ACNS CONFERENCE 2024

25th–29th November 2024

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

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Dear Colleagues, Students, Disginguished Guests, Valued Sponsors, and Supporters,

It is our great pleasure to host you to Newcastle for the 13th Annual Meeting of the Australasian Cognitive Neuroscience Society (ACNS). The conference is being held in the heart of Newcastle, spread across the University of Newcastle's NUSpace and Conservatorium of Music, as well as Newcastle City Hall – all within 100m of each other.

If you haven't been to Newcastle in a while, you will be pleasantly surprised! In the last 10-15 years, Newcastle has been transformed from a coal-dust covered steel town to a vibrant seaside city that balances a relaxed surfing and sky-gliding culture with an inner-city lifestyle!

The conference location is within walking distance of the Honeysuckle waterfront with many bars and restaurants, the iconic Newcastle Ocean Baths, Newcastle and Nobby's Beaches, the spectacular Newcastle breakwater, and many restaurants, bars, cafes and accommodation options.

As always, the ACNS conference brings together leading researchers and practitioners in cognitive neuroscience, with a focus on promoting the work of early career researchers. The program covers a range of topics, including cognitive and computational neuroscience, cognitive psychology, neuroscience of perception, and more.

This year, we will also be trialling two new ideas.

Firstly, in addition to the typical content areas, we have some content organised under three themes amongst those selected by the ACNS membership in our earlier survey. These include:

- Environmental Enrichment and Neuroplasticity
- Optimising Human Performance by Partnering with Defence
- AI and the Brain – Adversaries or Allies?

These themes will each include one or more plenary sessions, dedicated symposia and/or oral sessions.

Secondly, for the first time, we will run a free public forum at the Newcastle City Hall titled **Unlock the Future: Cognitive Neuroscience in the Age of AI** with a fantastic lineup of speakers from across Australia.

We are very grateful for the generous support of all our sponsors, and look forward to welcoming ACNS regulars and meeting new members in Newcastle!

Frini Karayanidis and Oren Griffiths

On behalf of the local organising committee:
Mattsen Yeark, Anna Behler, Felicity Simpson, Tijl Grootswagers, Tom Carlson & Jacob Paul

COMMITTEES

LOCAL ORGANISING COMMITTEE

Frini Karayanidis, *University of Newcastle*

Oren Griffiths, *University of Newcastle*

Anna Behler, *University of Newcastle*

Mattsen Yeark, *University of Newcastle*

Felicity Simpson, *University of Newcastle*

Tijl Grootswagers, *Western Sydney University*

Tom Carlson, *University of Sydney*

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Nathan Tran

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Almudena Ramirez Haro

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Reuben Rideaux, *University of Sydney*

Elise Rowe, *University of Melbourne*

Sophie Smit, *Macquarie University*

CONTENTS

The conference will run four workshops, including three technical workshops and an ECR workshop on Monday 25th November

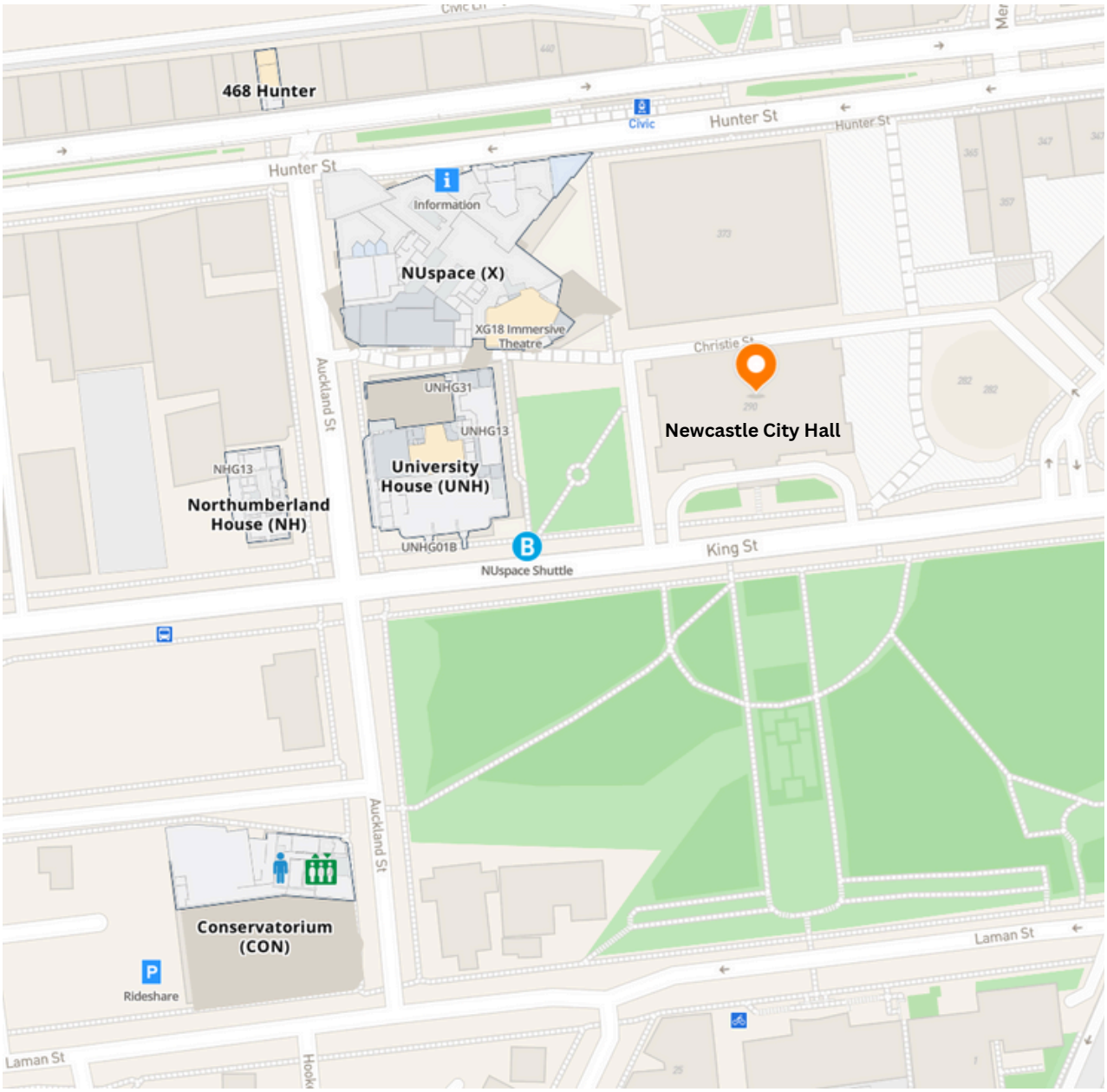
ACNS welcomes a variety of presenters across three themes: Enrichment & Neuroplasticity, Defence, and Artificial Intelligence

The Conference features three symposia, spanning Enrichment & Neuroplasticity, Naturalistic Paradigms in Neuroscience and Learning, Prediction & Action

A complete timetable of ACNS2024 including open talks, fast talks, poster sessions, symposia, social events and more!

VENUE MAPS

CITY OF NEWCASTLE



Venues for ACNS 2024 Conference

NUspace	– Main Conference Location – Open Talks, Fast Talks, Catering, Registration, Posters
Conservatorium of Music	– Plenaries, Keynote talks & Welcome Reception
Newcastle City Hall	– Keynote talks, ERA & YIA talks, Panel Discussion – AI Public Forum

DID YOU KNOW?

Parent/Quiet Room

We have a room for those needing privacy or a quiet space during the day. Can watch streams of presentations on phone/laptop.
Location: **Room X205** (Available from Tuesday)

Student Volunteers

Our amazing student volunteers will be helping throughout the Conference; assisting with check–in, helping with directions and supporting with presentations!

Free Wi–Fi!

NUspace, Conservatorium of Music and City Hall has free Wi–Fi. Please see details below to connect!

NUspace & Conservatorium
Username: UoN_Conference
Password: uon45597

City Hall
Username: Newcastle City Hall
Password: CityHall20

Prayer Room

We have a separate room booked for those needing Prayer Space.
Location: Room X110 (Available from Monday)

Newcastle Cowrie Hole Pumphouse – Newcastle NSW Australia

SOCIAL EVENTS

Alongside the scientific program, the conference features many social events, including a Welcome Reception, an Early–Career Researcher Social Night, AI Public Forum and Conference Dinner

WELCOME RECEPTION

Newcastle Conservatorium of Music

Monday, 25th November @5:30pm

The conference's welcome reception will be held on Monday evening, following the keynote talk by Professor Toby Walsh at the Newcastle Conservatorium of Music. Canapes will be served from 5:30pm along with a complimentary drink. The bar will be open for those wishing to purchase drinks until the events conclusion at 7:30pm. Please join us for this free networking event to open the Conference!

ECR SOCIAL

Honeysuckle Hotel

Tuesday, 26th November @6:30pm

Calling all Early Career Researchers!

The ACNS ECR group will host a special social event for early–career researchers on Tuesday evening at the Honeysuckle Hotel from 6:30pm.

Please come join us for a great night out!

ACNS CONFERENCE DINNER

Sponsored by SYMBIOTIC DEVICES

Customs House Hotel

Thursday, 28th November @7:00pm

We will be holding our ACNS Conference Dinner at the iconic Customs House Hotel. We will be having a sit down dinner with Entrée and Main (alternate serve, with one option being vegetarian) with a Cash Bar open for the duration of the night. Tickets are $88 each. Dietaries will indeed be looked after so please reach out if you are unsure about your dietary information entered during registration. Spots are limited so please get in early to reserve your spot!

AI AND THE BRAIN PUBLIC FORUM

UNLOCK THE FUTURE: COGNITIVE NEUROSCIENCE IN THE AGE OF AI

Are you intrigued by how Artificial Intelligence intersects with the study of the human mind? Join us for a compelling evening exploring the cutting–edge world where AI meets cognitive sciences!

Event Details

Date: Wednesday 27th November
Time: Doors open 5:30pm, Forum begins at 6:00 pm
Location: Newcastle Town Hall – Concert Hall

This special event features three distinguished experts who will share their knowledge and insights:
Dr Muneera Bano – Senior research scientist working at the CSIRO, with expertise in the ethical dimensions of AI, she was honoured as a Superstar of STEM and overall winner of the under–40 most Influential Asian–Australian Leadership award in 2019.
Prof Toby Walsh – Chief Scientist at UNSW's AI Institute. A leading AI researcher and named by the Australian newspaper as a "rockstar of the digital revolution".
Prof Andrew Barron – A neuroethologist renowned for his innovative research seeking to contrast natural and artificial intelligences.

Each speaker will deliver an engaging presentation, followed by a vibrant panel discussion moderated by local ABC radio host Dan Cox.

Whether you're a student, educator, or simply a curious mind, this is your chance to delve into how AI is transforming our understanding of the human brain and its potential. Engage with our experts, participate in a lively Q&A session, and explore new ideas and career opportunities in these exciting fields.

Why Attend?
– Hear from leading voices in AI and cognitive sciences.
– Participate in an interactive Q&A session.
– Discover the latest trends and future directions in these rapidly evolving disciplines.

Who Should Attend?
This event is open to all who are interested about the intersection of AI and cognitive sciences, including students of all ages, educators, and professionals. The evening has been designed for people about to start their careers in the age of AI, but it will be of interest to anyone intrigued by AI, neuroscience or intelligence.

RSVP: Tickets for this event are free. Please select this during registration to include it!

Don't miss this opportunity to be part of an engaging discussion about the future of AI and cognitive sciences. Reserve your spot today!

Note: This page was written using both human and artificial intelligence.

SCAN QR CODE TO GET TICKETS

WORKSHOPS

EEG/IMAGING WORKSHOP

Monday 25th November
@9:00am
#X101

EEG and fMRI: Measuring brain activity at different spatio-temporal scales

Presented by: Dr Oren Griffiths, Dr Anna Behler, Dr Bryan Paton & Agnieszka Iwasiw

This workshop will cover both EEG and functional MRI recording and processing. It will highlight important preprocessing steps and highlight pitfalls/tips to make using each technique easier than ever before.

PRE-REGISTRATION WORKSHOP

"Preregistration is hard! But it might be worth it"

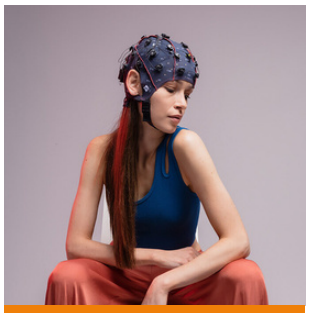
Presented by: Prof Alex Holcombe and Dr Kelly Garner

Preregistration of studies is old hat for some fields, but is relatively new in cognitive neuroscience. Should you do it? Preregistration is hard, so it's not always worth it! In this workshop, you will become familiar with the pain points of preregistration as well as the benefits.

We will begin by laying out why preregistration can be important and how its into the scientific ecosystem. After being introduced to common preregistration sites and formats, and after addressing a few case studies, you will work on a mock preregistration based on your own project. This will help open things up for discussion and the sharing of experiences.

Monday 25th November
@9:00am
#X205

BRAIN COMPUTER INTERFACE INNOVATION WORKSHOP



Monday 25th November
@12:30pm
#X205

Current and Future Technologies in Brain Computer Interface and Applications in Cognitive Neuroscience

Presented by: Christy Li & Arif Ahmad

g.tec has been producing top notch brain computer interface systems to suit different researchers' needs. This workshop would be showcasing the latest advanced systems with hands-on demonstrations.

ECR WORKSHOP

The complexities of science communication

Presented by: Dr Emma Beckett, A/Prof Karen Livesey & Shelley Wilson

Developing the expertise to communicate your research with a broad array of audiences is a skill that is not always recognised and can take considerable investment (and courage). While critical for the advancement and recognition of research, there can also be risks and barriers associated with public engagement – especially for early-career researchers. In this workshop, we'll hear from a broad array of science communicators on their approach and advice, and tackle some of the challenges faced by researchers engaged in this space.

Monday 27th November
@12:30pm
#X101

INVITED SPEAKERS

A/Prof Theodore Zanto

Tuesday 26th November @9:00am
CONSERVATORIUM OF MUSIC

Dr. Zanto has B.S. Degrees in Physics and Psychology from the University of Wisconsin, Whitewater and a Ph.D. In Complex Systems and Brain Sciences from Florida Atlantic University. He received postdoctoral training in cognitive neuroscience at the University of California San Francisco where he is now an Associate Professor in Neurology and Director of Neuroscape Neuroscience Division. Dr. Zanto is also a PI of an NIH Roybal Center at UCSF that is dedicated to investigating the efficacy of closed-loop digital interventions through a remote clinical trials platform. Dr. Zanto 's research utilizes fMRI, EEG, and non-invasive brain stimulation techniques to study neural mechanisms at the intersection of attention, perception, and memory. His research couples these neuroimaging tools with physiological recordings such as EMG, ECG, EGG, EDA, respiration and blood pressure to understand how the brain and body coordinate to promote successful cognition and positive emotional states. His translational research interests are to understand the role of neural entrainment in cognitive control and how it may be used as a potential therapeutic, particularly in the aging population. Notably, Dr. Zanto is assessing how neural entrainment affects basic cognitive control functions and whether select cognitive functions may be improved through neural entrainment with musical rhythms or with non-invasive oscillatory electrical neurostimulation. Dr. Zanto's work has received numerous awards and has been featured in various media outlets, including PBS, NBC, CBS, The Wall Street Journal, Wired Magazine, and Forbes.

Prof Karen Caeyenberghs

Monday 25th November @4:00pm
CONSERVATORIUM OF MUSIC

Prof Caeyenberghs completed her PhD in Biomedical Sciences in 2010 at the KU Leuven. She currently co-leads the Cognitive Neuroscience Unit in the School of Psychology at Deakin University as well as her own Neuroplasticity and Multimodal Imaging (NMI) Lab within the CNU. Prof Caeyenberghs is leading expert in the field of structural neuroimaging in TBI with exceptional outputs relative to opportunity. She has a h-index of 42 and a total of 4,872 citations from 148 publications (Sc). Her research contribution and impact have been recognised by several prestigious fellowships (including 2 from the Research Foundation Flanders, and an NHMRC CDF). She has received > $5.2 million in national and international research funding. Prof Caeyenberghs is an internationally recognised traumatic brain injury (TBI) expert advancing the understanding of (i) the biological basis of symptoms in TBI; and (ii) the biological mechanisms of action of TBI training programs. Her prominent role in microstructural imaging research has also been recognised by numerous recent awards, including the 2021 Young Investigator Award from the Australasian Cognitive Neuroscience Society, the Victorian Near-miss Award of Veski, and as a finalist in the 2023 Research Australia Health and Medical Research Awards and 2024 Deakin University Partnerships in Practice awards.

Prof Toby Walsh

Wednesday 27th November @2:30pm
BANQUET ROOM, CITY HALL

Toby Walsh is Laureate Fellow and Scientia Professor of Artificial Intelligence at the Department of Computer Science and Engineering at the University of New South Wales, research group leader at Data61, adjunct professor at QUT, external Professor of the Department of Information Science at Uppsala University, an honorary fellow of the School of Informatics at Edinburgh University and an Associate Member of the Australian Human Rights Institute at UNSW. He was Editor-in-Chief of the Journal of Artificial Intelligence Research, and of AI Communications. He is on the editorial board of the Journal of the ACM, Journal of Automated Reasoning and the Constraints journal. He has been elected a fellow of the Australian Academy of Science, the Association of Computing Machinery (ACM), the American Association for the Advancement of Science, the Association for the

INVITED SPEAKERS

Advancement of Science, the Association for the Advancement of Artificial Intelligence, and the European Coordinating Committee for AI in recognition of his reseach in artificial intelligence and service to the community. He has won the NSW Premier's Prize for Excellence in Engineering and ICT, the Humbolt Award, the Research Excellence Award of the Association for Constraint Programming and the IJCAI Donald E. Walker Distinguished Service Award. He has been Secretary of the Associtation for Constraint Programming (ACP) and is Editor of CP News, the newsletter of the ACP. He is one of the Editors of the Handbook for Constraint Programming, and the Handbook for Satisfiability. He has been Program and Conference Chair of the main conferences in Constraint Programming, Automated Reasoning and Artificial Intelligence.

Dr Muneera Bano

Wednesday 27th November @5:30pm
CONCERT HALL, CITY HALL

Dr Muneera Bano is currently working as a Senior Research Scientist and the Diversity, Inclusion, and Belongingness Officer at Australia's national science agency CSIRO's digital arm Data61. Muneera leads pioneering efforts to integrate diversity and inclusion within the artificial intelligence sector. She graduated with PhD in Software Engineering from the University of Technology Sydney (UTS). A passionate advocate for STEM and diversity, Muneera's impact has been widely recognised. She was honoured as the '2019 Most Influential Asian–Australian Under 40' and named a 'Superstar of STEM' by Science and Technology Australia. She was a finalist in Women in Tech APAC 2024 APAC as Most Disruptive Woman and the 2024 Woman in AI APAC awards for her contributions to AI in Social Good. Muneera's advocacy for inclusive tech environment continues to inspire and pave the way for future innovations in the industry. Her commitment to diversity and her research in AI not only advance the field but also ensure that the future of technology is inclusive and accessible to all.

Prof Andrew Barron

Wednesday 27th November @5:30pm
CONCERT HALL, CITY HALL

Professor Barron is the Director of the Macquarie Minds and Intelligences Initiative. He is a neuroethologist, which is a discipline of neuroscience studying the neural mechanisms of natural animal behaviour. Most of his research focuses on insects, especially honey bees. Using advanced techniques to visualise, manipulate, map and record from the insect brain Barron's team has made important contributions to the understanding of fundamental behavioural systems such as cognition, navigation, social behaviour and learning and memory. He also conducts research to improve honey bee health and welfare. He is studying how bees and bee colonies are impacted by pesticide and disease stressors, and how to best intervene to help bee colonies under stress.

Prof Scott Brown

Thursday 28th November @9:00am
CONSERVATORIUM OF MUSIC

Dr Scott Brown has focused on applying mathematical modelling techniques to the understanding of higher–order cognitive processes, primarily in memory and decision–making. He spent four years as an Assistant Professor at UC Irvine before taking up a position at the University of Newcastle. From 2008 to 2016, he was supported in research–only positions by the Australian Research Council, first through a Queen Elizabeth II Fellowship and later through a Future Fellowship. Dr Brown shares a lab with a strong group of math–psych researchers, and his research combines basic cognitive science aimed at understanding human psychology and behaviour with applied work investigating how human performance can be understood and improved in critical situations. In recognition of his contributions to cognitive science, Dr Brown was named the top Australian Cognitive Scientist in 2020 for the second consecutive year. He was among six University of Newcastle researchers recognised as leaders in their fields, as reported in The Australian's 2020 Research magazine.

INVITED SPEAKERS

Dr Melanie McGrath

Thursday 28th November @9:00am
CONSERVATORIUM OF MUSIC

Melanie is a researcher in CSIRO's Collaborative Intelligence and Responsible Innovation Future Science Platforms. Melanie's work addresses the integration of human and AI capabilities at the individual, group, and organisational levels. She specialises in the role and implications of human trust in AI, and how this understanding can be harnessed to develop and deploy responsible AI solutions. Her research expertise is coupled with a strong commitment to translating scientific concepts into actionable insights, and she has experience delivering workshops and presentations to industry, government, and academic audiences. Melanie has postgraduate qualifications in psychology from Monash University and a doctorate in social psychology from the University of Melbourne.

Mr Nick Willmot

Thursday 28th November @9:00am
CONSERVATORIUM OF MUSIC

Nick Willmot is a Cognitive Neuroscientist at the Defence Science & Technology Group (DSTG), where he works across Human Performance and Cognitive Science programs. Nick completed his Bachelor of Psychological Science (Hons I) at the University of New South Wales before joining DSTG and completing his PhD in Cognitive Neuroscience at The University of Queensland. During his PhD, Nick explored the utility and reliability of non–invasive brain stimulation for improving cognition in military contexts. Prior to DSTG, Nick worked in Community Mental Health and served in the Royal Australian Navy.

Nobbys Breakwall – Newcastle NSW Australia

ENRICHMENT AND NEUROPLASTICITY

Description:
Despite early notions of the brain as a fixed and immutable organ, extensive evidence from animal, clinical and intervention studies demonstrates that environmental and lifestyle factors can profoundly temporarily or permanently change brain structure and function. An important translational focus is now on characterising both the neurally–enriching and neurally–depleting impacts of environment and lifestyle factors. This knowledge is fundamental to the design of spaces and programs that can optimise intrinsic capacity across the lifespan, restore function following trauma and/or maintain functional ability into old age. Following on from Ted Zanto's discussion of the benefits of musical engagement on diverse cognitive abilities across the lifespan, this symposium will discuss examples of recent work on enrichment and neuroplasticity in a range of other contexts.

Speakers:

Dr Heidi Janssen
ESTEEM After Stroke – results from a pilot study translating the principles of environmental enrichment into community based stroke recovery?

Associate Professor Sharna Jamadar
The contribution of parenthood to cognitive reserve across the lifespan

Professor Frini Karayanidis
Can functionally 'exercising' the prefrontal cortex impact regional cerebral arterial elasticity in older adults?

Professor Karen Caeyenberghs
Towards neuroscience–guided training programs for clearing cognitive impairments in cancer survivors?

Dr Hannah Filmer
Neurophysiological predictors of training transfer induced by tDCS

Associate Professor Ted Zanto
Transcranial alternating current stimulation facilitates cognitive function in aging

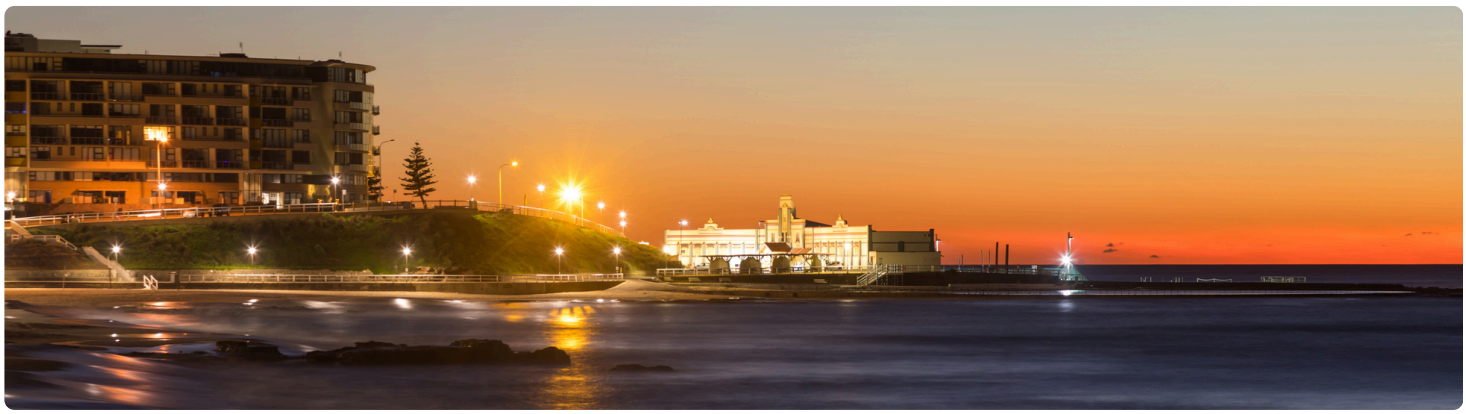
CHAIR
Dr Ted Zanto
University of California San Francisco

NUspace
Room #X101

Tuesday 25th November
@11:00am

Presenters

Dr Heidi Janssen
University of Newcastle
A/Prof Sharna Jamadar
Monash University
Professor Frini Karayanidis
University of Newcastle
Professor Karen Caeyenberghs
Deakin University
Dr Hannah Filmer
The University of Queensland
A/Prof Ted Zanto
University of California San Francisco



Newcastle Beach – Newcastle NSW Australia

HOW LEARNING AND ATTENTION SHAPE PREDICTION AND ACTION: UNDERSTANDING THE BRAIN AT MULTIPLE SCALES OF ANALYSIS

CHAIRS

Reuben Rideaux
The University of Sydney
Melissa Sharpe
The University of Sydney

NUspace
Room #X320

Friday 29th November @11:00am

Presenters

Dr Reuben Rideaux
The University of Sydney
Dr Melissa Sharpe
The University of Sydney
A/Prof Jay Bertran-Gonzalez
The University of New South Wales
Dr Maureen Hagan
Monash University
Dr Masakazu Taira
The University of Sydney

This symposium will explore cutting-edge research across different species and levels of analysis to advance understanding of how the brain processes information to create mental maps of the environment. Researchers will present their neuroscientific findings across mice, rats, non-human primates, and humans in tasks designed to reveal how learning and attentional mechanisms govern our ability to make new predictions and behave appropriately. We will discuss how insights from these various scales can be integrated to form a comprehensive picture of cognitive function and dysfunction. The symposium aims to foster interdisciplinary collaboration and dialogue, encouraging the exchange of ideas and techniques among these experts from the diverse fields of neurobiology, psychology, and computational neuroscience. Attendees will gain a deeper understanding of the complex interplay between different neural processes involved in cognition and behaviour, and how these insights can be applied to understand brain function more broadly. This event promises to be a stimulating forum for advancing our knowledge of the brain's remarkable ability to learn from and anticipate the world around us.

Description:
This symposium aims to foster a cross-disciplinary discussion of how the brain learns to anticipate important events to drive appropriate behaviour. We will provide a cross-species understanding of how learning, attention, and action is expressed at the synapse, cell, and regional level. Jay Bertran-Gonzalez will first present work that explores mesoscopic, dynamic, functional rearrangements of basal ganglia systems in mice as learning sets in. This work reveals interesting functional cell-to-cell interactions that can help reconcile the cytoarchitecture and anatomical organisation of the basal ganglia. Then, Mel Sharpe will present data in rats examining how a region associated with the basal ganglia, the lateral hypothalamus, organizes information to prioritize learning and behaviour towards reward cues and away from neutral information. These data are generated by tasks adopted from the human cognitive neuroscience field in tandem with cell- and pathway-specific optogenetics and recording techniques. Next, Maureen will move up a scale to present work looking at populations of cells and local field potentials in cortex of behaving marmosets. Specifically, she will discuss how spatial cues affect visual attention and its representation across cortical layers in the posterior parietal cortex. Finally, Reuben will discuss data generated from behavioural, physiological (pupil dilation) and neural (EEG) measures, which investigates the influence of temporal context on perception and action across different timescales. Together, this work will help to understand how learning and attention shape prediction and action. At the same time, this symposium will generate new questions for how we can integrate differential research spheres to create coherent models of how the brain represents information to influence action.

A note on diversity and inclusion:
We have gone to considerable lengths to diversify our symposium from both a scientific, gender, and geographical perspective. Specifically, we will discuss data on learning and attention across four different species from mice to humans, using a modern suite of neuroscience techniques. The symposium is also gender balanced, with academics at different stages of career that are from all around Australia.

PERCEIVING THE EVERYDAY: NATURALISTIC PARADIGMS AND THEIR USE IN COGNITIVE NEUROSCIENCE

This symposium will explore the perception and use of naturalistic stimuli and paradigms in neuroscience, focusing on how the brain processes complex, real–world environments. Naturalistic stimuli, including complex forms such as images, movies, and virtual reality (VR), mirror the experiences we encounter in our daily lives, yet traditionally, they have not been widely adopted. Their use in experiments enhances the ecological validity of the tasks under study allowing insights on how the brain integrates complex and multimodal information into meaningful experiences. Past decade has seen their increase in popularity with various subfields in neuroscience and psychology embracing naturalistic stimuli and paradigms.

This symposium brings together researchers from diverse neuroscience and psychology disciplines exploring the many facets of naturalistic stimuli — from the perception of natural scenes to the statistical analysis of complex images and, eventually, the diverse use of naturalistic stimuli to study perception, cognition and emotion. The symposium offers a comprehensive overview of this emerging field, equipping and guiding researchers with current developments and resources relevant to the use of naturalistic stimuli in diverse research areas for the next generation of studies.

Aims and importance

Naturalistic stimuli such as natural images, film clips/movies, and virtual reality (VR), and naturalistic paradigms such as mobile EEG attempt data acquisition and data analysis of brain functioning "in the wild". Their use in neuroscience builds upon the knowledge gained by the use of traditional abstract stimuli on how the brain integrates complex multimodal information. They reflect complex statistical properties which make them a rich, ecologically valid resource offering complementary and deeper understanding of brain function. Consequently, naturalistic stimuli have become increasingly important in cognitive and clinical neuroscience demonstrated by their adoption in task paradigms in large open access datasets such as the Human Connectome Project.

However, their use comes with the challenges of reduced experimental control requiring use of novel analytical strategies. This symposium will explore the statistical properties of complex natural images and how the visual system mirrors some of these statistics and integrates information. Furthermore, this symposium will highlight the use of naturalistic stimuli in studies that incorporate functional Magnetic Resonance Imaging (fMRI), eye–tracking, and psychophysiological measures, as well as the application of VR in cognitive science. The goal is to foster cross–disciplinary dialogue, highlight the opportunities of using naturalistic stimuli, and explore how these insights can enhance our understanding of cognitive processes in everyday contexts.

CHAIRS

Dr Saurabh Sonkusare
University of Newcastle
Dr Anna Behler
University of Newcastle

NUspace
Room #X321

Friday 29th November @11:00am

Presenters

Dr Saurabh Sonkusare
University of Newcastle
Dr Anna Behler
University of Newcastle
Dr Will Harrison
The University of Sunshine Coast
Professor Branka Spehar
The University of New South Wales
Dr Katherine Storrs
University of Auckland, NZ

Expected learning outcomes

i) Attendees will learn about various naturalistic experimental paradigms, including complex images/scenes, movies, narratives, mobile EEG and VR, and their differences to "traditional" abstract stimuli.
ii) Presenters will address the challenges and limitations associated with using naturalistic stimuli in research, offering practical solutions and strategies to overcome these hurdles.
iii) The symposium will provide insights into novel analytical strategies using fMRI, MEG/EEG, including both data–driven and model–driven approaches, to better understand how the brain processes complex, multimodal information.
iv) Attendees will explore the broader implications of utilising such stimuli and integration of cognitive functions such as attention, memory, and decision–making.

By the end of the symposium, attendees would have been informed about ways to integrate naturalistic stimuli into their own research, enhancing the ecological validity of their studies and advancing our understanding of cognitive processes in everyday contexts.

Target audience

We anticipate a diverse audience including psychologists, as well as cognitive and clinical neuroscientists, given the widespread use of naturalistic paradigms across various neuroimaging modalities, psychophysiology, and behavioural experiments. Researchers in fields such as vision science, as well as those studying higher–order cognitive and emotional processes, will find this symposium particularly valuable. The use of naturalistic paradigms has also resulted in newer and evolving analytical approaches, making this symposium interesting also for researchers working with advanced statistical and computational methods. Additionally, academics and professionals who want to stay informed about the latest trends and findings in neuroscience will benefit from the insights shared in the symposium offering a comprehensive view of this rapidly evolving field.

ACNS 2024 AWARD WINNERS

Dr Melissa Sharpe

YOUNG INVESTIGATOR AWARD

Dr. Melissa Sharpe has recently moved her research group from the Department of Psychology at UCLA to the University of Sydney. Dr. Sharpe holds a Ph.D. in Psychology (UNSW). Dr. Sharpe received postdoctoral research training in the United States at National Institute on Drug Abuse (NIDA) and Princeton University, which was supported by an NHMRC CJ Martin Biomedical Fellowship. Dr. Sharpe's lab investigates the neural circuits involved in reinforcement learning using a modern suite of neuroscience techniques including optogenetics and fiber photometry of genetically encoded activity sensors (e.g. calcium, dopamine, serotonin). In particular, the lab's work has challenged the way we conceptualize the dopamine prediction error as contributing to learning throughout the brain. The lab is funded by the National Health and Medical Research Council (NHMRC), the US National Science Foundation (NSF), and the US National Institutes of Health.

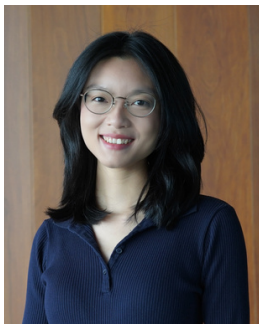
Dr Nigel Rogasch

YOUNG INVESTIGATOR AWARD

Dr. Nigel Rogasch is the head of the Brain Stimulation, Imaging, and Cognition research team at the University of Adelaide and the South Australian Health and Medical Research Institute. Nigel graduated with a Bachelor of Science (Hons) from the University of Adelaide in 2007, and a PhD from Monash University in 2014. Nigel's research is focused on improving cognition by tailoring non–invasive brain stimulation protocols to effectively remodel the neural circuits underlying cognitive ability.

Dr Shuting Li

EMERGING RESEARCHER AWARD



Dr. Shuting Li is a postdoctoral researcher at the Melbourne School of Psychological Sciences. Her research focuses on attention control and the underlying neural mechanisms in autistic individuals, people with subclinical autistic traits, and mouse models of autism. After completing her PhD at the University of Melbourne in 2022, she spent one year conducting postdoctoral research at the Florey Institute of Neuroscience and Mental Health. In 2024, she received a highly competitive postdoctoral research fellowship and returned to the Melbourne School of Psychological Sciences, where she began leading research projects as a principal investigator. Dr. Li has published five articles in prestigious journals, including Neuropsychopharmacology, and has presented at 22 conferences. She has received several competitive grants, including the Early Career Researcher Grant from the University of Melbourne. She has also won numerous research awards, such as the Emerging Researcher Award presented here by the ACNS and the ReWire Hines Early Career Research Award in 2024.

Dr Denise Moerel

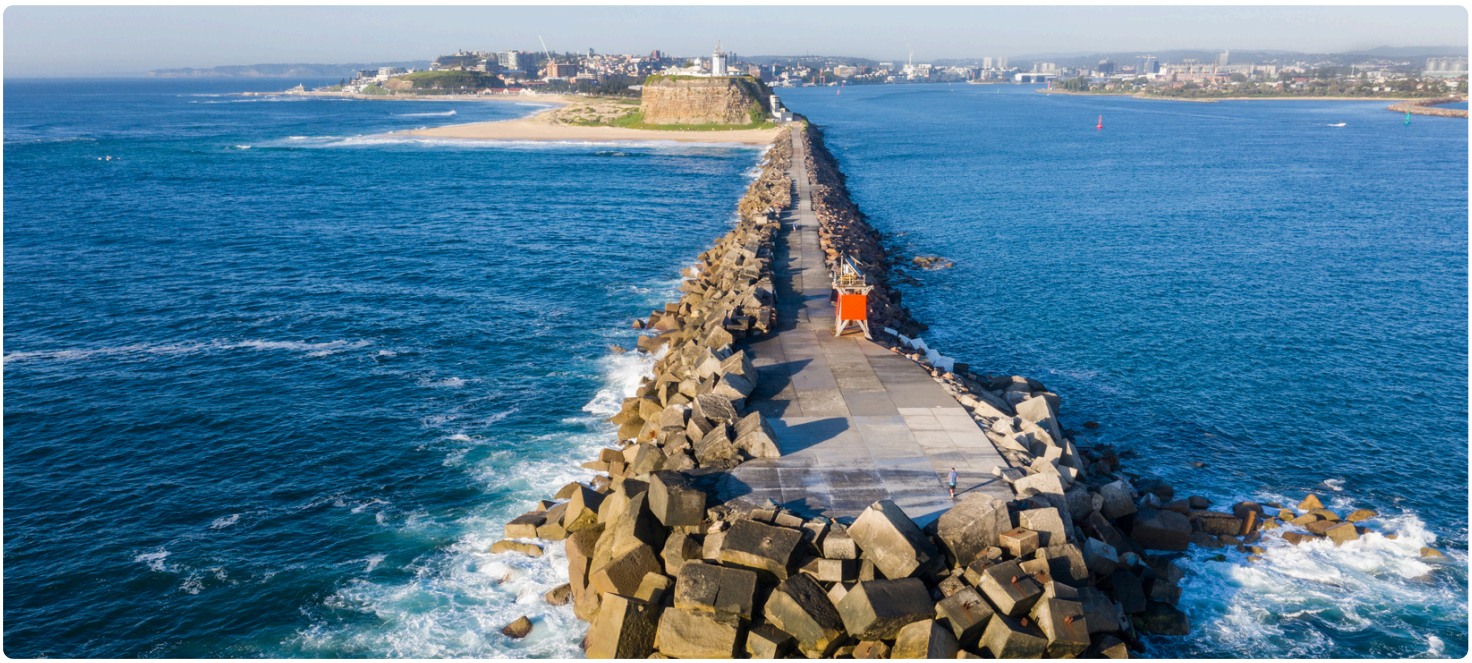
EMERGING RESEARCHER AWARD

Denise is a Postdoctoral Research Fellow at the MARCS Institute for Brain, Behaviour and Development at Western Sydney University. Her research investigates how perception enables complex behaviour, such as social interaction, and how attention facilitates these processes. She uses research methodologies such as EEG, MEG and fMRI in combination with multivariate decoding methods.

