acns {virtual} conference

2021

abstracts & program booklet

2021 award winners and keynote addresses

Lifetime Contribution Award

Emeritus Professor Michael Corballis

Michael Corballis was born in the farming district of Marton, New Zealand, in 1936. After completing Master's degrees in mathematics and psychology, he completed a Ph.D. in psychology at McGill University and joined the faculty there for some years before returning to the University of Auckland in 1977. He is now an emeritus professor and a "Creativity Fellow".

His interests have grown from experimental psychology and psychological statistics to cognitive neuroscience, language, and evolution.

He was awarded an honorary LL.D. by the University of Waterloo in Canada in 1998, and was appointed Officer of the New Zealand Order of Merit (ONZOM) in 2002. He is a past-president of the International Neuropsychological Society, and hold Fellowships in AAAS, the American Psychological Association, the Society of Psychological Scientists, and the Royal Society of New Zealand. In 2016, he was awarded the Rutherford Medal for foundational research on the nature and evolution of the human mind, including cerebral asymmetries, handedness, mental imagery, language, and mental time travel. He was a semifinalist for Senior New Zealander of the Year in 2020.

Young Investigator Award

Professor Karen Caeyenberghs

Professor Karen Caeyenberghs is a psychologist and neuroscientist. Her research interests are focused on mechanisms underlying neuroplasticity in brain-injured patients using a multidisciplinary approach, spanning the behavioural sciences and the cognitive neurosciences with a specific focus on the study of brain structure and connectivity using medical imaging technologies. Her contributions include publishing the first studies using diffusion MRI in children with TBI; developing novel home-based training programs for brain injured populations (BrainGames and CogMo); providing the first evidence of chronic cognitive impairments from a disconnection syndrome perspective; and publishing some of the first brain-wide maps of dynamic structural connectivity changes with training and disease progression. She holds an NHMRC Career Development Fellowship, with a focus on the underlying mechanisms of secondary injury of traumatic brain injury. Professor Caeyenberghs is the Program Leader for Microstructural Imaging and Rehabilitative Plasticity at the Cognitive Neuroscience Unit and she leads the paediatric moderate-severe TBI consortium (enigma.ini.usc.edu/ongoing/enigma-tbi/) examining the impact of brain injury on the developing brain. She has previously worked at the Australian Catholic University, University of Ghent, Cardiff University Brain Research Imaging Center, and Catholic University of Leuven. Professor Caeyenberghs has authored over 90 scientific articles in high-impact international peer-reviewed journals (e.g., Brain, Neuroimage, Developmental Science, Neurorehabilitation and Neural Repair, Journal of Neuroscience) and she has acted as a reviewer for over 20 academic journals. She has received over $2.5million in research funding. Bodies that have funded her research include the National Health and Medical Research Council (NHMRC) and the Flanders Fund for Scientific Research (FWO). Professor Caeyenberghs has recently taken-up the Co-Director role of the cognitive neuroscience unit at Deakin University.

Emerging Researcher Award

Dr Mana Biabani

Mana Biabani completed her PhD in Neuroscience at Monash University, in 2019. Currently, she is a research fellow at the Turner Institute for Brain and Mental Health at Monash. Her PHD was mainly focused on advancing methodological approaches in non-invasive brain stimulation research with the aim of maximising the potential of transcranial magnetic stimulation (TMS) to study brain dynamics. To achieve this aim, her research utilised multimodal investigations of neural mechanisms

sponsors

(EEG, EMG, MRI), advanced signal processing methods, and the development of novel analytical algorithms and pipelines. Following her PhD, Mana expanded the application of her findings into clinically oriented disciplines. She combines TMS with cognitive, neuroimaging and genetic assessments to develop integrated approaches to identify the key mechanisms underlying cognitive functions such as working memory in healthy individuals and cognitive impairments such as attention deficits in patients diagnosed with ADHD.

Emerging Researcher Award

Dr Sidhant Chopra

The ability to map and model the neural processes which underpin serious mental illness has become a primary goal of psychiatry. However, there has been little translation into actionable insights for clinicians, and treatments for patients. The primary goal of my research program is to bridge the divide between cognitive neuroscience and psychiatry, by conducting research that results in neurobiologically-informed actionable treatment insights for clinicians and patients. During my PhD, I have worked as a clinician in early psychosis treatment services and conducted research focusing on differentiating the effects of serious psychiatric illnesses from psychiatric medications. This research has so far resulted in two influential papers in popular journals (JAMA Psychiatry and Neuropsychopharmacology), with both articles in the top 2% of all research outputs ever tracked by Altmetric. In addition, I am a big advocate for open science and open-source software, having published all the code involved in my research, as well as developing several open-source tools for the neuroimaging community.

SYMBIOTIC DEVICES

Symbiotic Devices

Symbiotic Devices was founded in 2012 on a passion not only for neuroscience and neurotechnology, but also to provide clients with uncompromised quality, reliability and assistance. Striving to contribute to a sustainable successful research and clinical sectors across Australia and New Zealand, Symbiotic Devices aims to balance quality, accessibility and customisation.

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Medilink offers a range of innovative neuro stimulation and modulation devices as well as medical imaging hardware, software and consumables to the healthcare market within Australia.
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thank you

This event was made possible thanks to the following people:

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Bella Bower
Thomas Carlson
Paul Dux
Talitha Ford
Tijl Grootswagers
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Award Judging Panel

(oral and poster presentations)

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Katharina Voigt

Emerging Researcher Award Panel

(including equity and diversity oversight and administration)

Sophie Andrews
Thomas Carlson
Taz Clifford
Tijl Grootswagers
Sharna Jamadar
Hannah Keage
Gemma Lamp
Eric Tan

Young Investigator Award Panel

(including equity and diversity oversight and administration)

Thomas Carlson
Taz Clifford
Sharna Jamadar
Hannah Keage
Gemma Lamp
Jacob Paul
Eric Tan

Lifetime Contribution Award Panel

(including equity and diversity oversight and administration)

Isabella Bower
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Talitha Ford
Tijl Grootswagers
Sharna Jamadar
Hannah Keage
Gemma Lamp
Jacob Paul
Eric Tan

Program Overview (Sydney/Melbourne times)

18th November	
Session 1	**Welcome**
10.15-10.30	Welcome and acknowledgement of Lifetime Contribution Award
10.30-11am	Keynote from Emerging Researcher Award - Dr Mana Biabani

Session 2	**Rapid fire presentations**
11am-12pm	13 * 3 minute presentations

Poster session	**.pdfs on website**
12:15-1:15pm	Individual Zoom links provided by participants

Session 3	**Oral presentations**
1:30-2:30pm	4 * 10 minute presentations (5 minutes of questions per talk)

Session 4	**Rapid fire presentations**
2:30-3:30pm	13 * 3 minute presentations

Session 5	**Oral presentations**
4-5pm	4 * 10 minute presentations (5 minutes of questions per talk)

ECR EVENT
5-7pm

19th November	
Session 6	**Welcome**
10-11am	Keynote from Young Investigator Award winner - Professor Karen Caeyenberghs
	Keynote from Emerging Researcher Award - Dr Sidhant Chopra

Session 2	**Rapid fire presentations**
11am-12pm	13 * 3 minute presentations

AGM	**Please access through Whova platform**
12:15-1:15pm	

Session 8	**Oral presentations**
1:30-2:30pm	4 * 10 minute presentations (5 minutes of questions per talk)

Session 9	**Rapid fire presentations**
2:30-3:30pm	13 * 3 minute presentations

Session 10	**Oral presentations**
4-5pm	4 * 10 minute presentations (5 minutes of questions per talk)

Close

Full Program: 18th November (Sydney/Melbourne times)

Session 1	Welcome	
10.15-10.30	Welcome and acknowledgement of Lifetime award Co-chairs: Thomas Carlson and Sharna Jamadar	
10.30-11am	Keynote from Emerging Researcher Award - Dr Mana Biabani: Do TMS-evoked potentials reliably reflect the dynamics of the targeted cortical area?	Professor Thomas Suddendorf

Session 2	Rapid fire presentations: Ageing and clinical	
11am-12pm	13 * 3 minute presentations Co-chairs: Thomas Carlson and Talitha Ford	
	The Dellrium VULnerability in GEriatrics (DIVULGE) Study: Protocol for a prospective EEG study of incident delirium	Monique Boord
	Relationships between Cognition, Reward Drive, and Impulsivity in Adolescence and Young Adulthood	Montana Hunter
	Which measures from a sustained attention task best predict ADHD group membership?	Katherine Johnson
	Characterising anatomical heterogeneity in psychiatric disorders using normative models	Ashlea Segal
	Neural Correlates of Co-Occurring Pain and Depression: A Systematic Review and Activation Likelihood Estimation (ALE) Meta-Analysis	Carmen Zheng
	Cognitive and neural mechanisms of subjective time in frontotemporal dementia	Lulu Liu
	Anxiety Attenuates the Behavioural and Neuronal Learning Advantages Conferred by Statistical Stability	Elise Rowe
	A systematic review into the relationship between blood pressure variability and structural brain changes	Daria Gutteridge
	Compiling a typical ageing trajectory of the brain: Linking the meso- and macro- scale determinants of cognitive ageing.	Robert Di Paolo
	Does cardiorespiratory fitness mediate the relationship between physical activity and cognitive functioning?	Teigan Cotterill
	Periodic and aperiodic neural activity displays age-dependent changes across early-to-middle childhood	Aron Hill
	Cerebrovascular Health and Task Switching Variability in Healthy Ageing	Nicholas Ware
	Measuring Myelin in Attention-Deficit/Hyperactivity Disorder (ADHD)	Lillian Dipnall

Poster 1	.pdfs on website.	
12:15-1:15pm	Individual Zoom links provided by participants.	

