports of MMN are from violations of sequentially deterministic regularities. Here, we show that the predictive power of the MMN-system vanishes when sequential determinism is destroyed, that is, when the regularity does not obey a constant relation between consecutive sounds even though the overall rule is quite simple. We used two frequent but randomly presented standard tones (900 and 1100 Hz, p = .45 each) and one infrequent deviant tone (1000 Hz, p = .10) in the critical condition and compared our results with several, structurally equivalent but sequentially deterministic control conditions. According to traditional MMN results and theory one would expect that the MMN system could easily handle two different standards. However, we found reliable MMN only in the sequentially deterministic conditions, whereas there was no sign of MMN in the critical, sequentially non-deterministic condition. These results uncover a serious constraint on the MMN system’s intelligence. But the results also demonstrate how important sequential dependencies are in our auditory environment and that the MMN system might be fine-tuned to deal with those.

Evidence of an abnormal state in non-clinical hallucinations

Mr Sebastian Rogers, PhD candidate
The University of New South Wales

Are hallucinatory experiences dependent on an abnormal neural or perceptual state, like sleep, drug effects, or neurological changes such as in Parkinsons disease? Various models including abnormal states have been proposed to underlie clinical hallucinations. Here we sought evidence of an induced abnormal state in the normal population using simple geometric flicker-induced hallucinations. We presented subjects with an annulus with a 10 Hz flickering test annulus that reliably induces hallucinatory grey blobs that move around the annulus. Hallucination onset latency was measured by keypress when subjects saw the blobs, and was taken as evidence of being in this state. Onset latency in a 10 Hz flickering test annulus was reduced by a prior 50 Hz flickering annulus (that does not cause hallucinations) relative to a control annulus, suggesting that it expedited the induction of the hallucinatory state. Onset latency also increased with increasing temporal durations between a prior 13 Hz annulus and an identical test annulus, suggesting that the state survives short breaks in stimulation in a time dependent manner. This prestimulus priming effect was local in visual space, suggesting a local state effect in visual cortex and a contingency on retinotopic neural processes. Next we tested the frequency specificity of this state-like priming effect. We presented the prior and test stimuli at the same or different frequencies. The data did not support frequency specificity, suggesting that a state that is invariant to the particular frequency of neural oscillations. Together the data suggest that luminance flicker might induce a kind of non-ordinary state in visual processing. Mechanisms underlying this state and how it relates to other types of hallucination in clinical and normal populations remain unknown. Future research will attempt to determine whether the hallucinatory state generalizes to other forms of hallucination and will endeavour to uncover the associated neural mechanisms.
Domain specific processing or visual expertise?
Exploring the neural mechanisms underlying face processing using electroencephalography.

Ms Manuela Russo, PhD student
Queensland University of Technology
A/Prof Patrick Johnston, Queensland University of Technology
Dr Jordy Kaufman, Swinburne University of Technology

The N170 is a well-established electrophysiological brain index of higher-level vision. Research shows that the N170 has a greater amplitude to faces than to other stimulus categories and its peak is later and sometimes larger for inverted faces than for upright faces. Such findings led to the Face Specificity Hypothesis (FSH), suggesting the existence of specialized face processing mechanisms, and of orientation sensitive representations that are specific to face stimuli. An alternative is the Expertise Hypothesis (EH), which suggests the existence of a system for 'visual expertise' that allows people to develop a high level of subtle discriminative capacity in any class of visual stimuli, if sufficiently interesting/impor-tant to them. Thus, we develop a high level of expertise in discriminating faces since they are important to us, but the mechanisms supporting such expertise are domain general. However, the EH has been difficult to demonstrate. Our work builds on the findings of Johnston et al. (2014), that showed behavioral inversion effects are most likely to be observed when the stimulus set meets two criteria: (1) members are defined by standard configuration of features; (2) members share a canonical view, such as Cartographic contours (e.g. maps). In the current study we investigated whether the N170 elicited by familiar maps might show inversion effects similar to those typically seen in response to faces. Australian participants were asked to perform a simple vigilance task, and were exposed to visual stimuli (i.e. four different line drawings of countries). Stimuli were presented to participants in both upright and inverted orientations (i.e. north-top-south-bottom). We found that N170 amplitudes were greater to Australia than to other countries. N170 peak latencies for Australia Upright were significantly faster than those to Australia Inverted, Other Upright and Other Invert-ed. Our results offered support for the Visual EH in preference to the FSH.

Neuroinformatics tools for simulating realistic brain activity

Dr Paula Sanz-Leon,
University of Sydney

Mesoscopic-scale models known as neural masses and neural fields are widely used to study spatiotemporal dynamics of neural tissue. When analytic methods become intractable, the use of numerical simulations is essential to get a deeper understanding of brain activity. In this talk, I will begin by briefly explaining the motivations behind building a brain simulator. This will be followed by a description of current tools available to simulate from one single area (or tissue), to a few interconnected areas to the whole brain. I will also discuss their similarities, advantages and limitations. Lastly, I will show you that getting started with brain simulations is just a few clicks away.

More than meets the eye: effects of task instruction on direct gaze biases in schizophrenia.

Dr Kiley Seymour, Senior Research Associate
Macquarie University
Prof Gillian Rhodes, University of Western Australia
Dr Jonathan McGuire, Macquarie University
Mr Nikolas Williams, Macquarie University
Dr Linda Jeffery, University of Western Australia
A/Prof Robyn Langdon, Macquarie University

Research on poor interpersonal functioning in schizophrenia focuses on impairments of emotion recognition and mental-state reasoning; but little is known of more fundamental perceptual abilities such as those needed to process eye gaze. Healthy perception of gaze is sustained by dedicated neural substrates and is critical for social interaction, providing vital information about another person’s focus of attention and state of mind. People with schizophrenia misjudge averted gaze as directed towards them. However, current tasks do not dissociate an early perceptual bias from a high-level top-down effect. Studies that report a “direct gaze bias” in schizophrenia typically present faces with different gaze deviations and ask: “Are the eyes looking at you?” These tasks require a self-referential judgment and prompt inferences of the other person’s intent. Thus, tasks of this type may tap into top-down effects of a theory-of-mind impairment or abnormal beliefs about being watched that might bias a patient’s responses. Our study measured perceptual sensitivity to gaze deviations (“cone of direct gaze”) in schizophrenia by simply asking participants to judge whether eyes were directed left, right, or straight ahead. Such a judgement eliminates potential higher-order effects associated with self-referential processing or theory of mind impairments. Our results revealed that patients’ cone of direct gaze width was similar to controls. Thus, our findings suggest that, while patients may suffer from deficits associated with interpreting another person’s gaze, the early perceptual encoding of eye gaze direction is intact in schizophrenia. Tendencies to misjudge gaze direction in this group are therefore more likely to reflect effects of task instructions that prompt judgments of others’ intent and cue self-referential biases. This research was supported by the Society of Mental Health Research & ARC Centre of Excellence in Cognition and Its Disorders Program Support Scheme.

