ACNS

Australasian Cognitive Neuroscience Society

7th Australasian Cognitive Neuroscience Society

Conference ADELAIDE

23 - 26 November 2017

Conference Proceedings

Hosted at

University of South Australia

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Welcome

Dear Colleagues and Friends,

It is our great pleasure to welcome you all to Adelaide.

This is the first time the Australasian Cognitive Neuroscience Society has met in Adelaide for their annual conference. So, we hope you all enjoy your time here.

Thank you to our keynotes for traveling from the UK and US to join us and share their research. And for the support of our sponsors, who enable this conference to be held each year.

The conference organisation this year has been a true team effort, with members across all three Adelaide universities. Everyone has contributed an enormous amount of time, thank you. Special shout outs go to Mark for leading the sponsorship team; Ash for leading the workshop team; and Nathan and Scott who have pulled the electronic poster session together (a first for ACNS!). They have been joined by an army of enthusiastic and highly capable PhD students.

Final thanks go to you, ACNS researchers, for always making this an interesting, vibrant and approachable conference.

Have a wonderful few days in Adelaide,

Dr Hannah Keage
Chair of ACNS-2017

Dr Tobias Loetscher
Treasurer of ACNS-2017

And the rest of the Local Organising Committee!

ACNSC 2017

The 7th Australasian Cognitive Neuroscience Society Conference is hosted at the University of South Australia in Adelaide.

Local Organising Committee

Chair: Dr Hannah Keage

Members from UniSA

- Dr Tobias Loetscher
- Dr Mark Kohler
- Dr Ashleigh Smith
- Dr Scott Coussens
- Dr Michelle McDonnell
- Dr Tasha Stanton
- Dr Brenton Hordacre

Members from the University of Adelaide

- Professor Michael Ridding
- Professor John Dunn (now at University of Western Australia)
- Dr Mitchell Goldsworthy
- Dr Lyndsey Collins-Praino
- Dr Bahar Moezzi

Members from Flinders University

- Dr Owen Churches
- Professor Jason McCarley (now at Oregon State)
- Dr Nathan Leggett

Member from 2018 ACNS, University of Melbourne

- Dr Stefan Bode

Member from 2016 ACNS, University of Newcaslte

- Assoc/Prof Frini Karayanidis

Student Group

- Louise Lavrencic, University of South Australia
- Danielle Greaves, University of South Australia
- Dilushi Chandrakumar, University of South Australia
- Amanda Santamaria, University of South Australia

Logo

- Melissa Cava

Scientific Committee

- Prof Allison Fox, University of Western Australia
- Assoc/Prof Ben Harrison, University of Melbourne
- Assoc/Prof Frances Martin, University of Newcastle
- Dr Gina Grimshaw, University of Wellington
- Prof Jason McCarley, Oregon State
- Prof John Dunn, University of Western Australia
- Dr Michelle McDonnell, University of South Australia
- Dr Steve Provost, Southern Cross University

Wifi-Access Options during Conference

1. Eduroam

If you are visiting the University of South Australia from a participating eduroam institution you can connect to the eduroam wireless network using your login credentials (username and password).

Connecting to Eduroam:

1. Select the eduroam wifi network from available networks
2. Enter your full username including domain (eg. jsmith@institution.edu.au). So for UniSA staff visiting other institutions, please use your username@unisa.edu.au

2. UniSA-guest login

The unisa-guest wireless network provides wireless access to the internet to all delegates who are not from a participating eduroam institution.

Connecting to unisa-guest Wireless:

1. Create a guest account on https://guest.unisa.edu.au/
   • select **City West** as *Location*
   • indicate **ACNS** as *Event Name*
   • Boxes *'Company'* and *'Person being visited'* can be left empty
2. The unisa-guest credentials will be sent to you after you created the account
3. Select unisa-guest wifi-network from available networks
4. Connect and enter your temporary unisa credentials
5. If a 'Certificate Not Verified' message is displayed, select the Accept or Connect button

Oral Presentation Instructions

- Speakers are not permitted to use their own computers or devices for their presentation.
- All speakers are required to upload the slides at least 15 minutes prior to their assigned session. A technician will be available to upload speaker presentations.
- Presenters will have access to a remote pointer in each room.
- Please help the session chairs and stay within the time allotted, as each session is under strict time limits.
- PowerPoint files only, wide or standard format.

Poster Presentation Instructions

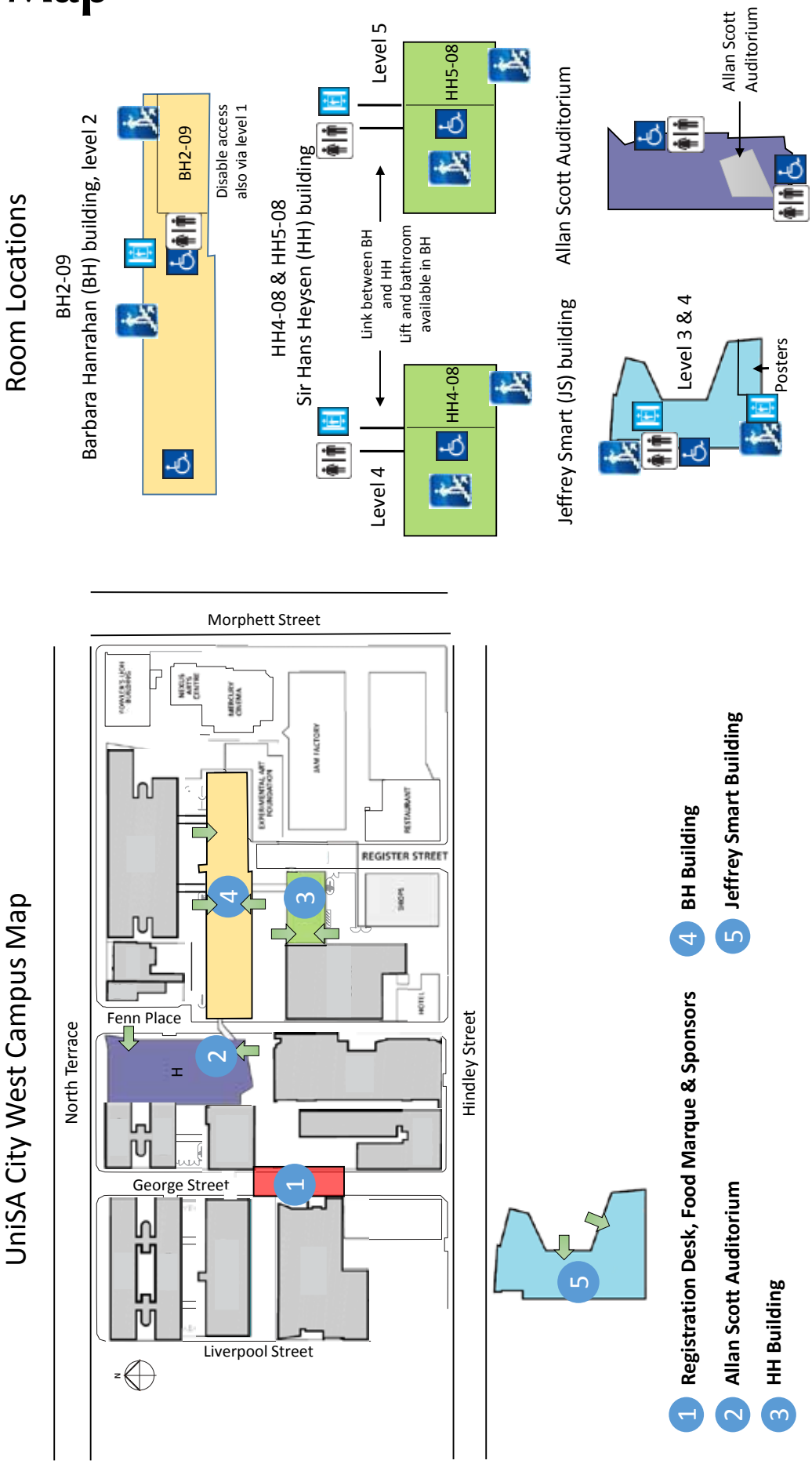
- The guidelines for the electronic poster session can be found on http://www.acns2017.conferenceonline.com.au/index/1167
- If you have not submitted the poster electronically, you can upload it at the conference registration desk (George Street).
- Please arrive at least 5 minutes prior to the start of your one hour slot (Session A or B); it is expected that presenters will be present for the entire one hour duration.

Venue Map Overview

The Conference main venue is in Adelaide's west end (City West Campus, University of South Australia)

1. Main Venue (City West Campus)
2. Poster Gala (Jeffrey Smart Building)
3. Welcome Reception (SAHMRI)
4. Dinner (Adelaide Oval)
5. ECR Mixer (Regattas)
6. Neuroanatomy workshop (University of Adelaide)

Venue Map


Room Locations
BH2-09
Barbara Hanrahan (BH) building, level 2
BH2-09
Disable access also via level 1
HH4-08 & HH5-08
Sir Hans Heysen (HH) building
Level 5
HH5-08
Link between BH and HH
Lift and bathroom available in BH
Level 4
HH4-08
Allan Scott Auditorium
Allan Scott Auditorium
Jeffrey Smart (JS) building
Level 3 & 4
Posters
UniSA City West Campus Map
Morphett Street
North Terrace
Hindley Street
REGISTER STREET
Fenn Place
George Street
Liverpool Street
1 Registration Desk, Food Marque & Sponsors
2 Allan Scott Auditorium
3 HH Building
4 BH Building
5 Jeffrey Smart Building

Social Events

Welcome Reception

Thursday 23 November **5.00pm - 7.00pm**

The Welcome Reception will take place after the first keynote on the evening of Thursday 23 November, at the South Australian Health and Medicine Research Institute (SAHMRI) on North Tce (approximately a 3-5 minute walk from George St). This free event will include canapes and drinks (soft/beer/wine).

ECR Mixer

Thursday 23 November **7.00pm onwards**

The ECR Mixer will follow the Welcome Reception on Thursday 23 November at Regatta's Bistro and Bar (Riverbank Promenade; just behind the Adelaide Convention Centre, approximately 3-5 minutes walk from George St). Finger food and bar tab will be provided.

Adelaide Oval Tour (pre-dinner)

Friday 24 November **5.30pm - 6.30pm**

For those interested, we will run a tour of the Adelaide Oval before the dinner on Friday 24 November. You do not have to go to the dinner to do the tour. The cost is $20.

Conference Dinner

Friday 24 November **from 5.30pm**

The Conference Dinner will take place at the Adelaide Oval on Friday 24 November. This will be a seated three-course dinner with drinks and the cost is $120. Pre-dinner drinks will start from 5:30pm in the Audi Stadium Club Rick Davies Bar. Doors open for dinner in the Cathedral Room from 6:15pm, with dinner starting at 6:30pm.

Poster Gala

Saturday 25 November **5.00pm - 7.00pm**

The conference will feature a single poster session on Saturday 25 November, in the UniSA Jeffery Smart Building on Hindley St. This free event includes canapes and drinks (soft/beer/wine).

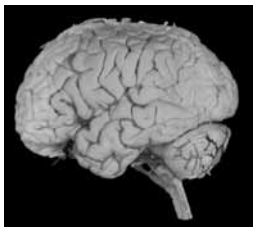
Fun Run

Sunday 26 November **from 7.00am**

We will hold a Fun Run around the River Torrens starting at 7am. There is a 4km and 8km option. This event is proudly supported by Compumedics, and they will be providing event t-shirts and a post-run snack.

Workshops

Neuroanatomy for Neuroimagers Workshop



Tuesday 21 November 11.00am - 4.00pm

University of Adelaide

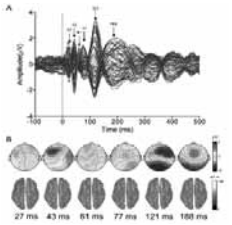
Meet at Engineering and Maths Sciences Building, room EM205
(and walking over to Medical School South, room S210, to view specimens)

Organised by Dr Lyndsey Collins Praino

Are you interested in learning more about the neuroanatomy behind your MRIs, fMRIs and PET scans? This workshop will provide you with the tools needed to interpret your images. In this interactive workshop, we will explore the normal functional neuroanatomy behind some of the major brain structures seen in the sagittal, coronal and axial imaging planes. We will then transition into an exploration of the anatomical changes observed in common neurological and psychiatric disorders. The workshop will pair brief lectures with interactive small group exercises and lab practical sessions to deepen your understanding of neuroanatomy. We will focus particularly on the transition from 2D images to 3D neuroanatomical circuits. Come explore the brain areas behind all of those colourful images with Dr Lyndsey Collins-Praino!

Lunch and afternoon tea provided.

Concurrent TMS-EEG Workshop



Wednesday 22 November 9.00am - 1.00pm

UniSA City West Campus, Room: HH3-09

Organised by Dr Nigel Rogasch with Symbiotic Devices

This half-day workshop will cover the use of electroencephalography (EEG) to: 1) measure the brain's responses to transcranial magnetic stimulation (TMS); and 2) guide the timing of stimulation from brain oscillations. Prof John Rothwell (UCL) will provide an overview of what we can learn about the brain using TMS-EEG, and Dr Nigel Rogasch (Monash) will describe the practical challenges of combining these techniques. The lectures will be followed by a demonstration of how to set up a TMS-EEG study, and a hands-on tutorial showing how to analyse TMS-EEG data using EEGLAB and TESA (the TMS-EEG signal analyser).

Morning tea provided.

Concurrent fNIRS-EEG Workshop

Wednesday 22 November 1.00pm - 5.30pm

UniSA City West Campus, Room: HH3-09

Organised by Medilink

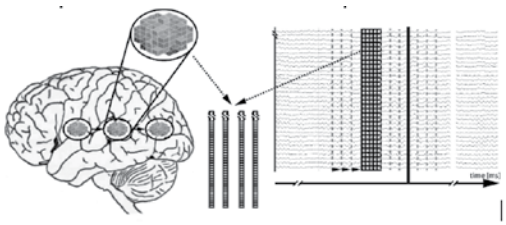
A local increase in cortical blood flow accompanies almost all neuronal responses to stimulus in the brain. This relationship, termed neurovascular coupling, involves many steps from the initial firing of the neurons to release of chemical transmitters to final vasoconstriction or vasodilatation. Understanding this relationship between brain activity and the resulting changes in metabolism and blood flow remains a vital research area. EEG and fNIRS capture signals inherent to different steps in this cascade of events, linked to the same neural activity. The combination of these two methodologies offers the possibility of examining the cortical activity more comprehensively. This half day workshop will be focused on experimental considerations for combined NIRS-EEG studies, as well practical considerations.

Afternoon tea provided.

Multi Variate Pattern Analysis (MVPA) for Cognitive Neuroscience Workshop

Thursday 23rd November 9.00am - 1.00pm

UniSA City West Campus, Room: GK3-28



Organised by Dr Stefan Bode

This half-day workshop will illustrate the use of multivariate pattern analysis (MVPA) for different neuroimaging techniques to investigate cognitive processes. Dr Alexandra Woolgar will cover MVPA for functional magnetic resonance imaging (FMRI), Prof Thomas Carlson and Tijl Grootswagers will introduce MVPA for magnetoencephalography (MEG), and Dr Stefan Bode and Dr Daniel Feuerriegel will show MVPA for electroencephalography (EEG). We will provide an introduction into variants of these techniques, as well as practical examples and some hands-on experience with data analyses.

Morning tea and lunch provided

How to Post-Doc: An Event for Postgraduate Students and Postdoctoral Researchers

Thursday 23rd November 1.00pm - 3.00pm

UniSA City West Campus, Room: HH4-08

Organised by the ACNS ECR Committee

This year the ACNS ECR committee is shining a spotlight on the challenges of the postdoctoral experience, with keen insights from our panel of distinguished researchers with unqualified success and experience in areas such as grant writing, getting a fellowship, with insights into career planning and making a success of your postdoctoral time. We are very fortunate this year to be joined by Prof Susan Rossell, Director of the Centre for Mental Health at Swinburne University, Melbourne and A/Prof Juanita Todd, from the University of Newcastle, NSW. We will also be joined by the newly minted ACNS Young Investigator Award and Emerging Research Award winners. After the panel discussion there will be an opportunity for you to mingle with other attendees and discuss your work which can be continued at the ECR social mixer later in the evening. So whether you are a current postdoc or a postgraduate student seeking to join the fray, come along and hear what our panellists have to offer and interact with your peers in a supportive and informative environment.

Keynote Addresses

Keynote Speaker 1

Chair: Professor John Dunn

Thursday 23 Nov - 4.00pm to 5.00pm ***Allan Scott Auditorium***

Professor Tom Palmeri

Vanderbilt University, USA

Approaches to Model-based Cognitive Neuroscience

Cognitive neuroscience aims to identify neural mechanisms associated with key aspects of cognition using techniques like neurophysiology, electrophysiology, and structural and functional brain imaging. Cognitive modeling has a rich history of formalizing and testing hypotheses about cognitive mechanisms within a mathematical and computational language, making exquisite predictions about how people perceive, learn, remember, and decide. These two come together in a powerful approach called model-based cognitive neuroscience, which can both inform cognitive modeling and help to interpret neural measures. Neural measures provide data that help constrain cognitive models and adjudicate between competing cognitive models that make similar predictions about behavior. Reciprocally, cognitive models decompose complex behavior into representations and processes and these model states can be used to explain the modulation of brain states under different experimental conditions. This talk provides an introduction to model-based cognition neuroscience, highlighting various approaches to this kind of work, with a specific focus on understanding perceptual decision making.

Keynote Speaker 2

Chair: Professor Mike Ridding

Friday 24 Nov - 9.00am to 10.00am ***Allan Scott Auditorium***

Professor Angela Clow

University of Westminster, UK

Links between aging, cortisol secretion and cognitive function

In addition to promoting sleep at night and wakefulness in the day the circadian pacemaker (suprachiasmatic nucleus: SCN) fine-tunes a range of functions that control how we perform across the day, including cognitive function. A crucial mediator of these effects is cortisol: changing levels across and between days synchronise and regulate processes that are not directly linked to the central pacemaker. A healthy pattern of cortisol secretion provides an important biological 'pacemaker' matched to daily needs. Secretion of cortisol is regulated by dual pathways: the SCN and the stress neuroendocrine system. Consequently chronic stress and older age are characterized by flattened circadian patterns of cortisol secretion, which are linked to poorer cognitive function. The talk will highlight how the daily dynamics of cortisol secretion lessen with increasing age and how this impacts on control of brain and cognitive function. Crucially, the talk will review evidence that patterns of cortisol secretion (in particular the cortisol awakening response) can be influenced by external cues and behaviour (e.g. light at awakening, exercise, sleep routines) making it a potential target for intervention to limit decline in cognitive function in old age.

Keynote Speaker 3

Chair: Professor Lorimer Moseley

Friday 24 Nov - 4.00pm to 5.00pm ***Allan Scott Auditorium***

Professor Charles Spence

University of Oxford

Gastrophysics: Pleasure and pain at the dining table (A special pre-dinner keynote)

Professor Charles Spence is a world-famous experimental psychologist with a specialization in neuroscience-inspired multisensory design. He has worked with many of the world's largest companies across the globe since establishing the Crossmodal Research Laboratory (CRL) at the Department of Experimental Psychology, Oxford University in 1997. Prof. Spence has published over 750 articles and edited or authored, 10 academic volumes including, in 2014, the prize-winning "The perfect meal", and "Gastrophysics" (2017). Much of Prof. Spence's work focuses on the design of enhanced multisensory food and drink experiences, through collaborations with chefs, baristas, mixologists, perfumiers, and the food and beverage, and flavour and fragrance industries. Prof. Spence has also worked extensively on the topic of multisensory contributions to pain perception.

Symposia

Symposium 1 - Non-invasive brain stimulation approaches to investigate behaviour

Friday 24 November ***2.00pm - 3.20pm***

Room: HH4-08

The use of non-invasive brain stimulation (NIBS) techniques offers significant opportunities to gain neurophysiological insights into the mechanisms associated with different forms of behaviour. In this symposium the four speakers will describe their research using cutting edge NIBS approaches to gain novel insights into cognitive and motor behaviour in both healthy and impaired humans.

Chairs

Prof Michael C Ridding, *The University of Adelaide*

Prof John C Rothwell, *University College London*

Speakers

Dr Mitchell Goldsworthy*, The University of Adelaide*

The Role of Cortical Network Connectivity and Neuroplasticity in Cognitive Reserve: a Combined TMS-EEG Study

Dr Ann-Maree Vallence, *Murdoch University*

Associations Between Supplementary Motor Area—Primary Motor Cortex Connectivity and Bilateral Voluntary Movement

Dr Nigel Rogasch, *Monash University*

Assessing the Role of Prefrontal Cortex Inhibition in Working Memory Using Combined TMS and EEG

Ms Melanie Emonson**,** *Monash University*

The Neurobiology of Cognition in Younger Adults, Older Adults and Mild Cognitive Impairment: A TMS-EEG study

Symposium 2 - Cognitive control from the cradle to the grave

Friday 24 November ***2.00pm - 3.20pm***

Room: HH5-08

Across the lifespan, cognitive control is late to develop and early to decline. It is a point of contention whether similar or unique factors underlie this progression. This symposium will discuss factors influencing cognitive control in childhood, adolescence and late-life. The diversity of predictive factors, and behavioural consequences, across the lifespan illustrate that aging does not reflect development in reverse.

Chairs

Ms Rebecca Hirst, *University of Nottingham*

Dr Nicholas Badcock, *Macquarie University*

Speakers

Professor Allison Fox, *The University of Western Australia*

Maturation of Performance Monitoring in Typically-Developing Children: Electrophysiological Indices of Cognitive Control

Assoc/Prof Frini Karayanidis*, University of Newcastle*

Risky Decision-Making and Cognitive Control in Late Adolescence and Young Adulthood

Rebecca Hirst*, University of Nottingham*

Do Changes in Sensory Processing Modulate Stroop Performance Across the Lifespan?

Dr Ashleigh Smith*, University of South Australia*

Lifestyle Contributions to Cognition in Late Life

Symposia

Symposium 3 - Using brain stimulation to probe brain and mind

Sunday 26 November ***11.40am - 1.00pm***
Room: HH4-08

Non-invasive brain stimulation techniques including transcranial magnetic stimulation are emerging as effective tools to selectively modulate the activity of whole-brain functional networks. This symposium will provide an overview of current knowledge on the effects of different stimulation techniques to the functional architecture of the brain and highlight the potential and pitfalls of brain stimulation as a tool for cognitive neuroscience.

Chair:
Dr Luca Cocchi*, QIMR Berghofer Medical Research Institute*

Speakers:

Dr Luca Cocchi, *QIMR Berghofer Medical Research Institute*

Using Brain Stimulation to Probe Information Flow Throughout the Brain

Dr Hannah Filmer*, The University of Queensland*

Neurochemical Inhibition in the Prefrontal Cortex Predicts Individuals' Response to Electrical Stimulation

Dr Leonardo L. Gollo, *QIMR Berghofer Medical Research Institute*

Modelling the Effect of Local TMS

Dr Jennifer Rodger, *The University of Western Australia*

rTMS in Animal Models: From Single Cells to Complex Behaviour

Symposium 4 - Multiple approaches to understanding cognitive and brain development in children

Sunday 26 November ***11.40am - 1.00pm***
Room: HH5-08

Large advances have been made over the last decade in our understanding of children's cognitive and brain development. This symposium showcases some very exciting research by developmental scientists from across Australia. The research presented within this symposium highlights the strengths of using different methods in developmental science in order to further understand the links between neural, cognitive, and behavioural variance and change.

Chair:
Dr Katherine Johnson, *The University of Melbourne*

Speakers:

Professor Virginia Slaughter*, The University Of Queensland*

Neonatal Imitation: Does it Exist?

Ms Benita Green, *The University of Melbourne*

Pragmatic Language in Children with Symptoms of ADHD: Relationships with Executive Functioning and Theory of Mind

Professor Kim Cornish, *Monash University*

Building Cognitive Architecture in Young Children with Compromised Attention Capacity

Dr Marc Seal, *Murdoch Childrens Research Institute*

The Application of Multivariate Analysis Techniques to Describe Paediatric Neurodevelopment

Awards

Student Travel Awards

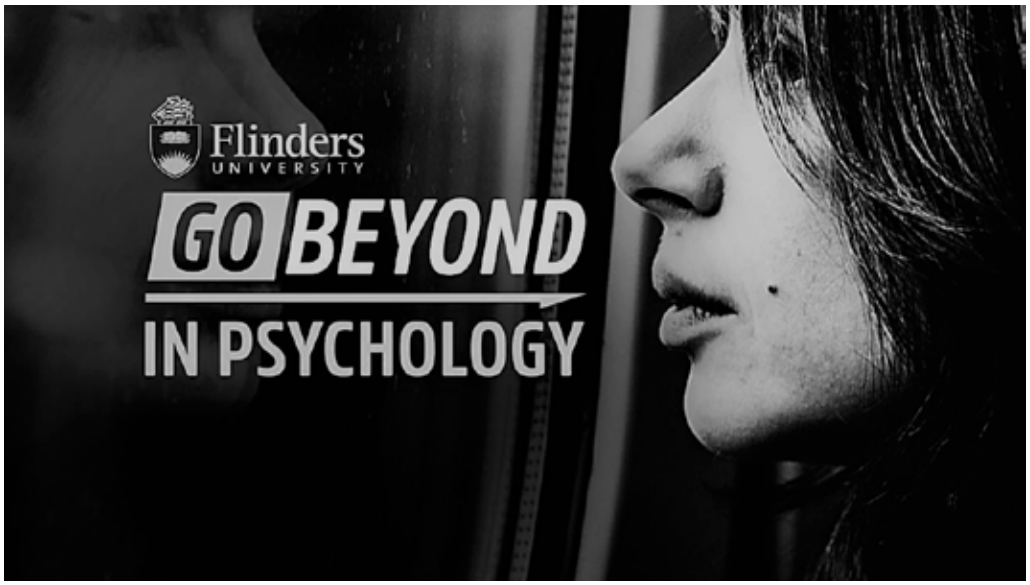
Sponsored by the ARC Centre of Excellence in Cognition and its Disorders (CCD)

- **Anne Löffler,** University College London
- **Alina Arulsamy,** University of Adelaide
- **Aron Hill,** Monash University
- **Cherie Strikwerda-Brown,** University of Sydney
- **Katharina Voigt,** University of Melbourne
- **Nahian Chowdhury,** University of Sydney
- **Nicole Mckay,** University of Auckland
- **Maria Soloveva,** Monash University
- **Riccarda Peters,** Swinburne University of Technology
- **Sally Grace,** Swinburne University of Technology
- **Sung Wook Chung,** Monash University

Poster and Presentation awards

Sponsored by the Australasian Cognitive Neuroscience Society (ACNS)

Poster and Presentation awards will be announced on Sunday 26 November starting at 1.00pm



Program

Day 1 | Thursday 23 November

12.00	**Registration Desk Opens**	George Street
15.30 - 15.45	**Welcome - Prof Tanya Monro**	Allan Scott Auditorium
15.45 - 16.00	**ACNS Award Announcements** *Chair: President ACNS A/Prof Paul Corballis*	Allan Scott Auditorium
16.00 - 17.00	**Keynote 1 - Prof Tom Palmeri:** Approaches to Model-based Cognitive Neuroscience *Chair: Prof John Dunn* *Sponsored by The University of South Australia*	Allan Scott Auditorium
17.00 - 19.00	**Welcome Reception** *Sponsored by Symbiotic Devices*	SAHMRI
19.00	**ECR Mixer**	Regattas

Day 2 | Friday 24 November

8.30 - 9.00	**Keynote: Young Investigator Award Keynote** *Chair: A/Prof Paul Corballis* *Sponsored by The Australasian Cognitive Neuroscience Society*	Allan Scott Auditorium
9.00 - 10.00	**Keynote 2 - Prof Angela Clow:** Links between aging, cortisol secretion and cognitive function *Chair: Prof Mike Ridding* *Sponsored by The University of South Australia*	Allan Scott Auditorium
10.00 - 10.40	**Morning Tea**	George Street
10.40 - 12.50	**Parallel Open Talks**	

	Open Talks: Stream 1 **Room: Allan Scott Auditorium** **Attention & Perception**	**Open Talks: Stream 2** **Room: BH2-09** **Cognition and Relevant Methods**
	Chair - A/Prof Anina Rich	**Chair - A/Prof Paul Corballis**
10.40	**A Practical, Empirical Approach to Address Gender Imbalance in Scientific Meetings** *Dr Ann-Maree Vallence*	**Neural Processing of Others Gaze Independent of Facial Features** *Dr Colin Palmer*
10.55	**Modelling Stochastic Resonance in Human Performance: The Influence of Attentional Lapses** *A/Prof Jeroen van Boxtel*	**White Matter Connectivity Disruptions Associated With Psychotic Experiences in 89 Healthy Individuals the Psychotic Connectome** *Dr Lena Oestreich*
11.10	**Anticipatory Coding of Visual Object Position Ahead of Moving Objects in Human Visual Cortex** *Dr Hinze Hogendoom*	**Amplitude Modulation of Single-Trial Midfrontal Theta Oscillations Predict Behaviour** *Dr Patrick Cooper*
11.25	**Gamma Coherence Mediates Interhemispheric Transfer of Visual Information During Multiple Object Tracking** *Mr Nicholas Bland*	**Evidence Against the Detectability of a Hippocampal Place Code Using Functional Magnetic Resonance Imaging** *Dr Oliver Baumann*
11.40	*--- Break ---*	
11.50	**Neural Processing of Orientation Disparities Yielding Fusion and Stereopsis** *Prof Robert P. O'Shea*	**Bayesian Inference As a Model of Complex Decision Making in Humans** *Dr Dragan Rangelov*
12.05	**The Neural Correlates of Preference Formation** *Ms Katharina Voigt*	**Evidence That Brain Noise Isn't Noise** *Dr Suresh Muthukumaraswamy*
12.20	**Behavioural and Computational Studies on the Value of Information** *Miss Ariel Goh*	**Development of Simultaneous Functional MRI and Functional PET Imaging** *Dr Sharna Jamadar*
12.35	**Asymmetry in Internal Model Updates and the Impact of Prior Precision** *A/Prof Juanita Todd*	**A Computational Model of EMG Signal Generation Following TMS** *Dr Bahar Moezzi*

Day 2 | Friday 24 November continued

12.50 - 14.00	**Lunch**	George Street
14.00 - 15.20	**Parallel Symposium** *Sponsored by The University of Adelaide*	

	Symposium 1: **Room: HH4-08** **Non-Invasive Brain Stimulation Approaches to Investigate Behaviour**	**Symposium 2:** **Room: HH5-08** **Cognitive Control from the Cradle to the Grave**
	Chairs: Prof Michael Ridding, Prof John Rothwell	**Chairs: Ms Rebecca Hirst, Dr Nicholas Badcock**
14:00	**The Role of Cortical Network Connectivity and Neuroplasticity in Cognitive Reserve: a Combined TMS-EEG Study** *Dr Mitchell Goldsworthy, The University of Adelaide*	**Maturation of Performance Monitoring in Typically-Developing Children: Electrophysiological Indices of Cognitive Control** *Professor Allison Fox, The University of Western Australia*
14:15	**Associations Between Supplementary Motor Area—Primary Motor Cortex Connectivity and Bilateral Voluntary Movement** *Dr Ann-Maree Vallence, Murdoch University*	**Risky Decision-Making and Cognitive Control in Late Adolescence and Young Adulthood** *Assoc/Prof Frini Karayanidis, University of Newcastle*
14:30	**Assessing the Role of Prefrontal Cortex Inhibition in Working Memory Using Combined TMS and EEG** *Dr Nigel Rogasch, Monash University*	**Do Changes in Sensory Processing Modulate Stroop Performance Across the Lifespan?** *Ms Rebecca Hirst, University of Nottingham*
14:45	**The Neurobiology of Cognition in Younger Adults, Older Adults and Mild Cognitive Impairment: A TMS-EEG study** *Ms Melanie Emonson, Monash University*	**Lifestyle Contributions to Cognition in Late Life** *Dr Ashleigh Smith, University of South Australia*
15:00	**Panel Discussion**	**Panel Discussion**

15.20 - 16.00	**Afternoon Tea**	George Street
16.00 - 17.00	**Keynote 3 - Prof Charles Spence:** Gastrophysics: Pleasure and Pain at the Dining Table (A special pre-dinner keynote) Charles will be signing copies of his new book, which are available for purchase, at the registration desk at the end of his keynote *Chair: Prof Lorimer Moseley* *Sponsored by The University of South Australia*	Allan Scott Auditorium
17.30 - 18.30	**Oval Tour**	Adelaide Oval
17.30 -18.30	**Pre-Dinner Drinks**	Rick Davies Bar, Adelaide Oval
18.30	**Dinner** *Sponsored by Flinders University*	Cathedral Room, Adelaide Oval

Day 3 | Saturday 25 November

9.00 - 10.30	**Parallel Fast Talks**	
	Fast Talks: Stream 1 **Room: HH4-08** **Cognition and Decision Making, & Sensation and Perception**	**Fast Talks: Stream 2** **Room: HH5-08** **Memory and Language & Social, Emotional and Motor Processes**
	Chair - Dr Stefan Bode	**Chair - Dr Katherine Johnson**
9.00	**Influence of Bias on Response Preparation and Execution Across the Lifespan: A Combined TMS and Computational Modelling Study** *Mr Rohan Puri*	**Task Demand Modulates the Event-Related Potential Response During Language Processing** *Ms Louise Kyriaki*
9.08	**Probing the Neural Underpinnings of Perceptual Decision Making Using a Combined Diffusion-MRI EEG Approach** *Ms Maadhbh Brosnan*	**Association Between White Matter Tracts and Language Functioning in Children Born Very Preterm** *Mrs Ines Mürner-Lavanchy*
9.16	**Distributed and Opposing Effects of Incidental Learning on Visual Processing in the Human Brain** *Ms Michelle Hall*	**Brain Processing of Syntax Violations in Language and Music** *Mr Theodore Teow*
9.24	**Statistical Modelling of Cognitive Function at Early Stages of Parkinson's Disease** *Miss Alexandra Gramotnev*	**Structural Integrity of Recognition Memory Circuits in Carriers of the Val66Met BDNF Single Nucleotide Polymorphism** *Ms Nicole Mckay*
9.32	**Effects of Exercise Combined With Increased Dietary Protein on Cognition and Quality of Life in Older Adults** *Mrs Melissa Formica*	**Increasing Motor Cortex Plasticity With Spaced Paired Associative Stimulation At Different Intervals in Older Adults** *Dr Simranjit Sidhu*
9.40	*--- Break ---*	
9.50	**Indexing Sensory Plasticity: Evidence for Distinct Predictive Coding and Hebbian Learning Mechanisms in the Cerebral Cortex** *Ms Rachael Sumner*	**Does FMRI Repetition Suppression Reveal Mirror Neuron Activity in the Human Brain?** *Dr Ian Fuelscher*
9.58	**The Uncanny Valley: A Multi-Disciplinary Investigation** *Miss Cait Beddows*	**Intranasal Oxytocin Increases Amygdala Responses to Emotional Faces in Body Dysmorphic Disorder** *Miss Sally Grace*
10.06	**Is Inhibition of Return Associated With Modulations of Early Sensory Or Late Attentional Event-Related Potentials?** *Dr Jason Satel*	**No Evidence for a Relationship Between Visual Processing and Mirror Neuron System Function in Autism Spectrum Disorder** *Miss Jacqueline Riddiford*
10.14	**Impairments in Functional Networks Linked to Attentional Deficits in Mild Cognitive Impairment in Patients With Parkinson's Disease** *Miss Ji Hyun Yang*	**Two Ways to Change Your Mind: Effects of Intentional Strength and Motor Costs on Changes of Intention** *Ms Anne Löffler*
10.22	**Mirror Neuron System Activation Differs in Experienced Golfers Watching Videos of Golf Compared to Novel Sports Depending on Conceptual Versus Motor Familiarity** *Ms Georgina Amos*	**Unconscious Reactions to Tearful Facial Expressions of Emotion** *Ms Sarah Krivan*
10.30 - 11.10	**Morning Tea**	George Street

Day 3 | Saturday 25 November - continued

11.10 - 1.20	**Parallel Open Talks**		
	Open Talks: Stream 1 **Room: HH4-08** **Cognitive Function Relevant to Ageing and Dementia**	**Open Talks: Stream 2** **Room: HH5-08** **Motor and Sensory Processes**	
	Chair - Dr Bryan Paton	**Chair - Dr Tim Silk**	
11.10	**Clinical and Cortical Progression in Non-Fluent Primary Progressive Aphasias and Alzheimer's Disease** *Prof Olivier Piguet*	**MEG Reveals Overactive Response Inhibition in People Who Stutter** *A/Prof Paul Sowman*	
11.25	**Fuel for the Ageing Brain: Acute Effects of Glucose on Resting State Functional Connectivity of the Posterior Hippocampus** *Ms Riccarda Peters*	**Individual Differences in Stopping Speed Explained by GABAergic Activity in the Motor Cortex** *Mr Nahian Chowdhury*	
11.40	**Sex Differences in Hippocampal Subfields After Controlling for Brain Size** *Ms Liza van Eijk*	**Exploring Somatosensory Cortex Using Ultra-High Field (7T) FMRI** *Dr Alexander Puckett*	
11.55	**Age-Related Changes to Cognitive Control As Assessed by FMRI** *Dr Helen Macpherson*	**The Effects of Individualised Intermittent Theta Burst Stimulation in the Prefrontal Cortex: A TMS-EEG Study** *Mr Sung Wook Chung*	
12.10	*--- Break ---*		
12.20	**Intensity Matters: A Single Bout of High-Intensity Interval Exercise Enhances Neuroplasticity in Healthy Adults More Than Moderate Exercise Or Rest** *Dr Sophie Andrews*	**Rapid Changes in Facial Temperature During Startle Reflex As Revealed by Thermal Imaging Technique** *Dr Saurabh Sonkusare*	
12.35	**Cognitive Reserve and Emotion Recognition in Older Adults: An ERP Study** *Miss Louise Lavrencic*	**Proactive Modulation of Corticospinal Excitability During Global Or Selective Stopping of a Planned Bimanual Action** *Dr Mark Hinder*	
12.50	**Do no Harm: Exploring Mechanisms of Moral Reasoning in Frontotemporal Dementia** *Miss Cherie Strikwerda-Brown*	**Computational Modelling of Auditory Distraction in Younger and Older Adults** *Dr Alexander Provost*	
13.05	**The Effects of Aerobic Fitness on Cognition in Cognitively Healthy Older People Living Independently Within Aged Care Facilities** *Mr Greg Kennedy*	**Magnetoencephalography Reveals an Increased P3a, But Not P3b, That Is Associated With High Non-Clinical Psychosocial Deficits** *Dr Talitha Ford*	
13.20 - 14.30	**Lunch**		George Street
13.30 - 14.30	**AGM (during Lunch)**		Allan Scott Auditorium

Day 3 | Saturday 25 November - continued

14.30 - 16.40	**Parallel Open Talks**	
	Open Talks: Stream 1 **Room: HH4-08** **Attention and Perception**	**Open Talks: Stream 2** **Room: HH5-08** **Facial and Emotional Processing**
	Chair - A/Prof Muireann Irish	**Chair - A/Prof Frini Karayanidis**
14.30	**Visual Selection and Distractor Suppression: A Gatekeeper for Working Memory?** *A/Prof Paul Corballis*	**Individuals with higher autistic traits show faster saccade onset times indicating anomalous attentional disengagement from face stimuli** *Dr Robin Laycock*
14.45	**Is Modulation of the N170 in Visual Competition for Representation Category Specific?** *Miss Sreekari Vogeti*	**Early Visual Attention to Preconscious Threat Mediates Growth in Anger Across Deployment Among Combat Veterans** *Miss Julia Caruana*
15.00	**Non-Conscious Effects of Landmark Cues on Overt and Covert Attention Movements** *A/Prof Anthony Lambert*	**Reduced Perception of Attractiveness, Cuteness, and Inclination to Give Care for Infants in Developmental Prosopagnosia** *Dr Edwin Burns*
15.15	**Spatial and Feature-Based Attention Have Qualitatively Different Effects on Object Representation** *Dr Alexandra Woolgar*	**Exploring the Uncanny Valley: Why Does He/she Look Creepy?** *Ms Jigwen Mao*
15.30	*--- Break ---*	
15.40	**Decrements in Sustained Attention Are Associated With a Decrease in Arousal** *Dr Katherine Johnson*	**Extraversion and Reward Processing: A High-Powered Replication and Mathematical Model of EEG Reward Prediction Error Signalling** *Ms Hayley Jach*
15.55	**Spatial Properties of the Premotor Attentional Shift Can Differ for Saccades and Reaches to the Same Target** *A/Prof Anna Ma-Wyatt*	**How Does Persistence Or Change in Early Childhood Behavioural Difficulties Relate to Preschool Language and Executive Control?** *Ms Stephanie D'Souza*
16.10	**Memory Guided Saccade Performance Across the Schizophrenia Continuum** *Ms Elizabeth Thomas*	**The Happy Face Advantage: Effects of Expression, Intensity and Sex on Emotion Recognition** *Miss Simone Hesford*
16.25	**FMRI Experiments of the Human Lateral Geniculate Nucleus** *Dr Phillippe Chouinard*	**Dissociable Roles for the DmPFC and RTPJ in Self-Other Processing: A High-Definition TDCS Study** *Ms Jasmine Huang*

17.00 - 19.00	**Poster Gala** *Sponsored by Medilink Australia*	Jeffrey Smart Building

Day 4 | Sunday 26 November

7.00	**Fun Run**	River Torrens
9.00 - 11.10	**Parallel Open Talks**	

	Open Talks: Stream 1 **Room: HH4-08** **Language and Learning**	**Open Talks: Stream 2** **Room: HH5-08** **Clinical Cognitive Neurosciences**
	Chair - A/Prof Juanita Todd	**Chair - A/Prof Olivia Carter**
9.00	**Cerebral lateralisation, task difficulty, and self-monitoring during reading** *Dr Nic Badcock*	**Evaluating Patterns of Semantic and Executive Dysfunction in Schizophrenia: A Cluster Analysis Approach** *Dr Eric Tan*
9.15	**Exploring White Matter Correlates of Dyslexia and Dyscalculia With Bayesian Model Comparison and Activation Likelihood Estimation** *Dr David Moreau*	**The Curious Case of Aphantasia: A Lack of Phenomenal and Sensory Visual Imagery With Retained Mental Rotation** *Miss Rebecca Keogh*
9.30	**Testing Predictions About the Processing of Word Stress in Reading Using Event-Related Potentials** *A/Prof Conrad Perry*	**The Site of the Stimulation Field Moderates Neuropsychiatric Symptoms After Subthalamic Deep Brain Stimulation for Parkinson's Disease** *Dr Alistair Perry*
9.45	**How do L2 Speakers Use Predictive Coding During Non-Native Sentence Comprehension? An Electrophysiological Investigation on the Role of L2 Exposure** *Ms Lena Zou*	**Progression of Cognitive Deterioration in Parkinson's Disease Patients** *Mrs Galina Gramotnev*
10.00	*--- Break ---*	
10.10	**Effects of Reward and Punishment on Learning from Errors in Smokers** *Ms Leonie Duehlmeyer*	**Disturbed Small-World Networks in Leukoaraiosis Patients With Cognitive Impairment** *Mr Zhang Yumei*
10.25	**Impaired Regularity Learning in Healthy Individuals With Psychotic Experiences Is Mediated by Reduced Top-Down Frontotemporal Effective Connectivity** *Dr Ilvana Dzafic*	**FMR1 Expression As a Predictor of Cognitive Functioning and Autism in Fragile X Syndrome: Is There a Difference Between Sexes?** *Dr Emma Baker*
10.40	**Conditioned Action Tendencies to Previously Trained Response Cues As Revealed by TMS** *Dr Dominic Tran*	**Multimodal Structural Neuroimaging Markers of Brain Development and ADHD Symptoms** *Dr Tim Silk*
10.55	**What Is the Function of the Frontal Pole in Fluid Reasoning?** *Dr Micah Goldwater*	**Combined Effects of Acute Exercise and TDCS on Cognition and Mood in Healthy Adults** *Dr Ashlee Hendy*

Day 4 | Sunday 26 November continued

11.10 - 11.40	**Morning Tea**	George Street
11.40 - 13.00	**Parallel Symposia** *Sponsored by AIMEDICAL*	

	Symposium 3: **Room: HH4-08** **Brain Stimulation as a Tool to Probe Brain and Mind**	**Symposium 4:** **Room: HH5-08** **Multiple approaches to understanding cognitive and brain development in children**
	Chair: Dr Luca Cocchi	**Chair: Dr Katherine Johnson**
11.40	**Using Brain Stimulation to Probe Information Flow Throughout the Brain** *Dr Luca Cocchi, QIMR Berghofer Medical Research Institute*	**Neonatal Imitation: Does it Exist?** *Professor Virginia Slaughter, The University Of Queensland*
11.55	**Neurochemical Inhibition in the Prefrontal Cortex Predicts Individuals' Response to Electrical Stimulation** *Dr Hannah Filmer, The University of Queensland*	**Pragmatic Language in Children with Symptoms of ADHD: Relationships with Executive Functioning and Theory of Mind** *Ms Benita Green, The University of Melbourne*
12.10	**Modelling the Effect of Local TMS** *Dr Leonardo L. Gollo, QIMR Berghofer Medical Research Institute*	**Building Cognitive Architecture in Young Children with Compromised Attention Capacity** *Professor Kim Cornish, Monash University*
12.25	**rTMS in Animal Models: From Single Cells to Complex Behaviour** *Dr Jennifer Rodger, The University of Western Australia*	**The Application of Multivariate Analysis Techniques to Describe Paediatric Neurodevelopment** *Dr Marc Seal, Murdoch Childrens Research Institute*
12.40	**Panel Discussion**	**Panel Discussion**

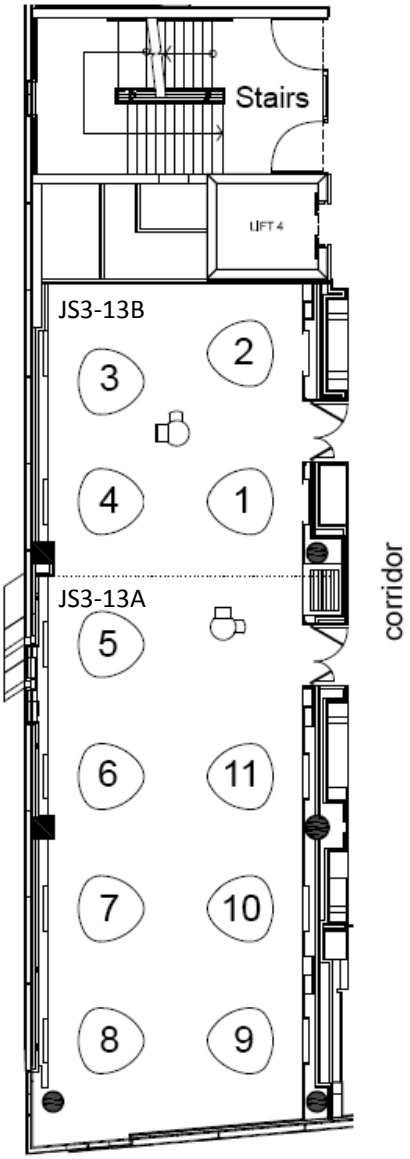
13.00 - 13.30	**Closing Ceremony and Award Presentations** *Dr Hannah Keage, Dr Tobias Loetscher*	HH4-08

Poster Gala Map

We will be running a two hour Poster Gala on Saturday 25 November in the UniSA Jeffery Smart Building. It will be an electronic poster format, utilising two large collaborative teaching rooms. In each room there are circular tables with standard desk-top computer screens, and each table is connected to a large wall-mounted LCD screen (1240 x 680 mm). We will run two sessions within the Gala: Session A 5-6pm and Session B 6-7pm. During each one hour Session, two posters will be continually displayed at each table on standard computer screens, and for half an hour of this time, each of the posters will be projected to the large wall-mounted LCD screen. That is, each poster presenter will have their poster up for one hour on a small screen, and during this period, for half an hour on a large wall mounted screen.