Session 3	Oral presentations: Methods	
1:30-2:30pm	4 * 10 minute presentations (5 minutes of questions per talk)	
	Activation Likelihood Estimates Meta-Analysis of Glucose Metabolism Across the Adult Lifespan	Hamish Deery
	Metabolic and functional connectomes show domain generality in cognition-connectome relationships: a simultaneous MRI-PET study	Katharina Voigt
	Real-time neurofeedback training of spatial and feature-based attention selectively enhances visual processing	Angela I. Renton
	NeuroDesk - A cross-platform data analysis environment for reproducible neuroimaging	Steffen Bollmann

Session 4	Rapid fire presentations: Methods and clinical	
2:30-3:30pm	13 * 3 minute presentations Co-chairs: Sharna Jamadar and Eric Tan	

	Capitalising on inter-individual differences in aperiodic activity to evaluate the exclusion of left-handers in EEG language research	Nicole Vass
	Cortico-striatal activity distinguishes human safety learning via Pavlovian conditioned inhibition	Patrick Laing
	Investigating the relationship between Research Domain Criteria Social Processes, and GABA and glutamate concentrations in the superior temporal sulcus	Nina Parrella
	External speech processing and auditory verbal hallucinations: A systematic review of functional neuroimaging studies	Sophie Richards
	An investigation of neuropsychological and lesion characteristics of post-stroke apathy	Kristina Horne
	A 1H MRS study investigating the relationships between cortical GSH and cognition and negative symptoms in chronic schizophrenia	Caitlin Yolland
	Noradrenergic modulation of saccades in Parkinson's disease	Isabella Orlando
	Characterisation of the Psychopathology of Autoimmune Encephalitis	Sher Ting Chim
	Electroencephalography measures of scopolamine's potential antidepressant effects	Joseph Chen
	Understanding the relationship between white matter and cognitive function in bipolar disorder: A systematic review	Georgia Caruana
	Combining information theoretic metrics with electrophysiological measures to characterise early statistical learning mechanisms	Thivina Thanabalan
	Natural vs forced language switching: free selection and consistent choices eliminate significant performance costs and cognitive demands in the brain	Judy Zhu
	Investigating predictive coding in younger and older children using MEG and a multi-feature auditory oddball paradigm	Hannah Rapaport

Session 5	**Oral presentations: Ageing and clinical**	
4-5pm	4 * 10 minute presentations (5 minutes of questions per talk) Co-chairs: Muireann Irish and Daniel Feuerriegel	
	Working memory as an endophenotype linking genetic risk for attention-deficit/hyperactivity disorder to its behavioural traits in a large population-based sample	Mia Moses
	White matter fibre degeneration over 3 years after ischemic stroke	Natalia Egorova-Brumley
	The locus coeruleus noradrenaline system in Parkinson's disease modulating impulsivity and reinforcement learning	Claire O'Callaghan
	Illness- and Medication-related Brain Volume Changes in Psychosis are Shaped by Connectome Architecture	Sidhant Chopra

ECR EVENT		
5-7pm		

Full Program: 19th November (Sydney/Melbourne times)

Session 6	Welcome	
10-11am	Keynote from Young Investigator Award winner - Professor Karen Caeyenberghs: Can we get closer to understanding the relationships between the brain, mind, and behaviour in health and disease? Co-chairs: Tijl Grootswagers and Anina Rich	
	Keynote from Emerging Researcher Award - Sidhant Chopra: Mapping and Modelling Brain Changes in Psychosis	

Session 7	Rapid fire presentations: Attention, memory and decision making	
11am-12pm	13 * 3 minute presentations Co-chairs: Tijl Grootswagers and Anina Rich	
	A longitudinal investigation of the impacts of sleep on sustained attention in children	Georgia Radford
	Decision strategies: causal investigations of the trade-off between decision speed and accuracy in the frontal cortex	Hannah Filmer
	The magic of memory: rapid consolidation via prior knowledge and repeated retrieval	Hayley Caldwell
	Built environment design modulates autonomic and EEG indices of emotional response	Isabella S. Bower
	Trans-ancestry genome wide association study of executive functions in up to 14 877 subjects	Aurina Arnatkeviciute
	No effect on visuospatial or temporal attention following offline parietal iTBS or alpha frequency tACS stimulation in healthy participants	Jessica Moretti
	Investigating individual differences in impulsivity in relation to varied risky decision-making	Taylah Williams
	Heightened risk aversion for auditory versus equivalent visual decision-making trials	Dylan Burrowes
	Choosing increases the value of non-instrumental information	Matthew Jiwa
	What's in the box? EEG correlates of the value of curiosity	Patrick Cooper
	Cognitive changes in early parenthood: A focus on male parents	Chloe Stevens
	Baby-brain Phenomenon is a Universal Experience: Cognitive Deficits found in both Birthing and Non-birthing Parents in the Postpartum.	Yashasveene Jayachandran
	White matter tracts underlying verbal fluency after ischaemic stroke	Chen Liang

AGM (Please access through Whova platform)
12:15-1:15pm

Session 8	Oral presentations: Social cognition and perception	
1:30-2:30pm	4 * 10 minute presentations (5 minutes of questions per talk) Co-chairs: Paul Dux and Katharina Voigt	
	Face detection from patterns of shading and shadows	Colin Palmer
	Investigating the encoding of predictive sensory representations in EEG frequency spectra	William Turner
	The interrelationship between haemodynamics, excitatory-inhibitory modulation, and social processing abilities.	Talitha Ford
	Differences in effective connectivity between postpartum mothers and non-mothers relate to maternal caregiving, cognitive performance, and social cognition	Winnie Orchard

Session 9	Rapid fire presentations: Perception	
2:30-3:30pm	13 * 3 minute presentations Co-chairs: Paul Dux and Katharina Voigt	
	Spatial Attention Does Not Modulate the Processing of a Motion Ensemble	Louisa Talipski

	Dissociating the temporal dynamics of prediction error corresponding to orthogonal attributes of the same visual stimulus	Benjamin Lowe
	A correlational study exploring the mechanisms underlying motion-induced position shifts.	Timothy Cottier
	Does conscious expectation influence adaptation to repeated auditory stimuli?	Joshua Sabio
	Motion Extrapolation in the Twinkle-Goes Illusion: Effects of Speed, Duration, and Visibility	Ella Wilson
	Perception in real-time: predicting the present, reconstructing the past	Hinze Hogendoorn
	Modulations of perceptual performance over the gait-cycle: a virtual reality experiment	Matt Davidson
	Can mental images compete with visual input?	Alexander Sulfaro
	Reconstructing remapped stimulus information from EEG in the pre-saccadic period	Caoimhe Moran
	The temporal dynamics of rotation-invariant object processing	Denise Moerel
	Asymmetry in colour similarity	Elizabeth Fisher
	Capacity for movement is a major organisational principle in object representations	Sophia Shatek
	Unique contributions of perceptual and conceptual humanness to object representations in the human brain	Tijl Grootswagers

Session 10	**Oral presentations: Decision making and memory**	
4-5pm	4 * 10 minute presentations (5 minutes of questions per talk) Co-chairs: Aurina Arnatkeviciute and Jacob Paul	
	Intertemporal choice reflects value comparison rather than self-control: insights from confidence judgments	Adam Bulley
	Mapping the neural correlates of decision confidence using event-related potentials	Daniel Feuerriegel
	Investigating the effects of varying analysis and signal parameters on multivariate decoding of event-related potential data	Claudia Locatelli
	The structural and functional connectivity of neuromodulatory systems underpins dynamic landscape shifts in brain topology	Natasha Taylor
5-5.15pm	**Close**	
	Chair: Hannah Keage	

Poster session (Day 1)

1	Foraging for the self: environment selection for agency inference	Kelsey Perrykkad
2	Australian and Scottish intracultural comparisons of the explicit self-reference effect	Harrison Paff
3	Schizotypal traits, efference copy function and human path integration.	Emma Francis
4	Examining potential enhancements in higher order functioning through observing cABR's in response to polyphonic musical stimuli in musicians and non-musicians	Jacob Sevastidis
5	Moment-by-Moment Prediction of Emotional Arousal and Physiological Responses	Harisu Abdullahi Shehu
6	Reinforcement Learning in Autism: A Systematic Review and Meta-Analysis	Robyn da Silva
7	Communities perceptions of EEG and neurofeedback: can we reach everyone?	Hedwig Eisenbarth
8	Does cerebrovascular status mediate the relationship between Mediterranean Diet and cognition?	Felicity Simpson
9	Age-related white matter microstructural organisation and fluid ability: the effect of controlling for crystallised ability	Emma Murray
10	Can functionally exercising the prefrontal cortex improve the arterial and structural health of the brain?	Jenna Johnson
11	Spatial and feature expectation violations to visual trajectories modulate event-related potential amplitudes across the visual processing hierarchy	Kristen Baker
12	Sensitive to a T: Testing two types of computer-aided detection and two user response types in a visual search task	Blake Cogle
13	Inflammation as a moderator of the relationship between obesity and white matter microstructure in bipolar disorder	Georgia Caruana
14	Psilocybin-Induced Changes in Effective Connectivity within Default Mode Network and its contributions to Dissolution of Self	Hoang Anh Mai
15	Exploratory factor analysis does not identify a theoretically plausible latent structure for task switching processes.	Nathan Tran
16	To recall or to recognise? How memory task design affects binding and associative memory performance	Nora Holmes
17	Machine-learning-generated EEG neuromarkers discriminate between high and low posttraumatic growth in healthy adults with and without PTSD symptoms	AJ Glazebrook
18	Visual impairment can hinder the accurate measurement of cognition	Anne Macnamara
19	Do corollary discharges contain information about the volume of inner speech?	Kevin Berryman
20	Controlling for motor-related activity in the self-stimulation paradigm	Chloe Bosworth
21	Neuroimaging signatures of hallucinations in Parkinson's disease	Joshua Tan
22	Biomarkers of Emotional Regulation under Psilocybin	Devon Stoliker
23	Multilayer community detection for functional brain networks via hierarchical Bayesian modelling	Lingbin Bian
24	Effective Connectivity Within the Visual Network in Variants of Young-Onset Alzheimer's Disease	Siti Raisya Audrea
25	A layered network with spike-timing-dependent plasticity can localise a moving object in real-time despite neural delays	Charlie Sexton
26	Sensory suppression from predicted and unpredicted sounds	Imogen Clarke
27	Let's be in touch: EEG decoding of touch location on the body within and across visual and tactile modalities	Sophie Smit
28	Inner speech or expectation: What is causing the N1-attenuation effect?	Isabella Cook
29	Thinking Laterally: A Novel Methodology to Examine Lateralization Effects in Facial Expression Perception	James Rankin
30	Visual cortex encodes the conjunction of colour and motion before conscious feature binding: a magnetoencephalography study	Erin Goddard

keynote abstracts

{Emerging Researcher Award}

Do TMS-evoked potentials reliably reflect the dynamics of the targeted cortical area?