Coping Through Crying

Miss Leah Sharman, PhD Candidate
University of Queensland

Dr Eric Vanman, University of Queensland

It has often been suggested that one of the main functions of crying may be to facilitate recovery after having been in distress. That is, crying could serve to sedate, reduce pain, and restore the homeostatic balance. Attempts to explore this topic have previously used retrospective studies, with more experimentally testing this functional explanation. This experiment investigated the intrapersonal functional explanation of crying by evaluating if crying before a stressor will facilitate coping and recovery. Participants were first year undergraduate female students at the University of Queensland asked to watch several short videos lasting 20 minutes. Participants were randomly assigned to either the sad or neutral (interesting) video sequence. Videos chosen in the ‘sad’ condition were chosen for their extreme emotion elicitation, i.e., sad crying responses. Performance on a stressor (cold pressor task) was then timed. Throughout the experiment participants heart rate, respiration, and facial expressions were recorded through iMotions using FACET software. Saliva samples were also taken at 4 separate time points to measure changes in cortisol over the hour for baseline, video response, reaction to stressor, and a final time point. It is predicted that compared to controls participants who have cried will: (a) be able to withstand a stressful task for longer; (b) show lower levels of cortisol following the stressor; and (c) have faster physiological recovery to baseline following the stress task measured using heart rate, respiration, and salivary cortisol. Preliminary results and implications will be discussed.

Examining the symptomology network of ADHD: A new way to view ADHD symptoms.

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Dr Charles Malpas, Murdoch Childrens Research Institute
Dr Richard Beare, Murdoch Childrens Research Institute
Prof Vicki Anderson, RCH Mental Health of Royal Children’s Hospital
Dr Daryl Efron, Royal Children’s Hospital
Prof Philip Hazell, University of Sydney
Prof Jan Nicholson, La Trobe University
Dr Emma Sciberras, Deakin University

Categorical and dimensional approaches to assess ADHD symp-toms are widely used, however rely on binary symptom count of equal weighting, with little attention to the individual make up of symptoms. By only assessing symptom count we might lose important information about the possible contribution of individual symptoms. Rather than as a list of separately summed symp-toms, it can be viewed as a network of interacting symptoms. Using a novel network model approach, this study explores the symptomology network consisting of the 18 DSM symptom criteria for ADHD in order to understand the complexity of the relationship between symptoms. Data was derived from the
Children’s Attention Project, a community cohort study of 146 medication naive children with confirmed ADHD and 209 confirmed non-ADHD controls (6-8 years). The presence of absence of each DSM-IV symptom criteria for ADHD were recorded from a parent face-to-face structured diagnostic interview. Analyses find that not all symptoms are equal, having different frequencies of endorsement, and different configurations of symptoms, with certain symptoms playing a more important role within the ADHD symptom network. There are 116,220 combinations of symptoms within a diagnosis of ADHD, with 91.8% the sample demonstrating a unique configuration of symptoms. Symptom association networks revealed the dissociation between inattentive and hyperactive symptoms, however highlights the importance of the hyperactive symptoms in the symptom network. In particular the ‘motoric’-type symptoms and interrupts may be the most clinically significant. This study provides a unique approach in examining the network structure of ADHD symptoms. Moving beyond classical categorical and dimensional approaches, conceptualizing the symptoms as a network of interacting features has the potential to reveal symptoms of clinical importance. The finding may help to explain the heterogeneity in the clinical, cognitive and behavioural ADHD phenotype

**Trigger failure in the stop-signal task triggers re-interpretations of electrophysiological relationships with inhibitory ability**

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Dr Ross Fulham, University Newcastle
Dr Dora Matzke, Universiteit van Amsterdam
Prof Andrew Heathcote, University of Tasmania
Prof Patricia Michie, University of Newcastle
A/Prof Frini Karayanidis, University of Newcastle

The latency of an individual’s inhibitory process, Stop-Signal Reaction Time (SSRT), can be estimated a number of ways. However, traditional SSRT estimation is fraught with numerous difficulties, such as the inability to predict the occurrence of and to control for trials on which the inhibitory process fails to trigger (Trigger Failure; TF). While numerous studies have investigated electrophysiological correlates of SSRT, none have investigated such relationships while taking TF into account. We use hierarchical modelling to derive posterior distributions of SSRT, while simultaneously estimating TF. Participants derived from a large healthy community sample (n=124; 56% female; mean age 21) completed the stop-signal task with concurrent EEG recording. Population inference of the relationships between ERPs locked to the stop-signal and the model parameters was completed using a Bayesian variable analysis. Our results show that SSRT was substantially inflated (~100ms) without the inclusion of TF in the estimation. The inclusion of TF substantially reduced relationships between SSRT and both the N1 and P3 components. Conversely, a relationship between SSRT and the N2 component was not found with traditional estimation methods but was apparent with the inclusion of TF. These results have important implications for the inhibition literature. Previously reported groups differences in SSRT may not be replicable with the inclusion of TF. In sum, the inclusion of TF reduces both the estimation and variance of SSRT, while also altering commonly reported relationships with ERPs.

**Patterns of sedentary behaviour are associated with cognitive performance and cardiovascular disease risk in mid to late life**

Dr Ashleigh Smith, Research Fellow
University of South Australia
Miss Danielle Greaves, University of South Australia
Miss Emma Tregoweth, University of South Australia
Dr Hannah Keage, University of South Australia

Emerging evidence indicates that engaging in extended periods of sedentary behaviour is associated with adverse health outcomes (including cognitive impairment) which remain independent of physical activity. In addition to total time engaged in sedentary activities, the way in which this time is accumulated is also important, with long sedentary bouts associated with poorer health outcomes compared to shorter bouts. Therefore, the purpose of this study was to compare sedentary metrics including those representing total time and fragmentation of behaviour with performance on the Addenbrooke Cognitive Exams-III (ACE-III) and self-reported cardiovascular disease risk. As a part of a larger study, 7-days of objectively measured PA were captured using a GenAActiv wrist worn tri-axial accelerometer in 90 adults (mean age 65.5 ± 7.25 years, 52 females). Raw accelerations were reduced into 60 second epochs and time spent in sedentary behaviour compared to predefined cut-points using a custom built software (COBRA, UniSA). To explore patterns of sedentary behaviour, sedentary bouts were defined as at least 30 continuous minutes where accelerations were 100% below the light intensity threshold. Mixed effects models demonstrated sedentary time spent in bouts, but not total sedentary time per day, were associated with lower ACE scores. Independent of ACE-III score, both total sedentary time and time spent in bouts were associated with increased cardiovascular disease risk. These findings provide initial evidence for the importance of breaking up long bouts of sedentary behaviour for both cognitive performance and cardiovascular disease risk.

The quality of visual information modulates response inhibition in the modified stop-signal paradigm

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Dr Govinda Poudel, Monash University
Dr Matthew Hughes, Swinburne University
Prof Nellie Georgiou-Karistianis, Monash University

Stop-signal response inhibition is a hallmark of executive function and can be explained by the outcome of a race between independent ‘go’ and ‘stop’ processes operationalised in a go and a stop signal task. Therein, inhibition is successful if the stop process finishes before the ‘go’ process and if the ‘go’ process finishes before the ‘stop’ process, response inhibition is unsuccessful. In this experiment, we assessed how parametrically manipulating the quality of visual information of the ‘go’ stimuli affects inhibition, as measured by probability of inhibition (Pi) and stop-signal reaction times (SSRTs). Fourteen healthy individuals (7 female and 7 male) (M = 31.36; SD = 8.90) underwent a modified 16-minute stop-signal task, where ‘go’ stimuli were the letters ‘Y’ and ‘V’ with low, intermediate-1, intermediate-2, and high levels of perceptual clarity (levels of Gaussian blur). On 33% of trials, the stop-signal (50 ms audio tone) followed the ‘go’ stimuli after a brief interval (the stop-signal delay, SSD), which was individually adjusted based on participant’s response to intermediate-2 level of visual difficulty. We found that reaction times to the ‘go’ stimuli increased with increased visual difficulty, F(3, 39) = 13.47, p < .001, and that the probability of inhibition (Pi) also increased as a function of visual difficulty, F(3, 39) = 11.60, p < .001. Notably, however, SSRTs did not vary across conditions. Our results indicate that manipulating the go task difficulty affects the Pi(1) but does not affect SSRT and further support a well-established assumption that mechanisms responsible for choosing responses or inhibitions are independent.