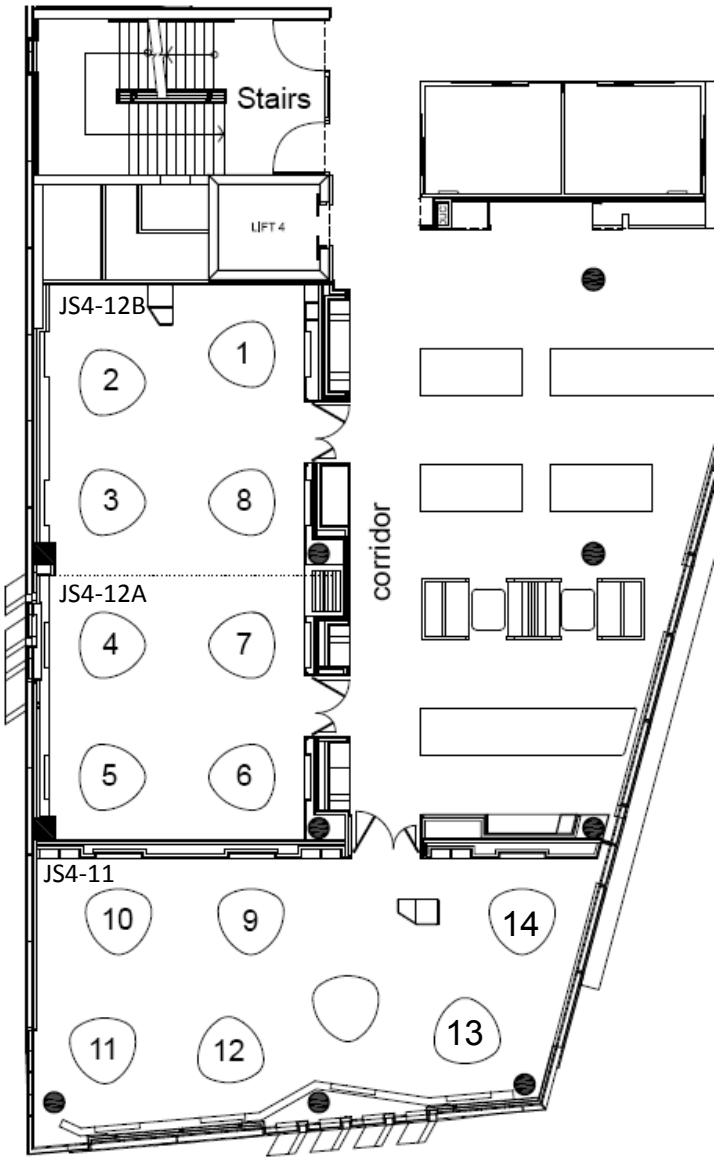
Jeffery Smart Building

Level 3



Jeffery Smart Building

Level 4



Poster Gala

1A: 5:00pm-6:00pm, large screens 5:00pm - 5:30pm Floor 3

Computer Number	Poster Title	Presenter
1	The Effects of Chromatic Saturation on Non-linear Evoked MEG Responses	Ms Laila Hugrass
2	Nasal Oxytocin Produces Marked Effects on Early Visual Evoked Potentials.	Prof David Crewther
3	Investigating the Effects of Spatial Frequency and Facial Emotion on Rivalry Dominance Durations	Ms Katie Wykes
4	The Modulation of Neural Gain Facilitates a Transition Between Functional Segregation and Integration in the Brain	Dr Mac Shine
5	Neural Signatures of Dynamic Emotion Constructs in the Human Brain	Dr Tijl Grootswagers
6	Inter-Individual Differences in Predictive Coding and Model Adaptation During Language Processing	Prof Ina Bornkessel-Schlesewsky
7	Measuring Face-Name Integration with Fast Periodic Visual Stimulation	Miss Angalique Volfart
8	Dynamic Causal Modelling Reveals Effective Connectivity of Brain Network Underlying Episodic Memory Retrieval During Natural Viewing	Ms Yudan Ren
9	Shining a Light on the Functional Network Signature of Heterogeneity in Freezing of Gait	Mr Kaylena Ehgoetz Martens
10	Graph Analysis of EEG Functional Connectivity and Response Time Variability	Mr Keitaro Machida
11	The Contribution of Sensory Evoked Potentials to TMS-EEG Recordings	Mrs Mana Biabani

1A: 5:00pm-6:00pm, large screens 5:00pm - 5:30pm Floor 4

Computer Number	Poster Title	Presenter
1	What's Attention Got to do With It? Re-Examining the Developmental Trajectory of Visual Orienting.	Dr Oriane Landry
2	Neural Correlates of Goal-Directed Attentional Capture in the Absence of Conscious Perception	Ms Susan Travis
3	What's My Cue? Attention Orienting to Local/Global Stimuli Across the High and Low Subclinical Autism Spectrum	Dr Melanie Murphy
4	The Relationship Between Subjective Sleepiness and Spatial Attention: A Behavioural Study	Ms Dilushi Chandrakumar
5	The Effect of Physical Fatigue on Spatial Attention	Ms Elly Gannon
6	Psycho-Physiological Measures to Understand Failure-to-Identify Hunting Accidents in Deerstalking	Mr Karl Bridges
7	The Rhythmic Brain: Entraining Resonant Frequencies for Therapeutic Intervention	Ms Natalya O'keefe
8	Objective Contrast Threshold Predicts Non-conscious Visual Cue Efficacy and Age	Dr Nathan Ryckman
9	The Developing Human Connectome Project Automated Functional Processing Framework for Neonates	Dr Sean Fitzgibbon
10	Assessing the Link Between Negative Mental States and Cognitive Performance in Health Professionals	Miss Shamona Maharaj
11	O. Stamineus Exhibits Anti-Amnestic Effects Via the BDNF-TrKB & CREB-BDNF Pathway	Miss Thaarvena Retinasamy
12	Age Related Decline at V1 is Predominately Magnocellular	Miss Alyse Brown
13	The Effect of Transcranial Direct Current Stimulation on Response Inhibition During a Perceptual Decision-Making Task in Young and Older Adults	Dr Hakuei Fujiyama
14	Oxytocin Modulates Socioemotional Brain Regions in Older Adults	Dr Izelle Labuschagne

Poster Gala

1B: 5:00pm-6:00pm, large screens 5:30pm - 6.00pm Floor 3

Computer Number	Poster Title	Presenter
1	Hypervigilance in Spider Fear: Evidence from Event Related Potentials	Miss Tess Nikitenko
2	Understanding the Influence of Speed-Accuracy Trade-Offs on EEG Markers of Perceptual Decisions	Miss Bridgitt Shea
3	Assessing the Relationship Between Auditory Sensory Gating and Interference Control Using Event-Related Potentials (ERPs)	Mrs Vicole Tarratt
4	The Effects of Stimulus Type and Duration on Visual ERP Components	Mr Haiyang Jin
5	Understanding the Acute Neural Effects of Ketamine Using Simultaneous EEG/ fMRI	Ms Rebecca McMillan
6	Modulation of Cortical Plasticity and Oscillatory Activity Following Network-Oriented High-Definition Transcranial Direct Current Stimulation (HD-TDCS)	Mr Aron Hill
7	Deception Detection Using a Task Switching Paradigm: An ERP Study	Miss Sarah Williams
8	The Decision Decoding Toolbox (DDTBOX) - A Multivariate Pattern Analysis Toolbox for Event-Related Potentials	Dr Daniel Feuerriegel
9	Neural Correlate of Visual Consciousness	Miss Evie Glasshouse
10	A Longitudinal Study Depicting Long Term Stability of Single-Trial Midfrontal Theta Oscillations Predictive of Behaviour	Mr Samuel Mclellan-Hall
11	Functional Dissociation of Latency-Variable, Stimulus- and Response-Locked P3-Like Positivities Indexing Response Inhibition and Interference Suppression	Dr Christopher Brydges

1B: 5:00pm-6:00pm, large screens 5:30pm - 6:00pm Floor 4

Computer Number	Poster Title	Presenter
1	The Effects of Modafinil on Attentional Networks: An ERP Study	Dr Allison Matthews
2	A Water Bottle and a Gun Walk Into a Bag: Multiple Targets and Target Prevalence Interact to Affect Visual Search	Mr Phillip Cheng
3	A Single-Session of Focused Attention Meditation Increases the N200 ERP Component During Subsequent Sequential Action After Brief Meditation Training.	Mr Russell W. Chan
4	Pro-Active Control of Attention in Young Adolescents	Ms Anica Newman
5	Mapping Risks to Horizontal Space: Rock Climbing on the Left and Climbing Mt. Everest on the Right	Miss Anne Macnamara
6	The Influence of Task Requirements on the Neural Representation of Non-Symbolic Numerical Magnitude	Miss Kristina Horne
7	The Brain Penetrable Antagonist YM344031 Attenuates Beta-Amyloid Deposition, Tau Hyperphosphorylation and Synaptic Loss in a Mouse Model of Alzheimer's Disease	Dr Yao Zhang
8	Intra-Individual Variability in Sustained Attention and Resting State Brain Networks in Children With ADHD	Ms Phoebe Thomson
9	The Interaction Between Attention Networks in 6-11 Year Old Children	Dr Frances Lewis
10	Prevalence and Predictors of Cognitive Decline and Delirium After Transcatheter Aortic Valve Implantation: A Systematic Review and Meta-Analysis.	Ms Erica Tilley
11	Speed of Information Processing for Simple Visual Perceptual and Salient Cognitive Tasks in Young and Older Adults	Miss Deena Ebaid
12	Relationships Between Postural Instability and Loss of Intragenic DNA Methylation in FMR1 Premutation Females.	Dr Claudine Kraan
13	Diffusion Weighted Imaging in Anorexia Nervosa	Dr Andrea Phillipou
14	The Interaction Between Attention and Associative Learning: Predictive Vs. Non-Predictive Cues	Mr Salvatore Russo

Poster Gala

2A: 6:00pm-7:00pm, large screens 6:00pm - 6:30pm Floor 3

Computer Number	Poster Title	Presenter
1	ERPs During Responses to Semantical Incongruence Are Mediated by IQ Level	Dr Olga Shcherbakova
2	The Cerebral Basal Arterial Network: Morphometry of Right and Left Outflow Arterial Components	Dr Arjun Burlakoti
3	Is the Mirror Neuron System Associated with Empathy? A Systematic Review and Meta-Analysis	Ms Soukayna Bekkali
4	The Colorful Calculator: Reducing the Mismatch Between the Veridical Inducer and the Non-veridical Concurrent	Mr Joshua Berger
5	A Meta-Analytic Review of the Size-Weight Illusion and Other Illusory Weight Perception	Ms Elizabeth Saccone
6	Liquid Volume and the Size-Weight Illusion: Contributions of Expectations and Vision	Miss Rachael Goldsmith
7	Mirror-Reading Changes Perception of Space	Ms Emily Rosenich
8	Subliminal Visual Processing of Aversive Stimuli During Visual Masking and Continuous Flash Suppression	Miss Emma J. Cox
9	Evaluating the Spidey Sense: The Metacognition of Intuition	Mr Galang Lufityanto
10	The Influence of the Laboratory Environment on the Measurement of Language Lateralisation	Ms Hannah Rapaport
11	Sex, Size, and Performance: Callosal Dimensions Correlate With Mental Rotation Performance in Women Only	Dr Eileen Luders

2A: 6:00pm-7:00pm, large screens 6:00pm - 6:30pm Floor 4

Computer Number	Poster Title	Presenter
1	An Investigation Into the Role of the Primary Motor Cortex in the Contextual Interference Effect for Motor Sequence Learning	Dr Maarten Immink
2	The Role of Early Versus Late Night Sleep in Memory Consolidation and Generalisation	Mr Alex Chatburn
3	Binding of Episodic Details Into Future Simulations	Ms Kristina Wiebels
4	V1 and Lateral Occipital Cortex Contributions to Recognition Memory in the Absence of Awareness	Dr Trevor Chong
5	Differences in Neurotransmitter Levels Between Depressed Patients and Control: A Systematic Review and Meta-Analysis.	Miss Kate Godfrey
6	Developing a Test of Language Comprehension for Non-Verbal Children With Autism Using the N400 Event-Related Potential	Miss Selene Petit
7	Smarter Does Not Reach to Grasp Faster: The Effects of Nonverbal Intelligence and Autism Traits on Visuomotor Behaviour	Mr Rosa Sola Molina
8	The Contribution of Eye Movements and Visual Attention to Performance on Tests of Nonverbal Intelligence and Rapid Automatic Naming of Adolescents With Intellectual Disability	Dr Chantanee Mungkhetklang
9	An Eye-Tracking Examination of the Shepard and Ebbinghaus Illusions in Children With Autism Spectrum Disorder.	Miss Kayla Royals
10	Eye Movements as Indictors of Item Difficulty and Problem-Solving Strategy on the Raven's Coloured Progressive Matrices in Primary-Aged Children	Dr Sheila Crewther
11	Neural Signatures of Reduced Cognitive Control in Frontal Lesion Patients: Altered Theta Oscillations in Parietal Brain Regions During Task-Switching	Dr Stefanie Enriquez-Geppert
12	Dysregulated Oscillatory Activity During Sensory Processing in Autism Spectrum Disorder	Mr Robert Seymour
13	Prefrontal and Frontostriatal Structures Mediate Academic Outcomes Associated With ADHD Symptoms	Mr Howard Chiu
14	Cognitive Bias As a Measure of Affective State in a Rat Model of Chemotherapy-Induced Mucositis	Miss Rebecca George

Poster Gala

2B: 6:00pm-7:00pm, large screens 6:30pm - 7:00pm — Floor 3

Computer Number	Poster Title	Presenter
1	Effect of Tone Frequency on Neural Entrainment to Rhythm	Mr Tomas Lenc
2	White Matter Microstructure Predicts Motor Imagery Ability in Young Adults: A Constrained Spherical Deconvolution Tractography Study	Dr Christian Hyde
3	Eye Movement Patterns During Fluent Reading in Primary School Children: Preliminary Findings	Ms Jessica Peters
4	The Contribution of Depth Cues in Emmert's Law	Miss Amy Siobhan Millard
5	Up, Down, In, and Out: Target Location Effects on Dual-Task Target Processing	Ms Stephanie Morey
6	Reinterpreting Correlates of Response Inhibition in the Stop Signal Task: Trigger Failure as a Predictor of Impulsivity	Mr Patrick Skippen
7	No Effect of Information Format on Performance in an Aided Signal Detection Task	Miss Megan Bartlett
8	Laplacian Filters Reveal Distinct Spatiotemporal Signatures of Cognitive Control: Evidence from the Cued-Trials Task Switching Paradigm	Mr Thomas Goodwin
9	Development of Spatiotemporal Frequency Tuning of the Larval Zebrafish Optomotor Response	Dr Patrick Goodbourn
10	The Social Chronnectome: Time-Variant Connectivity Based on Biometrics As a Research Tool in Real Classroom Settings	Dr Chase Sherwell

2B: 6:00pm-7:00pm, large screens 6:30pm - 7:00pm — Floor 4

Computer Number	Poster Title	Presenter
1	Where Is Working Memory: An Updated Neuroanatomical Model Using Activation Likelihood Estimation Meta-Analysis of n-Back Tasks	Ms Gemma Lamp
2	Attention and Emotion-Enhanced Memory: A Systematic Review and Meta-Analysis of Behavioural and Neuroimaging Evidence	Mr Zachariah Cross
3	Taking Note of Faces: Word Priming Effects in Musicians and Non-Musicians	Miss Elissa Cotterill
4	Traumatic Brain Injury Induces Long-Term Impairment in Executive Function in Rodents : Potential Implications for the Development of Neurodegenerative Disease	Ms Alina Arulsamy
5	Inhibition Deficits for Drug-Related Cues Remain After Longer-Term Heroin Abstinence	Dr Grace Wang
6	Cerebrovascular Function During Cognition in Parkinson Disease: Slower and More Variable	Dr Lyndsey Collins-Praino
7	EEG Resting State Power in Those With and Without Mild Cognitive Impairment	Dr Scott Coussens
8	Preliminary Evidence of Functional Compensation in Premanifest Huntington's Disease Using a Novel Visuospatial Working Memory Task	Ms Maria Soloveva
9	Anomalous Functional Network Integration in Response to Cognitive Control Demands in Human Callosal Dysgenesis	Mr Luke Hearne
10	Impaired Behavioural Self-Awareness Associated With Reduced Treatment Motivation and Cognitive Error Identification in Adults With Cocaine Use Disorder.	Mr Ben Castine
11	Modelling Me, Modelling You: The Autistic Self	Ms Kelsey Palghat
12	Decision-Making, Emotional Responsiveness and Somatic Markers in Long-Term Opiate Users	Ms Kathryn Biernacki
13	Associations Between Brain Morphology and Cognition in Individuals With Schizophrenia and Bipolar Disorder: A Review	Mr James Karantonis

Abstracts

Mirror neuron system activation differs in experienced golfers watching videos of golf compared to novel sports depending on conceptual versus motor familiarity

Ms Georgina Amos
La Trobe University

Mr Philippe. A. Chouinard, *La Trobe University*

Previous investigation has demonstrated that mirror neuron areas respond to visual stimuli in a way that reflects an individual's expertise in a given area (Calvo-Merino et al., 2005, Cerebral Cortex 15:1243-1249). For example, expert ballet dancers show greater mirror system activation whilst watching ballet compared to capoeira (martial arts dance) movements. Both forms of dance share similar movements. Thus, the results signify that there is a greater role for conceptual familiarity over movement familiarity in the mirror neuron system. Our fMRI study aims to further understand the roles of conceptual and movement familiarity by introducing a novel control condition whereby concept and movement can be more precisely disentangled.

In our study, we examined responsiveness of the mirror neuron system in experienced golfers (N = 10) watching videos of their sport, a novel sport with similar movements (ice hockey), and a novel sport with completely different movements (ballet). We analysed the data based on a general linear model. We modelled the time course for each of the three conditions, estimated the model, and extracted the parameter estimates (beta weights) from the left and right ventral premotor areas as defined by an independent functional localiser. ANOVA demonstrated a main effect in the left ventral premotor area [$F(2,16) = 3.87$; $p = .043$] driven by greater BOLD activation from watching golf compared to the other sports.

Taken from this, our results support those of Calvo-Merino et al. in that the mirror neuron seems to respond to conceptual familiarity. However, our research also highlights movement familiarity seems to have an important compounding effect with conceptual familiarity in the mirror neuron system.

Intensity matters: A single bout of high-intensity interval exercise enhances neuroplasticity in healthy adults more than moderate exercise or rest

Dr Sophie Andrews
Monash University

Mr Dylan Curtin, *Monash University*
Prof Julie Stout, *Monash University*
Dr James Coxon, *Monash University*

Background: Increasing evidence demonstrates that exercise enhances neuroplasticity, but the type and intensity of exercise needed to induce optimal neuroplastic change remains unclear. One way to assess synaptic neuroplasticity in humans is via changes to motor cortex cortical inhibition and facilitation using Transcranial Magnetic Stimulation (TMS). Intermittent theta-burst stimulation (iTBS), a type of repetitive TMS known to transiently increase cortical reactivity, may show greater effects if primed with exercise. The aim of the current study was to compare the effects of high-intensity interval and moderate-intensity continuous exercise on neuroplasticity responses to iTBS in healthy adults using TMS.

Methods: 20 healthy adults completed three sessions on three separate days. At each session they completed 20 mins of either high-intensity interval cycling, moderate steady-state cycling, or rest. TMS was applied to the motor cortex pre- and post-exercise, and post iTBS, to measure changes to short-interval cortical inhibition (SICI) and intracortical facilitation (ICF), as markers of neuroplasticity.

Results: Two-way repeated-measures ANOVAs revealed a significant main effect of exercise intensity for both SICI and ICF, and an exercise*time interaction for ICF, where a larger neuroplasticity response was seen following high-intensity exercise compared to rest, and moderate-intensity exercise showed an intermediate effect, and was not significantly different to either condition.

Discussion: Our results indicate that high-intensity exercise is more effective than moderate-intensity exercise in inducing a neuroplastic response to iTBS in healthy adults, at least in the short-term. If this effect is confirmed over a longer-term intervention, high-intensity interval exercise could be effective for enhancing neuroplasticity and maximising brain and cognitive reserve.

Traumatic brain injury induces long-term impairment in executive function in rodents : Potential implications for the development of neurodegenerative disease

Ms Alina Arulsamy
University of Adelaide

Dr Frances Corrigan, *University of Adelaide*
Dr Lyndsey Collins-Praino, *University of Adelaide*

Executive function, comprised of attention, inhibition and cognitive flexibility, is impaired in many neurodegenerative conditions, including Parkinson's disease. Studies have shown that traumatic brain injury (TBI) is a significant risk factor for the later development of neurodegeneration and the emergence of executive function impairment following TBI may be a predictor of this risk. Moreover, different subtypes of TBI have been linked to disparate neurodegenerative outcomes. This study aimed to investigate the time-course of executive dysfunction following different subtypes of TBI, including a single severe injury, a single mild injury and a repeated mild injury. TBI was induced in male Sprague Dawley rats using the Marmarou model of impact-acceleration. Animals were then tested on the Bussey-Saksida touchscreen cognitive chamber using the 5 choice- continuous performance task (5C-CPT), a rodent analogue of the human CANTAB CPT task, at either 6 months (n=2-6 /group) or 12 months (n=6-9 / group) post-injury. Attention was assessed using probability of hit (p(hit)) and omission percentage during GO-trials, while inhibition was assessed using false alarm probability (p(FA)) during NO-GO-trials. By 6 months post-injury, mild repetitive TBI animals showed the strongest deficits in attention, with the lowest p(hit) and highest omission percentage compared to all other groups, although inhibitory control appeared intact. By 12 months, all TBI groups showed deficits in attention but an intact inhibitory control when compared to shams, with single severe TBI animals having the lowest p(hit) and highest omission percentage. Taken together, the results indicate that executive function deficits are present at long-term time points following TBI, and may differ based on the nature of the injury and time since insult. This may have important implications for determining the later risk of neurodegenerative disease in individuals who have experienced different types of TBI.

Cerebral lateralisation, task difficulty, and self-monitoring during reading

Dr Nic Badcock
Macquarie University

Dr Ivan Yuen, *Macquarie University*
Ms Nicola Filardi, *Macquarie University*
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Reading is a complex process that includes the translation of visual symbols to sounds, combining to words which may be associated with meaning. This type of language processing is typically subserved by the left-hemisphere of the brain, which may be more active under circumstances of increased task demands. However, individual differences related to task strategies and effort may confound existing methods assessing this neural specialisation for language. In this experiment, we demonstrate a novel methodology for assessing language lateralisation during reading. Participants completed paced reading tasks, in easy and hard conditions of silent and aloud. Participants read single words were flashed on a computer screen and the rate was manipulated to adjust difficultly using an adaptive staircase procedure: 80 vs 50% accuracy of producing all presented words in a fixed time-period when reading aloud. Self-monitoring was induced by asking participants whether a specific sound was read. Cerebral lateralisation was assessed using functional Transcranial Doppler Ultrasound and lingual imaging was performed to objectively identify articulation errors. At the group level, cerebral lateralisation was right-lateralised and equivalent across in all four conditions, demonstrating a major influence of self-monitoring for a typically left-lateralised process. These results have implications for the strategies underpinning atypical language lateralisation, such as that observed in association with dyslexia and specific language impairment.

FMR1 Expression as a Predictor of Cognitive Functioning and Autism in Fragile X Syndrome: Is there a Difference between Sexes?

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Fragile X Syndrome (FXS) is a common single gene cause of mild to moderate intellectual disability and co-morbid autism spectrum disorder (ASD). It is usually caused by a large trinucleotide CGG expansion (>200 repeats), termed full mutation (FM), within the FMR1 gene located on the X chromosome. FM alleles have been associated with epigenetic changes that result in a significant decrease of FMR1 mRNA and loss of the FMR1 protein FMRP, which is essential for normal neurodevelopment. This study aimed to characterise gender differences in the relationships between levels of FMR1 mRNA in blood and phenotypic markers including symptoms of ASD as determined by the Autism Diagnostic Observation Schedule-2nd Edition (ADOS-2) and performance on the Wechsler Scales of Intelligence. This was performed in a large inter-national FXS cohort recruited through genetic testing centres and family support organisations, with age range ~2 to 43 years (N= 122, 27% female). FXS females performed better than males on all cognitive assessments (p = 0.014 - <.001), but were comparable to males for working memory performance. Similarly, the cut-off for Autism on the ADOS-2 was met by significantly less FXS females (21.1%) than males (81.4%) (p < 0.001). Genotype-phenotype correlation analyses showed that FMR1 mRNA in blood was strongly correlated with FSIQ (p = 8.1×10-11), VIQ (p = .0002) and PIQ (p = 9.8×10-9) in males; yet only correlated with ADOS-2 severity scores in females. In conclusion, this study is the first to show that FMR1 mRNA levels are related to developmental vulnerability for subtle effects to intellectual function and behavioural problems in females with FXS, compared to a more general impact to overall intellectual functioning in males. This dissociation by gender in the relationships between FMR1 expression and different types of phenotype outcome (e.g., intellectual deficits versus ASD symptoms) warrants further study.

No effect of information format on performance in an aided signal detection task

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Decision making tasks often require people to combine information from multiple probabilistic sources. Information integration in such tasks is often suboptimal, however. Participants asked to combine their own judgments in a visual signal detection task with numeric assessments from a computerized decision aid, for instance, achieve performance levels well below statistically ideal performance (Bartlett & McCarley, 2017). The present experiments asked whether the format in which numeric cues are rendered improves information integration in a signal detection task. Participants viewed orange and blue random-dot images, and were asked to determine each trial which colour was dominant. They performed the task alone or with assistance from a 93% reliable computerized aid (d' = 3.0) that rendered its judgement in the form of a binary diagnosis accompanied by an estimate of signal strength in the form of either a raw rating, confidence rating, or likelihood ratio. Participants received no feedback at the conclusion of each trial (Experiment 1), or received feedback at the conclusion of each trial (Experiment 2). The efficiency of the participants' information integration, as reflected in the aided sensitivity, was benchmarked to the predictions of various statistical models of collaborative decision making. Data were analysed using hierarchical Bayesian parameter estimation.

Assistance from the aid improved participants' discrimination performance in all cue format conditions. On average, aided performance was also suboptimal, hewing closest to the predictions of some of the least efficient models. This benefit, however, did not differ between cue conditions, suggesting that performance was similar whether the aid provided its diagnosis in the form of a raw rating, confidence rating, or likelihood ratio. Data indicate that participants combined probabilistic numeric cues with their own signal detection judgments inefficiently, regardless of the cue format.

Evidence against the detectability of a hippocampal place code using functional magnetic resonance imaging

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The hippocampus is widely assumed to play a central role in encoding and maintaining internal representations of space. Electrophysiological recordings in humans and rodents have shown that pyramidal neurons in the hippocampus selectively increase their firing rates when the animal traverses specific regions of the environment, thereby establishing a neural code of that environment. This neural code is demonstrably sparse and distributed, theoretically rendering such a code as undetectable with population recording methods such as functional magnetic resonance imaging (fMRI). Despite these theoretical considerations, several recent studies have reported decoding of place related signals from the human hippocampus using fMRI. We identified several task-related confounds and statistical shortcomings in these existing fMRI studies, calling into question the validity of their findings. To resolve these concerns, the present study reinvestigated the detectability of purely spatial hippocampal place codes via fMRI. We tested 18 participants and employed a virtual environment that eliminated visual and path related confounds to ensure that any positive findings of the signal decoding analysis would be indicative of a pure spatial code rather than a view code or a conjunctive view-trajectory code. We also employed a wide-range of signal processing and classification approaches, as well as a positive control condition to evaluate carefully the possibility of the nonexistence of a purely spatial voxel-place code. Our experiment showed that, while participants were fully orientated during the navigation task, there was no statistical evidence for a place code. Taken together with electrophysiological data on the nature of place cells, our results suggest that the claim of place codes at the level of large neuronal populations from fMRI studies is incorrect.

The Uncanny Valley: A Multi-Disciplinary Investigation

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As robots exit labs and integrate themselves within society, the potential significance of the Uncanny Valley (UV) as a constraint on design and human-robot interaction is now more relevant than ever. The UV theory predicts that robots that possess an almost but not exact human appearance will elicit adverse reactions from observers. More specifically, that as an entity becomes more human-like, the reactions of an observer will become increasingly positive, until a critical region of near-perfect human-likeness when a dramatic decline in likeability occurs and an observer's response becomes increasingly negative. This period of decreased likeability is referred to as the UV. This study sought to provide a pioneering multi-disciplinary investigation to quantify the existence of the UV both psychologically and physiologically. The UV prediction of a non-monotonic relationship between human-likeness and likeability was tested in Experiment 1. Using subjective ratings of mechanical-resemblance and human-resemblance of a sample of robot images a dimension of human-likeness was established, against which ratings of likeability were plotted. The proposed UV relationship was found to be supported, but only within certain age brackets. The results of Experiment 1 were also used to identify image categories of mechanical, uncanny, and human. Experiment 2 compared the event-related potentials of each

image category. Distinct differences in amplitude and latency were observed for uncanny stimuli in late event-related potentials, N400 and P300, when compared to mechanical and human stimuli. This study provides some of the first electrophysiological evidence for differential perceptual processing for stimuli falling within the UV. It is concluded that multi-disciplinary approaches such as this will prove crucial in understanding the social and perceptual aspects of human-robot interaction, and will be catalytic in the development of an optimal physical design for humanoid robots.

Is the Mirror Neuron System Associated with Empathy? A Systematic Review and Meta-Analysis

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The role of the mirror neuron system (MNS) in empathy is relatively unclear. Here, we consider empathy as an experience sub-served by multiple domains, specifically, motor, emotional, and cognitive processes. Due to its action-observation properties, it has been theorized that the MNS provides a simulation mechanism that may be the neural basis of empathy. Although some studies have attempted to investigate this potential relationship, the current literature seems to be mixed and inconclusive. To date, there have been no reviews conducted to collate and evaluate the existing data within the literature. The primary aim of the current systematic review and meta-analysis was to provide an overview of existing empirical studies investigating this relationship in healthy populations, and to provide a statistical estimate of this association. A total of 52 studies were found to investigate the association between this brain system and at least one domain of empathy, representing data from 1044 participants. Broadly, our results provide evidence to suggest an association exists between MNA and empathy. More specifically, emotional and cognitive empathy yielded significant moderate correlations with MNA, while very few studies examined motor empathy and the MNA. Our results also suggest that methodological variations seem to have an effect on the magnitude of this relationship.

The Colorful Calculator: Reducing the Mismatch Between the Veridical Inducer and the Non-veridical Concurrent

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The synaesthetic experience is characterized by the coupling of additional non-veridical 'concurrent' perceptions to 'inducing' veridical ones. Remarkably this often between sensory domains e.g. Seeing-Sound. Synaesthesia occurs as a neurodevelopmental trait, or phenotype, in over 4% of the adult population. It is highly under-recognized and under-reported; considering it's unobservable to the naked eye (c.f. eye colour), this is unsurprising. Inherent to synaesthesia is a mismatch between the veridical and non-veridical perceptions. Despite the cost to function and affect being well documented, until now it has remained untreated. Theoretically, a generalized solution would be to artificially align feed-forward sensory to reduce the mismatch between the non-veridical 'concurrent' and the veridical 'concurrent. In this paper, we instantiate this solution using a novel aid, the 'Colourful-Calculator', showing that it can be used to significantly improve the function and affect of synaesthetes' during an arithmetic-based task.

The contribution of sensory evoked potentials to TMS-EEG recordings

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Concurrent transcranial magnetic stimulation (TMS) and electroencephalography (EEG) is an increasingly popular method to study brain neurophysiology. Despite the considerable potentials offered by this technique, the combination of these two modalities is susceptible to different types of artefacts which can significantly distort the underlying neural signals. Today, many of these artefacts can be minimized by careful precautions and offline filtering methods. However, there is no currently available method to remove the somatosensory evoked potentials (SEPs), which are inevitably triggered by TMS induced scalp sensations, and the contribution of these signals to the overall activation is commonly assumed to be negligible. This study aimed to examine the contaminating effect of SEPs on TEPs. Twenty right-handed healthy participants received 100 single TMS pulses with the intensities of 120% of resting motor threshold over left motor cortex, and 100 single TMS pulses with the same intensity over left shoulder to produce SEPs by TMS-induced tapping sensation. Brain responses to TMS were recorded using 64-channels EEG during the session. The correlations between the EEG responses to shoulder and scalp stimulations, and the topographical distribution of the two signals were investigated. In addition, the alterations in TEPs after removing the effect of SEPs were evaluated. Results showed that SEPs and TEPs have similar topographical distributions and are significantly correlated across the scalp surface. Moreover, regressing out the SEPs substantially changed the shape and topographical pattern of TEPs. The findings indicate that the contribution of SEPs to TEPs is not negligible, and suggest removing the effect of these artefacts by adding a control condition to TMS-EEG experiments or implementing additional filtering procedures to avoid misinterpretation of TEPs.

Decision-making, emotional responsiveness and somatic markers in long-term opiate users

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Opiate use is associated with deficits in decision-making. This may be due to abnormalities of the orbitofrontal cortex, which is involved in the processing of emotion and the calculation of rewards. The Somatic Marker Hypothesis proposes that emotion is involved in decision-making, and that increased physiological arousal prior to poor choices (somatic markers) biases decisions away from poor long-term outcomes. Abnormal emotional responding and reduced somatic marker production prior to decisions have been argued to underlie poor decision-making, however this has not been assessed in opiate users. This study investigated whether the decision-making deficit observed in opiate users is associated with reduced somatic marking prior to poor decisions, and/or decreased emotional responsiveness more generally. The study included 28 opiate users and 34 healthy controls. To index somatic markers, skin conductance responses (SCR) were recorded whilst participants completed the Iowa Gambling Task (IGT). To measure more general emotional responsiveness, subjective and objective (SCR) measures of emotional arousal were collected while participants watched emotionally-arousing videos. On the IGT, opiate users demonstrated worse decision-making than controls. However, there were no differences between groups in somatic marking before each decision on the IGT or in subjective or objective emotional responses to the videos. The results show that while opiate users have reduced decision-making ability, this does not appear to be due to impaired somatic marking or emotional responsiveness.

Gamma coherence mediates interhemispheric transfer of visual information during multiple object tracking

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Sustained and successful tracking of multiple objects moving between the visual hemifields requires continuous integration of relevant information between the two cerebral hemispheres. Although the neural mechanisms responsible for interhemispheric integration remain unclear, it has been suggested that coherent neural oscillations in the gamma band might provide a mechanism for effective information transfer. Here we devised a multiple object tracking paradigm in which discrete visual objects moved either entirely within the left and right visual fields, or could cross freely between visual fields, thus requiring interhemispheric integration. We recorded brain activity using electroencephalography (EEG) as participants (N = 41) tracked either two or four target objects, and analysed endogenous neural oscillations across a range of frequencies. As expected, participants showed performance costs for four- versus two-target trials. They were also poorer at tracking objects that crossed between the left and right hemifields—relative to matched within-hemifield trials—reflecting a cost of interhemispheric integration. Critically, we found that tracking objects between the visual hemifields was associated with boosted gamma coherence over parieto-occipital areas, and that individual differences in the extent of the between-hemifield performance cost was associated with interhemispheric coherence over the same regions. Finally, participants' trial-by-trial performance in between-hemifield trials was uniquely associated with the instantaneous phase coherence ('phase-locking') throughout the tracking period. These findings suggest that gamma coherence plays a role in mediating interhemispheric transfer of visual information during multiple object tracking.

Inter-individual differences in predictive coding and model adaptation during language processing

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Predictive coding has been hailed a possible unifying theory of brain function. However, while there is evidence for changes in predictive coding mechanisms across the adult lifespan, little is known about how they differ between individuals. Here, we examined inter-individual differences in predictive coding within a complex cognitive domain, language, and investigated with which cognitive and/or neurobiological characteristics such differences correlate. The results reported here are initial findings from a larger study.

Native speakers of English (n=21; 11 women; mean age:23 SD:4) listened to 150 multi-sentence passages while their EEG was recorded. Ninety passages contained 2 two-adjective noun phrases (e.g. "huge grey elephant") at varying positions. In 50% of cases, adjectives occurred in the more common, canonical order ("huge grey"); in the other 50%, the order was non-canonical ("grey huge") to induce a prediction error. Participants heard recordings from two male speakers, with varying probability of non-canonical orders (70% canonical, "C-speaker", vs. 70% non-canonical, "N-speaker"). Data were analysed using linear mixed-effects models.

Results showed an N400 ERP effect at the second adjective for non-canonical vs. canonical orders. This effect, reflecting a prediction error, was qualified by an interaction of canonicity, speaker, epoch position within the experiment, and verbal fluency. The amplitude of the N400 canonicity effect for the N-speaker decreased across the course of the experiment and the decrease was more rapid with increasing verbal fluency.

These initial findings suggest that young adults update their predictive models dynamically based on speaker characteristics. Individual differences in model adaptability are predicted by verbal fluency, which has been linked to predictive processing in older adults, and which may reflect individual differences in the use of language production mechanisms to generate predictions for comprehension.

Psycho-physiological measures to understand failure-to-identify hunting accidents in deerstalking

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Deerstalking is prone to errors, sometimes with tragic consequences. Incidents in which a hunter mistakenly assumes that a target is a deer are termed "failure-to-identify" hunting incidents. The outcomes of such incidents often include fatal injuries to a person who has been accidentally targeted, psychological trauma and legal jeopardy for the hunter, the destruction of family units related to both the hunter and victim, and naïve vilification from the community. Failure-to-identify incidents are rare, but they nevertheless constitute some 11% of reported hunting accidents, and are of serious concern to hunters, safety organisations, and regulatory authorities. Somewhat surprisingly, there is little empirical research into their cause. Here, we present preliminary findings concerning the psychophysiological and psychological antecedents of failure-to-identify hunting incidents.

The first investigation was a field test in which we measured electrodermal activity, heart rate and inter-beat interval from a small number of hunters during an outdoor deer hunt. This was followed by a larger study, conducted at a popular national hunting show, in which we recorded the same measures during a simulated hunt using interactive video technology. This allowed us to recruit a much larger sample of hunters and to control the cues available to participants about the presence and nature of a target animal.

Preliminary results indicate Electrodermal Activity does increase over time after first spotting a deer and appears to offer some explanation to the outcomes of hunter performance.

These data suggest that failure-to-identify hunting incidents may be more likely to occur in circumstances in which perceptual discrimination and decision making are impaired by heightened sympathetic arousal. We are continuing to explore the interactions between arousal, visual target acquisition and recognition, and the ultimate decision that a hunter must make – whether to pull the trigger.

Probing the neural underpinnings of perceptual decision making using a combined diffusion-MRI EEG approach

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The superior longitudinal fasciculus (SLF) is a white-matter tract connecting frontal and parietal areas of the brain. Structural variability of the SLF has been shown to predict the speed of information processing in healthy individuals (Chechlacz, Gillebert, Vangkilde, Petersen, & Humphreys, 2015; de Schotten, 2005). We hypothesised that the association between response times and SLF structure might reflect (or be mediated by) the efficiency of evidence accumulation. Specifically, we proposed that larger SLF volumes would be related to more rapid evidence accumulation which allows an individual to reach a decision threshold more quickly, thereby facilitating faster response times.

Recent electrophysiological developments have led to unprecedented access to the temporal dynamics underpinning perceptual decision making. In particular, the build-up rate (slope) of a centroparietal positivity (CPP) signal, has been shown to faithfully represent the evidence accumulation process, including predicting reaction time (RT) for perceptual decisions at the single trial level (O'Connell, Dockree, & Kelly, 2012).

We therefore assessed the relationship between volume and microstructure of the SLF, electrophysiological markers of perceptual decision making, and performance on a perceptual decision-making paradigm (the random dot motion task).

We observed that larger volume within the dorsal branch of SLF (termed SLF1) was associated both with faster performance on the

decision-making paradigm and a steeper build up rate of the CPP. Moreover, inter-individual variability in the CPP slope mediated the relationship between SLF1 and RT.

This combined diffusion MRI-EEG approach provides novel mechanistic insights into the contribution of individual differences in the structural integrity of fronto-parietal neural networks and individual differences in human decision making.