CONFERENCE SCHEDULE

Day 1 | Monday 25th November

0800–1800	**Registration Desk** *(NUspace Ground Floor)*		
0900–1130	**EEG/Imaging Workshop** EEG and fMRI: Measuring brain activity at different spatio–temporal scales **Presenters:** Oren Griffiths (UON), Anna Behler (UON), Bryan Paton (UON) & Agnieszka Iwasiw (Symbiotic Devices) *(X101)*	0900–1130	**Preregistration Workshop** "Preregistration is hard! But it might be worth it." **Presenters:** Alex Holcombe (USyd) and Kelly Garner (UNSW) *(X205)*
1130–1230	**Break**		
1230–1400	**ECR Workshop** The complexities of science communication **Presenters:** Emma Beckett (UNSW), Karen Livesey (UON) & Shelley Wilson (Questacon) *(X101)*	1230–1500	**Brain Computer Interface Innovation Workshop** Current and Future Technologies in Brain Computer Interface and Applications in Cognitive Neuroscience **Presenters:** Christy Li & Arif Ahmad (g.tec) *(X205)*
1600–1630	**Acknowledgement of Country: Andrew McIlwraith** (Bundjalung & Worimi, Ma and Morley Scholar, UON) **Opening: Frini Karayanidis & Oren Griffiths** (co–Chairs of Local Organising Committee of ACNS2024, UON) **Welcome: Craig Simmons** (Pro Vice Chancellor, College of Engineering, Science and the Environment, UON); **Juanita Todd** (Pro Vice Chancellor, Research, UON) **Trevor Chong** (ACNS President, Monash University) *(Newcastle Conservatorium of Music)*		
1630–1730	**Enrichment & Neuroplasticity Keynote** **Prof Karen Caeyenberghs** (Deakin University) – *Combining ecological momentary assessment and advanced neuroimaging to investigate brain biomarkers of behavioural deficits in chronic disease* *Chair: Sharna Jamadar* *(Newcastle Conservatorium of Music)*		
1730–1930	**Welcome Reception** *(Newcastle Conservatorium of Music)*		



Nobbys Breakwall – Newcastle NSW Australia

CONFERENCE SCHEDULE

Day 2 | Tuesday 26th November

0800–1700	**Registration Desk** *(NUspace Ground Floor)*		
0900–1030	**Enrichment & Neuroplasticity Keynote** **Ted Zanto** (UCSF) – Mechanisms of Transfer: How Digital Musical Training Can Promote Cognitive Function *Chair: Frini Karayanidis* Discussants: Helen English (UON), Heidi Janssen (UON), Trevor Chong (Monash University) *(Newcastle Conservatorium of Music)*		
1030–1100	**Morning Tea** *(NUspace Ground Floor)*		
	Parallel Open Talks		
1100–1300	**Enrichment & Neuroplasticity Symposium** *Chair: Ted Zanto* *(X101)*	**Perception 1** *Chair: Deborah Apthorp* *(X320)*	**Mental Health / Motor Processes** *Chair: Bradley Jack* *(X321)*
1100–1115	**ESTEEM After Stroke – results from a pilot study translating the principles of environmental enrichment into community based stroke recovery?** *Heidi Janssen*	**Faster perceptual processing time and reduced inversion effects for self–face and familiar–face perception compared to novel faces** *Deborah Apthorp*	**Association between atypical attention orienting and a specific autistic trait** *Elisabetta Materazzo*
1115–1130	**The contribution of parenthood to cognitive reserve across the lifespan** *Sharna Jamadar*	**Local Motion Not Biological Form Influences Priority Access to Conscious Awareness during CFS** *Will Swann*	**Atypical Interactions of the Attention Networks in the Neuroligin–3 Mouse Model of Autism** *Shuting Li*
1130–1145	**Can functionally 'exercising' the prefrontal cortex impact regional cerebral arterial elasticity in older adults?** *Frini Karayanidis*	**Seeing the expected: Investigating the experience of implied colour for colour diagnostic objects** *Jordan Lyons*	**Enhanced brain MR imaging after cochlear implantation** *Bryan Paton*
1145–1200	**Towards neuroscience–guided training programs for clearing cognitive impairments in cancer survivors?** *Karen Caeyenberghs*	**Influences of Neural Oscillation Phase on Perception of the Tilt Illusion** *Anthony Harris*	**Using Real–time Resting–State–Networks as Digital Biomarkers for Mental Health** *Navin Cooray*
1200–1215	**Neurophysiological predictors of training transfer induced by tDCS** *Hannah Filmer*	**Individual differences in neural representations of face dimensions: Insights from Super–Recognisers** *Martina Ventura*	**The impact of variable cursor feedback delay on visuomotor performance** *Lucy Turner*
1215–1230	**Transcranial alternating current stimulation facilitates cognitive function in aging** *Ted Zanto*	**Spatial frequency influences the expectation effects of novel object–scene associations** *Morgan Kikkawa*	**Body Clocks: Physiological Signatures of Affective Timing across Modalities** *Efthymia Lamprou*
1230–1245	**Discussion and Q&A**	**Perceiving the 'gaze' of an artificial agent** *Lindsay Peterson*	**Individual alpha frequency does not index a mechanism underlying motion–position illusions** *Timothy Cottier*
1245–1300		**"Unseeing" fearful faces: inhibition of attentional capture is challenging for unpredicted negative emotions** *Philip Chalk*	

CONFERENCE SCHEDULE

Day 2 | Tuesday 26th November

1300–1400	**Lunch** *(NUspace Ground Floor)*		
	Parallel Open Talks		
1400–1600	**Enrichment & Neuroplasticity** *Chair: Hannah Filmer* *(X101)*	**Predictive Coding / Auditory Processing** *Chair: Juanita Todd* *(X320)*	**Emotion and Affect** *Chair: Ottmar Lipp* *(X321)*
1400–1415	**Irisin – a missing link? Relationships between circulating Irisin, hippocampal volumes, physical fitness and cognitive function in healthy older people** *Sophie Andrews*	**ERP and fMRI imaging the long timescale modulation of learning using auditory prediction and prediction–error signals** *Juanita Todd*	**Subcortical modulation of the fronto–insular and cingulate functioning during negative emotional processing in mood and anxiety disorders** *Sevil Ince*
1415–1430	**White matter microstructure predicts tDCS induced training generalisability** *Yohan Wards*	**Multimodal evidence that probabilistic cuing does not influence sensory representations** *Ziyue Hu*	**An Active Inference Account of Cognitive Effort** *Mengting Zhang*
1430–1445	**Baby–brain, a subjective experience that occurs in mother and fathers?** *M. Navyaan Siddiqui*	**Reductions in aperiodic gamma activity and the mismatch negativity response to frequency deviants are signatures of a first episode of psychosis** *Elise Rowe*	**Offline effects of real–time closed loop Default Mode Network inhibition** *Cameron Higgins*
1445–1500	**Colour–music association reveals an evolutionary ancient colour pathway** *Misha Vorobye*	**How do people with schizophrenia process information in volatile sound environments** *Mattsen Yeark*	**Affect and empathy task induced alpha–theta activity from direct neuronal recordings human bed nucleus of stria terminalis link with depression and anxiety severity** *Saurabh Sonkusare*
1500–1515	**Does cardiac activity influence emotional and aesthetic evaluation of dance?** *Andrea Orlandi*	**Probabilistic Stimulus Expectations Influence Behaviour but Not Visual Stimulus–Evoked Event–Related Potentials** *Elizabeth Chang*	**An active inference model of the optimism bias** *Elizabeth Fisher*
1515–1530	**An evidence–based neuronal framework for the behavioural effects of tDCS** *Daniel Fehring*	**No Effect of Value on the Task Irrelevant Auditory MMN** *Oren Griffiths*	**Presenting unpaired unconditional stimuli during fear extinction at full and reduced intensity slows re–acquisition** *Ottmar Lipp*
1530–1545	**Comparing content and timing predictions in music and speech: Differential effects depending on domain and music training** *Anna Fiveash*	**Environmental volatility effects on auditory perceptual processing in healthy populations and schizophrenia** *Matthew Godfrey*	**Understanding the relationship between anxiety, stress and depression on cognitive performance during exposure to different interior built environment room scales** *Isabella Bower*
1545–1600	**Dog–assisted intervention to reduce scanxiety and improve MRI quality** *Caroline Faucher*		**Can an online battery match in–person cognitive testing in providing information about age–related cortical morphology?** *Renate Thienel*
1600–1730	**Poster Session 1** with Afternoon Tea and Open Bar *(NUspace Ground Floor & Mezzanine*		
1900	**ECR Social Night** *Honeysuckle Hotel*		

CONFERENCE SCHEDULE

Day 3 | Wednesday 27th November

0800–1700	**Registration Desk** *(NUspace Ground Floor)*		
0930–1010	**Emerging Researcher Award Winners** *Chair: Hannah Keage* **Shuting Li** (Uni Melbourne) – *Attention Research in Autism: An Interdisciplinary Approach Through Human and Mouse Research* **Denise Moerel** (Western Sydney University) – *How internal states shape the neural encoding of visual information* *(Banquet Room, City Hall)*		
1010–1100	**Panel Discussion –** *Funding landscape of cognitive neuroscience research* *Chair: Trevor Chong (Monash University)* Discussants: Hannah Keage (University of South Australia), Katherine Johnson (University of Melbourne), Frini Karayanidis (UON) *(Banquet Room, City Hall)*		
1100–1130	**Morning Tea** *(NUspace Ground Floor)*		
	Parallel Open Talks		
1130–1330	**Neurodegenerative Disorders** *Chair: Sharon Savage* *(X101)*	**Perception 2** *Chair: Derek Arnold* *(X320)*	**Learning / Stimulation** *Chair: Dragan Rangelov* *(X321)*
1130–1145	**Alpha desynchronisation may be an informative marker of recognition memory in individuals with mild cognitive impairment** *Frances De Blasio*	**Distributed Networks in Working Memory Manipulation: Cerebellar and Subcortical Contributions** *Joshua Tan*	**Learning transfer is hindered by robust representations of learned task contingencies** *Kelly Garner*
1145–1200	**Resting-state EEG pink noise, white noise, and oscillatory activity in Parkinson's disease** *Aland Astudillo*	**Expectation defied: Corollary discharges do not predict and suppress complex sound sequences** *Imogen Clarke*	**Are predictions automatic? Investigating prediction-based motor attenuation using a novel TMS oddball paradigm** *Monique Cost-Chretien*
1200–1215	**Determining the predictors and longitudinal trajectories of hallucinations in people with Parkinson's disease** *Kyla-Louise Horne*	**Rapid visual engagement in neural processing of detailed non-social touch interactions** *Sophie Smit*	**Expectation dynamically modulates the representational time course of objects and locations** *Margaret Jane Moore*
1215–1230	**Integrity of the septohippocampal pathway and its significance in cognitive variability in Parkinson's disease** *Nicola Slater*	**Does competition from concurrent stimuli change functional activity in the ventral visual cortex?** *Jessica Taubert*	**Behavioural and neurophysiological effects of continuous theta-burst stimulation to the right superior temporal sulcus** *Bridgette Speranza*
1230–1245	**Dopaminergic modulation of vigour predicts mood in Parkinson's disease** *Huw Jarvis*	**Exploring opposing visual dimensional bias in humans and macaques** *Alexander Pascoe*	**Effects of cognitive noise on the temporal dynamics of risky choices** *Dragan Rangelov*
1245–1300	**Topographical memory impairment in Transient Epileptic Amnesia** *Sharon Savage*	**Multivariate decoding in a combined multiple-object tracking and working memory task** *William Ngiam*	**The influence of tDCS on the speed-accuracy tradeoff and metacognition** *Joshua Sabio*
1300–1315	**Clopidogrel administration impairs post-stroke learning and memory recovery in mice** *Marina Paul*	**Imagery: What is it good for?** *Loren Bouyer*	

CONFERENCE SCHEDULE

Day 3 | Wednesday 27th November

1330–1430	**Lunch** *(NUspace Ground Floor)*
1430–1530	**AI and the Brain Keynote** **Toby Walsh** (UNSW) – *What Cognitive Neuroscience can learn from AI (and vice versa)* *Chair: Tom Carlson* *(Banquet Room, City Hall)*
1530–1630	**Annual General Meeting (all ACNS members invited)** *Chair: Trevor Chong* *(Banquet Room, City Hall)*
1630–1700	**Afternoon Tea** *(NUspace Ground Floor)*
1800–1930	**AI and the Brain Public Forum** **Unlock the Future: Cognitive Neuroscience in the Age of AI** Welcome: **Lord Mayor of Newcastle Ross Kerridge** and **Craig Simmons** (Pro Vice Chancellor, College of Engineering, Science and Environment, UON) Discussants: **Muneera Bano** (CSIRO), **Toby Walsh** (UNSW), **Andrew Barron** (Macquarie University) MC: **Dan Cox** (ABC1233 Newcastle) *(Concert Hall, City Hall)*

Nobbys Beach and Fort Scratchley – Newcastle NSW Australia

CONFERENCE SCHEDULE

Day 4 | Thursday 28th November

0800–1700	**Registration Desk** *(NUspace Ground Floor)*		
0900–1030	**Partnering with Defence Plenary:** Partnering with Defence to improve human cognitive performance *Chair: Oren Griffiths* **Scott Brown** (UON) – *A tale of two projects (research with defence in psychology)* **Melanie McGrath** (CSIRO) – *Research with impact: Where to begin?* **Nick Willmot** (DSTG) – *Cognitive Neuroscience in Defence; Partnerships and Cooperation* *(Newcastle Conservatorium of Music)*		
1030–1100	**Morning Tea** *(NUspace Ground Floor)*		
	Parallel Open Talks		
1100–1300	**Biomarkers** *Chair: Mitchell Goldworthy* *(X101)*	**Ageing** *Chair: Alex Holcomb* *(X320)*	**Attention** *Chair: Evan Livesey* *(X321)*
1100–1115	**Brain–wide signatures of compositional cognition** *Rebekah Wong*	**Attentional decline? Limits on multiple object tracking in young and old** *Alex Holcomb*	**Complex trade–offs in a dual–target visual search task are indexed by lateralised ERP components** *Dion Henare*
1115–1130	**The role of traveling waves in cortico–hippocampal communication** *Anna Behler*	**The metabolic connectome shows reduced connectivity strength, altered hub function and a higher glucose cost in normative ageing** *Hamish Deery*	**Multivariate EEG markers of lapses in visual attention within a dynamic environment** *Benjamin Lowe*
1130–1145	**Temporal dynamics underlying the dimensions of object space** *Alexis Kidder*	**Verbal initiation, selection, strategy, and inhibition in stroke: A brief, novel screening tool to assess executive functions** *Gail Robinson*	**Js–mEye: An extension and plugin for the measurement of pupil size in the online platform jsPsych** *Luke Ney*
1145–1200	**Tracking information flow during cognitive tasks using time–resolved transfer entropy** *Chetan Gohil*	**The moderating effect of dietary patterns on the longitudinal relationship between symptoms depression and anxiety, and cognitive decline** *Hilal Al Shamsi*	**Perception of robots before and after movement: objects on the boundary of agency and animacy** *Astrid Zeman*
1200–1215	**Biophysical modeling of cortical–hippocampal interactions** *Richa Phogat*	**Older age associated with greater brain activity in motor and somatosensory cortices during dual task balance: a cross–sectional study using fNIRS** *Suzanne Snodgrass*	**Multivariate pattern analysis of visual stimulus evoked EEG responses offers no support for expectation suppression** *Giuliano Ferla*
1215–1230	**Modelling meditative deconstruction and its phenomenology under active inference** *Shawn Prest*	**Multidimensional representation of naturalistic facial attributes in normal adult aging** *Natalie Peluso*	**Don't think of a Pink Elephant: Individual differences in visualisation predict involuntary imagery and its neural correlates** *Derek Arnold*
1230–1245	**A novel approach to measure neural information alignment during social interaction** *Denise Moerel*	**Beyond Cancer: 'Chemobrain' and Support Challenges for Young Adult Childhood Cancer Survivors** *Ines Semendric*	**Pause or Cancel? The Role of Intracortical Inhibition in Stopping an Action** *Evan Livesey*
1245–1300	**Altering Consciousness With Flicker Light** *James Thurbon*		

CONFERENCE SCHEDULE

Day 4 | Thursday 28th November

1300–1400	**Lunch** *(NUspace Ground Floor)*		
	Parallel Open Talks		
	Sleep / Inner Speech *Chair: Isabella Bower* *(X101)*	**Developmental** *Chair: Iroise Dumontheil* *(X320)*	
1400–1415	**Neuromodulatory signatures surrounding NREM sleep microarchitecture in humans** *Isabella Orlando*	**Development of the attention networks and working memory in young primary school children** *Katherine Johnson*	
1415–1430	**Using the aperiodic slope change to predict N400 amplitude shift across sleep–based memory consolidation** *Annaliese Anesbury*	**Shared neural correlates of interference control and response inhibition during development** *Iroise Dumontheil*	
1430–1445	**Isolating the neural underpinnings of inner speech and inner non–speech** *Bradley Jack*	**Using generalised additive models to improve fTCD lateralisation estimates for young children** *Josie Quin–Conroy*	
1445–1500	**The Role of Auditory Imagery in Schizotypy: Understanding the link with Anauralia** *Zoé Mi Schelp*	**The Neural Basis of Viewpoint–tolerant Object Representations in Infants and Adults** *Mahdiyeh Khanbagi*	
	Parallel Fast Talks		
	Ageing *Chair: Hannah Keage* *(X101)*	**Cognition** *Chair: Jason Mattingley* *(X320)*	**Perception** *Chair: Branka Spehar* *(X321)*
1500–1505	**Exploring subcortical contributions to neuropsychiatric symptoms in frontotemporal dementia** *Angelo Bumanglag*	**Neural representations of food attributes in dietary decision–making** *Violet Chae*	**The impact of face masks on the development of face perception in preterm infants** *Robin Laycock*
1505–1510	**Tremor as a compensatory mechanism in healthy ageing: Relationship between theta–band tremor and cognitive function** *Brittany Child*	**The neural impact of attachment priming on network connectivity during social exclusion: A pilot fMRI study with resettled refugees** *Belinda Liddell*	**Object recognition under occlusion during rapid serial visual presentations** *Almudena Ramirez Haro*
1510–1515	**Enhancing Parkinson's Disease Monitoring: A longitudinal study of novel alternative measures** *Alycia Messing*	**Attention in team sport: What are we actually looking at?** *Yleia Mariano*	**What remains seen of the unseen? Neural location–tracking of an object occluded from view** *Jasmin Patel*
1515–1520	**Differential Influences of Cardiorespiratory Fitness and Metabolic Health on Cognitive Functioning in Older Adults** *Nicholas Ware*	**On the chronic effects of mild traumatic brain injury on working memory: Behavioural and electrophysiological evidence** *Amaya Fox*	**Beyond modularity: building coherent cognitive neuroscience theories through multi–scale integration** *Giulia Baracchini*
1520–1525	**Lower Aperiodic Activity is Associated with Reduced Verbal Fluency Performance Across Adulthood** *Daniel McKeown*		**Decoding Rapid Emotional Responses in the Brain Using EEG** *Nazanin Sheykh Andalibi*

CONFERENCE SCHEDULE

Day 4 | Thursday 28th November

	Parallel Fast Talks		
	Mental Health *Chair: Hannah Keage* *(X101)*	**Attention, Expectation, Prediction** *Chair: Jason Mattingley* *(X320)*	**Modelling** *Chair: Branka Spehar* *(X321)*
1530–1535	**The impact of cue reactivity on neurometabolic alterations in cannabis use disorder** *Alexandra Gaillard*	**Perceptual load modulates the interaction of prediction and attention** *Ulises Orbe Arteaga*	**Neural substrates of safety perception during development** *Yubing Zhang*
1535–1540	**Acute electrocortical and neuropsychological effects of running exercises in adults with ADHD: A study protocol** *Leonard Braunsmann*	Do people see spatio–temporally predictable visual inputs sooner, and does this align with neural pre–play findings? *Blake Saurels*	**Modulation of Neural Oscillations by a Nootropic Juice** *Rohan King*
1540–1545	**Left nucleus accumbens volume is associated with poor sleep in chronic pain** *Natalia Egorova–Brumley*	**How does prediction modulate the neural representation and visual perception of real–world objects?** *Phuong Dang*	**Conflict Monitoring and Mid–Frontal Aperiodic Activity** *Douglas Angus*
1545–1550		**Temporal Dynamics of Voluntary Decision–Making across Stable and Dynamic Contexts** *Lauren Fong*	**Investigating transfer between motor and episodic memory sequences** *Sophie Thong*
1600–1730	**Poster Session 2** with Afternoon Tea and Open Bar *(NUspace Ground Floor & Mezzanine)*		
1900–2300	**ACNS Conference Dinner** (ticketed event) *Customs House Hotel*		

Newcastle CBD above Hunter River – Newcastle NSW Australia

CONFERENCE SCHEDULE

Day 5 | Friday 29th November

0800–1430	**Registration Desk** (Baggage drop available) *(NUspace Ground Floor)*	
0900–1030	**Young Investigator Award Winner Talks** *Chair: Trevor Chong* **Melissa Sharpe** (University of Sydney) – *Distinct dopamine circuits encode unique neural signatures for learning* **Nigel Rogasch** (University of Adelaide)– *Improving memory with non–invasive brain stimulation: where to from here?* *(Banquet Room, City Hall)*	
1030–1100	**Morning Tea** *(NUspace Ground Floor)*	
1100–1300	**Symposium: How learning and attention shape prediction and action: Understanding the Brain at Multiple Scales of Analysis** *(X320)* *Chairs: Reuben Rideaux & Dr Melissa Sharpe* *Jay Bertran–Gonzalez* *Maureen Hagan* *Masakazu Taira*	**Symposium: Perceiving the everyday: Naturalistic paradigms and their use in cognitive neuroscience** *(X321)* *Chairs: Saurabh Sonkusare & Anna Behler* *Will Harrison* *Branka Spehar* *Katherine Storrs*
1300–1400	**Lunch** **Oral Presentation and Poster Awards, Close of Conference** *(X101)*	

NUspace, University of Newcastle – Newcastle NSW Australia

POSTERS

Poster Session I | Tuesday 26th November

1	**Hearing silences: Neural representation of deviant omissions using multivariate pattern analysis**	*Lilli Donovan*
2	**Reaction time as a measure of cognitive processes in human fear conditioning: A systematic review and meta-analysis**	*Yi Wang*
3	**Cyclical evolution of functional brain networks in rest**	*Cameron Higgins*
4	**Development of a multimodal methodology for studying social perception using eye-tracking and fNIRS in neurodivergent population**	*Bashriah Basri*
5	**Pre-motor and auditory processing for inner and overt speech**	*Lachlan Hall*
6	**Investigation of neuroimaging tools for the bedside assessment of consciousness in Disorders of Consciousness patients in New Zealand**	*Corinne Bareham*
7	**Effects of a three-month aerobic exercise intervention on brain structure in people with a cannabis use disorder**	*Suzan Maleki*
8	**Longitudinal Comparisons Between Left and Right Semantic Dementia Presentations using the SYDBAT**	*Holly West*
9	**Mesoscale iEEG and macroscale fMRI dynamic graph network properties during movie viewing link to heart rate changes**	*Saurabh Sonkusare*
10	**Evaluating Whether Acute single-Session Sham-controlled Theta-neurofeedback Training Improves Mnemonic Similarity Performance**	*Celeste Tipple*
11	**Modulating the exploration strategy in social reinforcement learning**	*Gota Morishita*
12	**Investigating the Influence of Anti-Epileptic Drugs on Aperiodic EEG Activity**	*Marissa Holden*
13	**Leveraging artificial intelligence methods to improve the diagnosis of frontotemporal dementia: A systematic review**	*Samuel Warren*
14	**Attentional bias towards looming angry faces revealed using eye-tracking**	*Linda Yu*
15	**On the neural substrates of mind wandering and dynamic thought: A drug and brain stimulation study**	*Tara Rasmussen*
16	**The Relationship between Dietary Patterns, Cognition and Cardiometabolic Health in Healthy, Older Adults**	*Felicity Simpson*
17	**Relationships between MRS-assessed neurochemical concentrations (GABA+, Glx, E/I balance) and behavioural inhibition in healthy ageing**	*Ciara Treacy*
18	**Brake failure: a meta-analysis on how different inhibitory control paradigms can distinguish Mild Cognitive Impairment and Alzheimer's Disease from healthy ageing**	*Rebecca St George*
19	**Colour preferences among people with mental health disorder – a systematic review**	*Saara Asarudheen*
20	**Hypatia Health: Cognitive Modelling Made Easy**	*Gavin Cooper*
21	**Neural bases of discrete positive emotions in stress reduction: awe and amusement involve common and distinct brain activities**	*Masayuki Tsujimoto*
22	**Image naturalness and recognisability fail to predict perception in binocular rivalry**	*Carlie Gavin*
23	**Can intermittent bursts of high frequency targets reduce vigilance decrements?**	*Anina Rich*
24	**Do corollary discharges contain information about the pitch of inner speech?**	*Olivia Gompes*
25	**Inner speech: Is the SNW effect associated with preparation or anticipation?**	*Sarah Twyman*
26	**The effects of repetitive transcranial magnetic stimulation over the left angular gyrus on episodic memory and future simulation**	*Constantino Toufexis*
27	**Directional connectivity alterations between the mediodorsal thalamus and core cognitive networks in mood and anxiety disorders**	*Sevil Ince*

Poster Session II | Thursday 28th November

1	**Theta oscillations during a recognition memory task differ between individuals with mild cognitive impairment and matched cognitively normal controls**	*Maria Angellica Evardone*
2	**Animate–inanimate object categorization from minimal visual information in human adults and infants**	*Céline Spriet*
3	**Cognitive inhibition assessed through upper limb and stepping tasks in people with age–related cognitive impairment**	*Marlee Wells*
4	**Influence of Age and Cognitive Reserve on Working Memory Maintenance and Manipulation**	*Victoria Prowse*
5	**Long–Term Neurocognitive Impairments in Attention Orienting Following Concussion: An Eye–Tracking Study**	*Wallaa Abbouche*
6	**Dementia risk reduction: what do young adults know and what are they doing about it?**	*Sarah Haskard*
7	**Is Your Phone Distracting You? The effect of phone–like vibration interruptions on sustained attention in a dynamic task**	*Anna Fioretti*
8	**Language diversity and cognitive health: Exploring multilingualism across the adult lifespan**	*Olivia Maurice*
9	**A Review of Human Visual Attention in EEG–Based Brain–Computer Interfaces**	*Yangyulin Ai*
10	**Neurological Response of SSVEP in Conventional Screen (2D) and Virtual Reality (3D)**	*Yangyulin Ai*
11	**Using Signal Detection Theory to Understand the Role of Alpha Phase in Visual Perception**	*Henry Beale*
12	**Towards Expanding Human Visual Understanding of the Essential Structure of Space to Four Dimensions Using Artificial Neural Networks**	*Stephan Chalup*
13	**Mapping cerebral arterial elasticity in health older adults with optical imaging**	*Jenna Johnson*
14	**Classification of EEG signals for creativity performance**	*Shoma Inoue*
15	**Brain morphology in individuals with chronic idiopathic neck pain over 6 months: a magnetic resonance longitudinal cohort study**	*Suzanne Snodgrass*
16	**Neuronal correlates of tactile decision making**	*Erfan Rezaei*
17	**Commonalities and Differences between the Flash–lag and Flash–grab Effects**	*Jye Marchant*
18	**A Cognitive Model of Cued Trials Task–Switching Performance**	*Nathan Tran*
19	**Individual Differences in Executive Functioning Predict Performance on a Novel Test of Change Detection**	*Ashley Norman*
20	**Movement planning and execution: Unravelling brain connectivity patterns associated with motor activity in healthy adults**	*Ekaterina Voevodina*
21	**Comparison of rest before and after meditation using loving kindness mediation/ non–meditation EEG data for single and multiple within–subject sessions**	*Nalinda Liyanagedera*
22	**Understanding the neural circuits involved in the balance of learning between cues with different proximity to rewards**	*Masakazu Taira*
23	**Face pareidolia in fractal noise patterns: effects of stimulus duration and size**	*Kateryna Marchenko*
24	**The neural basis of creative thought: an activation likelihood estimation meta–analysis**	*Melody Chan*
25	**Is visual processing depth robust to attention lapses?**	*Alexander Sulfaro*
26	**Perceptual judgements of noisy visual motion signals are biased by high–precision priors**	*Tim Gastrell*

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- BCI
- Sleep research
- Epileptic research
- Mobile/Sports EEG
- Pediatric study
- Hyper scanning
- Other clinical condition research
- Educational EEG
- Methodological research
- Bio-Markers

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Abstracts

MONDAY 25th NOVEMBER

Keynote – Karen Caeyenberghs

Combining ecological momentary assessment and advanced neuroimaging to investigate brain biomarkers of behavioural deficits in chronic disease

Karen Caeyenberghs
Deakin University

Behavioural deficits (such as mental health issues and cognitive deficits) fluctuate over time and are subject to daily rhythms and varying contexts in chronic disease populations (such as patients with traumatic brain injury, cancer survivors). However, assessments of behavioural outcomes are often limited to a single test session and are frequently conducted in lab-based environments. Characterization of behavioural deficits therefore typically lacks reliability, robustness, sensitivity to natural variation and ecological validity, which may, in turn, explain difficulties in identifying biomarkers of symptoms in a range of clinical populations. Complementing neuroimaging with ecological momentary assessment (EMA), which involves short daily assessments completed in the participant's own environment, may improve our capacity to unveil the neurobiological underpinnings of behavioural deficits in clinical populations. In the present presentation, I will show how we can combine EMA and diffusion magnetic resonance imaging (dMRI) to explore daily symptom dynamics in clinical populations. I will clarify how we can use fixel-based analysis (FBA), an advanced dMRI analysis technique, to investigate highly specific markers of white matter fibre density and morphology and their association with daily mental health status and cognitive functioning. I will also present results of normative analyses (Centilebrain) that is able to deal with the heterogeneity in behavioural outcomes and brain metrics in our patients. Finally, I will show how multi-layer network analyses enable us to model relationships among variables simultaneously across time and/or levels of organization. This will help identify important brain regions or behavioural functions to pinpoint potential intervention targets (e.g. using cognitive training and/or brain stimulation) to improve the behavioural outcomes of people living with a chronic condition.

TUESDAY 26th NOVEMBER

Keynote – Ted Zanto

Mechanisms of Transfer: How Digital Musical Training Can Promote Cognitive Function

Theodore Zanto
University of California, San Francisco

Engaging in music-based activities, such as playing an instrument, taxes numerous cognitive functions. These functions include sensorimotor coordination to perceive the music and produce movements in time, attentional control to track the beat and adjust responses, and short-term memory is needed to maintain a musical template and judge errors. Through the consistent engagement of these cognitive functions, musical training is thought to improve performance on non-musical tasks that rely on these abilities – such as academic performance in children and executive function in adults. Yet, direct evidence is limited, and it remains unclear how musical engagement can enhance performance on non-musical tasks. This talk will discuss recent research that provides new insight regarding the link between musical engagement and improvements on non-musical cognitive tasks across the lifespan. The highlighted research will also focus on whether digital forms of musical engagement can yield cognitive benefits akin to the improvements observed following traditional musical training. Given the prevalence of personal electronic devices (e.g., smartphones, tablets), digital musical training may be powerful approach to promote cognitive function in a more accessible, equitable manner.

Enrichment & Neuroplasticity Symposium

ESTEEM After Stroke - results from a pilot study translating the principles of environmental enrichment into community based stroke recovery?

Heidi Janssen
Heart and Stroke Program, Hunter Medical Research Institute / University of Newcastle / Hunter Stroke Service, Hunter New England Local Health District

K. Haracz, University of Newcastle
J. Newberry Dupe, University of Newcastle
M. D. Hasnain, University of Newcastle
N. de Carteret, Heart and Stroke Program, Hunter Medical Research Institute / University of Newcastle
J. Preece, Heart and Stroke Program, Hunter Medical Research Institute / University of Newcastle / Hunter Stroke Service, Hunter New England Local Health District
M. L. Bird, School of Health Science, University of Tasmania
T. Bidstrup, Mercy Services, West Wallsend, NSW
D. Simpson, University of Newcastle
L. Johnson, School of Behavioural and Health Sciences, Australian Catholic University
C. Garcia-Esperon, Hunter Stroke Service, Hunter New England Local Health District
A. McKenzie, Hunter Stroke Service, Hunter New England Local Health District
C. Shiner, Department of Rehabilitation and Pain Medicine, St Vincent's Hospital, Sydney

L. Christie, Allied Health Research Unit, St Vincent's Health Network Sydney / School of Allied Health, Faculty of Health Sciences, Australian Catholic University
and the ESTEEM After Stroke Collaborative Group

Objectives: Evaluate a co-designed model of community environmental enrichment, The ESTEEM Program. Methods: ESTEEM was delivered in-person in group format to stroke survivors who participated in a combination of exercise, socialisation and visual arts and movement to music, x2/week over 10 weeks. The difference in stroke survivor health outcomes post-program and at 3-months post-program compared to baseline were described using Wilcoxon rank-sum tests. Inductive thematic analysis of semi-structured interviews and a focus group conducted with stroke survivors, carers and staff, described participant experiences. Results: Stroke survivors [n=25, median 1.2 yrs post-stroke, 60% male, median 76 yrs old (range 30-90)] who participated in ESTEEM, at 3-months post-program experienced significant improvements in leg strength (reps) [median (range) = 9 (5-14) vs 10 (8-15);p=0.03], depression score [7 (2-17) vs 4.5 (0-11);p=0.04] and frailty score [2 (0-4) vs 1 (0-3);p=0.02] and had a non-significant trend towards improved quality of life (p=0.06). Within descriptions of participation by stroke survivors (n=10), carers (n=3) and staff (n=5), four themes emerged: "You've always got to adapt", "Getting things to run smoothly", "All worth the effort to get there" "It would be good if we could keep coming". Conclusion: This study demonstrates potential for positive outcomes and experiences following participation in a model of community delivered environmental enrichment. This data has informed a multi-site waitlist-controlled trial underway to determine the economic sustainability and effectiveness of The ESTEEM Program.

The contribution of parenthood to cognitive reserve across the lifespan

Sharna Jamadar
Monash University

Edwina Orchard
Monash University / Yale University

The transition to becoming a parent represents an important life milestone, and is accompanied by profound environmental and neurobiological changes. The physiological fluctuations associated with pregnancy, birth, and lactation experienced by the mother/birth-giving parent represent some of the most extreme transformations encountered during their lifetime, and new research is beginning to uncover the effects this transition has on the brain. However, parenthood does not 'end' at the postpartum period – the experience, challenges, and delights of parenthood continue for many years, shaping the complexity of the psychosocial environment in which the parent lives. According to the theory of *cognitive reserve*, increased environmental complexity contributes to resilience to cognitive ageing in late life. We argue that, just as occupational complexity and cognitively challenging hobbies may contribute to cognitive reserve, the increased life complexity associated with parenthood also contributes to resilience to cognitive ageing. Here, I will present results consistent with this hypothesis and outline directions for future research in this new field of parental neuroscience.

Can functionally 'exercising' the prefrontal cortex impact regional cerebral arterial elasticity in older adults?

Frini Karayanidis
School of Psychological Sciences, University of Newcastle

Jenna Johnson, School of Psychological Sciences, University of Newcastle
Sarah J Johnson, School of Engineering, University of Newcastle
Nathan Tran, School of Psychological Sciences, University of Newcastle
Sharna Jamadar, School of Psychological Sciences, Monash University
Mark Steyvers, Department of Cognitive Sciences, University of California USA
Christopher Levi, Hunter New England Local Health District
Kathy A Low, Beckman Institute for Advanced Science and Technology, University of Illinois, Urbana-Champaign, USA
Gabriele Gratton, Beckman Institute for Advanced Science and Technology, University of Illinois, Urbana-Champaign, USA
Monica Fabiani, Beckman Institute for Advanced Science and Technology, University of Illinois, Urbana-Champaign, USA

There is strong observational evidence for a link between ageing-related changes in vascular, brain and cognitive systems. This study aims to provide the first experimental evidence for a direct link between cognitive control ability and regional cerebral arterial health, by showing that intensive functionally "exercise" of the prefrontal cortex over an extended period produces changes in the structural properties of regional arteries that supply this region. Healthy mid-late life adults (50-85yrs, n=150) with low-moderate cardiorespiratory fitness participated in a cognitive training intervention. Participants were pseudorandomly assigned (2:1 training:control, sex/age-matched) to a training or waitlist condition. The Training group completed at least 20hrs of training over 12wks on adaptive gamified cognitive control tasks (Lumosity). Regional pulse relaxation function (PReFx), an optical imaging measure of arterial elasticity, was measured pre- and post-training over left, mid and right prefrontal cortex (PFC). In preliminary analyses (n=75), the training group showed substantial improvement in components of a non-practiced task-switching paradigm whereas the control group showed little to no improvement, consistent with near transfer. The training group also showed improvements in PReFx scores from pre- to post-test. Importantly, the amount of improvement in task-switching measures was associated with improvement in PReFx. These data provide early proof-of-principle that intensive cognitive control training may provide regional protection to cerebral arterial health in older adults.

Towards neuroscience-guided training programs for clearing cognitive impairments in cancer survivors?

Karen Caeyenberghs
Cognitive Neuroscience Unit, School of Psychology, Deakin University

Priscilla Gates, Cognitive Neuroscience Unit, School of Psychology, Deakin University / Peter MacCallum Cancer Centre
Jade Guarnera, Cognitive Neuroscience Unit, School of Psychology, Deakin University
Jake Burnett, Cognitive Neuroscience Unit, School of Psychology, Deakin University / Department of Emergency Medicine, St Vincent's Hospital

Annalee Cobden, Cognitive Neuroscience Unit, School of Psychology, Deakin University
Jacqui Saward, Cognitive Neuroscience Unit, School of Psychology, Deakin University
Juan F Domínguez D, Cognitive Neuroscience Unit, School of Psychology, Deakin University
Jocelyn Lippey, Department of Breast Surgery, St Vincent's Hospital Melbourne
Hamed Akhlaghi, Department of Emergency Medicine, St Vincent's Hospital

Cancer is among the leading causes of death worldwide. Improved treatment approaches have led to an increase in long-term survival rates, but also a growing number of individuals who are living with the long-term side effects of cancer therapies. Cognitive impairment is one common side-effect of cancer treatment that can persist well after the completion of treatment (CRCI, cancer-related cognitive impairment). Longitudinal MRI studies have also demonstrated significant associations between CRCI and alterations in frontal, temporal, and parietal brain regions. Although the symptoms in cancer survivors imply the necessity to intervene, until now only very few training studies in this population have been conducted. Recently, our randomised pilot trial demonstrated that a 6-week web-based cognitive rehabilitation program significantly improved self-reported and neuropsychological measures of cognitive functioning, and mental health outcomes in chemotherapy-treated aggressive lymphoma cancer patients. Future work should develop successful interventions at the individual level that allow patients to tolerate necessary cancer treatments and live a life not marked by ongoing debilitating symptoms.

Neurophysiological predictors of training transfer induced by tDCS

Hannah Filmer
School of Psychology, University of Queensland

Shane E. Ehrhardt, School of Psychology, University of Queensland
Yohan Wards, School of Psychology, University of Queensland
Paul E. Dux, School of Psychology, University of Queensland

Brain stimulation shows promise as an intervention to enhance executive function across a range of clinical and non-clinical settings, particularly when paired with cognitive training. However, we must understand the potential role of individual differences in the outcomes of such interventions to optimise future applications. Here, we investigated the combined effects of multi-session multitasking training and prefrontal transcranial direct current stimulation (tDCS) on the generalisation of performance benefits, focusing on how individual differences in cortical morphology predict performance improvements. 178 individuals underwent ultra-high field (7 Tesla) magnetic resonance imaging (MRI) before completing multisession training with online stimulation. A battery of cognitive tasks was completed pre- and post-training to assess performance improvements in trained and untrained tasks. In line with previous investigations, stimulating left or right prefrontal cortex at 1mA during multitasking training enhanced transfer to a visual search task – demonstrating generalisable performance benefits. Critically, we show here that cortical morphology predicted the efficacy of stimulation for inducing transfer. Specifically, cortical thickness in regions beneath the target electrode related to performance in the most difficult visual search condition. These results highlight the importance of individual anatomical differences in modulating the efficacy of tDCS, and identify specific neuroanatomical features that predict gains in cognition offered by combining tDCS with cognitive training.

Can functionally 'exercising' the prefrontal cortex impact regional cerebral arterial elasticity in older adults?

Theodore Zanto
University of California, San Francisco

The last decade has seen an exponential rise in research assessing the potential for non-invasive brain stimulation techniques to facilitate cognitive function in healthy and clinical populations. Unfortunately, effects of non-invasive neurostimulation can be highly variable, leading to replicability problems and drawing into question the utility of these techniques for therapeutic use. This talk will focus on the use of transcranial alternating current stimulation (tACS) to enhance cognitive functions in healthy older adults and those with mild cognitive impairment. Effects of tACS on behavioral performance appear to arise from network-level changes in brain activity, and a large contributor to individual variability stems from differences in neuroanatomy and neurophysiology. Interestingly, tACS is highly tolerable, relatively affordable, and can be used at home by the participant - even in populations with mild cognitive impairment. Therefore, as we learn more about how to deploy tACS to achieve consistent efficacy, this technology will continue to move toward becoming a feasible therapeutic tool.