Attention shifting performance in regular cannabis users following prolonged treatment with cannabidiol (CBD)

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Dr Samantha Broyd, University of Wollongong
Ms Camilla Beale, University of Wollongong
Dr Chao Suo, Monash University
Dr Peter Galettis, University of Newcastle
Prof Nagesh Pai, University of Wollongong
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Patients with schizophrenia and chronic cannabis users show impaired attentional processing. Cannabidiol (CBD) has been shown to have antipsychotic properties and to ameliorate cognitive, symptomatic and brain harm in cannabis users. We investi-
gated whether prolonged CBD administration to ongoing regular cannabis users may improve attention shifting performance and whether this may be related to changes in hippocampal glutamate levels and improved hippocampal psychometric subtests. Twenty cannabis users participated in a 10-week open-label trial in which they received 200mg oral CBD daily whilst continuing to use cannabis. The CANTAB Attention Shifting Task (AST) and clinical measures were administered at baseline and post-treatment. Magnetic resonance spectroscopy was performed at each time point to quantify hippocampal glutamate. At baseline, poorer AST performance was associated with higher hippocampal glutamate levels (switching cost: p=0.04) and a younger age of onset of cannabis use (greater errors, and switching and congruency costs: p=0.001). After 10 weeks of CBD treatment, AST performance improved in terms of latency to respond in switching blocks (p=0.008) and congruency cost (p=0.009). Better post-treatment AST performance correlated with higher CBD plasma levels (latency: p=0.12; switching cost: p=0.06; switching congruency: p=0.036). AST performance was associated with improved memory performance, but not strongly with improvements in depressive and psychotic-like symptoms. Prolonged treatment with CBD may improve attention shifting performance in regular cannabis users who continue to smoke cannabis. Improvements in verbal learning and memory, depressive and psychotic-like symptoms were also observed with some modulation of hippocampal glutamate levels. CBD holds promise for further potential therapeutic efficacy in cannabis dependence and a range of neuropsychiatric disorders. This study was enabled by an Australian Research Council Future Fellowship.

Universal preferences and individual differences in aesthetics: An exploratory comparison between vision and touch

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Miss Catherine Viengkham, University of New South Wales
Miss Zoey Isherwood, University of New South Wales
A/Prof Branka Spehar, University of New South Wales

Background: Empirical aesthetics is the second oldest area of experimental psychology, but for the much of its history, the progress has been limited by vacillating between the opposing views that focus exclusively on either the universal aspects or the culturally or individually specific differences in aesthetic preference. There has also been a significant neglect of aesthetic considerations in sensory systems other than the visual (and perhaps auditory) modality. Indeed, it has been argued that creating an aesthetic experience from vision to other senses was unachievable, simply because our sensory modalities are all so very different.

Methods: To address these limitations, we use fractal dimension to parametrically manipulate in the same way the complexity of abstract images/surfaces across the visual and tactile domains. In the first experiment we compare visual only, tactile only and visuo-tactile preferences for real 3D surfaces varying in fractal scaling properties. In the second experiment we study the stability and consistency of individual preference patterns across vision and touch for both static and dynamic visual and tactile stimuli, and both between and within individuals.

Results: We use k-means clustering and Q-mode factor analysis to determine dimensional structure of interindividual variations in aesthetic preference within and across different sensory domains. We found consistent and dimensionally similar clusters of individual differences in both tactile and visual preferences.

Discussion: We demonstrate that fractal dimension is an effective means of quantifying visual complexity even in stimuli that are superficially different in appearance and that these parameters mains. We found consistent and dimensionally similar clusters in aesthetic preference within and across different sensory domains. We found consistent and dimensionally similar clusters of individual differences in both tactile and visual preferences. There was no evidence for an association of the oblique superiority effect with schizophrenia. These results are consistent with the ability to spatially pool visual information being unrelated to the level of psychometrically-defined schizophrenia. This finding may reflect a difference between schizophrenia and high schizophrenia, and further research into the oblique superiority effect may provide insight into the neural circuitry of those with schizophrenia.

Investigation of auditory processing differences with synchronous vs. asynchronous bimodal stimulation

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In our daily life, we are continuously exposed to a variety of information from all senses. The simultaneous processing thereof is essential for building a coherent percept of our environment. In order to investigate auditory processing in the context of audio-visual stimulation, we tested two different conditions: The visual and the auditory information occurred either simultaneously or the visual information preceded the auditory information. In the former, the two modalities were expected to interact, whereas in the latter, whereas in the latter, the visual information was expected to predict the forthcoming sound (i.e., to generate an expectation of the upcoming auditory stimulus). In the synchronous condition, a white square was presented either above or below the fixation cross and simultaneously with a complex tone with either high or low pitch. The participants task was to indicate whether the tone was congruent with the square (e.g., high tone and square above fixation cross). In the asynchronous condition, the white square preceded the presentation of the tone by 600 ms, whereas the participants task remained the same. In both conditions the tones with their pitch being incongruent with the location of the squares elicited enhanced negativities, which started considerably earlier in the asynchronous condition (~150 ms) than in the synchronous condition (~200 ms).

Schizotypy and form perception through pooling: an application of the oblique superiority effect

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Dr Damien Mannion, University of New South Wales

The oblique superiority effect refers to a perceptual phenomenon in which a cardinal (horizontal and vertical) target is easier to detect than oblique dot patterns. Motivated by the critical role of spatial pooling in the proposed neural mechanisms underlying this phenomenon, we applied the oblique superiority effect to the investigation of psychometrically-defined schizotypy. Based on previous studies reporting spatial pooling impairments in schizophrenia, we hypothesised that ranked oblique superiority effect scores would decrease with increasing ranked scores on two schizotypy subscales: Unusual Experiences and Cognitive Disorganisation. Participants (N = 120, undergraduate psychology students) completed a computer-based task measuring the ability to discriminate cardinal (horizontal) and oblique target dot patterns from noise, and a paper-based questionnaire measuring schizotypy (O-LIFE). While the results supported the existence of the oblique superiority effect, there was no evidence for an association of the oblique superiority effect with schizophrenia. These results are consistent with the ability to spatially pool visual information being unrelated to the level of psychometrically-defined schizophrenia. This finding may reflect a difference between schizophrenia and high schizophrenia, and further research into the oblique superiority effect may provide insight into the neural circuitry of those with schizophrenia.