Age related decline at V1 is predominately magnocellular

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Age decline in visual processing is often attributed to a combination of lens, retinal and cortical changes. While there is research on how age affects the magnocellular (M) and parvocellular (P) pathways at retinal in humans and lateral geniculate nucleus (LGN) in monkeys, changes in cortex are less clear. Here, flicker fusion frequencies were obtained as a behavioural measure of magnocellular function and nonlinear flash visual evoked potentials (VEP) were recorded to identify second order contributions of M (K2.1) and P (K2.2) pathways to V1. Participants (n=79) ranged between 18 to 78 years in age. In accordance with previous research this study found increases in VEP latency with age as well as a decrease in flicker thresholds. The flicker fusion frequencies negatively correlated with age with the high contrast flicker accounting for 19% of the variance with age and the low contrast flicker accounting for 9% presumably because of lowered signal to noise. Non linear VEP recordings revealed N70 and P100 latencies in the second order kernels correlated with age. The strongest correlations with age were found in the early N70 component that is comprised of fast conducting M afferents, shown to input 10 -25 ms prior to P afferents. The temporally identified M input at K2.1 (low contrast condition) shows the highest rate of N70 latency increase at 11.67ms per decade. In components dominated by P activation amplitude significantly decreased with age in multiple first and second order components till around 30 years after which amplitude changed little with no significant difference found between middle (31-55yrs) and old (56-79) groups. In conclusion while both M and P related changes were found, the source of age related change contributing most to V1 was from M pathway where signals become slower to reach cortex with age.

Functional dissociation of latency-variable, stimulus- and response-locked P3-like positivities indexing response inhibition and interference suppression

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Cognitive control refers to a group of processes associated with performance of specific tasks through appropriate adjustments in executive attention and response selection. The well-known P300 waveform of the human event-related potential (ERP) has been associated with "context-updating" (a key aspect of cognitive control) in simple target detection tasks. Recent ERP research using novel single-trial EEG analyses – residue iteration decomposition (RIDE) – in task switching has shown topographically and functionally distinct P3-like potentials in stimulus-locked, response-locked, and intermediate component clusters over parietal and frontal regions, implying multiple functionally and temporally distinct, though partly overlapping context updating operations throughout the ERP epoch. We applied RIDE to extend this research into response inhibition and interference suppression. The EEG was recorded from 45 young adults while they completed a hybrid flanker/go-nogo task. The results showed a family of P3-like potentials in the stimulus-locked, response-locked, and intermediate component clusters over both frontal and parietal regions. Importantly, the topography of these peaks differed between task conditions in each of the three clusters, implying different patterns of neural generators are associated with different cognitive control processes. The results provide further support for a reformulated version of the context updating hypothesis, suggesting that the P300 waveform encompasses a taxonomy of functionally distinct P3-like subcomponents, plausibly indexing the complex workings of fronto-parietal cortical networks subserving cognitive control.

The cerebral basal arterial network: morphometry of right and left outflow arterial components

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Introduction: The aim of this project was to study whether there is a difference in blood supply to the right and left cerebral hemispheres.

Materials and Methods: Diameters of right and left outflow vessels (anterior, middle and posterior cerebral arteries) were measured and cross-sectional areas calculated in 52 cadaveric brain specimens. The external diameters of the arteries leaving the cerebral basal arterial network were measured at specific sites, perpendicular to the long axis of the vessels using a digital Vernier calliper.

Results: The average summarised cross-sectional area of the left major cerebral arterial components (19.0 mm2) was significantly (p= 0.001) larger than the combined cross-sectional area of right major cerebral arteries (18.8 mm2) supplying the right cerebral hemisphere.

Conclusion: It was concluded that the blood flow to the left cerebral hemisphere in an average is greater than to the right cerebral hemisphere. This may reflect more activities in the left hemisphere or a larger arterial territory of the left cerebral hemisphere.

Reduced perception of attractiveness, cuteness, and inclination to give care for infants in developmental prosopagnosia

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Cuteness is an intrinsic quality conveyed by infant faces that automatically elicits strong nurturing desires in those that view them. Increasing levels of infant cuteness also lead to greater activation in the fusiform gyrus and stronger inclinations for giving care in the viewer. Individuals with developmental prosopagnosia suffer from lifelong impairments in the recognition of facial identity and associative abnormalities in their fusiform gyrus. We therefore hypothesized that those with developmental prosopagnosia might exhibit behavioural difficulties when attempting to perceive cuteness, and subsequently feel a reduced desire to give care to infants. We asked a group of developmental prosopagnosia cases and matched controls to rate the attractiveness, cuteness, and their inclinations to give care for a series of adult human, cat, dog, infant, kitten and puppy faces. As anticipated, the prosopagnosia cases were severely reduced in their perceptions of cuteness and attractiveness, and felt lower desires to care for the human infants than their neurotypical counterparts. It is likely that the perception of facial identity, infant cuteness, and the subsequent generation of a nurturing instinct therefore share a common neural origin. Parents with developmental prosopagnosia may therefore be at a greater risk of developing disorders related to lower motivations towards infant care, such as anxiety and depression, than those with intact face recognition abilities.

Early Visual Attention to Preconscious Threat Mediates Growth in Anger across Deployment Among Combat Veterans

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About one in ten Australian combat veterans are affected by Post-Traumatic Stress Disorder (PTSD), a psychiatric condition underpinned by marked disturbances in the emotional processing networks of the brain. Anger dysregulation (differentiated from normal anger by its: frequency, severity, duration, lack of control, and damaging impact) is also highly prevalent among veterans. Despite the importance of anger, its mechanisms of onset are not well understood. Theories of posttraumatic anger emphasise threat sensitization after trauma as a key driver. Survival Mode Theory (SMT) posits increased

rapid automatic reactivity to threat that overgeneralizes to ambiguous cues. Appraisal Theory (AT) emphasises changes in conscious cognitive processing of these cues. Our study investigates the mediating role of emotional processing in how trauma exposure predicts increased anger across deployment among Australian Army personnel (N = 129). Emotional face ERPs were recorded during a passive viewing task; angry, happy, and neutral faces were presented in conscious and preconscious (backward masking) paradigms. ERP components analysed were: P120 at occipital sites (O1, O2) and P3 (at Pz); representative of early visual attention and conscious appraisal processing respectively. SMT was expected to enhance and shorten bilateral P120 components to preconscious threatening and ambiguous faces. AT was expected to enhance P3 to consciously presented threatening and ambiguous faces. A latent growth within-person mediation analysis showed that the extent to which trauma exposure predicted increased anger was partially mediated by: faster P120 latencies to preconsciously presented angry faces (bilaterally) and neutral faces (at O1). This was considered consistent with SMT and has implications for clinical approaches to anger in trauma-exposed populations.

Impaired behavioural self-awareness associated with reduced treatment motivation and cognitive error identification in adults with cocaine use disorder

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Patients with cocaine use disorder often display behaviours that are paradoxically misaligned with their situation. Typical examples include overestimating one's ability to control craving and drug use, and inconsistent motivation toward treatment, possibly reflecting alterations self-awareness. We examined whether impaired self-awareness of the behavioural consequences of addiction (symptoms of apathy, disinhibition, and executive dysfunction) was associated with self-correction of cognitive errors, self-reported craving and treatment motivation. Sixty-one outpatients with cocaine use disorder and their informants (e.g. relatives) completed parallel self and informant versions of the Frontal Systems Behaviour Scale. Behavioural awareness was indexed using self/informant discrepancy scores. Awareness of cognitive errors was measured with self-corrections on a colour-word Stroop paradigm. Self-reported craving was assessed using visual analogue and Cocaine Craving scales while the University Rhode Island Change Assessment Scale assessed treatment motivation. To account for the preponderance of near-floor values in self-corrected cognitive errors and craving, we employed a recently proposed two-part model of statistical analysis - Weibull mixture regression. Multiple regression models examined associations between treatment motivation and behavioural awareness. Although there were no associations with craving, poorer awareness of symptoms of executive dysfunction was associated with fewer self-corrected cognitive errors. Poorer awareness of symptoms of disinhibition was associated with lower treatment maintenance scores. We show that impaired behavioural self-awareness in outpatients with cocaine use disorder is associated with poorer awareness of cognitive errors and lower treatment motivation. Consequently, a lack of behavioural self-awareness in cocaine use disorder may represent an important clinical phenotype of behaviours inconsistent with effective treatment.

A single-session of focused attention meditation increases the N200 ERP component during subsequent sequential action after brief meditation training

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A single session of focused-attention meditation (FAM) has been shown to bias cognitive control processes involved in sequential action (Chan, Immink, & Lushington, 2017; Immink, Colzato, Stolte, & Hommel, 2017). Specifically, increased top-down control due to FAM immediately transfers to a motor sequence task resulting in narrowing of attention towards target stimuli and consequently, faster responding. Since the N200 component has been closely associated with top-down control and inhibition, it provides a neurobiological index to observe the behavioural effects of meditation on cognitive control (Folstein & Van Petten, 2007). The current experiment aimed to investigate if brief FAM training enhances the immediate effect of FAM mental states on top-down control, as indexed by the N200 component, of sequential action. Twenty-nine meditation naïve participants were randomised to one of three conditions reflecting the level of FAM experienced prior to a motor sequence task: 21 sessions of FAM (MED21, N = 12), a single FAM session (MED1, N = 9) or no preceding FAM control (CON, N = 8). Compared to CON and MED1, MED21 demonstrated a more pronounced N200 component during sequential performance over frontal-midline and central-midline regions. The findings suggest that short-term FAM training is associated with increased N200 amplitude, which is consistent with increased top-down control of attentional processes for selection, discrimination, feature detection in stimuli and inhibition of responses for motor sequence learning (Falkenstein, 2006). These results illustrate that the extent to which mental states associated with FAM influence neural substrates of attention control during sequential action, depend on a brief period of training with the meditation technique. This work represents an early endeavour to understand neurobiological mechanisms underlying the effects of meditation on sequential behaviour.

The relationship between subjective sleepiness and spatial attention: a behavioural study

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Alertness can influence attentional allocation. Typically, lower and higher levels of alertness lead to a leftward and rightward shift of attention, respectively. This relationship between alertness and spatial attention has major implications for work, health and safety. The relationship between subjective sleepiness, as a proxy of alertness, and spatial attention is poorly understood and the current study aimed to shed light on this relationship. Nineteen healthy right-handed participants (M=24.6±5.3 years, 11 males) completed a seven-day laboratory based simulated shift-work study. The Karolinska Sleepiness Scale (KSS) was used to measure sleepiness and the Landmark Task (mean bisection bias) assessed spatial attentional bias on four occasions (days two and seven at 1430h, and days four and five at 0300h). As an experimental check, a mixed model analysis with KSS as the outcome, with a fixed predictor of time of day, was conducted, revealing that subjective sleepiness was higher in the early morning (0300h) as compared to the afternoon (1430h) ($p<.001$). In another mixed model analysis, KSS scores did not significantly predict bisection bias ($p=.86$), suggesting sleepiness was unrelated to spatial attention. ID was always set as a random intercept in analyses. Further investigation exposed individual differences: 53% of the participants showed the predicted association between sleepiness and spatial bias, whilst the rest showed the opposite. These findings suggest that subjective sleepiness is unrelated to attentional bias; objective measures of alertness, such as EEG and reaction time procedures might be more sensitive.

The role of early versus late night sleep in memory consolidation and generalisation

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Using a behavioural paradigm, we isolated the effects of different sleep stages and sleep EEG phenomena on both memory consolidation and generalisation. Character-based language naïve subjects underwent a night-half protocol with EEG monitoring, and completed a Chinese character/English word paired associates learning task. This task allowed us to measure both recognition accuracy as well as the extent to which the subject could generalise this knowledge to rule-congruent but novel characters. Results indicate an effect of early night sleep in recognition of previously seen word-pairs (b=2.13, t(19.01)=2.37, p=0.02). This is in keeping with established literature, but do not indicate a direct role of sleep in generalisation (b=-0.6, t(18.10)=-0.35, p=0.73). Results also indicate a significant interaction between condition and condition order, such that the early night effects were increased if this was the subject's first encounter with the learning materials (b=3.46, t(18.7)=2.97, p=0.008). Theta power was found to be related to recognition accuracy (rs = 0.45, p<0.05) and slow sigma power was found to be predictive of recognition accuracy (b=0.35, SE b=0.16, ß=0.47, p=0.04), and these relationships have not been previously considered in sleep based memory models. In keeping with the broader memory literature, we interpret the theta relationship to indicate a direct role of the hippocampus in overnight memory consolidation (as opposed to the indirect role attributed to hippocampal replay through spindle activity common in the sleep literature). We interpret the slow spindle finding to be an important update to the original sleep and memory literature, which did not separate spindles into slow and fast frequency bands. Future investigations of sleep-based memory processes should take advantage of recent advances in EEG and machine learning in order to better study memory trace replay and associated cognitive functioning.

A water bottle and a gun walk into a bag: Multiple targets and target prevalence interact to affect visual search

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Visual search can be as mundane as looking for a milk and as vital as radiological examinations or baggage screening at the airport. In these life-threatening real-world searches, the consequence of missing a target (whether a tumor or a gun), can be catastrophic. Previous research has identified two factors that impair search accuracy. First, people are more likely to miss the second target after finding the first, known as 'subsequent search misses' (SSM). Second, misses increase greatly when the prevalence of a target is rare, the 'low prevalence effect' (LPE). Unfortunately, these two factors often coexist in real-world searches. For example, water bottles are far more prevalent than a knife in a baggage, but potentially co-occur. It is therefore important to test whether and how SSM and LPE interact in affecting search accuracy. In this behavioral study, we examined the interaction between the number of targets and their prevalence. Observers searched for all Ts (0,1 or 2) among Ls. In Experiment 1, the probability of 1T and 2T trials was equal (among 50% target absent trials for both Experiments). SSM occurred in this search. In Experiment 2, the probability of 1T vs 2T trials was 40% vs 10% or the reverse, in separate blocks. In the 40/10% condition, we found an interaction of SSM and LPE, such that low prevalence triggered more miss errors in 2T than 1T trials. In the 10/40% condition the accuracy for 1T and 2T trials was as high as that for the more prevalent 1T trials in Experiment 1. Pitting SSM against LPE mitigated the negative effects of both factors. Overall, the joint effect of the difficulty finding a subsequent target and low prevalence is likely to contribute to impairments in search accuracy in life-threatening real-world searches. The current finding that SSM and LPE can counteract each other may offer important clues for counteracting life-threatening misses.

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Prefrontal and frontostriatal structures mediate academic outcomes associated with ADHD symptoms

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Background: Children with Attention-deficit/hyperactivity disorder (ADHD) have poor academic functioning compared to controls. Executive dysfunction has been observed to mediate the relationship between ADHD symptoms and academic outcome. This study aimed to investigate if differences in prefrontal and frontostriatal cortical structures explain this mediating relationship.

Methods: 163 children aged 9 – 11 years (mean 10.43 years) completed a magnetic resonance imaging (MRI) scan, which included a structural T1 and high-angular resolution diffusion imaging (HARDI) acquisition. Cortical regions of interest were parcellated from the T1 image using Freesurfer. Frontostriatal tracts were generated using constrained spherical deconvolution (CSD) tractography. Executive functioning was assessed using a computerised battery of tasks (working memory, sustained attention and response inhibition). Academic achievement was measured by direct assessment of reading and mathematics abilities, teacher report of academic competence, and performance on the National Assessment Program-Literacy and Numeracy (NAPLAN) test. Serial mediation analysis was used to test whether executive function performance and frontostriatal structures mediate the poorer academic functioning seen in ADHD.

Results: Increases in symptom severity (both inattention and hyperactivity) were associated with poorer academic outcomes. Working memory partially mediated the relationship between symptom severity and academic outcomes. In a serial mediation model, left dorsolateral prefrontal cortex volume and left putamen to dorsolateral prefrontal cortex tract volume partially mediated academic outcome, with larger volumes associated with better academic outcomes.

Discussion: Prefrontal and frontostriatal structures mediate academic outcomes through working memory. These results will help to improve predictions about academic performance in children with ADHD, and inform intervention within the classroom.

V1 and lateral occipital cortex contributions to recognition memory in the absence of awareness

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Recognition memory enables us to discriminate whether an event has occurred in the past, and is widely interpreted to reflect the conscious retrieval of episodic traces. However, we have previously reported evidence of recognition memory in the absence of awareness, and demonstrated that V1 activity predicts the ability to recognise masked event sequences 15-20 min after initial learning. Here, we used task-based and resting-state fMRI (3.0-T) to investigate the neural mechanisms underlying the encoding, consolidation, and recognition of non-conscious stimuli. Participants were presented with a series of single words in a study phase, followed by a series of single-word retrieval cues in a test phase. Critically, all words in both phases were masked from awareness, and participants were required to judge whether the retrieval cues were old (studied) or new (unstudied). Resting-state data were acquired immediately before and after the study phase to determine changes in network functional connectivity during the consolidation of non-consciously studied items. Behavioural analyses demonstrated non-conscious recognition of the masked stimuli in the absence of awareness. fMRI data revealed three key findings. First, V1 and lateral occipital cortex exhibited greater activity at study for subsequent hits compared to subsequent misses (a non-conscious subsequent memory effect). Second, these areas were also implicated in retrieval success during non-conscious recognition. Finally, post-learning consolidation of the masked words

was associated with a topological change in connectivity within a visual network that included V1. Together, these results demonstrate that visual areas play a key role in non-conscious encoding, consolidation and retrieval, and present a challenge to current neurobiological accounts of recognition memory that are centred on the conscious retrieval of episodic traces or familiarity.

FMRI Experiments of the Human Lateral Geniculate Nucleus

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We performed two fMRI experiments in healthy individuals to characterise the retinotopic organisation and the magno-cellular (M) and parvo-cellular (P) layers of the human lateral geniculate nucleus (LGN) using a 3-Tesla Tim Trio Siemens scanner. Both experiments consisted of movies of clockwise or counter-clockwise rotating hemicircles of stimulus patterns subtending 20 degrees of visual angle. The patterns completed a full rotation every 32 seconds. There were 8 full rotations per run. In experiment 1, the stimulus pattern consisted of a black and white checkerboard flickering at 4 Hz, which is typical of most retinotopic experiments of the human visual cortex. In experiment 2, the stimulus patterns consist of an M version and a P version, each exploiting the distinct spatial, temporal, and chromatic characteristics that drive each of these systems. The M stimulus pattern consisted of an achromatic Gabor grating flickering at 15 Hz with a Michelson contrast of 10% and a spatial frequency of 0.2 degrees while the P stimulus pattern flickered at 2 Hz and consisted of a physically isoluminant red / green grating at maximal contrast and a spatial frequency of 2 degrees per cycle. Fourier analyses on the fMRI data were used to create phase maps. The resulting phase maps for Experiment 1 confirmed the well-established retinotopic organisation of the human LGN while the resulting phase maps for Experiment 2 showed that the more ventral and medial portions of the LGN tended to respond more to the M stimulus while the more dorsal and lateral portions of the LGN tended to respond more to the P stimulus. These spatial patterns of fMRI responses in the human LGN seem consistent with the known spatial arrangement of the M and P layers characterised in non-human primates.

Individual differences in stopping speed explained by GABAergic activity in the motor cortex

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In our daily lives, we are often required to abort an action after it has been has been initiated, with the speed of this process known as the Stop Signal Reaction Time (SSRT).We investigated the biological basis for stopping speed by determining whether GABAergic activity in the motor cortex could distinguish people who were fast at stopping ("fast stoppers") from those who were slow at stopping ("slow stoppers"). GABAergic activity was assessed by measuring Short-Interval Intracortical Inhibition (SICI). This manifests as a reduction in the motor evoked potential (MEP) elicited by a suprathreshold Transcranial Magnetic Stimulation (TMS) pulse if that pulse is immediately preceded by a weak subthreshold pulse separated by a very short interval (2-5 ms). In two experiments, participants completed the Stop Signal Task while we measured SICI (from the FDI muscle in their hand). In Experiment 1, SICI was measured at fixed time points after the onset of the stop signal (50ms, 100ms, 150ms, 200ms); in Experiment 2 SICI was measured at fixed time points before the end of the SSRT interval (-25ms, -75ms, -125ms). We performed a median split of the SSRT scores for the 30 participants in each experiment to classify participants as fast vs. slow stoppers. Participants classified as fast stoppers had stronger SICI than those classified as slow stoppers across both response execution (Go) trials and inhibition (Stop) trials. Moreover, for fast stoppers, SICI was stronger during inhibition trials than execution trials, whereas this difference was not observed for slow stoppers. Our results show that individuals who are fast at stopping not only show stronger GABAergic activity in the motor cortex during inhibition (and execution), but can more effectively control GABAergic activity to inhibit motor cortical excitability when stopping a response and disinhibit excitability when executing a response.

The effects of individualised intermittent theta burst stimulation in the prefrontal cortex: a TMS-EEG study

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Recent studies have highlighted the neurophysiological and behavioural variability in response to theta burst stimulation (TBS) in humans. This paradigm was originally developed in rodents to mimic gamma bursts that were coupled with theta rhythms and was shown to elicit long-term potentiation. The protocol was subsequently adapted for humans using similar frequency parameters, however, it is known that peak theta frequency differs between rodents and humans, and across individuals. Furthermore, the precise frequencies involved in theta-gamma coupling, a cornerstone of cognitive processing, is unique across individuals. The present study sought to explore whether individualised intermittent TBS (Ind-iTBS) could outperform the neurophysiological and behavioural (mood) effects of two conventional iTBS variants.

20 healthy volunteers received iTBS over left prefrontal cortex using 30 Hz, 50 Hz, or individualised frequency in separate sessions. Ind-iTBS was determined using theta-gamma coupling during the 3-back task. Concurrent use of transcranial magnetic stimulation and electroencephalography (TMS-EEG) was used to track changes in cortical plasticity measured. We also utilised mood ratings using a visual analogue scale before and after stimulation.

No group-level effect was observed following either 30 Hz or 50 Hz iTBS. Ind-iTBS yielded a significant increase in the amplitude of TMS-evoked P60, and a decrease in N100 and P200. A significant positive correlation between neurophysiological change and change in mood rating was also seen.

These findings highlight the critical importance of frequency in the parameter space of iTBS. Our Ind-iTBS protocol outperformed conventional protocols in neurophysiological and behavioural outcomes. This novel approach presents a promising option for enhancing the efficacy of iTBS and benefits may extend to clinical applications.

Using brain stimulation to probe information flow throughout the brain

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Brain functions are supported by the neural activity of local brain regions as well as macroscopic brain networks. The neural mechanisms that link changes in neural activity in specialised regions, with the emergence of large-scale brain network dynamics remain largely unknown. This knowledge is essential to understand how information flow across brain regions, as well as guide new brain stimulation interventions aiming to restore brain dysfunction. In this talk, I will describe the results of empirical and computational studies that have aimed to unfold the neural principles that underpin the emergence of distinct patterns of functional brain network activity following local deregulations. In these studies we used neuroimaging, brain stimulation, network science and computational modelling. I will discuss results suggesting that the effects of local neural perturbations on large-scale neural dynamics may reflect a fast-slow timescale hierarchy from periphery to core brain regions. These results highlight that the intrinsic temporal organisation of the human brain may support the dynamic emergence and dissolution of functional interactions between remote brain regions. Likewise such neural principles may explain the selective effect of localised neural pathology in whole-brain network dynamics. I will conclude by describing how knowledge gathered from these fundamental studies can be translated to clinical investigations aiming to restore brain network pathology.

Cerebrovascular function during cognition in Parkinson Disease: slower and more variable

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Dr Nicholas Badcock, *Macquarie University*
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Recent evidence links cerebrovascular pathology to Parkinson's disease (PD), which broadens the neuropathological conceptualisation of the disorder. The current study aimed to assess cerebrovascular function during cognition in those with and without PD. A total of n=16 adults with a diagnosis of PD (mean age=71.8, SD=8.6) and n=29 healthy controls (mean age=70.4, SD=6.4) undertook psychological testing (Addenbrooke's Cognitive Examination Revised/ACER, Geriatric Depression Scale and Hayling and Brixton tests) and had mean blood flow velocity recorded during a cognitive task (word generation) using transcranial Doppler (TCD) ultrasonography of the middle cerebral artery. The lateralisation of the hemodynamic response, termed lateralisation index, its peak (in seconds post-stimuli) and its standard deviation were calculated. The PD group displayed significantly higher depression scores, as well as significantly lower scores on the attention and fluency subscales of the ACER and Brixton Spatial Anticipation test. During the word generation task, the PD group displayed a slower and more variable hemodynamic response, as indicated by a longer latency of peak and higher standard deviation of the lateralisation index, although the degree of lateralisation was not significantly different between the groups. Conversely, during the same task, our group has previously shown that healthy ageing is related to an attenuation in the lateralisation index, but no changes in latency or standard deviation. Therefore, this finding suggests that hemodynamic changes associated with PD are different from those of healthy ageing. Furthermore, this is one of the first demonstrations of hemodynamic dysfunction in PD. Taken together, the results of the current study suggest that hemodynamic dysfunction may play an important role in cognitive change in PD.

Amplitude modulation of single-trial midfrontal theta oscillations predict behaviour

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Cognitive control processes allow the recruitment of goal-appropriate cortical regions to facilitate effective performance. While a broad frontoparietal network supports cognitive control, the medial prefrontal cortex (mPFC) is thought to play a critical role in control. MPFC likely recruits goal-critical regions through dynamic modulation of low-frequency, theta (4-8 Hz) oscillations. In this study, we explored whether such theta-band modulation supported cognitive control by improving behaviour. That is, could single-trial theta-band dynamics predict single-trial behavioural performance?

Participants performed a cued-trials task switching paradigm while simultaneous electroencephalography (EEG) was recorded. For each participant, single-trial time-frequency power was extracted from midfrontal electrodes, alongside that trial's reaction time, and entered into a robust regression. This produced regression time-frequency maps for each participant, which were standardised and assessed using parametric statistical analyses.

We found a strong locus of midfrontal theta-band activity that predicted RT. Specifically, during the cueing period, enhanced theta power led to faster RT (i.e., better performance) on trials with informative cues. Post-target we also found enhanced theta predictive of faster performance. Further exploration of these results revealed that ongoing theta oscillations were present during all trials (irrespective of performance speed). However, amplitude modulation of these theta oscillations post-cue led to knock on effects during the course of the trial, shifting the latencies of theta amplitudes pre and post-target onset. These amplitude modulations appeared to underpin benefits to performance.

Together, these results provide novel evidence of trial-by-trial midfrontal theta dynamics that underpin effective cognitive control. Interestingly, both preparatory and target-drive control processes were supported by a common midfrontal theta mechanism.

Visual Selection and Distractor Suppression: A Gatekeeper for Working Memory?

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Successfully interacting with the visual environment often involves identifying and focusing attention on task-relevant objects ("targets"). The visual field often contains many salient stimuli that share features with a target object, and management of distracting information is a critical aspect of this interaction, especially when targets and distractors are visually similar. In earlier research we have used electroencephalography (EEG) to isolate brain potentials related to the processing of target and distractor objects using a modified visual-search paradigm. We focused on a series of event-related lateralisations (ERLs) evoked by target objects and by salient distractors. The first of these is the N2pc – a negative potential that peaks between 180 and 250 ms post-stimulus at posterior electrodes contralateral to a possible target stimulus. When the salient stimulus is a distractor, a contralateral positivity with a slightly more anterior scalp-distribution – termed Ptc – often follows. We have speculated that the Ptc may be a manifestation of an active process of suppressing, or disengaging from, distracting visual stimuli. Here, we report results from additional studies in which the number of distractors and their similarity to the target stimulus were varied. Both manipulations resulted in robust modulations of the amplitude and form of the Ptc. This is consistent with the hypothesis that the Ptc component reflects the active management of distractors. In addition, a separate study revealed that individual differences in Ptc amplitude were correlated with performance in a concurrent visual working memory task. This further reinforces the suggestion that the Ptc may be a manifestation of a "gatekeeper" mechanisms controlling access to visual working memory. Further, variability in the operation of this gatekeeper mechanism may be a critical determinant of performance in a range of tasks requiring the selection and maintenance of visual information.

Building cognitive architecture in young children with compromised attention capacity

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The efficacy of cognitive training programs has been one of the most widely debated topics in cognitive neuroscience in recent years. Forever increasing numbers of "brain training programs" with no evidence base has led to significant scepticism about the effectiveness and reliability of such programs. In this presentation, we highlight our findings from two double-blind randomised control trials of a novel attention training program (TALI Train) designed to improve attention in children with vulnerable cognitive capacity. Focusing on two fundamental cognitive components of attention: alerting (sustained attention) and orienting (selective attention), we assessed the impact of TALI Train on attention, executive functions and academics in children with developmental delay aged 4 to 11 years (Study 1) and typically developing preschool children (Study 2). All children completed the program over a 5 week period and consisted of 25 sessions, each of 20 minutes duration. Outcomes were assessed pre-training, post-training, and at 3 or 6 month follow-up. Children with developmental delay showed greater improvement in selective attention performance compared to children in the control condition. These improvements were maintained 3 months after training had ceased. The attention training program was not effective in promoting improvements in other aspects of attention, problem behaviours or academic skills at post-training; however at follow-up the training group showed greater improvements in numeracy skills. A similar profile was observed in the typically developing children suggesting that selective attention may be the most amenable to change via cognitive training.

Taking note of faces: Word priming effects in musicians and non-musicians

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Processing of faces requires early encoding of structural features proceeded by slower, more intricate processing and attention to detail. Right brain engagement occurs in the earlier stages of processing whereas left hemispheric lateralization occurs when greater attention is required such as for outgroup or threatening faces. Differences in hemispheric processing of both music and word stimuli have been found between musicians and non-musicians. The aim of this study was to investigate the effect of positive and negative priming on responses to facial expressions in two groups of female participants. Behavioural responses (RT) and neurophysiological measures (ERPs) were recorded from 11 female musicians and 11 female non-musicians as they categorized faces as happy or angry in two tasks. Faces were preceded by positively or negatively valenced prime words. The first task compared male and female stimuli and resulted in greater P1 amplitude for congruent words and expressions, indicating that differentiation of emotions began as early as P1. Female happy faces were recognised more quickly than male happy faces although male angry faces were recognised more quickly than male happy faces suggesting, given the participants were all female, an outgroup bias. A positive prime tended to reduce reaction time for the female faces but not for the male faces. RTs to male and female faces did not vary after a negative prime. For N170, there were hemispheric differences between expressions; angry expressions elicited larger activity than happy expressions and musicians had larger amplitude N170 than non-musicians, particularly in the left hemisphere. Our results suggest that early processing of expressions occurs as early as P1 when facilitated by prime words and that musicians differ from non-musicians in recruitment of brain regions when processing faces.

EEG resting state power in those with and without Mild Cognitive Impairment

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Ms Danielle Greaves, *University of South Australia*
Dr Owen F. Churches, *University of South Australia*
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There have been many resting state EEG power investigations of cognitive states in late-life over the past three decades, from normal to mild cognitive impairment (MCI) to dementia. The findings have been mixed, although higher theta power, lower alpha power, and lower alpha peak frequency have been more consistently associated with impaired states such as MCI. Previous investigations have however employed poorly operationalised definitions of MCI, and many have used young-old samples (<65 years), representing early-onset dementia progression rather than the more common late-onset. We aimed to investigate if common EEG power measures 1) were significantly different between older adults with and without MCI, and 2) how these measures were related to cognitive performance over adulthood.

41 participants: 6 older adults with MCI (M=73.3, SD=4.5; according to the Addenbrooke's Cognitive Examination III/ACEIII), 19 healthy older adults (M=70.8, SD=5.2) and 16 healthy young adults (M=26.5, SD=6.9). EEG was recorded for 2 minutes with eyes closed. Cognitive performance was measured in all groups using the ACE III.

No linear relationships were found between EEG spectral power and cognitive performance using traditional analysis methods such as alpha:theta, alpha band power and delta+theta:alpha+beta in subgroups or across all participants. A follow-up quadratic regression analysis showed more extreme alpha peak frequency values (i.e. very low or very high) were associated with lower ACE III total ($r=0.5$, $p<0.05$), attention sub-scale ($r=0.6$, $p<0.005$) and spatio-visual sub-scale ($r=0.4$, $p<0.05$) scores in healthy young individuals. In older participants (regardless of MCI status), lower alpha peak frequency linearly correlated with reduced cognitive performance, but the relationship was driven by age (as reduced to non-significant when age added as a covariate).

These are preliminary findings from an ongoing, larger study. Once the intended sample sizes are reached, we will look at further measures such as coherence, and relationships with ERPs recorded during the sample data collection.

Subliminal visual processing of aversive stimuli during visual masking and continuous flash suppression

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Dr Robyn Laycock, *RMIT University*
Dr Philippe A. Chouinard, *La Trobe University*

There is some evidence for the unconscious processing of emotional stimuli (particularly aversive), which is thought to serve an adaptive purpose. However, results in the research literature have been inconsistent. This psychophysical study examined the subconscious processing of aversive (snakes and spiders) and neutral (cars and houses) images using a priming paradigm. Two experiments were conducted in which the awareness of a priming stimulus was suppressed in half of the trials using either visual masking (Expt 1; N =16) or continuous flash suppression (Expt 2; N =16). Participants were tasked with discriminating the proceeding target stimulus using a 2-alternative forced choice method. Reaction times (RTs) to this stimulus were recorded.

Expt 1: ANOVA demonstrated a three-way interaction for Valence (Aversive vs Neutral), Visibility (Visible vs Masked), and Priming Condition [Different Class (e.g. snake followed by spider) vs Different Exemplars (e.g. snake followed by different snake) vs Same Exemplar (e.g. same snake repeated)] ($F(2,30) = 9.66$, $p < .001$). This result was driven by faster RTs for Same Exemplar pairs in comparison to Different Class and Different Exemplar pairs, but only in the Visible condition. Aversive stimuli were found to have slower reaction times than Neutral stimuli but only in the Visible, Different Class condition.

Expt 2: ANOVA demonstrated a two-way interaction between Visibility and Priming Condition ($F(2,30) = 19.88$, $p < .001$). Similar to Expt 1, faster RTs were found for Same Exemplar pairs in comparison to Different Class and Different Exemplar pairs in the Visible condition. This priming effect was not found in the Masked condition. There were no interactions or main effects of Valence.

Given we have been unable to demonstrate evidence of priming in both the visual masking and CFS experiments, we conclude that the visual processing of aversive and neutral images is greatly facilitated by awareness.

Nasal Oxytocin produces marked effects on early visual evoked potentials

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The neuropeptide oxytocin (OXT) has been shown to be a potential atypical treatment approach for Social Anxiety Disorder (as well as for autism) via regulation of cortisol and amygdala activity. While neuroimaging research has focused on the social brain in looking for effects of OXT, there have been relatively few studies of impact of OXT on visual sensory processing. Using a cross-over double-blind placebo-controlled design with 6 neurotypical young males, measured twice, we tested the psychophysical and electrophysiological effects of nasally administered OXT and placebo. The psychophysical tasks involved visual recognition of facial emotions (happy, neutral, fear) and measures of the spatial extent of attention. EEG recordings over occipital and parietal cortex were taken during the visual recognition tasks. In addition, multifocal visual evoked potentials were recorded so that any variation in afferent magnocellular and parvocellular activity could be measured. Using permutation paired t-tests with FDR controls, significant differences were observed in several of the facial emotion evoked responses comparing OXT and placebo administration. For the P100 peak with fearful faces, mean amplitude

was significantly reduced under OXT cf Placebo for right hemisphere electrodes (P8, P08, P6; p<0.01), with no amplitude differences between sprays for Happy or Neutral stimuli. For the N170, mean amplitude was significantly reduced with OXT for the left hemisphere electrodes (P7, P5,P07, P05, at p<0.01 for Fear; p<.05 for Happy and Neutral). The multifocal VEP showed no differences for first order kernels; while the P-generated K22 second order kernels were not different. The first slice K2.1 kernels were more disordered with multiple peaks possibly showing an early latency shift for OXT. It appears that intranasal OXT is projecting effects on emotional visual processing onto occipital cortex without affecting the processing of simple non-affective stimuli.

Attention and Emotion-Enhanced Memory: A Systematic Review and Meta-Analysis of Behavioural and Neuroimaging Evidence

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Emotion indexes the significance of sensory events and elicits adaptive responses through modifying perception and attention. The interaction between attention and emotion is posited to substantially influence long-term memory consolidation. Here we systematically reviewed experiments investigating the influence of attention on emotional long-term memory to determine (i) if the literature demonstrates a robust effect of attention on memory for emotional stimuli, and (ii) if there is consistency between behavioural, electrophysiological, and neuroanatomical correlates of attention to, and long-term memory for, emotional information. Search terms included 'Emotion*' AND 'Memory' AND 'Attention*'. A total of 7,527 studies were identified through literature searches on PubMed, PsychInfo and MedLine databases, 29 of which matched inclusion criteria. Over half of the experiments reported a significant effect of attention on emotional memory as measured behaviourally. However, electrophysiological and neuroanatomical research provide mixed support for the role of attention-related neural processes in facilitating emotional information into long-term memory. Modulations in sensory-related event-related potentials at encoding were not predictive of long-term memory formation, while later components appear to differentially reflect the allocation of attention to heterogeneous emotional stimuli. This dissociation in neurophysiology is paralleled by the activation of distinct neural networks under full- and divided-attention conditions. We are currently conducting a meta-analysis to quantify the association between the temporal and spatial activation patterns during the encoding of emotional information, and whether subsequent memory performance is sensitive to specific methodological parameters.

How does persistence or change in early childhood behavioural difficulties relate to preschool language and executive control?

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Previous research has consistently shown that children with behavioural difficulties also appear to show lower cognitive functioning, specifically in areas such as language and executive control. However, there is limited research on how persistence or change in behavioural problems relate to cognitive functioning, particularly during the preschool years. The current study evaluated the persistence and change in total behavioural difficulties from 2 to 4.5 years in a large population-based New Zealand birth cohort, and how this related to cognitive functioning at 4.5 years. Children in the study were members of the ethnically and socioeconomically diverse Growing Up in New Zealand cohort. Behaviour was assessed in 5970 children when they were aged 2 and 4.5 years using the Strengths and Difficulties Questionnaire. To identify children with behavioural problems, scores were dichotomised into normal and abnormal ranges. Aspects of cognition that were of interest in this study included receptive language, early literacy ability and executive control, all of which were assessed at 4.5 years. Receptive language was assessed using the Picture Peabody Vocabulary Test (PPVT-III) and early literacy ability was measured using the DIBELS letter naming fluency task. A modified version of the Luria tapping task was used to evaluate children's executive control. All cognitive measures were also dichotomised into delayed and not delayed, so as to assess how persistence or change in behavioural problems related to more severe deficits. Results revealed that any experience of serious behavioural difficulties during early childhood increased a child's risk of receptive language and executive control delay at age 4.5 years, but only children who experienced persistent behavioural difficulties or difficulties at 4.5 years were at an increased risk of early literacy deficits.

Effects of reward and punishment on learning from errors in smokers

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Punishing errors facilitates adaptation in healthy individuals, while aberrant reward and punishment sensitivity in drug dependence may change this impact. Recent research has identified the insula to predict learning from highly aversive outcomes. With insula dysfunction being a common feature in drug dependence and most legal systems applying the concept of punishing errors, it is vital to explore how negative feedback influences adaptive behaviour in drug dependency. Applying varying monetary feedback to an associative learning task, we found that while smokers recalled higher rewarded locations (50¢) 11% more than lower rewarded locations (5¢), but did not correct higher punished locations more, controls exhibited the opposite pattern. Smokers showed mostly stronger neural activation but expressed lower error correction rates, potentially reflecting unsuccessful effort. Significant activity differences were found in regions, including left hippocampus, right anterior cingulate cortex, and right inferior frontal gyrus. As communication with other brain regions within the reward/punishment & error processing network is crucial for successful learning, we investigated event-related functional connectivity. Indeed, connectivity between insula and other regions of interest as well as between right and left insula differed between smokers and controls. The results suggest that smokers have poorer learning from errors when the feedback is negative. High rewards reinforce smokers' behaviour stronger than low rewards, whereas controls make no distinction. Impaired learning by smokers following differently activated brain regions suggests aberrant neural punishment and error processing in smokers. This is supported by findings from functional connectivity, albeit their directionality needs further investigation.

Impaired regularity learning in healthy individuals with psychotic experiences is mediated by reduced top-down frontotemporal effective connectivity

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Sensory perception is facilitated by prior beliefs about forthcoming experiences, which are based on our brain's predictive model about the world and its regularities. However, in our dynamic environment these regularities may suddenly change, leading to environmental 'volatility', which requires us to have a flexible predictive model that is able to update prior beliefs accordingly. Recently, it has been proposed that psychotic traits may result from an aberration in the precision of prior beliefs and a resistance to updating prior beliefs. Here, we examine how brain dynamics underlying regularity learning are altered in volatile environments, in a population of healthy individuals with a range of psychotic experiences. We designed a novel paradigm, which incorporated both stable and volatile environments by playing auditory oddball sequences with either fixed or alternating sound probabilities for short and long sounds. We measured the elicited prediction error with electroencephalography; moreover, we gauged regularity learning explicitly, by recording the participants' ability to estimate the probability of sounds. The findings show that during stable conditions there is greater prediction error response and this relates to improved regularity learning (i.e. a stronger predictive model). Scalp and source results revealed that compared to volatile conditions, stable conditions correspond to earlier neural responses and greater activity in frontomotor regions. Critically, with Dynamic Causal Modelling we were able to delineate the mediat-

ing role of frontotemporal connectivity in the relationship between poorer regularity learning and increased psychotic experiences. The findings provide evidence for a continuum of psychosis and have implications for understanding the neurobiological underpinnings of impaired regularity learning, with the potential to inform the application of neuromodulation therapies for psychotic disorders.

Speed of Information Processing for Simple Visual Perceptual and Salient Cognitive Tasks in Young and Older Adults

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Although age related declines in cognitive functions are consistently reported, there is little direct research relating to rate of visual information processing for particular cognitive activities when memory and/or motor contributions are minimized in older populations. Thus, the current study investigated changes in rate of processing in 67 young adults (59 F, 8 M) between the age of 18 – 29, and 33 well-educated healthy older adults (25 F, 8 M) between the age of 60 – 81 when performing simple perceptual and cognitive tasks including Inspection Time (IT), Change Detection (CD), and rate of reading (FastaReada). Results demonstrated that older adults performed equally as well as younger adults on the IT task, i.e., measures that were not dual tasks and requiring new learning nor reliant on encoding new information in memory (i.e., the CD). Thus, on the CD task, which required rapid perceptual processing, embedding new information in memory, followed by a comparison of multiple visual stimuli, younger participants performed significantly faster than older adults. However, on a relevant measure of cognition that assessed reading rate, younger and older participants demonstrated comparable scores despite the complex nature of this visual task. Results imply that changes seen in cognitive domains such as attention, new learning, and memory may be due to older adults being less efficient in encoding and/or embedding the new information, and not due to significantly slower rate of visual perception and slower activation of attention. Additionally, results also imply that on familiar and salient cognitive tasks that do not require learning of new strategies such as the FastaReada, older adults do not perform significantly differently to younger adults despite the task requiring ongoing goal directed eye movements, visual processing, and working memory.

Shining a light on the functional network signature of heterogeneity in freezing of gait

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Freezing of gait is a complex, heterogeneous, and highly variable phenomenon whose pathophysiology and neural signature remains enigmatic. This is due in part to the tendency for studies to investigate freezing of gait as a homogeneous entity. However, there is evidence to suggest that freezing is associated with impairments across multiple behavioural domains, including cognitive, motor and affective function. To investigate the pathophysiological mechanisms of this heterogeneity, we examined individual differences in the component processes that underlie freezing of gait in conjunction with task-based functional MRI. Specifically, we used a virtual reality paradigm to elicit freezing behaviour in 41 Parkinson's disease patients with freezing of gait. We then compared the severity of freezing behavior with measures that operationalized three unique components of the freezing phenotype: impaired cognitive flexibility; motor variability (estimated from the task); and self-reported anxiety and depression. By combining these measures in a principle component analysis, we were able to interrogate the pattern of task-based functional connectivity associated with freezing (compared to normal walking) in a sub-cohort of 20 participants. Specifically, we used the first principle component from our behavioral analysis to classify patterns of functional connectivity into those that were associated with increased severity (such as coupling between the cognitive and limbic network), with increase compensation (such as anti-coupling between the putamen and the cognitive and limbic networks) or those that were independent of overall severity (such as anti-coupling between cognitive cortical regions and the caudate nucleus). In conclusion, these findings provide confirmatory evidence for systems-level impairments in the pathophysiology of freezing of gait and further advance our understanding of the whole-brain deficits that mediate symptom expression in Parkinson's disease.