Open talks - Perception 1

Faster perceptual processing time and reduced inversion effects for self-face and familiar-face perception compared to novel faces

Deborah Apthorp
University of New England, NSW

Kasey McGinness, University of New England
Jessica Taubert, University of Queensland

Evidence that familiar faces are processed differently from unfamiliar faces has important implications for our understanding of how we recognise the people around us. Although familiarity effects on face recognition performance have been extensively researched, the perceptual and cognitive processes that underlie these differences are comparatively unknown. Although many different paradigms have been used to explore the effects of face familiarity, most have used reaction times as a measure, and familiarity has been operationalised in varying ways. Here we used participants' own faces as the most familiar possible face, as well as the face of the experimenter as a minimally familiar face, and compared these to a face selected from a face database. To isolate perceptual processing time, we used an adaptive staircase procedure, where stimuli were presented for increasingly short time periods until participants were at chance performing the task. 28 female participants aged between 18 and 65 participated in the study. We also measured reaction time for comparison with previous studies. Participants needed less time to recognise self and familiar faces compared to unfamiliar faces. Reaction times were also shorter. As expected, inverted faces took longer to recognise than upright faces, but this effect was reduced for familiar faces and completely abolished for self-faces. This provides evidence for distinct perceptual processing of faces

based on level of familiarity, and suggests that our ability to recognise familiar faces may be poorly characterised by current theories.

Local Motion Not Biological Form Influences Priority Access to Conscious Awareness During CFS

William Swann
University of Sydney

Matthew Davidson, UTS
David Alais, University of Sydney

The partitioning of unique visual stimuli to each eye induces a dynamic perceptual state where only one image is perceived at a time and the other is suppressed from awareness. This phenomenon, known as interocular suppression, has allowed researchers to probe the dynamics of visual awareness and unconscious processing in the visual system. A key result is that different visual stimuli may enter and exit awareness at different rates, however, there is still a wide debate as to whether low or high-level visual features modulate this suppression mechanism. Here we quantify the suppression depth of various motion stimuli in comparison to biological motion stimuli that are rich in high-level semantic information. We employ the 'tracking Continuous Flash Suppression' (tCFS) method, which recently demonstrated uniform suppression depth for a variety of static images that varied in semantic content. The accumulative findings of our three experiments outline that suppression depth is varied by different low-level visual motion features, in contrast to the uniform suppression depth that was shown for different static images. Notably, disrupting high-level semantic information via the inversion or rotation of biological motion did not alter suppression depth. Ultimately, our data supports the dependency of suppression depth on local motion information, further supporting the low-level local-precedence hypothesis of interocular suppression.

Seeing the expected: Investigating the experience of implied colour for colour diagnostic objects

Jordan Lyons
Macquarie University

Rebecca Keogh, Macquarie University
Anina N. Rich, Macquarie University

Colour diagnostic objects are strongly associated with their typical colour (i.e. a banana and the colour yellow). Previous research findings suggest that the typical or implied colour of a colour diagnostic object can change the subjective colour appearance of the object. Here, we investigated the impact of object colour knowledge on perception in two pre-registered experiments. In Experiment 1, we measured the effect of implied colour on the perception of greyscale objects viewed through red-green anaglyph glasses. We found that participants (N = 31) were more likely to report seeing a greyscale object as being congruently coloured (i.e. seeing a greyscale broccoli as green) compared to when they viewed a phase scrambled version of the object, even when stimuli were only presented for 100ms. In Experiment 2 (N = 45), we measured implied colour effects indirectly to reduce response bias. Participants completed binocular rivalry tasks that measured visual adaptation effects for 'real' (wavelength-based) and implied colour. Here, instead of directly reporting the colour appearance of an object, participants reported which of two stimuli dominated in a subsequent rivalry display (750ms) viewed through a mirror stereoscope. When presented with a weak real colour cue (200ms), participants were more likely to report seeing the cue colour (facilitation) in a rivalry display. Similarly, greyscale object cues (200ms) elicited greater facilitation for their implied colour compared to scrambled versions of the objects. Our findings suggest that implied colour affects perception in a similar way to weak real colour. Funding: DE240100606.

Influences of Neural Oscillation Phase on Perception of the Tilt Illusion

Anthony M. Harris
Queensland Brain Institute, University of Queensland

Jessica G. Williams, University of Queensland
William J. Harrison, University of Queensland / University of the Sunshine Coast
Henry A. Beale, University of Queensland
Jason B. Mattingley, University of Queensland, / Canadian Institute for Advanced Research, MaRS Centre, Canada

Rhythmic influences on neural processing have been shown at multiple levels from synapse to behaviour and have inspired many theories of the role oscillations may play in neural computation. Despite this, however, the results of studies testing an association between oscillation phase and human perception are inconsistent. In recent theoretical work, we proposed reasons why oscillation analyses may be insensitive when associated with higher-level visual functions, potentially producing spurious null results. Here, we followed up on that work, testing for an association between oscillation phase and visual discrimination in the direct tilt illusion, in which the perceived orientation of a central grating is biased away from the angle of an oriented surround. We titrated a central grating to each participant's perceived-vertical angle in the presence of an oriented surround. We then had them make forced choice reports of whether the central 'vertical' stimulus was rotated clockwise or counter-clockwise on each trial while we measured their brain activity with EEG. We replicated the direct tilt illusion in both surround conditions. Furthermore, we found that the likelihood of participants making an 'illusion-consistent' (i.e., repulsive) response fluctuated with the power and phase of pre-stimulus neural oscillations in the 8-14 Hz 'alpha' range, consistent with an influence of these oscillations on the strength of the illusion on single trials. These results explain one source of across-trials variance in perceptual reports of the direct tilt illusion, and confirm that neural oscillations influence visual discrimination, consistent with their broader role in neural communication and coordination.

Individual differences in neural representations of face dimensions: Insights from Super-Recognisers

Martina Ventura
MARCS Institute for Brain, Behaviour and Development, Western Sydney University

Tijl Grootswagers, MARCS Institute for Brain, Behaviour and Development, Western Sydney University
Manuel Varlet, MARCS Institute for Brain, Behaviour and Development, Western Sydney University
David White, UNSW Sydney
James Dunn, UNSW Sydney
Genevieve Quek, MARCS Institute for Brain, Behaviour and Development, Western Sydney University

Face processing is crucial for social interaction, conveying identity, emotions, sex, age, and intentions. Recent research has revealed significant individual differences in face recognition ability. Growing evidence suggests that there are people with exceptional face recognition skills – Super-Recognisers. However, the brain mechanisms underpinning their superior ability remain unknown. Here we use Electroencephalography (EEG) to investigate the neural processes underlying face recognition in Super- and Typical-Recognisers to test whether their superior ability for face recognition is restricted to identify or also extends to other face dimensions such as sex and age. Participants were presented with 400 naturalistic face images depicting 40 distinct identities in rapid succession (5 per second in streams of 40 images), stratified by sex, age, ethnicity, and viewpoint. We used Multi-Variate Pattern Analysis on EEG data to measure the strength and temporal dynamics of neural responses to different facial dimensions in both Super-and Typical-Recognisers. Our results indicated early and later advantages in the neural processing of facial identity as well as other face dimensions among Super-Recognisers compared to Typical-Recognisers. These findings suggest enhanced neural processing mechanisms in Super-Recognisers for face recognition extending beyond identity information.

Spatial frequency influences the expectation effects of novel object-scene associations

Morgan Kikkawa
University of Melbourne

Daniel Feuerriegel, University of Melbourne
Marta I. Garrido, University of Melbourne

The feed-forward sweep proposes that low-spatial frequency components of visual inputs rapidly propagate up the visual processing hierarchy to provide coarse preliminary estimates of sensory inputs. These estimates provide top-down influences on lower visual areas to constrain possible perceptual interpretations. Top-down influences on visual processing also arise by exploiting environmental statistical regularities to generate predictions about expected inputs. Despite both mechanisms involving feedback to lower visual areas, it remains unknown if the visual system uses concurrently presented low-spatial frequency information to constrain inferences relating to co-occurring stimuli. To assess this, we collected electroencephalographic data from 40 participants and presented them with objects embedded in visual scenes. There were two possible objects and two visual scenes with each scene having a more frequent object pairing to create an expected and unexpected pairing (75%/25%). Visual scenes contained exclusively low- or high-spatial frequency information and the embedded object contained only high-spatial frequency information. We assessed differences in event-related potentials for expected and unexpected object/scene pairings by spatial frequency condition. Cluster-based permutation tests revealed significant differences between expected and unexpected pairings for both spatial frequency conditions. These differences ranged from 31 – 500 ms for high-spatial frequency backgrounds and 68 – 500 ms for low-spatial frequency backgrounds. These results suggest spatial frequency plays an important role in modulating expectation effects. However, as high-spatial frequency information also modulated expectation effects, the feed-forward sweep may not underlie this effect. Alternatively, differential mechanisms may govern how different ranges of spatial frequency information are used to process object-scene associations.

Perceiving the 'gaze' of an artificial agent

Lindsay M. Peterson
UNSW Sydney

Colin W. G. Clifford, UNSW Sydney
Colin J. Palmer, National University of Singapore

When we look at a visual scene, salient features, such as a region of high contrast or a recognizable object, attract our attention. Here, we examined how image saliency—modelled on eye-tracking data—influences how we expect the visual attention of others to be directed. We created a 3D scene in which a cone-shaped object (the agent) 'looks' at an image on a screen in the scene. The observer's vantage point was on the other side of the screen, opposite the agent. The screen was semi-transparent so the observer could see the image being displayed on the screen and the agent on the other side. On each trial, an image would appear on the in-scene screen and the agent would turn to 'look' at the image. The agent's movement was controlled by a gaze pattern from a real observer, whose eye movements were recorded while they were looking at the same image as the agent or a different image. Participants (N = 24) judged whether the agent's 'gaze' was matched to the image displayed on the in-scene screen. We find that participants can detect a mismatch between the agent's movements and the displayed image. Discrimination sensitivity was modulated by the overlap between the agent's gaze and the salient image features: participants struggled to identify a mismatch when the mismatched gaze aligned with the salient features of the displayed image. Further analysis suggests that participant performance was not solely driven by the salient low-level image features, with participants likely using a combination of low- through to high-level image features to determine how consistent the agent's gaze was with the expected gaze behaviour. Our findings indicate that the same processes that drive an individual's attention may also contribute to how we perceive other people's visual attention. This research was supported by an Australian Research Council Discovery Project grant (DP200100003 to CJP and CWGC).

"Unseeing" fearful faces: Inhibition of attentional capture is challenging for unpredicted negative emotions

Philip T. Chalk
University of Queensland

Josef Ormsby, University of Queensland
Alan Pegna, University of Queensland

In this study, we investigated whether predictions modulate the attentional capture of threatening and non-threatening emotional face distractors in a visual search task. Twenty-eight participants were instructed to locate a face surrounded by a color singleton and subsequently discriminate the gender of this face. On some trials, the target was displayed concurrently with an irrelevant happy or fearful distractor. At the beginning of each block, the word HAPPY or FEARFUL informed participants of the probability with which a happy or fearful distractor could occur. We measured lateralized event-related potentials time-locked to the irrelevant distractors and found that the distractor positivity (PD), which reflects active attentional suppression, was only present for fearful faces when they were unpredicted, while no effects were

found for predicted happy and unpredicted happy, or for predicted fearful distractors. These findings suggest that facial expressions affiliated with threat have a high attentional priority due to their emotional value, but only when they are unpredicted; if the presence of a threat is predictable, the need for attentional capture – and thus active attentional suppression – is mitigated. This raises questions regarding the assumed priority of threat in visual processing and the important role of an individual's predictions when interacting with threat in the environment.

Open Talks – Mental Health / Motor Processes

Association between atypical attention orienting and a specific autistic trait

Elisabetta Materazzo
University of Melbourne
Katherine Johnson, University of Melbourne
Shuting Li, University of Melbourne

Spatial attention orienting, the ability to change focus in space, is atypical in autistic people. Existing research has primarily compared people with and without a clinical diagnosis of autism. Autistic traits, or characteristics associated with autism, however, may appear in the general population with varied intensities. It remains unknown whether attention orienting varies with different levels of autistic traits in the general population. This study aimed to examine 1) whether autistic traits are associated with atypical exogenous (stimulus-driven) and endogenous (goal-driven) orienting, and 2) whether age, sex, and co-morbid symptoms of anxiety and attention deficit-hyperactivity disorder (ADHD) moderated this association. One hundred and twenty participants (Mage = 22.8 years, SD = 5.82, 57% female) completed exogenous and endogenous Posner tasks. Participants responded to a target location that was either validly, invalidly, or neutrally cued by a visual stimulus. Response times and accuracy were recorded. Thirteen different autistic traits were measured using two self-report questionnaires. Participants completed both tasks with high accuracy. Participants who tended to pay attention to detail – a measure of autistic trait, were faster at disengaging their attention in both tasks. No significant associations were found between other autistic traits and attention orienting. No significant moderation effects of age, sex, or symptoms of anxiety and ADHD were found. The findings suggest that atypical attention orienting is associated with the paying attention to detail trait of autism. The advantages and disadvantages of attention functioning observed in autistic individuals may not extend to the general population with subclinical autistic traits.

Atypical Interactions of the Attention Networks in the Neuroligin-3 Mouse Model of Autism

Shuting Li
University of Melbourne

Emily Hart, University of Melbourne
Anthony J. Hannan, University of Melbourne
Katherine A. Johnson, University of Melbourne
Emma L. Burrows, University of Melbourne

Autism has been linked to atypical attentional control, but the underlying neural mechanisms remain unclear. Mouse models are useful for studying neurocognitive mechanisms. The existing mouse tasks, however, only allow for measuring one attention function at a time, preventing the investigation into the coordination of multiple attention functions. The current study aimed to 1) develop a mouse task based on the human Attention Network Task (mANT) to assess two major attention networks - attention orienting (changing focus in space) and executive attention (focusing while ignoring distractions), and 2) examine the interaction of these attention networks in mice with the autism-associated R451C mutation in neuroligin-3 (NL3). Twenty-six NL3 and twenty-six wild-type (WT) mice were randomly assigned to either exogenous (stimulus-driven) or endogenous (goal-driven) mANT. Mice were trained to touch a target on a touch-sensitive monitor. The target was either validly or invalidly cued and might appear with a distractor. The exogenous cue was a non-predictive flash, and the endogenous cue was a predictive symbol. Both genotypes performed better with valid cues compared to invalid cues, and in the no-distractor condition compared to the distractor condition. In the exogenous mANT, the invalid cue and distractor jointly affected the performance in WT mice but independently affected the performance in NL3 mice. In the endogenous mANT, the invalid cue and distractor independently affected the performance in both genotypes. This study introduced the first mouse task to examine multiple attention systems and provided the first evidence of deficient integration of exogenous orienting and executive attention in a mouse model of autism.

Enhanced brain MR imaging after cochlear implantation

Bryan Paton
University of Newcastle / Hunter Medical Research Institute / Mark Hughes Foundation Centre for Brain Cancer Research

Shiami Luchow, Hunter Medical Research Institute
Michael Breakspear, University of Newcastle / Hunter Medical Research Institute

A fundamental issue in human MR imaging is the presence of artefacts generated by implant devices, which interfere with the quality and utility of the images generated. The work presented here is part of a project aimed at combining applied physics, materials engineering and software development, to deliver a novel, combined software-hardware solution for this problem. The project involves three arms, 1. Refining MRI sequences that will maximise signal, whilst minimising artefact, drop-out and distortion, ensuring safe operation within MRI safety guidelines; 2. Develop a custom hardware device, individually tailored, to be placed on the scalp of a patient, to eliminate or ameliorate the artefacts generated by the implanted device. 3. Develop a deep learning-based software package to correct any remaining artefacts, distortion and missing data from MR images acquired after cochlear implantation. Having largely achieved the first aim we will show preliminary results for the efficacy of the proposed shim device and the proposed next steps.

Using Real-time Resting-State-Networks as Digital Biomarkers for Mental Health

Navin Cooray
Australian e-Health Research Centre / CSIRO

Cameron Higgins, Resonait Medical Technologies

Mental health disorders affect countless people worldwide and present a major challenge for mental health services, which are

struggling with the demand on a global scale. Recent studies have indicated that activity of the brain's Default Mode Network (DMN) could prove insightful in monitoring patient recovery from depression and has been used as a therapeutic target itself. An opportunity exists to replicate recent therapeutic protocols targeting DMN connectivity via functional magnetic resonance imaging using the more economically scalable modality of electroencephalogram (EEG). The aim of this work was to validate the accuracy of real-time DMN detection methods applied to EEG data, using a publicly available dataset. Using a Hidden Markov Model to identify a 12-state resting-state network, this work achieved an overall DMN detection accuracy of 95%. Furthermore, the model was able to achieve a correlation of 0.617 between the baseline and calculated DMN fractional occupancy. These results demonstrate the ability of real-time analysis to effectively identify the DMN through EEG data providing an avenue for further applications that monitor and treat mental health disorders.

The Impact of Variable Cursor Feedback Delay on Visuomotor Performance

Lucy Turner, University of Adelaide

Steven Wiederman, University of Adelaide
Jessica O'Rielly, University of Adelaide
Anna Ma-Wyatt, University of Adelaide

The processing of visual information and the sensorimotor integration necessary for action takes time. The visual system uses prediction to respond quickly to moving objects and compensate for inherent delays. Information displays, including computer monitors and virtual reality headsets, often require continuous user feedback, which adds to the processing delay. These onsets vary in frequency and duration, yet people still need to use information displays to complete tasks. Understanding how the visuomotor system handles this variability is critical to advancing knowledge of sensorimotor control and developing resilient information displays. Participants completed a pursuit task using a mouse while their eye and cursor movements were recorded. The timing of cursor latency was varied over two sessions. In the first session, our findings supported existing research. In conditions with high cursor latency, sub movements, revealed as fluctuations in velocity through spectral analysis, occurred at lower frequencies with high frequency corrections. This contrasted with the lowest latency condition where sub movements occurred more frequently with fewer high frequency corrections (tracking was smoother). In the second session, we introduced an abrupt latency mid trial. Increased latency led to larger errors ahead of the target, and small corrective movements were upregulated. Decreased latency led to a rapid reduction in error and velocity fluctuations returned to those seen in low latency. Both scenarios illustrate the visuomotor system's fast adaptive control, where the appropriate sub movement strategy was quickly implemented. We discuss the implications for models of sensorimotor integration and the development of robust information displays.

Body Clocks: Physiological Signatures of Affective Timing across Modalities

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Humans are highly accurate in their temporal judgements, yet their estimations could be prone to biases. In line with the internal clock model, fear-inducing events increase orienting reaction, enabling more "pulses" to be registered at the accumulator. However, the impact of state anxiety and its possible modality dependent mechanisms on time perception remains understudied. In the current protocol, a mixed-design was employed to investigate the influence of anxiogenic real-life events on perceived time, across visual and auditory sensory modalities. Participants in each modality group underwent three temporal bisection tasks, interposed by two affective film clips (i.e., elevated, and reduced anxiety videos) in random order. Even though anxiety induction successfully increased participants' physiological arousal, a temporal lengthening effect was prominent after both types of manipulation across modalities, likely due to switch latencies observed only in the visual group. The latter was accompanied by increased parasympathetic activation, pointing to the existence of two distinct attention-related mechanisms. Furthermore, participants in the auditory group showed greater temporal sensitivity than those in the visual group. As such, the temporal expansion we observed, could constitute a contextually driven cognitive mechanism that facilitates individuals' homeostasis, while being modality dependent. Finally, our findings demonstrate the predictive value of physiological signals on altered timing. This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 964464.

Individual alpha frequency does not index a mechanism underlying motion-position illusions

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Motion-Position Illusions (MPIs) involve the position of an object being misperceived in the context of motion (i.e. when the object contains motion, is surrounded by motion, or is moving). A popular MPI is the flash-lag effect, where a static object briefly presented in spatiotemporal alignment with a moving object, is perceived in a position behind the moving object. Recently, Cottier et al. (2023) observed that there are stable individual differences in the magnitude of these illusions, and possibly even their direction. To investigate the possible neural correlates of these individual differences, the present study explored whether a trait-like component of brain activity, individual alpha frequency (IAF), could predict individual illusion magnitude. Previous reports have

found some correlations between IAF and perceptual tasks. Participants (N=61) viewed the flash-lag effect (motion and luminance), Fröhlich effect, flash-drag effect, flash-grab effect, motion-induced position shift, twinkle-goes effect, and the flash-jump effect. In a separate session, five minutes of eyes-open and eyes-closed resting state EEG data was recorded. Correlation analyses revealed no evidence for a correlation between IAF and the magnitude of any MPIs. Overall, these results suggest that IAF does not represent a mechanism underlying MPIs, and that no single shared mechanism underlies these effects. This suggests that discrete sampling at alpha frequency is unlikely to be responsible for any of these illusions.

Open Talks – Enrichment & Neuroplasticity

Irisin – a missing link? Relationships between circulating irisin, hippocampal volumes, physical fitness and cognitive function in healthy older people

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Sufficient physical activity reduces risk of dementia and predicts good cognitive function in ageing, with neuroplasticity a key mechanism driving this benefit. Over the past decade, the exercise-induced myokine Irisin has been revealed as a potential mediator of this process, with animal-model studies demonstrating the neuroprotective properties of Irisin, particularly in the hippocampus. However, the relationships between irisin, fitness, cognition, and hippocampal volume in human ageing has not been well studied. In the current study, we analysed cross-sectional baseline data from the Lifestyle Intervention Study for Dementia Risk Reduction (LEISURE). 87 healthy older adults aged 50-84 years (69 women) provided fasting blood samples, and underwent a comprehensive exercise physiology fitness assessment, cognitive assessment (including executive function and memory), and MRI brain scan. We measured serum Irisin levels, calculated a fitness composite and MRI-derived hippocampal structural volumes. After controlling for age, gender and education, a series of multiple regressions investigated the relationships between irisin and a) left hippocampal volume, b) right hippocampal volume, c) fitness, d) memory, and e) executive performance. Results revealed higher irisin levels were associated with larger right hippocampal volume ($p = .01$), higher fitness levels ($p = .023$), and better executive performance ($p = .046$). In contrast, there were no relationships between Irisin and left hippocampal volume, or memory. These findings support the important role of Irisin in brain and cognitive health in ageing, and our next steps will be to investigate the mediating role of Irisin and relationship with other neuroplasticity-relevant proteins and processes.

White matter microstructure predicts tDCS induced training generalisability

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Brain plasticity underlies our capacity to learn and adapt. Transcranial direct current stimulation (tDCS) can be used to enhance learning generalisability, but our understanding of its interaction with endogenous mechanisms of plasticity remains incomplete. Here we examined plasticity in the form of activity-dependent changes in white matter, in which increases in neural activity stimulate myelination, boosting the speed and fidelity of electrical signal propagation and strengthening network connections. Such activity-dependent changes in myelination mirror the activity-specific effects of tDCS, which preferentially influences active networks. Our study aimed to characterise individual differences in white matter microstructure that predict tDCS-induced reaction time improvements in an untrained transfer task, as well as changes in white matter microstructure that correspond to this training transfer. We paired prefrontal cortex tDCS with multitasking training in 178 individuals, acquiring diffusion tensor imaging data before and after training. Using tractometry analysis, we found that less coherent white matter microstructure through striato-frontal and striato-parietal tracts is associated with the greatest improvements in an untrained (transfer) task under specific stimulation conditions. We expect these results, combined with our examination of white matter changes underlying the tDCS effects, will clarify the relationship between the structure of white matter networks, activity-dependent white matter plasticity, and the effects of non-invasive electrical brain stimulation on cognition. By revealing structural predictors of tDCS efficacy and associated white matter changes, our findings may inform personalised neuromodulation strategies and deepen our understanding of brain plasticity mechanisms.

Baby-brain, a subjective experience that occurs in mother and fathers?

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Becoming a parent is a large life transition marked by several complex bio-psycho-social challenges. It is often thought to have adverse consequences in various cognitive domains, such as memory, leading to a stigma know as ‘baby-brain’. Previous literature investigating whether such cognitive decline is observed postpartum has yielded inconsistent results. There is also a scarcity of research examining whether these cognitive changes are observed in non-birthgiving parents such as fathers. Here we examine cognitive changes in birthgiving mothers and non-birthgiving fathers up to two years postpartum, as well as comparing performance with non-parents. Four hundred participants (300 parents and 100 non-parents) completed an online questionnaire along with a cognitive battery assessing executive function, processing speed, verbal and working memory. Results showed that both fathers and birthgiving

mothers showed similar performance to non-parent controls on all objective cognition measures. While there were differences in subjective memory, the effect was driven by better self-reported memory in non-parent males compared to all other groups. Additionally, there were no significant differences in performance between mothers and fathers on any cognitive task, and there was no discernible effect of time postpartum. Therefore, these results challenge the societal 'baby-brain' stereotype by positioning cognitive changes as a potentially subjective perception due to the caregiving environment rather than being exclusive to the neuroendocrine influences related to giving birth.

Colour-music association reveals an evolutionary ancient colour pathway.

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In Western music, major mode corresponds to happy and minor mode corresponds to sad. Hence, since we say 'I feel blue' when we are sad, the difference between colours associated with minor and major modes is expected to correspond to the blue-yellow direction in the colour space. Alternatively, this difference can coincide with the directions in colour space defined by early stages of neural processing of colour. Human trichromacy has recently evolved - while non-primate mammals have only long-wavelength (L) and short-wavelength (S) cones, Old World primates, including humans, have duplicated the L-cone pigment giving rise to the middle-(M) wavelength cone. Therefore, primates have an evolutionary new L-M and an evolutionary ancient S-(L+M) colour pathways, which correspond respectively to parvocellular and koniocellular pathways from the lateral geniculate nucleus to visual cortex. Participants (N=45) adjusted colour to music on a calibrated (Sony Trimaster EL series OLED 17") monitor while listening to excerpts from Bach's Well Tempered Clavier (13 major mode and 13 minor mode pieces). The RGB values of colours were converted into LMS coordinates and analysed in the Cardinal direction space. On average, colours corresponding to minor and major music revealed the S-(L+M) rather than blue-yellow direction, and the L-M direction did not contribute to the difference between minor and major mode. Since music conveys emotion in a non-verbal way, the results indicate that the evolutionary ancient S-(L+M) pathway strongly contribute to emotion-colour association while the contribution of the evolutionary new L-M pathway is either weak or inconsistent among people.

Does cardiac activity influence emotional and aesthetic evaluation of dance?

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Dance severs as an excellent medium for neuroscientific investigations on body and movement representation and aesthetic evaluation. While the embodied cognition framework has highlighted the importance of an observer's body in aesthetic appraisals of artworks and dance (e.g., sensorimotor resonance processes), the role of an observer's internal body signals and the ability to focus on them (e.g., interoception) in influencing this experience requires further exploration. Previous studies indicate that the perceived intensity of emotional facial expressions varies with their presentation during an observer's cardiac phase (diastole vs systole). Additionally, interoception has been shown to modulate the relationship between dance movement expressivity evaluation and autonomic responses. The current study explores the role of internal body signals, specifically the cardiac phase, in modulating the aesthetic and emotional evaluation of dance postures. Digitized kinematics of dancers were used to create 3D avatars. Non-dancer participants evaluated the emotional intensity and likability of dance postures presented in both upright and inverted orientations, during systolic or diastolic cardiac phases. Perceived arousal and emotional valence were also evaluated, alongside participants' empathic, cognitive, anxiety dispositional traits, and interoceptive capabilities. Our findings reveal a positive correlation between perceived emotional intensity and arousal levels of dance postures. This relationship is disrupted during the presentation of inverted postures at systole, but not diastole. Empathic and anxiety traits, along with interoceptive capabilities, modulate emotional evaluation as a function of the cardiac phase. These findings might suggest a visceral relationship between the bodies (and brains) of observers and dancers, underlying non-verbal emotional communication.

An evidence-based neuronal framework for the behavioural effects of tDCS

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Transcranial direct current stimulation (tDCS) is increasingly recognized for its potential to enhance cognitive functions and serve as a therapeutic intervention for various cognitive disorders. However, clinical applications have been constrained by significant variability in outcomes and concerns regarding safety, largely due to our limited understanding of the underlying neural mechanisms. To address this, we investigated the effects of tDCS applied over the dorsolateral prefrontal cortex (dlPFC) on cognitive performance and neuronal activity during the Delayed Match-to-Sample task. Anodal tDCS attenuated both behavioural and neuronal adaptations when compared to sham. Furthermore, tDCS abolished the correlation between response time and neuronal firing rate. At a single-cell level, following tDCS neuronal firing rate was more likely to exhibit task-specific modulation than after sham stimulation. These tDCS-induced changes in both behaviour and neuronal activity persisted even after the end of tDCS stimulation. Importantly, multiple applications of tDCS did not alter burst-like firing rates of individual neurons when compared to sham stimulation. This suggests that tDCS modulates neural activity without enhancing susceptibility to epileptiform activity, confirming a potential for safe use in clinical settings. This work provides unprecedented insights into the 'where,' 'when,' and 'how' of tDCS effects, demonstrating that tDCS influences behaviour and neural activity in a task-specific and state-dependent manner. Our findings challenge the traditional view that tDCS effects are primarily due to polarity-specific shifts in cortical excitability, instead proposing a more complex mechanism of action for tDCS that encompasses various aspects of cortical neuronal activity without increasing burst-like epileptiform susceptibility.

Comparing content and timing predictions in music and speech: Differential effects depending on domain and music training

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Prediction is a fundamental aspect of cognition that allows us to predict what is about to occur, and when it will occur. However, little is known about how these predictions are integrated, and whether they differ depending on stimulus domain (i.e., melody, sentence). To investigate these questions, content and timing predictability were comparably manipulated within melodies and sentences to investigate effects on completion judgements. Musicians (n=26) and non-musicians (n=26) were recruited to investigate effects of music training on prediction in music, and potential transfer to speech prediction. Melodies and sentences were predictable or unpredictable in terms of content and timing, while also ending with an expected or unexpected note/word that was rated for completeness. Results showed differences depending on domain and musical training. Content manipulations were detrimental to both melody and sentence completion judgements, but more so for sentences. Timing manipulations were detrimental to melody completion judgements only. Musicians were better able to discriminate between expected and unexpected endings than non-musicians, and were more affected by content manipulations in melodies. Musicians and non-musicians were equally affected by timing manipulations in melodies, but only musicians were affected by timing manipulations in speech, suggesting transfer effects of timing predictions to the speech domain. These results suggest that content and timing predictions affect music and speech differently, perhaps depending on the relative importance of these cues for each domain. Our findings have implications for understanding different types of prediction in the brain, and the effects of expertise on predictive processing.

Dog-assisted intervention to reduce scanxiety and improve MRI quality

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Undergoing brain scans using Magnetic Resonance Imaging (MRI) can be an anxiety-inducing experience, leading to increased data noise from involuntary movements and, in severe cases, study drop-outs. To address this issue, our research investigates the effects of a brief dog-assisted intervention (DAI) on reducing pre-scan anxiety, particularly in cognitively healthy older adults. While therapy dogs are increasingly used to alleviate anxiety in medical settings, empirical evidence supporting their effect on physiological stress responses remains limited. In a systematic review, we examined the impact of single-session DAI on stress biomarkers, including cortisol levels, blood pressure, and heart rate, across various age groups. The majority of studies reported significant reductions in stress biomarkers in DAI groups compared to controls, suggesting that brief therapeutic interventions with a dog may positively influence the autonomic stress response. Building on these findings, we set up a randomised controlled trial to assess the impact of DAI on 'scanxiety' in older adults preparing for MRI brain scans as part of the Australian Dementia Network study. The five-minute intervention prior to the scan was provided by Maple, a 4-year-old male Golden Retriever trained as a therapy dog. We measured heart rate and blood pressure before and after DAI, as well as the quality of the MRI scans in terms of movement artifacts. Here, we present the key considerations for implementing DAI in a MRI setting, and preliminary data supporting the potential benefits of DAI in enhancing the MRI experience for participants and scan quality.

Open Talks – Predictive Coding / Auditory Processes

ERP and fMRI imaging the long timescale modulation of learning using auditory prediction and prediction-error signals

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The mismatch negativity (MMN) component of the auditory event-related potential (ERP) can be used to study our ability to learn patterns and anticipate their continuation. However, recent evidence suggests that these predictions may be based on learning over a much longer time course than originally thought. Using paradigms that embed patterns over multiple timescales we show that ERP components that correspond to “prediction” and rare “prediction error” are modulated over different timeframes, and that this modulation changes significantly with age. Data from 63 healthy adults aged 18-75 years will be used to demonstrate that in young adults, the prediction error response components to rare deviations from a learned pattern show modulation over a very long time course (many 10s of minutes) while prediction related components are modulated over a comparatively short time course only. This modulation pattern is reversed with age such that older adults show long time scale modulation (many 10s of minutes) of prediction response components while prediction-error related components change over a short time frame only. These different timeframes of modulation represent a challenge for prevailing models of perceptual inference that suggest that precision should increase over time and may instead be indicative of age-related change in the tendency to processes information in dominant model-driven versus sensory-driven patterns. Finally, the data on this same protocol has also been recorded using functional magnetic resonance imaging and preliminary results will be discussed in light of the likely brain regions involved in short versus longer term response modulation.

Multimodal evidence that probabilistic cuing does not influence sensory representations

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Predictive coding theories posit that prediction errors are generated by the mismatch between sensory inputs and expectations. While human neuroimaging studies have consistently reported increased neural activity associated with prediction errors, their effect on representational fidelity of expected/unexpected events remains unclear. Inconsistent findings may arise from the different experimental manipulations of expectancy, sensory modalities, and measures of perceptual fidelity employed in experimental designs. To address this, we used a multisensory probabilistic cueing paradigm, testing visual and motor expectancy (expected/violation) by manipulating the orientation and temporal predictability of target stimuli, respectively. Participants performed an orientation reproduction task while we recorded neural activity (EEG) and pupillometry. Mixture modelling of behavioural responses revealed that while participants made more guesses on visual/motor violation trials, there was no difference in precision. Univariate analysis of event-related potentials revealed greater P300 activity, cross-validated by larger pupillometry responses, for motor violation trials compared to expected trials, with no significant differences for visual conditions. Multivariate linear discriminant analysis of EEG data showed strong evidence for distinguishing expected and violation trials in motor conditions, and weak evidence for visual conditions. However, forward encoding modeling of EEG data indicated no differences in representational fidelity between visual/motor expected and violation trials. Our results indicate that probabilistically cueing events can manifest in differences across a variety of measures without influencing the fidelity of sensory representations. These findings are consistent with evidence from recent literature using probabilistic cues to manipulate expectancy, where this paradigm has failed to produce prediction errors.

Reductions in aperiodic gamma activity and the mismatch negativity response to frequency deviants are signatures of a first episode of psychosis

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Schizophrenia spectrum disorder is a debilitating mental health condition that affects around 3% of the population. Unfortunately, traditional dopaminergic antipsychotics fail for around 30-40% of patients, and even when successful, are only effective at treating the positive symptoms (such as hallucinations). This treatment-resistance is hypothesised to be due to dysfunction of an additional neurochemical, glutamate, which results in excitation/inhibition (E/I) imbalances believed to underlie the negative and cognitive symptoms of schizophrenia. Evidence from electroencephalographic (EEG) measures relating to E/I imbalance, specifically, gamma power (30-100 Hz) and the mismatch negativity (MMN) have been varied. Thus, the primary objective of the current study was to determine how resting-state gamma power and MMN amplitude differ in those with a first episode of psychosis (FEP) compared to healthy controls (HC) and whether these scale with the severity of psychotic symptoms. For this, we recorded 64-channel EEG data from young people (15-25 years) experiencing FEP (N = 27) and HC (N = 22). We examined aperiodic (non-oscillatory) and periodic (oscillatory) gamma power at frontal, central and posterior locations between groups. The MMN to frequency (pitch) and duration deviants was examined at the same locations. Finally, we correlated the FEP group measures with their symptom severity. We observed a significant decrease in aperiodic low gamma (30-45 Hz) activity at central locations for the FEP group. In addition, the frequency MMN was significantly reduced (between 136 ms and 248 ms at frontal and central locations) for those with FEP. However, we found no significant correlations with symptom severity. Our findings suggest that E/I imbalances may be present in those with a FEP. Future research is necessary to identify the neurobiological mechanisms underlying these changes and the role of glutamatergic dysfunction in psychosis.

How do people with schizophrenia process information in volatile sound environments

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Although a smaller mismatch negativity (MMN) component of the auditory event-related potential (ERP) is well known in schizophrenia, much remains unknown about what it might reveal about the biological basis of the illness. MMN is often recorded in a task-free oddball paradigm, with persons with schizophrenia showing a smaller mismatch response to the rare physical deviations from a repeating common standard tone. In the present study we measured ERPs to a more volatile sound sequence which was either proceeded or preceded by a stable traditional oddball sequence. Participants heard three “alternating oddball” sequences, each comprised of four blocks. The probability of the standard and deviant tones switched in each block and the response to standard and deviant tones was recorded. Previously, we have shown that MMN amplitude declines across blocks of the alternating sequence. Our results in schizophrenia replicate this pattern when the alternating sound sequence was heard first, with the clinical and control groups indistinguishable. However, when the alternating sequence was heard after the stable sequence, the clinical and control groups differentiated. While the control group still showed the decline in MMN across sequence blocks, the clinical group did not. These results suggest that the context/longer term learning environment

might impact MMN amplitude differentially in schizophrenia. These results will be discussed in reference to the hypothesis that persons with schizophrenia may over-encode the precision of their model (prior) where in this case, hearing the stable sound sequence altered the tendency to modulate MMN in the more volatile sound sequence.

Probabilistic Stimulus Expectations Influence Behaviour but Not Visual Stimulus-Evoked Event-Related Potentials

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Forming expectations about upcoming stimuli allows us to detect novel occurrences and make faster decisions when our expectations are fulfilled. According to a subset of influential predictive coding models, the presentation of expected stimuli is hypothesized to reduce neural activity, a phenomenon termed as expectation suppression. However, evidence for expectation suppression has been inconsistent due to confounds such as repetition effects and the predominant reliance on haemodynamic measures in prior literature. To address these issues, we tested for electrophysiological effects of predictive cueing in the visual system using electroencephalography (EEG). In our design, three cues differentially predicted subsequently presented oriented grating stimuli, which could either be expected (80% probability), neutral (50% probability), or surprising (20% probability). Participants completed a grating matching task in which they determined whether an additional grating (presented after the cued grating) had the same or different orientation. To reinforce the use of cue-stimulus associations, we introduced a discriminability manipulation, with the first grating presented at varying levels of discriminability (easy, medium, difficult). We did not observe expectation-related effects on event-related potentials across the three probability conditions, as demonstrated by non-significant cluster p-values and Bayes factors that favoured the null hypothesis. However, our training session did show faster response times for expected compared to neutral stimuli, suggesting that expectation may influence behaviour in the absence of detectable neural changes. Overall, our findings are consistent with previous studies, further challenging the notion of expectation suppression as proposed by predictive coding accounts.

No Effect of Value on the Task Irrelevant Auditory MMN

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Converging behavioural and neuroscientific data suggest visual stimuli that signal value involuntarily capture attention and are preferentially processed, even when unattended. We examined whether learned value associations for task-irrelevant auditory stimuli modulate pre-attentive processing and involuntarily capture attention. Across two experiments, the effect of learned value on the visual- and auditory-evoked MMN and P3a event-related potential (ERP) components was measured. Participants performed a primary visual detection task while an irrelevant, unattended oddball stimulus stream was concurrently presented. Deviants within this oddball stream had been previously learned to signal one of several value outcomes: monetary reward, loss or no change. Neither the auditory nor the visual MMN was influenced by value associations. However, stimulus value affected performance on the primary task and the magnitude of the P3a in those who could identify the stimulus-value pairings at test. Supplementary mass univariate analyses and time frequency decomposition (theta phase-locking) confirmed the presence of the MMN and the absence of any influence of stimulus value on the MMN response. Findings suggest that learned value associations do not meaningfully influence the MMN prediction signalling mechanism for task-irrelevant auditory stimuli.