Dr Mana Biabani, Monash University

The combination of transcranial magnetic stimulation (TMS) and electroencephalography (EEG) has emerged as an important method in cognitive neuroscience for understanding the role of cortical regions in particular behavioural and cognitive functions. However, this technique has been challenged by a controversy regarding whether TMS-evoked potentials (TEPs) recorded by EEG are a genuine marker of TMS-induced cortical reactivity or merely represent the sensory potentials inevitably evoked by the TMS clicking sound and scalp sensations. To address this issue, we conducted a series of studies to characterize genuine TEPs and suppress their undesired sensory components. One hundred and twenty healthy participants received single-pulse TMS over the three cortical areas of working memory network (left frontal eye fields, motor, dorsolateral prefrontal, and posterior-parietal cortices) as well as sensory control sites. We compared the spatiotemporal characteristics of TEPs across conditions in both time and frequency domains and also examined the evoked potentials in relation with the simulated TMS-induced electrical fields. The results showed a high level of site-specificity for the high frequency (Beta/Gamma) and early (<60ms) TEP components. The early evoked responses were spatially restricted to the site of stimulation, were not correlated with sensory potentials from the control condition and demonstrated higher associations with the simulated electric fields following TMS. In contrast, the lower frequency later components (>60-80ms) were not site-specific and were highly correlated with the control conditions, suggesting a strong contribution of sensory potentials at these time points. Taken together, these lines of evidence suggest that despite sensory confounds, early TEPs contain distinct components that reflect genuine cortical reactivity, thereby establishing their validity as reliable markers of region-specific dynamics following TMS.

{Young Investigator Award}

Can we get closer to understanding the relationships between the brain, mind, and behaviour in health and disease?

Professor Karen Caeyenberghs, Deakin University.

Numerous studies have linked behaviour and cognition to different structural properties of individual brain regions, fibre bundles, and brain networks in health and disease, using anatomical and diffusion MRI. While promising, these MRI studies have revealed weak to moderate relationships between the brain, mind, and behavior. We need to maximise the amount of quantitative information that we can extract about brain structure and behaviour. In this presentation, I will outline new directions associated with the examination of behaviour and cognition (moving towards ecological momentary assessments and the use of advanced models). In addition, I will clarify how we can improve the characterization of brain structure using specific structural MRI metrics. Finally, I will present proof-of-concept results of our novel tool (STREAMLINES) that is able to deal with the heterogeneity in behavioral outcomes and brain metrics in our participants. This will guide the development of personalised training programs to improve the behavioral outcomes of people living with brain injury.

{Emerging Researcher Award}

Mapping and Modelling Brain Changes in Psychosis

Sidhant Chopra, Monash University

First episode psychosis has been consistently associated with altered brain volume, as well as altered brain function. No prospective study to date has been able to distinguish the effect of antipsychotic medication from the natural progression of psychosis in driving these changes. We recently completed a triple-blind (participants, clinicians, and researchers) randomised placebo-control trial where 62 antipsychotic naïve young people with first-episode psychosis received psychosocial therapy in addition to either an atypical antipsychotic or a placebo pill over a treatment period of 6 months. This talk will first touch on two studies that have examined brain volume and functional connectivity changes in the context of this clinical trial. Briefly, in our first study examining brain volume, we observed a potentially protective effect of atypical antipsychotics in the early stages of psychotic illness. In our second study, which examines brain function, we found that prominent baseline connectivity differences in patients normalise with psychosocial therapy and placebo early in the illness course, with antipsychotics exerting thalamocortical circuit-specific effects. The remainder of this talk will discuss some unpublished findings where we demonstrate that structural white matter architecture of the brain shape and condition longitudinal antipsychotic- and illness-related brain changes in psychosis.

presentations

{Attention}

Trans-ancestry genome wide association study of executive functions in up to 14 877 subjects

Aurina Arnatkeviciute, Monash University

Mathieu Lemire, The Hospital for Sick Children, Toronto, Canada
Claire Morrison, University of Colorado-Boulder
Michael Mooney, Oregon Health & Science University
Joel Nigg, Oregon Health & Science University
Naomi Friedman, University of Colorado–Boulder
Jennifer Crosbie, The Hospital for Sick Children, Toronto, Canada
Christie Burton, The Hospital for Sick Children, Toronto, Canada
Russell Schachar, The Hospital for Sick Children, Toronto, Canada
Mark A. Bellgrove, Monash University, Australia

Effective executive function is critical to goal-directed behaviours and is related to a number of psychiatric disorders. Here we performed the first trans-ancestry genome wide association study (GWAS) using behavioural traits from the stop-signal reaction time task - go reaction time (GoRT), go reaction time variability (GoRT SD) and stop signal reaction time (SSRT) representing processing speed, response variability, and response inhibition. The total sample comprised data from up to 14 877 subjects, derived from 8 sites and four ancestries. GWASs summary statistics from each site and ancestral group were combined using trans-ethnic meta-analysis implemented in MR-MEGA. SNP heritability for each phenotype was assessed using LD score regression, polygenic risk scores (PRS) for ADHD were calculated in each EUR ancestry sample. No associations reaching genome wide significance ($p<5 \times 10^{-8}$) for any of the three traits were detected. Both GoRT SD and SSRT were significantly heritable h^2_{SNP} = 8.2% (p=0.002 and p=0.004 respectively). Power analysis showed that our sample had excellent power (>80%) to detect at least one GWAS significant association if the number of common variants explaining 8% heritability was less than 500. Consistent with the expectation higher ADHD PRS were associated with larger GoRT SD (b=0.0074; se=0.0021, p=0.0003). The lack of significant GWAS associations shows that the number of common variants contributing to the heritability of these phenotypes is relatively high and larger sample sizes are necessary to robustly identify associations. The significant association between ADHD PGRS and reaction time variability supports its suggested utility as an endophenotype for ADHD.

{Methods}

NeuroDesk - A cross-platform data analysis environment for reproducible neuroimaging

Steffen Bollmann, University of Queensland

Angela Renton, University of Queensland
Aswin Narayanan, National Imaging Facility
Paris Lyons, Swinburne University of Technology
David White, Swinburne University of Technology
Ryan Sullivan, University of Sydney
Oren Civier, Swinburne University of Technology
Will Woods, Swinburne University of Technology
Tom Johnston, Swinburne University of Technology

Reproducibility is one of the foundational principles of scientific investigation; repetition of the same investigative process should lead to the same result. However, analysis pipelines for neuroimaging data often fail to meet this basic benchmark. Cognitive neuroscientists require a diverse collection of bespoke command-line and graphical tools to analyse neuroimaging data. Installing and maintaining this software setup is challenging and often results in un-reproducible environments. To address these challenges, we developed NeuroDesk (http://neurodesk.github.io), an open-source containerised platform for processing and analysing neuroimaging data. In developing NeuroDesk, we aimed to lower the barrier-to-entry for accessing neuroimaging analysis software while providing a fully reproducible analysis environment. To this end, we developed a modular and open analysis environment consisting of a continuous integration system on Github to automatically build neuroimaging software containers based on community input. NeuroDesk enables researchers to access and use neuroimaging software within a lightweight Linux desktop container accessible via a browser interface that runs on any operating system supporting Docker (e.g. Windows, MacOS). Neurodesk allows researchers to retain access to the same virtual

desktop environment while seamlessly transitioning between any combination of operating system and computer platform, including high performance computing systems and cloud computing. We would like to present our open-source project to the ACNS community to demonstrate how to access and use the platform, and to gather feedback on the integrated tools so that we can make NeuroDesk even better at supporting researchers in reproducible neuroimaging.

{Ageing and Development}

The DelIrium VULnerability in GEriatrics (DIVULGE) Study: Protocol for a prospective EEG study of incident delirium

Monique Boord, University of South Australia

Daniel Davis, MRC Unit for Lifelong Health and Ageing at UCL

Peter Psaltis, South Australian Health and Medical Research Institute

Scott Coussens, University of South Australia

Daniel Feuerriegel, University of Melbourne

Marta Garrido, University of Melbourne

Alice Bourke, Central Adelaide Local Health Network

Hannah Keage, University of South Australia

Delirium is an acute and fluctuating neurocognitive disorder characterised by impairments in attention, arousal, and cognition following a precipitating medical event e.g., surgery. Those who experience delirium are at increased risk of dementia, cognitive decline and death. Electroencephalography (EEG) recorded during delirium is characterised by slowing and reduced functional connectivity, but markers of vulnerability to delirium and its subtypes are poorly described. The DIVULGE study aims to characterise neural mechanisms of delirium vulnerability using spectral power and event-related potentials (ERPs). Participants over the age of 65 planned to undergo elective coronary artery bypass grafting (CABG) or transcatheter aortic valve implantation (TAVI) are recruited and data collection is ongoing (current n=54). Cognitive testing and EEG are conducted in participants homes prior to their elective procedures. The EEG recording consists of a four-minute resting state (eyes open and eyes closed) and five-minute frequency auditory oddball paradigm. Delirium assessments are conducted daily from the first postoperative day onwards at the Royal Adelaide Hospital, Adelaide, South Australia. Outcome measures include preoperative periodic and aperiodic components of the power spectra and ERP amplitude measures, and will be linked with postoperative delirium status (presence, severity, and subtype). Delirium prevention is arguably more effective than treatment, and findings may inform delirium risk tools utilising EEG to identify individuals at high risk of developing delirium prior to elective surgery. Importantly, such a tool may differentiate between subtypes, which demand different care and are associated with different outcomes.

{Methods}

Built environment design modulates autonomic and EEG indices of emotional response

Isabella S. Bower, Engineering and Built Environment & Deakin University

Gillian M. Clark, Deakin University

Richard Tucker, Engineering and Built Environment & Deakin University

Jarrad A. G. Lum, Deakin University

Michael A. Mortimer, Deakin University

Peter G. Enticott , Deakin University

There is currently no robust method to evaluate how built environment design affects our emotion. Understanding emotion is significant, as it influences cognitive processes, behaviour, and wellbeing, and is linked to the functioning of physiological systems. As mental health problems are more prevalent, and exposure to indoor environments is increasing, it is important we develop rigorous methods to understand the effects of the built environment on the central and autonomic nervous systems, as these processes pertain to emotion and affective states. Here we investigated whether scale and/or colour of interior built environments modulate EEG, autonomic, and self-report indices of emotional processing. Using a cave automatic virtual environment and controlling indoor environmental quality variables responsible for physiological comfort, 66 healthy participants were exposed to different enclosed indoor room scenes. Our results showed enlarged room scale increased frontal midline power and left frontal lateralisation in the gamma bandwidth, but we did not detect changes in self-report or autonomic indices. In comparison, blue colour increased frontal midline

power in the alpha bandwidth and increased left frontal lateralisation in the theta bandwidth. We also found the colour condition significantly increased the range in respiration and skin conductance response, however no significant change to self-report was detected. These findings indicate we can detect neurophysiological responses when modifying design characteristics in the built environment. Our study provides a rigorous empirical framework for assessing the impact of the built environment on human emotion, which could deliver significant public health, economic and social benefits to the entire community.