The neurobiology of cognition in younger adults, older adults and Mild Cognitive Impairment: a TMS-EEG study

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Mild Cognitive Impairment (MCI) is an example of pathological aging that may represent a transition period prior to dementia. Investigation of neurobiological changes is needed, and can be achieved through the novel combination of transcranial magnetic stimulation with electroencephalography (TMS-EEG). The study used TMS-EEG to characterise the differences in neural plasticity responses, and its relation to cognitive performance in younger, older and MCI. 20 younger adults, 20 older adults and 10 adults with MCI completed a neuropsychological battery, computerised cognitive tasks (2-back and Cogstate subtests) and TMS-EEG (50 single pulses, 110%RMT, 0.2HZ + 5% jitter) to the left dorsolateral prefrontal cortex (DLPFC). EEG recording was also taking at rest, and during completion of the 2-back. When compared to younger adults, older adults had significantly reduced N100 and P200 peak amplitudes, and MCI N40 peaks of the TMS-evoked potential (TEP) (ps <.05). In MCI, N40 corresponded with total number of words recalled a word list task. TMS-evoked oscillations were reduced in the theta range for older adults, and in the beta and gamma bands for MCI. Analysis of 2-back EEG revealed significantly greater P150 and P300 peaks, as well as increased beta and gamma oscillatory power in both older adults and MCI compared to younger adults. TMS-EEG was used to characterise neurophysiological changes in aging and MCI. Preliminary results revealed reduced cortical reactivity in response to TMS in older adults and MCI, with altered early TEP responses in MCI related to poorer learning and memory ability. In contrast, 2-back EEG analysis revealed greater peak amplitudes, and beta and gamma oscillatory power in older adults and MCI. This was despite inferior behavioural performance, which may suggest less efficient cognitive processing of a complex task in normal and pathological aging.

Whether these neurophysiological differences can be modulated requires further investigation.

Neural signatures of reduced cognitive control in frontal lesion patients: Altered theta oscillations in parietal brain regions during task-switching

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Cognitive control is implemented in a fronto-cingulo-parietal network by oscillatory activity in the theta frequency band. Increased theta oscillations are associated with demands of cognitive control and increased task performance. Although, it is known that focal brain lesions can lead to widespread network disruptions and to dysexecutive functions, theta oscillations have been rarely investigated. We assessed the temporal dynamics of theta in three time windows of two different regions of interest (ROI) during a cued switching task, considering different conditions requiring high and low demands and different cognitive control processes (proactive vs reactive).

We investigated 15 unilateral frontal lesion patients and 15 healthy matched controls, recruited from the volunteer panel of the MRC: Cognition and Brain Science Unit, Cambridge, UK. We used a Gabor switching-task and depending on a cue participants were asked to either categorize the colour or the thickness of the stimuli. After con-

ducting time-frequency analysis, we extracted event-related spectral perturbations in the theta frequency band of frontal and parietal ROIs. For statistical analysis we conducted three mixed three-way ANOVAS with the factors GROUP, ROI and CONDITION, or TIMEWINDOW, or PROCES, each respectively for the research questions.

Regarding the behavioural analysis, lower accuracy scores in the switch condition were observed in frontal brain lesion patients compared to their controls. Regarding theta oscillations, the interaction of GROUP x ROI interaction indicated stronger theta in the parietal than in the frontal ROI of frontal lesion patients and this was not moderated by the process of cognitive control, neither the time window, nor the condition. Taken together, the behavioural results and the neural responses suggests that frontal lesions might be associated with failed compensatory effects and dedifferentiation within the network implementing cognitive control.

The Decision Decoding Toolbox (DDTBOX) - A multivariate pattern analysis toolbox for event-related potentials

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In recent years, neuroimaging research in cognitive neuroscience has increasingly used multivariate pattern analysis (MVPA) to investigate higher cognitive functions. Here we present DDTBOX, an open-source MVPA toolbox for electroencephalography (EEG) data. DDTBOX runs under MATLAB and is well integrated with the EEGLAB/ERPLAB and Fieldtrip toolboxes. It trains support vector machines (SVMs) on patterns of event-related potential (ERP) amplitude data, following or preceding an event of interest, for classification or regression of experimental variables. These amplitude patterns can be extracted across space/electrodes (spatial decoding), time (temporal decoding), or both (spatiotemporal decoding). DDTBOX can also extract SVM feature weights, generate empirical chance distributions based on permuted-labels decoding, provide estimates of the prevalence of decodable information in the population, and perform a variety of corrections for multiple comparisons. It also includes plotting functions for single subject and group results. DDTBOX complements conventional analyses of ERP components, as subtle multivariate patterns can be detected that would be overlooked in standard analyses. It further allows for a more explorative search for information when no ERP component is known to be specifically linked to a cognitive process of interest. In summary, DDTBOX is an easy-to-use and open-source toolbox that allows for characterising the time-course of information related to various perceptual and cognitive processes. It can be applied to data from a large number of experimental paradigms and is expected to be a valuable tool for the neuroimaging community.

Neurochemical inhibition in the prefrontal cortex predicts individuals' response to electrical stimulation

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Cognitive training can lead to performance improvements that are specific to the tasks trained. Recent research has suggested that transcranial direct current stimulation (tDCS) applied during training of a simple response-selection paradigm can broaden performance benefits to an untrained task. Here we assessed the impact of combined tDCS and training on multitasking, stimulus-response mapping specificity, response-inhibition, and spatial attention performance in a cohort of healthy adults. Participants trained over four days with concurrent tDCS – anodal, cathodal, or sham – applied to the left prefrontal cortex. Immediately prior to, 1 day after, and 2 weeks after training, performance was assessed on the trained multitasking paradigm, an untrained multitasking paradigm, a go/no-go inhibition task, and a visual search task. Training combined with anodal tDCS, compared with training plus cathodal or sham stimulation, enhanced performance for the untrained multitasking paradigm and visual search tasks. By contrast, there were no training benefits for the go/no-go task. Our findings demonstrate that anodal tDCS combined with multitasking training can extend to untrained multitasking paradigms as well as spatial attention, but with no extension to the domain of response inhibition.

The developing Human Connectome Project automated functional processing framework for neonates

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Resting state networks (RSNs) are spatially extended networks of synchronised fluctuations in brain activity during sleep, rest, and cognition. They correspond to major functional units of brain processing, and are useful markers of the integrity and strength of the connections underlying human behaviour. The developing Human Connectome Project (dHCP) is an ambitious large-scale imaging project that aims to map the development of RSNs over the crucial perinatal period, in over 1000 in- and ex-utero subjects. The cohort is enriched for twins and infants at high familial risk of autism. To date, 620 term and preterm infant datasets have been acquired, and 200 infants have been followed up at 18 months. This abstract presents the dHCP fMRI processing framework for neonates.

A custom multiband imaging protocol comprising structural, diffusion, and fMRI scans was acquired at 3T with a specifically developed 32channel receiver coil. The functional processing framework is inspired by the (adult) HCP and the FSL FEAT pipelines, however motion correction, registration, surface projection and QC have all been customised to provide a fully optimised and automated pipeline. RSNs are identified with PROFUMO, a Bayesian framework that identifies probabilistic functional modes using constraints associated with the neonatal hemodynamic response function and inter-subject variability.

We present validations derived from 117 subjects aged 37-44 weeks post-conception at scan. RSNs corresponding to known adult and neonate RSNs were resolved with fine spatial detail, and demonstrate established effects of age. Ongoing analyses are probing the fine structure of these networks, and their variability across subjects and age, with the aim of defining a state-of-the-art multi-modal time-varying map of the neonatal connectome.

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Magnetoencephalography reveals an increased P3a, but not P3b, that is associated with high non-clinical psychosocial deficits

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Autism and schizophrenia are heterogeneous spectrum conditions that have substantial phenotypic overlap, particularly within the psychosocial domains, as well as some similarities in their neural profiles. The underlying mechanisms for these similarities are poorly understood due to a lack of phenotype-specific research, as well as the confounding effects of psychiatric medications, illness duration and acute symptomatology in clinical studies. Through robust statistical analysis, we previously identified a shared autistic and schizotypal phenotype termed Social Disorganisation (SD), which has been utilised to identify phenotype-specific neural correlates, such as with mismatch negativity. Using magnetoencephalography (MEG), this study investigates differences in the oddball P3 profile of those with high and low SD, through spatio-temporal source clustering.

Participants were 18 low (9 female) and 19 high (9 female) SD scorers (18-40 years) who completed a three-stimulus auditory oddball paradigm of speech sounds (80dB, standard: 100ms 'o', deviant target: 150ms 'o', novel non-target: 150ms 'e').

Spatio-temporal cluster analysis, with minimum norm estimation, revealed increased source activity in a left anterior fronto-temporal (p= 0.006) and a right anterior temporal (p= 0.020) cortex cluster in response to the novel non-target P3a for the high SD group. There were no cluster activation differences in response to the target deviant P3b, suggesting that high SD is more closely associated with increased recruitment of cortical resources when processing unattended, novel speech stimuli.

These findings suggest a cortical inefficiency in processing of unattended, novel speech stimuli, which may have a downstream effect on the psychosocial functioning deficits seen across the higher end of the autism and schizophrenia spectra.

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Effects of Exercise Combined with Increased Dietary Protein on Cognition and Quality of Life in Older Adults

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Exercise, particularly progressive resistance training (PRT), and dietary protein are essential to optimize muscle health in older adults, but both factors may also influence brain health/cognitive function through the regulation of various neurotrophic factors and/or the modulation of systemic inflammation. The aim of this study was to investigate the effects of a multi-modal exercise program incorporating aerobic plus PRT combined with a protein-enriched diet achieved through the consumption of lean red meat on cognitive function and health-related quality of life (HR-QoL). Community-dwelling adults (n=154) aged 65+ years were randomised to either 24-weeks of PRT+lean red meat [2x80g cooked consumed at lunch and dinner on each of the three training days (RT+Meat)] or PRT+pasta/rice (CRT). Exercise compliance was no different between groups (?79%). Compliance with the meat and pasta/rice was 87% and 91%, respectively. Protein intake increased to ~1.4 g/kg/d in RT+Meat and remained unchanged in CRT. After 24-weeks both groups experienced similar increases in global cognitive function (z-score change: RT+Meat +0.17 SD; CRT +0.26 SD; both P<0.001). Psychomotor/attention decreased in CRT compared to RT+Meat after 12-weeks (interaction, P<0.05), but this difference was not maintained after 24-weeks. Working memory/learning increased in CRT compared to RT+Meat after 12- and 24-weeks (net difference in z-scores, 0.24-0.27SD, both P<0.05). Executive function, HR-QoL and serum levels of BDNF and inflammatory cytokines (IL-6, -8, -10, TNF-alpha) did not change in either group. These findings indicate that the provision of additional protein did not enhance the effects of exercise on cognitive function in the community-dwelling elderly.

Maturation of performance monitoring in typically-developing children: Electrophysiological indices of cognitive control

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One overarching metacognitive ability that shows dramatic improvements throughout late childhood is performance monitoring, whereby the individual is argued to continuously evaluate ongoing performance against desired goals and outcomes and to strategically adjust their performance to achieve an optimal level of functioning. The aim of the current study was to examine the development of performance monitoring longitudinally in children aged between 7 and 11 years, a timeframe over which the maturation of the electrophysiological index associated with error monitoring (the error-related negativity, ERN) is particularly marked. Children initially aged 7 or 9 years were recruited to a school holiday activity research program and returned two years later (N = 107). The ongoing electrical activity of the brain was concurrently recorded whilst they completed a child-friendly flanker task. A characteristic fronto-centrally distributed ERN was elicited in response to errors committed, and the amplitude of this component was significantly larger at follow-up than at baseline. Our results highlight the relatively protracted development of the neural substrates underpinning performance monitoring which has important implications for examining individual differences in the ability to regulate behaviour.

Does fMRI Repetition Suppression Reveal Mirror Neuron Activity in the Human Brain?

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Mirror Neurons (MN) have been proposed as the neural substrate for a wide range of clinical, social and cognitive phenomena. Over the last decade, a commonly used tool for investigating mirror neuron activity in the human brain has been functional magnetic resonance (fMRI) repetition suppression (RS) paradigms. However, the available evidence is mixed largely owing to inconsistent application of the methodological criteria necessary to infer MN properties. This raises concerns about the degree to which one can infer the presence (or absence) of MN activity from earlier accounts that have adopted RS paradigms. We aimed to clarify this issue using a well validated fMRI RS paradigm and tested for mirror properties by rigorously applying the widely accepted criteria necessary to demonstrate MN activity. While whole brain analysis in 12 healthy adults showed unimodal adaption effects within the supplementary motor area, no evidence for cross-modal adaption effects consistent with mirror neuron activity was found. Taken together, these results clarify disparate evidence from earlier adaption studies, highlighting that traditional fMRI adaption paradigms may not provide a reliable measure for detecting mirror neuron activity at the whole brain level. In light of these findings, we recommend that future studies consider the use of alternative fMRI techniques, including multivariate pattern analysis, for investigating MNs across the human brain.

The effect of transcranial direct current stimulation on response inhibition during a perceptual decision-making task in young and older adults

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The ability to suppress inappropriate actions and countermand planned actions are key features of the inhibitory control system, which are known to degrade with age. Imaging studies have identified that hypoactivity in brain networks including the pre-supplementary motor area (preSMA) may underlie this functional degradation. Here we investigated whether upregulating preSMA activity using transcranial direct current stimulation (tDCS) could improve inhibitory control during a perceptual decision-making task.

17 young (M=21.9y) and 15 older (M=68.7y) adults completed two experimental sessions in which they had to indicate (with left- or right-hand button presses) whether a flashing grid was comprised of more blue or orange dots (Go trials). On 30% of trials, a stop signal (SS, red rectangle) appeared around the grid which required inhibition (cancellation) of the chosen response. The delay between grid presentation and the SS was staircased to achieve 50% successful stops. Following a short baseline period (2 x 60 trials), tDCS with the anodal electrode over preSMA (1.5mA, 20min; real or sham; double-blind) was administered, after which another 10 x 60 trials were conducted.

For the younger adults, real tDCS (compared to sham) only resulted in a significant reduction in Go trial reaction time. In contrast, for older adults tDCS resulted in an improvement in stopping ability.

While preSMA stimulation appeared to improve perceptual decision-making with more rapid responses in the Go trials in young adults, for older adults preSMA stimulation facilitated inhibitory control and ameliorated accuracy declines. These results suggest that the upregulation of preSMA using tDCS is beneficial influencing the different processes of the decision-making in different age groups.

The effect of physical fatigue on spatial attention

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Mental fatigue is known to bias attention towards the right side of space; currently, there is limited knowledge on how physical fatigue affects spatial attention. The aim of this study was to investigate whether physically induced fatigue leads to a rightward shift of attention. Twenty-five participants performed a spatial attention task at three times (pre-exercise, post-exercise and 30-minutes post-exercise). Participants cycled for around 10 minutes at a high intensity of 85 to 90 per cent of their age-predicted heart rate maximum to induce physical fatigue. Spatial attention was measured by reaction time to 120 randomly presented targets in the left and right visual field. A repeated-measures ANOVA revealed a significant interaction between Side (left or right) and Time (pre, post and 30-minutes post-exercise) ($F = 8.25$, $p < .01$). While there were no significant differences in reacting to left and right-sided targets at pre-exercise and immediately post-exercise ($p > .7$), participants were significantly slower in detecting left than right-sided targets at 30-minutes post-exercise ($p < .01$). The current results are the first indicators of a rightward shift in spatial attention following a high intensity fatiguing exercise session. Interestingly, the attentional shift was not observed immediately after exercise, but only after a 30 minute break period following the high intensity exercise bout. Future research is needed to delineate the pathway from respiratory and metabolic responses post-exercise to a rightward shift of attention, particularly because the findings may have important implications for sporting professionals and emergency service workers such as fire fighters.

Cognitive bias as a measure of affective state in a rat model of chemotherapy-induced mucositis

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Chemotherapy-induced mucositis (CIM) is an extremely painful and debilitating condition that occurs in 40-60% of patients receiving chemotherapy treatment for malignancy. Due to the self-limiting nature of CIM, treatment effectiveness relies on the alleviation of symptoms and improvement of patient affective state. Rat models are frequently used in CIM research however, the assessment of positive and negative emotional states is difficult to determine. Cognitive bias is a novel approach to measure cognitive performance and assess the affective state of animals. Male Sprague Dawley rats (n=60) were trained to distinguish between two tactile stimuli associated with a positive or negative reward. Rats were allocated to 3 experimental groups; Saline, 5-fluorouracil (5-FU); and 5-FU/buprenorphine (q12hr sc). Cognitive bias was measured by investigating the response to an ambiguous probe over a 5-day period. Rats that were in a positive emotional state responded to the ambiguous probe with more optimism compared to those in a negative emotional state. Body weight and disease activity index (DAI) were measured daily. Prior to treatment, all rats showed optimistic decisions (100%) when presented with the ambiguous probe. On day 3, 5-FU-injected rats expressed significantly decreased optimistic decisions compared to 5-FU/buprenorphine and saline groups (21%; 53%; 85% respectively, $p=0.005$). Optimistic decisions significantly increased by day 5 for 5-FU-injected rats however, no significance differences were detected for rats administered 5-FU in combination with buprenorphine. Rats administered with 5-FU alone or in combination with buprenorphine showed a significant decrease in body weight compared to saline groups ($p<0.05$). These findings suggest cognitive bias assessment is a valid tool to evaluate emotional states of rats with chemotherapy-induced mucositis. Refinement to the animal model will improve successful transitioning of novel therapeutics to clinical practice.

Neural Correlate of Visual Consciousness

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We can reliably hide images from visual consciousness using binocular rivalry, in which we present dissimilar images, one to each eye. We see one image switch to the other and back again unpredictably. Using electroencephalography (EEG), we found a neural correlate of visual consciousness 150 ms after a reduction in the contrast of one of the rival images. The first component of the event-related potential (ERP), the N1, was larger, particularly at right occipital electrodes, when the contrast decrement was seen than when the same change in contrast was not seen.

Data came from participants with normal vision who viewed a horizontal grating with one eye and a vertical grating with the other. Participants pressed keys to track their experiences of binocular rivalry. Randomly, the contrast of one of the gratings was reduced by 25% for 800 ms. After finishing EEG data collection, participants performed a similar rivalry-tracking task and another task in 64 trials, signalled by a tone. Randomly in half of them, there was a contrast reduction; in the other half there was no contrast reduction. The participant pressed one of two other keys to say whether the contrast reduction happened. ERPs at invisible and visible contrast changes were compared. When the contrast decrement happened to the visible stimulus, sensitivity was slightly better (d's around 3.4) then when the contrast decrement happened to the invisible stimulus (d's around 3.0), but this difference was not significant.

We conclude that our approach revealed a neural correlate of visual consciousness 150 ms after a change in visual input. This agrees with the earliest neural correlate of visual consciousness found by other paradigms. Ours differs by confirming, using a forced-choice measure, that invisible stimuli yield measurable ERP activity that is

less than from visible stimuli, implying that visual consciousness/non-consciousness from binocular rivalry arises from quantitative differences in brain activity

Differences in neurotransmitter levels between depressed patients and control: a systematic review and meta-analysis

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Dysfunction of gamma-aminobutyric acid (GABA) and/or glutamate neurotransmitter systems have increasingly been implicated in the aetiology of Major Depressive Disorder (MDD). It has been proposed that alterations in levels of GABA and/or glutamate result in an imbalance of inhibition and excitation that may lead to the manifestation of MDD. In a review of the current literature, we identified studies using Magnetic Resonance Spectroscopy (MRS) to examine the neurotransmitters GABA, Glutamate, and the combination of Glutamate/Glutamine (Glx) in patients diagnosed with MDD and healthy controls. The main outcome measure was the difference in concentration of GABA, Glutamate or Glx between a patient MDD group and a control group. For GABA, 17 studies with 341 patients/336 controls, for Glutamate 12 studies with 265 patients/245 controls, and for Glx 11 studies with 165 patients/174 controls were identified. Results showed those with MDD had significantly lower GABA levels when compared to controls (SMD=-0.39, 95% CI=[-0.67,-0.10], p=0.009). No significant difference was found between levels of Glutamate or Glx (SMD=-0.08, 95% CI=[-0.47,0.31], p=0.69 and SMD=-0.41, 95% CI=[-0.91,0.08], p=0.1). Three sub-analyses were done, including only studies were the MDD group were currently depressed, field strength was 3T, and the Anterior Cingulate Cortex (ACC) was the region of interest (ROI). Results of the first two sub-analyses reflected that of the first meta-analysis, however when ROI was restricted to only the ACC, both GABA and Glx levels in MDD patients were significantly lower than that of controls (SMD=-0.79, 95% CI=[-1.19,-0.39], p=0.0001 and SMD=-1.11, 95% CI=[-1.8,-0.43], p=0.01). This review indicates a widespread cortical reduction of GABA in MDD, with localized reduction of Glx in the ACC. However, given both GABA and Glx appear decreased a simple interpretation in terms of an imbalance of overall excitation-inhibition is not feasible.

Behavioural and computational studies on the value of information

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Studies in human and non-human animals have shown that information is intrinsically valuable. Notably, some studies suggest that information is processed by similar neural circuits that underlie reward valuation. The current study investigated how humans value information that predicts, but does not change, the outcome of an event (non-instrumental information). Two experiments were conducted to examine the physical effort costs that individuals are willing to incur for such information. Effort was operationalised as the amount of force applied to a hand-held dynamometer. In Experiment 1, participants chose between exerting higher levels of effort to obtain complete predictive information about an unchangeable lottery outcome, versus exerting minimum effort and foregoing such predictive information. Results showed that participants were willing to exert effort to obtain non-instrumental information, but this effect declined as the effort cost increased. Experiment 2 required participants to make similar choices to Experiment 1, but manipulated the amount of predictive information provided at the time of choice. We found that decisions to seek information scaled with how much the information reduced their residual uncertainty about the outcome. Specifically, participants invested effort for information more often when prior uncertainty was high (i.e., when the outcome was ambiguous) compared to when it was low (i.e., when the outcome was predictable). Computational analyses showed that subjective valuation of information can be modelled as a function of the available reward; the magnitude of available information; and their associated costs. Overall, these data suggest that the intrinsic value of information is based on its capacity to reduce uncertainty, and that this valuation process is reflected in a willingness to trade off effort for information. This work provides a basis for future inquiry into the neural correlates of human information-seeking behaviour.

Liquid volume and the size-weight illusion: contributions of expectations and vision

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Earlier research has demonstrated how the motor system, (as assessed by lifting forces), and the perceptual system, (as assessed by magnitude estimations), respond differently to the size-weight illusion in which the smaller of two objects with the same weight feels heavier. The motor system quickly learns that both objects have the same weight while the perceptual system never does. We aimed to determine the contribution of conceptual knowledge and vision in mediating these effects. This was done by eliminating all somatosensory information about size by having participants lift milk bottles with strings attached to a handle. The handles were equipped with force transducers. Two experiments were performed.

The milk bottle experiment: Participants lifted half-full and full 500 ml milk bottles weighing 409 g 20 times each in an alternating order. Under these conditions, the concept of volume should drive the illusion. However, the participants did not perceive any weight differences (Bottle effect: $F(1,9) = 2.47$ $p = .150$) and lifted both bottles with similar force profiles, with slower rates in the initial trials (Trial effect: $F(4, 36)= 5.56$, $p < .01$).

The size-weight illusion experiment: Participants lifted 250 ml and 500 ml milk bottles 20 times each in an alternating order. Both were full and weighed 409 g. Under these conditions, the visual information about size should drive the illusion. However, the participants only began to experience the illusion in the latter part of the experiment (Bottle × Time interaction: $F(4,48)= 8.95$, $p < .001$) and again lifted both bottles with similar force profiles, with slower rates in the initial trials (Trial effect: $F(4,48)= 4.81$, $p < .01$).

Overall, these results indicate that we greatly diminished the illusion by removing all somatosensory information about size. Additionally, the force profiles reveal how the unnatural lifting using strings might not be conducive for determining the motor system's weight expectations.

The role of cortical network connectivity and neuroplasticity in cognitive reserve: a combined TMS-EEG study

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Advancing age is associated with progressive cognitive decline. However, the trajectory of this decline can vary considerably between individuals. The capacity to maintain cognitive function in the presence of age-related neurodegeneration or pathology is known as cognitive reserve. While we have a good understanding of the lifestyle factors that lead to high cognitive reserve, the fundamental neural mechanisms that underpin cognitive reserve are still to be determined. The lateral prefrontal cortex is a major cortical hub within the cognitive control network. The capacity for these networks to change and adapt to increasing task demands or brain pathology (i.e. neuroplasticity) is essential for maintaining healthy brain function and cognitive performance in later life. In this study, we used transcranial magnetic stimulation (TMS) in combination with electroencephalography (EEG) to investigate associations between prefrontal cortical connectivity, neuroplasticity, and proxies of cognitive reserve in healthy older adults. TMS-evoked cortical potentials (TEPs) were recorded before and following continuous theta burst stimulation (cTBS) applied to the left prefrontal cortex. The spread of TEPs from the stimulation site to the rest of the brain was used as a measure of left prefron-

tal connectivity, and change in TEPs following cTBS was used as a marker of neuroplasticity. Proxies of cognitive reserve included the Lifetime of Experiences Questionnaire (LEQ) and years of education. We showed that stronger connectivity and greater neuroplasticity of the left prefrontal cortex were associated with higher LEQ scores and more years of education. These findings provide novel evidence linking neurophysiological measures of cortical network function and cognitive reserve. By uncovering the neural processes that protect against later life cognitive decline, this research has the potential to inform novel strategies for the early diagnosis and intervention of dementia.

What is the function of the frontal pole in fluid reasoning?

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The frontal pole, or Broadman Area 10, the most anterior portion of the prefrontal cortex is critically involved in a fluid reasoning, but it is unclear what specific cognitive process it supports. Here, we aim to tease apart two popular explanations for the frontal pole's function 1. Integrating relational information and 2. Goal-directed search through a problem-space.

Matrix reasoning tasks, such as Ravens Progressive Matrices, present a 3x3 matrix where one cell is left blank. Across cells the perceptual features relate to each other in systematic ways, and through discovering these relations, the reasoner can infer what should fill the empty cell to maintain the pattern. fMRI studies using these tasks have shown that the frontal pole increases in activation with the increasing number of relations to be integrated (for example, that shapes change in color, size, and orientation across cells vs. just change in size), however relational integration demands are confounded with search-demands as more relations to integrate entails more to discover via searching the stimuli.

The current experiments de-confounded relational integration demands from search-demands by 1. Varying the number of relations to integrate and 2. Varying how the relations apply across the matrix. That is, the same relational rule is easier to discover when it applies horizontally or vertically, as opposed to diagonally due to biases in visual search processes. The behavioural results showed that increasing demands for relational integration and search affected accuracy to similar degrees, but fMRI results showed these two sources of difficulty elicited distinct neural correlates. Increased relational integration demands specifically increased activation of the bi-lateral frontal pole, while search demands activated classic cognitive control regions, such as the dorsolateral PFC, medial ACC, and superior parietal cortex. Implications for the organisation of the PFC will be discussed.

Modelling the effect of local TMS

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Transcranial magnetic stimulation (TMS) is an influential non-invasive brain stimulation technique that is routinely used for scientific and clinical experiments. One of the main problems using TMS to study brain activity is the lack of predictive models to understand the impact of local TMS on whole-brain activity. Progress in understanding the neural factors predicting the brain response to TMS is slow, as a theoretical framework does not exist. Informed by the human connectome, we developed a whole-brain computational model that simulates endogenous brain activity. In this virtual environment, we extensively emulated the effects of brain stimulation, which shows good agreement with our TMS experiments combined with fMRI and EEG neuroimaging recordings. A key prediction of our model is how theta burst stimulation affects the targeted region, and how this region interacts with other brain regions. In this talk, I will present the results of a study designed to address these hypotheses.

Development of spatiotemporal frequency tuning of the larval zebrafish optomotor response

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The zebrafish (Danio rerio) offers a compelling model system for studying visual development. A diurnal, visually guided predator, the zebrafish rapidly develops functional visual apparatus during the larval stage. Within five days of fertilisation, zebrafish larvae will swim in the direction of a moving grating or texture; in the wild, this optomotor response serves to stabilise larvae in moving water, but it can used in the laboratory to characterise the spatiotemporal frequency tuning of the visual system. Here, we compared the optomotor response of larval zebrafish at 5, 6 and 7 days post-fertilisation (dpf). On each trial, a narrowband filtered noise texture drifted for 30 sec beneath a dish containing 25 to 50 larvae. We captured images of their spatial distribution before and after presentation, and used an automated algorithm to determine the change in mean position (the 'optomotor index'). At all ages, and at all speeds tested (40 to 160 degrees per second) the optomotor response was spatially bandpass within the presented range (0.005 to 0.32 cycles per degree), and upper bounds matched the previously estimated limit of around 0.25 cycles per degree set by the density of the photoreceptor array. At all ages, the peak of the function shifted towards lower spatial frequencies as speed increased. In addition, while studies using other behavioural assays have reported no change in visual acuity from 5 to 7 dpf, we found that functions shifted towards higher spatial frequencies with increasing age. While the lens and retina are well developed at 5 dpf, our results suggest that synaptic maturation occurring over the subsequent period may improve the spatiotemporal resolution of the zebrafish visual system.

Laplacian filters reveal distinct spatiotemporal signatures of cognitive control: Evidence from the cued-trials task switching paradigm

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Task switching paradigms are frequently used to assess cognitive control functioning. Electrophysiological evidence supports distinct preparatory mechanisms, e.g., switch preparation (switch positivity) and general preparation (e.g., pre-target negativity), associated with task switching. However, these anticipatory electrophysiological signatures appear sensitive to the type of referencing montage used when creating event-related potentials (ERPs). Here, we aimed to assess the influence of reference montage on task switching ERPs.

We explored the impact of four distinct reference montages on ERPs: two common used schemes – average mastoid (AM) and common average (CAR) and two montages aimed at minimising volume conduction – zero reference (ZR) and the surface Laplacian (SL).

While different spatial filters produced highly compatible results, important differences emerged in the spatial distribution and number of switch-related effects. In the cue-target interval, AM montage produced a large diffuse switch-positivity, a significant and prolonged slow frontal switch negativity and a slow pre-target negativity for both switch and repeat trials. The CAR and ZR montaged produced similar but less diffusely distributed effects. All effects were evident in SL montage, but they were both temporally and spatially more tightly contained, indicating less volume conduction. SL switch-positivity was restricted to 350-550ms over a tight midline parieto-occipital cluster, and was preceded by lateralized parieto-occipital activity. The frontal switch negativity emerged ~450ms at a midline frontal cluster and persisted until target onset. The pre-target negativity showed a strong central cluster, consistent with a CNV-type effect. These results show reduced volume conduction in the SL montage allows improved spatiotemporal differentiation of ERP components associated with proactive control. Implications for ERP set-up and theories of task switching will be discussed.

Intranasal oxytocin increases amygdala responses to emotional faces in body dysmorphic disorder

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Patients with body dysmorphic disorder (BDD) are impaired at recognising facial emotions and have shown abnormal brain activity in regions involved in face and emotion processing. Past research has demonstrated that the neuropeptide oxytocin increases behavioural performance on face processing tasks, as well as modulates amygdala responses to emotional faces in healthy subjects and those with clinical disorders such as social anxiety and autism. Here, we aimed to assess amygdala responses to emotive faces in a sample of 20 male and female patients with BDD and 22 matched healthy control participants. In a randomized, double-blind placebo-controlled within-subject functional MRI study, we measured group differences in amygdala activation to an emotional face matching task of fearful, angry, disgusted, sad, surprised and happy faces following acute intranasal administration of OXT (24 IU) and placebo. Oxytocin elicited differential effects within the left amygdala, with the BDD group showing increased amygdala responses to surprised faces following intranasal oxytocin, whereas decreased amygdala responses were observed in the healthy control group. Our results provide new evidence that a single a dose of oxytocin has a modulatory effect on amygdala responses to emotive faces in BDD. These observations may reflect oxytocin-induced salience processing of emotive faces and subsequently enhance face emotion processing in male and female BDD patients, which have important clinical implications for the disorder.

Statistical Modelling of Cognitive Function at Early Stages of Parkinson's Disease

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Mrs Galina Gramotnev, *Research and Data Analysis Centre*

Early diagnostics of Parkinson's disease (PD) and evaluation of its symptomatic complex present a significant challenge because of the absence of a reliable PD biomarker, significant overlap with other conditions, diversity of clinical presentation, and lack of understanding of causal relationships between the symptoms and patient characteristics. Deterioration of cognitive and learning functions is one of the symptomatic manifestations in PD patients, having particularly detrimental impacts on the quality of life and patients' ability to perform daily activities.

This study uses generalised structural equation modelling (GSEM) to develop and characterise a network of causal effects of patient characteristics (gender, age, education, family PD history) and non-motor aspects of experiences of daily living from the Unified Parkinson's Disease Rating Scale (UPDRS) on cognitive functions at the initial presentation. The sample included 210 healthy controls, 444 PD patients, and 66 PD patients without evidence of dopamine deficiency (SWEDD). Cognition evaluation was based on the Montreal Cognitive Assessment (MoCA) test and Hopkins Verbal Learning Test (HVLT).

MoCA and HVLT scores were shown to depend negatively on the UPDRS factor score. The MoCA scores significantly decreased in PD and particularly SWEDD patients, whereas HVLT did not change significantly in SWEDD patients. It is argued that this was because MoCA captured a broader variety of cognitive impairments. The presence of parents with PD had a significant negative impact on cognition in PD patients. No effects on cognition were obtained from alpha-SYN, Amyloid beta, p-tau or t-tau. The negative impacts of age on cognition in PD were similar for MoCA and HVLT, but not significant for HVLT in SWEDD patients.

The outcomes demonstrated a significant potential of the considered variables as cognitive markers in PD patients.

The data was obtained from the Parkinson's Progression Markers Initiative (PPMI) database.

Progression of cognitive deterioration in Parkinson's disease patients

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Dr Dmitri Gramotnev, *Research and Data Analysis Centre*

Diagnosis of Parkinson's disease (PD) and evaluation of its progression remain essentially clinical and present significant challenge. The difficulties with the development of biomarkers for PD are largely related to its clinical and biochemical diversity. Resolution of this difficulty is likely to require modelling with the simultaneous involvement of multiple variables and/or their optimal combinations.

Here, we present mixed-effects multiple regression modelling (with 424 PD patients and 196 healthy controls) of cognitive PD progression to identify potential biomarkers. Non-motor aspects of experiences of daily living were evaluated using Part 1 of the Unified Parkinson's Disease Rating Scale (UPDRS). Cognition was evaluated using the Montreal Cognitive Assessment (MoCA). The rates of cognitive decline were determined from significant interactions between the considered variables and time.

The variables significant for cognitive decline in PD included age, gender, education, amyloid beta, alpha-syn, MoCA and UPDRS scores at initial presentation. For comparison, age was not significant for healthy controls within 6 years of observation. Whereas females had better cognitive functions, their rates of cognitive decline were statistically the same. More years of prior education had a slowing effect on the rate of cognitive decline. Lower cerebrospinal fluid concentrations of amyloid beta and alpha-syn were related to faster cognitive decline in PD. Increasing MoCA at the baseline caused significant reduction in the rate of cognitive decline, whereas increasing UPDRS score results in more rapid decline (larger UPDRS scores indicate greater severity of PD). The developed model accounts for > 40% of the total variance.

The outcomes demonstrate the need to consider the baseline general patient characteristics (age, gender, education, etc.) for PD progression biomarkers.

The data was obtained from the Parkinson's Progression Markers Initiative (PPMI) database.

Pragmatic language in children with symptoms of ADHD: relationships with executive functioning and theory of mind

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A moderate body of research indicates that children with ADHD, and children with elevated ADHD symptoms, experience some difficulty with the pragmatic aspects of language. Pragmatic language is thought to depend at least in part on intact theory of mind and on executive functions such as sustained attention and response inhibition. This study examines whether pragmatic language problems are related to the neurocognitive heterogeneity that is increasingly found in ADHD, and whether any theory of mind difficulties are similarly related to specific neurocognitive profiles. One hundred and ten children aged 8-10 years (57 boys) completed the Sustained Attention to Response Task (SART). The sample included children both with and without elevated ADHD symptoms. Pragmatic language was assessed using observational ratings from a semi-structured conversation and theory of mind was assessed using children's responses to a series of short animations. Cluster analysis indicated three distinct profiles of performance on the SART, with one group characterized by poor sustained attention and extremely variable response times (n = 13), one group with poor response inhibition (n= 16) and the remainder with no particular problems (n= 81). The group with poor sustained attention had a higher level of ADHD symptoms and a consistent pattern of poorer pragmatic language and theory of mind ability than the group who performed well on the SART. The study indicates that neurocognitive heterogeneity amongst children with ADHD symptoms is nested within the heterogeneity found in non-clinical populations. Moreover, the results suggest that specific weakness in sustained attention may contribute to behavioural symptoms of ADHD and to problems with pragmatic language and theory of mind amongst school-aged children. Sustained attention may be required to monitor the communicative intentions of conversational partners and likewise the content, timing and relevance of each conversational turn.

Neural signatures of dynamic emotion constructs in the human brain

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How is emotion represented in the brain: is it categorical or along dimensions? In the present study, we applied multivariate pattern analysis (MVPA) to magnetoencephalography (MEG) to study the brain's temporally unfolding representations of different emotion constructs. First, participants rated 525 images on the dimensions of valence and arousal and by discrete emotion categories (happiness, sadness, fear, disgust, and sadness). Thirteen new participants then viewed subsets of these images within an MEG scanner. We used Representational Similarity Analysis (RSA) to compare behavioural ratings to the unfolding neural representation of the stimuli. Ratings of valence and arousal explained significant proportions of the MEG data, after corrections for low-level image properties. Additionally, behavioural ratings of the discrete emotions fear, disgust, and happiness significantly predicted early neural representations, whereas rating models of anger and sadness did not. Different emotion constructs also showed unique temporal signatures. Fear and disgust – both highly arousing and negative – were rapidly discriminated by the brain, but disgust was represented for an extended period of time relative to fear. Overall, our findings suggest that 1) dimensions of valence and arousal are quickly represented by the brain, as are some discrete emotions, and 2) different emotion constructs exhibit unique temporal dynamics. We discuss implications of these findings for theoretical understanding of emotion and for the interplay of discrete and dimensional aspects of emotional experience.

Distributed and opposing effects of incidental learning on visual processing in the human brain

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Incidental learning affords a behavioural advantage when sensory information matches regularities that have previously been encountered. Previous studies have taken a focused approach by probing the involvement of specific candidate brain regions underlying the incidentally acquired memory representations, as well as expectation effects on perceptual representations. Here, we investigated the broader extent of the brain's sensitivity to violation and fulfilment of expectations, using an incidental learning paradigm in which the contingencies between target locations and target identities were manipulated without participants' overt knowledge. Multi-voxel pattern analysis (MVPA) of functional magnetic resonance imaging (fMRI) data was applied to compare the consistency of neural activity for visual events that the contingency manipulation rendered likely versus unlikely. We observed widespread sensitivity to expectations across frontal, parietal, occipital, temporal, and sub-cortical areas. These activation clusters showed distinct response profiles, such that some regions displayed more reliable activation patterns under fulfilled expectations, whereas others showed this pattern when expectations were violated. These findings reveal that incidental learning affects multiple stages of cognitive processing during visual decision making, rather than having focal effects at early sensory processing stages.

Anomalous functional network integration in response to cognitive control demands in human callosal dysgenesis

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Higher cognitive reasoning is thought to rely on interactions between spatially distributed brain networks. Such networks are bilateral and depend upon the corpus callosum, the major white matter commissure of the brain connecting the left and right cerebral hemispheres. Here we used high-field magnetic resonance imaging and brain network analyses to investigate the functional brain networks underlying cognitive reasoning in a group of individuals with callosal dysgenesis (CD), a structural abnormality that primarily affects the corpus callosum. Participants were asked to solve novel, Sudoku-like problems while their brain activity was measured. The complexity of these problems was parametrically varied by changing the number of relations that needed to be established between shapes with each problem matrix. Behaviourally, participants showed a reduction in response accuracy as task complexity increased. Brain activity evoked during the task was observed in cortical regions known to constitute two key cognitive control systems: the fronto-parietal and cingulo-opercular networks. Under low reasoning demands, patterns of local neural activity and network topology in the CD group closely resembled those observed in neurotypical controls. By contrast, under high reasoning demands the CD group demonstrated diminished activity and functional connectivity within the fronto-parietal network. These 'state' rather than 'trait' differences in functional network integration help explain the link between previously observed neurotypical resting-state networks and the heterogeneous cognitive deficits in CD.

Combined effects of acute exercise and tDCS on cognition and mood in healthy adults

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Anodal transcranial direct current stimulation (a-tDCS) induces brain plasticity and has beneficial effects on cognition and mood when applied to the dorsolateral pre-frontal cortex (DLPFC). Physical exercise may enhance the effects of a-tDCS by creating favourable conditions for adaptive plasticity, including increased levels of brain derived neurotrophic factor (BDNF). The aim of this study was to investigate the effects of a single bout of exercise performed prior to a-tDCS on cognition, mood, plasticity and BDNF.

24 participants attended 3 sessions in a double-blinded, randomised, crossover design. The sessions included 1) exercise + a-tDCS, 2) exercise + sham, and 3) a-tDCS. Exercise involved 20min of high intensity training on a stationary bicycle. Following this, 20min of a-tDCS (1mA) was applied to the DLPFC. Outcome measures, assessed pre-post, included a cognitive test battery (reaction time, congruent and incongruent stroop, 2- and 3-back), self-rated mood (Bond-Lader), corticospinal excitability, cortical blood flow, and circulating levels of BDNF (venous blood sample).

Early analysis (n=18) has revealed a reduction in response time during the congruent stroop task following exercise + a-tDCS condition (mean difference -25.9ms, $p=0.02$), but not the exercise + sham (-6.5ms, $p=0.53$) or a-tDCS (-2.4ms, $p=0.76$) conditions. Response time during incongruent stroop was reduced following exercise + a-tDCS (-35.5ms, $p=0.01$) and exercise + sham (-22.8ms, $p=0.02$), but not a-tDCS (0.4ms, $p=0.81$). There were no significant changes in accuracy (all $p>0.05$). There was an increase in the 'alertness' subscale for exercise + a-tDCS (12.1%, $p=0.04$) but not exercise + sham (6.4%, $p=0.11$) or a-tDCS (3.8%, $p=0.24$).

These preliminary findings indicate that an acute bout of exercise may facilitate the response to a-tDCS of the DLPFC in healthy adults. Full results, including analysis of plasma BDNF, cortical excitability and blood flow will be available in October 2017.

The Happy Face Advantage: Effects of Expression, Intensity and Sex on Emotion Recognition

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Under some conditions, happy expressions have been found to be categorised faster and with greater accuracy than other expressions; a phenomenon known as the Happy Face Advantage (HFA). Everyday expressions are typically displayed in low to moderate intensity however research examining the effect of expression intensity on the HFA is limited. We examined the effect of expression intensity and feature context (whole face, mouth only, eyes only) on the HFA. Twenty-nine female participants completed an expression categorisation task while event-related potentials (ERPs) were recorded to investigate the underlying neural mechanisms of the HFA. Stimulus sex, expression intensity, expression type, and feature context were investigated via the ERP components N170 and LPP, and reaction time of expression recognition were also recorded. Female happy expressions were responded to faster than female angry expressions indicating a HFA for the female stimuli. However, male angry expressions were responded to faster than male happy expressions, suggesting an angry face advantage for male stimuli. High intensity expressions were responded to faster and with greater accuracy than moderate intensity expressions and slower responses were recorded to eyes compared to whole faces and mouths with the longest RT being recorded for happy eyes only. N170 amplitudes were larger when the whole face was presented than when the mouth or eyes alone were presented and this effect was larger for the moderate intensity expressions. The LPP analysis indicated that angry expressions generally elicited higher amplitudes than happy expressions but this varied across context and stimulus sex. LPP amplitudes were larger for male stimuli in the whole face condition, but in the eyes only condition this difference was larger for female stimuli. These results suggest that expression type, facial context, stimulus sex, and intensity of the expression play key roles in facial processing.