Environmental volatility effects on auditory perceptual processing in healthy populations and schizophrenia

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Decades of EEG research have consistently shown that in relatively stable auditory environments, individuals with schizophrenia exhibit a reduced response to random sensory events compared to healthy controls, while responses to predictable regularities remain similar. While this finding is robust, our theoretical understanding of the underlying mechanisms remains uncertain. Current hierarchical Bayesian computational models of learning in schizophrenia suggest that this reduced response may arise from an overestimation of environmental volatility, causing random noise to be misinterpreted as meaningful change. To investigate this further, EEG was recorded in a schizophrenia group and a healthy comparison group during passive exposure to both a stable auditory sequence and a more volatile sequence. For those who heard the more stable sequence first, we replicated the well-known group differences in response to the unpredictable sounds, with no group difference in responses to the predictable sounds across both sequences. However, we found that when exposed to the more volatile sequence first, group differences in both the volatile and stable sequences emerged in response to the predictable regularity rather than the unpredictable events. Our results suggest that sequence volatility not only reveals novel patterns of sensory processing between healthy populations and schizophrenia, but also exposes longer-term influences of initial environmental stability on perceptual inference. These findings indicate that manipulating auditory sequence volatility may offer new insights into the aberrant mechanisms underlying perceptual abnormalities in schizophrenia.

Open Talks – Emotion and Affect

Subcortical modulation of the fronto-insular and cingulate functioning during negative emotional processing in mood and anxiety disorders

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Dysfunctional processing of negative emotional events is a transdiagnostic feature of mood and anxiety disorders and is often associated with aberrant functioning of the fronto-insular/cingulate network involved in salience processing. Coordination of responses to negative emotional events in this network relies on dynamic interactions with subcortical regions, including the amygdala and periaqueductal gray (PAG). However, the precise nature of these interactions is not well understood in mood and anxiety disorders. Using dynamic causal modelling (DCM), in this study we investigated directional interactions between the amygdala, PAG and the fronto-insular/cingulate network, comprising the anterior insula, dorsal anterior cingulate and ventrolateral prefrontal cortex, during negative emotional processing in mood and anxiety disorders. Thirty-seven participants with mood and anxiety disorders (29 Female) and 37 age and sex-matched healthy controls completed an emotional oddball paradigm during ultra-high field 7-Tesla functional magnetic resonance imaging scanning. DCM results revealed that while healthy control participants exhibited an inhibitory influence from the PAG to anterior insula, this effect was not detected in participants with mood and anxiety disorders (0.34 Hz, posterior probability=1.00). Leave-one-out cross validation revealed this effect was large enough to predict diagnostic status, overall negative affect, depression, and stress levels. Additional group differences emerged in modulatory amygdala-to-PAG and intrinsic PAG self-inhibitory connections. Our work indicates that altered PAG modulation of the anterior insula during negative emotion processing likely contributes to maladaptive autonomic arousal, salience attribution and affective response to negative emotionally salient events in mood and anxiety disorders.

An Active Inference Account of Cognitive Effort

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Ego depletion is a debated concept in cognitive effort research, with studies showing that various interventions can moderate this effect, challenging the direct cost account and supporting the opportunity cost account. This paper explores cognitive effort through the active inference framework, refuting the direct cost account and offering explanations for phenomena not fully addressed by the opportunity cost account, such as the effort involved in commencing an undemanding task and the role of goal decomposition and practice in reducing cognitive effort. The broad explanatory scope presents the active inference account as a highly promising account of cognitive effort. Within the active inference framework, cognitive effort is conceptualized as the Kullback–Leibler divergence between goal-directed action probability distributions and habitual action distributions. Cognitive effort arises when an individual's actions to achieve a specific goal deviate from habitual actions, necessitating an update of habitual beliefs to align with goal realization. Therefore, exerting cognitive effort means updating one's habitual beliefs about actions to beliefs that better align with goal realization, which is exactly to enhance the goal-directed fitness of one's beliefs. Since goal-directed fitness pertains to a temporary goal and excessive pursuit of fitness to a temporary goal threatens the fitness to the overall environment, ego depletion acts as a mechanism to constrain the pursuit of goal-directed fitness and ensure a balance. Interventions that moderate the ego depletion effect either enhance the individual's beliefs about the overall environmental fitness for the same level of effort exertion or reduce the perceived goal-directed fitness.

Offline effects of real-time closed loop Default Mode Network inhibition

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Hyperconnectivity in the brain's default mode network (DMN) is hypothesised as a mechanism underlying major depressive disorder (MDD). Normalisation of this hyperconnectivity pattern is thought to be the mechanism of action of Transcranial Magnetic Stimulation (TMS) when used for treating MDD. We investigated whether a real-time intervention could be designed to explicitly normalise this pattern of hyperconnectivity. Building on recent advances establishing an electroencephalogram (EEG) marker of DMN activity, we tested if real-time closed loop feedback could inhibit DMN inhibition and if this inhibition persisted offline. In a preregistered, triple-blind sham-controlled study we tested the effects of two experimental variables of modality (TMS and Audio-Visual Stimulation; AVS), and condition (active vs sham) on healthy volunteers. Feedback was applied during detected DMN activity in the active condition and randomly during the sham condition. At the time of writing, a planned interim analysis has been conducted following recruitment of half (N=28) of the planned subjects (N=56). Online data reflecting periods when the intervention was applied showed a significant effect of condition (active vs sham; $p<0.001$) and a significant effect of modality (TMS vs AVS; $p=0.002$). Offline data reflecting periods after the intervention was turned off showed a non-significant trend for condition (active vs sham; $p=0.054$). A secondary effect of modality was not significant (AVS vs TMS; $p=0.86$). As the stopping rule was not met, data collection will now continue to the planned endpoint of N=56 subjects.

Affect and empathy task induced alpha-theta activity from direct neuronal recordings human bed nucleus of stria terminalis link with depression and anxiety severity

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The bed nucleus of the stria terminalis (BNST), a part of 'extended amygdala', is densely connected with limbic structures, hypothalamic and brainstem nuclei. It plays a critical role in emotional processing especially fear, anxiety () and prosocial behaviour (3) with its dysfunction implicated in many psychiatric illnesses including major depression (4). Yet, its functional dynamics remain poorly characterised in humans. We acquired neuronal recordings from BNST from a cohort of 23 patients with treatment resistant depression undergoing deep brain stimulation (DBS) in a clinical trial. We employed two tasks : 1) empathy for pain (painful and non-painful pictures), 2) affect task (positive and negative pictures). We first characterised task induced spectral dynamics and used permutation testing to assess condition differences. Time-frequency clusters showing condition differences were then tested for their association with depression and anxiety scores. Behavioural ratings showed differences in painful and non-painful pictures ($p<.001$). Broad frequency range induced activity was seen for the empathy for pain task with condition differences in the alpha and theta frequency range activity which was greater in the painful condition ($p<.001$. Crucially, alpha activity correlated with baseline anxiety ($r=.51$, p-FDR<.05) and depression scores ($r= .55$, pFDR<.05) and remarkably also predicted reduction in anxiety symptoms at 3-month follow up ($r= .53$, pFDR<.05). Behavioural ratings showed differences in positive and negative valence pictures ($p<.011$, Figure 2B i). For the affect task, early theta range (0-250 ms) activity was significantly greater for negative pictures ($p<.001$and which correlated with baseline anxiety ($r = .50$, pFDR<.05) and depression scores($r= .52$, pFDR<.05). Overall, from direct human BNST recordings, we show theta-alpha spectral signatures specific for task conditions linking anxiety and depression. These spectral characteristics can be targeted as a potential biomarker for depression and anxiety severity and predictors of therapeutic outcome.

An active inference model of the optimism bias

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The optimism bias is a cognitive bias where individuals overestimate the likelihood of good outcomes and underestimate the likelihood of bad outcomes. Associated with improved quality of life, optimism bias is considered to be adaptive and is a promising avenue of research for mental health interventions in conditions where individuals lack optimism such as major depressive disorder. Here we lay the groundwork for future research on optimism as an intervention by introducing a domain general formal model of optimism bias, which can be applied in different task settings. Employing the active inference framework, we propose a model of the optimism bias as precision over a positive outcome. First, we simulate how optimism may be lost during development by exposure to negative events. We then ground our model in the empirical literature by showing how the developmentally acquired differences in optimism are expressed in a belief updating task typically used to assess optimism bias. Finally, we show how optimism affects action in a modified two-armed bandit task. Our model and the simulations it affords provide a computational basis for understanding how optimism bias may emerge, how it may be expressed in standard tasks used to assess optimism, and how it affects agents' decision-making and actions; in combination, this provides a basis for future research on optimism as a mental health intervention.

Presenting unpaired unconditional stimuli during fear extinction at full and reduced intensity slows re-acquisition

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Presenting unpaired unconditional stimuli during extinction reduces the return of fear as indexed by contextual renewal, extinction re-tests or slow reacquisition. The present study investigated whether this result would emerge also if the intensity of the US is reduced when presented during extinction. Using an ABA renewal paradigm that trained extinction in a context different from acquisition, test and reacquisition, participants (N=121) either received no unconditional stimuli (Standard extinction), five unpaired presentations of the aversive electro-tactile unconditional stimulus used during acquisition (Unpaired extinction) or five unpaired presentations of the aversive electro-tactile unconditional stimulus at half the intensity used during acquisition (Reduced extinction) during extinction training. Extinction was followed by tests for renewal and re-acquisition. Contrary to previous results, renewal of electrodermal conditional responses was absent in all groups. Re-acquisition was faster in group Standard than in groups Unpaired and Reduced, which did not differ. This indicates that the effect of presenting unpaired unconditional stimuli on extinction learning is not limited can be

observed even if unconditional stimulus intensity is reduced considerably. This finding may open the use of unpaired extinction training for translation into applied settings where extinction of conditioned fear is seen as a core mechanism such as exposure-based treatments of anxiety disorders. This work was funded by Grant GNT1156490 from the National Health and Medical Research Council.

Understanding the relationship between anxiety, stress and depression on cognitive performance during exposure to different scales of interior built environments

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Cognitive processes enable us to efficiently perform tasks and interact within our everyday environments. While emerging research is uncovering links between the design of our built environments and brain-based activity, often these studies neglect to consider the contributions of individual differences in mood. As the prevalence of mental illness is rising across society, and mood influences cognitive processes, we investigated how mood influences the association between cognition and the built environment during facial emotion recognition and working memory tasks. 65 adult participants (42 women, mean age = 27.4 ± 5.95 years) were exposed to a reduced, control, and enlarged indoor room through a Cave Automatic Virtual Environment (monitored for indoor environmental quality). We used Spearman's r correlations to assess relationships between reaction time and self-reported mood from the Depression Anxiety Stress Scales. Depression score was not associated with reaction time for emotion recognition but was associated with faster speed for working memory in the enlarged room. Higher anxiety was associated with faster reaction time in the enlarged room for both tasks. Lastly, elevated stress was linked to slower reaction time for emotion recognition in the reduced room but associated with quicker reaction time for working memory in the enlarged room. Although effect sizes are small and our data was collected after prolonged isolation periods from COVID-19 restrictions, our findings indicate aspects of mental health may mediate how the built environment is associated with response speed, and that individuals may benefit from different room scales based on task type and health.

Can an online battery match in-person cognitive testing in predicting age-related cortical changes?

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Clinical identification of early neurodegenerative changes requires an accurate and accessible characterization of brain and cognition. We assessed whether a brief online cognitive assessment can provide insights into brain morphology comparable to a comprehensive neuropsychological battery, comparing the relationship between brain morphology (sulcal width) and cognitive functioning, using online and in-person testing. 141 healthy participants (mean age 60, range 46-71 years, 75% female) assessed with structural MRI; cognitive batteries both, face-to-face and online (Creyos), and APOE genotype; Canonical Partial Least Square method to compare cognitive modalities and Sulcal width (SW; Morphologist pipeline-BrainVISA toolbox; Borne et al., 2020). Age effects tested with two-sided Wald Test. Analysis of covariance to test age and sex-interactions, and APOE status, sex-effects (controlling for age), and APOE (controlling for age and sex). Online cognitive testing strongly and significantly covaried with performance in in-person assessment (cov=2.67; z-cov=12.33; r=0.60; r2=0.37; p<0.001). For in-person assessment, the cognitive projection loaded most strongly onto memory and executive functions (1st mode, p=0.011, cov=3.55, z-cov=3.00, R2=0.18, z-R2=0.95; 2nd mode, p>0.99). For the online-battery, cognitive projection loaded most strongly onto executive function (1st mode, p<0.001, cov=2.76, z-cov=4.71, R2=0.14, z-R2=1.15; 2nd mode, p=0.99). Both cognitive projections loaded onto similar cognitive domains and projected with comparable strength and topography onto the brain's morphology. A cost efficient online cognitive battery parallels comprehensive cognitive in-person assessment in its correlation with brain morphology. This is particularly relevant given the anticipated increased cognitive screening demand resulting from recent advances in disease-modifying treatments for neurodegenerative disorders.

Poster Session 1 (Tuesday)

Hearing silences: Neural representation of deviant omissions using multivariate pattern analysis

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The brain is constantly making predictions about upcoming sensory input. For example, when listening to a sequence of predictable sounds (standards), the brain forms a template by replicating the activation pattern of sensory units from previous sounds. If one of those sounds is randomly omitted (deviant), there is a larger neural response compared to standards. Because an omission doesn't provide bottom-up input, it is thought that this response reflects the brain's representation of what was actually omitted (i.e., the standard). However, the specific electrophysiological representation of the deviant remains unclear. We sought to investigate this. In the predictable condition of our experiment, participants pressed a button to produce a sound on 88% of trials and a deviant omission on the remaining 12% of trials. In the unpredictable condition, participants pressed a button to produce a sound on a random 50% of trials and an unpredicted omission on the remaining 50% of trials. For half of the blocks, a 1000-Hz tone was presented; for the remaining blocks, a 500-Hz tone was presented. To examine the neural representation of sounds and omissions, we used multivariate pattern analysis. If deviant omissions represent what was actually omitted (i.e., the standard), then we hypothesise similar decoding accuracy for standards and deviant omissions, as well as higher decoding accuracy for deviant omissions than unpredicted omissions. The results and their implications will be discussed.

Reaction time as a measure of cognitive processes in human fear conditioning: A systematic review and meta-analysis

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Behavioural measures, reaction time, have been widely used in fear conditioning studies as an outcome measure to explore the processing of conditional stimuli paired with aversive unconditional stimuli. However, findings regarding the suitability of this measure to differentiate between danger cues and safety cues have been mixed. To address this, we conducted a systematic review and meta-analysis of human fear conditioning studies to evaluate the utility of reaction time as a measure to differentiate between danger and safety cues across different task domains. Our analysis categorized the different types of reaction time tasks used in previous research, revealing that these tasks assess distinct underlying cognitive processes. The primary processes include the psychological refractory period, attentional bias toward threat cues, and varying levels of cognitive resources allocated to the processing of danger and safety cues. Despite this classification, inconsistencies persist within each domain, indicating the need for further domain based analyses before definitive conclusions about the utility of behavioural measures as an index of human fear learning can be drawn.

Cyclical evolution of functional brain networks in rest

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The human brain exhibits recurrent oscillatory activity in cortical networks of neuronal populations, which are thought to play a role in specialized cognitive functions. However, it is not known whether these oscillatory network states evolve over time in a structured or random matter. In this study, we introduce a new method for analyzing the long-term evolution of these states, and demonstrate that they follow a cyclical architecture when the brain is at rest ($p<0.001$, permutation tests), with typical cycle durations of 300-500 milliseconds. This cyclical organization structure positions the default mode network (DMN) and dorsal attention network (DAN) at opposite phases of the cycle, with the DMN preceded by higher frequency oscillations in sensorimotor networks and followed by lower frequency oscillations in frontotemporal networks respectively. The cyclical structure was robust over three large magnetoencephalography (MEG) resting state datasets ($p<0.001$ in all 3 datasets), and the position of individual states within the cycle was preserved in each. The observed cyclical activation structure persists in a visuo-motor task ($p=0.027$), where cycle phase predicts reaction time ($p<0.001$). Moreover, individual cyclical dynamics were predictive of demographics: older people deviate less from the cycle structure ($p<0.001$) and show a general slowing of cycle rate ($p=0.012$), and genetic data shows cycle rate is strongly heritable ($p=0.004$). Cycle metrics furthermore correlate with scores reflecting individual cognitive abilities ($p=0.009$). These findings suggest that the evolution of oscillatory network states in the human brain may be more organized than previously thought and provide potential biomarkers for health and disease.

Development of a multimodal methodology for studying social perception using eye-tracking and fNIRS in neurodivergent population

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Visual social attention research plays a crucial role in understanding prevalent neurodevelopmental conditions. Many neurocognitive studies gather rich data using eye-tracking, focusing on gaze behaviour and attentional processes. Separately, neuroimaging has highlighted relevant neural networks linked to these conditions during face perception. Few studies have combined neuroimaging and eye tracking, perhaps in part due to the technical challenges of multimodal recording. Advancements in portable non-invasive neuroimaging techniques such as functional near-infrared spectroscopy (fNIRS) have made

analysing cortical brain activity more accessible and, therefore, increasingly relevant to different clinical populations that might experience discomfort in an fMRI scanner. We present here an overview of our methodology. We use an EyeLink 1000 Plus (SR Research) to record saccadic and fixation patterns while participants view a series of dynamic displays of facial expressions. Concurrently, a multichannel fNIRS system (Brite, Artinis) measures the neural hemodynamic response in the temporoparietal junction (TPJ) and posterior superior temporal sulcus (pSTS). Our detailed piloting overcame the technical challenges of synching multiple systems, establishing an optimal study protocol that preserved the requirement for a repeated trial structure for eye-tracking, incorporating a block design allowing increased signal-to-noise of face compared to baseline conditions for fNIRS analysis. We evaluated the overall design and specific task-related components of the experiment (e.g., inter-stimulus interval, baseline duration, participant task requirements) which sometimes required balancing between requirements favoured by either eye-tracking or haemodynamic response measurements. Our proposed study will aim to provide a more comprehensive understanding of the underlying cognitive processes involved in social perception.

Pre-motor and auditory processing for inner and overt speech

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There is a long-standing debate as to whether the neural processes associated with inner speech – the silent production of words in one's mind – and overt speech – the audible production of words via movement of the articulator organs – are the same or different. Watson (1913) claimed that the only difference between them is that inner speech does not produce an audible sound, whereas Vygotsky (1934) argued that they are completely different. To distinguish between these possibilities in the context of pre-motor and auditory processing, we sought to investigate the similarities and differences in both the N1, an event-related potential (ERP) associated with auditory processing, and the slow negative wave, a negative-going deflection preceding the onset of a voluntary action. To elicit these potentials, participants were instructed to watch an animation which provided them with precise knowledge about when they should produce a sound (e.g., "cat") in either inner or overt speech. At the same time, participants would hear an audible sound played through headphones that either matched (e.g., "cat") or mismatched (e.g., "dog") the sound they produced. The results and their implications for understanding inner and overt speech will be discussed.

Investigation of neuroimaging tools for the bedside assessment of consciousness in Disorders of Consciousness patients in New Zealand

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Providing an accurate diagnosis for patients in a prolonged disorder of consciousness (pDoC), following severe brain injury, remains a clinical challenge. Brain imaging has uncovered remarkable hidden signs of awareness in some patients, but these advances have not yet been translated into clinically viable tests available at the bedside. Here we address this translational gap, by investigating the acceptability and feasibility of bedside neuroimaging tools for repeatable deployment in a healthy sample in Aotearoa, New Zealand (NZ). Whilst bedside EEG functional connectivity measures have been shown to accurately classify consciousness states in pDOC (Chennu et al., 2017), here we explore whether the addition of functional near-infrared spectroscopy (fNIRS) improves classification accuracy. Thirty-one healthy participants underwent continuous fNIRS-EEG during 15 minutes of rest with eyes open. Our preliminary results indicated that for most participants, EEG measures of alpha power and alpha functional connectivity (dwpli) was negatively associated with deoxygenated blood (HbR) and positively associated with oxygenated blood (HbO) over time. Alongside, we investigated the feasibility of incorporating fNIRS-EEG within the Te Waka Oranga framework; to assess both the brain and cultural rehabilitation needs of pDoC patients, their family and whānau in NZ. Follow-up semi-structured interviews with a subgroup of the participants (N = 3) were conducted. Reflective Thematic Analysis highlighted themes of "Whakamārama – illuminate and help me to understand", "Whakaruruhau – keep me safe" and "Whakawhanaungatanga – building relationships" as important for Māori. Using these insights, we have developed a set of neuroimaging best practice recommendations for NZ researchers and health care professionals.

Effects of a three-month aerobic exercise intervention on brain structure in people with a cannabis use disorder

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Cannabis use disorder (CUD) is associated with mental ill-health, social dysfunction, and deviation in brain structure and function, including white matter alterations. Physical exercise offers a non-pharmacological, accessible, and acceptable intervention that has been shown to enhance brain function and mental well-being through neuroplasticity and vasculogenesis. Neuroimaging studies show a positive link between cardiorespiratory fitness, physical exercise and brain structure (including white matter integrity and morphometry) in key brain regions linked to CUD. In this clinical trial, we randomised 57 individuals with CUDs to either a High Intensity Interval Training (HIIT) group or Strength and Resistance Training (SRT) group. Both interventions ran for 45

minutes, 3 times per week for 12-week. The HIIT group aimed to achieve 80% of their maximum heart rate, while the SRT group aimed to remain ≤ 70%. Anatomical T1 and diffusion weighted images were collected using a 3T Siemens scanner. At the end of the trail, the HIIT group showed increased FA (Fractional Anisotropy) in left uncinate fasciculate compared to SRT group (p=0.004, df=83). Compared to the SRT, our longitudinal results showed significant increase of cortical thickness (percent of change per year, p-corrected=0.016) within right pars-opercularis. The longitudinal FA changes in the left uncinate fasciculus was positively correlated with cortical thickness of right parsopercularis (p=0.012). This is the first longitudinal neuroimaging study using a combination of physical exercise interventions in CUD cohort. Our findings suggest that three months HIIT exercise improves brain connectivity and morphometry in individuals with CUD.

Longitudinal Comparisons Between Left and Right Semantic Dementia Presentations using the SYDBAT

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Semantic Dementia (SD) is a neurodegenerative disorder, that is a type of frontotemporal dementia, where language is primarily impacted throughout the disease course. There is limited research comparing the 2 subtype presentations of Semantic Dementia: 'Left SD' (where greater deterioration occurs in the left vs the right temporal regions during the earlier stages of the disorder) and 'Right SD' (where greater deterioration occurs in the right vs the left regions (early in the disorder), despite reports that these presentations have differing symptoms. In addition, the majority of the existing research neglects to examine these presentations over time, limiting our understanding of the progression of this disorder. The present study aimed to address this gap by comparing the Left and Right presentations of SD over time on four single-word processing tasks within the Sydney Language Battery (SYDBAT). This study was retrospective, using pre-collected data gathered between 2008-2022 by the FRONTIER group at University of Sydney. The final sample included 39 Left SD participants, 16 Right SD participants and 93 age and education matched controls for normative comparisons. Eligible participants were assessed at least 2 times. Linear Mixed Effects Models were used to compare the two SD presentations over time on each of the SYDBAT subtests (Naming, Repetition, Comprehension and Semantic Association) to identify similarities and differences. The findings of this study will provide a valuable contribution to understanding of the progression and language differences of these two forms of Semantic Dementia. This study has not yet been completed.

Mesoscale iEEG and macroscale fMRI dynamic graph network properties during movie viewing link to heart rate changes

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The brain's ability to rapidly adapt derives from the flexible reconfiguration of its functional networks (Sporns, Chialvo, Kaiser, & Hilgetag, 2004). The global trade-off between functional integration versus segregation reflects changes in physiological processes including arousal, which in turn depend on ascending neuromodulatory effects acting over multiple (short and long) time scales. However, the association of these dynamic network properties to fluctuations in bodily physiology such as changes in the heart rate (HR) has not been well quantified. Heart rate is modulated by the adrenergic-cholinergic balance has also been proposed to be linked to the neurotransmitter related brain states of integration and segregation (Shine, 2019) and thus provides a good physiological measure to link dynamic network properties. Methods: Here, we acquired data from two modalities 1) high-fidelity intracranial-EEG recordings from 12 patients undergoing clinical epilepsy evaluation, and 2) functional magnetic resonance imaging (fMRI) data from 18 healthy subjects. Schema of the study approach shown in Figure 1. The participants in both these datasets watched a short unedited emotional movie "The Butterfly Circus" while their respective data was acquired. For iEEG data, we first segment ECG data corresponding to the movie viewing data into 5 second epochs to account for variability in heart rate changes across patients. Subsequently, iEEG high frequency broad band activity (60-140 Hz), a metric of local neuronal firing and which has been found to be correlated with the BOLD signal, of all the grey matter channels was computed and which was segmented into 5 second epochs. Adjacency matrices were constructed for each 5 second epochs, network properties of integration (global efficiency) and segregation (modularity) properties were obtained for each epoch. For fMRI data, standard pre-processing was employed (van der Meer et al., 2020) and then we extracted BOLD signals using AAL atlas. Subsequently, we used sliding window (~30 seconds) method to construct adjacency matrices and thresholding the matrices to obtain network properties of integration and segregation. Heart rate data corresponding to each TR was obtained using the TAPAS toolbox similar sliding windows used to obtain dynamic HR signal. For testing associations between HR and network properties, we calculated the group mean of the Pearson correlation between HR and integration and HR and segregation. To generate the null distribution, permutation testing with randomly circular shifting the data was used. Results: We find dynamic integration states were negatively correlated with HR ($r = .14$, $p<.0001$), and segregation states were positively correlated, with HR ($r = -.09$, $p<.0001$) (Figure 2 top). In other words, integration or widespread communication was associated with higher heart rate and segregation states associated with lower heart rate. Notably, in fMRI data acquired from the participants viewing the same movie, we find the opposite pattern of results i.e. integration states associated with high heart rate ($r = -.17$, $p<.0001$) and segregation states associated with low hear rate ($r = .15$, $p<.0001$) (Figure 2 bottom). Conclusions: We established with direct neuronal activity that integrations states were linked with higher heart rate and segregation states linked with lower heart rate. Thus, our results also indirectly link brain network states to activity in neuromodulatory systems. However, we found opposing pattern of results with fMRI. These opposing findings from iEEG and fMRI

highlight the complex relationship between the cortical activity, BOLD signals and cardiac homeostasis.

Evaluating Whether Acute single-Session Sham-controlled Theta-neurofeedback Training Improves Mnemonic Similarity Performance

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Electrophysiological theta activity is functionally linked to a variety of memory processes, including the accurate discrimination between mnemonically similar, old or new objects. Participants received 30-minutes of NF training targeting peak theta (4-8 Hz) activity across three groups: spatially-derived frontal midline theta (FM-theta, N = 12) and functionally-derived medial temporal/parietal source-based theta (MTL-theta, N = 11). NF training used continuous and discrete feedback, with online eyeblink blocking to reduce artifacts. A sham NF group (N = 11) viewed pre-recorded EEG activity via the NF paradigm. EEG was recorded using a 62-channel setup with linked mastoid reference. The mnemonic similarity task assessed participants' ability to categorise test items as 'new,' 'old,' or 'similar' to previously displayed objects before and after NF training. Contrary to expectations, a robust mixed-design ANOVA with 20% trimmed means on overall MST reaction time (RT correct trials only; within-subject: pre to post NF, between-subject: FM-theta, MTL-theta, sham) showed no significant group by time interaction ($F(2, 10.45) = .970$, $p = .412$), nor a main effect of group ($F(2, 11.32) = 0.14$, $p = .872$). However, there was a significant main effect of time ($F(1, 12.62) = 11.05$, $p < 0.01$). Post-hoc results indicated a significant improvement in RT over time (Estimate = 0.071, $p < .001$). Despite counterbalancing measures, the observed improvements in mnemonic similarity performance from pre to post-NF training are likely due to practice effects, as improvements were seen across all three groups, rather than being attributed to increased theta activity from acute NF training.

Modulating the exploration strategy in social reinforcement learning

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Exploring unfamiliar options to gain a new piece of information is crucial for adaptive decision-making, while excessive exploration loses the opportunity to exploit the currently learned best option. The trade-off between exploration and exploitation is a central issue in reinforcement learning. Theory predicts that, in learning from not only one's own but also others' reward experiences, individuals should modulate their exploration levels depending on the others' level of exploration. Specifically, when learning from a high-explorative individual (compared with when learning from a low-explorative individual), they should reduce their exploration level and focus more on exploitation while outsourcing more exploration to the partner. In this study, we tested the theoretical prediction through a behavioural experiment of a social version of the three-armed bandit task ($N = 40$). Consistent with the overall prediction, computational modelling of behaviour showed that participants modulated their exploration strategy depending on their partners' exploration levels. However, the direction of the modulation was found to be opposite to the specific prediction: that is, participants reduced the level of directed-exploration (i.e., active sampling of unfamiliar options) when learning from the low-explorative partner, while the level of random-exploration (i.e., stochastic noise in choices) remained unchanged. The present study, we believe, provides significant insights into how humans control their exploration strategies in social learning.

Investigating the Influence of Anti-Epileptic Drugs on Aperiodic EEG Activity

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EEG signals contain both periodic (i.e., oscillatory) and aperiodic (i.e., non-oscillatory) components. Aperiodic activity results in the 1/f-like background of the EEG power spectrum and can be quantified by fitting a model to the spectra with parameters for offset and steepness of the slope (i.e., 1/f exponent). Computational modelling and GABAergic drug studies show that increased inhibitory input leads to a steeper slope (higher exponent). The aim of this study was to quantify the effect of two antiepileptic drugs (AEDs) which reduce cortical excitability on properties of aperiodic EEG activity. Resting EEG data with eyes open and closed were collected from 15 healthy male volunteers at baseline and 2 hours post-administration of Lamotrigine (300 mg), Levetiracetam (3000 mg), or placebo. EEG data were processed in MATLAB, and power spectra were calculated using Welch's method. Aperiodic fits were performed using the specparam algorithm in Python, with goodness-of-fit metrics and visual inspection to ensure model accuracy. In the eyes-open, but not eyes-closed condition, Lamotrigine administration reduced the aperiodic offset pre to post drug intake ($p = 0.022$, i.e., less power in low frequencies), a change which was stronger when compared to the placebo condition ($p = 0.0032$). There were no significant changes in exponent values during eyes-open or eyes-closed conditions, or in any parameters following Levetiracetam intake. Our findings suggest that altering cortical excitability with AEDs can reduce the aperiodic offset in EEG activity under certain conditions.

Leveraging artificial intelligence methods to improve the diagnosis of frontotemporal dementia: A systematic review

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Artificial intelligence (AI) methods are rapidly changing the way researchers approach the early and accurate diagnosis of dementia. This has led to widespread adoption of machine

learning (ML) and deep learning (DL) models for Alzheimer's disease (AD) classification research. Such AD classification models are highly accurate and adaptable to multiple data modalities (e.g., neuroimaging, genetics, speech, and clinical tests). In contrast, far less research has been conducted using AI classification methods for other forms of dementia, such as frontotemporal dementia (FTD). This dearth of knowledge is problematic as FTD presents unique diagnostic challenges including heterogeneous clinical subtypes, overlapping symptom profiles, and relatively small clinical datasets. This systematic review aimed to understand which ML and DL methods can accurately and reliably classify FTD syndromes and determine the clinical viability of current AI-based classification techniques for use in FTD. We identified and reviewed relevant articles using a keyword search of popular databases (PubMed and Scopus) and ASReview (a systematic review software). This procedure resulted in 60 articles containing approximately 136 different FTD AI classification scenarios. Most of these studies performed FTD classification with ML methods (82%), support vector machine classifiers (47%), structural MRI data (47%), and 10-fold cross-validation designs (29%). Similarly, the majority of studies performed binary classification (i.e., FTD versus Control/other disease entity; 80%) and investigated diagnostic scenarios for dementia types (FTD versus AD; 40%; bvFTD versus Controls; 19%). AI classification approaches are increasingly being used to diagnose FTD. We discuss specific recommendations to promote best practices for future model development and the role of cognitive neuroscience in this regard.

Attentional bias towards looming angry faces revealed using eye-tracking

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Previous studies have shown that the human brain responds rapidly to angry faces in looming motion. It is commonly assumed that this early neural sensitivity reflects the detection of an imminent threat. From this perspective, it follows that angry faces in looming motion should summon attention at the behavioural level, more so than angry faces in receding motion. The current study tested this hypothesis by examining whether looming angry faces elicit cueing effects using continuous eye movements as a proxy for attention. Faces were bilaterally presented in simultaneous looming or receding motions. Control trials presented participants with two neutral faces, while other conditions always presented an angry face with a neutral face: Valid trials consisted of the target replacing the angry face, whereas invalid trials consisted of the target replacing the neutral face. Bayesian data analysis methods of time-resolved, horizontal eye positions indicated that the participants found it more difficult to disengage attention from looming angry faces than looming neutral ones. Eye movements were systematically drawn by invalid angry faces around 200ms after face onset, which caused a considerable delay in target selection. This finding aligns with the literature showing attentional biases towards threatening facial expressions. However, our results did not yield evidence of attentional capture by looming angry faces, as eye movements toward the targets were equally rapid in valid looming angry trials and the control conditions. This is likely because motion captures initial attention more broadly.

On the neural substrates of mind wandering and dynamic thought: A drug and brain stimulation study

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The impact of mind wandering on our daily lives ranges from diminishing productivity, to facilitating creativity and problem solving. There is evidence that distinct internal thought types can be modulated by transcranial direct current stimulation (tDCS), although little is known about optimal stimulation parameters or the mechanisms behind such effects. In addition, recent findings suggest changes in dopamine availability may alter the effect tDCS on neural and behavioural outcomes. Dopaminergic functioning has also been implicated in executive processes anticorrelated with mind wandering such as attention and working memory, however the neurochemical mechanisms involved in internal thoughts are largely unknown. Thus, this registered report aimed to investigate the role of dopamine, and tDCS, on internal thought processes. Specifically, using an attentional control task, we tested whether dopamine availability (levodopa or placebo) mediated the effects of online HD-tDCS. Preliminary findings suggest that dopamine may modulate freely moving thought, reflected by a decrease in freely moving thought for the levodopa, relative to the placebo group. However, there does not appear to be an effect of HD-tDCS alone on freely moving thought. Together, these findings provide insight into the causal neural mechanisms underlying internal thought processes and the role of dopamine in facilitating changes in attentional control.

The Relationship between Dietary Patterns, Cognition and Cardiometabolic Health in Healthy, Older Adults

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Optimal dietary patterns are associated with cognitive, brain and cardiometabolic health in mid-late life. As cardiometabolic risk factors increase in prevalence with age and are associated with cognition, they may play a key role in linking dietary to cognitive outcomes. This study examined the relationship between dietary

patterns and cognition in healthy older adults and assessed whether cardiometabolic health moderated these relationships. We analysed cross-sectional observational baseline data from the ACTIVate study (n=426 cognitively healthy adults, 60-70 years). Dietary intake was assessed using the Australian Eating Survey. Cambridge Neuropsychological Test Automated Battery (CANTAB) tasks were used to derive composite scores across four cognitive domains: processing speed, attention, short-term memory, and long-term memory. The Metabolic Syndrome Score (MetSSS) included measures of HDL cholesterol, triglycerides, systolic blood pressure, fasting blood glucose, and waist circumference. Principal Component Analysis (PCA) identified three primary dietary patterns: plant-dominant, meat-dominant, and Western-style. The plant-based dietary pattern was not associated with cognitive outcomes. There was a small, negative association between the meat-dominant diet and long-term memory, that remained significant after controlling for age, sex, education, energy intake, and physical activity. This was moderated by MetSSS. Specifically, in individuals with higher MetSSS, there was a stronger, negative association between the meat-dominant diet and long-term memory performance. These findings suggest that cardiometabolic health may play a critical role in the relationship between diet and cognitive function in mid-to-late life.

Relationships between MRS-assessed neurochemical concentrations (GABA+, Glx, E/I balance) and behavioural inhibition in healthy ageing

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Inhibition underlies the ability to suppress environmental interference and ignore competing distractions, building resistance against task-irrelevant information. The impact of ageing on inhibitory functioning, and the role of neuroplasticity - largely driven by the relative balance of predominant excitatory (glutamatergic) and inhibitory (GABAergic) neurochemicals- is unclear. We examined the relationships between neurochemical concentrations and three sub-components of inhibition (measured using Flanker, Stroop and go/no-go tasks) in the context of healthy ageing. Magnetic resonance spectroscopy (MRS) data was acquired in the prefrontal (PFC; n=58,Mage=67.6years,30f) and sensorimotor (SM1; n=71,Mage=68.2years,39f) regions using a HERMES sequence and analysed using OSPREY's pipeline. Surprisingly, we did not identify significant relationships (rho) between age and GABA+ or Glx concentrations, nor the excitation/inhibition (E/I) balance, in either the SM1 or PFC regions before or after controlling for sex and education. Through partial correlation (rho), after correcting for age, sex and education (and multiple comparisons), we identified that participants with higher Glx concentrations in SM1 region performed more accurately on the go/no-go task. Weaker relationships between PFC GABA+, Glx and E/I (im)balance with different sub-component processes of behavioural inhibition were identified ($p < 0.05$), although these relationships did not remain significant following correction for multiple comparisons. These results indicate that GABA+/Glx may not uniformly decline with age, casting uncertainty on the prevailing understanding that these neurochemicals are reduced in the aged brain. Further, Glx may be important for response inhibition in a regionally specific manner, indicating a role for this neurochemical system in supporting sub-component processes of inhibition during ageing.

Brake failure: a meta-analysis on how different inhibitory control paradigms can distinguish Mild Cognitive Impairment and Alzheimer's Disease from healthy ageing

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Impulsive behaviours are often observed in people with dementia. Various behavioural inhibitory paradigms, including the Go/No-Go task (measuring response withholding), Stop Signal task (motor inhibition), Flanker task (perceptual inhibition), Simon task (aspects of cognitive and motor inhibition) and the Stroop task (cognitive inhibition), have been used experimentally to investigate inhibitory changes in individuals with Mild Cognitive Impairment (MCI), who are at high risk of developing Alzheimer's Disease (AD). This meta-analysis of 45 studies meeting PRISMA selection criteria, determined the sensitivity of these paradigms in distinguishing between healthy age-matched controls (n=2639 in total), AD (n=1097), MCI (n = 582), and amnestic MCI (aMCI, n=741) a subtype with an even higher risk of AD progression. Results indicated that individuals with MCI performed significantly worse than controls on the Flanker task, Go/No-Go task and had more Stroop interference errors. However, only the Simon task and Stroop task (both error rates and response times) were effective in differentiating individuals with AD from healthy controls. The findings suggest either that inhibitory control deficits as measured by the Go/No-Go and Flanker tasks do not progress from MCI to AD, or that the outcome parameters of the Flanker and Go/No-Go tasks reflect global response slowing or task non-compliance rather than isolating specific inhibitory deficits in populations with impaired cognition. Inhibitory control tasks, particularly the Simon and Stroop tasks, with a focus on error rates rather than changes in response speed, may enhance early detection of AD in at-risk populations and quantify inhibitory impairment in AD.