{Decision Making}

Intertemporal choice reflects value comparison rather than self-control: insights from confidence judgments

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Intertemporal decision-making has long been assumed to measure self-control, with prominent theories treating choices of smaller, sooner rewards as failed attempts to override immediate temptation. If this view is correct, people should be more confident in their intertemporal decisions when they "successfully" delay gratification than when they do not. In two pre-registered experiments with built-in replication, adult participants (n=117) made monetary intertemporal choices and rated their confidence in having made the right decisions. Contrary to assumptions of the self-control account, confidence was not higher when participants chose delayed rewards. Rather, participants were more confident in their decisions when possible rewards were further apart in time-discounted subjective value, closer to the present, and larger in magnitude. Demonstrating metacognitive insight, participants were more confident in decisions that better aligned with their independent valuation of possible rewards. Decisions made with less confidence were more prone to changes-of-mind and more susceptible to a patience-enhancing manipulation. Together, our results establish that confidence in intertemporal choice tracks uncertainty in estimating and comparing the value of possible rewards - just as it does in decisions unrelated to self-control. Our findings challenge self-control views and instead cast intertemporal choice as a form of value-based decision-making about future possibilities.

{Decision Making}

Heightened risk aversion for auditory versus equivalent visual decision-making trials

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Decision-making is a cognitive process largely driven by an individual's risk aversion and loss aversion. Parameters for these processes can be estimated through computational modelling of performance in decision-making tasks, however, no research to date has compared risk and loss aversion behaviour between a visual decision-making task and an equivalent auditory task. In this study, 105 participants each completed 150 trials of a decision-making task, allocated to either visual or auditory conditions. Participants selected between 'certain' (p = 1) and 'gamble' (p = 0.5) choices of differing monetary value, with individual and group-level parameters for risk aversion and loss aversion computed using hierarchical Bayesian modelling. Group-level differences were found at the 95% credible interval revealing increased risk aversion for the auditory group compared to the visual group, but not for loss aversion. These results suggest heightened preference for certainty over uncertainty for the spoken word compared to the written word.

{Memory}

The magic of memory: rapid consolidation via prior knowledge and repeated retrieval

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Recent advances demonstrate that the transfer of hippocampal memory traces into stable, generalised representations in the cortex can occur within hours, rather than months to years and over sleep, through repeated retrieval practice linking new engrams to pre-existing, related memory stores. To date, no study has investigated rapid memory consolidation with naturally acquired prior knowledge that varies between participants, or with adequate control conditions for both training and prior knowledge. To address this gap, healthy participants (N = 28, 18F, mean age = 25.5, range = 18-41) learnt face pairs made of either *Harry Potter* or stranger faces, then practiced these pairings through retrieval training (effortful cued recall) or restudy (seeing the face pairs again). After a one-hour break, participants' memory of the face pairs was tested and the amplitude of the late positive component (LPC; 500-800ms post-stimulus) was estimated as a neural marker of episodic recollection. Results revealed that only retrieval trained *Harry Potter* faces in participants with high *Harry Potter* prior knowledge demonstrated decreased LPC amplitudes. Decreased episodic recollection was paired with high behavioural accuracy, suggesting rapid consolidation processes occurred over only two waking hours. This evidence of rapid consolidation challenges the assumptions of existing consolidation theories that memory transfer requires months to years and sleep-associated mechanisms. Additionally, our study was the first to use EEG to measure changes in the episodic recollection of memories as they become rapidly incorporated into the neocortical landscape.

{Clinical}

Understanding the relationship between white matter and cognitive function in bipolar disorder: A systematic review

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Cognitive dysfunction is becoming increasingly established as a core feature of bipolar disorder (BD), however the neural substrates underpinning these deficits remain unclear. Converging neuroimaging evidence has proposed alterations in white matter as being related to cognitive outcomes BD, yet to date, no body of work has aggregated these findings. This systematic review sought to address this, by providing a comprehensive summary of relationships between white matter micro/macrostructure, and several cognitive domains in BD. An initial search of PubMed, Scopus and Web of Science databases resulted in 2689 records, of which, 33 met criteria for review. All 33 of these studies were cross-sectional, and consistent evidence of significant relationships between cognition and either microstructure or macrostructure was minimal. A limited number of microstructural studies utilising diffusion tensor imaging broadly observed that complex attention and executive functioning were positively correlated with fractional anisotropy, and negatively correlated with mean diffusivity, in regions of the corpus callosum. The majority of microstructural studies were, however, unable to detect or replicate such associations. Along with this, no major macrostructural morphologies, including white matter volume, hyperintensities or thickness, were robustly linked to cognition. Collectively, the findings of this review highlight that whilst key regions such as the corpus callosum are significant for some domains of cognition, white matter may not be the major neural substrate related to cognitive dysfunction in BD.

{Clinical}

Electroencephalography measures of scopolamine's potential antidepressant effects

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Depression is a leading cause of disability with current pharmacotherapies typically taking several weeks to achieve efficacy. Comparatively, prior studies involving intravenous scopolamine infusions reduced depressive symptoms compared to saline placebo infusions within days. However, several parameters of scopolamine's potential antidepressant effect remain unknown, such as the duration of response and the confounding effect of saline placebo.This study recruited forty individuals with depression and randomised them to receive single intravenous 15-minute infusions of either scopolamine hydrobromide (4-6µg/kg) or glycopyrronium bromide (4µg/kg). Glycopyrronium was chosen as the active placebo due to its similar antimuscarinic properties to scopolamine, but inability to cross the blood-brain barrier. The primary mood outcome measure for detecting depression severity was the Montgomery-Ãsberg Depression Rating Scale (MADRS), which was administered from pre-infusion and 1, 3, 7, 14, 28, 42 days post-infusion. Electroencephalography (EEG) recordings were made during drug administration until 4 hours post drug-infusion. While scopolamine improved MADRS scores by 12.6 (±8.7sd) points at Day 3, glycopyrronium showed similar improvements (11.2±9.6sd). Frequentist linear mixed models showed no antidepressant effect of scopolamine versus placebo (d=0.17). These results raise questions about the magnitude of the placebo response of prior studies along with the central and peripheral antimuscarinic contributions to depression. Prior studies indicate that treatment responders to traditional antidepressants exhibited differential EEG alpha spectral power, alpha asymmetry, and functional connectivity to non-responders. Further investigations into scopolamine's effect on responders and non-responders' EEG will be presented.

{Decision Making}

What's in the box? EEG correlates of the value of curiosity

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Humans expend significant effort to satisfy their curiosity - from continuing a hike to see what is just around the corner, or sending a robotic rover to the surface of Mars. However, the neural mechanisms that drive us to satisfy our curiosity remain unclear. Here, we asked how individuals value the prospect of viewing a familiar object relative to an entirely novel object. On each trial, we parametrically varied the amount of effort required to reveal each stimulus category. Our behavioural results showed that, overall, individuals were willing to invest greater amounts of effort to view the novel relative to the familiar objects. Critically, we found an EEG signal that was sensitive to the value that individuals ascribed to novel stimuli. Finally, the preference for novel over familiar objects correlated with higher levels of day-to-day curiosity. Together, our results demonstrate how the desire to satisfy our curiosity is neurophysiologically encoded, and provides a basis for explaining how curiosity drives behaviour.

{Ageing and Development}

Does cardiorespiratory fitness mediate the relationship between physical activity and cognitive functioning?

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Cognitive control abilities decline with increasing age and are associated with changes in frontal networks essential for their execution. However, there is significant heterogeneity within trajectories of decline, with physical activity shown to be a protective factor for late life cognitive functioning. Physically active older adults have better cognitive functioning than older adults who live a sedentary lifestyle. The present study examines whether differences in physical activity levels and CRF are associated with cognitive performance. Healthy older adults (aged 60-70; N=78) were classified as engaging in high or low amounts of physical activity based on a median split of accelerometry data recorded across a seven-day period. Cognitive control was assessed with a cued-trials task-switching paradigm with concurrent EEG. This paradigm relies heavily upon the frontal regions of the brain sensitive to age-related decline. Greater physical activity levels and higher CRF were associated with better performance on the task-switching paradigm. However, all findings failed to reach statistical significance. However, significant group differences may be present in the EEG recorded during the task. Changes in brain structure and function are often present before cognitive changes are detected. As such, the next step will be to analyse cue- and target-locked event-related potentials (ERPs) to examine neural processing associated with task-set updating and implementation. We predict that participants in the high physical activity group will have higher cue- and target-locked ERP amplitudes, in line with greater engagement in preparatory and task implementation processes.

{Perception}

A correlational study exploring the mechanisms underlying motion-induced position shifts.

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Motion-induced position shifts (MIPS) broadly refers to a group of visual illusions, in which motion signals cause the position of an object to be misperceived. Amongst others, these illusions notably include the flash-lag effect, in which a static flash presented in spatial and temporal alignment with a moving object, is perceived in a position behind the moving object. A variety of mechanisms have been proposed to underlie MIPS (e.g., postdiction, motion extrapolation, discrete subsampling). However, most previous studies have focused on the mechanisms underlying individual illusions. Consequently, the degree to which these phenomenologically similar illusions result from shared or dissociated mechanisms remains unknown. The present study seeks to address this gap and identify which MIPS could be due to shared or distinct mechanisms. Participants (target N = 100, data collection ongoing) viewed eight different MIPS: the flash-jump effect, Fröhlich effect, flash-drag effect, flash-grab effect, flash-lag effect, luminance flash-lag effect, twinkle-goes illusion, and the illusory displacement of stationary objects with internal motion. These illusions show substantial between-subjects variability in illusory magnitude. This study will conduct correlation analyses on the illusory magnitudes of these eight illusions across individuals. Positively correlated magnitudes will be interpreted as suggesting that the illusions likely share underlying mechanisms, whereas absence of correlations will suggest these illusions are due to dissociable mechanisms. By exploring if different MIPS are due to dissociable or shared mechanisms, this study will help to identify the mechanisms underlying the perception of both motion and position.