Semantic priming and self-reported thought disorder

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Dr Matthew Hughes, Swinburne University of Technology
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Prof Susan Rossell, Monash Alfred Psychiatry Research Centre

Semantic memory deficits in schizophrenia have been investigated for decades. These seem particularly sensitive and exacerbated in those with thought disorder (TD). Semantic priming has been common among the tasks used in the study of TD. However, difficulty has been encountered in the definition and measurement of TD, where typical assessments have relied on measures with a limited number of endorsed items that exhibit positive skewed. In this study, a long-5OA semantic priming task (lexical decision) was administered to 26 individuals with either schizophrenia or schizoaffective disorder, as well as to 26 healthy controls. Participants also completed a 29-item self-report questionnaire in terms of the frequency with which they had experienced various symptoms of TD. Although evidence of semantic priming was found using a 2 (semantic relatedness) x 2 (diagnostic group) mixed-design ANOVA, this priming did not differ significantly between those with schizophrenia and controls (i.e. there was no interaction between semantic relatedness and diagnostic group on lexical decision reaction times). Nevertheless, there was a trend-level (p=0.096) group effect on semantic priming when individuals with schizophrenia were subgrouped into those who had higher and lower levels of self-reported thought disorder.
TD. Moreover, there was a weak positive association between total self-reported TD and the priming effect (r=0.25, p=0.046). These results are consistent with abnormal semantic function and hyper-priming in TD, and demonstrate the level of its severity across diagnostic groups. Further work is being conducted to investigate the functional neuroimaging underpinnings of these semantic deficits.

**Neurocognition and formal thought disorder in schizophrenia: do impairment profiles differ between symptoms?**

**Dr Eric Tan,** Postdoctoral Research Fellow

Swinburne University

Prof Susan Rossell, Swinburne University

Neurocognitive deficits are regularly associated with formal thought disorder (FTD), with semantic and executive dysfunction being the most consistently linked to the symptom, with attention and working memory less so. The classic approach to FTD research has tended to employ group comparisons (FTD versus non-FTD) and a composite FTD severity score. However, FTD is a heterogeneous symptom with 18 recognised sub-symptoms that present differently. It follows then that the underlying neurocognitive profile may differ between these. This study sought to address this by examining relationships between individual symptom severity across diagnostic groups. A global FTD score and eight neurocognitive domains on a comprehensive battery: Speed of Processing (SP), Attention/Vigilance (ATT), Working Memory (WM), Verbal Learning (VerL), Visual Learning (VisL), Reasoning and Problem Solving (RPS), Social Cognition (SOC) and Inhibition/Executive function (INHB). 59 schizophrenia/schizoaffective disorder (M=43.46,SD=10.67) completed the MATRICS battery and the D-KEFS Colour-Word Interference Test. FTD was assessed using the Thought, Language and Communication Scale (TLC). Spearman’s correlations were conducted, p-values corrected to <0.05. Pressure of speech was negatively correlated with INHB scores. Derailment was significantly negatively correlated with VisL. Loss of goal was significantly correlated with ATT and VerL. There were also a number of correlations that showed nonsignificant trend towards association: poverty of speech with SOC scores; tangentiality with WM and ATT; loss of goal with WM and ATT; and global FTD scores with VerL and INHB scores only. The findings strengthen existing evidence relating neurocognition and FTD; and confirm a differential pattern of associations between individual FTD symptoms and neurocognitive variables. Heterogeneity in FTD presentation appears to be associated with underlying neurocognitive heterogeneity. The mechanistic implications of these are discussed.

**Do repetition suppression and expectation have different effects on the fidelity of sensory representations?**

**Dr Matthew Tang,** Post-doctoral research fellow

University of Queensland

Prof Jason Mattingley, University of Queensland

Repetition suppression - a reduction in neural activity when a stimulus is repeated - has been widely used to examine neural coding of sensory information. Traditionally, the reduced response to the repeated stimulus has been attributed to neural adaptation. Recently, however, an alternative account has suggested that the reduction in neural activity to a repeated stimulus reflects a fulfilled sensory prediction. Consistent with this account, when a repeated stimulus is presented unexpectedly, the neural response is not reduced relative to the initial presentation of the same event. A possible resolution of the debate between the adaptation and predictive coding accounts is that prediction causes sharpening of tuning curves to relevant stimulus properties while adaptation decreases the amplitude of neuronal responses. Here we tested this hypothesis using a forward encoding analysis approach to electroencephalography (EEG) recorded at the scalp, which allows for the reconstruction of orientation-selective visual responses. To do this, participants were presented with sequential pairs of Gabor stimuli while recording EEG. The critical variable was the match in orientation between the first and second Gabor, manipulated across two conditions. In one condition the two Gabors had the same orientation on 80% of trials and one of the 8 other orientations on 20% of trials, and in the other condition these probabilities were reversed. This manipulation allowed us to separate effects of expectation and adaptation on repetition suppression, as the orientation change was either expected or unexpected. We used forward encoding modelling to reconstruct the orientation-selective responses to the stimuli from EEG signals across the different expectation conditions. We found that expectation and adaptation have distinct effects on the neural representation of orientation information, suggesting that these two processes make different contributions to the repetition suppression effect.

**Decoding dice and digits with Magnetoencephalography: How long does it take to access magnitude?**

**Ms Lina Teichmann,** PhD Student

University of Auckland

A/Prof Anina Rich, Macquarie University

Numerical format describes the way quantities are conveyed, for example as digits (‘3’) or Roman Numerals (‘III’). There is an ongoing debate about whether numerical representation in the brain is abstract and independent of format or format-dependent. The answer to this question has consequences for our understanding of how mathematical skill develops, and is taught. Magnetoencephalography (MEG) offers an opportunity to monitor brain activity with millisecond accuracy. Representational similarity analysis (RSA) applied to MEG data allow us to decode what type of information the brain processes at what time. Here, we use these methods to examine the time course of magnitude processing. We presented participants with a series of digits and dice patterns corresponding to the magnitudes of 1 to 6. We use MEG decoding and RSA to determine the time point at which information about magnitude is represented. Our results show that we can successfully decode digits and dice as early as 100ms after stimulus onset, but the abstract magnitude is represented several milliseconds later time. Thus, with our methods we can differentiate format-specific from abstract magnitude representation, as well as distinguishing processing of purely visual from higher-level magnitude information.

**Decoding dice and digits with Magnetoencephalography: How long does it take to access magnitude?**

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**Decoding dice and digits with Magnetoencephalography: How long does it take to access magnitude?**

MS Lina Teichmann, PhD Student

University of Auckland

A/Prof Anina Rich, Macquarie University

Numerical format describes the way quantities are conveyed, for example as digits (‘3’) or Roman Numerals (‘III’). There is an ongoing debate about whether numerical representation in the brain is abstract and independent of format or format-dependent. The answer to this question has consequences for our understanding of how mathematical skill develops, and is taught. Magnetoencephalography (MEG) offers an opportunity to monitor brain activity with millisecond accuracy. Representational similarity analysis (RSA) applied to MEG data allow us to decode what type of information the brain processes at what time. Here, we use these methods to examine the time course of magnitude processing. We presented participants with a series of digits and dice patterns corresponding to the magnitudes of 1 to 6. We use MEG decoding and RSA to determine the time point at which information about magnitude is represented. Our results show that we can successfully decode digits and dice as early as 100ms after stimulus onset, but the abstract magnitude is represented several milliseconds later time. Thus, with our methods we can differentiate format-specific from abstract magnitude representation, as well as distinguishing processing of purely visual from higher-level magnitude information.
Sustained attention as a predictor of antisaccade performance in schizophrenia

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Monash Alfred Psychiatry Research Centre, Alfred Hospital and Monash Central Clinical School

Mrs Jessica Myles, Alfred Hospital and Monash Central Clinical School
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Dr Eric Tan, Alfred Hospital and Monash Central Clinical School
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Dr Caroline Gurvich, Alfred Hospital and Monash Central Clinical School