Colour preferences among people with mental health disorder – a systematic review

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Do healthy people and people with mood disorders have different preferences to colours and can colour preferences reveal the mental state of person? The objective of this review is to report the colour preferences of people with mental health disorders. A literature search was made in databases such as PubMed, OVID Medline, Scopus, Scholar, PsycINFO adhering to the PRISMA guidelines and was registered with PROSPERO (CRD42024523853). Data extraction, Quality assessment with diverse studies (QuADS) and Guidelines for a High-Quality Study on Color and Psychological Functioning by Elliot and synthesis of result was completed by two independent reviewers. 733 titles, 183 abstracts and 63 full texts were screened, and 10 articles were included for the review. The unique hues, red, green, yellow and blue were used in all the articles and achromatic hues were used in 7 studies. The number of colours ranged between 3 and 38. All the studies presented the colours in a printed sheet or on a

monitor. Of the 1095 participants with mental health disorders (>18 years), 150(13.7%), 108(9.8%) and 19(1.73%) preferred green, blue and achromatic hues as their favourite colour. Studies(n=5) that included healthy volunteers showed that preferences varied but none preferred black or brown. People with mental health disorders tend to prefer cold/dark colours, which can be explained by a hypothesis that cold colours relax mood while warm colours trigger anxiety. This also demonstrates that individuals choose colours that reflects their mood and could possibly benefit from exposure to colours that enhances their mood.

Hypatia Health: Cognitive Modelling Made Easy

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Applying cognitive modelling to behavioural data can add important information about the underlying processes that lead to this behaviour. Cognitive modelling has significantly impacted research into aspects of cognition such as reinforcement learning, decision-making, memory and more. There are significant barriers to implementing cognitive models as researchers cannot be experts in all fields. Hypatia Health is designed to make the application of cognitive modelling to your domain as seamless as possible. We offer robust and rigorous mathematical and statistical models, all within an easy-to-use interface. You can interact with the models, receiving visual feedback as you manipulate model parameters. You can also plan your studies, adjusting the trials per participant and the participants per group, and then simulate participant responses to ensure your studies are appropriately specified. When you have your simulation results, you can feed them back into our estimation module, allowing you to assess whether the known model parameters are recoverable. After running your cognitive task, you can also bring your empirical data back to Hypatia Health and have the confidence that your cognitive modelling analysis is being performed with cutting-edge and open cognitive science practices. We plan to integrate with experiment design platforms to reduce friction between a project's planning and implementation stages. We are instantiating a gold standard for model simulation and estimation, ensuring that code and model variation are removed from analysis bottlenecks, making it easier for experimentalists to focus on their research theory, questions and outcomes.

Neural bases of discrete positive emotions in stress reduction: Awe and amusement involve common and distinct brain activities

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Positive emotions, such as amusement and awe, play a crucial role in health. One key mechanism is the undoing effect, where positive emotions counteract the adverse effects of stress and negative emotions. However, the effects of discrete positive emotions and their neural bases are not fully understood. This study investigates the effects of amusement and awe on stress and their neural mechanisms. This study was approved by the Institutional Review Board of Smart-Ageing Research Center of Tohoku University. 30 healthy college students performed the Montreal Imaging Stress Task in an MRI scanner, and then watched videos that induced amusement, awe, or neutral emotions. The results showed that both amusement and awe conditions led to a reduction in perceived stress compared to the neutral condition. Additionally, in the amusement condition, there was increased activity in a broad range of areas, including the middle frontal gyrus and the temporal gyrus, while activity in the medial frontal and cingulate cortices decreased. Conversely, the awe condition showed increased activity in the angular gyrus and decreased activity in a broad range of areas including the temporal and occipital gyrus. A conjunction analysis revealed that both emotions reduced activity in the occipital gyrus compared to the neutral condition. These results suggest that both emotions effectively reduce stress and share the common feature of decreasing visual processing. Moreover, each emotion may reduce stress through different cognitive processes. Specifically, amusement is associated with enhanced social cognition and reduced self-reflection, while awe may promote the integration of vast experiences.

Image naturalness and recognisability fail to predict perception in binocular rivalry

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Binocular rivalry is a perceptual phenomenon that occurs when incongruent images are presented to corresponding retinal locations of each eye. Perception fluctuates over time, including coherent percepts (where one image is completely suppressed), and mixed percepts (a combination of both images). Previous research indicates that images with higher-level structure (e.g., objects or faces) have higher rates of coherence than simpler images (e.g., gratings), and that recognisable images tend to dominate (are coherent for longer) perception when paired with phase-scrambled images. We extended this work by including stimuli with intermediate statistics and recognisable structure. We used natural images along with their phase-randomised and texture-synthesised counterparts. Both phase-randomised and texture-synthesised images match the original in their amplitude spectra, but texture-synthesised images also match the original image in second-order statistics, and elicit similar responses to natural images in mid-level visual areas (V2 and V4). Consistent with previous results, intact images tended to dominate when paired with phase-scrambled images, but we did not observe a significant difference in coherency between these conditions. Surprisingly, although the texture-synthesised images are intermediate to the other conditions in terms of image statistics and recognisable structure, binocular rivalry with these images did not follow a pattern intermediate to the other conditions. Instead, texture-synthesised images were significantly less coherent compared to both other conditions. They were also more dominant when paired with natural images, but less dominant when paired with phase-scrambled images. Overall, these results argue against the idea that image naturalness or recognisability predict perceptual experience in binocular rivalry.

Can intermittent bursts of high frequency targets reduce vigilance decrements?

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Sustaining attention under monitoring conditions, where responses are rarely required, is effortful and difficult, resulting in decreases in performance with time on task. These 'vigilance decrements' can have tragic consequences if they occur in high risk environments (e.g., train/aircraft network control). In this pre-registered study, we used the low target frequency condition of the Multiple Object Monitoring (MOM) task to test whether intermittent 'bursts' of higher target frequency could reduce vigilance decrements, operationalised as higher miss rates and slower correct reaction times over time. In the MOM task, moving dots approach an obstacle along visible trajectories. Intervention is only required if a dot of a cued 'relevant' colour fails to deflect and instead continues on a collision course with the obstacle (~12.5% of relevant dots). The control group replicated our standard finding of increased miss rates and reaction times in later blocks compared with early blocks. The experimental group completed the same blocks but had additional high frequency (50% of relevant dots were targets) blocks after the 5th and 10th blocks. While both groups showed vigilance decrements, miss rates were lower in the burst compared to control groups. Both groups showed the classic slowing of correct RTs with time on task with no group differences. These findings suggest that adding high frequency bursts may reduce some of the costs of sustaining attention under monitoring conditions, but vigilance decrements remain difficult to extinguish. Funding: ARC DP220101067.

Do corollary discharges contain information about the pitch of inner speech?

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When we move our articulator organs to produce overt speech, the brain generates a corollary discharge that acts to predict and suppress the neural and perceptual responses to our speech sounds. Recent research suggests that inner speech – the silent production of words in one's mind – is accompanied by a corollary discharge that contains information about the timing and content of inner speech. Evidence for this comes from multiple studies showing that producing an inner sound attenuates the N1 – an event-related potential associated with auditory processing – compared to passive listening, but only when the inner and audible sounds occur concurrently and match on content. The aim of the present study was to determine whether this corollary discharge contains information about the pitch of inner speech. To investigate this, participants watched an animation which provided them with precise knowledge about when they should produce an inner sound. At the same time, they heard an audible sound that was either a recording of the participant's overt speech or a recording of someone else's voice. If corollary discharges contain information about the pitch of inner speech, then N1-attenuation should be larger when the audible sound is a recording of the participant's overt speech compared to when it is someone else's voice. Alternatively, if corollary discharges do not contain information about the pitch of inner speech, then there should be no difference in N1-attenuation. We will discuss the results and their implications.

Inner speech: Is the SNW effect associated with preparation or anticipation?

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When we move our articulator organs to produce overt speech, the brain generates a corollary discharge that acts to predict and suppress the neural and perceptual responses to our speech sounds. Recent research suggests that inner speech – the silent production of words in one's mind – is also accompanied by a corollary discharge. In these studies, participants typically watch an animation which provides them with precise knowledge about when they should produce an inner sound and hear an audible sound through headphones. The typical finding is that producing an inner sound enhances the slow negative wave (SNW) – a pre-stimulus event-related potential associated with motor preparation and anticipation – compared to passive listening. However, because the inner and audible sounds occur simultaneously, it is unclear whether the SNW effect reflects preparatory activity associated with producing the inner sound or anticipatory activity associated with the audible sound. To distinguish between these possibilities, in different blocks of trials, participants either expected to hear an audible sound, expected to not hear an audible sound, or did not know whether an individual trial would have an audible sound or not. If the SNW effect is associated with preparatory activity, then it should be elicited regardless of whether there is an audible sound or not. Alternatively, if it is associated with anticipatory activity, then it should be elicited only when participants know whether there will be an audible sound or not. We will discuss the results and their implications.

The effects of repetitive transcranial magnetic stimulation over the left angular gyrus on episodic memory and future simulation

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The left angular gyrus (AG) has been implicated in both episodic memory (EM) and episodic future thinking (EFT). This study aimed to investigate whether repetitive transcranial magnetic stimulation (rTMS) over the left AG influences the level of detail reported during elicitations of EM and EFT. Thirty-six healthy adults (41.7% female, mean age = 25.36 years ± 2.52) attended four experimental sessions corresponding to four different conditions: high-frequency (20 Hz) rTMS, low-frequency (1 Hz) rTMS, active-control stimulation (1 Hz) over the vertex, and sham stimulation. Following rTMS, participants completed EM and EFT tasks. In these tasks, participants verbally detailed personal memories or

future scenarios. Participants also completed a free association task, operating as a non-episodic control. Results demonstrated a significant difference in both EM and EFT across all conditions. Post-hoc analyses showed that compared to the active-control and sham conditions, low-frequency stimulation significantly reduced the level of episodic detail and significantly increased the level of semantic detail in both EM and EFT. However, there was no significant difference in episodic detail and semantic detail between high-frequency rTMS and the active-control and sham conditions on either EM or EFT tasks. Analyses also demonstrated no significant difference on the free association task across all conditions. This study suggests that the left AG is involved in the level of episodic detail elicited in both EM and EFT, with the potential for rTMS to modulate both EM and EFT in healthy populations. Future research is required to investigate these effects in clinical populations

Directional connectivity alterations between the mediodorsal thalamus and core cognitive networks in mood and anxiety disorders

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Emerging evidence suggests that the mediodorsal thalamus (MD) plays an integral role in modulation and information integration in core cognitive networks that show functional alterations in mood and anxiety disorders, including the salience (SN), default-mode (DMN) and fronto-parietal networks (FPN). However, the precise interactions between the MD and these cognitive networks remain unexplored in mood and anxiety disorders. Using spectral dynamic causal modelling, this study investigated directional causal interactions between the MD and the core regions of the SN, DMN and FPN. Forty-three participants with mood and anxiety disorders (*n*=33 females) and 43 sex and age-matched healthy controls underwent resting-state scanning during 7-Tesla ultra-high field magnetic resonance imaging. Compared to the healthy controls, participants with mood and anxiety disorders exhibited greater MD inhibition of left dorsolateral prefrontal cortex (dlPFC; -0.072 Hz), lower MD inhibition of left angular gyrus (AG; 0.095 Hz), and lower SN excitation of the MD (dorsal anterior cingulate: -0.037 Hz & right anterior insula: -0.033 Hz). Exploratory analysis using leave-one-out cross validation revealed that MD to left dlPFC connectivity was predictive of participants' perseverative thinking tendency, whereas MD to left AG connectivity specifically predicted anxiety and stress levels. In contrast, the top-down connectivity from the SN to MD predicted depression severity. Together MD connectivity alterations were able to predict participant diagnostic status. Our findings indicate that aberrant MD interactions with core cognitive networks contribute to multiple dimensions of psychopathology in mood and anxiety disorders, likely contributing to deficits in cognitive flexibility, increased apprehension, and altered homeostatic function.

WEDNESDAY 27th NOVEMBER

Emerging Research Award - Shuting Li

Attention Research in Autism: An Interdisciplinary Approach Through Human and Mouse Research

Shuting Li
University of Melbourne

Many autistic people have reported atypical experiences in managing their attention. Attentional features in autistic people, however, are not clearly understood. The underlying neural mechanisms between autism and atypical attention functions also remain unclear. The mouse has emerged as a powerful animal model for investigating cognitive functions through targeted genetic modifications and circuit manipulations. In this talk, I will share my experience studying attention functions in autistic people and in a mouse model of autism. I will also introduce how I adapted a classic human psychology paradigm for use with mice, which greatly improves the translatability of the mouse research results. This interdisciplinary approach has provided new insights into attention functions in autism from behavioural, neural, and genetic perspectives.

Emerging Research Award - Denise Moerel

How internal states shape the neural encoding of visual information

Denise Moerel
MARCS Institute for Brain, Behaviour and Development, Western Sydney University

Our goals shape how the brain processes visual information, but separating the contributions of various cognitive processes remains a challenge. In this talk, I will demonstrate how well-controlled stimuli, combined with multivariate decoding techniques applied to time-resolved neural data (M/EEG), can help disentangle the specific role of selective attention in modulating visual processing from other cognitive functions such as visual short-term memory and decision-making. I will then provide a real-world example demonstrating how factors such as attention, personal preferences, and hunger alter the neural encoding of food images, highlighting the dynamic interaction between internal states and sensory processing in the brain

Open Talks – Neurodegenerative Disorders

Alpha desynchronisation may be an informative marker of recognition memory in individuals with mild cognitive impairment

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Aland Astudillo, NICM Health Research Institute, Western Sydney University
Maria Evardone, School of Science, Western Sydney University
Genevieve Z. Steiner-Lim, NICM Health Research Institute, Western Sydney University

Dementia cases are increasing in developed countries, and it is currently the second leading cause of death and disease burden in Australia. While there is presently no cure, at least 4 out of 10 cases may be preventable. EEG is a cost-effective and non-invasive tool that provides promising utility in the early detection of dementia, such as during the mild cognitive impairment (MCI) phase, and the identification of accurate and effective biomarkers remain a priority. Age-related changes are well documented in the alpha band, along with changes in cognitive and memory function, particularly in those with MCI. Event-related desynchronisation in alpha is reported to reflect semantic memory performance, and the current study assessed this using a word recognition memory task. Participants with MCI (n = 50) and a sample of age- and sex-matched cognitively normal controls (CNT; n = 17) completed three phases of this task (encoding, immediate recognition, and delayed recognition) while continuous EEG was recorded. Event-related Spectral Perturbation (ERSP) in the alpha band was compared between the groups for correctly responded trials. Alpha desynchronisation was visibly reduced in the MCI relative to CNT group in each phase of the task, but most notably in the delayed recognition phase, where this difference reached statistical significance (p = .03). These findings are in line with earlier work in cognitively normal adults that observed greater desynchronisation in better memory performers and suggests that alpha desynchronisation may be an informative marker of decline in recognition memory processing in MCI.

Resting-state EEG pink noise, white noise, and oscillatory activity in Parkinson's disease

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Parkinson's disease (PD) affects over 10 million people worldwide, and currently there is no cure. PD has a neurodegenerative pathophysiology, resulting in the gradual loss of dopaminergic neurons in the substantia nigra and a progressive worsening of motor and non-motor symptoms. EEG is a cost-effective tool that may offer utility in the early detection of functional changes in PD so that early prevention-based approaches can be implemented. Differences are seen in beta and alpha activity in PD, but these results may be misleading due to the presence of aperiodic (non-oscillatory) activity. In this study, we administered a neuropsychological test battery in people with PD (N = 17) and a cognitively normal control group (HC; N = 17) and analysed 2 blocks of resting-state EEG data: 2-min eyes-open and 2-min eyes-closed. We extracted aperiodic pink (1/f) noise (PN) and white noise (WN), and assessed noise-corrected oscillatory activity in delta, theta, alpha, and beta EEG bands using PaWNextra. Amongst other findings, the PD group showed lower frontocentral PN reactivity compared to the HC group (p = .03), suggesting that pink noise reactivity may be sensitive to neural alterations in PD. Somewhat similarly, we previously found that PN reactivity showed an association with executive function in mild cognitive impairment. Findings contribute to the identification of novel EEG markers sensitive to functional changes in neurodegenerative conditions including PD, which may have potential to inform interventions designed to support the maintenance of everyday activities and functional independence.

Determining the predictors and longitudinal trajectories of hallucinations in people with Parkinson's disease

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Many people with Parkinson's disease experience hallucinations. They are usually visual, ranging from sensing the presence of someone nearby to experiencing fully formed figures. For some, hallucinations can become distressing and escalate to paranoid psychosis and precipitate hospital and early rest home placement. To manage hallucinations effectively, and improve quality of life, we must understand how and why hallucinations occur. Detailed longitudinal hallucination data has been collected from 266 Parkinson's participants (sessions = 676) from the New Zealand Parkinson's Progression Programme. Bayesian regressions were used to examine cross-sectional associations between the presence of Parkinson's hallucinations and clinical and other factors. Within the sub-group of 64 participants who did not experience hallucinations at study entry, 34 participants developed hallucinations over a median follow-up period of 2.8 years. Bayesian regression models were also used to identify predictors for the development of future hallucinations in this sub-group. At any time, 67% of participants experienced hallucinations. Hallucinations were associated with lower

cognitive ability (parameter estimate [PE]: -0.58[95%CI:-1.00,-0.17]) and higher levodopa equivalent daily dose (LEDD; PE:0.43 [0.10,0.78]), but not gender, education, diagnosis age, disease duration, motor impairment, depression, or poor sleep. There was, however, no evidence that any of the aforementioned factors predicted the development of hallucinations in those who initially did not experience them. Although no factors predicted the development of hallucinations, lower cognitive ability and higher LEDD were associated with hallucination presence. Ongoing analyses will incorporate genetic and MRI imaging data which may help to elucidate why people develop hallucinations in Parkinson's disease.

Integrity of the septohippocampal pathway and its significance in cognitive variability in Parkinson's disease

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The septohippocampal pathway is a critical feature of the hippocampal system. An association between the integrity of this pathway and cognition has been reported in 52 patients with Parkinson's disease (PD) (Gargouri et al., 2019). We further investigated this association by examining structural and diffusion-weighted MRI and neuropsychological assessment in 108 participants with PD, of whom 59 showed normal cognition (PD-N), 37 met criteria for mild cognitive impairment (PD-MCI), and 12 with Parkinson's disease dementia (PDD), and in 41 controls (C). We found a trend of decreasing mean integrity across diagnosis groups and, using a Bayesian regression model accounting for age and sex, evidence of decreases in microstructural septohippocampal pathway integrity between control and all PD groups (FA: P(C > PD-N, PD-MCI, PDD) > 98%). Additionally, across all participants we found a small effect of an association between septohippocampal pathway microstructural integrity and a global cognitive score derived from tests that covered domains of attention, executive function, memory, and visuospatial function (FA:β=0.3[0.1,0.4], P(β>0) >99%). This association suggests that integrity of the septohippocampal pathway may play a role in the cognitive heterogeneity observed in PD. However, the modest effect size observed indicates further research is needed to clarify the role of pathology in this pathway in cognitive decline, and its relative contribution to changes in the wider hippocampal system, in PD. Longitudinal studies are needed to clarify both the timing and progression of these changes and how these temporal patterns relate to cognitive decline.

Dopaminergic modulation of vigour predicts mood in Parkinson's disease

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Loss of dopamine neurons in Parkinson's disease (PD) causes motor impairment, but it is also associated with depressive symptoms. It is currently unclear how the dopaminergic drugs used to treat the motor symptoms of PD interact with the affective component of the disease. In particular, it remains unclear whether improved mood on these medications is primarily driven by functional improvement associated with the relief of motor symptoms, or whether dopamine replacement directly modulates the mechanisms underlying the subjective experience of wellbeing. We investigated this question in 96 patients with PD and 38 healthy age- and gender-matched controls. Over 21 days, participants used their personal electronic device (e.g., smartphone) to complete a gamified effort-based decision-making task in which they tapped the screen repeatedly to acquire rewards. Participants also made affective valence ('happiness') ratings throughout the task, which allowed us to test whether mood was explained by movement vigour. Patients with PD completed half of their plays on their usual dopaminergic medication (ON), and half of their plays following overnight withdrawal (OFF). Overall, patients were faster and happier when tested ON vs. OFF medication. Critically, across the group, the degree to which dopaminergic drugs boosted vigour predicted improvements in mood. These results thus establish that the positive benefits of dopaminergic medication on mood are directly related to its capacity to enhance simultaneous motor performance, suggesting that this mood effect is not solely driven by long-term functional changes, but by direct modulation of the dopaminergic mechanisms contributing to subjective wellbeing.

Topographical memory impairment in Transient Epileptic Amnesia

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Transient Epileptic Amnesia (TEA) is an epilepsy syndrome characterised by amnestic seizures alongside which three inter-ictal memory problems are frequently reported: loss of autobiographical memories, fast forgetting of new information, and new difficulties with topographical memory. While several studies to-date have focused on the first two of these memory changes, little investigation has been undertaken in topographical memory. Twenty-two patients with TEA were recruited from across

the UK and were compared with 26 age-matched healthy control (HC) participants. All participants completed the Four Mountains Test (4MT) of topographical memory as part of a comprehensive neuropsychological battery. Participants also completed a self-assessment of topographic and other memory skills using a Memory Rating Scale (5 items on a 10-point scale rating, e.g. "How much difficulty have you had with remembering familiar routes?"). There were no significant group differences in predicted full scale IQ, visuoconstructional skills or 30-minute recall of a complex visual figure. However, the TEA group performed significantly below HCs on the 4MT (MTEA =17.1; MHC = 21.0; t = 2.89; p=.006) and self-reported more difficulty with remembering familiar routes (U = 138.50, z = 2.91, p = .004) and recalling having visited certain places (U = 169, z = 2.25 , p = .024). These results provide the first empirical evidence of topographical memory impairment in TEA, with differences found on both subjective and objective measures. Future research should seek to explore whether such difficulties respond to treatment or change over time. Funding was via the Dunhill Medical Trust.

Clopidogrel administration impairs post-stroke learning and memory recovery in mice

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Clopidogrel, one of the most prescribed antiplatelet medications in the world, is given to stroke survivors for the prevention of secondary cardiovascular events. Clopidogrel exerts its antiplatelet activity via antagonism of the P2Y12 receptor (P2Y12R). Although not widely known, or considered during clinical trials, P2Y12R is also expressed on brain microglia, where the receptor facilitates microglial chemotaxis toward cellular damage and repair processes. When microglial P2Y12R is blocked, microglia lose the ability to migrate to sites of damage within the brain and facilitate repair. We wanted to determine whether the post-stroke administration of clopidogrel is associated with; (i) impaired cognitive recovery, (ii) physiological changes, such as survival rate and body weight, and (iii) neurovascular unit changes. Photothrombotic stroke (or sham surgery) was induced in adult male C57BL/6 mice (n=7-8 per group). From 24 h post-stroke, mice were treated daily for 14 days with either clopidogrel or vehicle. Cognitive performance was assessed using a mouse touchscreen platform (paired associated learning task). At day 15, animal brains were collected for immunohistochemistry analysis. Clopidogrel administration significantly impaired learning and memory recovery ($p=0.0108$), reduced mouse survival rates ($p=0.0285$), and reduced body weight ($p=0.0046$) post-stroke. Furthermore, clopidogrel significantly increased vascular leakage ($p=0.0274$), increased the number ($p<0.0001$) and appearance ($p=0.0118$) of microglia, and reduced the number of T cells ($p<0.0001$) within the peri-infarct region post-stroke. These data suggest that clopidogrel enters the brain due to stroke-induced vascular leakage, where it then hampers the ability of microglia to facilitate brain repair and promote cognitive recovery.

Open Talks – Perception 2

Distributed Networks in Working Memory Manipulation: Cerebellar and Subcortical Contributions

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Working memory manipulation is a dynamic process that is applied in various scenarios – i.e., mentally rotating and object or organising a shopping list. However, the mechanisms of working memory manipulation are poorly understood, due in part to largely cortical explanations for the phenomenon. We hypothesised that working memory mechanisms are facilitated by cerebellar engagement, which may provide a parsimonious understanding for the neural mechanisms of working memory. Twenty-four right-handed individuals (mean age = 23.8, SD = 2.6, 16 women) participated in the study and completed a mental rotation task. Participants underwent three days of training before the first scanning session. Each participant completed 16 imaging runs (10 min per run) spread across two days. General linear mixed effects models were constructed and modelled the estimated BOLD response during the mental rotation task. From these models, a working memory network was identified that included regions from the dorsolateral prefrontal cortex, parietal lobe, lobules VI and VIIb of the cerebellum, and the basal ganglia. Models were also constructed identifying regions from the prefrontal cortex, inferior parietal lobe, and cerebellum as important when completing trials of increased difficulty. Time-varying functional connectivity throughout the task was also estimated, identifying significant connectivity between subcortical and cerebellar regions. These results provide evidence that working memory processes extend beyond the cerebral cortex and include subcortical and cerebellar regions. By going beyond cortico-cortical interactions, we find distinct differences in neural patterns that differentiate brain states required to do the task versus brain states that interfere with task performance.

Expectation defied: Corollary discharges do not predict and suppress complex sound sequences

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Sensory suppression refers to the phenomenon where sensory input generated by our own actions elicits smaller neural responses than input generated by external agents. This is often explained by the "cancellation" model, where an efference copy of the motor command generates a neural prediction – a corollary discharge – that suppresses neural responses. Alternatively, the "sharpening" model suggests that corollary discharges enhance responses from neurons tuned to the sensory input and suppresses those that are not. We sought to distinguish between

these hypotheses. To accomplish this, we measured the N1 event-related potential (ERP) elicited by self- and externally-generated tones that were either predictable by repetition (e.g., AAAAAA...), predictable by alternation (e.g., ABABAB...), or unpredictable by randomness (e.g., ABBABA...). As expected, predictable repeated tones yielded N1-suppression, in that self-generated tones elicited a smaller N1 than externally-generated tones, whereas unpredictable tones did not. Unexpectedly, there was no difference between self- and externally-generated alternating tones, even though the sequence was predictable. Furthermore, decoding accuracy was higher for self-generated repeating tones compared to self-generated alternating and unpredictable tones, with no difference between externally-generated repeating, alternating, and unpredictable tones. These results suggest that action "sharpens" neural representations of sensory input, rather than "cancelling" them, but only for simple patterns. If the pattern is complex, such as from an alternating sequence, then there is no "sharpening" of neural responses. These results suggest that corollary discharges "sharpen" neural responses for simple sequences, but not complex ones.

Rapid visual engagement in neural processing of detailed non-social touch interactions

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Humans can quickly interpret visual information about tactile events, essential for assessing whether a touch is pleasant or unpleasant and if it occurred on oneself or another. Previous studies indicate that social-emotional information from observed touch between people is processed within 200ms, involving an early visual pathway. However, the timing of information for non-social touches, like a simple brush stroke to a hand, remains unclear. Additionally, the temporal encoding of features like body part orientation, sensory qualities, and certain emotional aspects like threat is unexplored. Our study used multivariate decoding on EEG data to investigate neural signals as participants viewed 600ms videos of various hand touches. Our findings indicate that hand orientations, distinguishing self from other and left from right hand, are encoded within the first 75ms, highlighting rapid visual engagement. By around 130ms, the brain discerns sensory characteristics and emotional dimensions like valence and arousal, underscoring early visual processes in touch perception. Later stages differentiate interactions involving direct contact with another hand versus an object, followed by detecting threat and pain. This sequence shows that initial emotional reactions are followed by more complex harm evaluations. The late stage captures hand movements, such as one hand approaching another, illustrating the interplay between early visual and later brain regions. Our results reveal how the brain transitions from interpreting basic visual cues to intricate sensory and social-emotional evaluations in observing detailed touch interactions, emphasising the importance of rapid visual processing in evaluating potential harm and benefit, crucial for survival.

Does competition from concurrent stimuli change functional activity in the ventral visual cortex?

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According to a prominent view in neuroscience, high-level visual stimuli are encoded by discrete areas located along the ventral visual cortex. Neurons in these areas respond preferentially to specific visual categories such as objects, scenes and faces. Although these areas are thought to contribute directly to conscious perception and recognition, activity has almost always been measured while stimuli were presented in isolation and behind a central fixation point, a situation atypical of the real world. How these areas respond under more naturalistic conditions remains largely unknown. For example, we do not yet understand whether activity in the fusiform face area (FFA) is modulated by competition from nearby stimuli in cluttered visual environments. Here, we used high-field (7T) functional MRI to address this fundamental question. We scanned healthy adults (N=20) across two separate sessions. In the main experiment, participants were shown images of faces and objects at different horizontal locations (at fixation, left and right) in the presence or absence of competing stimuli (i.e., scenes occupying the remaining screen locations). When the faces and objects were presented in isolation, without accompanying scenes, preferential activity in the FFA in response to faces versus objects was uniform across the visual field, with a strong contralateral bias. By contrast, when competing scenes were present, preferential activity for peripheral faces in the right FFA was eliminated. Collectively, these findings provide important clues about how the ventral visual cortex responds to multiple, competing, stimuli present in the visual field.

Exploring opposing visual dimensional bias in humans and macaques

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In the Wisconsin Card Sorting Test (WCST), humans consistently demonstrate a behavioural bias towards the colour dimension, which appears as improved performance in colour trials, whilst macaque monkeys demonstrate bias towards the shape dimension. Children with autism spectrum disorder fail to demonstrate bias towards either dimension in a similar task. It is unclear how dimensional bias emerges in these paradigms, with current evidence supporting neither an exclusive top-down (prefrontal mediated), nor bottom-up (sensory driven) neural mechanism. In two cross-species studies in humans and

monkeys, we employed modified delayed matching to sample (DMS) and target detection tasks (TDT) to further elucidate which discreet cognitive functions can be influenced by dimensional bias. We found, consistent with WCST performance, both species demonstrated dimensional bias, where humans' working memory and visual discrimination performance was improved in the colour dimension, whilst monkeys' performance was improved in the shape dimension. Furthermore, we found monkeys' mnemonic load in the DMS modulated the magnitude of dimensional bias, whilst humans' set formation (where consecutive trials with similar task-relevant features leads to processing advantages) within the TDT occurred only in the preferred colour dimension. Together, these findings indicate the emergence of dimensional bias cannot be explained by solely top-down or bottom-up mechanisms, instead suggesting it may originate when processed visual information interacts with executive functions to support goal-directed behaviour. They also provide perspective to the evolution of executive functions in primate species, and elucidate some of the pathophysiological changes underlying neurodevelopmental disorders.

Multivariate decoding in a combined multiple-object tracking and working memory task

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Human visual processing is limited – we can only track a few moving objects at a time, and encode a few items in working memory (WM). Researchers have demonstrated spatiotemporal attention (multiple-object tracking; MOT) and WM rely upon shared cognitive resources. In the present study, we explored this with electroencephalography (EEG). Our task required subjects to concurrently track moving items and remember visual content. In Experiment 1, participants tracked one or two moving discs, either ignoring or remembering their colors (two or four colors in total). In Experiment 2, participants attended two static or moving discs, while remembering their colors (two or four colors in total). We examined the contralateral delay activity (CDA), an event-related potential that increases in amplitude with increasing memory load. In both experiments, the CDA was driven by attentional tracking demands - amplitudes reflected the number of tracked discs and not the number of to-be-remembered colors. However, when attended discs were static, the CDA amplitude did reflect WM load. Multivariate decoding (representational similarity analysis; RSA) with the same data revealed a neural signal for WM load was present, one obscured in the CDA with moving discs. This multivariate signal did not generalise to the tracking only condition (where colors were ignored), but did generalise between static and moving discs. We propose spatiotemporal attention and WM rely on largely distinct neural representations, and discuss implications for cognitive models of the representation of information. The authors were supported by research grants from the NIH (2R01MH087214) and ONR (N0014-22-1-2123).

Imagery: What is it good for?

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The ability to voluntarily imagine a visual experience within the mind's eye has long been assumed to be beneficial in many contexts. However, congenital Aphantasics assert that they have never been able to voluntarily create an image within their mind's eye. Though they have this supposed deficit, they have performed similarly to those who do use visual imagery on tasks purported to measure visual imagery. This could be due to Aphantasics using alternate mechanisms or techniques that perform just as well as imagery, or researchers have been mistaken about the tasks being a reliable metric of the capacity to visualise. In our study, we examined these issues using a delayed match-to-sample task – which has been used as a metric of visualisation. Participants were asked to either imagine or sub-vocally name the stimulus between experiencing and recreating the stimulus. Evidence of compliance with task instructions was attained via successful trial-by-trial decoding of the trial condition from spectra analyses of electroencephalography (EEG). We found that people were worse at replicating a recent experience of colour when they relied on visualisation, relative to when they used the naming technique. This contrasted with tonal pitch, which was more accurately matched when people tried to sustain the experience in their mind compared to when they used the naming technique. We suggest that this could mean that vividness and specificity of imagery are distinct. So, reliance on a coarse imagined sensation in tests of memory precision may be detrimental if the perceptual dimension is well segmented into familiar semantic categories.

Open Talks – Learning / Stimulation

Learning transfer is hindered by robust representations of learned task contingencies

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What types of practice promote or hinder transference of knowledge to new tasks? An emerging hypothesis is that stable task environments promote robust but inflexible representations of task contingencies, which promotes cognitive stability at the expense of learning transfer. Here, we provide the first test of this theory. 100 participants searched through grids of doors to find hidden targets. During task acquisition, door grids were bordered by one of two coloured cues; each colour signalled the relevance of a different set of target locations. Thus, participants learned two task-sets, each signalled by a different task cue (colour) and

associated with a unique set of contingencies. Participants then completed a practice manipulation where explicit colour cues were removed and the task-set was randomly switched over trials. The low-stability group experienced more frequent switches (30% of trials) whereas the high-stability group experienced rarer switches (5%). The impact of practice was assessed on two transfer tasks that used novel coloured cues. The 'stable-transfer' task used all four locations from a previously learned task-set whereas the 'flexible-transfer' task combined two locations from each task-set. In line with our hypothesis, the high-stability group showed impaired performance on the flexible-transfer task, relative to the low-stability group, and relative to the stable-transfer task. These findings provide the first empirical support for the theory that the stability of task environments can determine the potential for learning transfer.

Are predictions automatic? Investigating prediction-based motor attenuation using a novel TMS oddball paradigm

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Predictive coding theory posits that the brain modulates sensory input based on predictions about the external world. These predictions are hypothesised to be generated automatically via an internal, generative model that continuously updates based on incoming sensory information. To test this automaticity hypothesis, auditory oddball tasks have been administered on participants during varying states of consciousness. Past research has found that auditory oddballs (i.e., unpredictable tones in a sequence) can generate prediction error signals in coma patients, and the presence of these neural signatures are associated with a higher likelihood of awakening. To explore whether predictive coding mechanisms are domain-general and occur automatically, the current study sought to replicate these findings in the motor system. Transcranial magnetic stimulation (TMS) delivered over the motor cortex can elicit motor-evoked potentials (MEP) in peripheral muscles, which provide an index of corticospinal excitability within the motor system. We varied stimulation intensity in an oddball-like manner as a way of signalling the predictability of TMS pulses and tested whether the amplitude of MEPs differed for predictable versus unpredictable intensity-matched stimulation. Replicating previous sensory and motor research on prediction-based attenuation effects, predictable TMS resulted in motor attenuation (i.e., smaller MEPs) compared to unpredictable stimulation. We also manipulated whether participants were informed of the experimental manipulations or not and found preliminary evidence to suggest that motor predictions are modulated by explicit knowledge. These results have important theoretical implications, adding to the growing body of evidence calling into question the automaticity principle in predictive coding theory.

Expectation dynamically modulates the representational time course of objects and locations

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Past work has demonstrated that prediction modulates how the brain responds to visual stimuli, but these reported effects have not been entirely consistent across studies. Here, we aim to identify factors which modulate the occurrence and directionality of prediction effects in patterns of evoked brain activity. Participants (n = 40) viewed real-world object images in rapid serial visual presentation (RSVP) streams which were predictable both in terms of object identity and stimulus location. Multivariate pattern analyses of electroencephalography (EEG) data were used to quantify and compare the degree of information represented in neural activity when stimuli were random (unpredictable), expected, or unexpected. Decoding accuracy for expected locations was significantly reduced relative to random locations between 160–238 ms post-onset. However, this effect subsequently reversed with decoding accuracy for expected locations becoming higher than accuracy for random locations between 273-430 ms. This temporally dynamic effect was not replicated within analyses decoding object identity. However, consistent evidence for reduced decoding of unexpected relative to random stimuli in later time windows (>250ms) post-onset was identified across both stimulus types (e.g. objects and locations). These findings extend fundamental understanding of how the brain detects and employs predictive relationships to modulate visual perception.

Behavioural and Neurophysiological Effects of Continuous Theta-Burst Stimulation to the Right Superior Temporal Sulcus

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Facial emotion processing (FEP) is vital for social interactions and fostering positive, healthy relationships. The posterior portion of the right superior temporal sulcus (pSTS) is particularly involved in FEP and has been implicated in conditions characterised by FEP difficulties such as autism spectrum disorder (autism). The present research tested the causal role of the right pSTS in FEP using continuous theta-burst stimulation (cTBS). Nineteen right-handed, English-speaking, neurotypical adults aged 18-24 years (Mean = 20.42, Standard Deviation = 1.80; biological sex: 12 females, 7 males) received either active or sham cTBS over the right pSTS. Participants completed a neutral face recognition task and emotional face recognition task. We measured the face-sensitive N170 event-related potential (ERP) using electroencephalography. N170 amplitudes were larger in response to fearful and happy faces compared to neutral faces. cTBS did not modulate N170 amplitudes (microvolts), accuracy (percent), or reaction time (milliseconds) in response to neutral or emotional faces. The right pSTS is involved with emotional face processing, however, we did not confirm a causal role. This research provides insight into the role of the right pSTS in FEP and may inform future research seeking to understand FEP in neurotypical and clinical cohorts.

Effects of cognitive noise on the temporal dynamics of risky choices

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Real-life choices often require striking a balance between the value of choice outcomes and their likelihood. When taking out flood insurance, for example, it is important to consider both the cost of any damage and the probability of flooding. Rational choice theory assumes that risky choices rely on an optimal integration of choice values with their probabilities. The literature, however, is replete with examples of irrational, biased choices, and these observations have motivated piecemeal modifications of the theory. Recently proposed cognitive imprecision theory can account for most reported biases in a principled fashion by assuming that noisy subjective representations of choice value and probability are integrated optimally. Here, we developed a novel perceptual game to test a key prediction of this theory, namely, that the temporal dynamics of risky choices and their neural correlates should co-vary with cognitive noise. Forty healthy, adult humans first estimated the average orientation of a briefly presented circular array of twelve differently oriented gratings and then chose to either play the game or not (risky and safe choices). If they chose to play, they were awarded points proportional to the average orientation in that trial. Noise was manipulated by randomly switching between high and low variability in the orientations of displayed gratings. Computational modelling of behaviour showed that cognitive noise impacted estimates of loss and risk aversion. Similarly, multivariate feature-specific analyses of functional brain activity showed an effect of noise on the precision of neural value representations, lending neurobiological support to the cognitive imprecision theory.

The influence of tDCS on the speed-accuracy tradeoff and metacognition

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Prof. Paul Dux, University of Queensland
Dr. Hannah Filmer, University of Queensland

The speed accuracy-tradeoff (SAT) describes the inverse relationship between fast and accurate responding; and metacognition how well an individual can monitor and evaluate their own thoughts and decisions. While these aspects of human behaviour are two of the most well-documented in the cognitive sciences, to date, their respective causal neural underpinnings are not well understood. Here, we used transcranial direct current stimulation (tDCS) to investigate the causal roles of the prefrontal cortex (PFC), superior medial frontal cortex (SMFC), and posterior parietal cortex (PPC) in the SAT and metacognition. Subjects received active or sham tDCS before completing a perceptual task with explicit SAT cues and graded confidence reports. We fit the linear ballistic accumulator model to behavioural data to extract latent decision variables and used confidence to compute meta-d' and m-ratio. Stimulation influenced performance on the perceptual task but not metacognition. Specifically, PFC stimulation reduced subjects' response caution, especially when accuracy was emphasised; SMFC stimulation decreased response caution and increased the discriminability between choices; and PPC stimulation increased both response caution and discriminability. These results show that the impact of tDCS over the frontoparietal network implicated in flexible cognitive control critically depends on the stimulated region. Meanwhile, that metacognition was not impacted by tDCS highlights a potential dissociation between the neural processes implicated in object-level and meta-level behaviour. In sum, our findings provide further evidence that tDCS can selectively alter fast, accurate decision making – and ultimately extend our understanding of the causal neural substrates of two hallmarks of human behaviour.