{Decision Making}

Reinforcement Learning in Autism: A Systematic Review and Meta-Analysis

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Decision-making is based on reward or punishment of previous actions. Reinforcement learning, i.e., learning which actions are rewarded or punished, therefore plays a critical role in decision-making. Therapy using reinforcement learning principles is often administered as an early intervention for autistic children, however there is variability in client responsiveness that could be explained by differences in reward processing and learning. Behavioural studies measuring reinforcement learning in relation to autistic diagnoses and traits have been conducted, however results are conflicting and require integration. This study aimed to systematically review research investigating the relationship between reinforcement learning and autism. Electronic databases, PsychINFO, PubMed, and CINAHL were searched in

June 2021. Key search terms were variations on autism, decision-making, reinforcement, probabilistic, feedback learning, and specific tasks such as the Iowa Gambling Task. A total of 2543 unique articles were identified and screened. Differences between autistic and non-autistic participants, and correlations between tasks and autistic traits will be presented including: overall task performance, win-stay and lose-shift behaviour, learning from rewards compared to punishments, and early learning compared to late learning. Through this review, it may be possible to associate specific decision-making patterns with autistic traits, such as aversive learning and social deficits, which could inform behavioural therapy. Reinforcement learning also has neurological importance as it is facilitated by the basal ganglia. Due to the specificity of reinforcement learning tasks and their ability to infer basal ganglia pathway integrity, this review could help guide future research into basal ganglia functioning in autism and decision-making.

{Perception}

Modulations of perceptual performance over the gait-cycle: a virtual reality experiment

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Nearly everything we know about visual perception comes from tightly controlled environmental settings in the tradition of stationary, seated laboratory experiments. Arguably however, this traditional approach can never provide a complete account of how vision may operate in ecologically valid conditions, such as during dynamic activity in immersive environments. Advances in virtual-reality (VR) now enable the tightly-controlled presentation of immersive environments, and to complement traditional measures from psychophysics with continuous movement kinematics. In our experiments we investigate how the accuracy and sensitivity of visual perception varies as a function of the gait-cycle. Participants were engaged in steady-state walking while tracking a floating spherical target, which advanced at a constant comfortable walking speed into the foreground. In the first experiment, we capitalised on a continuous psychophysics method, to record a frame-by-frame tracking-response at the presentation rate of the target stimulus. Participants minimised the distance between their dominant hand and the floating sphere, and the error between the time-series of target position and tracking response were quantified over the gait-cycle. We observed a sinusoidal rhythm in tracking error, which peaked at the ascending phase of the gait-cycle, before rapidly returning to baseline. In the second experiment, participants monitored the target for brief increases in contrast. We observed clear differences in visual sensitivity and detection accuracy over the gait-cycle. These results illustrate how the most common of everyday actions influences perception, and evinces the utility of VR technology to broaden our understanding of visual information processing.

{Ageing and Development}

Activation Likelihood Estimates Meta-Analysis of Glucose Metabolism Across the Adult Lifespan

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The brain relies primarily on glucose as its energy source. Research has shown that brain glucose utilisation changes across the lifespan and that disruptions to normal glucose homeostasis can impact brain function and cognition, particularly in neurodegenerative disease. However, the imaging research on brain glucose metabolism in ageing has not been systematically reviewed and meta-analysed. Studies published between 1953 and August 2021 were retrieved from PubMed. After reviewing 653 records, seven studies with nine samples were retained that reported local foci coordinates of peak activation differences in glucose metabolism for younger and older adults. Studies on disease states were excluded. The coordinates were meta-analysed using Activation Likelihood Estimates and the peak locations of significant age differences were queried in the Brainmap database for their functional correlates. A large cluster (2,728 mm^3) of significant age difference in glucose metabolism was found in the right superior temporal gyrus. Larger (2,264 mm^3) and smaller (528mm^3) clusters were found in left inferior frontal gyrus. Clusters were also found in the right (528mm^3) and left (264mm^3)

anterior cingulate, subcallosal (456 mm^3), caudate (408mm^3) and the left inferior parietal gyrus (368 mm^3). In the Brainmap database, the peak coordinates of the clusters were found to be associated with action execution and inhibition, emotion, interoception, language, motor learning, perception, reasoning and working memory. The results are discussed in relation to functional changes in ageing and assumptions in the field about locations that drive age-related changes in cognition.

{Ageing and Development}

Compiling a typical ageing trajectory of the brain: Linking the meso- and macro-scale determinants of cognitive ageing.

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Over the course of normal ageing, our bodies become less adept at self-maintenance and repair, resulting in progressive physiological declines in our ability to function independently. Despite consistent and progressive biological declines, there is significant variation in cognitive healthspan between ageing individuals: Some individuals are able to maintain their cognitive faculties with age, while others may decline or develop cognitive impairments during their later years. With the advent of increasingly powerful and informative neuroimaging modalities paired with physiological and molecular techniques, compiling a multi-scale "typical" ageing trajectory of the brain could assist in the early identification of deviations from the norm. Defining the typical ageing trajectory across the meso and macro scales will also uncover the endogenous processes or factors that may be protective or predisposing to cognitive-ageing and neurodegeneration. To better understand what may be driving the disparity between physiological and cognitive-healthspan trends, it is advantageous to consider how micro- or meso-scale biomarkers may underpin macro-scale changes in the brain during ageing. This review provides an introduction to the synthesis and interpretation of macroscale neuroimaging data with mesoscale molecular and physiological hallmarks of ageing. We highlight the combined utility of different neuroimaging modalities and peripheral biomarkers as predictors of long-term cognitive healthspan.

{Ageing and Development}

Measuring Myelin in Attention-Deficit/ Hyperactivity Disorder (ADHD)

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Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder impacting the lives of 5-7% of people globally. Cognitive manifestations are widespread, affecting sustained attention, working memory, and inhibition amongst other domains. Diffusion magnetic resonance imaging studies indicate atypical white matter could contribute to ADHD neuropathology, however, it is not clear how much of this contribution relates to axonal myelination. The T1w/T2w-ratio allows for the non-invasive, *in vivo* estimation of myelin. We aim to explore the role of neural white matter in ADHD using the T1w/T2w-ratio to estimate the contribution of myelin. Children with ADHD are expected to exhibit different myelination of neural white matter tracts.
Methods: The sample consisted of neuroimaging scans from 129 children (M_{age}=10.40, SD_{age}=0.47; 87 males; 54 ADHD) recruited from the Neuroimaging of the Children's Attention Project cohort. Preliminary voxel-based morphometry conducted in FSL assessed whether myelination of white matter tracts was associated with ADHD diagnostic status. Tracts included the arcuate fasciculus (AF), corpus callosum (CC), superior longitudinal fasciculus (SLF), and corticospinal tract (CST). Models controlled for age, sex, and medication status.
Results: Preliminary results indicate that compared to typically developing controls, children with ADHD exhibit significantly lower myelination for the CC, AF, SLF, and CST. Clusters of voxels within all tracts investigated reached significance at the $p<0.05$ corrected level.
Discussion: Results indicate that white matter differences exhibited in ADHD could be attributed to microstructural alterations in myeloarchitecture. Future work aims to investigate the development of myelin in children with ADHD and the role of epigenetics.

{Clinical}

White matter fibre degeneration over 3 years after ischemic stroke

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White matter is susceptible to the deleterious effect of ischaemia. Several cross-sectional studies demonstrated reduced white matter integrity in stroke compared to control participants. However, the longitudinal trajectory remains unexplored. We aimed to chart white matter integrity over 3 years after stroke, to examine if post-stroke loss of white matter continues to be accelerated compared to control participants. We applied a longitudinal "fixel"-based analysis, sensitive to fibre tract-specific differences within a voxel, to assess white matter loss in stroke (N=71, 22 women) compared to control participants (N=36, 13 women) across the whole brain. We studied microstructural differences in fibre density and macrostructural (morphological) changes in fibre cross-section. In stroke participants, we observed extensive neurodegeneration across the whole brain, particularly affecting the thalamic, cerebellar, striatal, superior longitudinal tracts and corpus callosum. The reductions were significantly greater compared to controls. Importantly, this decline in fibre density and cross-section from 3 to 36 months was associated with worse performance in several cognitive domains, especially visuospatial processing, speed and recognition, at 3 years post-stroke. We conclude that white matter neurodegeneration, including but not limited to ipsi- and contra-lesional thalamic and cerebellar diaschisis, progresses faster in stroke survivors compared to controls even years after the stroke event, likely underlying earlier onset of cognitive impairment and increased dementia odds post-stroke.

{Methods}

Communities' perceptions of EEG and neurofeedback: can we reach everyone?

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Neuroscientific research often includes measures that require touching of the head in the process of assessment. As some cultures and religious groups see the head as sacred (e.g. Māori, Indian) or wear attire related to religious practices (head scarf), we might unintentionally exclude individuals from neuroscientific research. We asked members of New Zealand communities about their knowledge and views on EEG and neurofeedback, and their affiliation with ethnicities. Out of the 181 participants (127f, 45m, 9d; M_{age} = 27.95 +/- 10.04), the identification rates were highest for NZ European, Māori, Chinese and Indian ethnicities. Just half of the participants (58%) reported they know/had heard of EEG and 29% about neurofeedback. Participants overall reported they would feel comfortable wearing an EEG cap and (M = 6.53, SD = 2.22, range 1-9) and would be interesting in taking part in EEG/neurofeedback studies (M = 7. 43, SD = 1.75, range 1-9). Although, identification with Māori, Chinese or Indian ethnicities correlated negatively with feeling comfortable with waring an EEG cap and interest in EEG/neurofeedback, linear regression did not confirm the low correlations. Thematic analyses of several open text questions showed that participants openness to try those methods seems to be linked with a comfortable setting and good explanation by an experimenter and "less sci-fi" appearance of the instruments. Taken together, there is little evidence that individuals vary in their interest in neuroscientific research in the context of EEG/neurofeedback based on their ethnic affiliations. Providing good information and a comfortable environment could help participants.

{Decision Making}

Mapping the neural correlates of decision confidence using event-related potentials

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Every decision we make is accompanied by an estimate of the likelihood that our decision is accurate or appropriate. This likelihood estimate is known as our degree of decision confidence. Recent work has uncovered event-related potential (ERP) correlates of confidence both during decision formation and after a decision has been made. However, the interpretation of these findings is complicated by methodological issues related to ERP amplitude measurement that are prevalent across existing studies. To more accurately characterise the neural correlates of confidence, we presented participants with a difficult perceptual decision task that elicited a broad range of confidence ratings. We identified a novel fronto-central ERP component occurring prior to the behavioural response, which exhibited more positive-going amplitudes in trials with higher confidence ratings. This frontal effect also biased measures of the centro-parietal positivity (CPP) component at parietal electrodes via volume conduction. Amplitudes of the error positivity (Pe) component that followed each decision were negatively associated with confidence for trials with decision errors, but not for trials with correct decisions. We provide evidence for both pre- and post-decisional neural correlates of decision confidence that are observed in trials with correct and erroneous decisions, respectively. This pattern of effects does not fit neatly into existing theoretical accounts of decision confidence and suggests there are temporally distinct time windows associated with confidence computations and error detection.