Antisaccade (AS) performance is regarded as one of the most promising markers of the presence and severity of schizophrenia. The AS task requires individuals to suppress the automatic response of looking at a target and instead look at the mirror (opposite) location. Successful AS performance is thought to rely on cognitive abilities including inhibition, attention and speed of processing. It has been suggested that the poorer AS performance in schizophrenia reflects a generalised neuropsychological deficit. Few studies have directly investigated the relationship between eye movements and neuropsychological functioning in schizophrenia. This study investigated potential neuropsychological predictors of AS performance. 41 adults (64 patients with schizophrenia/schizoaffective disorder and 87 healthy controls) were assessed for AS performance using an EyeLink II head-mounted eye tracker. Continuous Performance Task (CPT), Stroop and the Symbol-coding task were administered to assess cognitive processes likely to be engaged in the AS task. AS performance was unrelated to any neuropsychological measure in the control group. In patients, the model explained 17.2% of the total variance in AS error (percentage of saccades towards the peripheral target) performance, F (3,36)=3.71, p=0.020. CPT performance made a significant unique contribution of 15.4% (β=0.431, p=0.011). The model also explained 18.4% of the total variance in AS latency (time from target onset to saccade onset) performance, F (3,38)=3.37, p=0.019. None of the measures were significant unique contributors, though CPT performance contributed at a trend level (β=0.310, p=0.067). The results suggest that AS performance is not a reflection of broad neuropsychological performance as previously thought, but is an extension of attentional deficits in schizophrenia.

Cognitive improvement during stroke rehabilitation: Spontaneous recovery or practice effects?

Mrs Christine Torrance, Undergraduate Student
University of Newcastle

Dr Helen Andrews, University of Newcastle
Dr Heidi Janssen, University of Newcastle
Dr Neil Spratt, University of Newcastle
Mr Michael Pollock, University of Newcastle
Dr Ruby Hooke, University of Newcastle
Dr Nicolas Buckley, University of Newcastle
Dr Karen Drysdale, University of Newcastle

A/Prof Frini Karayanidou, University of Newcastle

Recognition Memory, Simple Reaction Time, Choice Reaction Time and Intra-Extra Dimensional Shift (IED) task. Stroke patients (N=30) were assessed on admission to and discharge from a rehabilitative ward (average 16.3 days). At baseline, assessments included the Functional Independence Measure (FIM), current global level of cognitive functioning (MoCA), premorbid functioning (WTAR) and the neuropsychological test battery. At retest only the FIM and neuropsychological tests were administered. The data were analysed using a two-way ANOVA with Session (baseline, retest) as a repeated measures factor and Group (stroke, health controls) as a second factor. Practice effects are represented by a main effect of Session, whereas spontaneous recovery is represented by a Group × Session interaction. Stroke patients performed poorly on all neuropsychological tests compared to healthy controls, however both groups showed improved performance at re-test. The rate of improvement did not differ between groups on any tests except for IED. Stroke patients improved more than healthy controls on IED with a rate of recovery above that of task practice, indicating spontaneous recovery.

Empirical testing of integrated information theory of consciousness

A/Prof Naotsugu Tsuchiya,
Monash University

A significant problem in neuroscience concerns the distinction between neural processes that is correlated with conscious perceptions from processing that is not. Integrated information theory proposes that conscious perceptions arise from a hierarchical structure of causal interactions between neuronal populations, i.e. a pattern of integrated information. We tested this proposal by computing integrated information patterns from intracranial electrocorticography from 6 neurosurgical patients with electrodes implanted over lateral and ventral cortices. During recording, subjects viewed continuous flash suppression and backward masking stimuli intended to dissociate conscious percept from stimulus, and unmasked suprathreshold stimuli. Object-sensitive areas revealed correspondence between conscious percepts and integrated information patterns. We quantified this correspondence using supervised classification methods that revealed clustering of visual experiences with integrated information, but not with broader information measures including mutual information and entropy. Our findings point to a significant role of locally integrated information for understanding the neural substrate of conscious experience.

Speech normalisation in EEG: an optimal paradigm?

Dr Alba Tuninetti, Postdoctoral Fellow
Western Sydney University

A/Prof Paola Escudero, Western Sydney University

In recording the mismatch negativity (MMN) to sound stimuli in EEG/ERP, the standard oddball paradigm has been the cornerstone in eliciting reliable waveforms to acoustic and categorical differences (see Näätänen, 2001, for a review). Changes to the oddball paradigm, such as a multi-deviant paradigm where, for a particular deviant stimulus, other deviants act as standards, have also elicited reliable MMN responses to acoustic changes, suggesting that the human auditory system can still construct a reliable memory trace of the deviants as standards to index the change (Näätänen et al., 2004). We applied this method to natural speech tokens to compare the MMN in a standard oddball paradigm and a multi-deviant oddball paradigm. Two groups of participants with no knowledge of Dutch were presented with isolated Dutch vowels: a standard vowel and four deviants, a vowel change, a sex change, a speaker change, and an accent change. One group received a blocked presentation, wherein each deviant was presented in a separate block with the same standard in all blocks. The other group received a mixed presentation where the standard and all deviants were presented in a single block. The MMN response was measured for each deviant. Preliminary results suggest that the standard presentation group (n = 8) shows a larger MMN response to the vowel and sex deviants. However, the mixed presentation group (n = 13) shows a larger MMN response to the accent and sex deviants. There is a marginal interaction (p = .11) between deviant type and condition that suggests qualitative differences between the mixed and the standard oddball paradigm. Because previous work only focused on acoustic differences in intensity, duration, location, and frequency, we sug-
gest that natural speech tokens may be perceived differently at pre-attentive levels depending on the memory traces formed during standard presentation.

**Multivariate pattern analysis of event-related potentials predicts the general desirability of objects**

Mr William Turner, Honours Student
University of Melbourne

Mr Phillip Johnston, University of Melbourne
Ms Kathleen de Boer, University of Melbourne
Dr Carmen Morawetz, Freie Universitaet Berlin
Dr Stefan Bode, University of Melbourne

Visual stimuli have been proposed to undergo immediate semantic processing during which information relevant to decision-making is extracted. Critically, previous research has not determined whether information directly predictive of decisions regarding everyday objects is automatically extracted during passive stimulus exposure. The current study investigated whether information regarding the general desirability of a stimulus (termed ‘wanting’) was rapidly and automatically processed. Participants completed a foreground attention task while their brain activity was recorded using electroencephalography (EEG). On each trial, a task-irrelevant image was presented in the background. After the experiment, participants rated the images with regards to wanting, as well as the potentially related stimulus attributes of relevance, familiarity and aesthetic pleasantness. Multivariate support vector machine classification was used to test whether these subsequent ratings could be predicted from spatial-temporal patterns of participants’ EEG data. Prediction of wanting ratings was possible from brain activity at 70 and 110ms following stimulus presentation. Prediction of relevance ratings was possible between 90-120ms following stimulus presentation. Familiarity and aesthetic pleasantness ratings could not be predicted. Additional analyses revealed that wanting and relevance ratings were highly correlated and displayed similar feature weight maps. These ratings were also highly correlated with normative ratings for stimulus valence (valence and approach/avoidance). These current findings indicate that information related to the desirability of everyday objects is rapidly and automatically processed for a wide range of visual stimuli. Furthermore, they suggest that wanting judgments may result, in part, from the integration of information regarding stimulus-relevance/approach-avoidance.