Keynote – Toby Walsh

What Cognitive Neuroscience can learn from AI (and vice versa)

Toby Walsh
UNSW Sydney

We've seen spectacular advances in AI, specifically in neural networks over the last decade culminating in the launch of systems like ChatGPT which took the world by storm and surprised many with their fluency and capabilities. What can cognitive neuroscience learn from this success? And what can AI still learn from cognitive neuroscience? When can we expect AI to match human intelligence? Will it even exceed human intelligence?

THURSDAY 28th NOVEMBER

Partnering with Defence Plenary

A tale of two projects (research with defence in psychology)
Scott Brown
University of Newcastle

Defence-related research can be the best of projects, it can be the worst of projects. I will try to illustrate the vastly different ways psychology researchers can engage with defence through two projects from the Cognitive Psychology Research Group. One project has a gross budget of nearly $1mil at UoN and $10+ million for industry partners. It focusses on thwarting state-sponsored hackers who attack critical infrastructure, and is sponsored by a US intelligence agency. That project is very intensive, heaps of fun, and a massive pain in the bum all at the same time. The other project has a budget of absolutely zero money. It focusses on improving the selection of RAAF combat air controllers to work with special forces units. It is long-running, low-effort, and very rewarding. I will discuss how the projects came about, what is good and bad about each type, and how others might get involved with defence-related research in similar ways.

Research with impact: Where to begin?
Melanie McGrath
Data61, CSIRO

For research to have impact it has to be used. And for research to have its greatest impact it will generally need to be used outside academia. This talk will provide practical insights on where to begin in bringing your research to defence and other partners. It is intended to provoke discussion on how to communicate with potential partners, the role of cross-disciplinary capability, what it looks like it practice and how to develop it, and how to navigate and master the administrative and logistical processes of working externally.

Cognitive Neuroscience in Defence; Partnerships and Cooperation
Nick Willmot
Defence Science and Technology Group

The Defence environment provides unique opportunities for cognitive neuroscientists to study cognition in real-world contexts and to develop practical applications for their research. As Defence seeks to increase the capability of Australia's sovereign IS&T ecosystem, these partnering opportunities have never been more vital. This talk will cover several successful collaborations between cognitive neuroscientists and the Defence sector, including research on decision-making, attention, memory, and resilience. We will also discuss the challenges and opportunities presented by these collaborations, as well as the ethical considerations that must be taken into account when conducting research in this area.

Open Talks: Biomarkers

Brain-wide signatures of compositional cognition
Rebekah Wong
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Joshua Tan, Brain and Mind Centre, University of Sydney
Isabella Orlando, Brain and Mind Centre, University of Sydney
Eli Müller, Brain and Mind Centre, University of Sydney
Mac Shine, Brain and Mind Centre, University of Sydney
Claire O'Callaghan, Brain and Mind Centre, University of Sydney

Compositional cognition describes our ability to recombine existing ideas, concepts and skills to form new thoughts and behaviours. There's a lack of empirical studies that fully explain how compositional cognition is implemented in the brain in a dynamic way. Within the limited research, there's been an exclusive focus on the cortex, ignoring how subcortical regions may play a role in the flexibility of our neural architecture. Here, we used an openly available fMRI dataset where the Concrete Permuted Operations (C-PRO) task was administered to 96 people. The C-PRO operationalises compositional cognition by examining how we learn and recombine rules in novel ways. These rules cover three domains – logic, sensory and motor. Using unique combinations of these rules, a total of 64 unique tasks are generated. We tested the hypothesis that there would be a common neural signature across the 64 task sets that reflected recombining/reusing the rules. We predicted this signature would be distinct from the neural signature captured by the unique demands of the 64 tasks and would be characterised by increased brain wide communication. We employed a general linear model and applied dimensionality reduction techniques. Our preliminary results confirm a whole-brain neural signature present across tasks, which is distinct from the task-related patterns. Our next steps are to identify time-varying neural signatures. Improved understanding of compositional cognition will advance knowledge of how integrated cognition arises from distributed brain activity. These findings have broader relevance for artificial intelligence where there is a push to implement human-like compositionality algorithms.

The role of traveling waves in cortico-hippocampal communication
Anna Behler
University of Newcastle / Hunter Medical Research Institute

Richa Phogat, University of Newcastle / Hunter Medical Research Institute
Nikitas Koussis, University of Newcastle / Hunter Medical Research Institute
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Dynamic interactions between subcortical structures and cortical regions are essential for cognitive functions, particularly in memory encoding and retrieval. The hippocampus and cortex exhibit oscillatory activity characterized by traveling waves, yet the mechanisms underlying their interactions remain poorly understood. This study investigates hippocampal wave dynamics and their interactions with the cortex through computational modelling. Using biophysically informed non-linear neural mass models (Jansen-Rit columns), we simulated neural activity on hippocampal and cortical meshes. Coupling within each system

followed an exponential distance rule, while inter-system coupling was based on a projection of a hippocampal functional gradient (during a memory task) onto the cortex. We conducted parameter sweeps and perturbation analyses to explore global coherence, phase velocity, and wave propagation patterns under various hippocampal-cortical coupling scenarios. Our findings highlight the importance of a small spatial gradient - an anterior-posterior imbalance - in external input to the pyramidal population for the emergence of traveling waves in the hippocampus. These waves propagate along the hippocampal long axis, with direction and phase velocity dependent on the gradient's magnitude and the oscillation frequency. Additionally, complex interactions emerged when the hippocampus was coupled to the cortex, showing that hippocampal waves induce wave fronts on the cortex, with hippocampal wave direction and frequency playing roles in the patterns of resulting cortical waves. These analyses provide mechanistic insights into traveling wave formation and cortico-hippocampal interactions, aligning with neurophysiological data and offering a computational framework for future research in cognitive neuroscience and memory-related neurodegenerative disorders.

Temporal dynamics underlying the dimensions of object space

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We effortlessly process a variety of visual objects, yet how our brain organizes this object information in largely unknown. A comprehensive model of object space in macaques was proposed, defined by two orthogonal axes of aspect ratio and animacy (Bao et al., 2020). However, when using stimuli that dissociated aspect ratio, animacy, and category, no tuning of aspect ratio was found in human fMRI data (Yargholi & Op de Beeck, 2023). This difference could be a result of the alternative stimulus set, or the limited temporal resolution of fMRI. Here, we asked if, and when, aspect ratio and/or animacy information was available over time using whole-brain electroencephalography (EEG). Participants (N = 20) viewed both the stimulus set used by Yargholi & Op de Beeck (2023), and binarized versions of these stimuli to mask object details. Stimuli were presented in 5Hz streams using rapid serial visual presentation. Intact and binarized stimuli were shown in separate streams. Using standard multivariate decoding and representational similarity analysis, we found that both aspect ratio and animacy are represented during visual object processing. The dominant dimension was modulated by stimulus type, demonstrating that dimensions of object space depend on the nature of the presented stimuli. Taken together, these findings suggest that the dimension of aspect ratio is represented during object processing, however earlier and more transiently than categorical dimensions, such as animacy. Our results provide new insights into the contradicting findings reported in previous work and demonstrate that timing information is crucial when studying the brain.

Tracking information flow during cognitive tasks using time-resolved transfer entropy

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It is widely believed that the coordination of distinct brain regions is needed for the brain to perform cognition. An aspect of this coordination that has not been fully explored is the directional flow of information. Modern neuroimaging techniques enable us to simultaneously measure the activity at multiple locations within the brain. This data can be used in combination with methods from the field of information theory to estimate the flow of information in the brain. Quantifying the directional pathway of information and relating this to behaviour is an important step in understanding how the brain performs cognition. However, the calculation of information theoretic measures from brain imaging data presents several methodological challenges, particularly in the estimation of the underlying probability distribution of the data. In this work, we evaluate the use of transfer entropy in understanding the directional pairwise interaction between distinct brain regions. We describe this measure of information flow and apply it to functional neuroimaging data. Finally, we compare this approach to conventional measures of functional connectivity and highlight some key advantages of applying information theoretic measures to brain data.

Biophysical modeling of cortical-hippocampal interactions

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The study of functional MRI data is increasingly performed on cortical mesh surfaces instead of volumetric voxels. Using Human Connectome Project data, we demonstrate a gyral bias in commonly used meshes. Inter-vertex distances are 3 times greater in gyri, so that gyral vertices occupy up to 9 times greater surface area than sulcal vertices. The bias is propagated to fMRI data, where the correlation between adjacent sulcal vertices is artefactually inflated due to their proximity. Consequently, the spatial pattern of fMRI correlations tracks individuals' cortical gyrifications. This constitutes a leakage of anatomical cortical folding information into fMRI time series. We explore the consequences using empirical and random noise surrogate fMRI data. Biased correlations lead to spurious results across a spectrum of common fMRI pipelines. For example, test-retest reliability and fMRI "fingerprinting" are artefactually inflated, while common functional parcellations are biased to find parcel boundaries at gyri. Other potential spurious results include inflated associations between different brain imaging modalities and inflated brain-behaviour prediction. We conclude by recommending approaches to avoid or remedy these spatial

biases. These include testing with null data, and using newly developed surface meshes with more uniform inter-vertex spacing.

Modelling meditative deconstruction and its phenomenology under active inference

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Meditative experience has long been associated with conceptual attenuation, reduced reactivity to phenomena and more pleasantly valenced experience. However, the computational mechanisms underlying meditative deconstruction are not well understood, with no formal computational models available to explicate how deconstruction alters perception and action during meditation. Using the active inference framework, we demonstrate that the phenomenology of deconstruction–in terms of conceptual complexity, reactivity and affective valence–naturally emerges from the dynamics of hierarchical inference when 'letting go' is cast as a reduction in belief precision regarding hidden states at a specific level of the generative model. We present a hierarchical three-level generative model and simulate deconstruction as an intervention in a facial recognition task, where the agent engages in deconstruction when perceived affective valence becomes excessively negative. The results demonstrate that the capacity to deconstruct permits agents to self-regulate experienced affect in a way otherwise unavailable. The model offers a novel perspective within the paradigm of computational neurophenomenology on conceptual attenuation, reduced reactivity and affective valence during meditative deconstruction.

A novel approach to measure neural information alignment during social interaction

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Humans are inherently social beings, but it is still unclear how social interaction shapes our brain and behaviour. Previous studies have simultaneously recorded brain activity of two individuals and have shown enhanced brain wave synchronisation during social interaction. However, recent work suggests that brain wave synchronisation is not sensitive to represented information, with similar synchrony observed regardless of whether two participants are viewing the same content. Here, we developed a new method, based on Representational Similarity Analysis, to measure the neural information alignment between two interacting individuals. We simultaneously recorded electroencephalography (EEG) data from two participants sitting back-to-back (24 pairs), while they performed a 4-way categorisation task on visual stimuli they previously jointly sorted into 4 arbitrary groups. We determined the time-course of neural information alignment between 1) individuals within a pair and 2) randomly matched-up individuals who saw the same stimuli. Our findings show that information alignment was present between 80 and 150 ms regardless of whether pairs were real or random, whereas after 200 ms it was only present for real pairs who built the categories together. Finally, our results show an information alignment increase (200 – 1000ms) in the second experiment half, mirrored by a behavioural similarity increase. Together, these results suggest our method has the power to measure 1) shared visual information, and 2) shared decision information that is linked to behavioural similarity. This novel method therefore provides a powerful tool to study shared representations during social interaction, which was not possible with brain wave synchronisation methods.

Altering Consciousness With Flicker Light

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Background: Ganzflicker combines stroboscopic light and unstructured sound, capable of inducing a mild altered state of consciousness (ASC) with changes to visual, cognitive and affective experience. However, an understanding of underlying mechanisms is required to optimise practical applications (e.g., enhance mindfulness interventions). Here we aim to explore these mechanisms by investigating neural correlates and predictors of Ganzflicker experience. Methods: Thirty participants first undertook trait measures before three 10-minute MEG scans: resting-state baseline, then counter-balanced conditions of (a) Ganzflicker at 15Hz with white noise and (b) a novel sham condition, where steady light without sound was falsely described as Ganzflicker using frequencies too high to perceive. Conscious state was characterised using MEG signal diversity as well as self-reported ratings of altered consciousness (OAV scale) and imagery. Results: Imagery and signal diversity were stable over Ganzflicker exposure and higher than the sham condition. Expectancy predicted ratings of altered consciousness during Ganzflicker, which were greater than a comparable flicker study without audio. Qualitative reports suggest experiential similarities between Ganzflicker and psychedelic substances. Conclusions: Ganzflicker induces an ASC characterised by increases in complexity of neural signalling and visual imagery that are stable over time. Expectancy does not explain all Ganzflicker effects but may shape aspects of the experience. The addition of audio to flicker presentations may enhance consciousness alteration and potential practical outcomes. Ganzflicker shows promise as a research tool to develop understanding of consciousness and a clinical tool to screen and prepare individuals for more intense ASC-based therapies.

Open Talks: Ageing

Attentional decline? Limits on multiple object tracking in young and old

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The ability to follow objects with our attention, and to shift attention among objects, is essential to everyday life. There is evidence that aging has a pronounced adverse effect on this ability, but this remains poorly understood. Multiple object tracking tasks (MOT) provide a high-reliability assessment of associated abilities. A previous study utilising MOT found that elderly people had intact tracking of a single target, but were greatly impaired at tracking two or three targets (Roudaia & Faubert, 2017). METHODS: Here we conducted a conceptual replication, testing several dozen participants in each group, and refining the methods in various ways. One modification, reducing the number of distractors, and adding a spatial crowding assessment, was to address the possibility that the result stemmed from larger spatial crowding zones in the elderly. RESULTS and DISCUSSION: Speed thresholds have been estimated for each participant in each condition by the combined use of staircases and psychometric function fits. Unlike the work we based this study on, there were no participants, young or old, for which performance was so poor that thresholds could not be estimated. This suggests any age-related decline here is not as dramatic as previously suggested, possibly due to lower spatial crowding with our stimulus configuration. However, refinement of the analysis and the excluding of trials based on eye tracking data is incomplete, and the data analysts have blinded themselves to group membership to avoid unintentionally biasing the results.

The metabolic connectome shows reduced connectivity strength, altered hub function and a higher glucose cost in normative ageing

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Information transfer across the brain relies on a large portion of the body's total metabolic budget from glucose. Positron emission tomography (PET) studies have shown that ageing is associated with a decline in cerebral glucose metabolism, but until recently studies have been limited to indexing glucose rates across the entire scan for an individual subject, which cannot reveal insights about information transfer across the brain. Research using BOLD-fMRI suggests that ageing is associated with a more integrated functional brain network. However, the BOLD signal is a relative rather than a fully quantified measure of neuronal activity and is impacted by multiple vascular and metabolic processes that change in ageing. Here we use recently developed high temporal resolution functional PET (fPET) to create a timecourse of glucose metabolism for individual subjects and assess the relationship between metabolic connectivity and cognitive function in normative ageing. The metabolic connectomes of 40 younger (mean 27.9 years; range 20-42) and 46 older (mean 75.8; 60-89) adults were characterised by high connectivity in the frontal, temporal, motor, parietal and medial cortices. Older age was associated with lower global integration of metabolic hub regions, with older adults using a higher proportion of a smaller energy budget to support mostly posterior hub regions. This metabolic network topology of older adults was associated with worse cognitive performance. We conclude that ageing is associated with a high glucose cost in hub regions and disrupted information transfer across the metabolic network. Our results highlight the critical role that metabolism plays in supporting information transfer in the brain and the unique insights that metabolic connectivity provides into the ageing brain.

Verbal initiation, selection, strategy, and inhibition in stroke: A brief, novel screening tool to assess executive functions

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Many stroke-specific screening tools cater to patients with aphasia and more subtle impairments often go undetected. Further, current widely used cognitive screens only minimally assess executive control processes impacted in acute stroke. To address this, we introduce a brief (<5minutes) verbal screening tool, which assesses four executive control processes required for spoken language: initiation, selection, inhibition, and strategy. We aimed to determine the convergent validity of the BELS-SC and compare left and right hemisphere (LHS and RHS, respectively) stroke patients' performance on each component assessed by the BELS-SC. Eighty-eight acute stroke patients and 116 healthy age-matched controls completed the BELS-SC. The BELS-SC Initiation and Inhibition subtests demonstrated good convergent validity. RHS were significantly poorer than controls on all BELS-SC components. LHS were significantly poorer than controls on all components except Initiation HC items. LHS and RHS appeared to be relatively equally impaired on initiation and selection processes; however, RHS showed more profound impairment on inhibition and strategy compared with LHS. This was particularly clear for Inhibition HC items, where RHS were significantly worse than LHS. The BELS-SC is a valid, brief, bedside screening tool that can capture four key distinct executive processes required for spoken language production. The current study highlights bilateral involvement in executive control functions in a group of stroke patients without significant aphasia. The BELS-SC is a useful and practical tool which may aid in detecting executive language deficits and prompting early intervention and rehabilitation post-stroke.

The moderating effect of dietary patterns on the longitudinal relationship between depression, anxiety, and cognitive decline

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Background: The link between depression and an increased risk of Alzheimer's disease highlights the need to explore how dietary

patterns may moderate the relationship between mood and cognitive decline. Methods: This study included 407 cognitively unimpaired participants (>60 years, 41% male) from the Australian Imaging, Biomarkers and Lifestyle (AIBL) study. Participants completed a food frequency questionnaire (baseline only), along with cognitive and mood assessments at baseline and four additional time points. Scores were generated for six cognitive domains and three dietary patterns: Mediterranean (MeDi), Dietary Approaches to Stop Hypertension (DASH), and Western diet. Moderation and simple slope analyses examined interactions between baseline dietary patterns, mood changes, and cognitive decline Results: After adjusting for false discovery rate, increasing depression was associated with greater decline in the AIBL PACC score among males with mean and below mean MeDI adherence (β=-0.006, SE=0.004, p=0.011 and β=-0.006, SE=0.003, p=0.025, respectively). This was also observed in males with mean and above mean Western diet adherence (β=-0.006, SE=0.004, p=0.019 and β=-0.006, SE=0.003, p=0.033, respectively). Increasing depression was associated with greater decline in language in Apolipoprotein E (APOE) ε4 carriers with mean MeDi adherence (β=-0.006, SE=0.003, p=0.048). Additionally, increasing anxiety was associated with greater decline in the AIBL PACC score in APOE ε4 non-carriers with lower than mean DASH diet adherence (β=-0.003, SE=0.014, p=0.045). Conclusion: This study highlights healthier dietary intake may moderate the relationship between changes in mood and cognitive decline. These findings suggest the importance of gender- and genotype-specific approaches in mood, cognition, and diet research.

Older age associated with greater brain activity in motor and somatosensory cortices during dual task balance: a cross-sectional study using fNIRS

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Falls injury risk increases as balance control declines; this is compounded by 'dual-tasking' (i.e., balance under cognitive load). Cortical mechanisms underpinning dual-task balance require better understanding to support targeted interventions for age-related balance decline. Twenty participants (19-73 yrs) without known balance problems performed static balance tasks (feet together [FT], tandem) while executing digit span tasks (ordered control 1-2-3-4, random forward, random backward). Functional near-infrared spectroscopy measured change in oxyhaemoglobin (ΔHbO) in the prefrontal (PFC), motor and somatosensory cortices. General linear mixed models examined relationships between brain activity, tasks (foot position, cognitive task) and age group (< 55, ≥55). In PFC, ΔHbO was greater for tandem compared to FT tasks, and for both random digit span tasks compared to control, but did not differ with age. Motor cortex showed greater ΔHbO for tandem vs FT tasks, forward digit span vs control, and older vs younger age groups (EMM difference 51.2, 95% CI 10.6-92.0, p=.014). Older group had significantly greater ΔHbO than younger group for all FT tasks and forward digit span in tandem, but no other tandem tasks. Somatosensory cortex showed greater ΔHbO for both random digit span tasks compared to control, and for older vs younger group (EMM difference 36.3, 95% CI 0.6-72.0, p=.047), but no difference for foot position. Greater ΔHbO in the older group in motor and somatosensory cortices suggests need for more cortical involvement in these brain regions to manage dual-task demands, potentially due to age-related degenerative changes affecting the motor or somatosensory systems impacting balance control.

Multidimensional representation of naturalistic facial attributes in normal adult aging

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Normal adult aging is associated with changes in social intelligence, particularly the perception and interpretation of emotive facial displays. However, our understanding has been shaped by tasks using staged facial expressions, criticised for exaggerating facial morphology to fit putative emotion categories. Thus, it remains unclear how more ambient naturalistic faces might convey important information for detecting changes in socio-cognitive ability. Using a data-driven approach, we mapped perceptual judgements of wild-type naturalistic face stimuli across the adult lifespan. Adults aged 20 to 76 years (N = 365, evenly split by preferred gender) completed an odd-one-out task measuring perceived dissimilarity using 75 naturalistic stimuli from the Wild Faces Database (Long, Peluso, et al., 2023). We characterised responses to stimuli within a multidimensional space using Representational Similarity Analysis and compared these spaces across age and gender groups. Further we compared group data to a number of independent behavioural models. We found that perceptual judgements of similarity among the Wild Faces were remarkably stable over the adult lifespan, with behaviour best explained by perceived genuineness and emotional valence. Interestingly, this data-driven approach unearthed reliable differences between females and males, suggesting there is a complex relationship between gender and age that can alter our perception of facial expressions. Together, these findings suggest that 'uncontrolled' naturalistic stimuli maintain powerful socially diagnostic cues which may help elucidate the processes underlying age-related changes in social intelligence. This research was supported by University of Queensland and Australian Research Council (FT200100843 to JT).

Beyond Cancer: 'Chemobrain' and Support Challenges for Young Adult Childhood Cancer Survivors

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Cancer-related cognitive impairment, or 'chemobrain,' is associated with declines in diverse cognitive functions, including memory, learning, and decision-making, following cancer and its

treatment(s). This can have short- and/or long-term impacts on multiple areas, including education, independence, and quality of life. However, everyday impacts on childhood cancer survivors are relatively understudied and there are no universal guidelines for diagnosis/management. Exploring lived experiences is critical to understand what supports are needed, and when, to improve outcomes. Young adult childhood cancer survivors, aged 18-25, participated in a 1:1 semi-structured interview via Zoom. Interviews explored experiences of 'chemobrain', with a focus on; (1) impact of symptoms on daily life, (2) if/how concerns are managed, and (3) adequacy of existing supportive care and potential areas for improvement. Interviews were transcribed by hand and reflexive thematic analysis was conducted to identify emergent themes. Preliminary findings indicate that support is often self-initiated and contingent on individual circumstances, such as proactive family and supportive educators. Survivors reported feeling they had "fallen through the cracks," due to inadequate support during critical transition periods, such as school reintegration or transitioning out of the paediatric system. Additionally, there was a notable absence of awareness and monitoring of cognitive function despite symptoms persisting into adulthood, leading to reduced confidence in seeking help from healthcare providers. Childhood cancer survivors face unique disruption during critical stages of development, leading to poorer outcomes. Implementing early cross-disciplinary support has the potential to alleviate, or prevent, this, promoting improved quality of life.

Open Talks: Attention

Complex trade-offs in a dual-target visual search task are indexed by lateralised ERP components

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In everyday tasks, the choices we make incorporate complex trade-offs between conflicting factors that affect how we will achieve our goals. Previous experimental research has used dual-target visual search to determine how people flexibly adjust their behaviour and make choices that optimise their decisions. In this experiment, we leveraged a visual search task that incorporates complex trade-offs, and electroencephalography (EEG), to understand how neural mechanisms of selective attention contribute to choice behaviour in these tasks. On each trial, participants could choose to respond to the gap location on either of two possible targets. Each target was coloured coded such that colour indicated which of the two had the easier gap discrimination. Orthogonally, we manipulated the set size of coloured distractors to modulate how efficiently each target could be found. As a result, optimised task performance required participants to trade-off conflicts between the ease of finding a target given the current set size, and the ease of making its associated gap discrimination. Our results confirm that participants are able to flexibly adjust their behaviour, and trade-off these two factors to maintain their response speed and accuracy. Additionally, the N2pc and SPCN components elicited by search displays could reliably predict the choice that participants would ultimately make on a given trial. These results suggest that initial attentional processes may help to determine the choice participants make, highlighting the central role that attention may play in optimising performance on complex tasks. Funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – project number 222641018 – SFB/TRR 135 TP2 and TP3

Multivariate EEG markers of lapses in visual attention within a dynamic environment

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Sustaining attention is effortful and attentional lapses are common. We developed methods to detect multivariate patterns within EEG data indicative of behavioural misses in our Multiple Object Monitoring (MOM) task, which are assumed to result from spontaneous lapses in sustained visual attention. In the MOM task, multiple concurrent moving dots, of either an attended or unattended colour, travel along visible trajectories on course to collide with an obstacle at central fixation. On a variable proportion of trials, the dots are automatically deflected away from the collision at a set point in the trajectory. Dots that fail to automatically deflect require a behavioural response to prevent a collision if they are the attended colour (targets). We collected EEG data from participants completing this task under an 'active' condition (50% target frequency). We then quantified a proxy measure for how well each dot was encoded during the task from representational dissimilarity matrices characterising the pairwise dissimilarities for 15 discrete distance-from-obstacle bins along the trajectory before the automatic deflection point. This method was successful in decoding the trajectory of each dot and showed that the distance-from-obstacle information was stronger for attended dots compared to unattended dots. We further found that when a target was missed, this correlated with a drop in distance-from-obstacle information up to one second before the deflection point, compared to detected targets. Importantly there were no visual differences between hit and missed dots. These results suggest that spontaneous lapses in selective visual attention may result in a transient loss of neural information, like when stimuli are unattended. Funding: DP220101067 to ANR and AW.

Js-mEye: An extension and plugin for the measurement of pupil size in the online platform jsPsych

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The measurement of pupil size has become a topic of interest in psychology research over the past two decades. However, pupil measurements have been limited by the necessity to conduct experiments in laboratory using high quality and costly equipment. The presentation will describe the development and use of a JsPsych plugin and extension that incorporates an existing software (mEye) that estimates pupil size using standard low-cost hardware, such as a webcam. In a sample of 63 healthy

participants that attending a laboratory session, we validated this new program (js-mEye) against a task involving changes to screen luminance and colour, as well as two tasks of cognitive load, the N-Back task and the Stroop task. Changes to luminance and colour produced significant changes in pupil size in the hypothesised direction. Changes to cognitive load throughout the N-Back and Stroop tasks produced less clear findings; however, these findings were explained to some extent when participant engagement – indexed by cognitive performance – was controlled for. This work presents an exciting future direction for pupillometry and with further validation may present a platform for measuring pupil sizes during online research studies, as well as during experiments within laboratories that require minimal equipment.

Perception of robots before and after movement: objects on the boundary of agency and animacy

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Visual objects in the human brain are represented along an animacy continuum, where objects that are more animate (e.g. humans) are placed on one end of the spectrum, and objects that are less animate (e.g. a lemon) are placed on the other. This spectrum has been explored in terms of agency, humanness, predictability and more. This topic has predominantly been studied using static images, neglecting the dynamic aspects that contribute to object representations. In this study, we include video stimuli to investigate how motion, in addition to shape, influences object perception of familiar and unfamiliar objects. Specifically, we employ robots as less familiar objects that sit on the animate-inanimate border and are shape matched to biological counterparts that fall along the animacy spectrum. Robots are capable of self-initiated movement, with both fast and slow dynamics, and we include a control case of objects being moved by external forces. Thus, our experiment has 3 shape-matched conditions: biological, fast robots and slow robots. Participants (n=19) perform a triplet odd-one-out task, as well as rank objects for agency, humanness and intelligence, before and after watching videos of the objects in motion. Prior to video watching, participants rank humanoids close to biological dogs, in terms of agency, humanness and intelligence. After video watching, rankings of agency increase for all fast moving but not slow-moving robots. In conclusion, viewing objects in motion affects our internal representations of them. Our results reveal how we may represent embodied artificial agents alongside animals on the animacy spectrum.

Multivariate pattern analysis of visual stimulus evoked EEG responses offers no support for expectation suppression

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The forming of expectations allows us to make predictions about future sensory events so that we may exploit environmental regularities to our benefit. Certain predictive coding models theorise reduced neural responses for expected sensory input in a process called expectation suppression. Evidence in support of expectation suppression is scarce, however, and what evidence there is may not sufficiently account for potential confounds — such as repetition suppression or effects of attention. In the current study, we sought to test for expectation suppression in the visual system while controlling for these confounds. Participants were tested using a predictive cueing design while electroencephalography (EEG) was recorded. They learned cue-stimulus associations for grating orientations in expected (80% probability), neutral (50%) and surprising (20%) conditions. In the experimental task, two gratings — with matching or mismatching orientations — were presented sequentially. Ambiguity was introduced in the presentation of the first grating, which encouraged participants to use the learned cue-stimulus associations in order to correctly discriminate between pairs of stimuli. Participants were then required to identify matching and mismatching stimulus pairs. Multivariate classifiers were trained to discriminate between stimulus appearance probability conditions. The classifier was unable to detect differences between expected, neutral and surprising conditions at above-chance levels based on distributed patterns of EEG data. Our findings do not support those predictive coding models that specify expectation suppression effects. Alongside previous studies, our work contributes to a growing body of evidence that challenges influential hierarchical predictive coding accounts of stimulus evoked neural activity in the visual system.

Don't think of a Pink Elephant: Individual differences in visualisation predict involuntary imagery and its neural correlates

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There are substantial differences in the capacity of people to have imagined visual experiences, ranging from a lifelong inability (Congenital Aphantasia) to people who report having imagined experiences that are as vivid as actually seeing (Hyper-Phantasia). While Congenital Aphantasia has typically been framed as a cognitive deficit, it is possible that a weak or absent ability to have imagined visual sensations is balanced by a heightened resistance to intrusive thoughts – which are experienced as an imagined sensation. Here, we report on a direct test of that proposition. We asked people to either imagine, or to try not to imagine having a range of audio and visual experiences while we recorded their brain activity with electroencephalography (EEG). Ratings describing the vividness of different peoples imagined visual experiences predicted if they would also report having involuntary visualisations – such as an imagined experience of seeing a pink elephant when they were asked not to. The prevalence of involuntary visualisations was also predicted by neural correlates of disinhibition, working memory, and neural feedback. However, only the last two of these correlates also predicted the vividness of visualisations. Our data suggest that the propensity of people to have involuntary visual experiences can scale with the subjective intensity of their typical experiences of visualisation.

Pause or Cancel? The Role of Intracortical Inhibition in Stopping an Action

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Successfully stopping a prepotent action (response inhibition) is considered a goal-driven process that requires cognitive control, and is closely associated with GABA-mediated intracortical inhibition in motor cortex. Recent evidence suggests that response inhibition involves two distinct processes, a fast "pause" process automatically elicited by any unexpected salient stimulus, and a slower "cancel" process that selectively disengages the prepared action. For instance, research using transcranial magnetic stimulation (TMS) to probe the motor system suggests that a sudden stimulus onset temporarily suppresses corticospinal excitability, even when the stimulus does not signal stopping, raising questions about the precise role played by inhibitory mechanisms in controlled stopping. In this study, we used TMS with a modified stop signal task in which a go and either stop or ignore signals were presented on every trial. Across multiple experiments, we found evidence of rapid modulation of GABAergic inhibition that cannot be attributed to sudden stimulus onset and is specific to the goal of stopping. The results have implications for both the speed of goal-directed action cancellation and the role of intracortical inhibition.

Open Talks: Sleep

Neuromodulatory signatures surrounding NREM sleep microarchitecture in humans

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Neuromodulatory systems undergo profound alterations across neurodegenerative diseases of ageing. Understanding the role of these systems in the sleep-wake circuitry of healthy humans is crucial for improving sleep treatment and probing the bidirectional relationships between altered sleep, cognition and neurodegenerative diseases. Mammalian sleep studies have established an integral role for the noradrenergic locus coeruleus (LC) in sleep: precise timing of LC firing during NREM sleep is required for the coupling of sleep spindles to slow wave oscillations and hippocampal sharp wave ripples. In humans, dynamic interplay of the LC and sleep spindle activity remains unexplored. Here, we aim to uncover whole brain signatures during human NREM sleep, using an openly available dataset of simultaneous EEG and fMRI recordings across wake and NREM sleep. Individual sleep scans were time locked to 30-sec epochs of sleep stage scoring from EEG and sleep spindle detection was conducted using Wonambi package in python. Using general linear models to compare BOLD activity in sleep to wake, we found the hippocampus, dorsoposterior thalamus, ventral tegmental area, LC and regions of the default mode network were preferentially activated in sleep ($p < 0.05$). These findings suggest the LC may show unique activation patterns across states. Functional connectivity of the LC in sleep implicated critical thalamic regions compared to in the wake state where connectivity was stronger to cortical regions ($p < 0.05$). Ongoing analyses will investigate LC dynamics surrounding sleep spindle initiation and termination. So far, these results substantiate a role for noradrenergic modulation of large-scale brain state patterns.

Using the aperiodic slope change to predict N400 amplitude shift across sleep-based memory consolidation

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The EEG aperiodic slope reflects the ratio of excitation to inhibition in the brain and is related to improved memory outcomes across sleep, consistent with synaptic homeostasis models of sleep function. This study extends previous findings by investigating the underlying mechanisms of homeostatic changes, and their relation to memory outcomes. Participants learned object-word pairs, followed by an immediate recognition test. They were then given a 2-hour nap opportunity or remained awake before a final delayed recognition test. Aperiodic slope values were derived from resting-state EEG recordings before and after the learning and retention intervals. Changes in N400 amplitudes from the immediate recognition to the delayed recognition test were used to assess model updating, where lower values indicate less surprisal to previously learnt stimuli and, therefore, more effective model updating. Preliminary results from a linear mixed-effects model indicate that condition and changes in slope across the learning and interval phases interacted to predict N400 responses (chi-square (degrees of freedom = 1)=9.26, p=.002). Specifically, a shift towards a steeper slope across learning (shift towards inhibition), followed by a flattening of the slope across the interval (shift towards excitation)— and vice versa, predicted decreases in the N400 response across the nap only. This may mean that for model updating to occur, the learning-related excitation-inhibition ratio is reversed, but only across sleep, not wakefulness. Additional analyses will explore these interactions further, and their impact on behavioural outcomes. These findings will highlight the role of sleep-induced synaptic homeostasis processes on model updating in memory consolidation.

Open Talks: Inner Speech

Isolating the neural underpinnings of inner speech and inner non-speech

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We have previously shown that inner speech – the silent production of words in one's mind – attenuates the auditory-evoked potential elicited by an audible sound via corollary discharge. In the present study, we sought to determine whether this effect also occurs for inner non-speech. To test this, participants watched an animation which provided them with precise knowledge about when they should produce an inner sound. At the same time, they heard an audible sound – a synthetic signal which can be perceived as speech or non-speech depending on whether the participant is informed or not, respectively – that either matched or mismatched the content of the inner sound. We found that the inner sound attenuated the N1 – a brain signature of auditory processing – compared to passive listening, but only when the inner sound was speech, when participants were informed that the audible sound was speech, and when the inner and audible sounds matched on content. If the inner sound was not speech, if participants were not informed, or if the inner and audible sounds did not match, there was no attenuation of the N1. This shows that the N1-attenuation effect is specific to speech, suggesting that there is a functional difference between the neural processes associated with the production of inner speech and inner non-speech, which might have important implications for our understanding of auditory verbal and non-verbal hallucinations.

The Role of Auditory Imagery in Schizotypy: Understanding the Impact of Anauralia

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Auditory imagery is the ability to experience and manipulate sounds mentally without a physical stimulus. Current literature often fails to clearly distinguish between the productive (subvocalization, making sounds with the "inner voice") and receptive (hearing sounds in the "mind's ear") dimensions of auditory imagery, despite evidence linking schizotypy to both aspects of auditory imagery. This study examined the relationship between schizotypal traits and these two dimensions, with a focus on anauralia—the complete absence of auditory imagery. Schizotypy, a spectrum of non-clinical traits resembling those in schizophrenia, was hypothesized to correlate with these imagery dimensions. Specifically, individuals with anauralia were expected to score lower on the positive dimension of schizotypy, reflecting a reduced tendency to report hallucinatory experiences, particularly auditory ones. Schizotypy was assessed using the Multidimensional Schizotypy Scale – Brief (MSS-B), which measures positive (e.g. magical thinking, unusual perceptual experiences including hallucinations), negative (e.g. social anxiety, anhedonia) and dissociative (e.g. odd eccentric behaviours or disorganised speech) features, while auditory imagery was evaluated using the Auckland Auditory Imagery Scale (AAIS), covering both productive and receptive dimensions. Results supported the hypothesis, showing that positive schizotypal traits were associated with both dimensions of auditory imagery, with a stronger influence from the mind's ear. Anauralia was linked to fewer positive schizotypal symptoms, while lower imagery vividness was also associated with increased negative schizotypy traits. These findings underscore the relationship between schizotypy traits and imagery vividness and suggest implications concerning the genesis of auditory hallucinations and hallucinatory proneness.

Open Talks: Developmental

Development of the attention networks and working memory in young primary school children

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Attention control and working memory are foundational cognitive skills thought to be closely related in functioning. How they develop through childhood is unclear. Posner and Petersen proposed that four networks are central to attention functioning - the alerting, exogenous and endogenous orienting, and executive control networks. These networks help keep children awake and alert, help them shift attentional focus through external and internal prompting, and help them ignore distractors, respectively. A total of 248 children participated in a three-year, annual testing study, when they were aged 6, 7, and 8. Developmental growth in attention, assessed using the Staged Attention Network Task, and working memory, judged using the Corsi Block Task, were measured. Additionally, concurrent and predictive relationships between each of the attention networks and spatial working memory were assessed. Children showed improvements over time on performance of the four attention network tasks and the working memory task. A benefit of the alerting cue was shown only in year 3. Exogenous orienting of attention benefited from valid cues at each year. Intriguingly, endogenous orienting benefited from valid cues only in year 3. The executive attention network was active each year. Working memory performance improved at each year. Evidence of a cross-sectional and longitudinal predictive relationship between the executive control network and working memory was found, but no predictive relationships between working memory and the alerting, exogenous or endogenous orienting networks were found. The attention networks develop at different rates through childhood. Working memory and functioning of the executive control network showed a bidirectional effect, where greater working memory predicted a larger flanker effect, and vice versa. This longitudinal study highlights inter-relationships between executive attention control alone and working memory.

Shared neural correlates of interference control and response inhibition during development

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Inhibitory control (IC) is the ability to deliberately inhibit dominant or automatic behaviours, responses, or thoughts, to allow the selection of appropriate goal-directed responses. IC is a core executive function (EF) and shows prolonged development into mid-adolescence. Conceptualisations of IC often distinguish between interference control, the suppression of prepotent thoughts or beliefs, and response inhibition, the suppression of a prepotent motor response. However, other conceptualisations of EF suggest that a multi-demand system supports the elaboration and maintenance of structured mental programs across a range of tasks. Over the course of adolescent development, latent factor analyses of behavioural data suggest that EF becomes increasingly differentiated. Here, functional magnetic resonance imaging data were collected from different IC tasks within the same participants to investigate similarities and differences in brain activation between tasks and age groups. Adolescent (11–15 years old, n = 34) and adult (n = 33) participants completed a numerical Stroop task and simple and complex go/no-go tasks. All tasks followed a block design. Univariate analyses showed large overlapping fronto-parietal activation in the Stroop and complex go/no-go tasks, with more limited activation in the simple go/no-go task. Adults showed greater increases in activation than adolescents in the left precentral gyrus in the Stroop and complex go/no-go tasks and in the right inferior frontal gyrus in the Stroop task. To test the hypothesis of increased specialisation of EF networks during adolescence, multivariate similarity analyses further investigated whether patterns of activation across voxels showed greater correlation between tasks in adolescence than adulthood.