{Decision Making}

Decision strategies: causal investigations of the trade-off between decision speed and accuracy in the frontal cortex

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The ability to strategically adapt how we make decisions is important in a range of everyday settings. One key decision strategy is the speed accuracy trade-off (SAT; the faster people respond the more likely they are to make an error), and it is arguably the most robust finding in cognitive psychology. Neuroimaging has implicated two frontal regions as neural substrates of the SAT: the prefrontal cortex and the preSMA (part of the superior medial frontal cortex; SMFC). However, there is no causal evidence for these regions involvement in the SAT, nor is it clear what role each plays in the underlying processes. Across two double-blind, pre-registered studies, we applied cathodal transcranial direct current stimulation (tDCS) to prefrontal and SMFC. The SAT was measured using a dot-motion task. In Study 1 (41 participants), we varied participants explicit response strategy (focus on accuracy, speed, or both). In Study 2 (42 participants) we employed an incidental manipulation of decision strategy via varying variability in task signal. In Study 1, both target regions modulated decision strategies but in opposing directions: stimulation to left prefrontal cortex increased, whereas stimulation to the SMFC decreased, caution in decisions. These effects were most pronounced when participants were instructed to focus on accuracy over speed. In Study 2, the same overall dissociation was present for the two regions. The findings indicate that both the SMFC and the prefrontal cortex are causally involved in decision strategies, but play distinct roles.

{Perception}

Asymmetry in colour similarity

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Psychological studies have extensively used similarity judgements to reveal structures of various perceptual qualities. For example, similarity relationships between pairs of isoluminant colours can reveal a colour wheel structure. However, previous similarity studies tend to ignore empirically found violations of assumptions about similarity judgements that they are symmetric. For example, when we ask participants to rate how similar A is to B, they may differ from the rating on how similar B is to A. Here, we tested if asymmetry in similarity judgments are empirically apparent in a simple colour judgement task. We ran three similarity experiments online (N=15 for each) using two colour stimuli presented in different temporal orders. The experiment consisted of 81 colour pairs generated from 9 different colours. Each colour was shown once in the fovea and periphery, after which all colour pair presentations were repeated in a second pass. In all experiments, we found asymmetry in colour similarity judgements for particular combinations of colours (7 colour pairs $p<0.05$, uncorrected for multiple comparisons, 1 colour pair $p<0.05$, Holm's correction). This asymmetry was reproducible in our double pass paradigm, supporting the robustness of the findings. Our results suggest colour stimuli can generate asymmetric similarity experiences based on presentation order. Currently we are performing several further experiments to explain this enigmatic result. A candidate set of explanations include adaptation, associations of concepts, and quantum cognition effects.

{Social}

The interrelationship between haemodynamics, excitatory-inhibitory modulation, and social processing abilities.

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The relationship between brain haemodynamics and excitation-inhibition has been well established, particularly in relation to visual processing. Research is yet to investigate this relationship in the context of social information processing, however, which is important given many neurodevelopmental conditions are characterised by social processing difficulties.

In this pilot study, 12 healthy adults (7 female; 18-40 years old) underwent functional magnetic resonance imaging (fMRI), magnetic resonance spectroscopy (MRS), and gold standard Research Domain Criteria Social Processes assessments (Social Responsiveness Scale; SRS) to directly probe BOLD response to dynamic face stimuli, excitatory (glutamate) and inhibitory (GABA) neurotransmitter concentrations in the right superior temporal sulcus (STS; a social brain region), and social processing ability, respectively. Spearman's rho was used to investigate the relationships between fMRI BOLD response, glutamate, GABA and glutamate/GABA ratios, and SRS scores.

There were moderate-strong associations between fMRI BOLD response to social stimuli and glutamate (rho=-.427), GABA (rho=.545) and the glutamate/GABA ratio (rho=-.692) in the right STS. SRS scores moderately increased with higher glutamate concentrations (rho=.480) and glutamate/GABA ratios (rho=.516). There was no relationship between BOLD and SRS scores (rho=-.007). Given the small sample, none of these correlations were significant (ps>.006, corrected).

These data support the established excitation-inhibition hypothesis of neurodevelopmental conditions, such as autism and schizophrenia, and suggest that the haemodynamics of social processing are related to resting excitatory-inhibitory processes. Data also suggest that BOLD response to dynamic faces is not associated with social processing abilities. Larger studies are necessary to validate these findings.

{Perception}

Schizotypal traits, efference copy function and human path integration.

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Path integration is a process in which navigators track their location by using body-based signals. Afferent input from vestibular and proprioceptive senses constitutes these signals, but it is postulated that efference copies of motor commands, or predictions of the sensory consequences of an action preceding actual movement, also play a role in path integration. However, this role is near indecipherable from that of proprioception in healthy individuals because whenever they voluntarily move their body, efference copies and proprioceptive feedback co-exist. To overcome this challenge, we capitalised on the idea that failures of efference copy may underlie schizotypy, a presentation of subclinical psychosis symptoms. That is, we aimed to isolate the effect of efference copy in path integration by comparing performance of high and low schizotypal individuals on a task in which they walked or imagined walking to a previewed target without vision. It was hypothesised that, as a result of having to rely more on proprioceptive feedback that is available only after executing body movement, high-schizotypal participants would take longer to update their location while walking to the target than low-schizotypal participants with unimpaired efference copy function. The same pattern was expected in imagined walking as motor imagery is believed to be based on suppressed motor commands and their efference copies. Results showed that high-schizotypal participants took longer to reach the target across both real and imagined walking, showing promise in using schizotypy as a model to find empirical evidence for the involvement of efference copy in human path integration.

{Perception}

Visual cortex encodes the conjunction of colour and motion before conscious feature binding: a magnetoencephalography study

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Visual cortex incorporates functional specialization, with different features processed in distinct regions (e.g. colour and motion). This parallel processing gives rise to the question of how different features of a single object are associated with one another: the 'binding problem'. Psychophysically, detection of feature conjunctions is slower than detecting the presence of a single feature, suggesting that perceptual binding may rely on higher order processes and/or recurrent processing. fMRI work reveals that information about feature conjunctions can be decoded from early visual areas, including V1.

Here, we collected preliminary MEG data while participants viewed two moving dot fields of different colours, simultaneously moving in opposite directions. A classification analysis of the MEG data revealed that as soon as stimulus colour could be decoded, the conjunction of motion and colour could also be decoded, suggesting that visual cortex contains information about colour/motion conjunction before this is consciously perceived.

To confirm that perception of bound features lags perception of colour for our stimuli, we made psychophysical measurements, where participants judged colour or colour/motion properties of the same stimuli of varying durations, followed by a mask. Results showed that at longer stimulus durations, participants performed similarly across tasks based on conjunctions or colour alone, but at the shorter stimulus durations colour information was always present before conjunction information.

This dissociation between the timing of colour and conjunction information in the brain and in perception suggests that visual cortex contains early conjunction signals that are not perceptually accessible.

{Perception}

Unique contributions of perceptual and conceptual humanness to object representations in the human brain

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The human brain is able to quickly and accurately identify objects in a dynamic visual world. Objects evoke different patterns of neural activity in the visual system, which reflect object category memberships. However, the underlying dimensions of object representations in the brain remain unclear. Recent research suggests that the brain organises objects according to their similarity to humans, but the nature of the human-similarity features driving this organisation are still unknown. Here, we investigate the relative contributions of perceptual and conceptual features of humanness to the representational organisation of objects in the human visual system. We collected behavioural judgements of human-similarity of various objects, which were compared with time-resolved neuroimaging responses to the same objects. The behavioural judgement tasks targeted either perceptual or conceptual humanness features to determine their respective contribution to perceived human-similarity. Behavioural and neuroimaging data revealed significant and unique contributions of both perceptual and conceptual features of humanness, each explaining unique variance in neuroimaging data. Furthermore, our results showed distinct spatio-temporal dynamics in the processing of conceptual and perceptual humanness features, with later and more lateralised brain responses to conceptual features. This study highlights the critical importance of social requirements in information processing and organisation in the human brain.

{Ageing and Development}

A systematic review into the relationship between blood pressure variability and structural brain changes

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Blood pressure variability (BPV) has, independent of the mean BP, been linked with cognitive impairment and dementia. However, the pathophysiological mechanisms by which BPV affects cognition is unclear. This systematic review assessed the relationship between different BPV measures and white and grey matter structures. The following databases were last searched in January 2021; EMBASE, MEDLINE, EMCARE, and SCOPUS. Peer-reviewed studies that reported on the relationship between within-subject BPV (short-, medium- or long-term variability) or a circadian blood pressure measurement and MRI assessed brain structures were included. Overall, twenty studies met the criteria and were included, of which eleven studies looked at short-term BPV, eight articles investigated visit-to-visit BPV, and one study looked at a compositional BPV measurement. Due to heterogeneity in study samples, meta-analysis was not possible. Across the included studies, associations between MRI indices and BP dipping patterns were mixed but higher long-term systolic BPV and higher sleep systolic BPV was found to be associated with lower whole brain volume and hippocampal volume. This review highlights the adverse effect that increased BPV has upon the brain and helps to better understand the biological mechanisms of how BPV is linked with cognitive decline, including dementia, in late life.

{Ageing and Development}

Periodic and aperiodic neural activity displays age-dependent changes across early-to-middle childhood

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The neurodevelopmental period spanning early-to-middle childhood represents a time of significant growth and reorganisation throughout the cerebral cortex. Such changes are critical for the emergence and maturation of a range of social and cognitive processes. Resting-state electroencephalography (RS-EEG) recordings provide a valuable window to the intrinsic functional state of neural circuits within the cortex. Here, we utilised a spectral parameterisation approach to explore age-related changes in both periodic and aperiodic (i.e., 1/*f*-like) components of the RS-EEG signal. Eyes-open and eyes-closed recordings were analysed from 139 children ranging from 4-to-12 years of age (average age=9.41 years, SD=1.95). Linear regression models were then used to evaluate if age could predict aperiodic slope and offset, as well as well as peak frequency and power within the alpha and beta bands, after adjusting for the aperiodic signal. Age significantly predicted both aperiodic slope and offset, with the spectral slope flattening, and offset decreasing, with increasing age. The aperiodic-adjusted alpha peak frequency also increased with age; however, there was no association between age and peak frequency for the beta band, or between age and aperiodic-adjusted spectral power within either the alpha or beta bands, despite power in both frequencies being correlated with the aperiodic signal. Together, these findings highlight the capacity for both periodic and aperiodic components of the RS-EEG to elucidate age-related functional changes within the developing brain. Importantly, these results emphasise the aperiodic slope and offset recorded using RS-EEG as novel non-invasive physiological markers of neurodevelopment.