Modulation of cortical plasticity and oscillatory activity following network-oriented high-definition transcranial direct current stimulation (HD-tDCS)

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Transcranial direct current stimulation (tDCS) provides a means of non-invasively altering cortical activity through the delivery of weak electric currents to the brain. Although tDCS has traditionally targeted single brain regions, there is a growing consensus that complex cognitive functions such as working memory (WM) strongly rely on activations across a number of distributed neural networks. Here, we utilised a focal 'high-definition' form of tDCS (HD-tDCS) to modulate two important nodes within the fronto-parietal WM network using a sham-controlled crossover design. Sixteen healthy adults received anodal stimulation (1.5mA, 15min) over either the dorsolateral prefrontal cortex (DLPFC) alone, the DLPFC in combination with the parietal cortex (DLPFC+PC), or sham stimulation. Concurrent transcranial magnetic stimulation and electroencephalography (TMS-EEG) was used to probe cortical reactivity via TMS-evoked potential (TEP) amplitudes both before as well as five and 30 minutes following HD-tDCS in order to investigate short-term changes in cortical plasticity. WM performance was also examined, both before and after stimulation, while oscillatory power was measured using EEG via time-frequency analyses. Results revealed that both the DLPFC and combined DLPFC+PC stimulation conditions potentiated the P60 TEP, while N100 TEP amplitudes were reduced, relative to baseline, following DLPFC+PC stimulation only, suggestive of a possible alteration to excitation and inhibition, respectively. Task-related increases in theta and gamma EEG power were also observed following DLPFC+PC stimulation compared to baseline. Interestingly, despite these neurophysiological changes, WM performance remained unaffected at the group level. However, an association was observed between WM performance and N100 amplitude changes. Overall, these findings provide important neurophysiological insight into the effects of a novel network-oriented approach to HD-tDCS.

Proactive modulation of corticospinal excitability during global or selective stopping of a planned bimanual action

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The ability to inhibit planned actions in response to altered visual cues is a critical attribute of the human motor system. Here we investigated behavioural indices and neural processes associated with global and selective stopping. 24 right-handed adults (20-40 yr) performed a rapid response task requiring simultaneous button presses (bimanual Go) with the left (L) and right (R) index finger in response to an imperative stimulus (IS). A dynamic Stop Signal (SS) followed the IS on 30% trials; this required countermanding the L or R press (while executing the response with the contralateral limb; selective stop), or countermanding both L and R presses (bimanual stop). A warning stimulus (WS) was presented prior to the IS on the majority of trials and informed participants of which stop type (L, R, bimanual) would be required if, indeed, a SS was to appear. Transcranial magnetic stimulation to the R primary motor cortex assessed corticospinal excitability (CSE) of the L hand at various times between the WS and IS. A substantial behavioural cost was incurred in selective stop trials, whereby unimanual reaction times (RT) in successful L and R stop trials were significantly longer than RT in bimanual Go trials irrespective of WS ($p<0.001$). These data are consistent with a model of bimanual action inhibition prior to reprogramming a unimanual action. Knowledge of the type of stop that might be required (via the WS) resulted in statistically significant improvements in stopping performance of both selective stops, i.e., L stop and R stop (as indicated by shorter SSRT; both $p < 0.001$) and global (bimanual) stops ($p=0.020$). L hand CSE was significantly greater when the WS indicated that a R stop might be required, than when it indicated the L hand might be required to stop (i.e., L stop or bimanual stop) ($p = 0.027$). This suggests that early inhibitory influences on a limb may depend on task context i.e., whether subsequent cancellation of the action may be required.

Do changes in sensory processing modulate Stroop performance across the lifespan?

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The ability to suppress irrelevant information appears to be lower in children and older age. However, perceptual change across life might influence measurements of this effect. This has been shown using the Stroop task, participants must identify the colour a word is written in, whilst ignoring the words meaning. Typically participants are slower and less accurate when the colour and word are incongruent. Using unimodal and cross-modal versions of the Stroop task, we found greater general interference in children (n=49; 4- 11y) and greater unimodal, but not cross-modal, interference in older adults (n=39; 65-85y) than younger adults (n=33; 18-25y). There may be a perceptual or cognitive basis for this effect. Older people may have maintained cognitive abilities not yet developed in children. However, reduced perceptual abilities, such as in colour vision, may limit Stroop performance in later life. We present findings exploring the effect of colour quality on unimodal Stroop performance at a behavioural and neural level using eventrelated potentials. Thirty-three young adults (19-30y) were presented with a Stroop task alongside concurrent EEG. Colour information was either high saturation or partially occluded by a "desaturation mask". Initial analyses showed that there was no difference in the size of behavioural interference between high and low saturation conditions, or in the N450 ERP component as identified in the high saturation condition in a time window of 490-540ms. We discuss these findings in the context of the impact of sensory changes on cognitive performance with age.

Anticipatory coding of visual object position ahead of moving objects in human visual cortex

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Due to the delays inherent in neuronal transmission, our awareness of sensory events necessarily lags behind the occurrence of those events in the world. If the visual system did not compensate for these delays, we would consistently mislocalize moving objects behind their actual position. Anticipatory mechanisms that might compensate for these delays have been reported in rabbits and cats, and such mechanisms have also been hypothesized to underlie perceptual effects in humans such as the Flash-Lag Effect. However, to date no physiological evidence for anticipatory mechanisms has been found in humans.

Here, we apply multivariate pattern classification to time-resolved EEG data to investigate anticipatory coding of object position in human observers. By comparing the time-course of neural position representation for objects in both random and predictable apparent motion, we isolated anticipatory mechanisms that might compensate for neural delays when motion trajectories were predictable.

As well as revealing an early neural position representation (lag 80-90 ms) that was unaffected by the predictability of the object's motion trajectory, we demonstrate a second neural position representation at a lag of 140-150 ms that was distinct from the first, and that was pre-activated ahead of the moving object when it moved on a predictable trajectory. The latency advantage for predictable motion trajectories was approximately 16 ms.

To our knowledge, this provides the first evidence of anticipatory coding in human vision. The results are numerically consistent with earlier work in other species, and suggest that current models of spatial predictive coding in visual cortex can be effectively extended into the temporal domain.

The influence of task requirements on the neural representation of non-symbolic numerical magnitude

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The ability to understand and manipulate magnitude information, such as numerosity, is considered crucial in a range of everyday living tasks and in educational settings. The neural mechanisms underlying magnitude judgments have been widely investigated. In particular, much work has focussed on the extent to which different types of numerical stimuli draw on shared representations. Indeed, functional neuroimaging methods such as multivariate decoding approaches, have been used across a variety of magnitude tasks and presentation formats. These studies have implicated a range of format-dependent and format-independent brain regions, including areas in the parietal and frontal cortices (most commonly the intraparietal sulcus, IPS). There has been comparatively less research, however, on the influence of contextual factors, such as task requirements, on how magnitude is processed. Here, we investigated this by employing a multivariate analysis approach, on BOLD activity generated by two non-symbolic numerical magnitude tasks, with identical physical stimuli: an estimation and a comparison task. We found significant decoding of small versus large magnitudes within-task, across several ROIs, such as the bilateral IPS and dorsolateral prefrontal cortex. In addition, there were regions involved in both tasks, but also others implicated in one or the other. Importantly, after collapsing across all magnitudes, we found accurate decoding of task type in most ROIS (16 of 20), indicating that different patterns of activity were evoked by the differing task requirements. In further support of this, cross-task generalisation analyses found that classifiers trained on the comparison task only partially generalised to the estimation task, and vice versa. Therefore, non-symbolic numerical magnitude appears to be represented in both overlapping and distinct brain regions for comparison and estimation tasks, but the two give rise to substantially different activity patterns.

The effects of chromatic saturation on non-linear evoked MEG responses

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The effects of achromatic luminance contrast on V1 responses have been studied extensively; however there has been relatively little research into the cortical correlates of chromatic saturation. Although the magnocellular (M) pathway is not chromatically selective, evidence that the K2.1 non-linear VEP response increases with chromatic saturation suggests that M-input to V1 is sensitive to colour. We used magnetoencephalography (MEG) to investigate the effects of chromatic saturation on the non-linear temporal structure of cortical evoked magnetic responses. MEG was recorded from 9 young adult neurotypical participants while they viewed a multifocal stimulus that was made up of a series of wedges which changed between blue and grey in independent, pseudo-random binary m-sequences (m=14, luminance contrast = 10%, display frequency = 60Hz). Evoked responses were recorded at five chromatic saturation levels (0, 20, 40, 60, 80, 95%). Linear (K1) and non-linear (K2.1 and K2.2) evoked responses were analysed for the central four multifocal quadrants. Source localisation was performed using Brainstorm's minimum norm estimation (MNE) procedure, and the effects of chromatic saturation were modelled using Partial Least Squares analysis (PLS). Evoked responses to the four quadrants were localised to the expected retinotopic regions of visual cortex. PLS analyses indicated that the effects of chromatic saturation were most apparent for the K2.1 responses, particularly in V1 at approximately 70ms post stimulation; however, the K1 and K2.2 amplitudes also increased with chromatic saturation. It was concluded that chromatic saturation modulates cortical responses at very short latencies. We speculate that the effects of chromatic saturation on K2.1 non-linear responses may reflect M-pathway input to the cytochrome oxidase blobs in V1.

This work was funded by the Australian Research Council.

White matter microstructure predicts motor imagery ability in young adults: a constrained spherical deconvolution tractography study

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While there is compelling evidence to suggest that motor imagery (MI) activates similar cortical regions to real movement, surprisingly little is known about if, or how, microstructural differences in those tracts that facilitate communication between sensorimotor cortices influence MI performance. The present study aimed to address this glaring omission in the literature. To date, 10 of an expected 15 healthy adults (18-46 years) have performed the hand laterality task (HLT), a well-validated measure of MI. Sensorimotor tracts including the corticospinal tract (CST), superior longitudinal fasciculus (SLF), forceps major and forceps minor were reconstructed for each participant using constrained spherical deconvolution tractography (CSD). Quantitative diffusion metrics of white matter microstructure were generated, and correlated with performance efficiency on the HLT. Group level analysis of HLT performance was bound by the biomechanical constraints of movement, consistent with a MI strategy. As predicted, preliminary analysis demonstrated a significant relationship between diffusion metrics and MI performance efficiency in a number of sensorimotor tracts, including the left CST, forceps major and forceps minor. These preliminary analyses are the first to our knowledge to provide evidence suggesting that white matter organization in sensorimotor pathways may predict individual differences in MI ability. These findings compliment neuro-functional data from fMRI and TMS and provide critical insight into the neural substrate of MI (and 'neural' action representation more broadly), and those factors that contribute to individual performance differences.

An investigation into the role of the primary motor cortex in the contextual interference effect for motor sequence learning

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The contextual interference (CI) effect is a robust motor sequence learning phenomenon where interleaved practice demonstrates poorer immediate performance but enhanced delayed test performance relative to repetitive practice. Given a causal link between primary motor cortex (M1) function and motor sequence learning, delayed sequence learning benefits exhibited by interleaved practice might depend on neural circuits involving M1. If this is so, then M1 disruption following practice using repetitive transcranial magnetic stimulation would be expected to mitigate the ensuing advantage of interleaved practice for motor sequence learning. To test this prediction, twenty right-handed participants were randomly allocated to either interleaved (N = 10) or repetitive (N = 10) practice on key-pressing sequences involving the dominant hand. Upon completion of practice, participants in each practice condition were then randomly allocated such that half received subthreshold continuous theta burst stimulation (cTBS) on the contralateral M1 and the other half received sham stimulation on the same site. Twenty-four hours after practice, participants were tested on practiced sequences under interleaved and repetitive testing schedules. Practice performance was consistent with the CI effect as interleaved practice demonstrated significantly longer sequence response times. Interleaved practice subsequently resulted in significantly shorter sequence response times at test, but only under interleaved test conditions. Importantly, test performance was not significantly influenced by post-practice stimulation or an interaction between practice schedule and stimulation factors. These results indicate that cTBS disruption of M1 following interleaved and repetitive practice does not attenuate the long-term performance benefits of interleaved practice. Thus, it does not appear that M1 alone plays a functional role in the CI effect.

The Prospective Brain" – What do we know and where do we go?

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Episodic memory is often conceptualized as a past-oriented memory system enabling us to recollect events from the past in a vivid and evocative manner. A recent shift in the field of cognitive neuroscience, however, has led to the reframing of the human episodic memory system as one that is particularly well suited to acts of prospection, most notably that of envisaging the future. Here, I explore how the study of neurodegenerative disorders has revealed unique insights into the neurocognitive mechanisms which support the capacity for future thinking. Loss of episodic memory is a cardinal feature of Alzheimer's disease attributable to atrophy in medial temporal and posterior parietal brain regions. By contrast, degeneration of the anterior temporal lobes in semantic dementia results in pervasive conceptual knowledge deficits in the context of relatively intact episodic memory. Across a series of studies in these patient groups, I will demonstrate the necessary interplay between the episodic and semantic memory systems in the service of past and future constructive endeavours. Finally, I will consider future directions in this field, enabling us to move towards an integrative account of mental construction.

Extraversion and reward processing: A high-powered replication and mathematical model of EEG reward prediction error signalling

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The feedback-related negativity (FRN) is an EEG-based event-related potential that appears to index reward-prediction error signalling in humans. The personality trait extraversion has been implicated in sensitivity to reward and, consistent with this view, three previous studies have found a relationship between extraversion and the size of the FRN. To address the issue of small samples used in these studies, we conducted a replication study with 80% power to detect the typical effect in personality neuroscience (r ~ .25). One hundred participants (58% female) completed personality measures, then took part in a probabilistic learning task involving passively viewing of stimuli predicting a reward (a gold bar) or non-reward (a lemon), followed by an outcome reward or non-reward. Stimuli were 80% predictive of their outcome. Consistent with previous studies, results indicated that the FRN difference wave, produced by contrasting unpredicted rewards with unpredicted non-rewards, was larger in high-extraverts compared to low extraverts—and moreover, this finding held for multiple measures of extraversion, uniquely for this trait (i.e., was not found for other Big-Five personality traits). To further investigate mechanisms that might account for this FRN-extraversion relationship, a model of reinforcement learning was developed following the differential cognitive neuroscience approach, wherein individual biologically inspired parameters were systematically varied over simulated participants. Results concerning simulation and data-fitting procedures are presented, and implications for the future of personality neuroscience outlined.

Development of simultaneous functional MRI and functional PET imaging

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fMRI is the most common method of studying brain function in health and disease. fMRI indirectly infers neuronal activity from changes in blood oxygenation and is not a quantitative metric of brain function. It is therefore impossible to determine if BOLD-fMRI differences between groups are due to differences in neuronal activity or due to differences in blood oxygenation physiology. F-18 fludeoxyglucose positron emission tomography (FDG-PET) provides an index of neuronal glucose metabolism, which is tightly coupled to neuronal activity. However, while the temporal resolution of fMRI is in the order of seconds, standard FDG-PET imaging has no effective temporal resolution, and represents a static snapshot of glucose metabolism. Here, we develop a novel experimental protocol that introduces a temporal component to the FDG-PET data, while simultaneously providing a BOLD-fMRI contrast. Twelve participants underwent a 90-min simultaneous fMRI-fPET scan. 100MBq of F-18 FDG was infused over the course of the 90-min scan at a rate of 36mL/hr. Non-functional MRI (T1, T2, ASL, MRS) was acquired in the first 20min to allow the fPET signal to rise to detectable levels. For the remaining 70mins, a flashing checkerboard stimulus was presented in an embedded on/off design. The slow on/off design provided fPET contrast, and alternated between checkerboard 'on' (10min and 5min) and 'off' (eyes open rest, 20, 5, 15min). The fast on/off design provided BOLD-fMRI contrast and was embedded within the 10 and 5min 'on' periods; and alternated between 32sec 'on' and 16sec 'off'. Results show that this embedded design provides both BOLD-fMRI and FDG-PET contrast within the visual cortex. Joint analyses show for the first time the complex interaction between glucose metabolism and BOLD-fMRI activity throughout the cortex and draining veins. This novel design demonstrates that a temporal component can be introduced to FDG-PET imaging, while simultaneously providing BOLD-fMRI contrast.

The effects of stimulus type and duration on visual ERP components

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In three experiments, we explored the influence of visual stimulus type (faces, houses, and scrambled) and duration on the manifestation of the P1 and N1/N170 components of the event-related potential (ERP). In Experiment 1, twenty participants were presented with face and house images for different durations (17, 50, 100, or 200 ms) and were asked to judge whether the image was a face or house via a keypress. Experiment 2 (n = 20) controlled for lower-level confounds across stimulus types by matching luminance and introducing an additional factor: intact vs pixel-scrambled images. In Experiment 3 (n = 20), visual processing time was further restricted by adding masks immediately following the stimuli. In all experiments, ERPs were derived from EEG recorded at 128 scalp locations. Behaviorally, accuracy for discriminating intact faces from houses was approximately 80% when stimuli were presented for 17ms in Experiment 3. Accuracies for other stimulus-intact conditions were above 90%, while discrimination of scrambled stimuli in Experiments 2 and 3 was at chance (50%) across all durations. The ERP data revealed several effects: (1) All stimuli evoked a P1 component. In E1, P1 was larger for faces than houses. This was most likely the result of higher stimulus contrast or luminance for faces, as the same effect was not observed in E2 and E3, when these factors were controlled. (2) Faces, but not houses or scrambled images evoked a significant N170. The amptitdue of N170 was significantly larger for correct than incorrect trials when processing time was most restricted (i.e., when faces were presented for 17ms in E3). Finally (3), there were also main effects of exposure duration on the amplitude of of P1 and on the latency of N170. These effects appear to be related to the physical propoerties of the stimulus, as they did not interact with stimulus type. These results concur with the idea that the face-specific N170 occurs independently of stimulus processing time.

Decrements in sustained attention are associated with a decrease in arousal

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Maintaining attention for a long period of time is essential for many cognitive functions. Decrements in sustained attention during a task may be due to depletion of cognitive resources, increased mindlessness, and/or a reduction in arousal. The cognitively simple fixed Sustained Attention to Response Task (SART) was used to measure sustained attention over a 10 minute period. The Thought Occurrence questionnaire and tonic pupil diameter measured mindlessness and changes in arousal during the task. It was expected that participants with greater decremental time-on-task performance would also show greater thought interference and decreases in tonic pupillary response. Twenty-three adult participants participated. The SART was broken into four blocks, with Time treated as a continuous variable. Generalized Linear Mixed modelling was used. Each participant was allowed to have varying intercepts in the model, controlling for individual differences in pupil size. Mean response time (RT) decreased over Time, while the standard deviation of RT and fast moment-to-moment variability in RT increased over Time. There was no effect of Time on the number of errors made. Tonic pupillary response significantly decreased over Time. Thought Occurrence did not show any significant effect on the SART or pupil diameter measures. These adult participants found this task easy to perform, with a low number of errors made. Nevertheless, the increase in SDRT and fast variability in RT indicate subtle time-on-task effects on the SART. Participants' mindlessness levels did not show an association with task performance or pupil diameter. Tonic pupillary response is thought to be an indicator of arousal, and participants showed a decrease in arousal over the course of the task. The findings on this extended version of the fixed SART indicate that decrements in sustained attention are associated with a decrease in arousal rather than a depletion of cognitive resources or increased mindlessness.

Associations between brain morphology and cognition in individuals with schizophrenia and bipolar disorder: a review

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Although nosologically distinct, there is overlap in the disease presentation of individuals with schizophrenia (Sz) and bipolar disorder (BD). For example, both disorders are characterized by abnormalities in cognitive performance. Abnormalities in brain volume, surface area and cortical thickness have also been observed in both SZ and BD. It is possible the these abnormalities are related, however the nature of the brain structure-cognition relationship in these disorders is inconclusive. This review aims to elucidate the association between common measures of brain morphology and cognitive impairment in Sz and BD. Science Direct, PubMed, NCBI, and Web of Science databases were searched for papers investigating cognition and brain morphology (cortical thickness, surface area and volume) in Sz and BD. Studies indicate that grey matter volume is positively associated with cognitive performance, with evidence of relationships between IQ and volume of the temporal regions, and the hippocampal volume and verbal memory/learning. The relationship between cortical thickness and cognitive impairment is less clear, with working memory being positively correlated with increased thickness of temporal regions whilst inversely related to decreased thickness of the anterior cingulate in Sz. Inconsistency in the direction of cortical thickness-cognition relationships in BD was also evident. Only a handful of studies have investigated surface area with regards to cognitive impairment in Sz and BD. The insufficient number of studies and inconsistency amongst them makes it difficult to draw supported conclusions. There is a need for more novel approaches to uncover the nature of brain morphology-cognition relationships in BD and Sz.

Risky decision-making and cognitive control in late adolescence and young adulthood.

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Adolescence is a period of rapid psychological and physical transitions. While risk-taking forms an integral and adaptive part of this transition towards adult patterns of behaviour, some risk behaviours can have adverse lifelong consequences for the young person and the people around them. Neurobiological models explain adolescent risk-taking as arising from staggered development of subcortical networks that are sensitive to reward and prefrontal networks that support cognitive control processes. Staggered brain maturation is consistent with behavioural models that characterize adolescence as a period of heightened reward drive in the presence of developing cognitive control. The Age-ility Project is designed to test dual network models of adolescent risk-taking. Here I will present data addressing whether risky decision-making varies with cognitive control ability in late adolescence and young adulthood (n=215, 15-35y). Participants completed a task-switching paradigm and a stop-signal task with concurrent EEG, as well as behavioural (Cambridge Gambling Task) and self-report measures of risk propensity and risky behaviours. Behavioural and electrophysiological (ERP, time-frequency) measures of cognitive control targeted conflict anticipation, interference control and response inhibition. Across the board, self-report measures of risk behaviours showed weak relationships with cognitive control ability. Behavioural measures showed patterns consistent with a relationship between cognitive control and risky decision-making. Implications for dual network models will be discussed.

The effects of aerobic fitness on cognition in cognitively healthy older people living independently within aged care facilities

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Dr Helen Macpherson, *Deakin University*
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The Lifestyle Intervention in Independent Living Aged Care (LIILAC) trial is investigating the potential for cognitive change in a cohort of

cognitively healthy older adults, living in independent accommodation within Australian aged care facilities. This four-arm trial, involving 102 participants, examined the effect on mental functioning following the introduction of a Mediterranean style of diet and/or increased aerobic exercise, in the form of regular walking. This presentation will focus on the relationships between exercise/fitness and cognition. Additionally, mechanisms by which these changes may occur will also be discussed.

Participants were assessed with a battery of computer-based cognitive assessments as well as a walking based assessment of their ambulatory fitness. Mood, general health, perceived wellness and sleep quality were also assessed. Potential mechanisms such as blood pressure and arterial stiffness were examined, as were changes in metabolic profiles, including brain derived neurotrophic factor (BDNF), inflammatory factors and insulin sensitivity.

Preliminary baseline analysis has found that greater aerobic fitness and lower central arterial stiffness were associated with better cognitive performance, specifically in spatial working memory. Baseline findings and change at six months will be discussed, as will findings with regard to potential associated mechanisms of action. This research has the potential to provide an evidence base for simple lifestyle interventions to improve brain health and cognitive outcomes for older people.

The curious case of aphantasia: A lack of phenomenal and sensory visual imagery with retained mental rotation

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A/Prof Joel Pearson, *University of New South Wales*

For most people the use of visual imagery is pervasive in daily life, but recent findings suggest that for a small group of people the experience of visual imagery is entirely unknown. Research based on subjective phenomenology indicates that otherwise healthy people can completely lack the experience of visual imagery, a condition now referred to as congenital aphantasia. To date aphantasia has been based on subjective reports, and as such it remains unclear whether participants are really unable to imagine visually, or if they have very poor metacognition. Here we measured self-diagnosed aphantasic's low-level sensory imagery, using the binocular rivalry paradigm, as well as measuring their self-rated object and spatial imagery with multiple questionnaires (VVIQ, SUIS and OSIQ). Additionally we measured mental rotation performance and reaction times, which has been closely tied to mental imagery, using the mannequin test. We also assessed perceptual and attentional priming using binocular rivalry, to control for the possibility that aphantasic individuals are wholly unable to prime binocular rivalry in any way. The experimentally naive aphantasic's showed almost no imagery-based rivalry priming, while a large sample from the general population showed significant priming. Interestingly, the aphantasic participants showed retained mental rotation abilities and both perceptual and attentional priming for binocular rivalry. Additionally, Aphantasic participant's self-rated visual object imagery was well below average, however their spatial imagery scores were not. These data suggest that aphantasia is a condition involving a lack of sensory and phenomenal imagery, and not a lack of metacognition.

Relationships between postural instability and loss of intragenic DNA methylation in FMR1 premutation females

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Repeat expansions between 55 and 200 CGG tri-nucleotides within the FMR1 gene, termed premutation (PM) are common (1 in 150 females) and have been linked to the late-onset disorder fragile X tremor-ataxia syndrome (FXTAS). FXTAS, which has been reported in 17-45% of individuals over the age of 50 who have PM alleles, has been associated with increased FMR1 mRNA levels and gain-of-function RNA toxicity. This study examined relationships between molecular biomarkers including CGG size, FMR1 mRNA levels and DNA methylation, with postural control and verbal fluency performance, in 35 PM females aged between 22 and 55 years old and 35 age- and IQ-matched controls (CGG<45) that did not have FXTAS. Compared to controls, PMs had significantly reduced FMR1 Intron 1 methylation, with the greatest difference at a novel FMR1 3' intron 1 methylation boundary ($p<0.0001$). Deceased PM methylation of the boundary also significantly correlated with: (i) increased CGG size and FMR1 mRNA levels ($p <0.01$); (ii) poorer postural control in the condition of disrupted visual and proprioceptive input ($p < 0.001$). In the control group a different pattern emerged, of weak, but significant correlation between reduced boundary methylation and improved postural control ($p=0.025$) , yet no correlations with CGG size or FMR1 mRNA. There were also no epi-genotype-phenotype relationships with verbal fluency performance. In conclusion, decreased methylation at the novel FMR1 3' intron 1 boundary was PM specific, showing significant correlations with CGG size, FMR1 mRNA levels and postural instability in PM females without FXTAS. This suggests that the boundary may have an important biological function linking CGG size with elevated FMR1 mRNA levels and motor phenotypes in PM females. Future longitudinal studies will explore these epi-genotype-phenotype relationships in the context of PM-specific developmental mechanisms and neurodegenerative changes observed in FXTAS.

Unconscious reactions to tearful facial expressions of emotion

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When viewing another's facial expressions of emotion, people unconsciously match, or mimic the other's expression. This mimicry is said to facilitate social communication, and provide a mechanism for 'feeling' as another feels. Facial expressions of sadness, especially those with emotional tears, garner increased support and empathy from observers in self-report studies when compared to other expressions of emotion. To investigate the mechanisms underlying facial mimicry, static images depicting sad, happy, angry and neutral facial expressions (all shown with and without tears), were presented and assessed by measuring electromyographic activity over the zygomaticus major and minor (ZMaj and ZMin respectively), and the corrugator supercilii muscles. To ensure the participants were not aware of the focus on tearful expressions, the images were presented briefly, for 30ms, and masked using forward and backward masking techniques. Preliminary results indicate that despite not consciously perceiving the stimuli, the participants reacted with distinct facial responses. Happy expressions elicited a greater ZMaj response than other emotional expressions, however, the corrugator muscle did not differentiate between different emotions. Critically, sadness expressions facilitated responses of the ZMin, with greater activity to tearful-sad and neutral expressions, than their tear-free duplicates. We interpret these results to mean that tears produce a unique mimicry response, which in turn facilitates the sharing of affective states.

Task demand modulates the event-related potential response during language processing

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Debate arose when unpredicted event-related potentials (ERPs) were found in response to semantic reversal anomaly (SRA) sentences, which challenged existing models of language processing. SRAs are sentences such as "The meals will devour the men in the restaurant", where the two nouns are reversed from a plausible sentence ("The men will devour the meals ..."). The late positivity (LPS) ERP was long thought to reflect syntactic processing, but was recorded in response to semantic manipulations, such as SRAs, in English and Dutch. These findings provoked considerable discussion regarding the neural architecture of language processing. However, the LPS in semantic manipulations may be a result of task demand (such as binary yes/no judgements) during sentence presentation. This study is the first to investigate whether task demand modulates the ERP response to SRAs in English, by comparing judgement and comprehension tasks between participants. Participants (n=34; mean age= 23.8±1.03; 22 female) read SRAs and control sentences in a rapid serial visual presentation paradigm, and undertook a judgement or comprehension

task while their electroencephalogram was recorded. Data were analysed using linear mixed effects models. At the position of the verb (i.e. "devour"), SRAs engendered a more positive deflection than control sentences within the LPS time-window (700-900ms). The LPS amplitude was significantly larger in the judgement task compared to the comprehension task. The larger amplitude in the judgement condition suggests that the LPS may be a task-relevant, response-aligned deflection, reflecting stimulus categorisation (as suggested in the "P600-as-P3" hypothesis). Future research should consider the modulatory effect of task type during study design, and the role judgement tasks may have on influencing positive deflections. L.K. is supported by an Australian Government Research Training Program Scholarship.

Oxytocin modulates socioemotional brain regions in older adults

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Why should the young get all the attention? More than a decade of research shows that the neuropeptide oxytocin is a key mediator in the regulation of human brain processes that underlie social cognitive functions in young adults. However, little is known about oxytocin and social cognition in older adults. It is likely that oxytocin is also very important in the declining social cognitive skills of older adults, and we aimed to test this with a novel study using functional magnetic resonance imaging (fMRI). Participants included a pilot sample of 15 young (aged 19-35; 9 females) and 10 older adults (aged 62-80; 3 females). All participants underwent two separate fMRI scan sessions, during which they carried out an emotion recognition task (of angry, sad, fear, happy and neutral faces). During each session, participants administered an intranasal spray dose of either 24 IU of oxytocin, or placebo. Region of interest amygdala analyses were conducted. Results found that older adults (vs. young) had heightened right amygdala activity to angry faces during placebo (d = .50), and oxytocin eliminated the age differences. The findings were specific to angry faces. The current study provide support for a role of oxytocin in modulating social cognitive brain functions in older adults for at least some emotions. Furthermore, the current results provide initial evidence of oxytocin 'normalising' effects on brain activity in older adults, making them more similar to young adults.

Non-conscious effects of landmark cues on overt and covert attention movements

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In three experiments we investigated effects on attention of peripheral landmark cues, that predicted a target at the same location, and counter-landmark cues, that predicted a target at a different location. In all three experiments, the delay between cue and target onset was very brief (66ms), and participants were not informed of the cue-target relation. On trials where cue and target appeared at the same location, simple response times (Experiment 1) and eye movements (Experiment 2) were faster on valid (landmark) compared to invalid (counter-landmark) trials. This effect was apparent early in practice. On trials where cue and target appeared at different locations, valid (counter-landmark) and invalid (landmark) trials did not differ. In Experiment 3 neutral cue trials were introduced. Here, on trials where cue and target appeared at the same location, eye movements were launched more rapidly on valid compared neutral trials, which did not differ from invalid trials. That is, the rapid effect of landmark cues on eye movements can be characterised as benefit without cost. Again, this effect was apparent early in practice, and was independent of awareness of the cue-target relationship. We propose that rapid movements of attention can be viewed as a form of visually guided action, controlled by rapid, non-conscious encoding in the dorsal visual stream. This work was supported by the Marsden Fund of New Zealand.

Where is working memory: an updated neuroanatomical model using activation likelihood estimation meta-analysis of n-back tasks

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The underlying neural correlates of working memory (WM) have been a contentious area for decades. We aimed to revise meta-analytically the normative functional neuroanatomy of a common WM measure, the n-back task. An influential meta-analysis over a decade ago, revealed five fronto-parietal regions, allocating each region a role based on existing literature. The current meta-analysis utilized updated voxel-based activation likelihood estimation (ALE) software, with stricter inclusion criteria and incorporating many more studies. Ninety-five of 999 papers reviewed fit the inclusion criteria. While the original study compared only stimuli type across studies, the current meta-analysis also compared WM load. Results revealed similar fronto-parietal regions as previously established, but with more sites activated including the anterior cingulate, bilateral insula and bilateral cerebellum. Furthermore, it was revealed that regardless of stimulus type or WM load, common areas are consistently activated across studies. This updated meta-analysis should help to shift the focus of research away from traditional functional segregation of cognitive tasks, towards a core network view of WM. Funded by ARC Discovery Project (DP170101035).

What's attention got to do with it? Re-examining the developmental trajectory of visual orienting

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There is a long-standing assumption that covert orienting, the shifting of the "mind's eye" independent of a saccade to a location in space, is a more "pure" measure of underlying attention. Testing this covert attention relies on target detection tasks, which depend on making choices about when or where a target has appeared, and what is the appropriate action to indicate that choice. These present potential confounds in measuring attention in children. This study examined the developmental trajectory of endogenous visual orienting in two tasks, one that measured covert orienting with a button press response, and one that measured overt orienting with eye-tracking to measure saccades.

The participants included 60 children age 6-12 years old, divided into 4 quartiles (6;2-8;1, 8;3-9;3, 9;4-10;8, 10;10-11;9). Two experimental tasks were completed: a traditional Posner (1980) arrow cuing task with forced-choice button press responses, and an overt orienting task in which participants were instructed to saccade to the target. Both tasks included valid (75%) and invalid (25%) cues at six cue-target SOAs (150ms - 900ms).

A 2x2x6x4 Mixed ANOVA was used to examine performance. Three-way interactions were found with Task x Congruency x Age, $F(3,48)=5.57$, $p=.002$, Congruency x SOA x Age, $F(15,240)=1.97$, $p=.018$, and Task x Congruency x SOA, $F(5,240)=3.18$, $p=.014$. The three-way interactions were probed further using simple effects tests with Bonferroni corrections applied to paired comparisons. These revealed that a Congruency by Age interaction was found on the Covert but not the Overt task, and Congruency by SOA patterns differed across ages and across the two tasks

The differences in patterns between the two tasks suggests that Overt and Covert orienting tasks are measuring distinct underlying processes, with clear developmental trajectories. Overt orienting is mature by age 6, while more complex response selection skills continue to develop through middle childhood.

Cognitive Reserve and Emotion Recognition in Older Adults: An ERP Study

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Recognising emotions in others is imperative for navigating social situations, but this ability declines in late adulthood after initial gains. Cognitive reserve (CR) explains individual differences in the effects of age- and dementia-related neuropathology on cognitive function. However, associations with social cognition are unclear. This study investigated how CR associated with neural activity when recognising happy, angry, and neutral faces, accounting for structural brain changes.

Participants included 34 older adults (M=70.5, SD=6.04; 23 female). The Lifetime of Experiences Questionnaire (LEQ) indexed CR. Mean amplitudes and peak latencies of the P1, N170, and P3 ERP components were calculated for each emotion condition (happy, angry, and neutral). Diffusion Tensor Imaging fractional anisotropy (FA) values indexed white matter microstructural integrity; analyses were also run using adjusted hippocampal volume as the index of integrity. Linear mixed effects modelling was used to investigate predictors of ERP amplitudes and latencies: LEQ scores, FA values, and emotion category were entered as fixed factors, and ID as a random intercept.

CR did not relate to neural processing during emotion recognition, as indexed by either the amplitude or latency of the ERP components. There was an effect of emotion category on P3 amplitude, with larger amplitudes for happy ($p<.001$) and angry ($p=.003$) faces compared to neutral faces. FA predicted P3 latency, where those with higher FA had shorter latencies ($p=.002$).

These findings extend behavioural findings from our own laboratory showing non significant associations between CR and social cognition (unlike general cognitive functioning). It appears that CR is not associated with improved cognitive performance, including underlying neural processing, in social tasks. Findings extend current theory, suggesting social cognition tasks may be sensitive to age-related decline, unaffected by CR compensatory mechanisms.

Individuals with higher autistic traits show faster saccade onset times indicating anomalous attentional disengagement from face stimuli

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Individuals with autism spectrum disorder (ASD) demonstrate a range of attentional anomalies beyond the traditional diagnostic criteria, with much research having focussed on impairments in social attention. Eye-movement evidence suggests an association between ASD and slower ability to select and orient to a target, especially when this target is social in nature. Attentional disengagement, which requires disengaging from the current focus of attention and making an attentional shift to a new target in a different spatial location, has also been suggested to be impaired (demonstrated by slower orienting from non-social stimuli to a new target) in ASD populations. Taking a dimensional view of autism, this study explored attentional disengagement from social stimuli across the subclinical range of autistic traits. Using a gap-overlap task, saccade onset times were measured with participants required to fixate on centrally displayed photographs of faces with angry, happy, neutral, or inverted neutral expressions. The inverted faces were photographs rotated 180 deg. In the gap condition, the central face was removed, and following a 200 ms delay, a simple target appeared randomly to the left or right of fixation. In the overlap condition, the central face remained visible after the peripheral target appeared. High and low autism trait groups did not respond differently to the different emotions in either the gap or overlap conditions. However, all participants were faster to disengage from inverted faces in overlap trials, indicating that these did not engage attention to the same degree as the other upright faces. A comparison of saccade onset times for all upright faces combined showed that the high autism trait group were significantly faster to disengage and orient to the targets in the overlap condition only. These results suggest sub-clinical autism traits are associated with differences in social attention, in particular in attentional disengagement.

Effect of tone frequency on neural entrainment to rhythm

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The spontaneous ability to entrain to a periodic pulse-like beat is central to the perception and production of music across cultures. There is increasing evidence that this ability is supported by a selective entrainment of neural populations to the beat, even when the beat is not physically marked by sounds as in syncopated rhythms. However, the frequency of the tone conveying the rhythm might also play a key role, as in music, low-pitched instruments usually carry the rhythm and drive people's movements to the beat.

To investigate the role of tone frequency in these neural processes, we recorded the EEG while 14 participants listened to rhythms conveyed either with high- or low-frequency tones. We found that the selective neural entrainment to the beat was greater for the low-frequency tone, especially when conveying the more challenging syncopated rhythm. This effect could not be accounted for by differences in loudness between low- and high-frequency tones, as a second experiment with a contrast of loudness alone did not yield significant differences across conditions.

Together, these results indicate a privileged role of low-frequency spectral content in shaping the brain responses to rhythm. The greater entrainment of neural populations to the musical beat delivered by low-frequency tones could account for the widespread practice of using bass instruments to carry the rhythmic foundations of a musical piece and to make people move to the beat.

The interaction between attention networks in 6-11 year old children

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The attention systems of alerting, orienting and executive attention rely on separate but interdependent systems. The relationship between networks is thought to change throughout childhood into adulthood; however this is poorly understood. 114 children aged 6, 8 and 10 years performed the Attention Network Task, modified with invalid spatial cues to provide a measure of reorienting attention. When response time (RT) data was used to calculate network scores, there was a positive correlation between orienting and reorienting attention for the 6-year-old and 8-year-old groups. The 8-year-old group also showed a negative correlation between orienting and executive attention. Those who were faster after a spatial cue, relative to a non-spatial cue, showed a smaller difference in RT between the incongruent and congruent flanker trials, which may suggest they were better able to resolve the conflict induced by the congruent flanker. The 10-year-old group did not show significant correlations between networks. Using accuracy data, there was a positive correlation between orienting and reorienting attention for all three groups. The 8-year-old group showed a positive correlation between orienting and alerting; those who showed better accuracy after a spatial cue, relative to a non-spatial cue, also showed greater accuracy after an alerting cue, relative to no cue. The 10-year-old group showed a negative correlation between executive attention and alerting; those who showed greater accuracy after an alerting cue, relative to no cue, showed a smaller difference in accuracy between the incongruent and congruent flankers. This study highlights the changing nature of the relationships between attention networks through childhood. At 8 years, there were important interactions between networks not seen at either 6 or 10 years. At 10 years, attention networks are independent in terms of RT, as previously reported with adults.

Two Ways to Change Your Mind: Effects of Intentional Strength and Motor Costs on Changes of Intention

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Previous studies on Changes of Mind largely focused on perceptual choice. This study investigated reversals of voluntary action decisions. Selecting an appropriate voluntary action requires combining external sensory information with internally-generated (endogenous) intentions. We hypothesized that both perceptual and endogenous choice can be dynamically updated during action, suggesting two potentially dissociable types of Change of Mind. In a novel version of the random-dot motion task, participants moved to a target that matched both the dot-motion direction and an internally-generated intention about the target colour. Analysis of movement trajectories indicated if and when participants 1) changed their mind about a perceptual decision, or 2) additionally changed their intention regarding the target colour. Participants changed their intentions less frequently when they had strong colour intentions, as indicated by higher performance costs when external evidence conflicted with the endogenous intention (Exp. 1). Additionally, Changes of Intention were more frequent when motor costs of intention pursuit were high (Exp. 2). However, motor costs reduced intention pursuit less strongly when intentions were implemented into potential motor commands prior to dot-motion onset (Exp. 2), suggesting that advance action planning shields intentions from cost-induced updates. Our results provide new insights into the dynamic decision-making processes that allow agents to flexibly choose which intention to pursue and how to pursue it. Insights into the factors that influence behavioural flexibility vs. persistence are highly relevant to our understanding of the mechanisms underlying goal pursuit and its disturbances.

Sex, Size, and Performance: Callosal Dimensions Correlate with Mental Rotation Performance in Women only

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Rotating mental representations of objects is accompanied by widespread bilateral brain activations. This may suggest a significant role of inter-hemispheric communication channels when engaging in mental rotation tasks. The corpus callosum is the main commissure system connecting the two hemispheres through millions of fibers and, indeed, links between callosal attributes and mental rotation have been reported. However, existing findings are sparse and inconsistent across studies. Here we set out to further characterize the nature of any such link, including its exact location across the corpus callosum. For this purpose, we applied an advanced image analysis approach assessing callosal thickness at 100 equidistant points in a sample of 38 healthy adults (19 men, 19 women), aged between 22 and 45 years. We found a significant sex effect, with significant structure-performance relationships in women, but not in men. That is, better mental rotation performance was linked to a thicker corpus callosum in female brains, specifically within the callosal splenium, posterior midbody, and anterior third. These findings may suggest sex differences in problem solving strategies, where in women more than in men stronger inter-hemispheric connectivity – especially between occipito-parietal, frontal, and prefrontal regions – is associated with improved task performance. This research was funded by NIH / NICHD through R01HD081720 to EL and MH.

Evaluating the Spidey Sense: The Metacognition of Intuition

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The notion of intuition, despite lacking strong scientific support is a common phenomenological description of how people feel they make some decisions. Previous work has demonstrated an objective lab-based method to measure intuition - the rapid use of differential non-conscious emotional information to boost concurrent categorically unrelated conscious decisions. It remains unknown how real-world phenomenological self-reports of intuition might be related to such objective lab-based measures and physiology. To investigate this, we compared performance in the lab-based intuition task and physiological response, with self-report measures of intuitive thinking (the Rational-Experiential Inventory). We found that the intuitive sub-scale was positively correlated with the use of non-conscious emotional information in the lab-based task suggesting good metacognition for intuition. Further, we found that those categorized as 'intuitive thinkers' performed better on the lab-based intuition task, relative to 'rational thinkers'. This effect was evident when the amount of conscious task-related evidence was limited or unlimited. Interestingly, individuals categorized as neither intuitive or rational thinkers demonstrated psychophysical adaptability in their degree of intuition, depending on the availability of evidence. These findings support the link between objective psychophysical lab-based measures, physiology, and subjective phenomenology of how much people use intuition to make decisions (good metacognition).

Graph Analysis of EEG Functional Connectivity and Response Time Variability

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Individuals with Attention Deficit Hyperactivity Disorder (ADHD) show greater Response Time Variability (RTV) when they perform cognitive tasks. Greater RTV may be due to inefficient information flow through the brain. Specific connectivity patterns in the brain, reflecting information flow, can be characterised using graph theory analysis. Global efficiency is a measure of functional integration, and modularity is a measure of functional segregation. This study aimed to investigate the relationship between functional connectivity in the brain, RTV, and levels of ADHD symptoms in 28 children (9-12 years) and 49 adolescents (15-18 years). These participants performed the Detection of Disappearance Task (DDT) to measure the ability to maintain cognitive focus while EEG was recorded. In the DDT, participants were asked to detect which digit disappeared from a display of four digits. This task requires maintenance of attention for a varied length of seconds prior to digit disappearance. The Conners 3 Questionnaire was used to measure each participant's levels of ADHD symptoms. Functional connectivity between 64 electrodes was computed by the Phase Lag Index to form a weighted network of the brain. Graph analysis characterised the pattern of functional connectivity. Greater RTV was associated with higher levels of ADHD symptoms. The graph analysis of EEG functional connectivity showed that those with more integrated brain activity, measured by global efficiency, responded less variably. This finding suggests that highly integrated brain connectivity may help to produce more stable responses. A better integrated brain may process and combine information more efficiently and allow for smoother shifts between different brain states.