Using generalised additive models to improve fTCD lateralisation estimates for young children

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Cerebral lateralisation—the tendency for cognitive functions to be processed more in one hemisphere of the brain than the other—has long interested researchers due to its relationship with cognitive development. Some evidence suggests that certain patterns of language and visuospatial lateralisation are associated with individual differences in developmental trajectories. However, investigating this relationship can prove challenging given the difficulty of collecting neurophysiological data from young children. Thompson et al. (2023) recently introduced a generalised additive model (GAM) method for analysing functional transcranial Doppler ultrasound (fTCD) data which substantially decreases the uncertainty of individual lateralisation estimates. We aimed to establish if the GAMs method increased the precision of the laterality estimates compared to the popular period-of-interest (POI) averaging method when dealing with noise in child fTCD data. Here we present data from samples of 3-year-old (n = 102) and 4- to 7-year-old (n = 108) children who completed two child-friendly fTCD tasks to estimate their language and visuospatial lateralisation. The laterality estimates from the complex GAM approach correlated strongly with the traditional POI averaging method while also substantially decreasing standard error. Using the GAM laterality estimates, we found that typical patterns of language and visuospatial lateralisation (language lateralised to the left hemisphere, and visuospatial to the right) are associated with better cognitive performance in young children. These findings support the GAM method of processing fTCD data from young children and we recommend future research into cerebral lateralisation uses fTCD with GAM analysis to reduce the noise in LI estimates.

The Neural Basis of Viewpoint-tolerant Object Representations in Infants and Adults

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Humans have a remarkable ability to recognise objects quickly and accurately, even in the face of enormous visual variability. How does this ability develop despite the vastly different retinal projections caused by changes in an object's position, scale, pose, and illumination? The capacity for invariant object recognition must be acquired by the human brain throughout the course of development. Here, we compared the temporal dynamics of viewpoint-tolerant object representations among infants and adults. We aimed to examine how well neural representations of objects generalize across different viewpoints in the developmental trajectory. We used 3D models to generate multiple viewpoints of 14 different objects, each viewed from 8 distinct angles, consistently spaced along the front-facing half of the object. Brain activity was recorded from adults and 6-month-old infants using electroencephalography (EEG) while they observed the objects presented in a random order in rapid succession. Multivariate Pattern Analysis in the adult data showed that evoked neural signals contained reliable information about the object identity despite the viewpoint change. This means that neural responses evoked by the same object presented in different viewpoints were reliably similar to each other compared to the other objects. Preliminary results from the infant data suggest that similar invariant information exists in the infant brain but occurs later after stimulus presentation compared to adults. Our results provide evidence that the neural mechanisms of invariant object representation might emerge early and continue to refine throughout development.

Fast Talks: Ageing

Exploring Subcortical Contributions to Neuropsychiatric Symptoms in Frontotemporal Dementia

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Frontotemporal dementia (FTD) is a neurodegenerative disorder characterized by progressive atrophy of the frontal and temporal lobes, leading to significant behavioural changes. Subcortical structures are compromised from early in FTD and have been linked to neuropsychiatric symptoms such as apathy and anhedonia. Here, we sought to explore the relationship between subcortical volumes and these symptoms in FTD. We recruited 162 participants, including 53 behavioural variant of FTD (bvFTD), 24 semantic dementia (SD), 35 Alzheimer's disease (AD) as a disease control group, and 50 healthy controls. Anhedonia and apathy were assessed through carer ratings on the Snaith-Hamilton Pleasure Scale and Dimensional Apathy Scale, respectively. Volumetric analyses of regions of interest were conducted using T1-weighted images in FSL_FIRST, with Pearson correlation analyses performed in MATLAB 2024a. Relative to Controls, hippocampal grey matter volumes were significantly lower across all patient groups (ps<.0001). The nucleus accumbens was significantly lower in bvFTD and SD (p<.05) while the amygdala was significantly lower compared to AD (p<.05) with disproportionate volume loss in the SD group (p<.0001). Pearson correlations revealed that lower right nucleus accumbens volume was associated with greater anhedonia (r=0.54, p<.01) and greater emotive apathy (r=-0.50, p<.05) in SD. Left pallidum volumes was associated with greater hedonic tone in both AD (r=0.34, p<.05) and FTD (r=0.32, p<.05), while lower left hippocampal volume was associated with executive apathy (r=-0.38, p<.05) and cognitive apathy (r=-0.41, p<.05) in AD. Overall, our findings highlight disease-specific contributions of distinct subcortical structures to apathy and anhedonia in FTD, suggesting potential treatment pathways.

Tremor as a compensatory mechanism in healthy ageing: Relationship between theta-band tremor and cognitive function

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In Parkinson's disease, theta-band rest tremor is associated with better cognitive outcomes; compared to non-tremor patients, tremor-dominant patients have more intact cognitive function and reduced likelihood of dementia. These findings are in line with suggestions that tremor results from a compensatory mechanism, deployed in response to the dopamine depletion underpinning Parkinson's. Specifically, it has been proposed that this compensatory mechanism serves to facilitate activity along the direct pathway of the basal ganglia, thereby aiding voluntary movement and direct pathway-mediated cognition (e.g., reward learning). As in Parkinson's disease, healthy ageing is characterised by dopamine loss, albeit to an lesser degree. It is possible, therefore, that a similar compensatory mechanism may be observed in healthy older adults, resulting in a positive relationship between tremor and cognitive performance. To investigate this, we examined the relationship between tremor and cognition in ~1300 healthy adults aged 18-86 years. Participants completed a battery of cognitive tasks intended to assess basal ganglia function, including two reinforcement learning tasks. Separate measures of direct (reward) and indirect (punishment) pathway learning were extracted. An accelerometer was used to measure rest tremor in both hands, and the amount of power in the theta-band was calculated. Regressions will be used to examine whether tremor predicts cognitive function in young, middle, and older adults; it is hypothesised that tremor will be a stronger predictor of direct pathway learning compared to indirect pathway learning, especially in older adults. Findings will be interpreted in the context of healthy ageing and early detection of neurodegenerative disease.

Enhancing Parkinson's Disease Monitoring: A longitudinal study of novel alternative measures

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Parkinson's disease (PD) is the second most common incurable neurological disorder in Australia. Accurate diagnosis and monitoring of disease progression are crucial. The "Movement Disorder Society Unified Parkinson's Disease Rating Scale" (MDS-UPDRS) is currently the gold-standard measure, but it has limitations in reflecting disease state and prognosis sensitivity. Improved measures of disease severity and deterioration are needed. This study presents preliminary results from longitudinal research aimed at examining alternative measures of disease severity, including balance, motor function, brain activity, and cognition. We followed 22 participants with PD from the Hunter New England area over a 12-month period and generated a rich longitudinal dataset that includes EEG, postural sway, finger tapping, cognitive and emotional functioning measures, alongside traditional MDS-UPDRS scales for comparison. This data was also compared to measures from 22 control subjects. This research has the potential to enhance our ability to characterise disease progression in PD, increase health literacy, and improve psychosocial outcomes. More precise tools will enable clinicians to better assess patient needs for treatment and evaluate the effectiveness of those treatments.

Differential Influences of Cardiorespiratory Fitness and Metabolic Health on Cognitive Functioning in Older Adults

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Increasing age is associated with cognitive decline, increased prevalence of cardiometabolic risk factors and reduced cardiorespiratory fitness. While cardiometabolic health and cardiorespiratory fitness are both associated with cognitive function, their common and distinct contributions to age-related cognitive decline have not been examined. Here, we apply structural equation modelling (SEM) in an age-restricted sample of 354 healthy older adults from the ACTIVate study (60-70yrs) to model cross-sectional relationships between cardiometabolic health, cardiorespiratory fitness and domain-specific cognitive performance. Participants completed cognitive testing across multiple domains (e.g., cognitive control, verbal memory, processing speed, crystallised ability) and clinical measures (e.g., BMI, brachial blood pressure, heart rate, blood-based metabolic markers). Moderate-to-vigorous physical activity (MVPA) was captured using a wrist-worn accelerometer. Clinical history and demographic information were also collected via brief interview questions. SEM first tested the feasibility of a cognitive model (Model 1). Models 2 and 3 tested the unique effects of two theory-driven dimensions of cardiovascular health on cognition: cardiorespiratory fitness and cardiometabolic health, respectively. Model 4 compared the relative effects of cardiometabolic health and cardiorespiratory fitness on cognition. Cardiorespiratory fitness and cardiometabolic health demonstrated unique associations with specific cognitive domains. Fitness significantly predicted cognitive control and processing speed, whereas cardiometabolic health predicted verbal memory and crystallised ability. Importantly, Model 4 confirmed that, although these factors were positively associated, they were unique and independent predictors of their respective cognitive domains. These findings show, for the first time, that different aspects of cardiovascular health differentially predict cognitive abilities across crystalised and fluid domains.

Lower aperiodic activity is associated with reduced verbal fluency performance across adulthood

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Age-related cognitive decline associations with human electroencephalography (EEG) have previously focused on periodic activity. However, EEG is primarily made up of non-oscillatory aperiodic activity, which can be characterised with an exponent and offset value. In a secondary analysis of a cohort of 111 healthy participants aged 17 – 71 years, we examined the associations of the aperiodic exponent and offset with a battery of cognitive tests assessing processing speed and response inhibition, working memory, verbal learning and memory, psychomotor speed, and verbal fluency. Using Principal Component Analysis and K-Means Clustering, we identified clusters of electrodes that exhibited similar aperiodic exponent and offset activity during resting-state eyes-closed EEG. Robust linear models were then used to model how aperiodic activity interacted with age and their associations with performance during each cognitive test. Exponent by age and offset by age interactions were identified for the verbal fluency model where flatter exponents and smaller offsets were associated with poorer performance in adults as early as 30 years of age. Steeper exponents and greater offsets become increasingly related to verbal fluency performance and executive functioning in adulthood.

Fast Talks: Mental Health

The impact of cue reactivity on neurometabolic alterations in cannabis use disorder

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Craving is a core element of cannabis use disorder (CUD) and has been identified as the most valuable treatment target to reduce dependence severity as it is a strong driver of use, development and maintenance of misuse, and relapse. Craving is vulnerable to exposure of drug related cues or stressors. Anatomical and functional brain changes have been observed in CUD, however there is limited understanding of the underlying neurometabolic alterations, which to date have been assessed at rest. To address this, we have investigated the underlying neurometabolite alterations in the dorsolateral prefrontal cortex (dlPFC) during a cue-reactivity task. Neurometabolite concentration estimates were acquired using Hadamard Encoding and Reconstruction of MEGA-Edited Spectroscopy (HERMES) from participants with a moderate-to-severe cannabis use disorder and matched controls. Interestingly, during presentation of neutral stimuli, those with CUD displayed significant neurometabolite alterations compared to controls, however, during presentation of cannabis-related cues, the magnitude of these alterations was dramatically amplified and associated with significant changes in subjective craving. This additionally incorporated changes to the directionality of the observed alterations and quantity of neurometabolites displaying alterations. This work demonstrates the importance of elucidating the temporal dynamics of neurometabolites in CUD during subjective craving. These findings could inform the development of both reliable and targeted therapeutics as neurometabolite changes may provide a greater substrate for neuroplastic changes or inform what patients should be doing during intervention delivery (activating pathological circuits or not).

Acute electrocortical and neuropsychological effects of running exercises in adults with ADHD: A study protocol

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Psychopharmacotherapy is the first-line therapy for attention deficit hyperactivity disorder (ADHD), but it has several drawbacks, including possible side effects. Aerobic exercise might serve as a beneficial adjunct therapy. Studies in children and adolescents suggest that exercise reduces ADHD symptoms and improves executive functions (Liang et al., 2021). However, evidence in adults is scarce, and the underlying neurophysiological mechanisms remain unclear. The effects of various training methods (continuous vs. interval) and intensities (moderate vs. intense) are also not well understood. High-intensity interval training may offer superior benefits, as observed in neurotypical individuals (Ballester-Ferrer et al., 2022). This study aims to compare the acute effects of different running modalities on mood, cognition, and brain activity in adults with ADHD. Data collection is ongoing, with an estimated sample size of N = 10 by the conference. Participants complete an incremental step test to determine blood lactate levels, enabling the setting of exercise intensities based on physiological responses. The randomized, controlled crossover design includes four conditions: (1) moderate-intensity continuous training for 30 minutes at 2 mmol/L, (2) moderate-intensity interval training for 20 minutes at 2,5 mmol/L, (3) high-intensity interval training for 20 minutes at 5 mmol/L, and (4) a control condition involving a 30-minute documentary. Cognitive testing using a Flanker Task, accompanied by electroencephalography (EEG) recordings, and affective questionnaires will be conducted pre- and post-exercise. EEG outcome measures include periodic and aperiodic components of the power spectra and event-related potentials. Understanding how exercise characteristics influence ADHD-related symptoms is crucial for effective sports therapy.

Left nucleus accumbens volume is associated with poor sleep in chronic pain

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Sleep disturbance is a known comorbidity of chronic pain, yet specific neurobiological correlates of the sleep-pain relationship remain poorly understood. The left nucleus accumbens has recently emerged as a subcortical signature of chronic pain transition and has been implicated in the effect of sleep deprivation and fragmentation on pain perception. To further understand the role of the nucleus accumbens in pain and sleep, the current study investigated whether the nucleus accumbens volume in chronic pain is associated with sleep quality and quantity. Left and right nucleus accumbens volumes were estimated using FreeSurfer in N=34 participants with hip osteoarthritis (aged 60+/-12 years, 23 females). Associations between clinical pain measured with the numeric rating scale (0-10) and various subjective sleep measures, including the Pittsburgh Sleep Quality Index (PSQI) global score, sleep efficiency, as well as sleep duration were examined. Controlling for age, sex and total intracranial volume, a significant association was observed between the left (but not the right) nucleus accumbens volume and the global PSQI score (r=-0.55, p=0.001), as well as sleep efficiency (r=0.41, p=0.021). Pain severity alone did not significantly correlate with the nucleus accumbens volume. In participants with regular sleep duration (6-9 hours), there was higher left nucleus accumbens volume than in those sleeping more/less than the recommended amount (p=0.042). Our results confirm the role of the left nucleus accumbens in the sleep-pain relationship, by providing novel evidence for its association with sleep quality and quantity in chronic pain.

Fast Talks: Applied Cognition

Neural representations of food attributes in dietary decision-making

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When we are faced with an aisle full of snacks at the grocery store, how do we choose which to buy? Multi-attribute utility theory posits that people make decisions by firstly appraising multiple attributes of each decision option, then calculating an overall value for each option. Previous work has suggested that some food attributes (e.g., tastiness) may be processed more quickly compared to others (e.g., healthiness) and may therefore give greater weighting in the decision process. However, the specific temporal dynamics of the neural representations of food attributes remain unknown. In this study, participants (N = 109) evaluated food images based on either healthiness, tastiness, or their willingness to consume each food item through categorisation (yes/no) while we recorded brain activity using electroencephalography (EEG), and separately through ratings (0-100) on a continuous scale. A different group of participants rated the food images on additional food attributes: familiarity, recognisability, typicality, valence, arousal, perceived caloric density, edibility, and level of transformation. Multivariate support vector regression models trained on distributed patterns of EEG signals were used to decode food attribute information using individual's own ratings, or the group-average ratings. All three task-specific food attributes were decodable early (from ~150ms) following food image presentation, for both individual and group-average ratings. Additional food attributes were also decodable within the first second. In contrast to previous work, we found that time courses were similar for healthiness and tastiness representations. Our findings suggest that key food attributes may be automatically and rapidly processed in parallel during appraisal.

The neural impact of attachment priming on network connectivity during social exclusion: A pilot fMRI study with resettled refugees

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Social difficulties such as isolation and loneliness are amongst the strongest predictors of poor mental health outcomes amongst resettled refugees, but the biological and psychological processes underlying this association are unclear. Building attachment systems may be an approach to mitigate these adverse effects. This study investigated whether the priming of attachment figures modulated brain network connectivity patterns during experimentally induced social exclusion in a pilot sample of refugees resettled in Australia. During fMRI scanning, 44 refugees from diverse backgrounds played the "Cyberball" – a computerized ball tossing game where a period of inclusive play is followed by exclusion from play. Mental induction of a personal attachment figure preceded round 2 of the Cyberball. Independent components analysis identified 53 active networks, and subtraction analysis compared exclusion to inclusion blocks in the post-attachment round compared to the pre-attachment round. Attachment priming increased connectivity in a subcortical network including the basal ganglia and caudate, and in the default mode network – principally the dorsomedial prefrontal network, but decreased connectivity in an occipitotemporal network and right central executive network in the right lateral prefrontal cortex, during exclusion. No effect of psychological symptoms, separation from attachment figure or demographic factors were observed. Findings suggest that attachment priming might buffer the neural impact of social exclusion by enhancing activity in networks important for self-referential processing and regions implicated in emotion regulation. This study supports the idea of a role for attachment figures – whether present or absent - in enhancing social stress coping amongst resettled refugees.

Attention in team sport: What are we actually looking at?

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Attention is an integral part of team sport, particularly in processing, storing, and retrieving information from the environment to selectively focus on stimuli. However, the term attention is also used to describe a range of abilities and types that have been studied in different ways and sometimes overlap with other types or cognitive constructs. For example, selective attention (i.e., the ability to ignore irrelevant stimuli) is important for spatial attention and awareness as well as for maintaining concentration. The variety of types and measures to investigate attention begs the question: what exactly are sport science researchers looking at when they refer to 'attention'? This narrative review presents an overview of the current understanding of attention in team sport and provides recommendations and directions for clear and comprehensive advancements in this area. Cognitive perspectives of psychology have shaped attention research and methodologies in sport science. While cognitive perspectives have helped establish the relationship between attention and team sport performance, furthering our understanding of this relationship in a more representative context requires a shift towards other more ecological perspectives. Using methods from these perspectives, such as supporting established objective measures with subjective measures, can provide a comprehensive understanding of what team sport athletes pay attention to in their environment. Expanding on previous perspectives and the current methodologies being used will allow researchers to develop more representative methodologies that better reflect the environment that team sport athletes perform in and thus further our understanding of how attention influences team sport performance.

On the chronic effects of mild traumatic brain injury on working memory: Behavioural and electrophysiological evidence

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Zeguo Qiu, University College London
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Working memory, a critical executive function, may be particularly vulnerable to the lasting effects of mild traumatic brain injury (mTBI), but the precise nature of this impact is unclear. Previous evidence suggests that verbal working memory is diminished following injury, yet there are conflicting findings regarding whether a history of mTBI influences performance on tasks taxing visual working memory capacity. To further elucidate the impact of mTBI history on the different components of working memory, the current study utilised both verbal (operation span) and visuospatial (symmetry span) complex span tasks. In addition, we used a change detection paradigm and event-related potentials (ERPs) to explore the electrophysiological indices of visual working memory capacity following injury. Participants with a history of mTBI (n = 20) demonstrated poorer verbal working memory under the dual-task storage and processing demands of the operation span task compared to control participants (n = 38), but no differences in visuospatial working memory under dual-task demands were revealed. Thus, it appears that executive working memory processes remain intact after mTBI, and the reduced performance on the operation span task is likely associated with the verbal content to remember. Supporting this, both behavioural and electrophysiological measures of visual working memory capacity from the change detection task did not differ between the groups. Together, these findings suggest that history of mTBI may be associated with a lasting, isolated disruption in the subsystem underlying verbal working memory storage.

Fast Talks: Attention, Expectation, Prediction

Perceptual load modulates the interaction of prediction and attention

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Although attention and prediction are considered two fundamental mechanisms involved in sensory perception, their interplay is not well understood. Studies on the interactions between attention and prediction have yielded discrepant results, possibly due to different task demands. The present study examined the effect of perceptual load on the processing of expectancy violations at attended and unattended locations. To this end, we developed a novel delayed match-to-reference task that orthogonally manipulated attention, expectancy, and perceptual load, measuring accuracy and response time (RT). We hypothesized that low-load conditions should facilitate the processing of task-irrelevant information due to the availability of spare attentional resources. Data from 28 healthy young participants were analyzed with separate repeated measures ANOVAs for accuracy and RT. The results confirmed the effectiveness of the load manipulation, as high perceptual load significantly increased RTs and decreased accuracy. Importantly, the analysis of accuracy yielded a significant three-way interaction between attention, expectancy, and load. Post-hoc analyses revealed that load modulated the processing of expectancy violations: unexpected features in an unattended stimulus reduced accuracy only under low-load conditions. These findings suggest that predictive processing in unattended space is contingent on the availability of processing resources, with high perceptual load inhibiting the processing of unexpected events in unattended regions.

Do people see spatio-temporally predictable visual inputs sooner, and does this align with neural pre-play findings?

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Consider a world where it took seconds for your brain to process sensory information before you had access to it. Perhaps your brain would compensate by constantly making educated guesses about the present, to help you interact with moving objects. Thankfully, the neural latencies of the sensory brain are not this severe – just tens of milliseconds. Nonetheless, some have suggested that your visual brain tries to compensate for these brief lags. While the utility of this remains in question, as compensation could be left to motor planning to minimise complications when predictions are wrong, some recent neuroimaging has been taken as evidence that your brain 'sees' moving object positions in real-time. When people were shown predictable moving objects, neural activity could be decoded as representations coinciding with an extrapolated position, with a magnitude that could compensate for processing delays. While this does not establish that you see moving objects in their real-time positions, it does suggest the involvement of predictive processes. We aimed to link these neural findings to perception. In a series of psychophysical experiments, we found that people reported seeing visual inputs sooner when they aligned with short-term spatio-temporal expectations. However, we also found that attentional biases played a large role in this effect. There was some evidence of perceptual extrapolation beyond attentional biases, which we are currently studying in relation to the neural correlates of predictive processes.

How does prediction modulate the neural representation and visual perception of real-world objects?

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According to predictive coding accounts of brain function, efficient processing of sensory information is achieved by modelling current and future perceptual states. Previous research has shown that neural representations of low-level visual features, such as orientations, are modulated by predictions. It is unclear, however, whether the same is true for more complex, real-world objects. To address this gap, we recorded brain activity using EEG while participants (N = 40) viewed RSVP sequences containing high-fidelity (intact) and degraded (diffeomorphically warped) object images which were placed in the sequence such that objects were statistically random, equally likely to occur, expected or unexpected based on a preceding image cue. Participants were asked to report whether target object images were 'intact' or 'warped'. Multivariate pattern analysis was used to quantify the degree of object information represented in neural activity. Decoding accuracy and discrimination task performance were compared across random, equal-likelihood, expected, and unexpected objects. There were no significant differences in decoding accuracy, discrimination accuracy or discrimination response times amongst the four probability conditions. One potential explanation for these null results is that participants did not have sufficient exposure to the embedded statistical structure; another is that the behavioural task might have interfered with participants' learning of the image statistics. In a follow-up experiment, therefore, we explored these possibilities by increasing exposure to the structured sequences, and employing a modified object detection task that was undertaken separately from the neural recordings. We will discuss the implications of these findings for predictive coding theories of visual perception.

Exploring the Temporal Dynamics of Voluntary Decision-Making across Stable and Dynamic Contexts

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Voluntary decisions are conscious, endogenously driven decisions mediated by goals and preferences. In dynamic environments, re-evaluating new information may prompt a change or reinforce an initial choice. While fMRI studies have identified brain regions involved in voluntary decision-making, the temporal unfolding of these decisions, especially in dynamic contexts, remains unclear. We used high temporal resolution electroencephalography (EEG) recordings to examine neural signatures of voluntary decisions in stable and dynamic contexts. Participants (N=50) completed a decision task. In the stable context, they freely chose between two of four balloons (blue, green, orange or pink) or were forced to select a sole presented option. In the dynamic context, occurring in half the trials, either a new option was introduced (in trials with one initial option) or one initially available option was removed (for trials with two initial options), prompting participants to maintain or switch choices. Slower response times were observed for free versus forced choices, subsequent versus initial choices, and switched versus maintained choices. These temporal costs suggest additional cognitive demands for free, subsequent, and revised choices. Multivariate pattern analysis revealed above-chance decoding for forced choices early in initial choices, but not at all for free choices. No above-chance decoding was observed for subsequent free or forced choices. Taken together, neural signatures of voluntary decisions remain elusive in EEG signals, possibly due to individual differences (e.g., decision strategies and decision times) and complexities of voluntary decision-making over time. Future research could examine these individual differences through behavioural modelling of RTs.

Fast Talks: Perception

The impact of face masks on the development of face perception in preterm infants

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Faces are a critical conveyer of social information, and the development of face perception is important for broader socio-cognitive development. Preterm birth is associated with socio-cognitive dysfunction, and potentially also with anomalies in face perception, that could be exacerbated by a partial 'face deprivation' due to the use of face masks in most Neonatal Units. Our aim was to measure the functional brain response to masked and full faces in preterm and term infants using functional near-infrared spectroscopy (fNIRS). Preterm (24-30 weeks' gestational age) and term infants were studied at 6 months post-term age. The infants viewed happy face images presented at 1 Hz in alternating 5 sec blocks of masked or full faces, interspersed with 9-15 sec baseline blocks. The cerebral haemodynamic response function was measured as changes in oxy- and deoxyhaemoglobin concentration (ΔHbO and ΔHbR), using multichannel fNIRS covering inferior-frontal, temporo-parietal, and lateral occipital regions. Term infants showed higher ΔHbO than preterm infants for both full and masked faces in the left inferior-frontal region, an important part of the 'social brain' network linked to face and emotion processing. The ΔHbO was higher for full than masked faces in one temporo-parietal channel (10/20 system) in term (P6-P8 channel) and preterm infants (P6-CP6) respectively, suggesting this cortical region that is linked to social perception processes masked and full faces differently. Our findings highlight anomalies in the social brain of preterm infants and underscores the importance of understanding how changes to brain development could impact socio-cognitive skills in this vulnerable population.

Object recognition under occlusion during rapid serial visual presentations

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The success of visual object recognition relies on its robustness and speed. This robustness is evident when the visual system recognises objects in ambiguous contexts (e.g., occlusion or high speed), and even in these cases, object recognition is resolved in a matter of milliseconds. However, we do not know exactly how visual mechanisms differ when recognising objects under different levels of ambiguity. We used electroencephalography (n = 30) to record the brain responses to natural objects in ambiguous situations - four levels of occlusion (0%, 25%, 50% and 75%) and two levels of rapid visual presentation (5 Hz and 20 Hz). Varying the ambiguity of the objects allows us to study how much information the brain carries in the different cases, providing insight into the contribution of different mechanisms to object recognition. Using time-series decoding, we found differences in the temporal dynamics with different levels of occlusion and speed in addition to a systematic reduction in object decoding under increasing levels of occlusion. The decoding accuracy at image and object levels happened earlier and was more consistent across the occlusion conditions compared to more abstract categories of information. These results show that feedforward processes carry more information to solve ambiguous visual recognition than what was generally thought. Furthermore, the later feedback information flow that complements the feedforward stream does not behave as an all-or-nothing process, and it varies between image, object, category and animacy brain decoding.

What remains seen of the unseen? Neural location-tracking of an object occluded from view

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An object moving behind something else is still perceived to exist, maintaining conscious awareness and position tracking even

without reinforcing visual input. However, what information is retained in neural activity while the object is obscured is yet to be fully resolved. In particular, does an occluded object's location as it moves continue to be represented in the same format as when it can be seen? To address this question, we apply time-resolved decoding techniques to EEG signals from observers passively tracking a circularly moving object, which is occasionally hidden by an occluder positioned along its trajectory. We construct position maps of the probable location of the object over time based on the information available in the neural signals and compare visible and occluded trajectories. Preliminary results (N = 15, data collection ongoing) show a transient persistence in the decoded position of the object after it is obscured from view, but that this may not, in any large part, differ from that of an object which disappears entirely. Additionally, following the re-emergence of the object from behind the occluder, there is a slight delay before the object's position is represented, indistinguishable from the object's initial (unpredictable) appearance. This fails to replicate previous suggestions that the decoded position representation 'jumps' to the anticipated reappearance location of the object and instead suggests that the position of an occluded object is encoded in a non-visual pattern of neural activation.

Beyond modularity: building coherent cognitive neuroscience theories through multi-scale integration

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Cognitive neuroscience aims to understand how nuanced patterns of thought and behaviour emerge from coordinated interactions between neurons across multiple spatial and temporal scales. Traditionally, this task has been approached in a modular fashion that conceptualises neural activity and behaviour as two separate streams. This approach has led to a conceptual schism: neural mechanisms are typically characterised as dynamic, context-dependent, multi-scale processes, whereas cognition and behaviour are framed as static, context-independent, single-scale phenomena. Importantly, brains and behaviour share universal principles–typical of all complex systems–that our current modus operandi cannot capture. For instance, cognition and behaviour are also clearly organised across multiple scales – e.g., prioritising immediate vs delayed benefits in decision-making tasks; perceiving local or gestalt features of a perceptual scene; or performing multiple simultaneous tasks in parallel. Here, we bring together concepts and tools from physics, ecology, design, and architecture to re-interrogate the multi-scale nature of brain-behaviour relationships in cognitive neuroscience. We argue that rapid progress in cognitive neuroscience will come from rethinking behaviour as an equally complex, multi-level structure that operates both serially and in parallel, evolves over time, and is the product of past and present internal and external constraints. Dissolving our previous modular approach will allow us to frame hypotheses that combine brain and behaviour using the same scientific language. This will enable the formation of "permeable" theories that navigate within and across these merged multi-level compositions, allowing an enriched brain-behaviour framework that will catalyse rapid developments in cognitive neuroscience.

Decoding Rapid Emotional Responses in the Brain Using EEG

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The rapid processing of emotions in the brain is crucial for survival, social interaction, and adaptive behaviour. Emotional responses within milliseconds allow individuals to react promptly to potential threats. However, the mechanisms underlying the human brain's remarkable ability to process emotional information from sensory inputs remain unknown. How rapidly emotional information emerges and evolves in the brain? In other words, are there measurable moment-to-moment changes in brain activation as emotional information is processed? To address these questions, high temporal resolution neuroimaging techniques, such as electroencephalography (EEG), are crucial for investigating the fast processes associated with emotions. Here we recorded EEG from 50 participants while viewing 10 repetitions of 900 emotional images from the OASIS database (Kurdi et al., 2017) in 4Hz rapid visual streams. The emotional images depicted various visual category types including animals, people, objects, and scenes, with valence and arousal behavioural ratings. Our results showed that we could estimate the visual category type by decoding the EEG data. Secondly, we used regression to successfully predict valence and arousal values from the EEG data. The EEG responses to the rapid presentation of stimuli revealed that the brain processes emotional valence and arousal moment-to-moment at different times, highlighting how these emotional experiences are associated with unique temporal neural dynamics. These findings showing rapid and selective encoding of emotional information in the brain emphasizes the necessity of measuring and understanding timely responses to environmental cues to gain further insights into the neural underpinnings of emotion.

Fast Talks: Modelling

Neural substrates of safety perception during development

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Safety learning is critical for survival as well as freeing up resources for other important non-defensive pursuits (eating, mating, socialising). Safety is primarily studied as the inverse of external threat through conditioning. However, human safety learning also involves identifying self-oriented protective resources. The present studies investigated the role of external and self-oriented information in safety evaluation during adolescence and adulthood. Participants (adults: N = 100 online,

N = 30 MRI, ages 18-40; adolescents: N = 34 MRI, ages 12-17) viewed stimuli pairs comprised of external threat (dangerous animal) and self-oriented protection (powerful weapon), and judged whether they would win or lose the battle against the animal with their weapon. Behaviorally, both adults and adolescents relied more on self-oriented protective information when making safety decisions. Adolescents were more nuanced to different sources of information and were more accurate when compared to objective outcomes, while adults were generally overconfident. Neurally, the ventromedial prefrontal cortex (vmPFC) tracked and integrated self-related safety signals but not external threat. When viewing self-oriented protection, activation also increased in the nucleus accumbent, overlapping with response to safety certainty during win outcomes. In contrast, when viewing external threatening animals, activation increased in salience regions, including the insula. Adult-adolescent comparisons are ongoing and will be presented. We predict vmPFC response and differentiation for safety and threat will be reduced in adolescents given prior work on the developmental timing of the PFC. Findings advance understanding of safety learning, its neurobiological underpinnings, and how it develops.

Modulation of Neural Oscillations by a Nootropic Juice

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This study examined the effects of a nootropic drink, named Ārepa and code-named the juice for this research. The juice contains l-theanine, pine bark extract, and a custom extract and juice of blackcurrants. l-Theanine has been shown to affect cognition and brain activity in rodents, and in humans under certain circumstances. The bark of Pinus radiata is rich in proanthocyanidins and the berries of Ribus nigrum are replete with anthocyanidins. Some studies have suggested positive effects on health and cognition. A double-blind placebo-controlled crossover study was conducted to test the juice versus a control drink. 21 people participated through two 5-week periods of daily intake, with measurement of their electroencephalogram (EEG) and memory performance on the first and last days of each period. EEG data was analysed in terms of oscillatory power. The first drink of the juice induced a significant negative effect on neural oscillations related to working memory recall at frontal midline and posterior parietal electrodes. This effect appears to be suppression of the characteristic burst of theta-band oscillations elicited by working memory demands. Memory recall accuracy and reaction time were unaffected, however. Chronic consumption of the juice for 5 weeks did not demonstrate any effect versus the control drink. In conclusion, the juice acutely alters oscillations related to working memory recall via a negative effect on frontal and parietal oscillatory power. It may negatively modulate oscillations in the theta-band, in particular. These changes in brain activity suggest that the juice may influence information processing during memory, although memory performance is unaffected. The absence of chronic effects may indicate homeostatic adaptation or insufficient administration.

Conflict monitoring and mid-frontal aperiodic activity

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Conflict monitoring and cognitive control processes are associated with distinct neural signatures, such as the N2, and theta oscillations. In contexts requiring greater control, such as increased conflict, N2 amplitudes and theta power increase. However, ERPs and periodic activity cooccur with an underlying aperiodic signal, which recent work suggests is greater in conditions that require more cognitive control, and which may reflect a relative increase in inhibitory neural activity. In this study, we examined stimulus-locked frequency and time-domain activity in a Flanker task that parametrically manipulated the level of incongruency between flankers and targets. Aperiodic activity and N2 amplitudes were extracted from pre- and post-stimulus segments for trials over a composite of Fz, FC1, FC2, and Cz. Response times were slowed, errors increased, and N2 amplitudes increased as a function of incongruency. The aperiodic exponent increased from pre-stimulus to post-stimulus in all conditions, and the magnitude of this change increased as a function of incongruency. These results are consistent with research suggesting that conflict monitoring involves selective increases in inhibitory neural activity.

Investigating transfer between motor and episodic memory sequences

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Memories for actions (motor memories) and daily events (episodic memories) have been traditionally considered to have distinct neural underpinnings. Yet, these different memories were found to interact: implicit knowledge of the order of a list of words was generalisable to the learning of sequential actions, and vice versa, when both sequences shared an ordinal structure (Mosha & Robertson, 2016, Current Biology). Importantly, generalisation is theorised to occur when different sequences engage the same neural networks, and thus represents a means to behaviourally approximate an overlap between different memory systems. We thus aimed to replicate the aforementioned finding, and to examine whether the timing (durations) of sequential actions and images can also generalise across different sequences. In our protocol, healthy adults (N = 101) first completed tasks assessing generalisation of the ordinal structure, and then tasks assessing generalisation of timing. Across four participant groups, two completed motor tasks first, while the other two completed episodic tasks first. Between these groups (motor or episodic

tasks first), one completed tasks with the same ordinal and timing structure, while another completed tasks with differing structures. Preliminary findings suggest better learning of a motor sequence when it shares an ordinal structure with a preceding word list, as per the aforementioned study (d = 1.01). Additionally, there appears to be an interference effect on episodic timing if participants first learned a motor sequence with the same timing (d = .83). These findings corroborate and extend past findings of interactions / overlap between our different memory systems.

Poster Session 2 (Thursday)

Theta oscillations during a recognition memory task differ between individuals with mild cognitive impairment and matched cognitively normal controls

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Individuals living with mild cognitive impairment (MCI) are at an elevated risk of progressing to dementia, a neurodegenerative condition characterised by significant cognitive decline and impaired functioning. Impaired memory function in MCI is central to the progression to Alzheimer's disease, the most common cause of dementia. Electroencephalography (EEG) studies have linked activity in the theta band with episodic memory, in particular, greater event-related synchronisation while encoding items that were later successfully remembered. We explored this association in a word recognition task, comparing the Event-Related Spectral Perturbations (ERSP) in the theta (4-7 Hz) band for individuals with MCI (n = 50) and an age- and sex-matched cognitively normal control group (CNT; n = 17) during an encoding phase, and an immediate and a delayed recall phase. Phasic theta synchronisation was observed in both groups during the first ~500 ms following stimulus onset in each phase (encoding, immediate recall, delayed recall). This was followed by a marked desynchronisation during each recognition phase in the CNT group, while the MCI group showed comparatively less desynchronisation, centrally, during the immediate (p = .03) and delayed (p = .04) recognition phases. The identification of distinct oscillatory profiles in individuals with MCI linked to unstructured recognition memory offers potential as a marker that could enable timely implementation of intervention therapies aimed at slowing cognitive decline and delaying the onset of dementia.

Animate-inanimate object categorization from minimal visual information in human adults and infants

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Object categorization by animacy is a main organization principle in perception – yet it remains unclear what visual features would assign, say, a pigeon and a giraffe to a category, separate from a pear and a hammer. Using frequency-tagging electroencephalography (EEG), we targeted a direct and automatic signature of visual object categorization by animacy in the adult and infant brain, to study the visual features that primarily contribute to the automatic distinction between animate and inanimate objects. Adult participants (N=36) saw rapid sequence (6 Hz) of images, exhibiting an exemplar of a category (e.g., animate) every five exemplars of another category (e.g., inanimate). We captured a response in correspondence to the periodic categorical change (1.2 Hz), indicating fast and automatic animate-inanimate categorization. Such EEG-response was measured using a set of colorful images, grayscale versions of the same images, or (unrecognizable) phase-scrambled and texform versions of those images. Infants participants (4-month-old, N=64) saw the same type of rapid sequence (4 Hz), with the original colorful images or phase-scrambled versions of the images. We observed stronger EEG-response for the original and grayscale versions of the images. Nevertheless, an EEG-response was also captured, in both adults and infants, with phase-scrambled and texform versions of the images, suggesting that animacy perception is resilient to the loss of visual information, so much that its neural signature can still be captured in the EEG signal for images that are no longer recognizable but preserve only some mid- and/or low-level features.

Cognitive inhibition assessed through upper limb and stepping tasks in people with age-related cognitive impairment

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Cognitive inhibition, essential for suppressing irrelevant thoughts and behaviours to facilitate goal-directed responses, is often impaired in Alzheimer's Disease (AD) as shown by Stroop-colour task performance. However, differentiating healthy aged-matched controls (HC) from those with Mild Cognitive Impairment (MCI) (a group with a high risk of conversion to AD) using the Stroop task is less clear. Slowing in motor function, notably in finger tapping and gait, has been demonstrated in people at risk for AD. Thus, assessing cognitive inhibition via such motor tasks may distinguish between MCI and HC better than simple movements alone. Groups of HCs (n = 25, Mean age = 73), MCI (n = 17, Mean age = 70) and a small sample of people with AD (n = 4, Mean age = 81) completed a baseline 2-choice (left/right) response (CRT) condition and an arrow-word spatial Stroop task (75% congruent trials) via motor responses in the upper limbs and stepping from force plates. Functional Near Infrared Spectroscopy recorded haemodynamic changes in the Pre-Frontal Cortex. Preliminary analysis revealed that individuals with MCI exhibited Stroop interference effects (incongruent relative to congruent trials) comparable to HCs in both upper-limb and stepping tasks. However, the MCI group showed larger increases in RTs between

the upper limbs and stepping than HCs for the Stroop condition but not the baseline CRT condition. This suggests that stepping responses are particularly affected in people with MCI when conditions are more ambiguous.