{Perception}

Perception in real-time: predicting the present, reconstructing the past

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We feel that we perceive events in the environment as they unfold in real-time. However, this intuitive view of perception is impossible to implement in the nervous system due to biological constraints such as neural transmission delays. I propose a new way of thinking about real-time perception: at any given moment, instead of representing a single timepoint, perceptual mechanisms represent an entire timeline. On this timeline, predictive mechanisms predict ahead to compensate for delays in incoming sensory input, and reconstruction mechanisms retroactively revise perception when those predictions do not come true. This proposal integrates and extends previous work to address a crucial gap in our understanding of a fundamental aspect of our everyday life: the experience of perceiving the present.

{Clinical}

An investigation of neuropsychological and lesion characteristics of post-stroke apathy

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Apathy is a multi-dimensional syndrome that affects ~30% of stroke patients, and refers to reductions in goal-directed behaviour, cognition or emotion. The multi-dimensional nature of post-stroke apathy is currently not well understood as most previous work has employed unidimensional measures. It is also unclear whether the sub-dimensions of apathy map onto distinct neuropsychological functions and lesion profiles as has been demonstrated in neurodegenerative disease. This study aimed to address this question in a series of stroke patients presenting with apathy.

12 acute stroke patients were identified as having clinically significant apathy on one or more domains

on the Dimensional Apathy scale from a larger sample of 65 patients. Participants were assessed within three weeks of their stroke on tasks assessing speed, working memory, prospective memory, executive functions and a questionnaire assessing social reactivity. Individual scores were compared to a group of healthy controls using modified t-tests. Lesion mapping was performed using structural clinical images.
There were no distinct patterns of neuropsychological performance or lesion sites for each of the apathy dimensions. Difficulties with inhibition were observed across all dimensions. Poorer prospective memory was also common across domains, while social reactivity was reduced in emotional apathy only. Lesions were predominantly located in right subcortical regions, with some additional frontal, temporal and cerebellar involvement; however, there was substantial overlap in lesion locations between dimensions and individual differences within dimensions. Our results suggest that neuropsychological and lesion profiles of apathetic stroke patients are likely more heterogenous than in neurodegenerative diseases.

{Ageing and Development}

Relationships between Cognition, Reward Drive, and Impulsivity in Adolescence and Young Adulthood

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Adolescence is a period of significant physical, social, and psychological development. It is also a time of increased engagement in risky behaviours. This is thought to be because the areas of the brain that are involved in reward drive and emotion are fully developed, while the areas of our brain that are involved in helping to regulate behaviour are still in the process of developing. This means that adolescents are more likely act on emotions or make decisions that will result in the biggest reward, without thinking through the consequences of that decision. However, these theories do not account for individual differences among young people. The present study examined individual differences in cognition, reward drive and impulsivity in adolescents and young adults (N = 75). Participants completed 2 phases of testing 2-4 years apart where they completed of cognition, reward drive and impulsivity. We used linear mixed effects modelling to examine the relationship between these measures, and how these relationships changed over time. We found that age effects on cognitive control, impulsivity, and reward drive were broadly consistent with previous literature, with continuing maturation across adolescence into young adulthood, and plateauing thereafter. However, relationships between cognitive control, reward drive, and impulsivity were more heavily influenced by individual differences across these measures than by age itself. These findings contribute to a growing body of evidence that the developmental models of risk-taking may be too simplistic to account for all adolescents and their behaviour.

{Memory}

Baby-brain Phenomenon is a Universal Experience: Cognitive Deficits found in both Birthing and Non-birthing Parents in the Postpartum.

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Subtle, yet consistent declines in memory performance exist during pregnancy. Literature examining the endurance of these declines into the postpartum period and whether they occur in other areas of cognition is scarce, with inconsistencies abound. While clinically insignificant, mild deficits in multiple areas of cognition can make the adjustment to parenthood difficult. This study aimed to determine whether these declines persist in the first two years of parenthood, extend to other cognitive domains, and explore underlying mechanisms driving these differences (i.e., hormones and/or caregiving experience) by comparing birthing parents (*N*=35), non-birthing parents (*N*=9), and non-parents (*N*=33), who were all assigned female at birth (*Mean* = 30.16 years, *Standard Deviation* = 7.35). Participants completed a computerised survey comprised of demographic questions, psychosocial measures, and a cognitive battery. An

ANOVA and t-tests revealed that birthing and non-birthing parents performed significantly worse on processing speed and subjective memory tasks when compared to non-parents. No significant differences between the birthing and non-birthing parents in performance was found on any measure of cognition. Results did not change after controlling for covariates. No significant differences found between parent groups and non-parents on executive functioning, verbal and working memory tasks. Our results build on previous parenthood literature, showing deficits in processing speed and subjective memory for birthing, and non-birthing parents in the first two years of parenthood.

{Decision Making}

Choosing increases the value of non-instrumental information

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Curiosity pervades all aspects of human behaviour and decision-making. Recent research indicates that the value of information is determined by its propensity to reduce uncertainty, and the hedonic value of the outcomes it predicts. Previous findings also indicate a preference for options that are freely chosen, compared to equivalently valued alternatives that are externally assigned. Here, we asked whether the value of information also varies as a function of agency. A sample of 47 participants rated their preference for information that resulted from either an agentic (self-chosen) decision, or non-agentic (externally-imposed) condition. Our results showed that agentic decisions significantly increased the subjective value of information about the outcome. Computational modelling indicated that this change in information-seeking behaviour was not due to changes in the subjective probability of winning, but instead reflected an independent effect of agency on the value of resolving uncertainty. These results demonstrate that agency is an important source of information value.

{Attention}

Which measures from a sustained attention task best predict ADHD group membership?

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Difficulty with sustaining attention to a task is one of the hallmark symptoms of Attention Deficit Hyperactivity Disorder (ADHD). There are many different measures of sustained attention and it would be useful to know which measures best predict whether a participant has a diagnosis of ADHD. One-hundred and twenty-nine children with a diagnosis of ADHD and 129 age- and sex-matched typically developing children completed the fixed version of the Sustained Attention to Response Task (SART). The measures of sustained attention were errors of omission and commission estimated using count and signal detection analysis, and speed and variability in responding, estimated using Gaussian, Ex-Gaussian, and frequency analyses. The measures of both error types, standard deviation of response time, tau, moment-to-moment (FFAUS) and slow changes (SFAUS) in variability, d', and mu were able to successfully classify children with and without ADHD. The mean response time, criterion, and sigma were not able to classify participants into the two groups. Children with ADHD had substantial difficulties with maintaining their attention on the task. There was no time-on-task effect, suggesting the difficulties were apparent from the start of the task. The best classifiers were d' (0.75 Area Under the Curve, AUC), tau (0.74), SDRT (0.74), omission errors (0.72), commission errors (0.71), and SFAUS (0.70). The count of omission and commission errors and the SDRT provide substantial classification information without the need for more sophisticated modelling of RT data. This list of the best classifier measures may prove useful for the planning of future studies.

{Other}

Cortico-striatal activity distinguishes human safety learning via Pavlovian conditioned inhibition

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Safety learning generates associative links between neutral stimuli and the absence of threat and is thought to be a distinguishing feature of anxiety-related disorders. Despite its clinical relevance, the neural basis of human safety learning remains unclear. Here, we aimed to distinguish between (a) conditioned inhibition and 'general' safety signal learning, and (b) safety learning versus expression/appraisal. Forty-nine subjects underwent a 'Pavlovian conditioned inhibition' task during ultra-high field fMRI. One safety signal (a conditioned inhibitor, 'X') predicted threat-omission when paired with a known threat signal (A+/AX-), and another ('general') safety signal preceded threat omission without threat-proximity (BC-). These stimuli evoked similar behavioural and subjective affective responses but exhibited highly divergent neural responses. Safety learning via conditioned inhibition was characterised by prominent engagement of the dorsal striatum, together with midbrain, thalamic and motor cortex regions. Conversely, the general safety signal involved an array of cortical areas, including the ventromedial prefrontal cortex, consistent with conventional studies of safety signal processing. Overall, this represents novel evidence that inhibitory safety learning involves a distributed cortico-striatal circuitry, which extends the current cortico-centric model of safety to include regions with well-known involvement in associative learning. This finer-grained mapping of subcortical regions may have implications for advancing neurobiological models of anxiety-related disorders.

{Clinical}

Cognitive and neural mechanisms of subjective time in frontotemporal dementia

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Although ubiquitous and central to everyday life, how humans apprehend, experience, and mentally navigate time remains poorly understood. This is particularly the case where dementia is concerned as few studies have explored the capacity for subjective time in dementia. We explored subjective time in the behavioural-variant frontotemporal dementia (bvFTD), semantic dementia (SD) and progressive nonfluent aphasia (PNFA) in comparison to healthy older adults. Prospective timing was assessed using time estimation, production, reproduction and discrimination tasks (ranging from 300ms to 12s), and a measure of retrospective timing (retrospective time judgment of the test session, ~60 mins) was conducted. A questionnaire was further applied to explore the past- and future-oriented memory in daily life in dementia.
Relative to Controls, subject time changes were observed in bvFTD, while variable performance was observed in SD and PNFA. These changes were found to be related to grey matter intensity decrease in predominantly frontoinsular brain regions and the basal ganglia (i.e., putamen, caudate and claustrum), as well as decreased functional connectivity of the frontoparietal network and salience network. We further demonstrated significant disruptions of past- and future-oriented memory in daily life in bvFTD but not SD or PNFA. Irrespective of temporal context, these disturbances of time perception in daily life were related to atrophy of the orbitofrontal cortex.
Taken together, these findings provide novel insights on how subjective time changes in neurodegenerative disorders and its implications for everyday function.