**The effect of competition and adaptation on the amplitude of the event-related potential n170**

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University of Auckland

Mr Oliver Saltmarsh, University of Auckland
A/Prof Paul Corballis, University of Auckland

When two or more faces are presented at the same time, they appear to ‘compete’ for representation in the visual system (Desimone & Duncan, 1995). Evidence for this comes from several studies investigating the modulation of the N170 component of the event-related potential (ERP) when a stimulus is presented (e.g., Jacques & Rossion, 2006). The N170 evoked by the presentation of a target face is attenuated in amplitude when the face is flanked by other faces compared to when it is flanked by other objects or by phase-scrambled faces. Similarly, the N170 evoked by a target face is reduced in amplitude when another face is presented prior to it. This is referred to as adaptation, or repetition suppression (Grill-Spector, Henson, Martin, 2006). It has recently been suggested that both competition and adaptation may reflect a stage of the same underlying process (Kovacs, Zimmer, Voolv, Lavric, & Rossion, 2013). In the present experiment, we aim to examine the temporal development of competition and adaptation by examining the amplitude of the N170 evoked for target stimuli using the both paradigms with the same participants. Here we presented i) a single target ii) a target and two peripheral flankers simultaneously, iii) two peripheral flankers followed by a target (as in competition paradigms), and iv) a central image followed by the target (as in adaptation paradigms). We found
The association between Internet use and cognition: A pilot study
Grace Y. Wang, Auckland University of Technology, New Zealand
Alesia Chhokar, Auckland University of Technology, New Zealand
Apoorva Sheka, Auckland University of Technology, New Zealand
Background: Given the vast development of technological progress and enhanced accessibility to information technologies over the last two decades, issues surrounding its excessive use and abuse have become an increasingly important topic for research. It is argued that excessive Internet users suffer from a loss of control over their Internet use, resulting in various negative consequences. Although only Internet gaming disorder has been included in the DSM-5, evidence suggests that the harmful effects associated with addictive use of the Internet need to be addressed. The present research aimed to investigate the relationship between Internet use and cognitive function.
Method: Cognitive function of Internet users was evaluated using a battery of self-administered computerized neuropsychological test (IntegNeuroTM, Brain Resource Company, Australia) measuring seven cognitive domains, including mental speed of processing and motor function, attention, executive function, verbal function, emotion identification and social cognition. The intensity of non-work/study-related Internet use was measured using Young's Internet Addiction Test. Results: There was a significant positive correlation between intensity of Internet use and errors in the tasks measuring verbal memory (r = 0.45, p = 0.04) and working memory (r = 0.85, p < 0.001). Increased Internet use also led to greater negativity bias (r = 0.58, p < 0.05).
Discussion: Excessive Internet use may adversely affect cognition. Further study is required to examine the neurophysiological change associated with Internet use.

The role of infant and maternal factors on the early development of infant cognition
Ms Olivia Whalen, PhD candidate University of Newcastle
A/Prof Frini Karayanidis, University of Newcastle
A/Prof Alison Lane, University of Newcastle
Dr Linda Campbell, University of Newcastle

Improved cognitive control is associated with greater coordination of cognition and affect, which in turn permits individuals to better monitor social and emotional arousal with deliberate reasoning, rational decision making and goal directed behaviour. A longitudinal study conducted by Moffitt et al., (2011) confirmed a causal relationship between early cognitive control ability and adaptive/adaptive or maladaptive outcomes, whereby individual levels of self-control in childhood were highly predictive of real-world outcomes in adulthood, including physical health, substance abuse, wealth and criminal behaviour. The foundations for cognitive control develop through the pre-school years and remain stable across the rest of life. Thus it is critical to understand how the precursors to cognitive control develop in childhood, and even in infancy. Individual differences in attentional control in infancy have been shown to be preludial, me of cognitive control in childhood, however the majority of research on infant attention has been purely descriptive with a perceptual focus.

The present study uses a comprehensive assessment of early cognitive ability and attention measures in infants aged 6mths and 12mths. Tracking tasks will be used to assess infant attention, and include smooth pursuit, habitation, joint attention and visual expectation paradigms. We are looking at how individual variability in performance on these measures relate to child development (as measured by the Bayley Scales), mother-child attachment and social interaction, infant temperament and sensory abilities, as well as parent health, mental health and executive functioning. 164 mother-infant dyads have been assessed in the present study to-date, and with the eye tracking currently being piloted, pilot data from the tasks will be reported. Understanding the early environmental influences on infant cognition has the potential to inform interventions that assist in the healthy development of children.

A spotlight on attention and prediction in the dragonfly.
Dr Steven Wiederman, University of Adelaide
Whether a human catching a ball, a dog leaping at a Frisbee or a dragonfly pursuing one prey amidst a swarm, brains both large and small have evolved a relatively simple and efficient solution to a task that challenges the most sophisticated robotic vision systems - the detection, selection and pursuit of moving targets in cluttered environments. With behavioural and physiological recordings from flying insects, we examine the mechanisms underlying target selectivity, predictive coding of trajectory, selective attention and roles for active-vision strategies. We translate these bio-inspired models onto our autonomous ground vehicle, and test the robot's ability to pursue moving targets within unstructured environments.

Examining the auditory mismatch negativity in adults with and without developmental coordination disorder (DCD): a pilot study
Dr (Charles) Adam Wigley, Research Fellow University of Notre Dame Australia
Prof Beth Hands, University of Notre Dame Australia

The aetiology of DCD is unclear but evidence suggests that the forward (predictive) modelling of motor actions may be a core problem. The mismatch negativity (MMN) electroencephalogram (EEG) response has been implicated in predictive error detection (e.g., forward modelling) and updating internal representations (e.g., motor learning). Deficits in both these areas have been associated with DCD. We will compare auditory MMN’s in an initial sample of five adults with and five without DCD. Dynamic casual modelling (DCM) of the data will be used to investigate effective connectivity associated with the MMN response in both groups. Data will be collected during the tasks from a Biosemi™ 64 channel EEG system. Blocks of stimuli are presented using a roving-standard paradigm. Stimuli are 1000Hz and 2000Hz sinusoid tones, 70msec duration, 5msec rise/fall times and ISIs of 500msec. Randomised alternating sequence of 8-12 repetitions are presented. Participants are asked to press a button every time they hear a randomly inserted (8 occurrences) spoken phoneme.

Data is pre-processed and analysed using SPM 12. SPM’s of the averages from 8th (standards) and 1st stimuli occur- rences (deviants) will be compared across groups. DCM group analysis will be undertaken based on networks established in previous literature. Preliminary analysis indicates a significant MMN at 180msec in frontal electrodes for the TD group supporting previous research. We anticipate the DCD group will show significantly attenuated MMN responses compared to the TD group. The DCM analysis will examine top down and bottom up influence in the MMN networks for both groups. The ability to detect and attend to violations of expectation is central to error correction and task learning. As yet, no one has investigated auditory MMN in this population using DCM tools. This research has the potential to refine our understanding of the role early automatic neural responses play in the aetiology of DCD.
the 6th Australian Cognitive Neuroscience Conference

Mr Royce Willis, Student
Southern Cross University

Dr Stephen Provost, Southern Cross University

Prof Leslie Christidis, Southern Cross University

The unpleasant feelings associated with environmental issues may lead some individuals to avoid thinking about them; "The problem is just too big and what can I do?" Despite the overwhelming nature of environmental issues, some people confront them and adapt their behaviour to reduce their negative impact on the natural environment. The EEG Theta/Beta ratio has been found to positively correlate with trait approach motivation, while negatively correlating with anxiety. For this reason, it was hypothesized that the Theta/Beta ratio may correlate with pro-environmental attitudes and behaviour by allowing individuals to regulate anxiety and confront environmental issues. After completing the EEG stage of the study, participants (n=34) completed a number of self-report measures of environmental attitudes and behaviour, as well as measures of motivation tendencies. Right frontal Theta/Beta was found to support previous literature, positively correlating with a Behavioral Approach System (r = .361, p < .036). However, right frontal Theta/Beta also positively correlated with an Egocentric Value orientation (r = .479, p = .004), and negatively with environmental attitude (r = -.404, p = .018) and value (r = -.453, p = .007) measures, and self-reported pro-environmental behaviour (r = -.415, p = .015). This is preliminary evidence that the Theta/Beta ratio is positively related to self-rewarding approach behaviour, but inversely related to behaviour with benefits external to the self, such as pro-environmental behaviour.