Mapping Risks to Horizontal Space: Rock Climbing on the Left and Climbing Mt. Everest on the Right

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Quantifiable domains such as numbers, music, and size, are implicitly mapped onto space with small/low/less and large/high/more represented on the left and right sides of space, respectively. Recent research has also demonstrated that more abstract domains (colours, language, political party names) are also mapped onto space in the same way. This study investigated a novel domain, risk, to examine if this same pattern of effects is apparent (left = low risk / right = high risk) and to get a better understanding of how risks are judged. Two experiments were conducted on healthy young adults. Experiment 1 (n = 26) presented objective risk stimuli (micromorts) to participants, who indicated if the activity stimuli had lower or higher risks than a referent, with their left and right hands. The expected association of risk magnitude in space was not found. This outcome was attributed to participant subjectivity interfering in making accurate risk judgements. Experiment 2 (n = 25) attempted to leverage the role of risk bias by utilising the same judgement task, but asking the participants to generate their own risk activity stimuli instead. Faster left

hand responses were found for low risk stimuli and faster right hand responses were found for high risk stimuli – which is indicative of a standard left-right spatial association. Risk judgements, therefore, appear to map onto space (with low to the left and high to the right) only when congruent with participants' personal beliefs about risk (not for statistically calculated objective micromorts). This study is the first to assess the spatial mappings of risk judgements, and the findings contribute to the growing evidence for a generalised magnitude system and may inform best practices in risk communication.

Age-related changes to cognitive control as assessed by fMRI

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Working memory is a cognitive process particularly susceptible to decline in the later years of the lifespan. Older adults have demonstrated increased neural activation during working memory, compared to younger adults and these alterations to brain function have commonly been interpreted as compensatory (i.e. beneficial to performance) or inefficient. However it is also possible that alterations in activation reflect differential cognitive strategies adopted by older and younger adults. Evidence from other executive function paradigms suggest that older adults may shift from a proactive control strategy to rely on reactive control. Using fMRI we examined whether such strategy shifts occur during working memory, when there is concurrent demands of goal maintenance and high interference resolution. Participants were 18 healthy young adults (20 to 34 years) and 17 healthy older adults (55-69 years) who were matched for years of education, IQ and working memory digit span. Participants completed an n-back task consisting of 2-back (target) trials and high interference 3 and 4-back (lure) trials, designed to elicit reliance on reactive control strategies. A second version of the n-back contained cued trials signalling upcoming lure trials, to promote the use of proactive control strategies. Behavioural results indicated that older adults were less able to utilise a proactive strategy than younger adults. Greater cue-related activation was identified in left inferior parietal regions in older adults, but this activity was suggestive of greater susceptibility to interference, rather than an increased reliance on reactive control. These results did not indicate that reduced proactive control in older adults, during working memory, leads to greater utilisation of reactive control strategies.

Assessing the link between negative mental states and cognitive performance in health professionals

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Background: Australia's healthcare network consists of an interdisciplinary team of doctors, nurses, and allied health staff; all working under the increasing demands of the ever-growing healthcare system. While recognised that health professionals have inherently stressful occupations, posing a risk for psychological distress, little is known about the effects of this distress on their cognitive performance. Hence, the aim of the current study is to assess the effects of negative mental states (i.e., depression, anxiety, and stress) on cognitive performance in health professionals.

Methods: Data from 113 clinically active health professionals (77 Nurses, 25 Allied Health professionals, 11 Doctors) was used in the current analysis. The Depression Anxiety Stress Scale was administered to assess depression, anxiety, and stress. Global and domain specific cognitive performance was assessed using the Cognistat and the Mini Mental State Examination.

Results: Preliminary results show significant negative correlations between all three mental states and performance in the memory domain ($p<0.01$), and between anxiety and comprehension performance ($p=0.04$) in Nurses. Significant negative correlations were also found between all three mental states and comprehension ($p<0.05$), depression and attention ($p=0.03$), and anxiety and global cognitive performance ($p=<0.0001$) in Allied Health professionals.

Implications: The present study provides evidence concerning the relationship between stress, anxiety, and depression and cognitive impairment in healthcare workers. The detrimental impact of these mental states on cognitive activity may result in inadequate performance, poor patient care, and increases in the number and severity of adverse medical events. Therefore, the health and welfare of health professionals should be a priority to not only ensure their personal well-being but also ensure optimal patient care and safety.

Exploring the uncanny valley – Why does he/she look creepy?

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New technologies have facilitated the creation of extremely realistic and human-like computer generated characters ("avatars"). It is believed that realism is important in establishing emotional engagement with realistic avatars. However, emotional engagement often breaks down when avatars become nearly – but not completely – realistic, and may be replaced by a sense of discomfort and weirdness. This has been termed the "uncanny valley". We collected event-related brain potentials (ERPs) from 54 participants to investigate the psychophysiological correlates of the uncanny valley and its interaction with low-intensity facial expressions. Participants viewed pictures generated using two avatar models, "Leah" and "Xyza", as well as photographs of two human faces. The faces were shown with either a neutral expression, or depicting mild anger or happiness. The ERP components of interest were P1, N170, and frontocentral emotional positivity (FcEP). We found significant differences in the responses to photo and avatar images as early as the P1, which were sustained until around 300ms. During both the N170 and FcEP time windows, photo images evoked higher amplitude responses than avatar images. We also ran further exploratory analyses to examine differences between the two avatar faces. These revealed that the Leah face evoked very similar responses to the photographic images, while the Xyza face was processed quite differently. Participants often described Xyza as having a "sci-fi" look, and generally rated this avatar the less realistic. While preliminary, these data suggest that our Leah avatar face had crossed the uncanny valley, and was perceived as human and realistic. The Xyza avatar, on the other hand, evoked a large ERP difference with similar spatial and temporal distributions to the FcEP. This is consistent with an emotional response, possibly indicative of the sense of weirdness or discomfort evoked by a nearly realistic simulation of a human agent.

Dissociable roles for the dmPFC and rTPJ in self-other processing: a high-definition tDCS study

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Background: The social brain refers to a network of brain regions that are consistently recruited during social interactions. The dorsomedial prefrontal cortex (dmPFC) and right temporoparietal junction (rTPJ) are engaged during higher-order social tasks requiring the integration and distinction between self and other representations. However, little is known about whether the regions have dissociable roles.

Method: 52 healthy young adults (18-36 yrs) were stratified into two groups; 26 received dmPFC anodal HD-tDCS and 26 received rTPJ anodal HD-tDCS in double-blind, sham controlled, crossover studies. Both groups completed a social cognitive battery measuring self-other processing across implicit and level one and two explicit visual perspective taking (VPT) tasks, as well as self and other encoding effects on episodic memory.

Results: Anodal stimulation to the dmPFC increased the integration of other into self for both level one and two explicit VPT tasks, indexed by a greater interference effect of the allocentric perspective when judging a scene from the egocentric perspective. No such effect was identified for implicit VPT. Anodal stimulation to the dmPFC removed the bias towards self-encoded memories, without affecting overall

memory performance. Anodal stimulation to the rTPJ increased inhibitory control of the egocentric perspective, indexed by a reduced interference of the egocentric perspective when taking on the allocentric perspective only during level two VPT. No stimulation effects were identified for implicit or level one VPT. Anodal stimulation to the rTPJ had no effect on self or other encoded memories.

Conclusion: This is the first causal evidence for dissociable roles of the dmPFC and rTPJ in self-other processing in a task-specific manner. The results have important implications for understanding and potentially modulating the social brain with potential clinical applications.

The effects of modafinil on attentional networks: An ERP study

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Modafinil is a wakefulness-promoting medication that is increasingly used off-label for cognitive enhancement in healthy persons. The aim of the study was to examine the acute effects modafinil (200mg) on behavioural and event-related potential (ERP) measures of attention using an attentional network task (ANT). In this double-blind, randomised, placebo-controlled study, healthy non-sleep deprived males (N=22) completed the ANT at baseline and at 2.5 hours post-ingestion. Congruent or incongruent flanker targets were preceded by a central alerting cue, an informative spatial cue, or no cue. Participants also completed subjective ratings of mood, fatigue, performance, and drug effects. There was an overall reduction in reaction time (RT) from following ingestion of modafinil relative to placebo, and this effect was greater on incongruent relative to congruent trials, suggesting behavioural improvement in executive control. In addition, effect sizes were greatest for no cue and alerting cue conditions. Target-locked occipital N1 amplitude was greater overall following administration of modafinil relative to placebo, with effect sizes greater for no cue and alerting conditions. Results suggest that modafinil may improve tonic and phasic alerting, as indexed by an improvement in early selective attention. However, it remains possible that modafinil acted to prevent fatigue rather than to improve specific attentional mechanisms. Further analysis is required to examine the effects of modafinil on the neural correlates of executive control.

Spatial properties of the premotor attentional shift can differ for saccades and reaches to the same target

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Background: People make goal directed movements to interact with their environment. Each hand movement is typically accompanied by a saccade. The preparation and execution of saccades and goal-directed hand movements also elicits an accompanying shift in attention at the locus of the impending movement. Some key aspects of the spatiotemporal profile of this attentional shift between eye and hand movements are not however resolved. While there is evidence that attention is improved at the target location when making a reach, it is not clear how attention shifts over space and time around the movement target as a saccade and a reach are made to that target. Determining this spread of attention is an important aspect in understanding how attentional guidance works in relation to movement planning.

Methods: We compared performance on a perceptual discrimination paradigm during a saccade-alone task, reach alone task and a saccade-plus-reach task to map the temporal profile of the premotor attentional shift at three locations around the movement target.

Results: The results show that when a reach is being planned in addition to a saccade, attention shifts on a similar timescale to when a saccade alone is being produced, and this differs markedly from when a reach alone is being made. This spread of attention was not symmetrical around the target.

Discussion: The similar profile of attention between the reach + saccade and saccade alone tasks suggest that attention may be drawn from one common resource, and that when a concurrent saccade and reach is being made, the attention accompanying the saccade dominates the observed spatiotemporal profile. We also observed a consistent asymmetric spread of attention around the movement target, suggesting that attention is not allocated to all surrounding locations in a uniform manner. The spatial and temporal profile of attention during goal directed movements can differ depending on the type of movements made.

Structural integrity of recognition memory circuits in carriers of the Val66Met BDNF single nucleotide polymorphism

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Brain derived neurotrophic factor (BDNF) is part of a family of growth factors known to influence the development of brain structure during early life. BDNF is particularly important for stimulating the growth of new neurons, as well as having a critical role in neuronal pruning. In humans, there is a variation within the gene for BDNF that affects the protein's intracellular trafficking and level of activity-dependent secretion. One such genetic variant, known as the Val66Met single nucleotide polymorphism (SNP), has previously been associated with lower accuracy on recognition memory tests. Diffusion tensor imaging (DTI) is a method that provides an in vivo measure of the microstructural integrity of white matter pathways. Here we investigate the integrity of white matter tracts directly linked to recognition memory in order to provide some insight into why carriers of this genetic variant have lower performance on memory tasks. Our results show reduced connectivity within the pathway typically associated familiarity based recognition judgments in carriers of the genetic variant. However, pathways associated with recollection-based recognition judgments do not differ in connectivity between the groups. Furthermore, we also find a significant correlation between the degree of circuit connectivity within an individual and their accuracy on a recognition memory task. We therefore propose that reduced integrity across these memory tracts underpins the reduction in memory performance observed in carriers of the Val66Met variation.

A longitudinal study depicting long term stability of single-trial midfrontal theta oscillations predictive of behaviour

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Cognitive control facilitates flexible behaviour, through top-down guidance of behaviour in line with current goals. Low-frequency, theta (4-8Hz) oscillations within the prefrontal cortex are increasingly recognised as playing a crucial role. Specifically, theta oscillations over medial frontal recording sites (i.e., midfrontal theta; MFT) are frequently reported as a neural signature reflecting the need for cognitive control. We assessed the relationship between midfrontal theta and cognitive control by determining if trial-by-trial midfrontal theta could predict trial-by-trial cognitive control performance. Additionally, the stability of relating single-trial theta to single-trial behavioural performance was analysed longitudinally (mean = 24 months between testing sessions).

Electroencephalography (EEG) was recorded while participants performed a cued-trials task switching paradigm, that disentangled temporal cognitive control processes: i.e., proactive (cueing period), vs. reactive (target presentation) control. Single-trial time-frequency analyses were performed to extract power from midfrontal electrodes. Each trial's corresponding behavioural performance (ie, RT) was extracted alongside the power measures and entered into a robust regression.

We found MFT was associated with cognitive control and trial-by-trial MFT power predicted trial-by-trial RT. Specifically, at time 1, greater theta power during the cueing period resulted in faster RT. Importantly, this was only for trials with informative cues. Additionally,

theta was increased around target presentation, for all conditions. This effect was consistent across all trials, regardless of performance. At time 2, cue-related theta relationships were replicated (ie, theta power predicted RT for informative cues). However, post-target relationships were not replicated. These results confirm the role of MFT in cognitive control, and suggest that proactive relationships may be stable over time.

Understanding the acute neural effects of ketamine using simultaneous EEG/fMRI

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Ketamine is a commonly used anaesthetic with recently discovered rapid-antidepressant actions at subanaesthetic doses. Current understanding of the acute effects of ketamine on the brain is limited due to contradictory findings from EEG/MEG and fMRI. The EEG/MEG literature has consistently shown that ketamine enhances gamma, reduces alpha and produces an onset burst of theta. These studies also show that ketamine reduces cortical connectivity. However, fMRI studies have shown widespread BOLD increases in response to ketamine, with localised decreases in the subgenual cingulate, and widespread hyperconnectivity. Ketamine is particularly challenging to study with fMRI as it alters the vascular properties of the brain and most previous studies have not attempted to control for this. As EEG is unaffected by vascular changes, simultaneous EEG/fMRI acquisition presents an opportunity to overcome the difficulties of ketamine-induced vascular confounds and to make sense of this disparity in ketamine-induced neural changes.

Simultaneous EEG/fMRI data was collected from 25 healthy male participants in a single-blind randomised cross-over study of ketamine and placebo. Resting-state data was collected both before and during a ketamine infusion, and during a placebo session. Heart and respiration rates, and expired O2 and CO2 were continuously measured. As expected, large oscillatory power changes were seen in the EEG resting-state data including decreased delta, increased frontal theta, decreased posterior alpha, decreased low beta (14-26 Hz) and increased high beta (26-40 Hz). However, relatively small changes were seen in the fMRI resting-state data. Frontal, parietal, and thalamic regions showed BOLD increases, while there was a BOLD decrease in the subgenual cingulate. Notably the activity in the subgenual cingulate was not significant when motion was added to the model. Further analysis of the data is required to ascertain ketamine's effects on cortical connectivity.

The Contribution of Depth Cues in Emmert's Law

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The size of an afterimage will appear larger when it is projected onto a surface that is further away, and smaller when projected onto a surface that is closer. Emmert's law provides a mathematical equation for calculating the perceived size of an afterimage when all depth cues are available. In accordance with this law, an afterimage will change in direct proportion to the distance one believes they are viewing it from. As Emmert's law relies on successfully gauging distance, it is expected that the magnitude of the proportional change will decrease as depth cues are eliminated. In this study, we aimed to determine to what extent removing binocular depth cues affects the constancy of Emmert's law.

Participants (N = 22) projected afterimages induced by a ring of LEDs onto a board presented at ten distances under monocular and binocular viewing conditions. We calculated the slope of the change in perceived size of the afterimage over viewing distance and then computed how much this slope deviated from the hypothetical slope predicted by Emmert's law. A paired-samples t-test found an increase in the deviation from Emmert's law when participants viewed afterimages monocularly (M = .09, SD = .04) compared to binocularly [M = .04, SD = .04, t (22) = 5.26, p <.001, Cohen's d = 1.25].

Our findings show that under monocular viewing conditions when fewer depth cues were available, the distance of the board was misperceived, resulting in afterimages that reflected a breakdown in Emmert's law. Whereas, under binocular viewing conditions when all depth cues were available and the distance of the board was computed more reliably, the perceived size of the afterimages more closely reflected Emmert's law. This provides the first demonstration of how perceived size is modulated by the availability of depth cues under conditions of constant retinal size.

A computational model of EMG signal generation following TMS

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Transcranial magnetic stimulation (TMS) is a technique that enables noninvasive manipulation of neural activity and holds promise in both clinical and basic research settings. The effect of TMS on the motor cortex is often measured by electromyography (EMG) recordings from a small hand muscle. However, the details of how TMS generates responses measured with EMG are not completely understood. We aim to develop a biophysically detailed computational model to study the potential mechanisms underlying the generation of EMG signals following TMS.

Our model comprises a feed-forward network of cortical layer 2/3 cells, which drive morphologically detailed layer 5 corticomotoneuronal cells. The effect of the TMS pulse is modeled as a direct current injection to the somata of the cortical L2/3 neurons and the initial segments of the cortical L5 neurons' axon. We model sustained contraction with a Poisson drive to the layer 2/3 cells. Layer 5 corticomotoneuronal cells project to a pool of motoneurons and EMG signal is the summation of motor unit action potentials. EMG recordings from the first dorsal interosseous (FDI) muscle are performed in four subjects and compared to simulated EMG signals.

Our model predicts firing patterns of neurons along the entire pathway from cortical layer 2/3 cells down to spinal motoneurons. It successfully reproduces several characteristics of the experimental data. The simulated EMG signals match experimental EMG recordings in shape and size, and change with stimulus intensity and voluntary contraction level as in experimental recordings. EMG signals exhibit cortical silent periods that are close to the biological values, and reveal an interesting dependence on inhibitory synaptic transmission properties.

We successfully simulate EMG recordings in a range of conditions. Our model should be considered as a viable tool for explaining and analysing EMG signals following TMS.*

Exploring White Matter Correlates of Dyslexia and Dyscalculia with Bayesian Model Comparison and Activation Likelihood Estimation

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Learning disabilities such as dyslexia, dyscalculia and their comorbid manifestation are prevalent, affecting as much as fifteen percent of the population. Structural neuroimaging studies have indicated that

these disorders can be related to differences in white matter integrity, although findings remain disparate. Here, we used a unique design composed of individuals with dyslexia, dyscalculia, both disorders and controls, to systematically explore differences in fractional anisotropy across groups using diffusion tensor imaging. Specifically, we focused on the corona radiata and the arcuate fasciculus, two tracts associated with reading and mathematics in a number of previous studies. Using Bayesian hypothesis testing, we show that the present data favor the null model of no differences between groups for these particular tracts [CR: left hemisphere: BFM = 6.52, p(M | Data) = .87; right hemisphere: BFM = 6.46, p(M | Data) = .87; AF: left hemisphere: BFM = 5.75, p(M | Data) = .85; right hemisphere: BFM = 5.65, p(M | Data) = .85]. These results seem to go against the current view, but might be representative of the disparities within this field of research. Furthermore, reading ability was not associated with reliable differences in white matter integrity in an Activation Likelihood Estimation meta-analysis of Diffusion Tensor Imaging (DTI) studies investigating white matter correlates of dyslexia. Together, these findings suggest that structural differences associated with dyslexia and dyscalculia might not be as reliable as previously thought, with potential ramifications in terms of remediation.

Up, down, in, and out: Target location effects on dual-task target processing

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Operators in complex environments often monitor visual displays while performing other tasks. Motorists, for instance, must scan for potential hazards occurring on and off the road, and even for alerts appearing on the vehicle's dashboard. In such situations, accurate and rapid detections are critical to avoid problematic outcomes. Although factors such as target visual field and eccentricity influence visual search performance, it is unclear whether these factors also influence how efficiently an operator processes multiple visual targets simultaneously, while also under a secondary task load. Thus, in two experiments, we examined target visual field (Experiment 1) and target eccentricity (Experiment 2) effects on target processing within a simulated driving dual-task paradigm. Sixty right-handed undergraduate students (N = 30 in each experiment) completed a redundant-target detection task while performing a manual joystick tracking task. In Experiment 1, targets appeared in either the upper visual field (UVF) or the lower visual field (LVF). In Experiment 2, targets appeared in either a high or low level of eccentricity. We assessed target processing efficiency using measures of standardised workload resilience on response time data. Results found target processing efficiency was highly limited-capacity in both experiments, suggesting that processing is less efficient than predicted by a standard, unlimited-capacity, parallel model. In addition, we found no evidence of any visual field or target eccentricity effects on target processing efficiency. Thus, neither the location of visual targets, nor the eccentricity of targets from fixation, appear to influence processing efficiency while under dual-task load. Our findings suggest the location of targets within the visual field does not affect the processing of redundant targets. Furthermore, we find consistent evidence for a limited-capacity parallel model of target processing within visual dual-tasks.

The contribution of eye movements and visual attention to performance on tests of nonverbal intelligence and Rapid Automatic Naming of adolescents with intellectual disability

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The contribution of visual attention to performance on tests of nonverbal intelligence (NVIQ) or tests of Rapid Automatic Naming (RAN) of adolescents with ID has seldom been investigated. Thus we compared performance on three NVIQ tests and threshold performance on four visual tasks requiring rapid and maintained activation of attention of adolescents with ID and younger typically developing (TD) children of comparable mental age. Performance of the ID group was worse than that of the younger TD group on all visual attention tasks. Indeed the ID group required longer exposure time to ascertain the orientation of a simple stimulus icon and a longer exposure duration in order to embed a simple array of four objects sufficiently well to be able to detect a change (or no change) in the array at a second sequential presentation. Multiple regression analyses were utilized to compare the contribution of the visual attention tests scores to variance on NVIQ scores. These tasks contributed significant variance to nonverbal tests scores for the ID group but not for the TD group. Threshold visual attention scores also contributed substantial amounts of variance to NVIQ test scores for those of the ID group comorbid for ASD but not for the ID without ASD group. Furthermore, comparison of patterns of eye movements and ability to shift attention rapidly showed a shorter stimulus examination time by the older participants (that is the ID group) and greater number of extraneous off-task excursion eye movements than the TD group. In contrast, the TD group spent more time fixating the items in each RAN task. These findings have important implications for future educational approaches.

Association between white matter tracts and language functioning in children born very preterm

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Very preterm birth is associated with altered white matter microstructure and language difficulties which may compromise communication, social function and academic achievement. However, brain structure-function relationships in this domain are poorly understood. The aim of this study was to associate the microstructure of white matter tracts with language functioning in semantics, grammar and phonological awareness and to investigate the role of the arcuate fasciculus, an important language pathway. Language functioning was assessed in 143 very preterm-born (<32 weeks' gestation) children aged 7 years. Diffusion magnetic resonance images were used to obtain fractional anisotropy (FA), axial diffusivity (AD), radial diffusivity (RD), mean diffusivity (MD), neurite density and neurite dispersion values. Using Tract-Based Spatial Statistics (TBSS), the relationship between diffusion parameters throughout the white matter and language performance was measured. In addition, the arcuate fasciculus was delineated using constrained spherical deconvolution tractography and diffusion values were extracted from this region of interest. TBSS analyses revealed higher FA and lower AD, RD, and MD in many major fibre tracts, including those subserving language, to be related with better language functioning in all domains, and higher neurite density in widespread tracts to be associated with better semantic performance. In the region of interest analyses, higher FA and lower RD of the left arcuate fasciculus were associated with better grammatical performance and lower MD of the left arcuate fasciculus was associated with better phonological awareness. Microstructural characteristics reflecting white matter integrity in widespread fibre tracts were associated with better language functioning in very preterm children, including the arcuate fasciculus. The findings suggest that language functioning in very preterm children is dependent on a widespread network of white matter tracts.

What's My Cue? Attention Orienting to Local/Global Stimuli Across the High and Low Subclinical Autism Spectrum

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Given the evidence describing differences in attention processing in clinical Autism Spectrum Disorder (ASD), it is of particular interest to examine the degree to which individuals exhibit ASD-like traits (ATs) and how this can influence which features of the visual environment grab and orient attention. The current study expands previous pilot data exploring differences in involuntary/reflexive attention orienting by local/global compound arrows when viewing Navon-letter stimuli, with different stimulus onset asynchronies (SOA) in a sub-clinical adult sample with high or low AT.

Participants were categorized as high or low AT based on Subthreshold Autism Trait Questionnaire (SATQ) scores. The Navon task required participants to detect the presence or absence of a target letter 'A' that appeared at either local, global, or both levels. The Compound Arrow-Cueing task required the participants to respond to the appearance of a dot target presented to either side of a congruent and incongruent hierarchical arrow stimulus pointing left or right after a 250 or 750 ms SOA.

High AT participants showed a greater local-interference effect (based on RT) when the target appeared at the global-level only. This supports the association between AT and a local bias in visual processing in subclinical AT. Both groups shifted from a global to local-cueing effect with a longer SOA in the Arrow task, indicating that local/global cueing of spatial attention is subject to temporal factors regardless of level of ATs. The greater local bias during explicit global target identification for the High AT group did not transfer to reflexive local/global processing differences in the cueing task. 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.

Evidence that brain noise isn't noise

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Electrophysiological recordings such as Electroencephalography (EEG), Magnetoencephalography (MEG) and Electrocorticography (ECoG) are dominated by non-rhythmical activity who spectral densities can be characterised by power laws (1/f beta). Relatively little is known regarding the neural generators and temporal dynamics of this arhythmical behaviour compared to rhythmical behaviour. Here we used Irregularly Resampled AutoSpectral Analysis (IRASA) to quantify beta, in both the high (5-100 Hz, beta hf) and low frequency bands (0.1-2.5 Hz, beta lf) in EEG/MEG/ECoG recordings and to separate arhythmical from oscillatory modes of activity, such as, alpha rhythms. In MEG/EEG/ECoG data, we demonstrate that oscillatory alpha power dynamically correlates over time with beta hf and similarly, participants with higher rhythmical alpha power have higher beta hf. In a series of MEG investigations using the GABA reuptake inhibitor tiagabine, the glutamatergic AMPA receptor antagonist perampanel, the NMDA receptor antagonist ketamine and the mixed partial serotonergic agonist LSD we reveal systematic effects of excitation-inhibition balance on both beta hf and beta lf. Additionally, strong modulations of beta hf are seen in monkey ECoG data during general anaesthesia using propofol and ketamine. Surrogate data analysis suggest that beta hf is generated by a mixture of underlying linear and non-linear schemes, with non-linear effects emerging at extreme values of beta hf. Overall our results demonstrate that arhythmical activity is sensitive to excitation-balance and interacts dynamically with oscillatory rhythms. When considered alongside previous data showing functional relationships between arhythmical activity and behaviour, there is little justification for describing the arhythmical activity of the brain as noise.

Pro-active control of attention in young adolescents

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Metacognition encompasses skills such as cognitive control and self-monitoring, and allows us to effectively regulate our attentional resources in preparation for task performance (Schneider & Artelt,2010). The amplitude of activity in the alpha band, as measured using electroencephalography (EEG), immediately preceding a stimulus, appears to be an index of proactive control of attentional resource allocation (Hanslmayr et al., 2007). Such recruitment of attentional resources is modulated by task difficulty (Lenartowicz et al. 2014). We investigated whether alpha oscillations can be voluntarily modulated in preparation for a task according to task difficulty. While EEG was recorded, sixty-five 12 to 14 year old participants completed a visual search task where a cue was presented prior to stimulus presentation, indicating the difficulty of the upcoming search display. In addition, participants rated their metacognitive skills on the BRIEF and Conner's rating scales. We observed a strong event-related desynchronisation (ERD) in the alpha-band power in response to both cue types, however this decrease occurred earlier following a cue indicating an easy trial. Across easy and hard trials, a larger ERD after cue onset was both related to participants' processing of cue content, as indicated by a reduced cue-elicited P2 amplitude, ($r = .32$, $p = .009$) as well as with a faster response time, ($r = .25$,$p = .049$). We found no relationships between alpha band power in the cue to stimulus period and participants' self-reported metacognitive skills (BRIEF: $r = .04$, $p = .776$, Conner's Inattention: $r = .23$, $p = .066$, Hyperactivity: $r = .20$, $p = .108$). Thus, collectively, our results suggest that adolescents can 1) use an informative cue to pro-actively control their allocation of attention and 2) this preparative response is related to stimulus processing and behavioural performance on the task but does not seem to be related to participants' self-reported metacognitive skills.

Hypervigilance in Spider Fear: Evidence from Event Related Potentials

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This research examined behavioural and electrophysiological measures of hypervigilance in spider fear using a spatial cueing task. Females with high (n=14) or low (14) spider fear completed a modified spatial cueing task comprising photographic cues of spiders (feared), beetles (neutral) or butterflies (positive) appearing in the left or right visual field. Subsequent targets appeared at the same (valid trial, 75%) or different (invalid trial) location as cues. It was hypothesised that high fear participants would show faster reaction time and greater P1 amplitude following valid spider cues as an indicator of

hypervigilance. Contrary to the hypotheses, high fear participants showed greater reaction time to all targets, with this increase greater following spider cues. These findings were interpreted as cognitive interference following feared stimuli. P1 amplitude was higher overall in the high fear group suggesting generalised attentional hypervigilance compared to low fear participants. However, both groups showed greater P1 amplitude following spider cues, which may indicate a phylogenetic hypervigilance mechanism in response to threat-related stimuli.

White matter connectivity disruptions associated with psychotic experiences in 89 healthy individuals – the psychotic connectome

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Background

Widespread fronto-temporal white matter disruptions in schizophrenia have been widely reported, but it remains unanswered whether these abnormalities are associated with psychotic symptoms specifically or schizophrenia in general. This study compared the structural connectome between healthy individuals with high and low quantities of psychotic experiences. By investigating the extent of white matter connectivity disruptions specific to psychotic experiences in healthy people we eschew the common and mostly unavoidable confounding variables in schizophrenia studies, such as medication, deterioration of cognitive functioning and institutionalization.

Methods

High resolution, multi-shell diffusion-weighted magnetic resonance images were acquired from 44 healthy individuals with a low quantity of psychotic experiences (PE-) and 45 healthy individuals with a high quantity of psychotic experiences (PE+). Whole-brain white matter fiber tracking was performed to quantify the strength of white matter connections. Network-based statistics were applied to white matter connections in order to test for significant streamline count reductions in the PE+ group, relative to the PE- group.

Results

Compared with the PE- group, the PE+ group displayed significant streamline count reductions across fronto-temporal networks, mainly lateralised to the right hemisphere.

Conclusion

We found white matter disruptions in healthy individuals with psychotic experiences across fronto-temporal networks that overlap with those commonly reported in schizophrenia – albeit to a lesser degree. This indicates that white matter abnormalities connecting frontal and temporal brain regions are associated with psychotic experiences specifically rather than schizophrenia in general.

The rhythmic brain: entraining resonant frequencies for therapeutic intervention

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Perturbations in oscillatory activity within and between functional networks have been linked to several psychopathologies including attention deficit hyperactivity disorder, autism spectrum disorder, schizophrenia, and depression. If efficient and effective communication via oscillatory activity underlies good or optimal brain functioning and disordered oscillatory activity within and between networks underlies brain based disorders, then optimisation of this oscillatory activity may play a noted role in reducing symptomatology and improving brain functioning, cognition, and behaviour. Repetitive auditory and visual stimuli are known to be effective methods for the entrainment and modulation of cortical activity, producing changes in functional connectivity by enhancing the connections between neurons and neuronal groups. The current study initially seeks to identify the locus of frequency specific entrainment and to map the networks defined by the spread of functional connectivity entrained by narrow frequency bins of rhythmic auditory and visual stimulation. The current research systematically delivered rhythmic stimuli in 2Hz frequency bins from 2 to 16 Hz while recording 64 channel EEG. For each frequency bin in visual and auditory entrainment conditions respectively eLORETA source localization will compare spectral activity averages with eyes open and eyes closed baseline. Results will be reported (analysis underway) mapping cortical sources in which oscillatory activity is entrained at each frequency bin for the corresponding frequency. Entrained frequency specific networks will then be compared to known functional and structural networks.

Neural processing of orientation disparities yielding fusion and stereopsis

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If we look at a vertical spear, it has a vertical image in each of our eyes. We see a single spear. If the spear is slanted slightly, with its pointy end closer to us, its image in the left eye is tilted slightly clockwise from vertical and its image in the right eye is tilted slightly anticlockwise from vertical. This difference in orientation in each eye is orientation disparity. Despite the different images in each eye, we see a single spear—from binocular fusion—that is slanted toward us—from binocular stereopsis. Orientation disparities increase the more the spear is slanted towards us. Seeing a single spear fails, so we see two images of the spear, at a smaller orientation disparity than our seeing the slant of the spear.

We measured the electrical activity of the brain to 200-ms presentations of gratings presented one to each eye with a range of orientation disparities from 0° to 18° between the eyes. Disparities were around vertical, yielding fusion and stereopsis, or around horizontal, yielding only fusion. Event-related potentials yielded two components from electrodes over the occipital cortex:

- A positive deflection 100 ms after the onset of the lines (the P1) whose amplitude decreased with increasing orientation disparity and that was greater for disparities around vertical than around horizontal.
- A negative deflection 170 ms after the onset of the lines (the N1) whose amplitude increased with increasing orientation disparity and that was less for disparities around vertical than around horizontal.

We conclude that:

- The P1 reflects activity from fusion and stereopsis, cooperative processes between the inputs from the two eyes. These decline as orientation disparities exceed the processes' operating ranges.
- The N1 reflects activity from binocular rivalry, a competitive process that comes more into play with larger orientation disparities.
- The differences in activity from orientation disparities around vertical are from stereopsis.

Modelling me, modelling you: the autistic self

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The stereotype of Autism Spectrum Conditions (ASC or "autism") focuses on the social and communicative elements of the diagnostic criteria. In this review, we step back from autism as a social and communicative disorder and focus on the autistic self. The autistic self is a key component of the condition which has nevertheless received comparatively little attention. We provide a taxonomy for experimental paradigms in the cognitive sciences that aim to address questions related to the self in the areas of action, memory, attention, recognition, body-representation, awareness of internal states, language and self-knowledge. We critically evaluate their relationships to philosophical conceptions of the self including Bayesian accounts, narrative, minimal and embodied selves. Further, we articulate reasons why the self might differ in ASC drawing from the empirical evidence presented. We emphasize the possible impact of a predictive processing account of autism on conceptualizing the autistic self, with a focus on context sensitivity, model complexity, learning, integration, active inference and precision. This opens up large scope for future

research on unique differences in the autistic self, which is intended to be extended as a framework for understanding the condition as a whole in a new and unified way.

Neural processing of others' gaze independent of facial features

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It is a distinct feeling to be the focus of another's attention, and this information is crucial to guiding our interaction with others, understanding their thoughts, and anticipating their behaviour. Enabling this, the primate visual system is specialised to detect and integrate sensory cues to others' head position and eye deviation, which together jointly specify their direction of regard. Recent research in humans has localised processing of these facial features to the anterior superior temporal sulcus (STS), but whether this region underlies our perceptual experience of others' gaze is yet to be determined. To answer this question, we exploited a visual illusion in which identical eye regions are seen as looking in different directions depending on the orientation of the surrounding head. With functional MRI, we measured differences in neural activation in human observers to faces that appeared to be regarding them versus faces that appeared to be looking elsewhere, while exactly matching the facial features in the stimulus that combine to produce these percepts. This revealed a neural correlate of perceived gaze direction in anterior STS, namely an increased response when the direction of gaze was away from the observer compared to when the observer was the focus of attention. These data extend upon existing knowledge by distinguishing the neural responses that reflect the sense of where other people are looking from those that reflect the physical attributes of faces that convey this information.

The Site of the Stimulation Field Moderates Neuropsychiatric Symptoms after Subthalamic Deep Brain Stimulation for Parkinson's Disease

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Deep Brain Stimulation (DBS) of the subthalamic nucleus (STN) is an established advanced therapy for the motor symptoms of Parkinson's Disease (PD). However, DBS may also precipitate unwanted mood and behavioural changes. The location of the stimulating electrode is theorised to influence the evolution of neuropsychiatric side-effects.

64 patients (48 M, mean age=61.8) with PD received STN-DBS. Motor and neuropsychiatric symptoms were evaluated at baseline and 3-months post-DBS. Neuropsychiatric measures included the Excluded Letter Fluency (ELF) task, Hayling task and Empathy-Quotient. DBS parameters were used to estimate a Volume of Activated Tissue (VAT), with reference to the motor, associative and limbic sub-territories of the STN.

Repeated measures ANOVA confirmed a significant decrease in motor symptoms post-DBS (indexed by the UPDRS, mean change=-3.66, $p=0.001$). At the group level there were no significant neuropsychiatric changes ($p>0.52$), although there was considerable inter-subject heterogeneity. The extent of VAT overlap in the right associative STN was significantly associated with post-DBS impairment in the ELF ($r=-0.40$, $p=0.001$), and improvement in the Hayling task ($r=0.30$, $p=0.02$). We delineated clusters of STN-voxels significantly associated ($p<0.05$, tfce-corrected) with post-DBS changes in ELF and Hayling performance. Discrete patterns of stimulation in the associative STN related to impairment and improvement in these measures of inhibitory control.

In sum, we identified zones within the STN related to both improvement and deterioration in neuropsychiatric symptoms of patients treated with STN-DBS for PD. This underscores the importance of accurate electrode targeting, contact selection and device programming to reduce the likelihood of DBS-related psychiatric impairment.

Testing predictions about the processing of word stress in reading using event-related potentials

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Both computational models of English reading that generate word stress predict a processing advantage for words with initial syllable stress. They differ, however, on whether they process words incrementally and learn nonlinear spelling-stress relationships. Two experiments using event-related potentials were used to investigate these predictions. The first examined trisyllabic stimuli. Differences found on P200 and N400 components suggested a processing advantage for words with initial syllable stress. The second examined root morphemes within words that have high frequency suffixes that are stress predictive. A processing advantage on the N400 component was found with root morphemes that typically have initial syllable stress, even when the whole-word stress pattern differed. This provides evidence that stress is generated incrementally, where it is assigned to parts of words as they are processed, and that stress assignment is not necessarily affected by high frequency nonlinear relationships.

Eye movement patterns during fluent reading in primary school children: preliminary findings

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Fluent reading is the ability to seamlessly read text with accuracy and speed and considered the hallmark of a good reader. However measuring fluent reading across the reading spectrum is challenging, as one must consider the influence of word familiarity/difficulty. Thus, the current study aimed to investigate the role of eye movements on text-difficulty-controlled reading fluency in children of a broad range reading abilities from Grades 3-6 (64 participants). All had adequate intelligence (>85), and no developmental or neurological disorders, other than those associated with reading. The Neale Analysis of Reading Ability (3rd Edition) was used to determine the appropriate text difficulty to assess reading fluency for each child. The highest passage at which each child read with < 5 errors was taken as an indicator of appropriate text difficulty to measure rate and accuracy. An alternative form of the same passage level was presented on a computer screen and students were told to read as quickly and as accurately as they could while eye movements were recorded. Partial correlational analyses (controlling for text difficulty and grade level) show that reading fluency (taken as words read per minute) correlated significantly and negatively with Fixation Count, Regression Count, Mean Fixation Duration, and Mean Number of Fixations per Word Read. This suggests that reading fluency in children is associated with the ability to make shorter and fewer fixations, fewer regressions, and fewer fixations for each word read. Interestingly, multivariate analyses of variance comparing these eye movements between passage levels revealed no significant differences in eye movements. This would seem to suggest that readers of different reading ability levels use similar eye movement patterns when fluently reading text appropriate to their individual ability level.

Fuel for the ageing brain: Acute effects of glucose on resting state functional connectivity of the posterior hippocampus

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Ageing is a natural process and typically associated with some degree of cognitive decline. One brain structure that is particularly associated with cognitive decline in ageing is the hippocampus.

Age-related cognitive decline has also been linked to changes in glucose metabolism.

Glucose is the primary energy source of the brain. An increasingly well-defined effect of glucose ingestion is a transient improvement in cognitive performance, which has been termed the 'glucose facilitation effect'. Relatively little is known about the neurocognitive mechanisms of this effect. As episodic memory has been most reliably demonstrated to benefit from glucose ingestion, the hippocampus has been hypothesized to be involved.

This talk will describe the outcomes of a placebo-controlled, double-blind, crossover neuroimaging study investigating the relationship between age, glucose and human cognition with a special emphasis on the connectivity of the hippocampus along its anterior-posterior axis to the rest of the brain.

Young (n=16; age: 21-30) and ageing (n=16, age: 55-78) cognitively normal, healthy subjects attended two separate testing sessions. After the ingestion of a drink containing glucose on one and placebo on the other visit (in randomized order), participants underwent resting-state functional MRI and cognitive testing.

Seed-based connectivity analysis revealed that resting state functional connectivity of the posterior hippocampus to clusters in the left dorsolateral prefrontal cortex, right prefrontal cortex, and right inferior frontal gyrus was modulated with a glucose load in older people, but not in the younger group. The strength of the change in connectivity was related to glucoregulation and cognition in the older group, which provides an interesting framework for the relationship between ageing, glucoregulation and hippocampal connectivity.

Developing a test of language comprehension for non-verbal children with autism using the N400 Event-related Potential

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Verbal communication is central in everyday life, and the ability to understand language is often taken for granted. However, for individuals who don't speak, such as minimally-verbal children with autism, it is crucial to assess the extent of their language comprehension, without relying on their behavioural responses. Thus, we sought to develop a non-invasive measure of language comprehension using neuroimaging. Using Electroencephalography with typically developing children, we examined the possibility of detecting language comprehension by recording the N400 Event-Related Potential in response to semantic violations. The N400 is a well-known marker of semantic comprehension, but its sensitivity for detecting semantic processing in individual children has not been established. In Experiments 1 and 2, we used two auditory paradigms that manipulate the semantic dimension of language: in the first one we presented congruent and incongruent sentences (e.g. "She wore a necklace around her neck" vs "She wore a necklace around her milk"), and in the second one we presented pairs of words that were either related or unrelated (e.g. "row-boat" vs "row-pen"). In both experiments we elicited a reliable N400 effect in our group of children aged 6 to 12 (N=16 for Exp 1 and N=15 for Exp 2). When looking at individual participants, we found considerable variation in children's responses in both topology and timecourse. We were able to record reliable N400 effects in about 60% of children. In Experiment 3, we sought to increase the rate of detection of the N400 effect at the individual level by presenting animated videos concurrent with the auditory sentences of Exp 1. With this new design, we intended to boost children's engagement with the task and to increase their semantic expectations for each sentence. Eventually, the presence of an N400 effect in a non-speaking individual would be a positive sign of semantic integration, and point towards preserved language comprehension.

Diffusion Weighted Imaging in Anorexia Nervosa

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Anorexia nervosa (AN) is a psychiatric illness characterised by significant disturbances in body image leading to excessive weight loss. The neurobiological mechanisms involved in AN are unclear, particularly the role of white matter in the illness. The aim of this study was to investigate white matter microstructure, estimated with the fractional anisotropy (FA) in individuals with AN and healthy controls (HC). Diffusion-weighted magnetic resonance images were acquired in 26 female participants with AN and 27 age- and gender-matched HC, and FA was tested for significant differences between groups. Reduced FA was found in AN participants, relative to HC, in a number of regions including the corpus callosum, corticospinal tract and left forceps major. The findings suggest white matter pathology in AN in regions of the brain involved in multisensory integration and the production of saccadic eye movements; deficits which have been reported in AN and may contribute to the body image disturbance experienced in the illness.

Clinical and cortical progression in non-fluent primary progressive aphasias and Alzheimer's disease

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Diagnosis and prognosis of the two non-fluent variants of primary progressive aphasia - nonfluent/agrammatic variant (nfvPPA) and logopenic variant (lvPPA) - is challenging due to overlapping language features at presentation and heterogeneous clinical courses. Whether the emerging clinical changes are associated with phenotype-specific and/or common trajectories of neurodegeneration is currently unknown. Here, we used (social) cognitive evaluations and neuroimaging data to examine brain-behaviour associations in 15 nfvPPA, 14 lvPPA and 15 Alzheimer's disease patients (AD) over 5 years of follow-up. Our results demonstrate that despite showing similar language profiles at presentation, non-fluent primary progressive aphasia patients have divergent clinical courses, with rapid cognitive and neural changes in lvPPA and additional social cognition decline in both nfvPPA and lvPPA. Our findings further show that, despite both harbouring Alzheimer pathology in the brain, lvPPA and AD represent distinct clinical and neurobiological entities, also with disease progression. Clinically, our results inform the characterisation and prognosis in nfvPPA and lvPPA and demonstrate the need for the inclusion of social cognition tasks in the monitoring and everyday management of these patients. Further, our results shed light on the longitudinal spread of pathology in these syndromes in vivo and suggest that underlying Alzheimer pathology is associated with a more severe disease course in nonfluent progressive aphasias. Finally, the identification of phenotype-specific sites of atrophy in nfvPPA and lvPPA is useful information for future clinical trials.