Influence of Age and Cognitive Reserve on Working Memory Maintenance and Manipulation

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Working memory (WM), the ability to temporarily store and manipulate information for complex cognitive tasks, declines with older age. Older adults show reduced accuracy in WM tasks involving manipulation. Cognitive reserve (CR) may protect against age-related WM decline, but little research has focused on how CR affects the ability to manipulate, as opposed to solely maintain, information within WM. This study examined age- and CR-related differences in WM maintenance and manipulation. Data were collected from 29 younger (18-35 years) and 44 older adults (65-85 years) who completed a visuospatial WM task in two experiments. In experiment 1, participants were presented between two and six squares within the top or bottom half of an 8x6 grid, and locations were maintained over a 2-second delay period. In experiment 2, the number of squares was reduced (between two and four), and participants either maintained the location of the squares (maintenance) or mentally flipped them across the horizontal midline during the delay period (manipulation). Recall accuracy (mean errors) was compared between age groups and across levels of CR proxies (National Adult Reading Test intelligence quotient and Cognitive Reserve Index questionnaire). Older adults had lower recall accuracy at higher WM loads and during manipulation trials. There were no relationships with CR proxies. Age-related decline in the ability to encode, maintain, update and recall information within WM can impact the daily lives of older adults. These results will add to the understanding of age-related cognitive decline and the effect of CR on WM performance.

Long-Term Neurocognitive Impairments in Attention Orienting Following Concussion: An Eye-Tracking Study

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Concussion is a significant public health concern due to its potential for long-term effects across individuals of all ages. However, in the absence of an objective test or biomarker for diagnosing concussion, diagnosis primarily relies on clinical judgment based on the observation of signs and symptoms. A further challenge is the lack of an objective test for brain recovery, hence a better understanding of the longer-term effects of concussion is required. Given previous reports indicating attentional orienting deficits following acute concussion, the present study aimed to determine whether these deficits persist over time and to assess the extent of any long-term impairments in individuals with a history of concussion in the last 24 months. Employing a case-control design, eye-tracking was used to record the saccadic latency performance of post-concussion (PC) participants and a healthy control group (HC) matched for gender, age, and intelligence. PC participants showed a reduced cueing benefit effect (neutral cue–valid cue) compared to HCs, indicating a subtle difference in capacity to utilise spatial cues to orient attention. Notably, increased reports of concussion symptoms, particularly anxiety, mood disturbances, and migraine clusters, among the concussion group, were associated with weaker cueing benefit effects. This study provides novel insights into long-term concussion-induced impairments in attentional orienting, potentially implicating the dorsal frontoparietal regions of the brain. The findings also suggest that eye-tracking could be a promising tool for monitoring long-term concussion effects and warrant further multimodal investigation to enhance understanding of the ongoing impairments following concussion.

Dementia risk reduction: what do young adults know and what are they doing about it?

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Dementia poses a significant global challenge, affecting millions of individuals. Currently there is no cure, such that prevention remains crucial. Despite this, research indicates that the general public lacks awareness of dementia risk reduction strategies, with minimal improvement over the past decade. It is important to maximise dementia risk reduction and intervene early in younger populations. This study aims to assess knowledge levels and engagement in risk reduction behaviours among young-midlife adults. An online survey of 616 Australian adults aged 18-44 years was conducted to assess their knowledge of dementia risk reduction, engagement with behaviours that either increase or decrease risk, and intentions to change behaviour to reduce risk. These were assessed via true/false questions and rating statements scales. Participants demonstrated an overall accuracy of only 45% on knowledge statements. Despite low knowledge, of the 10 risk reduction behaviours screened, the majority (70%) of participants were engaging in at least 5 of these. With respect to risk reducing behaviours, 90% reported avoiding smoking, however, protective behaviours such as regularly checking cholesterol levels were low (18%). For participants who were not engaging in risk reduction behaviours, willingness to change was high, with up to 100 of 104 participants indicating intention to change when asked about improving physical activity. Although knowledge of risk reduction remains poor among young-midlife adults, their engagement in risk-reducing behaviours is generally high. Encouragingly, participants expressed a strong willingness to adopt new behaviours. These findings support dementia initiatives targeting younger-middle-aged adults to enhance risk reduction efforts.

Is Your Phone Distracting You? The effect of phone-like vibration interruptions on sustained attention in a dynamic task

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Despite the many benefits of smartphones, they also frequently interrupt us. Previous behavioural research shows that interruptions produce costs on performance, and that the mere presence of a smartphone may be distracting enough to produce similar effects. However, few studies have tested this with dynamic tasks which may better model crucial aspects of real-world scenarios, such as driving. In this pre-registered study, we examined the effect of phone presence, and a phone-like vibration, on performance in a dynamic task, the Multiple Object Monitoring (MOM) paradigm. In this task, dots move along visible trajectories towards a central obstacle. In the Active MOM, used here, 50% of dots in a relevant colour deflect automatically, but 50% continue towards a collision and must be manually deflected using a button press. In a within-subjects experimental design (N=30), participants completed ~28 minutes of the MOM task under two conditions: with their phone visible and a notepad (control) condition. Within the phone condition, half of the blocks included phone-like vibrations. Measures of accuracy and reaction times showed that there was no overall effect of phone presence, nor interruption, using Bayesian analyses. There was insufficient evidence regarding the effects on eye movements. This suggests that either participants were able to effectively ignore the vibrations, or the MOM task is not sensitive to transient capture of attention. Funding ARC Future Fellowship to ANR (FT230100119).

Language diversity and cognitive health: Exploring multilingualism across the adult lifespan

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Epidemiological literature has suggested speaking two or more languages can delay onset for neurodegenerative conditions such as Alzheimer's disease. Cognitive ageing research offers inconclusive explanations for this effect: While some studies have found neural and behavioural advantages for working memory, inhibitory control and attention for multilinguals across the lifespan, others have not. Emerging research has begun to explore how dimensions of language experience (e.g., age of acquisition, acquisition mode, frequency of use, proficiency) and stimulus modality (visuospatial versus auditory processing) could influence these effects. The current study aimed to address these mixed findings by examining the impact of language experience and task modality on domain-specific cognitive functioning. Participants (N = 87) aged 18-78 years (M = 41.9, SD = 21.0) completed the Language History Questionnaire v3 (LHQ-3), visuospatial and auditory tasks indexing working memory (2-back task), attention (Attention Network task, Dichotic Listening task), and inhibitory control (Simon task). A partial correlation model revealed that language experience, calculated using the LHQ-3 Multilingual Language Diversity score, did not significantly predict performance (RT, accuracy) across any cognitive measure, irrespective of stimulus modality, $p > .05$. Age and highest level of education also did not significantly predict performance. The findings add to the mixed body of literature and suggest that epidemiological evidence supporting neuroprotective effects of multilingualism may stem from alternate non-cognitive mechanisms. Examples of this may include increased resilience to neurodegeneration due to greater cerebrovascular activity and oxygenation in areas responsible for higher order cognition and language.

A Review of Human Visual Attention in EEG-Based Brain-Computer Interfaces

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This paper reviews electroencephalography (EEG)-based brain-computer interface (BCI) technologies and their applications in studying the mechanisms of human visual attention. Visual attention is a crucial physiological process that enables individuals to filter information in complex environments and focus on the most relevant or urgent tasks. It is a significant research area closely tied to the development of BCI systems. BCI technology allows direct communication between the brain and external devices, and non-invasive EEG-based BCI systems have gained widespread use due to their low cost, high temporal resolution, and minimal risk. While visual attention can enhance BCI systems' accuracy and information transfer rate (ITR), a comprehensive understanding of the cognitive mechanisms underlying visual attention remains elusive, particularly regarding individual differences, environmental influences, and the brain's processes for filtering stimuli. This review delves into the unique advantages of EEG-based BCI systems, including those using steady-state visual evoked potentials (SSVEP), event-related potentials (ERPs), and hybrid paradigms, in capturing and analysing brain activities related to visual attention.

Neurological Response of SSVEP in Conventional Screen (2D) and Virtual Reality (3D)

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This study investigates the differences in steady-state visual evoked potentials (SSVEPs) between screen monitor-based and Virtual Reality (VR)-based environments. Research on SSVEP brain-computer interfaces (BCIs) in combination with VR has been gaining attention in recent years; however, as screens in VR environments are usually closer to the eyes than conventional screens, their potential impact on SSVEP signals needs to be investigated. By comprehensively comparing SSVEP in the environments of screen monitors and VR technology, this study aimed to evaluate the impact of these two environments on various aspects including fatigue and SSVEP amplitude. We used flicker stimuli of the same frequency and compared participants'

electroencephalography (EEG) activity in these two environments via 64-channel EEG data acquisition. Through an in-depth analysis of EEG differences, this study assessed the potential effects of screen display versus virtual reality environments on cognitive processes.

Using Signal Detection Theory to Understand the Role of Alpha Phase in Visual Perception

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Perceptual sensitivity to visual stimuli is influenced not only by sensory input but also by the ongoing state of the brain. Spontaneous oscillations in the visual cortex, particularly within the alpha frequency band (8-14 Hz), have been shown to exert a phasic influence on the detection of weak, low-contrast stimuli. Previous work on alpha power suggests that it produces an increase in baseline neural excitability that results in changes to the criterion in a signal detection model. In contrast, studies on alpha phase have exclusively analysed hit rates making it unclear whether there are distinct roles of alpha power and alpha phase in modulating perceptual sensitivity and bias using signal detection theory. In our study, eight participants performed a visual detection task involving brief presentations of Gabor patches, with contrast levels adaptively sampled around each participant's threshold. We found that stronger alpha power prior to stimulus onset was associated with a shift in decision criterion, leading to more liberal responses and increased false alarms. Importantly, while alpha power significantly impacted contrast gain and perceptual sensitivity, alpha phase did not modulate sensitivity but was linked to fluctuations in false positives. These findings suggest that previous reports attributing perceptual changes to alpha phase may, in fact, reflect the moment-by-moment shifts in signal detection theory criterion that has been demonstrated in previous studies on alpha power.

Towards Expanding Human Visual Understanding of the Essential Structure of Space to Four Dimensions Using Artificial Neural Networks

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Understanding higher dimensions, such as the fourth dimension, presents a significant challenge for humans, rooted in our three-dimensional experiential framework. While mathematical training and abstract tools have enabled some to conceptualize and even visualize 4D spaces through projections and sections, intuitive grasp remains elusive. The complexity of the essential structure of 4D data, that is, its topology, surpasses that of 3D. This challenge parallels the struggles of Flatland's inhabitants, as depicted in Abbott's 1884 novel, in comprehending the third dimension. In this study, we introduce a novel convolutional neural network-based approach, which is designed to function as a '4D camera' that is capable of perceiving the topological structures within 4D image-type data. This vision-based method diverges from traditional topological data analysis methods such as persistent homology, offering a new perspective on 4D data analysis. Simulation experiments conducted on synthetic 4D data demonstrate the network's potential, though the processing demands are substantial. As computational power becomes more accessible, this approach could be extended to spatiotemporal (3D plus time) medical imaging, paving the way for innovative applications in the medical field. Our findings suggest that with enhanced computational resources, the proposed 4D computer vision technology could bridge the gap in human understanding of higher-dimensional spaces, leading to new insights and applications in science and beyond. This project is supported by ARC DP210103304.

Mapping cerebral arterial elasticity in health older adults with optical imaging

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The integrity of the cerebrovascular system is essential for healthy brain and cognitive ageing and is influenced by lifestyle factors, such as cardiorespiratory fitness (CRF). There is currently no simple, non-invasive method for monitoring the health of regional cerebral arteries that support cognitive function. Pulse-DOT, a novel method of diffuse optical imaging, measures properties of regional cerebral arteries across the cerebral mantle and is sensitive to ageing and CRF in lifespan samples. Here we present the first use of pulse-DOT data in a large Australian sample of cognitively healthy older adults (n=180, 60-70yrs). We examine whether pulse-DOT measures of arterial elasticity in three regions of interest (ROI) perfused by the anterior and the left and right middle cerebral arteries (ACA, l-MCA, r-MCA) are associated with variability in cardiovascular health. We also present the first longitudinal pulse-DOT data over an 18mo test-retest period in a subset of participants (n=70). The pulse relaxation function (PreFx), a measure of arterial elasticity, was highly reliable across recording blocks for l-MCA, r-MCA and ACA ROIs. Higher arterial elasticity in these ROIs was associated with lower age (even in the age-restricted sample), higher estimated CRF, and lower pulse pressure (measured brachially). Early outcomes from longitudinal analyses showed a significant decline in PReFx even in the short 18mo period. These findings provide support for PReFx as a sensitive measure of cross-sectional and longitudinal variability in cerebral arterial elasticity. This positions PreFx as a potential key biomarker for monitoring cerebral arterial health and its impact on cognitive ageing.

Classification of EEG signals for creativity performance

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Understanding the potential of human creativity can help us advance our intellectual endeavors. To assess creativity, we ask participants to complete an Alternative Uses Test (AUT), in which they think of creative uses for everyday objects. We utilize a large language model, GPT-4, to evaluate each response based on its novelty and feasibility. The overall creativity of the answer is then defined as the product of the scores for novelty and feasibility. We record 128-channel electroencephalography (EEG) and develop a classifier using resting EEG data prior to each question to predict the participant's upcoming creativity performance. We termed this "creativity potential." We use linear discriminant analysis to classify EEG coherence, a connectivity measure. We find that EEG coherence leads to a classification accuracy of 60%. Specifically, the EEG coherence density in electrodes around the central and left temporal areas across all frequency bands has more contribution to identifying later creativity performance. These results reveal a potential brain marker that reflects the flexibility of the brain for creative problem-solving. With further exploration of machine-learning techniques and data collection, this classifier for pre-task resting brain states might pave the way for creating devices designed to train and enhance creativity potential.

Brain morphology in individuals with chronic idiopathic neck pain over 6 months: a magnetic resonance longitudinal cohort study

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Cortical mechanisms may partially explain pain chronicity, yet few studies examine brain structure in individuals with pain, whether it changes over time or is related to self-reported clinical outcomes. Thirty-three participants with chronic idiopathic neck pain (11 female, mean age 35.1 years) and 30 asymptomatic controls (12 female, 34.5 years) underwent structural MRI at baseline and after six months. Morphological differences between groups over time were examined using Freesurfer cluster-wise analysis and linear mixed-effect models (LMMs) investigating pain-specific brain regions of interest (ROI) with p-values adjusted using False Discovery Rate (FDR), without and with imputation of missing data. Relationships between brain morphology and pain intensity (visual analogue scale), neck disability index, and general health (Short Form-12 physical and mental component scores) were investigated with LMMs of ROIs with missing clinical data imputed with Bayesian linear regression and multiple imputation. Freesurfer clusterwise analysis found no significant differences between groups or time points. ROI analyses identified between group differences in six brain regions and differences over time in nine brain regions, but these did not survive FDR adjustment for multiple comparisons. For clinical outcome measures, two associations were consistent across models with and without imputation: right caudal anterior cingulate cortex thickness and left thalamus volume were associated with pain intensity. However, these associations did not survive FDR adjustment. Conservative statistical approaches may contribute to the lack of statistical significance. Results highlight that studies investigating brain morphology in pain may overestimate morphological changes if adjustments for multiple comparisons are not considered.

Neuronal correlates of tactile decision making

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The neuronal mechanisms underlying high-level attributes of tactile inputs and perceptual judgments based on them has remained largely unknown. Here, we investigated a particularly poorly-understood, yet fundamental quality of tactile perception: motion. We delivered a pair of vibrations (at 100 Hz) with sinusoidal envelopes (at frequencies of 0.5, 1 and 1.5Hz) and various phase differences to two fingertips, generating the perception of tactile motion across the fingers. The strength of the perceived motion was correlated with the phase difference between the vibration envelopes. We simultaneously recorded (n=20) the brain activity using a 64 channel EEG system. The early components of the event related potentials (ERP) in parietal (Pz-P1-P2-P3-P4) electrodes were correlated with the initial amplitude of the vibrations. The perceived direction of tactile motion was marginally affected by the amplitude of the vibration envelopes. The slope and peak of response locked centroparietal positivity (CPP) signal – a measure of evidence accumulation – was correlated with the perceptual acuity based on accumulated tactile evidence. Interestingly, the performance in bimanual stimulation (one finger of either hand) was 7.8% greater than that in unimanual stimulation (two fingers in right hand). Consistently, the peak and slope of the CPP for bimanual condition was 16.9% and 21.7% greater compared to the unimanual condition. These findings suggest that the CPP tracks the subjective perceptual accumulated evidence, over and above the basic physical attributes of sensory input such as the amplitude of the vibrations. The vibration-based motion stimulation paradigm, analogous to the random dot motion paradigm in vision, can be used to investigate the neuronal mechanisms of tactile perception and decision making.

Commonalities and Differences between the Flash-lag and Flash-grab Effects

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Stimuli presented briefly in the presence of nearby motion signals are subject to consistent localisation errors, as demonstrated among a number of motion-position illusions (MPIs). Predictive processes such as motion extrapolation are commonly implicated in these illusions, however temporal uncertainty and attention likely contribute to some, but not all MPIs (Hubbard, 2014; Holcombe & Corbett, 2023). Prior research indicates an interesting dissociation between two well-known MPIs; the flash-lag effect (FLE) is larger for presentations in the left visual field

(Kanai et al., 2004; Suzuki et al., 2023), while the flash-grab effect (FGE) has been found to be larger in the right (Adamian & Cavanagh, 2024). This dissociation implies disparate mechanisms may underlie these effects; consistent with this across participants, the illusions are not strongly correlated (Cottier et al., 2023). Here, we investigated how the FLE and FGE relate and vary within observers, correlating the size of these illusions across different regions of the visual field and directions of motion in relation to the fovea. This is the first study we are aware of to directly compare hemifield asymmetries between these MPIs, or to test directional anisotropy for the FGE. Early findings from pilot data suggest larger effects for foveopetal motion in both illusions; further results after completion of data collection will be presented at the meeting (expected to be finalised by October 2024).

A Cognitive Model of Cued Trials Task-Switching Performance

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Task-switching paradigms have been used to investigate cognitive control processes, emulating everyday tasks which require regulating cognitive resources. Conventional behavioural measures, such as switch and mixing cost, have been theoretically linked to underlying cognitive control processes such as set-shifting ability and working memory. However, these measures do not directly map to neural processes and do not necessarily tap into distinct cognitive components. Cognitive modelling approaches have sought to identify constituent processes contributing to task-switching performance. They have typically used diffusion decision models (DDM) that are not designed to capture task-switching behaviour. Here, we extend a recent model of task-switching (Steyvers et al., 2019) to capture the complex dynamics of task activation in a cued-trials task-switching paradigm in a large sample of healthy older adults (n=177, 60-70 years). The model is based on an evidence-accumulation architecture extended to incorporate cognitive processes associated with task-set maintenance and updating that occur in the cue-target interval, namely task-set activation and deactivation. Results show that, with the additional processes associated with task activation, the model captures qualitative and quantitative trends in behavioural data that are consistent with task-switching literature (e.g., switch cost, mixing cost, and congruency costs) and provides a strong, quantitative basis for some of the theoretically proposed processes underlying task-switching performance (e.g., task activation). On examination of the parameter values of the weakest and strongest performers on five different task-switching metrics, the model provided unique insights into individual differences on the cognitive processes driving performance in cued trials task-switching behaviour.

Individual Differences in Executive Functioning Predict Performance on a Novel Test of Change Detection

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Russell Conduit, RMIT University
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Change blindness is a phenomenon where people fail to detect changes in two different but similar images despite being available within visual perception and obvious when pointed out. Although the ability to detect changes is crucial for driving and occupations such as search and rescue, there is still very little known about the individual differences that contribute to one's change detection ability. The two main cognitive processes that influence visual search are often categorised as top-down and bottom-up attention processes. Executive functions, consisting of attention control, working memory, and cognitive flexibility, are higher-order top-down processes involved in coordinating other lower-level cognitive abilities and actions during goal-directed behaviour. Previous research has highlighted the involvement of attentional and visual memory processes in successful change detection. The present study used a novel test of change detection, paired with a battery of cognitive tests, to ascertain which cognitive domains are most strongly associated with change detection performance in a sample of 260 participants. A multiple linear regression analysis revealed that executive functioning accounted for a significant amount of variance in change detection scores. Specifically, those with superior visuospatial working memory correctly identified more changes. Neither attention and processing speed, or cognitive flexibility were significant predictors. The results of this study have helped further our understanding of the cognitive mechanisms involved in change detection. These findings have important real-world implications where the change detection task could be used as a screening and prerequisite tool for drivers and occupations requiring identifying visual changes in the environment.

Movement planning and execution: Unravelling brain connectivity patterns associated with motor activity in healthy adults

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Human movement is an inherent component of daily life, and it is therefore crucial to understand the brain mechanisms that guide motor function. Previous research revealed that movement is underpinned by coordinated oscillatory brain activity, with interactions between oscillations of different frequencies, or cross-frequency couplings (CFC), thought to be especially informative (Combrisson et al., 2017; Herz et al., 2012) However, the distinction in CFC during motor planning and execution for different levels of task complexity are still unclear. In this study we aim to characterise these discrepancies by recording 64-channel electroencephalography (EEG) as younger adults (n=30, age=18-40, gender-balanced) perform a delayed-response visuomotor adaptation task and a simple finger tapping task. We will then extract measures of phase-amplitude coupling (PAC; a form of CFC) from these recordings to reveal oscillatory interactions related to motor functions. These measures will be compared

between: (1) movement phases, revealing changes associated with planning vs. execution, and (2) simple and complex tasks, to index complexity differences. We expect that PAC in the complex visuomotor adaptation task will be increased compared to the simple motor task. Moreover, the complex visuomotor adaptation task will lead to recruitment of a broader motor network that includes areas responsible for cognitive control and attention. Additionally, we anticipate seeing spectral power modulations across task stages. The mechanistic insights provided by this project may be relevant for understanding functional connectivity of the brain and inform the development of targeted therapies and interventions for motor rehabilitation. This project was funded by ARC DECRA (DE230100022).

Comparison of rest before and after meditation using loving kindness mediation/ non-meditation EEG data for single and multiple within-subject sessions

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A study was conducted to develop a classifier to discriminate between meditation versus non-meditation EEG data (127-channel) using both single and multiple within-subject sessions. Two types of Loving Kindness Meditation (LKM-Self and LKM-Others) were classified with two non-meditation instances (rest before meditation and rest after meditation) while conducting four studies for each meditation/non-meditation pair. For the single session study, data from 32 participants were used, and for the multiple session study, data from 5 sessions from 15 participants were used. In both cases, for each participant, EEG data was epoched (2 secs) and placed into a pool. For each pairwise classification, train/test data were randomly selected from the pool, and for each pairwise comparison for a single person, 25 tests were conducted, and an average result was obtained. After the initial preprocessing, Common Spatial Patterns (CSP) was used as the feature extraction algorithm, and Linear Discriminant Analysis (LDA) was used for the classification. Out of the four tests, average classification accuracies were obtained for rest before meditation vs. meditation and rest after meditation vs. meditation. Out of 32 participants for the single session, 26 (81.3%) showed a lower classification accuracy for rest after meditation vs. meditation when compared with rest before meditation vs. meditation. Supporting this, out of 15 participants for multiple sessions, 13 (86.7%) showed similar results. This pattern of the classification accuracy differences indicates that, meditation and rest after meditation have more similar characteristics, leading to lower classification accuracies.

Understanding the neural circuits involved in the balance of learning between cues with different proximity to rewards

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GABAergic neurons in lateral hypothalamus (LHGABA) are critical for learning about reward cues. We have shown that LHGABA neurons differently regulate learning about reward cues depending on the relative distance of the cues to rewards. This led to our hypothesis that LHGABA neurons bias behaviours toward cues closest to reward and away from distal cues. To formally investigate this in rats, we adapted the "Daw two-step task" developed to investigate the ability of human subjects to use complex task structure to influence decision making. Our task enables us to measure behavioural controls as dependent on cues that have different distance to reward. Rats first receive one of two distal cues that are further from reward followed by insertion of two levers into the chamber. After pressing one of the two levers, rats receive one of two proximal cues that are closest to reward. The distal cues inform different state transitions from the levers to the proximal cues. In turn, the proximal cues inform the fluctuating reward probabilities (high/low). Rats can "find" the rewarding proximal cue through the session by using the transitional structure of the task dictated by the combination of distal and proximal cues. Using a logistic regression model, we showed that rats adapted their choices depending on whether the last trial was rewarded and the nature of the transitional structure. We will combine our task with optogenetic approaches to parse the contribution of LHGABA neurons in the differential weighting of distal and proximal cues over learning and behaviour.

Face pareidolia in fractal noise patterns: effects of stimulus duration and size

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The extent to which face pareidolia - the spontaneous perception of faces in images where there are none - is affected by low-level stimulus features remains unclear. Fractal noise can be used to evoke pareidolia while systematically varying low-level stimulus dimensions, e.g., symmetry. Here, we investigated the incidence of face pareidolia in fractal noise at three levels of symmetry around the vertical midline, perfect symmetry, half symmetry, and no symmetry, while varying the stimulus presentation duration (Experiment 1) and size (Experiment 2). In both experiments, participants reported whether they saw a face in a Yes/No task. Symmetry substantially increased the incidence of pareidolia even at the briefest presentation duration, 50 milliseconds, and the smallest size, spanning as little as 0.74 degrees of visual angle. The proportion of 'yes' responses increased with duration across both symmetry conditions but not in the no symmetry condition. Similarly, the incidence of pareidolia in symmetrical and half-symmetrical patterns increased with stimulus size, plateauing between 3 and 6 degrees of visual angle. The presentation duration and size parameters associated with increased pareidolia incidence in fractal noise are broadly consistent with those reported in the past literature for face individuation tasks with images of real faces and the associated neural responses. This suggests that symmetrical fractal noise stimuli might recruit similar mechanisms to those involved in the detection of real faces. This research is supported by an Australian Government Research Training Program (RTP) Scholarship.

The neural basis of creative thought: an activation likelihood estimation meta-analysis

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Creativity has long been considered a distinct mental function that is associated with some fundamental cognitive domains supporting complex human behaviour (e.g., attention, memory, cognitive control). However, converging clinical-cognitive neuroscience evidence suggests that creative thought might not be functionally distinct, but instead arises from general purpose cognitive mechanisms supporting controlled semantic cognition, controlled episodic memory retrieval, and executive control mechanisms (i.e., "cognitive cornerstones hypothesis", Chan et al., 2023). We aimed to validate our hypothesis by conducting an activation likelihood estimation (ALE) analysis. Based on a comprehensive literature search, we included 784 positron emission topography or functional magnetic resonance imaging experiments that represented 14975 healthy adult participants (aged 18-40) in the analysis. ALE maps (cluster family-wise error [FWE] corrected $p<.05$) revealed the following: 1) creativity tasks consistently recruit bilateral frontal-temporo-parietal brain regions; 2) cognitive tasks tapping controlled semantic cognition and controlled episodic memory retrieval consistently recruit left-lateralised fronto-parieto-temporal brain regions; and 3) cognitive tasks tapping executive control mechanisms consistently recruit bilateral frontoparietal brain regions. Importantly, conjunction analysis showed that the brain regions implicated in creativity tasks heavily overlap with the brain regions implicated in cognitive tasks tapping controlled semantic cognition, controlled episodic memory retrieval, and executive control mechanisms (cluster FWE-corrected $p <.05$). Our results provide powerful evidence in support of the cognitive cornerstones hypothesis of creative thought. To understand the neural basis of creative thought, we suggest that it would be beneficial to study the complex interactions between the cognitive cornerstone components in support of various creative mental activities.

Is visual processing depth robust to attention lapses?

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We investigated whether visual stimuli are processed less deeply through the visual hierarchy during a lapse of sustained attention by analysing an existing dataset from Grootwagers et al. (2021). Participants sequentially viewed images depicting an object overlaid with a letter, performing a 2-back task on either the object or letter while electroencephalographic (EEG) data were recorded. Behavioural responses were used as an index of attention, with failure to detect the 2-back target within 2 seconds classified as an attention lapse. Neural decoding was used to determine whether hierarchically organised stimulus and task features (e.g., exemplar-, object-, category-, and task-level information) were differentially represented in the brain depending on whether participants successfully or unsuccessfully detected 2-back targets. Although image exemplar matching was directly relevant for the 2-back task, there were virtually no differences between hits and misses in how accurately individual image exemplars could be decoded. Additionally, only minimal differences between hits and misses were detected when decoding higher-level visual features such as whether a stimulus was a boat or a plane (e.g., object-level decoding), or whether a stimulus was an animal or vehicle (e.g., category-level decoding). However, the neural representations encoding abstract information about which 2-back task was being performed consistently differed between hits and misses. Overall, visual feature processing was largely robust to lapses of sustained attention, with lapses likely to relate more to how abstract task information is maintained in memory and applied to behaviour rather than how the visual features of stimuli are encoded. Funding: ARC FT230100119.

Perceptual judgements of noisy visual motion signals are biased by high-precision priors

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Everyday decisions are often made under conditions of sensory uncertainty – for instance, recognizing a friend across a crowded concert hall. To navigate such uncertainty, adaptive choices may incorporate prior knowledge about relevant sensory features, such as the colour of the friend's clothing or distinctive facial characteristics. The Bayesian inference framework posits that decisions arise from a combination of prior knowledge and current sensory input, weighted by their respective precisions. This framework predicts stronger reliance on prior knowledge as the sensory uncertainty increases. To test this prediction, we had human volunteers view random-dot motion patches and indicate the direction of brief coherent motion signals presented at varying levels of uncertainty. Unbeknownst to participants, motion directions were drawn from a sampling distribution whose mean and variance were manipulated across blocks, allowing us to assess the degree to which a prior embedded in the task structure influenced participants' judgements. We contrasted motion-direction judgement errors across different levels of sensory and prior uncertainty and found that decisions were biased toward the central tendency of the prior, with the strongest biases emerging for weak motion signals presented under a high-precision prior, consistent with a Bayesian inference framework.

FRIDAY 29th NOVEMBER

Young Investigator Award - Melissa Sharpe

Distinct dopamine circuits encode unique neural signatures for learning

Melissa Sharpe
University of Sydney

There is now a lot of evidence that phasic dopamine prediction error signals act as general teaching signals to stamp in learned associations throughout the brain. This has spurred research aimed at understanding how the quintessential dopamine teaching signal might act differently in distinct circuits to support unique forms of learning. In this spirit, our lab has recorded dopamine release in the nucleus accumbens, lateral hypothalamus, and ventral hippocampus during reinforcement learning. Surprisingly, this work reveals that dopamine release in these regions does not reflect a uniform teaching signal that look like a quintessential prediction error. Instead, dopamine release in these regions reflects a qualitatively unique signature that tracks learning in distinct ways. Our behavioural studies provide evidence that these signals are contributing to different forms of learning. We are now working towards understanding how changes in dopamine release in these circuits could contribute to psychological disorders, in particular drug addiction and Alzheimer's disease.

Young Investigator Award - Nigel Rogasch

Improving memory with non-invasive brain stimulation: where to from here?

Nigel Rogasch
University of Adelaide

Working memory is a fundamental cognitive process which refers to the ability to hold information in the mind for brief periods for use in a future task. Impairment in working memory is common across a range of brain disorders, as well as with healthy aging, and is often closely related to quality of life. However, there are currently few interventions capable of improving working memory. I will discuss our work assessing whether we can improve working memory using transcranial magnetic stimulation (TMS), a non-invasive brain stimulation technique capable of reorganising targeted neural circuits by inducing neuroplasticity. Despite early promise, our more recent findings paint a complex picture, with high inter-individual variability in both behavioural and neurophysiological outcomes following stimulation. These results have led to a challenging question: what is the best way to deliver stimulation to reliably improve working memory? I will detail how we are approaching this problem, using a combination of neuroimaging, electrophysiology, pharmacology, and biophysical modelling to improve our understanding of the neural mechanisms underlying working memory performance, and how TMS interacts with these mechanisms. The overarching goal of this work is to develop a 'precision TMS' framework, which will allow tailored TMS interventions for improving cognitive function at the individual level.

Symposium - How learning and attention shape prediction and action: Understanding the Brain at Multiple Scales of Analysis

Understanding learning integration in basal ganglia networks

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The basal ganglia are a group of evolutionarily preserved nuclei that sits at the brain's core and fulfills functions related to action control. While a strong focus on their role in motor control has traditionally been given, our research has contributed to unravel what could easily be their most important function: the integration of learning. Indeed, close inspection of their cytoarchitecture gives away such a function. For example, the two main circuits that support basal ganglia function—the direct and indirect pathways—are composed by neurons with incredible capacity for plasticity, revealing great integrational potential. Moreover, the way these two pathways are organised in the striatum—completely intermingled and occupying all striatal spaces in equal proportions—also provides clues of how these neural systems might collaborate to integrate learning. In my lab we model basal ganglia-dependent behaviours in transgenic mice to visualise learning processes within these circuits. Our experiments show explicit dynamic patterns of neuronal plasticity as learning sets in, the trajectory of which maps with well-established functional domains drawn from corticostriatal connectivity. We also observe that indirect pathway neurons modulate plasticity in direct pathway counterparts in a permissive way, underscoring key collaborative mechanisms that are central to learning integration.

Understanding the neural circuits involved in the balance of learning between cues with different proximity to rewards.

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GABAergic neurons in lateral hypothalamus (LH_{GABA}) are critical for learning about reward cues. We have shown that LH_{GABA} neurons differently regulate learning about reward cues depending on the relative temporal distance of the cues to rewards. This led to our hypothesis that LH_{GABA} neurons bias learning and behaviour toward cues proximal reward, and away from those distal to rewards. To formally investigate this in rats, we adapted the "Daw two-step task", which quantifies the ability of human subjects to use complex task structure to predict rewards. This task enables us to measure the weights of distal and proximal cues on future choice. Rats first receive one of two distal cues followed by presentation of two levers. Rats then press one of the levers and receive one of two proximal cues. The distal cues inform the probabilistic state transitions from the lever choice to the proximal cues. In turn, the proximal cues inform the fluctuating reward probabilities. We found that rats are able to guide their choices by using the transitional structure of the task, including significant weightings on choice behaviour by both the distal and proximal cues. We will combine our task with optogenetic approaches to parse the contribution of LH_{GABA} neurons in the balance of learning between distal and proximal cues of rewards.

Laminar organization of visual attention in the posterior parietal cortex

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Brain areas communicate with temporal precision to control complex, cognitive behaviors like visual attention. One strategy the brain uses to keep track of inputs across areas is the laminar organization of the cortex. Inputs from different brain areas arrive at different cortical layers, yet we have little understanding of how individual cells keep track of different streams of information. One hypothesis is that the frequency components of the local field potential (LFP) may synchronize inputs from different streams of information. Because of their lissencephalic brains, marmosets provide a unique animal model for dissecting the functional roles of cortical lamina. To test whether spike-LFP phase coherence is related to cognitive behavior, we trained the marmosets to do a cued-saccade task. For cells with that were tuned to saccade directions near the cued direction, there was a significant increase in spike-LFP coherence in the beta band (20 Hz) on cued trials compared to uncued trials, and superficial cortical layers had higher spike-LFP coherence compared to deep cortical layers. Therefore, spike-LFP coherence may be a mechanism for cells to integrate feedback information and support cognitive behavior.

The influence of temporal context on vision over multiple time scales

Reuben Rideaux
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Kacie Lee, School of Psychology, University of Sydney

Past sensory experiences influence perception of the present. Multiple research subfields have emerged to study this phenomenon at different temporal scales. These fall into three categories: the influence of immediately preceding sensory events (micro), short sequences of events (meso), and regularities over long sequences of events (macro). In a single paradigm, we examined the influence of temporal context on perception at each scale. Combining psychophysical, physiological, and electrophysiological recordings from 200 human participants, we identify two distinct mechanisms that operate across all scales. The first is moderated by attention and supports rapid motor responses to expected events. The second is independent of task-demands and dampens the feedforward neural responses to expected events, leading to unexpected events eliciting earlier and more precise neural representations. We further show that perceptual recall exclusively reflects neural representations during this initial feedforward stage and that serial dependence (recall biases towards previous events) is explained by expectation of sensory stability over time.

Symposium - Perceiving the everyday: Naturalistic paradigms and their use in cognitive neuroscience

Stimulus variance should be a feature, not a bug

Will Harrison
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If we develop generalisable theories in cognitive neuroscience, we should be able to predict what people will see, think and feel when they are outside the lab. To mitigate the risk of building theories that solely predict how people will respond to abstract spots of light on a computer monitor, we must embrace naturalistic high-variance stimulus sets. I will describe how observer models can generate accurate quantitative predictions for such naturalistic stimuli, thereby (hopefully) improving our understanding of human psychology in the real world.

What Does the Eye See Best?

Branka Spehar
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The answer to this question depends on the nature of the stimuli, tasks and the processes that one chooses to investigate. Their intertwined characteristics determine, if not limit, the practical implications and theoretical conceptualizations regarding the nature and capacity of perceptual experience. For example, one widely influential view holds that it is a small, briefly exposed circular patch of sinusoidal grating having a spatial frequency of 7 cycles/degree, drifting at-4Hz, that is detected better than any other stimuli (Watson et al., 1983; Watson & Ahumada, 2016). In a similar vein, it is also widely accepted that early sensory and perceptual processing is best characterised as “affectively neutral”, with “meanings, values and feelings” added through post-perceptual processing. We employ synthetic stimuli inspired by natural scene statistics that manipulate only the foundational spatial and temporal dimensions of sensory coding. By moving beyond threshold detection and discrimination tasks and interrogating the perception of high-level dynamic and expressive properties in such stimuli, we aim to broaden our understanding of the contribution of fundamental sensory processing to the richness of perceptual experience across senses.

Reading or Viewing: The trade-off of visual attention in captioned movies

Anna Behler
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Closed captions have become an integral part of modern film viewing, adding a layer of complexity to the multisensory experience by prompting viewers to balance attention between visual scenes and text. This study explores how eye movements, as indicators of attentional states, respond to captions and visual scenes under varying sound conditions, revealing how auditory cues and narrative elements influence visual engagement. Findings show that viewers adapt their gaze patterns to manage both textual and visual inputs, even adjusting their transitions when audio is absent to maintain engagement. Modelling these gaze behaviours reveals distinct differences in reading versus gazing patterns, with more consistent eye movements observed during caption reading. Overall, these results suggest that reading and gazing reflect flexible visual behaviours shaped by sensory

and narrative cues. That highlights how captions are naturally integrated into media experiences, offering insights into the brain's ability to adaptively manage multisensory information in complex, real-world environments.

Movies as a platform to probe brain-body responses

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Neuroscience has predominantly used simplistic stimuli such as static pictures of faces with emotional expressions to investigate neural underpinnings of emotional perception and experience. However, perception, identification and recognition of emotions inherently limit the complex and dynamic interplay of the brain-body-behaviour in generating emotional experiences. Naturalistic stimuli such as movies provide an ideal platform which elicit robust physiological responses associated with emotions. Furthermore, they enhance the ecological validity of task paradigms mirroring everyday scenarios. I will present work from three studies which leverage movies to investigate multimodal bodily responses and high-fidelity intracranial EEG. First, I will show how movies elicit a consistency of various body physiological measures such as heart rate, skin conductance and novel facial thermal imaging among subjects. Next, I will show dynamic interactions between anterior insula and anterior cingulate, key regions underpinning emotions as well as regulating autonomic signals, and how their interactions is linked with heart rate as well as movie properties. Finally, I will show how emotionally evocative movies enable insights into how the brain and the body signals dynamically interact underpinning integration and segregation properties of the brain.

Titrating levels of realism in virtual reality to explore a visual illusion

Katherine Storrs
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In vision science, VR allows us to restrict or provide sensorimotor information in an immersive yet controlled environment. We used this to explore an illusion in which perfectly matte surfaces can appear glossy (Wijntjes & Pont, 2011). Observers may misattribute bright regions on a bumpy surface to a reflective material, rather than to sharp peaks catching a nearby light source. If so, we reasoned that by progressively allowing observers an increasingly naturalistic and interactive experience with a test object in VR, we could isolate the visual cues needed to correctly disambiguate its shape, lighting, and material. In two experiments (N=34, N=25) we measured the presence and strength of illusory gloss under four viewing conditions: 1) static 2D surface, 2) static 3D surface, 3) moveable 3D surface with object-relative lighting, and 4) moveable 3D surface with world-fixed lighting. Illusory gloss was, surprisingly, strongest in the most naturalistic viewing condition (eta-squared = 0.80) and weakest in the most impoverished (eta-squared = 0.56). Observers do not appear to make optimal use of the available information, and may instead rely on simple heuristics to judge material in this context.