Consciousness in dreaming & dreamless sleep: Questions & challenges for future research
Dr Jennifer Windt, Lecturer
Monash University

Consciousness is often defined contrastively by pointing to the difference between dreaming and dreamless sleep, where dreamless sleep is thought to be characterized by a loss of consciousness. This assumption is central to philosophical work on consciousness, but also informs research methodology in cognitive neuroscience. In this talk, I propose that the definition of dreamless sleep as a unified state of unconsciousness is oversimplified. Sleep supports a range of different types of cognitive activity, including memory consolidation and emotional processing, as well as complex behavior, and different lines of research suggest that some of these are associated with kinds of conscious experience distinct from dreaming. This means that standard theoretical approaches to dreamless sleep, as well as the research methodologies they inspire, are oversimplified. I suggest that progress can be made by refining the taxonomy for describing conscious experience during sleep and the criteria for sleep-stage scoring in concert. This approach can inform research on memory consolidation in sleep, but also on the diagnosis and treatment of sleep disorders.

Replication and effects of practice using cued task-switching paradigm through evidence accumulation model: Robust EZ diffusion
Dr Aaron Wong, Post-doctoral Researcher
University Of Newcastle

Mr Patrick Cooper, University Of Newcastle
Dr Ross W. Fulham, University Of Newcastle
Prof Scott Brown, University Of Newcastle
A/Prof Frini Karayanidis, University Of Newcastle

Previous work has suggested that slower switch performance during task-switching is actually a consequence of higher cautious response and a slower rate of evidence accumulation. In addition, we have shown that these modelling parameters are malleable with practice. Repeated measures ANOVA was conducted to see the influence of Robust EZ parameters. There were significant effects of Trial Type, Session, and Trial Type by Session on all Robust EZ parameters. With practice, non-decision time reduced for all trial types. A significant reduction in criterion was seen between first and second practice sessions for all trial types but does not continue for testing sessions. Drift rate increased with practice and was particularly evident in prepared repeat trials, but was not seen in non-informative repeat and switch to trials. A replication of Karayanidis et al. 2009 using a larger cohort, further re-enforces that slower switch performance during task-switching is a result of higher cautious response and a slower rate of evidence accumulation. In addition, we have shown that these modelling parameters are malleable with practice.

The association of infant temperament and maternal pitch contours
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University Of Newcastle

Dr Titia Benders, Macquarie University
Dr Linda Campbell, University of Newcastle
Prof Joerg Mattes, University of Newcastle
Dr Vanessa Murphy, University of Newcastle
A/Prof Frini Karayanidis, University Of Newcastle
A/Prof Alison Lane, University Of Newcastle

Infant temperament is defined as the pattern of reactivity and regulation displayed by an infant, and is suggested to influence the mother-infant interaction. One component of the interaction is the mother’s infant-directed speech (IDS). Adaptations to pitch contours during IDS involve acoustic exaggeration, and they are used to regulate infant affect and attention. Rising and bell-shaped contours attract and maintain infant attention and communicate affect, whereas slowly-falling contours soothe infants and rapidly-falling contours prohibit unwanted behaviour. The aim of the study was to investigate whether these pitch contours were associated with infant temperament. Eight six-month-old infants and their mothers were recruited through the Breathing for Life Infant Development study. Mother-infant dyads participated in a 15-minute recorded play interaction, and mothers’ pitch contours were extracted and classified. Infant temperament was assessed using the observer rated Temperamental Adjective Triad Assessment and the maternal rated Carey Temperament Scales. Infant temperament scores were correlated with the mothers’ proportion of each pitch contour used during the interaction. Significant correlations were found between all contours and at least one temperament dimension. Mothers used more rising and bell-shaped contours when infants were more approaching and more rising contours when infants were more resistant. Fewer rising and more slowly-falling and rapidly-falling contours were used when infants displayed a negative mood. Finally, more rising and rapidly-falling contours were associated with higher infant activity. The current study provides evidence of a relationship between infant temperament and maternal pitch contours. The results implicate the infant as an active participant in the mother-infant interaction. Further work is needed on this area, as understanding this interaction is integral to infant social, language, and cognitive development.

Don’t judge a book by its cover - case of a minimally-verbal Autistic child with excellent receptive and productive language
Dr Alexandra Woolgar, Research Fellow
Macquarie

Ms Selene Petit, Macquarie University
Dr Nicholas Badcock, Macquarie University
A/Prof Anina Rich, Macquarie University
Dr Jon Brock, Macquarie University
Prof Lyndsey Nickles, Macquarie University
Very little is known about the cognitive abilities of Autistic children and adults who are minimally-verbal (i.e. with no or unreliable speech). Anecdotal evidence suggests that some of these individuals may have intact spoken language comprehension and can demonstrate intact language production through non-speech modalities. Traditionally, however, this population has been very difficult to test. We present a case of a minimally-verbal autistic child with intact spoken language comprehension and written language production. This 9-year-old girl has a profile of autism as clinically assessed and as measured on the Autism Diagnostic Observation Schedule (ADOS) and parental report (Social Communication Questionnaire and Vineland Adaptive Behavioural Scales), and little productive spoken language. She has learnt to communicate by pointing to letters on a letter board (using Rapid PromptingTM Method). By adapting behavioural tests to enable her to respond using this communication method, we show that she has normal-range IQ and receptive vocabulary scores. Using a low-cost portable brain imaging (Electroencephalography) device, we also show that her neural responses distinguish between spoken sentences with meaningful versus anomalous completion (e.g. “The hungry baby wanted to drink milk” versus “She wore a necklace around her milk”), and between forward-associated or unassociated spoken word pairs (e.g. “arm-leg” versus “nap-leg”). This brain imaging approach provides objective evidence for semantic processing of spoken words and sentences. It may have utility for detecting hidden language abilities in other children who are minimally-verbal and have not yet found a method to demonstrate how much they understand. This study was funded by the ARC CCD Neural Markers Training Scheme.

**Individual differences in binocular rivalry across autistic personality traits**

**Ms Katie Wykes, Honours Student**  
Swinburne University

**Ms Laila Hugrass, Swinburne University**  
Prof David Crewther, Swinburne University

Numerous visual processing differences for autism spectrum disorder extend to the neurotypical population, for groups with high vs. low levels of autistic personality traits. There is some controversy as to whether binocular rivalry is different across the autistic spectrum. Studies using complex, object images as rival stimuli found that switching rates are slower in autism and durations of mixed percept are longer; however, there is mixed evidence as to whether rivalry between simple gratings stimuli differs for autistic and control groups. Here we investigate differences in binocular rivalry across a neurotypical sample with high and low autism quotient (AQ) scores. We also investigated differences in rivalry across a social disorganisation factor that is shared across AQ and schizotypal personality scales. The rival stimuli were pairs of simple gratings or complex objects presented at fixation or in the periphery. When the rival stimuli were presented at fixation, individuals with high AQ showed higher proportions of mixed perception, and lower switching rates for both simple and complex rival pairs. Contrary to previous studies, complex stimuli were found to produce higher proportions of mixed perceptions than simple stimuli across all groups. When the stimuli were presented peripherally, there were no between-groups differences in switch rate or mixed percept durations for the complex rival pair, yet the high AQ group showed higher proportions of mixed rivalry for the simple stimuli. When participant groups were split by social disorganisation, rather than AQ, we observed the same differences, with slightly higher effect sizes. These findings suggest that low-level visual processing differences in across autistic and schizotypal personality spectra may account for differences in binocular rivalry dynamics.