Computational modelling of auditory distraction in younger and older adults

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In an auditory-auditory distraction mismatch negativity (MMN) paradigm, participants respond to equiprobable features of stimuli (e.g. tone duration) while another task irrelevant feature of the stimuli has probabilities that make one feature rare (deviant) and the other common (standard), e.g. tone pitch. Older adults are slower and more error prone compared to young adults having a more pronounced "distraction" effect i.e. longer reaction time when the sound is deviant on the irrelevant feature. This presentation shows how we have tightly linked neural observations (single trial ERPs) to behavioural observations by using a novel approach to jointly fit a computational model. Methodological limitations that have made this type of analysis difficult previously have been largely solved by fitting the data in a hierarchical Bayesian framework, which means low error rates can be constrained by group level parameters and neural data with relatively small trial numbers can be accommodated. Our approach links several ERP mean amplitude measures to capture the key components of the auditory evoked potential (P1, N1, P3) from each trial at three frontal electrode clusters with parameters of the Linear Ballistic Accumulator (LBA) model. In this model, the only parameter free to modulate the modeled ERP amplitude was the rate of evidence accumulation. Given MMN can be used as an index of relevance filtering integrity, we expected that a sound pattern being violated by an unexpected sound (i.e. a rare deviation from a highly repetitious pattern) would elicit increased MMN and increased distraction, which should be linked to lower drift rate (longer time to evaluate evidence for a decision). Smaller MMN should be accompanied by less distracted performance in the concurrent behavioural task and modeling this will lead to a better understanding of the underlying mechanism. How this fits in the context of reduced MMN amplitude observed in clinical populations will be discussed.

Exploring somatosensory cortex using ultra-high field (7T) fMRI

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Recent advances in fMRI, particularly accelerated image acquisition and ultra-high field (7T), have enabled high-resolution measurements and thus have provided the capability to non-invasively study the organization and function of smaller cortical areas in humans. One such area is primary somatosensory cortex, S1, in which the neuronal processing of tactile information largely occurs. We recently showed that high-resolution fMRI at 7T can be used to access and measure neural correlates of both sensory stimulation and endogenous attention to individual fingertips in S1. Here, we combined a novel experimental design with fMRI at 7T to further explore these correlates within individual participants.

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 types of experimental conditions: sensory and attention. During sensory conditions, vibrotactile stimulation was delivered to individual fingertips. The frequency of vibrotactile stimulation changed every 2 s, and three different frequencies were used (5, 20, and 100 Hz). During the attention conditions, participates attended to a particular fingertip in order to report the nature of the frequency changes (higher or lower than previous) at that fingertip while ignoring the stimulation at other fingertips.

Both stimulation and attention elicit responses along the postcentral gyrus in a somatotopically appropriate fashion permitting a direct comparison between the two. Importantly, this modulation was measured at the level of the cortical representation of individual fingertips. 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.

Influence of bias on response preparation and execution across the lifespan: a combined TMS and computational modelling study

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The current study aimed to determine how humans utilise specific task-related information in order to select and execute the most appropriate response from multiple possible actions during rapid response tasks.

Young (n=15; 18-35 years) and older (n=15; > 60 years) adults performed a choice reaction time task using the left- and right-hand index fingers in response to left- and right-sided visual stimuli. On a block-by-block (block bias) and trial-by-trial (trial bias) basis, conducted in separate sessions, participants were informed of the probability that the required (correct) response would be with the left or right hand. Different blocks were either unbiased (equal number of left- and right-sided stimuli) or biased (50% more left- or right-sided stimuli) to a certain response.

Preliminary conventional analyses suggest that differences in reaction time ($p = 0.02$) and accuracy ($p = 0.03$) between young and older adults varied as a function of the type of bias (block vs. trial). That is, older adults exhibited a greater slowing (46 ms) during the trial than block bias compared to younger adults (20 ms). Accuracy during trial-bias was lower (0.5%) compared to block-bias for older adults whereas higher accuracy (1.6%) was observed for younger adults in the trial-bias compared to block-bias condition.

Ongoing computational modelling of reaction time distributions will permit us to investigate how the bias conditions influence the underlying cognitive processes of decision threshold setting and evidence accumulation, as well as understanding how these are affected by the ageing process.

Furthermore, based on the above behavioural results, transcranial magnetic stimulation (TMS) will be utilised to elicit motor evoked potentials (MEPs) from the responding effector at various time points during action preparation and action execution to more fully understand the neural correlates underlying the bias effects.

Eye Movements as Indictors of Item Difficulty and Problem-Solving Strategy on the Raven's Coloured Progressive Matrices in Primary-Aged Children

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Eye movements are generally well accepted indicators of shifts in attention, though their role in understanding problem solving capacity and efficiency is a relatively new area of research. Thus, this study explored eye movement (EM) patterns as a predictor of non-verbal intelligence and problem solving strategies.

Eye movements were measured for fifty-four typically developing primary school children (aged eight and twelve years) while attempting to solve a computerised version of the Raven's Coloured Progressive Matrices (RCPM). Measures consisted of total time viewing matrices and potential answers, and number of switches in relation to areas of interest (i.e. matrices vs answers) on selected groups of items representing four item categories of the RCPM (Simple Pattern Completion, Discrete Pattern Completion, Continuity and Reconstruction of Simple and Complex Structures, and Reasoning). These measures were compared across correct and incorrect responses to determine potential differences in problem solving strategy.

Results did not demonstrate significant differences in EM based on

correct responses. However, significantly longer times viewing the puzzle matrix and greater frequency of switching between the matrix and answers were observed for more difficult item categories, such as Reasoning in comparison to Pattern Completion. Within category differences also indicate that participants spent significantly more time on the matrix in comparison to the answers for Reasoning items. In comparison, participants tended to spend more time on the answers for the second most difficult item category, Continuity and Reconstruction.

These differences in EM patterns are an indication of problem solving strategy varying in terms of item difficulty, where more complex matrices require encoding of item rules before answer selection, and easier items are based on response elimination process.

The influence of the laboratory environment on the measurement of language lateralisation

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Hemispheric lateralisation can be assessed with both functional magnetic resonance imaging (fMRI) and functional transcranial Doppler ultrasonography (fTCD). However, concordance between these techniques is imperfect. This discrepancy may be partially explained by differences in the fMRI and fTCD laboratory environments: while fMRI occurs in a noisy, confined space while subjects lie supine, fTCD typically occurs in a quiet, unconfined space while subjects sit upright. This study investigated the influence of the fMRI and fTCD laboratory environments on the measurement of language lateralisation. FTCD was used to measure of language lateralisation while participants performed a word generation task either twice in an fTCD environment (control group), or once in an fTCD environment and then in a simulated fMRI environment (experimental group). A Bayesian analysis revealed evidence of no effect of the laboratory environment on absolute lateralisation change scores. However, relative to the control group, test-retest reliability of lateralisation indices was considerably lower in the experimental group. This may have been driven by several individuals, whose lateralisation indices switched from positive to negative between the two assessments. Consistent with this, several participants in the experimental group switched lateralisation categories between the two testing session. These findings suggest that the laboratory environment may partially account for the discordance between fMRI and fTCD lateralisation estimates. Future research should embrace protocols that aim to reduce the interference of the laboratory environment, such as noise-cancelling headphones and open, multi-postural fMRI, to further our understanding of hemispheric lateralisation.

Bayesian inference as a model of complex decision making in humans

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Bayes' theorem postulates that the probability of a hypothesis (e.g., has it rained today?) given an observation (e.g., the streets are wet) is a weighted sum of the probability of the hypothesis on its own (e.g., it seldom rains in Adelaide) and the probability of the observation given the hypothesis (e.g., when it rains the streets are always wet). Bayes' rule has been used successfully to model different aspects of human cognition, from shape constancy to spatial navigation. In the present study, we tested whether complex decision making also follows Bayes' rule. As the defining aspect of complex decisions, we identified the necessity to integrate several sources of information to reach a single decision. To measure the integration process, we used a motion averaging task in which a field of randomly moving dots was presented for several seconds. Twice per trial, coherent motion was presented briefly and participants reported the average motion direction across the two epochs. The motion coherence (low vs. high) varied randomly across epochs yielding four conditions (2 coherence levels x 2 trial epochs). Behavioural responses were modelled as a weighted average of the first and the second target motion. Consistent with Bayes' rule, participants' response weights were stronger for high motion coherence relative to low. Analyses of concurrently recorded EEG focused on the CPP, a positive deflection at central/parietal electrodes thought to reflect the temporal dynamics of decision making. Consistent with the behavioural data, the peak amplitude of the CPP was larger for high motion coherence relative to low. Taken together, the behavioural and electrophysiological results suggest that combining different sources of information operates in a weighted fashion, with weights being proportional to the quality of each source. In other words, complex decision making in humans follows Bayesian inference rules.

Dynamic causal modelling reveals effective connectivity of brain network underlying episodic memory retrieval during natural viewing

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Episodic memory is the memory of previously experienced events. While hippocampal lesion dramatically impacts episodic memory, recent imaging studies has revealed a brain network consistently engaged during episodic retrieval, including hippocampus, precuneus, angular gyrus and prefrontal regions. However, the causal relationship between these cortical regions and their roles in episodic retrieval remain elusive. This study investigated this network relationship using a novel naturalistic fMRI paradigm on episodic memory. Twenty-two participants viewed 18 news clips, including 9 clips which are continuation of previously viewed news and 9 novel clips. Comparing to novel clips, continuing viewing evoked greater activation in anterior hippocampus, precuneus, angular gyrus and superior medial frontal regions, etc, presumably due to the retrieval of memory from the previously viewed news clips. We then employed dynamic causal modelling (DCM) to investigate the effective connectivity between these regions using a systematic, unbiased method. Our results revealed inferences about how information in these brain regions propagates during natural memory function. Intriguingly, task condition significantly modulated the connections from the precuneus and the hippocampus, which further correlated with successful memory retrieval. Using an elegant design of naturalistic stimuli, our study provides an ecologically-valid framework for elucidating the neural mechanism of memory retrieval in a rich context resembling one's real life. This paradigm could be further adopted to examine memory impairments in neuropsychiatric disorders.

O. stamineus exhibits anti-amnestic effects via the BDNF-TrKB & CREB-BDNF pathway

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Alzheimer's disease is a chronic neurodegenerative disease that causes cognitive impairment like decline in learning and memory. Orthosiphon stamineus (OS) is a medicinal herb that contains many flavonoid components like rosmarinic acid that has been reported to exert various pharmacological activities. The objective of this study was to evaluate the effect of OS in the scopolamine induced amnesia model in experimental animals. Rats were orally treated with OS extract or donepezil, followed by scopolamine (1mg/kg i.p.), once daily for 7 days. On the 7th day after dosing animals were subjected behavioral analysis to assess memory function and molecular studies to understand the mechanism of action. OS was found to improve memory functions. The expression of brain-derived neurotrophic factor (BDNF), tropomyosin receptor kinase B (TrkB) and cAMP re-

sponsive element binding protein 1 (CREB-1) were also modulated by OS treatment. Additionally, it was also observed that OS treatment increased the immature neurons against hippocampal neurogenesis suppressed by scopolamine, which was observed by the DCX-positive stained cells. These findings therefore infer that OS could be a promising therapeutic moiety in treating neurodegenerative diseases like Alzheimer's disease.

No evidence for a relationship between visual processing and mirror neuron system function in autism spectrum disorder

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Autism spectrum disorder (ASD), a serious neurodevelopmental disorder characterised by lifelong social and behavioural dysfunction, remains elusive in terms of its core neurobiological underpinnings. The mirror neuron system (MNS), a group of frontoparietal neurons believed to underlie social function by discharging during action observation and execution, has been theorised to underlie the social difficulties in ASD. Results, however, remain inconclusive. To date, studies have not as yet considered the role of visual processing style differences in ASD. Given this, and the close relationship between the visual processing system and MNS, it is important to determine whether the MNS is dysfunctional in ASD or whether it can be better explained by deficient visual processing input. The aim of this study was to determine the impact of visual processing ability on MNS function in ASD. A group of 35 participants (20 neurotypical, 15 ASD) completed a series of visual perception tasks and viewed a series of short videos sourced from well-known films and television series containing goal-directed right-handed biological movements. Concurrent transcranial magnetic stimulation and eyetracking were employed to provide indices of putative MNS activity and gaze allocation, respectively. Dynamic interest areas were created around regions within each video that were deemed to be central to understanding the social dynamics of each video. Results demonstrated that as expected that ASD had significantly lower scores on measures of social cognition. There were also significant group differences in performance on visual perception tasks. In contrast to expectation, groups did not differ in MNS activity, and measures of visual processing did not relate to MNS activity. Overall, findings do not support a global MNS deficit in ASD, nor does visual processing ability explain MNS function. Findings, however, need to be considered in the context of the heterogeneous nature of ASD.

rTMS in animal models: from single cells to complex behaviour

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Repetitive transcranial magnetic stimulation (rTMS) induces plastic changes in normal and abnormal neural circuits. Here we study the potential synergistic interactions between low-intensity rTMS (LI-rTMS) and endogenous brain activity to promote beneficial long-term neural circuit reorganisation. We delivered LI-rTMS to the visual cortex of awake, freely moving ephrin-A2A5-/- mice engaged in a visual learning task because their morphologically abnormal visual maps have been shown to be beneficially impacted by LI-rTMS. Mice received chronic implantation of a detachable coil support and underwent 2 weeks of weight restriction and 10 minutes daily training in a two choice visual discrimination task using food rewards, with concomitant LI-rTMS or sham (no stimulation control). No-task controls were placed in the task arena and received the reward food without visual discrimination training. Visuomotor function and corticotectal topography were assessed at the end of the intervention. The visual learning task prevented the beneficial anatomical reorganisation in the corticotectal projection induced by LI-rTMS alone, but did not affect visuomotor function, or accuracy in the visual learning task. Intriguingly, there was a significant increase in the total number of trials completed by task+LI-rTMS mice. Interactions between intrinsic brain activity and LI-rTMS may not always be synergistic, although LI-rTMS may affect motor function and/or increase motivation and drive. We have established a protocol to investigate the 'online' effects of LI-rTMS in awake freely moving mice that can be used to better understand rTMS effects, an essential step in improving future clinical translation.

Assessing the role of prefrontal cortex inhibition in working memory using combined TMS and EEG

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Working memory, the capacity to hold items in the mind for several seconds, is a fundamental cognitive function. Animal studies have implicated the modulation of cortical inhibition in the prefrontal cortex as an important mechanism allowing the short term storage of information, however whether this is also true in humans remains unclear. Combined transcranial magnetic stimulation (TMS) and electroencephalography (EEG) provides a new method for non-invasively assessing cortical inhibition in the prefrontal cortex of humans. In this series of studies, we assessed whether modulation of the N100, a TMS-evoked cortical potential (TEP) related to cortical inhibition, was important for working memory performance.

In study 1, paired pulse TMS-EEG (interstimulus interval = 100 ms) was used to assess inhibitory function over left prefrontal cortex at rest (N=20). Correlation analysis was performed between the capacity to inhibit the N100 and performance on a Sternberg working memory task. In study 2, single pulse TMSEEG over prefrontal cortex was given at rest and during the delay period of the Sternberg task to further assess memory-related modulation of N100 amplitude (N=20). The capacity to reduce the N100 following paired-pulse TMS at rest was negatively correlated with working memory reaction time, indicating that individuals capable of stronger N100 modulation performed faster than those with less modulation. During the delay period of working memory, the prefrontal TMS-evoked N100 was supressed compared to at rest, providing functional evidence that the capacity to reduce prefrontal cortical inhibition is important for working memory. Taken together, our findings provide evidence that inhibition is modulated in the prefrontal cortex during working memory. Our results inform the neural mechanisms responsible for healthy working memory, and provide a framework for linking deficient inhibitory function to impaired working memory in disorders such as schizophrenia.

Mirror-reading changes perception of space

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The perception of space might be modulated by the culture we live in: Healthy Western individuals typically show a slight bias towards the left of space. Individuals from cultures with right-to-left reading scripts, however, have been reported to show a bias in the opposite, rightward direction. The aim of this study was to (1) assess spatial biases in individuals with opposite reading directions and (2) investigate the malleability of these spatial biases by employing a brief mirror-reading paradigm.

In their home countries, 24 English (left-to-right ((L-R)) and 23 Hebrew (right-to-left (R-L)) readers read two travel recounts out loud at separate times, presented in either a standard or mirror-reversed format (counterbalanced order). Immediately after reading, the participants' spatial bias was assessed by the means of a landmark task. Results showed that (1) native L-R and R-L readers have opposite spatial biases and (2) that short exposure to mirror-reading was sufficient to reverse the spatial biases in both groups. L-R readers demonstrated a rightward shift in perception following mirrored as compared to standard reading (vice versa for R-L readers). The findings demonstrate that cultural reading habits have a profound effect on spatial perception and hence question purely neurobiological explanations for spatial asymmetries (e.g. right hemispheric dominance for spatial tasks). Such explanations are further questioned by the demonstration that the spatial biases were reversed after reading mirrored

script. The findings of this study thus suggest the need for a more flexible and adaptive account of spatial asymmetries than captured with pure neurobiological explanations.

An eye-tracking examination of the Shepard and Ebbinghaus illusions in children with autism spectrum disorder

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There are many reports of more accurate and detail-focussed visual processing in individuals with autism spectrum disorder (ASD) – even though perceptual differences are not included in the DSM-5. Recent studies have found reduced susceptibility to the Shepard illusion in adolescents and adults with ASD, as well as reduced illusory strength as a function of autistic traits in the typically-developing (TD) population. This study aimed to examine susceptibility to computerised versions of the Shepard and Ebbinghaus illusions in children with ASD, while monitoring eye movements to determine if shifts in attention relate to illusion strength. Participants consisted of 18 individuals with ASD (12 males, age range 6.5 – 15.5, mean = 11.4) and 18 TD individuals (12 males, age range 6.0 – 14.7, mean = 11.4) matched for gender, age, and raw scores on the Raven's Progressive Matrices. The ASD children (M = .14, SD = .09) demonstrated reduced illusion strength relative to the TD group (M = .20, SD = .05) for the Shepard ($t(34) = 2.41$, $p = .043$) but not for the Ebbinghaus illusion ($t(34) = 0.41$, $p = 1$). There were no group differences on any of the eye-tracking measures. However, in the ASD group, there was a positive correlation between the strength of the Shepard illusion and how much time the children spent looking at the standard stimulus. Overall, we conclude that the presence of a difference in illusory strength between ASD and TD children depends on the illusion, and that the illusory difference is attributable to perceptual, rather than cognitive, attentional, or oculomotor mechanisms.

The interaction between attention and associative learning: predictive vs non-predictive cues

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The relationship between attention and learning is not fully understood. Attention might be biased towards cues that have already been learned to be good predictors of important outcomes. Conversely, attention might be biased towards cues whose relationship to future events is uncertain, so that more information about these currently ambiguous stimuli can be obtained. In three experiments (N = 23, N = 26, N = 18), human participants completed an intermixed associative learning and dot probe task. Participants had to learn to categorise cue compounds, with one of the cues being predictive of the categorisation response and the other being non-predictive. The same stimuli were then used as invalid spatial cues in a dot probe task (the target was equally likely to appear over the previously predictive and non-predictive cues). We used electroencephalography to measure a lateralised event-related potential (ERP) component, the N2pc (posterior contralateral N2), which is related to the deployment of covert visual-spatial attention. Our results showed that participants were faster to respond to a target that appeared in the location of a cue that was predictive of the categorisation response. The mean amplitude of the N2pc elicited by the target when it appeared over the non-predictive cue was significantly larger compared to when the target appeared over the predictive cue. In addition, participants reported that they noticed the target appear over the predictive cues more often compared to the non-predictive cues, even though all cues were invalid predictors of the target. Lastly, we found attention modulations in another lateralised ERP component, the Ppc (posterior contralateral positivity). The mean amplitude of the Ppc elicited by the target showed an inhibition-of-return-like interaction with cue-target onset asynchrony. These results have implications regarding cue and outcome processing, and may help to reconcile competing attentional learning models.

Objective Contrast Threshold Predicts Non-conscious Visual Cue Efficacy and Age

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School of Psychology

Dr Nathan Ryckman, *University of Auckland*
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Using a staircase procedure, the contrast level at which participants were no longer able to accurately discriminate between two visually dissimilar cues (letters: X, T) was obtained. The threshold was obtained by presenting cues briefly (33ms, 33ms ISI) before being masked by non-predictive shapes (a circle or a square). The threshold was then used as the stimulus level in an eye-movement orientation phase. In this phase participants were instructed to rapidly orient their visual focus to a particular shape (circle or square), and that the accurate letter from the previous phase would be 75% predictive of shape location. Cue onset was separated from target onset by a variable ISI (33ms or 467ms). Lastly, participants completed a discrimination task at their threshold to confirm their continued inability to consciously discriminate between cue stimuli. Participant threshold was significantly predicted by eye movement orientation reaction times and age in a multiple regression model, with age being the largest factor. It was further determined that where younger participant eye movement reaction time was facilitated by the non-conscious cue, older participant reaction time was not. Younger participants demonstrated a 74ms facilitation effect (i.e., responding 74ms faster to valid compared to invalid trials) for brief ISI trials, and a modest 30ms facilitation effect for long ISI trials. Our results suggest that unconscious visual cues may be utilized to rapidly shift attention, but that this advantage may drop off at a relatively early age (our sample mean age = 23) and is stronger for individuals with lower peripheral detection thresholds (threshold and age correlated at r = .621). This work was supported by the Marsden Fund of New Zealand.

A meta-analytic review of the size-weight illusion and other illusory weight perception

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Findings from weight-related illusions demonstrate that our perceptual experience of weight varies with differing object properties. The most robust of these illusions is the size-weight illusion (SWI), in which individuals are presented with two objects of different volume but equal mass, and invariably report that the smaller of the two objects feels heavier. Although several theories exist to explain the SWI, none of them account for all relevant findings. The most prominent theories fall into one of two categories: 1) top-down cognitive accounts highlighting how expectations of object weight impact perception, and 2) bottom-up accounts related to the variables that are directly perceived by the body during lifting, variables that must be interpreted consciously as weight. We conducted a meta-analysis of findings of the SWI and other, related findings on illusory weight perception. To inform on the mechanisms driving the SWI, we examine the contribution of both visual and haptic/kinaesthetic object information to the strength of the illusion. Haptic and kinaesthetic feedback may be particularly important in illusory weight perception, which would point to a bottom-up account of the SWI and weight perception more generally. We also statistically compare illusion strength between the SWI and other weight illusions that are founded entirely on explicit expectations of weight (e.g., the material weight illusion). This analysis will inform on the contribution of top-down, expectation effects in the SWI. This analytical review of the research base will increase our understanding of the factors and mechanisms that underlie our subjective experience of weight.

Is inhibition of return associated with modulations of early sensory or late attentional event-related potentials?

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Inhibition of return (IOR) is a robust phenomenon that leads to inhibited responses at locations that have been previously attended. IOR is thought to have arisen to facilitate visual search by promoting novelty seeking. To accomplish this functional role, IOR must be long lasting and represented in spatiotopic coordinates. Most studies of IOR have observed modulations of early sensory ERPs, such as P1, but these effects are retinotopic and are only observed with repeated peripheral stimulation. When IOR is generated with central arrows, early sensory effects are not observed, but modulations of later ERPs such as Nd arise whether or not stimuli are repeated peripherally. However, modulations of Nd in these paradigms have been inconsistent. Although most IOR studies show an Nd effect, the direction of the effect is seemingly random, sometimes positive and sometimes negative. In the current project, we have extended previous work on IOR with ERPs to determine whether another late attentional ERP, the N2pc component, is modulated by cueing. Since calculating N2pc requires a visually balanced design, we first conducted a series of behavioral time course experiments with distractors presented along with targets. Participants made a saccade to centrally or peripherally cued locations, then manually localized peripheral targets. IOR was observed behaviorally at all cue-target intervals with peripheral cues, and at the longest interval with central cues. We then conducted an ERP version of the paradigm using a single time interval with peripheral cues, and again observed IOR behaviorally. ERP results showed no modulation of early sensory ERPs. However, cueing did lead to modulations of Nd, with negative effects at occipital sites and positive effects at central sites. N2pc components were also observed, with smaller effects on cued trials. These results provide further evidence that IOR is associated with modulation of late attentional, rather than early sensory, ERPs.

The application of multivariate analysis techniques to describe paediatric neurodevelopment

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Brain development in childhood is a dynamic process with tissue-specific alterations that reflect complex and ongoing biological processes. In this presentation I will present two recent studies from our group that employed sophisticated multivariate analysis approaches to assess age related changes in brain morphology across childhood and adolescence. First, we used non-negative matrix factorisation, a data-driven, multivariate approach, to model the structural network architecture of the brain as a set of network components. Next, we built a model of age- and sex-related anatomical variation using multimodal imaging measures and manifold learning. This work highlights possible long-term implications of alterations to the developmental trajectories.

Dysregulated Oscillatory Activity During Sensory Processing in Autism Spectrum Disorder

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Autism Spectrum Disorder (ASD) is associated with atypical sensory processing, however the computational and neurophysiological principles underlying this remain largely unknown. Recent MEG-autism research has suggested that one candidate mechanism may be disorganised local oscillations in response to sensory stimuli combined with reduced top-down modulation. To investigate this further, we utilised an interactive visual paradigm combined with non-invasive MEG in a group of 17 participants diagnosed with ASD and 17 matched controls. As expected, gamma-band (30-60Hz) power increases and alpha-band (8-13Hz) power decreases localised to occipital regions. In the ASD group, virtual electrode time- courses from area V1 showed reduced coupling between the amplitude of gamma-band oscillations and the phase of alpha- band oscillations. Furthermore, inter-regional connectivity in the alpha band from area V4 to V1 was reduced in the ASD group. Overall, our work suggests that the complex interplay of alpha and gamma oscillations within the human visual system is dysregulated in autism, and that this may underlie sensory processing difficulties.

ERPs during responses to semantical incongruence are mediated by IQ level

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There is a consistent body of research reporting an increase in N400 amplitude while processing semantically incongruent verbal stimuli. However, there is no evidence to suggest that ERPs during semantic incongruence might be associated with certain psychological parameters, such as IQ. We tested whether ERPs during responses to perceptions of verbal antilogies differed in participants with varying levels of IQ. Specifically, we expected to find differences in the N400 and P600 components.

We used Raven's "Standard Progressive Matrices" to assess the participants' (N = 155) IQ and rank them according to the scores they achieved. Out of the initial pool of participants, we composed 3 groups (N = 15 each): HighIQ (120 – 130 scores), ModIQ (102 – 116 scores), LowIQ (83 – 100 scores). The groups were presented with 3 types of visual stimuli: verbal antilogies (to bereave generously), normal (gift generously) and meaningless (to sink generously) phrases while ERPs were recorded.

Differences in ERPs during responses for the 3 types of stimuli were found between the groups. HighIQ: N400 was more pronounced in response to antilogies and meaningless phrases vs. normal phrases; P600 was more pronounced in response to antilogies and normal phrases vs. meaningless phrases. ModIQ: N400 was more pronounced in response to normal phrases vs. antilogies and meaningless phrases; differences in P600 were the same as HighIQ. LowIQ: N400 was more pronounced in response to meaningless phrases vs. antilogies and normal phrases; no differences in P600 were found between the 3 types of stimuli. We interpret these findings as support for the idea that participants with higher IQ (compared to those with low or moderate IQ) have more sufficient cognitive schemes for processing semantic incongruence, which allow them to take antilogies as similar to normal phrases and opposite to meaningless ones.

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Understanding the influence of speed-accuracy trade-offs on EEG markers of perceptual decisions

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Perceptual decision-making has been modelled as the gradual accumulation of sensory evidence, with a decision being made once a threshold of evidence is attained. Such sequential sampling models are historically based on behavioural data, and seek to explain the ubiquitous speed-accuracy trade-off by adjustments in the decision threshold. However, the neural correlates of this process remain contentious. Here, we examine the effect of speed and accuracy on modulating two recently identified electroencephalographic (EEG) markers of perceptual decision-making: namely, the centroparietal positivity (CPP; thought to reflect the process of evidence accumulation), and the N2 (an early negative deflection over posterior electrodes that is involved in target detection). We recorded EEG data from 25 young, healthy participants (mean age 22 years; 12 females). Participants completed a coherent dot motion discrimination task under three separate conditions, in which they were instructed to prioritise being: (1) fast, (2) accurate, or (3) both fast and accurate. Surprisingly, EEG analyses showed no differences in the CPP or N2 waveforms between any of the conditions, indicating that manipulations of speed and accuracy do not alter the processes of target detection or evidence accumulation. Critically, however, the latency between the peak of the CPP and individuals' motor responses was greater in the accuracy relative to the speed condition, with responses under speed pressure occurring soon after the peak rate of evidence accumulation. These findings contribute to our current understanding of

the neural mechanisms of perceptual decision-making, by clarifying the susceptibility of neurophysiological markers to speed and accuracy manipulations.

The social chronnectome: Time-variant connectivity based on biometrics as a research tool in real classroom settings

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Prof Annemaree Carroll, *University of Queensland*
Prof Robyn Gillies, *University of Queensland*
Prof Ross Cunnington, *University of Queensland*

Structuring classroom activities around effective social interactions is of fundamental importance. Teacher-student and peer-to-peer engagement are at the centre of current pedagogical strategies to encourage cognitive states that are conducive to learning. Previously, physiological evidence of successful interactions inducing shared states, or social synchrony, has been limited to the controlled research laboratory. With the increasing availability of wearable technologies, recording biometric data from students in real-life classrooms has become an accessible means of integrating physiology and educational research to assess the state of the learner. I will present recent developments in the analysis of data recorded from high-school students using biometric wristbands, focusing on skin conductance. By taking a network analysis approach based on graph theory, we quantify social synchrony as mutual changes in physiological arousal. Using techniques developed for the analysis of neural networks, we can establish a social 'connectome' of the classroom that maps the level of connectivity, or shared engagement, of students during various learning activities. Our recent expansion of this concept to time-variant connectivity, or the social 'chronnectome', provides a detailed picture of changes in shared student engagement over time. I will present case-studies validating such graph metrics as useful research tools for supporting behavioural data, as well as providing unique insights into social dynamics in ecological research settings.

The modulation of neural gain facilitates a transition between functional segregation and integration in the brain

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Background and Aims:

Cognitive function relies on a dynamic, context-sensitive balance between functional integration and segregation in the brain. Previous work has proposed that this balance is mediated by global fluctuations in neural gain by projections from ascending neuromodulatory nuclei.

Methods:

To test this hypothesis in silico, we studied the effects of neural gain on network dynamics in a model of large-scale neuronal dynamics. Specifically, we used the Virtual Brain platform to simulate neuronal dynamics with a generic 2d oscillator model, constrained by a directed structural connectome from the CocoMac database. Simulated data were then passed through a balloon model in order to simulate realistic BOLD time series data. We then estimated a time-averaged connectivity matrix from this data and subsequently applied graph theoretical analyses, which allowed us to test the hypothesis that ascending neural gain leads to alterations in global network topology.

Results:

We found that increases in neural gain pushed the network through an abrupt dynamical transition, leading to an integrated network topology that was maximal in frontoparietal 'rich club' regions. This gain-mediated transition was also associated with increased topological complexity, as well as increased variability in time-resolved topological structure, further highlighting the potential computational benefits of the gain-mediated network transition.

Conclusion:

These results support the hypothesis that neural gain modulation has the computational capacity to mediate the balance between integration and segregation in the brain.

Increasing motor cortex plasticity with spaced paired associative stimulation at different intervals in older adults

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The ability of priming non-invasive brain stimulation (NIBS) to modulate neuroplasticity induction (i.e. metaplasticity) within primary motor cortex (M1) may be altered in older adults. Previous studies in young subjects suggest that consecutive NIBS protocols interact in a time-dependent manner and involve homeostatic metaplasticity mechanisms. This was investigated in older adults by assessing the response to consecutive blocks of paired-associative stimulation (PAS) separated by different inter-PAS intervals (IPIs). Fifteen older (62-82 years) subjects participated in 4 sessions, with each session involving two PAS blocks separated by IPIs of 10 (IPI10) or 30 (IPI30) mins. For each IPI, the first (priming) PAS block was either PASLTP (N20 latency+2ms) or PASLTD (N20 latency-10ms), while the second (test) PAS block was always PASLTP. Changes in M1 excitability were assessed by recording motor evoked potentials (MEPs) from a muscle of the right hand. For both IPIs, the response produced by PASLTD-primed PASLTP was significantly greater than the response produced by PASLTP-primed PASLTP ($P < 0.01$). Furthermore, the effects of PASLTD priming on PASLTP were significantly greater for IPI30 ($P < 0.001$). These findings suggest that priming PAS can increase plasticity induction in older adults, and this occurs through mechanisms involving homeostatic metaplasticity. They also demonstrate that the timing between priming and test NIBS is a crucial determinant of this effect, with a 30 min interval being most effective. Providing a 30 min delay between priming NIBS and motor training may improve the efficacy of NIBS in augmenting motor performance and learning in the elderly.

Multimodal structural neuroimaging markers of brain development and ADHD symptoms

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Introduction: Neuroimaging studies of ADHD have been inconsistent with effects attributed to different tissue types distributed across the brain. Image modalities are typically analyzed in isolation, telling only a part of a larger story. Advanced statistical analysis now allows us to model patterns of covariation across multiple modalities to better characterize the neuroanatomical correlates of ADHD symptoms in a data-driven way.

Methods: Multimodal imaging data and multi-informant cognitive and clinical data were collected for 80 diagnostically-confirmed children with ADHD and 80 controls. We combined linked independent component analysis and canonical correlation analysis to identify multivariate relationships between clinical and cognitive factors and multimodal imaging markers derived from tissue volume, cortical thickness and surface area, fractional anisotropy and mean diffusivity.

Results: We found four novel brain patterns, each independently associated with clinical and cognitive data. The first two patterns represent overall brain size and development respectively. The third was associated with increased hyperactivity and greater likelihood to being medicated and male. This pattern was associated with stressful life events, a lower quality of life and time spent in neonatal intensive care. Parents were less educated and had a less consistent, and

angrier parenting style. The final pattern was associated with poor academic attainment and lower parental education. We validated our observations, finding that the third imaging marker significantly predicted hyperactivity in an independent cohort.

Conclusions: We combine multimodal imaging with data-driven multivariate statistical analysis to identify separable imaging markers associated with specific risk factors, clinical and cognitive phenotypes in ADHD.

Reinterpreting Correlates of Response Inhibition in the Stop Signal Task: Trigger Failure as a Predictor of Impulsivity

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Response inhibition is often measured using the Stop Signal Task (SST), where a prepotent response to a stimulus needs to be inhibited upon the subsequent presentation of a stop signal. Typically, response inhibition is measured as Stop Signal Reaction Time (SSRT), an estimate of the latency to inhibit the prepotent response. Increased SSRT latency is interpreted as representing less efficient response inhibition. In clinical samples, poor response inhibition is often found in conditions associated with reduced impulse control, such as ADHD – suggesting a conceptual link between response inhibition and impulsivity. In fact, in personality literature, SSRT is often used as a behavioural measure of impulsivity. However, studies show that, in healthy participants, the two constructs are poorly, if at all, related. This may be partly due to methodological limitations of these studies and partly to modelling response inhibition as a singular process represented by SSRT. Here we use Hierarchical Bayesian modelling of the SST to estimate both SSRT and trigger failure – the failure to initiate response inhibition and examine their relationship with self-report and behavioural measures of impulsivity and risk taking, as well as real-world outcome behaviours in a large sample of healthy young people (N=124). Estimation of trigger failure attenuates SSRT latency and this may influence the relationship between SSRT and impulsivity. We report attenuation of mean SSRT by approximately 100ms with the inclusion of trigger failure in our modelling. The addition of trigger failure also reduced the relationships between SSRT and our measures of impulsivity, risk taking, and outcome behaviours. Interestingly, the relationships found between traditional estimates of SSRT and covariates are the same that related to trigger failure in the updated model. We suggest that previously reported relationships between SSRT and impulsivity may be spurious, and better accounted by trigger failure

Neonatal imitation: Does it exist?

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Neonatal imitation is a cornerstone in many theoretical accounts of human development, social behaviour and cultural change, yet its existence has been debated for the last 40 years. I will present data from the largest-ever longitudinal study of newborn imitation in which over 100 infants were tested for imitation of nine different gestures at four time points over the first 10 weeks of life. This study revealed no evidence of imitation of any gesture, at any time point (Oostenbroek et al, 2016, Current Biology). I will also present results from the first-ever meta-analysis of available data on the phenomenon. For this, we synthesised effect sizes from 31 independent samples of human infants under 6 weeks of age, reported in 24 papers. The meta-analysis revealed that when studies are combined, there is evidence for neonatal imitation (d = 0.74, 95% CI = 0.44 to 1.03). However this overall effect is undermined by publication bias analyses that indicate non-reporting or non-publication of null and negative results. Considering these sources of evidence, the most plausible conclusion is that neonates do not imitate. This demands re-consideration of the development of imitation and its foundational role in human social life.

Lifestyle contributions to cognition in late life

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Cognitive control abilities in mid-late adulthood might be influenced by lifestyle factors, such as physical activity (PA). The purpose of this study was to compare objective measures of physical activity with global cognitive performance (assessed with the Addenbrooke's Cognitive Exam (ACE-III) and cognitive control tasks assessed behaviourally with an attention switching task and an n-back task with concurrent EEG (0-back 1-back and 2-back). Objectively measured 24 h activity data were captured for 7-days using GENEActiv wrist-worn tri-axial accelerometers in 72 adults stratified for cardiovascular disease risk burden (age range 50-80 years, mean age 65.5 ± 7.52, 52 females). Using 60-s epochs, average daily time spent in sleep, sedentary behaviour, light PA and moderate to vigorous PA was calculated using pre-defined cut-points using custom software (COBRA, UniSA). To investigate the relationship between daily activity patterns and cognition, daily time spent in different activities (i.e. the activity composition) was expressed as isometric log ratios and regressed against cognitive performance and cognitive control outcomes. When adjusted for age and sex, activity composition significantly predicted global cognition (ACE-III score) but not tasks related to cognitive control. Individuals with the best overall cognitive performance spent >30% of their day engaged in light, moderate and vigorous PA. Findings from this study provide evidence of activity patterns for optimal cognitive performance and is discussed in terms of defining optimal patterns of physical activity for cognition in late life.

Smarter does not reach to grasp faster: the effects of nonverbal intelligence and autism traits on visuomotor behaviour

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Research has shown that intelligence (IQ) moderates the effect of autism spectrum disorder (ASD) differently, depending on the motor task. Motor tasks requiring higher levels of visuomotor integration are most affected by ASD traits in individuals presenting average IQ. Thus two visuomotor tests were used requiring low (hand-eye-coordination using an iPad) and high (reach-and-grasp) levels of visuomotor integration in our population with average IQ. We hypothesised a three-way interaction would be found between nonverbal IQ scores as measured with the Raven's, ASD traits as measured with AQ scores, and type of motor task as measured with iPad and reach and grasp tasks. When controlling for nonverbal IQ between groups, we hypothesised improved accuracy and speed among individuals reporting higher AQ on the iPad task. In contrast, we hypothesised that individuals who report higher AQ would present slower reaction times and more mistakes in the reach-and-grasp task. Participants were screened for normal vision, and depression, anxiety and stress (DASS-21). 3D recordings of reaching and grasping objects were taken using three Qualisys motion capture Oqus 300 Plus cameras. A preliminary sample of N=52 participants (22 males, aged 19-40 years) were included in the pilot analysis. Groups of high, low and mid-range AQ were compared across measures. As predicted, these preliminary findings point towards an interaction between IQ, AQ, and scores from tasks requiring high and low levels of visuomotor integration. Initial patterns of hand movement in terms of velocity, accuracy and trajectory, by grouping of high, low and mid-range AQ will also be presented. These preliminary results will guide future analysis of a larger sample and drive future hypothesis driven research involving eye-tracking, fMRI, MEG and TMS. Funded by ARC Discovery Project (DP170101035).

Preliminary Evidence of Functional Compensation in Premanifest Huntington's Disease Using a Novel Visuospatial Working Memory Task

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Evidence suggests that presymptomatic Huntington's disease individuals (pre-HD) are able to functionally compensate for brain changes associated with disease. However, no study to date has explicitly characterised compensatory function in HD. In this study, we used a quantitative model of compensation, known as the CRUNCH (Compensation-Related Utilization of Neural Circuits Hypothesis) to characterise compensation in HD using functional magnetic resonance imaging (fMRI). The CRUNCH model postulates that individuals usually show over-activations at low levels of difficulty and under-activations at high levels of difficulty accompanied by a deterioration in performance. To test CRUNCH predictions, five pre-HD individuals (M = 37.20; SD = 12.28) and five age- and gender- matched healthy controls (M = 35.60; SD = 11.19) performed an 18-minute fMRI visuospatial working memory task (VSWM) with four levels of memory load (e.g., low, intermediate-1, intermediate-2, and high). Although VSWM performance did not differ between both groups, pre-HD individuals showed compensatory over-activation at low, intermediate-1, and intermediate-2 loads in inferior frontal gyrus, superior frontal gyrus, dorsolateral prefrontal cortex, and precuneus compared to healthy controls who showed over-activations at high levels of difficulty only. Furthermore, with the highest memory load, pre-HD individuals made more errors and showed less activation in the same regions compared to healthy controls. This provides preliminary evidence to suggest that level of difficulty can influence the level of activation within fronto-parietal and parieto-occipital compensatory networks in HD. These results provide support for the CRUNCH model in HD, although further research is warranted with increased sample sizes

Rapid changes in facial temperature during startle reflex as revealed by thermal imaging technique

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Thermal imaging [infra-red imaging (IRI)] is an innovative new tool for monitoring psychophysiological states. IRI could detect variations in face and body temperature, a read out of the autonomic, predominantly sympathetic, control of the cutaneous blood circulation. Despite of its potential, validation of thermal imaging measurements during classic psychophysiological experiments has been limited in terms of accuracy, response latency and comparison to other physiological measures. The objective of the present study was to investigate the validity of infra-red thermal imaging as a physiological marker for startle reflex. We found significant changes in GSR and heart rate in response to the acoustic startle stimuli, replicating previous results. For thermal data extraction, we used advanced face tracking algorithm to track the head motion of participants. IRI response from different facial regions (nose-tip, right and left cheeks, right-side and left-side of forehead, and right and left periorbital regions) revealed significant increase in temperature after the startle stimulus. Furthermore, cross correlation analysis confirmed IRI response preceded GSR response by 2-3 seconds, contrary to previous findings reported in the literature. Our data demonstrated that IRI is sensitive in capturing the facial physiological changes underlying startle reflex. Its contact-free feature provides advantages over the traditional psychophysiological methods and has the potential to open up new avenues of research in affective neuroscience.

MEG reveals overactive response inhibition in people who stutter

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Neuroimaging studies of stuttering consistently find that regions in the right prefrontal cortex (rPFC) are over-activated. We propose that this reflects an over-recruitment of inhibitory control in stuttering that causes excessive suppression of speech. To test this hypothesis, we used magnetoencephalography (MEG) to examine event-related fields (ERFs) evoked by vocal response inhibition. We compared inhibition-related ERFs across a group of people who stutter (PWS) (n=16) and a group of age and sex-matched control adults (PWDS) (n=16). We hypothesised that PWS would exhibit hyperactive inhibitory responses to stop signals.

This study used a stimulus selective stop signal task (SST) to measure response inhibition. Go trials consisted of a simple forced choice reaction time task where participants were required to make a short vowel sound, as it would occur in the words hit and hot for the letters "I /h?t/" and "O /h?t/" respectively. Stop trials and ignore trials followed the go signal on a minority of trials at a delay that was modulated by a dynamic staircase.