**Top-down modulation of onset capture by feature relationships, within and between feature dimensions.**

**Ms Ashley York, MPhil Student**  
University of Queensland

Dr Stefanie Becker, University of Queensland

Current models of attention propose that we can tune attention in a top-down controlled manner to a specific feature value (e.g. shape, colour) to find specific items. However, recent studies have shown that attention is often tuned in a context-dependent manner to the relative features of a sought-after target item, that is, the features that the target has relative to other surrounding non-target items (e.g. bluer, faster). However, the previous evidence is limited in that it is unclear whether tuning to relative features can modulate very early processes such as attentional capture by irrelevant, salient items. Moreover, it is currently unclear whether we can tune attention to multiple different feature relationships simultaneously (e.g., to larger and bluer). To investigate these questions, we randomly varied the target in visual search (e.g., target was either faster-rotating or bluer than the non-targets). In a second study, we tested whether attention can be tuned to two different relative features within the same stimulus dimension of colour (i.e., by randomly varying the target between being bluer or greener than the non-targets). As we were interested in top-down modulation of the earliest visual processing steps, we centrally assessed the participant’s first eye movement on each trial. The results showed that the relational congruent distractor (e.g., bluest, fastest) captured attention and the gaze most often, beyond maximally salient or feature-specific (e.g., target-matching) distractors. These results demonstrate that attention can be simultaneously tuned to different feature relationships, both within and across different feature dimensions (i.e., relative colour and relative motion; and two relative colours). Taken together, these results indicate that the relational account can potentially be extended to explain how we allocate attention in natural environments, which often require tuning to multiple features.

**Time-resolved connectomics**

**Dr Andrew Zalesky, University of Melbourne**

Functional neuroimaging can be used to map the effects of non-invasive brain stimulation on functional brain systems. In this talk, I will introduce attendees to the language of networks and graphs, as applied in neuroscience, and demonstrate how network science can be used in a time-resolved manner to understand dynamic changes in functional connectivity and functional brain networks. I will highlight key methodological and statistical challenges inherent to analysing time-resolved functional brain networks, particularly the choice of sliding window length, the need for appropriate network null models to discern true neural fluctuations from spurious ones, and the pros and cons of regularised (partial) versus full correlation as measures of network connectivity. Another key challenge that I will address is defining networks nodes in a dynamic manner so that their boundaries can change, or they can merge and divide, as a function of time. Finally, I will present various examples where functional neuroimaging has been combined with network science to map dynamic changes in functional connectivity in neuroscience and clinical applications.
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**Australian Graduate Survey 2015

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## Agenda at a Glance

### Thursday 24 November

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>Early Career Research Workshop</td>
<td>Sea &amp; Star Room</td>
</tr>
<tr>
<td>10:30</td>
<td>Morning Tea</td>
<td></td>
</tr>
<tr>
<td>11:00</td>
<td>ECR Q&amp;A Session</td>
<td>Sea &amp; Star Room</td>
</tr>
<tr>
<td>12:30</td>
<td>Registration Desk Opens</td>
<td></td>
</tr>
<tr>
<td>13:00</td>
<td>Mid-Career Research Workshop</td>
<td>Sea &amp; Star Room</td>
</tr>
<tr>
<td>14:30</td>
<td>Afternoon Tea</td>
<td></td>
</tr>
<tr>
<td>17:00</td>
<td>Conference Opening</td>
<td>WhiteSands Ballroom</td>
</tr>
<tr>
<td>17:30</td>
<td>Keynote 1: Dr David Strayer</td>
<td>WhiteSands Ballroom</td>
</tr>
<tr>
<td>18:30</td>
<td>Welcome Reception</td>
<td>Promenade &amp; Sandyfoot</td>
</tr>
<tr>
<td>20:30</td>
<td>ECR Social Drinks</td>
<td>Port Stephens Country Club</td>
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### Friday 25 November

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
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<tbody>
<tr>
<td>9:00</td>
<td>Keynote 2: Dr Rosalyn Moran</td>
<td>WhiteSands Ballroom</td>
</tr>
<tr>
<td>10:00</td>
<td>Morning Tea</td>
<td></td>
</tr>
<tr>
<td>10:30</td>
<td>Open Talks A1 (Sun Room), B1 (Sea &amp; Star Room)</td>
<td></td>
</tr>
<tr>
<td>12:30</td>
<td>Lunch (Promenade)</td>
<td></td>
</tr>
<tr>
<td>13:30</td>
<td>Symposia A1 (Sun Room), B1 (Sea &amp; Star Room)</td>
<td></td>
</tr>
<tr>
<td>15:00</td>
<td>Afternoon Tea</td>
<td></td>
</tr>
<tr>
<td>15:30</td>
<td>Fast talks A1 (Sun Room), B1 (Sea &amp; Star Room)</td>
<td></td>
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<tr>
<td>18:30</td>
<td>Poster Gala Session</td>
<td>WhiteSands Ballroom</td>
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### Saturday 26 November

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>Keynote 3: Dr Sara Festini and Michelle Farrell</td>
<td>WhiteSands Ballroom</td>
</tr>
<tr>
<td>10:00</td>
<td>Morning Tea</td>
<td></td>
</tr>
<tr>
<td>10:30</td>
<td>Open Talks A2 (Sun Room), B2 (Sea &amp; Star Room)</td>
<td></td>
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<tr>
<td>12:30</td>
<td>ACNS Equity Policy Launch &amp; Lunch</td>
<td>Promenade</td>
</tr>
<tr>
<td>12:30</td>
<td>Other Lunch</td>
<td>WhiteSands Reception</td>
</tr>
<tr>
<td>14:00</td>
<td>Symposia A2 (Sun Room), B2 (Sea &amp; Star Room)</td>
<td></td>
</tr>
<tr>
<td>15:30</td>
<td>Afternoon Tea</td>
<td></td>
</tr>
<tr>
<td>16:00</td>
<td>Fast talks A2 (Sun Room), B2 (Sea &amp; Star Room)</td>
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<tr>
<td>18:30</td>
<td>Conference Dinner</td>
<td>Broughtons at the Bay</td>
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### Sunday 27 November

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:30</td>
<td>2016 ACNS Young Investigator Award: Dr Paul Dux</td>
<td>WhiteSands Ballroom</td>
</tr>
<tr>
<td>10:00</td>
<td>Morning Tea</td>
<td></td>
</tr>
<tr>
<td>10:30</td>
<td>Open Talks A3 (Sun Room), B3 (Sea &amp; Star Room)</td>
<td></td>
</tr>
<tr>
<td>12:30</td>
<td>Working Lunch</td>
<td>Promenade</td>
</tr>
<tr>
<td>13:00</td>
<td>Annual General Meeting</td>
<td>Promenade</td>
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