MEG was recorded at a sampling rate of 1000 Hz and an online bandpass filter of 0.03-200 Hz. Statistical analysis of the M300 was conducted across the full sensor topography in the time window from 350 to 450ms post stop stimulus onset. Correction for multiple comparisons in the spatial dimension was performed using cluster-based permutation analysis.

MEG data show that the amplitude of the ERF M300 peak (approximately 400 ms after the stop signal) evoked on unsuccessful stop trials, was significantly larger in PWS over right fronto-central regions compared to that evoked in PWDS.

The current results suggest that PWS have hyperactive responses to stop signals in the SST. Given that the neural substrates supporting response inhibition are largely located in the rPFC, inhibitory hyperactivity may explain the consistent finding of rPFC over-activation in stuttering.

Do no harm – Exploring mechanisms of moral reasoning in frontotemporal dementia

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Would you harm another person to potentially save the lives of many others? Such moral dilemmas often produce a high level of inner conflict as they require a choice between competing moral standards, and involve consideration of societal norms and personal belief systems, emotional reactions, and rational reasoning. A novel approach to explore the mechanisms underlying moral decision making lies in the study of clinical populations in which these component processes break down. The behavioural variant of frontotemporal dementia (bvFTD) is characterised by progressive decline in emotional and reasoning processes and the eventual decay of conceptual knowledge. Here we explored moral reasoning in 16 bvFTD patients and 11 healthy controls, using a novel, vignette-based paradigm. Participants were required to make moral decisions across situations in which level of conflict and personal involvement were manipulated. Subjective ratings of certainty, feelings about the decision, and perceived vividness of the scenario were obtained, as well as qualitative descriptions of the decision-making process. Overall, patients and controls did not differ in the actual decisions endorsed. Notably, however, a significant group difference emerged for the affective ratings provided by participants, with controls reporting a greater level of emotional concern compared to bvFTD. Further inspection of the data revealed this finding was driven by a distinct subgroup within the bvFTD sample who reported minimal remorse following their decisions. On a separate measure of social norms, this unremorseful subgroup further displayed impaired knowledge of socially acceptable behaviour. Our findings suggest that reduced emotional concern in response to highly conflicting moral dilemmas in bvFTD, is, in part, mediated by loss of fundamental knowledge of social norms, potentially reflecting the spread of atrophy beyond the frontal lobes with disease progression.

The brain penetrable antagonist YM344031 attenuates beta-amyloid deposition, tau hyperphosphorylation and synaptic loss in a mouse model of Alzheimer's disease

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Presented by Dr Yoa Zhang

Our previous study has shown that deletion of CCR3 significantly prevented the disease progression in amyloid precursor protein and presenilin 1 (APP/PS1) double transgenic mice, a mouse model of Alzheimer's disease (AD). To further explore the therapeutic potential of CCR3 antagonism on AD, 12-month-old APP/PS1 double transgenic mice were treated with the brain penetrable CCR3 antagonist, YM-344031 (50 mg/kg, twice daily), for 2 months, and neurodegenerative pathologies were evaluated. Treatment with YM-344031 significantly reduced ?-amyloid deposition, accompanied by a significant decrease in the APP processing. YM-344031 treatment also robustly attenuated tau hyperphosphorylation, associated with the marked decrease in the activities of both cyclin-dependent kinase 5 and GSK3 beta. The YM-344031-treated APP/PS1 mice showed decreased activation of microglia and astrocytes, attenuated synaptic loss, and improved spatial learning and memory compared with the vehicle-treated APP/PS1 mice. These results support CCR3 antagonist as an effective therapeutic agent for the prevention and treatment of AD.

Indexing sensory plasticity: Evidence for distinct Predictive Coding and Hebbian Learning mechanisms in the cerebral cortex

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The Roving Mismatch Negativity (MMN), and Visual LTP paradigms are widely used as independent measures of sensory plasticity. However, the paradigms are built upon fundamentally different (and seemingly opposing) models of perceptual learning; namely, Predictive Coding (MMN) and Hebbian plasticity (LTP). The aims of the current study were to 1) compare the generative mechanisms of the MMN and visual LTP, therefore assessing whether Predictive Coding and Hebbian mechanisms co-occur in the brain, and 2) assess whether the paradigms identify similar group differences in plasticity. As well as being the first to compare both paradigms, this study presents a novel method for assessing changes in predictive coding precision by analysing changes in the variability of the deviant response across successive trials in the Roving MMN paradigm. It also serves as the first DCM assessment of effective connectivity changes in the visual LTP paradigm.

Forty participants were split into two groups based on the BDNF Val66Met polymorphism and were presented with both paradigms whilst continuous EEG was recorded. Consistent with Predictive Coding and Hebbian predictions, Dynamic Causal Modelling revealed that generation of the MMN modulates forward and backward connections in the underlying network, while Visual LTP only modulates forward connections. Genetic differences were identified in the ERPs for both paradigms that appear to show contrasting effects in Hebbian versus Predictive coding models of plasticity. Whereas DCM revealed genetic effects in backward connections of the MMN network only. These results suggest that both Predictive Coding and Hebbian mechanisms are utilised by the brain under different task demands. In addition, both tasks provide unique insight into plasticity mechanisms, which has important implications for future studies of aberrant plasticity in clinical populations.

Evaluating patterns of semantic and executive dysfunction in schizophrenia: a cluster analysis approach

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Semantic and executive dysfunction are among the most prominent of the cognitive impairments in schizophrenia. Using a cluster analysis (CA) approach, the primacy of semantic and executive dysfunction and their relationship to psychopathology was examined in a two-step investigation. In Study One, 76 schizophrenia/schizoaffective disorder (SZ) patients completed three semantic (category fluency productivity, category errors, Hopkins Verbal Learning Test) and three executive function (inhibition, switching, verbal fluency) measures. Three groups were predicted: semantic-dominant (SD), executive-dominant (ED) and mixed. The CA results confirmed the first two specific groups but revealed a third group unimpaired in both domains (UN). Positive and negative symptoms did not differ between all groups. In Study Two, 52 SZ patients completed the MATRICS Consensus Cognitive Battery (MCCB) alongside the previous semantic/executive battery to better characterise the UN group. The CA results confirmed the presence of the same three groups: SD, ED and UN. One-way ANOVAs confirmed that MCCB overall cognitive scores were significantly higher in the UN group, compared to the other two groups which did not differ from each other. Psychopathology again did not differ between the three groups. The findings confirm semantic and executive dysfunction as two main areas of cognitive impairment in SZ while also affirming the presence of cognitively unimpaired patients. Symptomatology patterns do not appear to differ between cognitive impairment profiles, highlighting the complexity of symptomatology mechanisms and cognitive deficits being a discrete entity within the illness. These conclusions have implications for the nosology of schizophrenia and the delivery of cognition-based therapies.

Assessing the relationship between auditory sensory gating and interference control using event-related potentials (ERPs)

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Auditory sensory gating, a neural filtering mechanism, has previously been identified as attenuation of the early auditory evoked responses (P50 and N100 peaks) to paired auditory stimuli. The underlying mechanism of auditory sensory gating is currently poorly understood, though preliminary results indicate that sensory gating is a top down process that is related to executive functioning. The current study aimed to assess the relationship between sensory gating and the executive functioning domain of interference control. Participants included 41 adults (14 males and 27 females, mean age = 21.54, SD = 5.04). Auditory sensory gating was evident as an attenuation of N100 amplitude of the second tone presented in a tone pair. This measure was correlated with the ability to resist distraction from irrelevant flanking stimuli, indicating that participants who showed greater auditory sensory gating showed less interference by incongruous flankers. Faster reaction times were also associated with increased auditory sensory gating. These findings further support the assertion that top- down processes impact on the ability to filter incoming information at a relatively early stage of processing. Executive functioning is a complex multifaceted process; therefore, future research should consider the relationship between additional executive functioning domains with auditory sensory gating. Funding was provided by the School of Psychological Science.

Brain processing of syntax violations in language and music

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One key aspect of our understanding language is our processing its syntax—its rules and grammar. Similarly, understanding music depends on our processing its syntax—its rules and harmony. Aniruddh Patel's shared syntax integration resource hypothesis (SSIRH) is that both language and music share common brain processing. One way of studying brain processing for language is to measure each trial's event-related potentials (ERPs) for key presses when participants detect violations of syntax. This reveals an ERP component, the P600, 200 ms after the key press. Does the same component appear for syntax violations in music? According to SSIRH, it should.

We used a repeated measures design with Domain (Language, Music) and Stimulus Category (Control, Critical Syntax Error, Distractor Syntax Error) as factors. Participants (N=18) listened to 400 sequences comprising seven words or chords with 600 ms between onsets. Sequences were completely correct (control) or contained a syntax violation (adjective noun plurality error or dissonant chord) at the end of the sequence (critical syntax error) or in the middle of the sequence (distractor syntax error). We used the latter to ensure participants listened to the whole sequence. Participants pressed a key to indicate whether each sequence was correct or incorrect.

In both domains, we found that P600 peak latency increased as reaction time increased. This provides novel converging evidence for the SSIRH from music. Our result opens the way to other studies to determine whether the similarity between language and music arises from similar processing in different areas of the brain or from processing in the same area.

Memory guided saccade performance across the schizophrenia continuum

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Saccadic (ocular motor) deficits are one of the most replicated findings in schizophrenia. However, less research has been conducted investigating the broader schizophrenia continuum. Recent research suggests that the personality characteristics and symptoms observed in schizophrenia lie on a continuum with subclinical symptoms, known as schizotypy, observed in the non-clinical population. As saccadic deficits are a cognitive hallmark of schizophrenia, it is believed that saccadic deficit may be associated with higher schizotypy. This study investigated saccadic performance across the schizophrenia continuum using the memory guided (MG) saccade paradigm as no studies to date have investigated MG performance in schizotypy. 43 patients with schizophrenia/schizoaffective disorder and 93 healthy controls completed the MG saccade task, which engages spatial working memory and inhibition processes. Schizotypy was assessed using the Oxford-Liverpool Inventory of Feelings and Experiences (O-LIFE) questionnaire, which measures the four schizotypy factors: unusual experiences (UnEx), introvertive anhedonia (InAn), cognitive disorganisation (CogDis) and impulsive nonconformity (ImpNon). MG latency and error rate were significantly different between patients and controls ($p < 0.001$). Looking across the schizophrenia continuum, there were significant correlations between MG latency and UnEx ($p < 0.001$), InAn ($p = 0.047$) and CogDis ($p = 0.001$), as well as with the O-LIFE total score ($p < 0.001$). There was also a non-significant trend between MG error and O-LIFE total score ($p = 0.086$), though no significant correlations were observed with any schizotypy factor scores. This is the first study to investigate and demonstrate the relationship between higher schizotypy and impaired MG performance. The findings also support the theory of schizotypy and a broader schizophrenia continuum.

Intra-individual variability in sustained attention and resting state brain networks in children with ADHD

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Background: Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder, commonly featuring impaired sustained attention. Variability in task performance is consistently found in ADHD, generally attributed to lapses of attention. Mean functional connectivity (FC) in the brain during tasks and at rest has been extensively examined in ADHD, however no studies have explored whether network variability in resting FC over time could help explain performance variability.

Methods: As part of the Neuroimaging of the Children's Attention Project, 31 ADHD and 50 control children aged 9-11 years completed the Sustained Attention to Response Task (SART), and an MRI session including 6-minute resting state functional MRI sequence in a 3-Tesla scanner. Performance variability was characterised by signal detection, ex-Gaussian and fast Fourier transform approaches. Ten resting state brain networks were identified through independent component analysis, including executive control, sensorimotor, default mode, frontoparietal, and visual networks.

Results: Greater number of ADHD symptoms was associated with more variable and less accurate responding on a range of SART measures. Lateral visual network variability was related to larger ex-Gaussian measure tau, indicating greater magnitude or frequency of abnormally long response times (RT) following lapses of attention. More sensorimotor network variability was related to greater criterion (tendency to respond) and standard deviation of RT. An interaction was observed between sensorimotor network variability and inattentive ADHD symptoms predicting criterion.

Discussion: In children presenting with severe inattentive symptoms, more sensorimotor network variability lead to reduced tendency to respond, while in children with no inattentive symptoms tendency to respond increased. This points to neural abnormalities in the sensorimotor network in children with ADHD, potentially driving deficits in sustained attention.

Prevalence and predictors of cognitive decline and delirium after transcatheter aortic valve implantation: A systematic review and meta-analysis

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Cognitive decline and delirium are severe complications in older adults after transcather aortic valve implantation (TAVI). The objective of this systematic review was to examine the prevalence and risk factors for cognitive decline and delirium in TAVI patients.

All full-text studies published in English since the first TAVI procedure in 2002 until April 2017 were considered for inclusion. Outcomes of interest were the prevalence and risk factors for cognitive decline and delirium. Key search terms included TAVR, TAVI, transcatheter aortic valve replacement, cogn*, delirium, dementia, or cognition disorders across five databases. Random-effects meta-analysis was used for estimates and odds ratio.

In total, 17 prospective cohort studies were included (n=1848). The mean prevalence of short-term (3-7 days) cognitive impairment was 12.6% (95%CI 2.2-47.7%), mid-term (1-3 months) was 22.9% (95%CI 13.5-36.3%), long-term (6-12 months) was 11.6% (95%CI 8.6-15.6), and delirium was 22.7% (95%CI 16.9-29.7%). Studies reporting risk factors for cognitive decline were considered to be too heterogeneous for meta-analysis. There were small effect sizes for a range of pooled risk factors for delirium including atrial fibrillation, prior stroke/TIA, and hypertension; medium effect sizes for carotid artery disease (OR=3.9, 95%CI 1.9-7.8) and prior cognitive impairment (OR=2.7, 95%CI 1.3-5.8), and a large effect size for transapical approach (OR=4.5, 95%CI 1.4-14.3).

Approximately 20% of patients experience delirium post-TAVI. The prevalence of cognitive impairment after TAVI fluctuates across time, but also peaks at around 20% at 1-3 months. Although pre-procedure risk factors from existing studies have been identified, more definitive evidence is required to better identify individuals at high risk of delirium and cognitive decline post-TAVI, with a view of implementing preventative measures.

Asymmetry in internal model updates and the impact of prior precision

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Rare deviations from a pattern in sound elicit the mismatch negativity (MMN) component of the auditory evoked potential (AEP). MMN indicates the presence of an internal model expressing predictions about probable properties of sound in the current context. MMN amplitude indexes the precision associated with this model. This study demonstrates that initial variance in the environment impacts the degree to which precision is updated when a subsequent change in variance is encountered.

AEPs were recorded to 3000 pure tones including a common repeating 30ms sound (p=0.90) and a rare 60ms tone (p=0.10) with attention directed to a subtitled movie. Sequences were arranged in an Increasing Variance (IV, n=15) condition with low timing variance (500ms ± 10ms) for the first 1000 tones, and high timing variance (500ms ± 200ms) for the second 2000 tones, or a Decreasing Variance (DV, n=15) condition with high timing variance for the first 1000 tones and low timing variance for the next 2000 tones. A mixed model ANOVA compared MMN amplitude to deviants for each condition (IV, DV) over the three sequence periods (1,2,3 - first, second and third 1000 tones, respectively).

A condition by period interaction ($F(2,56)=4.3$, $p<.05$) indicated that initial variance altered the effect of subsequent variance on MMN. Under IV conditions there was a non-significant decline in MMN amplitude moving from a low to high variance context. In contrast, MMN amplitude in the DV condition increased significantly when timing variance narrowed in period 2, reducing to period 1 equivalence in period 3 (quadratic trend ($F(1,14)=14.1$, $p<.005$).

Results show dynamic order-dependent updates to internal model precision. MMN amplitude was minimally impacted by change from a low to high variability environment. Conversely, a high to low variability change initially had a pronounced impact on model precision consistent with accelerated learning, with this impact depleting over time to initial levels.

Conditioned action tendencies to previously trained response cues as revealed by TMS

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Action tendencies can be elicited by stimuli with motivational salience (e.g., appetitive rewards) or objects that support "utilization behaviours" (e.g., graspable tools). These action tendencies can potentiate behavioural performance through speeded reaction times in response tasks, and improve detection accuracies in attentional capture tasks. We used transcranial magnetic stimulation (TMS) to investigate the neural signatures of action tendencies in the presence of previously trained response cues. In three experiments, participants were presented with a continuous letter stream and instructed to quickly respond to two target letters using two different response keys. Following this training phase, the target letters were embedded within a new task (test phase) and we applied TMS to the motor cortex and measured motor evoked potentials in the contralateral hand as an index of corticospinal excitability. We found that action tendencies, in the form of increased corticospinal excitability, can be elicited by response cues trained within a single experimental session, and that successful control over these provocations were accompanied by motor suppression. These results provide a model for understanding the relationship between well-trained response cues, the provocation of action tendencies by these cues, and the implementation of cognitive control to override such action tendencies.

Neural correlates of goal-directed attentional capture in the absence of conscious perception

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An observer's current goals can influence the processing of visual stimuli via feedback from higher cortical areas. Such influences are exemplified by the 'contingent capture' effect, in which spatial attention is captured to the location of a briefly presented cue that shares a critical feature, such as its color, with the observer's current task set. Here we combined behavioral testing and electroencephalography (EEG) to examine whether such contingent attentional capture effects can arise even when the cues that elicit them are masked from conscious awareness. We used a variant of the classic contingent capture paradigm, in which participants searched four-item arrays for a target in a specific, cued color. Immediately prior to the target array, a non-predictive cue display was presented in which one cue matched the searched-for target color, and appeared either at the target location (spatially valid) or at another location (spatially invalid). Cue displays were masked using continuous flash suppression (CFS). Behaviorally, target-colored cues yielded significantly faster responses when the cues were spatially valid than spatially invalid. Critically, the cueing effects occurred for both conscious and unconscious cues, and were roughly equivalent in magnitude for the two awareness conditions. Concurrently recorded EEG data revealed that target-colored cues produced a robust N2pc response – a well-known signature of spatial orienting – for both conscious and unconscious cues, although the amplitude was reduced for the latter. Our findings suggest that top-down control settings for task-relevant features elicit attentional orienting even in the absence of conscious perception. We conclude that conscious perception modulates early processing of visual features, but later processing stages involved in decision making, response selection and execution are largely independent of this modulation.

A practical, empirical approach to address gender imbalance in scientific meetings

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Invited presentations at prestigious conferences are critical for the career development of scientists. In the neurosciences, gender imbalance exists in invited speakers in majority of international conferences, which is disproportionate to the base gender ratio in the field. This might contribute to the low female representation at senior levels in neuroscience. We recently proposed a practical, empirical approach to address gender imbalance in invited speakers using the International Brain Stimulation Conference as an exemplar. We audited original research publications in the journal Brain Stimulation: first, we identified high impact publications (indexed by citation count); second, we obtained the field-weighted citation impact for first and last authors of highly cited publications. Results showed that, of the top-ranked authors, 47% of the first authors and 20% of the senior authors were female. These data are inconsistent with the gender of invited presentations at the International Brain Stimulation Conferences (<5% female invited speakers). Our current project used this approach to identify top-ranked authors in the neurosciences. We audited the top 10 neuroscience journals (indexed by Scimago

Journal and Country Rank), identifying (1) highly cited papers, (2) field-weighted citation impact of first and last authors, and (3) gender of authors. Preliminary results suggest that female scientists are publishing highly cited original research in top-ranked neuroscience journals, but when considered with the gender imbalance evident in conference programs, this contribution is not reflected in invitations for presentations. This study provides empirical data on the gender of top-ranked authors that can be used to select invited speakers at neuroscience conferences. Furthermore, we believe that our approach could be used to promote gender diversity and equity across the sciences, as well as provide a model to promote diversity and equity more broadly in science.

Associations between supplementary motor area—primary motor cortex connectivity and bilateral voluntary movement.

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Cortico-cortical connectivity between motor areas plays an important role in voluntary movement control. The supplementary motor area (SMA) is densely connected with the primary motor cortex (M1) and, together, these two regions play an important role in bilateral movement. Transcranial magnetic stimulation (TMS) protocols can be used to measure functionally relevant excitatory interactions between SMA—M1: when a conditioning TMS pulse to SMA precedes a test TMS pulse to M1 at appropriate intervals, the MEP elicited by the test TMS pulse is facilitated due to activation of excitatory networks acting between SMA and M1. We investigated associations between SMA-M1 connectivity and bilateral movement in young adults, older adults, and chronic stroke survivors. Dual-coil TMS was used to measure the excitability of connectivity between SMA—M1 in the hand motor region (and preSMA-M1 as a control). The Purdue

Pegboard was used to measure bimanual dexterity and the four square step test to measure dynamic balance. Younger adults performed better on the movement tasks than older adults and stroke survivors. We showed that, in younger adults, the interaction between SMA—M1 (but not PreSMA—M1) was facilitatory, and that SMA—M1 facilitation was reduced in older compared to younger adults. Furthermore, a significant positive correlation was found between SMA—M1 facilitation and performance on the Purdue Pegboard task and the four square step test: greater SMA—M1 facilitation is associated with greater number of pegs placed and quicker step time. Together, these findings suggest that SMA—M1 connectivity is functionally relevant, contributing to bilateral movement control, and that SMA—M1 connectivity decreases with age. These data provide a neurophysiological basis on which to test whether strengthening SMA—M1 connectivity can improve voluntary motor control in older adults and stroke survivors.

Modelling stochastic resonance in human performance: the influence of attentional lapses

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Adding noise to a sensory signal generally leads to a decrease in human performance. However, in some conditions, noise can improve performance, called stochastic resonance. This paradoxical finding may be exploited in experiments, potentially allowing additional insights into sensory processing, not provided by conventional experimental approaches where stochastic resonance does not occur. Here, we develop a model for stochastic resonance to study the influence of noise on human perception, while including lapse rate as an explicit parameter. The inclusion of lapse rate allowed for the occurrence of stochastic resonance in terms of the performance metric d'. At the same time, we show that high levels of lapse rate cause stochastic resonance to disappear. We also show that noise generated in the brain (i.e., internal noise) may obscure any effect of stochastic resonance in experimental settings. We further relate the model to a standard equivalent noise model, the linear amplifier model, and show that the lapse rate can function to scale the threshold verses noise curve, in equivalent ways to the efficiency parameter in equivalent noise models. Therefore, lapse-rate provides a psychophysical explanation for reduced efficiency in equivalent noise paradigms. Furthermore, ignoring lapse rate, may lead to an overestimation of internal noise in equivalent noise paradigms. Overall, describing stochastic resonance in terms of signal detection theory, with the inclusion of lapse rate, may provide valuable new insights into human performance, and a better description of some of the published psychophysical data.

Sex differences in hippocampal subfields after controlling for brain size

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Male brains are approximately 10-15 percent larger than female brains, but it is unclear whether sex differences exist in the brain after controlling for brain size. Some studies have found sex differences in the hippocampus, a brain region involved in learning and memory, while others did not replicate this. These mixed findings could be due to heterogeneity of the samples or the methodology of controlling for brain size. Here we investigate whether sex differences exist in the hippocampal subfields while using different methods to control for brain size.

We examined data from two cohorts: the Queensland Twin Imaging (QTIM) (N= 741 (63.2% female) age= 23.90 ±2.43 years) and Human Connectome Project (HCP) (N=986 (55.4% female; age= 28.79 ±3.71 years), using Freesurfer 6.0 to extract 12 hippocampal subfields for each hemisphere, and Brain Segmentation Volume (BSV). In both cohorts we looked for sex differences using a MANOVA and regression analyses, controlling for brain size (BSV), age, and general cognitive ability, and, for HCP only, race. Then, within each cohort, females and males were matched on brain size (BSV), and we used a MANOVA to test for sex differences in the subfields.

All hippocampal subfields were larger in males, but this sex effect was strongly driven by brain size (BSV). After controlling or matching for brain size, sex differences remained in three hippocampal subfields in both the QTIM and HCP cohort. This included the bilateral hippocampal fissure (5-8%), bilateral presubiculum (2-3%) and right fimbria (4-7%). Sex differences in other subfields were also found to be significant, but not consistently across all samples.

Taking brain size into account, we repeatedly found small sex differences in three hippocampal subfields. This finding might have implications for understanding behavioral sex differences such as strategies or processes associated with learning and memory.

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Is modulation of the N170 in visual competition for representation category specific?

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Visual adaptation and competition paradigms are frequently used as tools for investigating 'pools' of neurons dedicated to processing specific stimuli. Both paradigms have found category specific reduction of the amplitude of the N170 component of the event related potential. In adaptation studies, N170 amplitude to a target (S2) is reduced when preceded by a stimulus of the same, or similar category (S1). In competition studies, N170 amplitude for S2 is reduced when presented in the context of same, or similar S1. Recently, it has been suggested that adaptation and competition may reflect the same underlying process (Kovács, Zimmer, Lavric, and Rossion, 2013). However, Nemrodov and Itier (2012), suggest that modulation of the N170 in adaptation paradigms is not category specific over short stimulus du-

rations and short inter stimulus intervals (ISIs). Feuerriegel, Churches and Keage (2015), examined the effects of a range of stimulus categories, presentation durations and ISIs in an adaptation study, and suggested that the N170 is modulated by S1, irrespective of S2 category. As adaptation and competition may be driven by similar mechanisms, we investigated whether modulation of the N170 amplitude is category specific in the competition paradigm. We presented all possible combinations of faces, houses, chairs, cars, and sunflowers in the center and periphery. To ensure that participants were paying attention, they were asked to respond via key press whether or not they saw a sunflower. Our results show the greatest reduction in N170 amplitude when any S2 was presented in the context of faces, followed by chairs, houses, and cars. These results are consistent with Feurriegel et al.'s suggesting that competition may be tapping into the same process as adaptation. Furthermore, our data challenge the idea that visual competition indexes effects on specialised 'pools' of neurons that code for specific stimuli.

The neural correlates of preference formation

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Where do our preference come from? Standard decision theory assumes that choices result from stable preferences. This position has been challenged by claims suggesting that choices between equally valued alternatives themselves shape preferences. In this functional magnetic resonance imaging (fMRI) experiment, we tested these assumptions while also employing eye-tracking to shed light on how and when choices might shape preferences. Participants completed an experimental sequence in which they first evaluated snack items, then made binary choices between equally valued items, and finally re-evaluated the items. We showed that choices changed preferences, but only when past decisions were explicitly remembered at the time of re-evaluation. The neuroimaging data revealed that changes in preferences for items that were subsequently remembered were systematically associated with activity during the choice phase within a brain network comprised of left dorsolateral prefrontal cortex and medial precuneus, as well as with the hippocampus during revaluation. Fixation durations during decision formation already predicted the subsequent change in valuations. Further, the analysis of resting state fMRI data showed that the individual variability in the susceptibility to preference change effects was predicted by intrinsic functional connectivity within this brain network. This research demonstrates that preference reconstructions occur endogenously and dynamically already as the initial decisions evolve, potentially as a mechanism to prevent future stalemate situations in underdetermined decision scenarios.

Measuring face-name integration with fast periodic visual stimulation

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Associating specific names to faces of familiar identity is crucial for social interactions. This is a difficult process, which can be severely disrupted in neurodegenerative disorders such as Alzheimer's disease or temporal epilepsy. An outstanding issue is whether face and name representations are kept separated in the human brain and associated through re-entrant interactions, or if they are integrated into common representation at higher stages.

Here we addressed this issue with fast periodic stimulation in EEG. Healthy subjects (n=12) were exposed to randomly alternating face photographs and written names of a famous identity (base stimuli) at a fast rate (3.999 Hz, about 4 images per second) while recording their brain activity with high density (128 channels) scalp EEG. A change in identity (either presented as a face or a name) occurred every seven stimuli (i.e., 0.5713 Hz; "oddball" stimuli). Following a few minutes of recordings, there were significant electrophysiological responses at the frequency of a face identity change (i.e., 0.5713 and harmonics), suggesting integrated representations of faces and names.

Experiment 2 (n=20) replicated these findings, with two control conditions: A face only condition in which the specific identity names presented at the base rate were replaced by other famous names, and a name only condition which followed the same principle for names. There were much weaker amplitudes at the periodic change of identity in control conditions. Most importantly, the sum of the two control conditions was weaker than the effect found in the main condition, in particular over the left medial occipital region and extending to the posterior part of the left occipito-temporal region.

Overall, these observations provide evidence for integrated face/name representations in the human brain, with a left occipito-temporal locus.

Inhibition deficits for drug-related cues remain after longer-term heroin abstinence

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Background Chronic heroin use can cause deficits in response inhibition, leading to a loss of control over drug use, particularly in the context of drug-related cues. Heightened incentive salience and motivational bias in response to drug-related cues may exist following abstinence of heroin use.

Objective The present study aimed to examine the effect of drug-related cues on response inhibition in long-term heroin abstainers.

Methods Response inhibition of long-term (8-24 months) male heroin abstainers (n=16) was compared with male healthy controls (n=16) using a modified two-choice oddball paradigm, in which a neutral "chair" picture served as frequent standard stimuli, the neutral and drug-related pictures served as infrequent deviant stimuli of different conditions respectively. Event-related potentials were compared across groups and conditions.

Results Our results showed that heroin abstainers exhibited smaller N2d amplitude (deviant minus standard) in the drug cue condition compared to the neutral condition, due to smaller drug-cue deviant-N2 amplitude compared to neutral deviant-N2. Moreover, heroin abstainers had smaller N2d amplitude compared with the healthy controls in the drug cue condition, due to the heroin abstainers having reduced deviant-N2 amplitude compared to standard-N2 in the drug cue condition, which reversed in the healthy controls.

Conclusion Our findings suggested that heroin addicts still show response inhibition deficits specifically for drug-related cues after longer-term abstinence. The inhibition-related N2 modulation for drug-related could be used as a novel electrophysiological index with clinical implications for assessing the risk of relapse and treatment outcome for heroin users.

Binding of episodic details into future simulations

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It has been proposed that the increased neural activity associated with imagining the future relative to remembering the past reflects more intensive cognitive demands when constructing novel events (Schacter et al., 2012). In a previous study (van Mulukom, 2013), we had participants repeatedly imagine past and future events, and measured the decrease in construction times across repetitions (RT benefit) as an index of initial construction demand. We reported larger RT benefits for future than past events, confirming that future events are associated with more intensive constructive demands. However, the nature of this additional processing still remains unclear. Here, we investigated whether it reflects the binding of content details (e.g., people) into novel scenarios during imagination, and/or the construction of a novel spatial context. Using the logic from van Mulukom's (2013) study, we tested whether changing a person or the location of the imagined event reduced RT benefits upon repetition. Participants repeatedly imagined future events either with the same details (No change), with a different person (Person change), or a dif-

ferent location (Location change), and construction times were collected. A Bayesian repeated-measures ANOVA showed overwhelming evidence for the main effect of condition (BF > 10^3). Bayesian pairwise comparisons with default priors indicated that a change in either person or location reduced the RT benefit of repetition relative to the No change condition (both BF > 10^3); there was no difference between the Person change and Location change conditions (BF = 0.58). Together, these results suggest that increased demands associated with future imagination reflect binding details related to both content and spatial context into a coherent episode, with the type of detail not affecting construction demands.

Deception Detection Using a Task Switching Paradigm: An ERP Study

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Compared to repeating a cognitive task, switching between two different tasks incurs a response time cost, labelled the switch cost. Switching also produces event-related potential differences such as a sustained switch positivity after a task switch has been cued, and a switch negativity on switch trials following target presentation. The aim of this study was to determine whether switch costs and switch-related ERPs occur when a person switches between responding truthfully and responding deceptively. Participants completed a "sincerity switching" paradigm in which they memorised a list of objects, and then repeated and switched between responding truthfully and deceptively about whether each presented stimulus had been on the list. Participants also completed a traditional task switching paradigm in which they repeated and switched between responding to the direction each stimulus object was facing and the environment in which it was most commonly used. Behavioural and electrophysiological measures of switch costs were examined in both paradigms. Preliminary data suggest that switching between responding truthfully and deceptively does produce a switch cost. Preliminary data also suggest that similar switch-related ERPs occur in both the deception and traditional paradigms. Results are discussed in terms of the potential for task switching to be used as a new method of lie detection.

Spatial and feature-based attention have qualitatively different effects on object representation

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At any moment, there is more information available from our senses than we can process to a high level, making it crucial that our brains devote the greatest resources to the most relevant information. We can achieve this in different ways. We can direct our attention in space (spatial attention, e.g. attend left) or to a specific feature (feature-selective attention, e.g. detect colour). What is the neural basis for this ability, and do the same mechanisms give rise to spatial and feature-based attention? We addressed this question using multivariate decoding in MEG. Participants (n=20) covertly attended to an object on the left or the right of fixation (spatial attention) and reported the object's shape or colour (feature-selective attention). We used multivariate pattern classification to measure the coding of attentional set and to track the effect of attention on object representation. Attentional set (e.g. attend to colour, attend left) could be decoded at all times but was significantly enhanced once stimuli were presented. To test the effect of attention on object representation, we compared coding of attended and ignored stimulus features, at attended and ignored locations, and tracked the evolution of this coding in the first second after stimuli were presented. We found that both spatial and feature-based attention increased the decodability of object features. However, they did so in qualitatively different ways: Feature-based attention primarily enhanced small stimulus feature differences, while spatial attention produced greater enhancement for larger feature differences. Using a computative model, we found that the principles of response-gain and tuning curve sharpening at the level of a single neuron can account for the differences in spatial and feature-selective attention that we recorded at the population level. The remarkable cognitive ability to attend to different aspects of the environment may rely on qualitatively different neural mechanisms.

Investigating the effects of spatial frequency and facial emotion on rivalry dominance durations

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Rapid identification of facial emotion is important to human survival and social interactions. Several studies have indicated that during binocular rivalry between emotional and neutral faces, the emotional faces predominate over the neutral faces. It has been proposed that fear-based content is rapidly projected to the amygdala via a low-spatial frequency magnocellular pathway. In the present study, we investigated the effects of implicitly processed fearful and neutral face stimuli on binocular rivalry between orthogonally oriented gratings that were positioned on the noses of fearful and neutral faces. The face stimuli were processed with low-pass (roll-off 2 cycles per degree) and high-pass (roll-off 6 cycles per degree) spatial frequency filters. In order to understand the role of the magnocellular pathway in implicit face processing, we used a 2(face spatial frequency) by 2(face emotion) design to compare the effects of face stimuli on perceptual dominance durations for the grating stimuli. As expected, on average, gratings were perceived for longer durations when they were paired with fearful faces, compared with neutral faces. However, contrary to expectations, this effect was the same, regardless of the spatial frequency of the faces. This raises questions about the involvement of the magnocellular route to the amygdala in relation to spatial frequency. Given that fearful faces tend to draw attention and rivalry rates are known to depend on attentional levels, the negative finding here suggests the involvement of a passive attentional system independent of the transient attentional system known to be associated with magnocellular function.

Impairments in functional networks linked to attentional deficits in mild cognitive impairment in patients with Parkinson's disease

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Miss Alexandra Toft, *University of Queensland*
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INTRODUCTION: Cognitive disturbances in Parkinson's disease (PD) contribute to a high disease burden. Mild cognitive impairment (MCI) is common in PD and is a prodromal state of dementia. This study aims to identify neuroimaging markers associated with PD-MCI to increase understanding of neurobiology of dementia in PD. METHOD: 26 PD patients and 11 healthy controls completed the study. PD patients were subdivided to the presence or absence of MCI using standard criteria. Participants were scanned (3T Siemens PRISMA) while they performed an attention network test (ANT). Activation and deactivation of networks were compared between PD MCI, PD non-MCI and HC groups. Significance was determined as $p<0.001$ uncorrected, with cluster level FWE correction ($p<0.05$). RESULTS: PD patients demonstrated an overall slower reaction time than HC participants when performing the task. In comparison to HC participants, PD showed a decreased activation in bilateral middle frontal gyri, which are part of fronto-parietal network (FPN), and a decreased deactivation in the default mode network (DMN), particularly in inferior parietal lobule and middle temporal gyrus. The decrease in activation in the FPN was observed in PD-MCI compared to HC including additional regions such as right superior frontal gyrus and left inferior frontal gyrus. Furthermore, increased activation was also found in regions of the dorsal attention network in PD-MCI compared to HC.

There were no differences between PD with and without MCI or PD non-MCI and HC. DISCUSSION: Results provide preliminary evidence for deficits in the FPN and DMN in PD-MCI with respect to attentional processing. Further investigations in a larger sample of PD and HC is required.

Disturbed small-world networks in leukoaraiosis patients with cognitive impairment

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Background: The small-world networks have been proposed to be the optimal brain network with maximal efficiency in information processing at a minimal cost, and facilitating rapid information interactions.In this study, we aimed to investigate the small-world properties of the brain functional network and their relationship with cognition impairment in Leukoaraiosis (LA) patients.

Methods: Subjects were selected from communities using MRI, and given cognitive tests including Montreal Cognitive Assessment (MoCA) and Clinical Dementia Rating (CDR), and then divided into LA with normal cognition (LA-NC), LA with vascular mild cognitive impairment (LA-VaMCI) and the healthy control (HC) groups. Resting-state functional MRI data were collected and graph theoretical analysis was applied to evaluate the difference of the small-world networks among the three groups.

Results: Both LA-NC and LA-VaMCI cases presented with modified small-world topological properties. Compared with HC group, LA-NC group had increased small-world properties, whereas LA-VaMCI group showed decreased small-world properties. Moreover, we also found the small-world network properties was negatively correlated with the score of MoCA in LA-VaMCI patients.

Conclusions: Our study indicated that disrupted small-world networks may be one mechanism of cognitive impairment in LA patients, and the degree of small-world network changes might be associated with the level of cognitive impairment. The small-world networks could be used as a potential marker to detect vascular cognitive impairment in LA cases.

Discussion:

Our findings suggest that vascular mild cognitive injury may reduce the sensitivity of the response cells undergoing the optimal stimuli, leading to the reduced optimal small-worldness in LA-VaMCI patients. In contrast, the suppressor for the optimal small-worldness may be damaged in the LA-NC patients, which causes abnormally increased optimal small-worldness. These speculations need to be

How do L2 speakers use predictive coding during non-native sentence comprehension? An electrophysiological investigation on the role of L2 exposure

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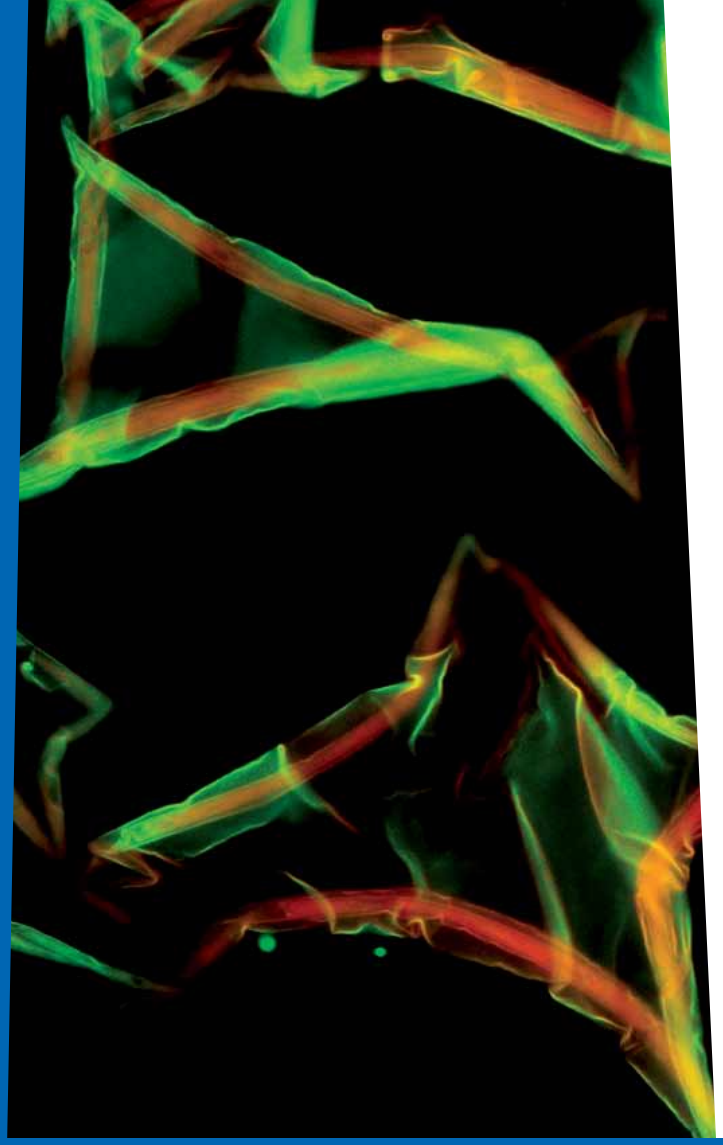
Language processing relies on predictive coding: comprehenders match top-down predictions against bottom-up perceptual feedback; and mismatches between the two induce prediction errors and internal model updating. Model updating is reflected in the N400 ERP, which is induced by unexpected sentence continuations. Predictions are formed via language-specific cues, e.g. word order in English and animacy (humans are more likely to act on objects) in Mandarin. This leads to language-specific processing patterns, as observable. For example, in semantic reversal anomaly (SRA) sentences (e.g. "The apple will eat the boy"), Mandarin monolinguals use animacy information to update their internal model to a patient reading of "apple" when they encounter "eat", engendering an N400. By contrast, English monolinguals interpret the first noun as the agent regardless of animacy, hence not showing an N400. This raises the question: how does predictive coding operate in Mandarin learners of English as a second language (L2)? In this EEG study, Mandarin-English bilinguals (n=26; 7 male; mean age=25.88) read English sentences comprising SRAs, controls (e.g. "The boy will eat the apple") and fillers. They judged sentence acceptability. We used linear mixed-effects models to examine the relationship between L2 exposure and mean N400 amplitude at the critical verb position. Behaviourally, accuracy increased with higher L2 proficiency. In terms of ERPs, SRAs elicited a biphasic N400–late positivity (LPS) pattern relative to controls. Both N400 and LPS amplitudes were more pronounced with higher English exposure. Our findings indicate that, as participants became more native-like behaviourally, their N400 responses showed less native-like ERP patterns. From a predictive-coding perspective, we propose that the degree of online prediction increases with increasing L2 exposure. However, rapid predictive coding continues to draw on L1 cues even at moderate-to-high L2 proficiency levels.



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Future Industries Institute
Image title: Beautiful delamination

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Agenda at a Glance

Thursday 23 November		
12:00	**Registration Desk Opens**	George Street
15:30	**Welcome**	Alan Scott Auditorium
15:45	**ACNS Award Announcements**	Allan Scott Auditorium
16:00	**Keynote 1** - Prof Tom Palmeri	Allan Scott Auditorium
17:00	**Welcome Reception**	SAHMRI
19:00	**ECR Mixer**	Regattas
Friday 24 November		
8:30	**Keynote** - Young Investigator Award Winner	Allan Scott Auditorium
9:00	**Keynote 2** - Prof Angela Clow	Allan Scott Auditorium
10:00	**Morning Tea**	George Street
10:40	**Parallel Open Talks:** Stream 1 - Allan Scott Auditorium, Stream 2 - BH2-09	
12:50	**Lunch**	George Street
14:00	**Parallel Symposium:** Symposium 1 - HH4-08, Symposium 2 - HH5-08	
15:20	**Afternoon Tea**	George Street
16:00	**Keynote 3** - Prof Charles Spence	Allan Scott Auditorium
17:30	**Oval Tour - Ticketed**	Adelaide Oval
17:30	**Pre-Dinner Drinks - Ticketed**	Rick Davies Bar, Adelaide Oval
18:30	**Dinner - Ticketed**	Cathedral Room, Adelaide Oval
Saturday 25 November		
9:00	**Parallel Fast Talks:** Stream 1 - HH4-08, Stream 2 - HH5-08	
10:30	**Morning Tea**	George Street
11:10	**Parallel Open Talks:** Stream 1 - HH4-08, Stream 2 - HH5-08	
13:20	**Lunch**	George Street
13:30	**AGM (during Lunch)**	Allan Scott Auditorium
14:30	**Parallel Open Talks:** Stream 1 - HH4-08, Stream 2 - HH5-08	
17:00	**Poster Gala**	Jeffrey Smart Building
Sunday 26 November		
7:00	**Fun Run**	River Torrens
9:00	**Parallel Open Talks:** Stream 1 - HH4-08, Stream 2 - HH5-08	
11:10	**Morning Tea**	George Street
11:40	**Parallel Symposium:** Symposium 3 - HH4-08, Symposium 4 - HH5-08	
13:00	**Closing Ceremony and Award Presentation**	HH4-08