{Methods}

Investigating the effects of varying analysis and signal parameters on multivariate decoding of event-related potential data

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The application of multivariate pattern analysis to event-related potential (ERP) data, as measured using electroencephalography (EEG), has become increasingly popular in cognitive neuroscientific research. Prior studies have trained and tested classifiers using spatial patterns of ERP data at single timepoints or averaged over small (e.g., 10 ms) or large (e.g., 100 ms) analysis time windows. However, there remains little consensus regarding what analysis window size is optimal for identifying decodable information in EEG signals, particularly when ERP components underlying an experimental effect are highly variable in time. To investigate this, we generated sets of simulated EEG datasets comprising two experimental conditions. A signal resembling an ERP component was added to one condition in each dataset. Across datasets, we varied the timing variability of the signal across trials, ranging between 0 - 100 ms. Linear support vector machines were applied to classify the conditions using sliding analysis time windows ranging from 2 - 100 ms. We estimated statistical power to detect above-chance decoding performance by applying significance tests to randomly-sampled datasets drawn from a larger pool. We found that, as window size increased, statistical power also increased. As signal timing variability increased, statistical power decreased, particularly when using narrow analysis time windows. Our findings demonstrate that sensitivity to detect decodable information is reduced when the cognitive and neural processes are variable in time. This effect is particularly prominent when decoding based on single timepoints or narrow analysis windows.

{Perception}

Dissociating the temporal dynamics of prediction error corresponding to orthogonal attributes of the same visual stimulus

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Any object within the visual world is constructed of multiple attributes (colour, form, orientation, etc.), which the brain must encode from sensory data to make perceptual inferences of the outside world. To date, evidence points to such encoding occurring at asynchronous, attribute dependent latencies, within functionally specific regions of cortex. The present study is a continuation of this work under a predictive coding framework. Specifically, we evoked prediction errors corresponding to one of three orthogonal visual attributes within the same two-dimensional stimulus, by violating a five-step sequence of image changes across: brightness, size, and orientation. Using time-resolved decoding of EEG data, attribute specific violation trials were classified against those of a fully predictable control condition. Crucially, there were no physical differences between all conditions during the fourth and fifth image steps, meaning above chance classification must have been driven by prediction error propagation and not bottom-up processing. Results found that both size and orientation violations were decodable from ~150 ms until stimulus offset. Moreover, the classification parameters learnt for each decodable violation type generalised to one another - with preliminary temporal generalisation suggesting that the shared dynamics might be operating at asynchronous time courses. Furthermore, pairwise classification between size and orientation violation trials showed that the two conditions were also decodable from one another post ~350 ms. Taken together, these results suggest that the early stages of prediction error signalling are domain-general, though potentially subject to asynchronous, attribute dependent latencies, with the later stages being reflective of attribute-specific processing.

{Perception}

The temporal dynamics of rotation-invariant object processing

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Humans can recognise objects from many different viewpoints. One of the sources of this variability is rotation, where an object is seen from different perspectives that rotate its retinal image. While different viewpoints result in different retinal inputs, we have little difficulty recognising the object in most circumstances suggesting the brain creates and maintains representations of objects that are viewpoint-invariant. Here, we studied how the brain transforms images into invariant representations of objects. We measured time-varying electroencephalography responses to objects in eight rotations, presented at either 5Hz or 20Hz. Multivariate classification was used to assess at what point in time high-level rotation-invariant information emerged, and to what extent very fast (20Hz) presentation rates disrupted this high-level representation. Our results showed that both rotation-specific and rotation-invariant information emerged at an early stage of processing, only ~84-92ms after stimulus onset. However, rotation-invariant information peaked later, suggesting that rotation-specific information is transformed into a higher-level invariant representation. The rotation-invariant information was lower for the 20Hz compared to 5Hz presentation rate, which suggests that rotation-invariant processing is disrupted, but not eliminated, with only a glimpse of an object. Together, the results suggest that rotation-specific and invariant object information arise at similar times in the brain, but that it takes more time for invariant object information to be fully established.

{Perception}

Reconstructing remapped stimulus information from EEG in the pre-saccadic period

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Saccadic remapping is the updating of retinotopic coordinates across saccades. This process is thought to compensate for the shift of the visual world across the retina with eye movements. It is suggested that prior to a saccade, neurons currently representing a visual stimulus predictively shift this representation to neurons whose receptive fields will encompass the stimulus after a saccade. It is currently hotly debated whether this process involves only the updating of spatial pointers, or whether featural information, such as orientation, is also remapped. In the present study, we recorded neural activity using electroencephalography (EEG) during a saccade task. Participants made saccades between two fixation points while covertly attending to oriented gratings briefly presented at various locations on the screen. Data recorded during trials in which participants maintained fixation, were used as training data for multivariate pattern analyses. Subsequently data collected during saccade trials were used to test for the presence of stimulus information at the post-saccadic retinotopic location shortly before the saccade (i.e. the pre-saccadic period). These analyses allow us to reveal the contents and temporal dynamics of the remapped response. We found preliminary evidence that information about stimuli presented in the pre-saccadic period is encoded in the remapped position. This finding advances our understanding of how the brain keeps track of objects in the external world despite constantly changing retinoptopic input.

{Attention}

No effect on visuospatial or temporal attention following offline parietal iTBS or alpha frequency tACS stimulation in healthy participants

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Non-invasive brain stimulation is a growing field with potentially wide-ranging clinical and basic science applications due to its ability to transiently and safely change brain excitability. There are several types of brain stimulation techniques including repetitive transcranial magnetic stimulation (rTMS) and transcranial alternating current stimulation (tACS). Single session stimulations with both techniques have previously been reported to induce changes to attention, which has implications for cognitive enhancement. To better understand and compare effectiveness of each technique and the basis of their effects on cognition we assessed changes to both temporal and visuospatial attention using an attentional blink task and a line bisection task following offline stimulation with an intermittent theta burst (iTBS) rTMS protocol or 10Hz tACS. We also included a novel rTMS stimulation technique, low-intensity rTMS, which uses stimulation intensities an order of magnitude below conventional rTMS. Animal models show that low-intensity rTMS modulates cortical excitability despite sub-action potential threshold stimulation. Stimulation was delivered over the right posterior parietal cortex (rPPC) using a within-subjects design (n=19). Frequentist and Bayesian analyses showed no evidence for an effect of either stimulation technique on spatial biases in the line bisection task or on magnitude of the attentional blink. Investigation of individual variability did not support task performance following sham stimulation as a predictor for stimulation effects. Our results suggests that offline iTBS or 10Hz tACS over rPPC do not modulate performance in tasks assessing visuospatial or temporal attention, which aligns with previous studies showing poor replicability of cognitive modulation following brain stimulation.

{Ageing and Development}

Working memory as an endophenotype linking genetic risk for attention-deficit/hyperactivity disorder to its behavioural traits in a large population-based sample

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Endophenotypes are heritable and quantifiable traits indexing genetic liability for a disorder. Here we examined which potential cognitive endophenotypes statically mediate the relationship between the genetic risk for attention-deficit/hyperactivity disorder (ADHD) and attention problems reported in a large population-based sample.

We used genetic, cognitive, and behavioural data for up to 2306 participants aged 9-10 at baseline, from the Adolescent Brain Cognitive Development Study. Polygenic risk scores (PRS) quantified ADHD genetic risk. Attention problems were assessed using the Child Behaviour Checklist attention problems sub-scale, where raw scores were a proxy for ADHD traits. Candidate cognitive endophenotypes were quantified using task-based measures: i) working memory defined as the accuracy on the emotional n-back task, ii) response inhibition and iii) reaction time variability estimated form the stop-signal task, and iv) and delay discounting calculated as area under the curve from the adjusting delay discounting task. After corrections for multiple testing, cognitive measures that were associated with ADHD traits and PRSs were evaluated as potential mediators.

Higher ADHD PRSs were associated with more pronounced attention problems. Lower working memory performance, poorer response inhibition, and increased reaction time variability were associated with more pronounced attention problems. Higher ADHD PRSs were associated with poorer working memory accuracy, but no other cognitive measures. Working memory performance partially mediated the relationship between ADHD PRSs and attention problems (proportion mediated: 10%). Together, these findings indicate that working memory can be understood as an endophenotype underlying the relationship between the genetic risk for ADHD and its behavioural traits in a population-based sample.

{Clinical}

The locus coeruleus-noradrenaline system in Parkinson's disease - modulating impulsivity and reinforcement learning

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The locus coeruleus-noradrenaline system plays a critical role in cognition and behaviour. Understanding how this system is impacted by disease has important implications for treatment, and can offer insights into how the system functions in the healthy brain. Our work has focused on the locus coeruleus-noradrenaline system in Parkinson's disease - in particular, the role it plays in impulsivity and reinforcement learning. Using a combined approach, we characterised the locus coeruleus using 7T MRI and probed the system in a pharmacological study with the noradrenergic reuptake inhibitor atomoxetine. Following on from extensive preclinical work linking stop-signal inhibition to the noradrenergic system, we show that stop-signal task performance is modulated by atomoxetine and dependent on locus coeruleus integrity. We also use this framework to further confirm a role for noradrenaline in navigating uncertainty during reinforcement learning, by showing improved learning behaviour under atomoxetine via computational modelling and pupillometry. Together, these findings advance ideas around noradrenergic therapy in Parkinson's disease and hopefully provide some new insights into how the locus coeruleus-noradrenaline system orchestrates human behaviour.

{Social}

Differences in effective connectivity between postpartum mothers and non-mothers relate to maternal caregiving, cognitive performance, and social cognition

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The 'parental caregiving network' encompasses several interconnected sub-networks, including the motivation-reward, theory of mind, and executive control networks. Understanding the dynamics of these networks in mothers may uncover neural correlates of maternal care. We used spectral dynamic causal modelling (spDCM) to investigate how the dynamic communication between these critical networks differs between a group of 40 first-time mothers one year postpartum and 39 age- and education-matched women who had never been pregnant (non-mothers). We investigated the effective connectivity between six key brain regions (dorsal medial prefrontal cortex, ventral medial prefrontal cortex, posterior cingulate cortex, parahippocampal gyrus, amygdala, and nucleus accumbens). Specifically, we explored how the dynamics of the maternal brain relates to differences in maternal caregiving behaviour, cognitive performance, social cognition. Our results demonstrate (1) the network dynamics of the motivation-reward network (nucleus accumbens and amygdala) was related to maternal caregiving; (2) that mothers out-performed non-mothers on measures of social cognition, which was related to the effective connectivity of the executive function network; and (3) while mothers and non-mothers did not differ on tasks of cognitive performance, there were group differences in effective connectivity between the executive function network and motivation-reward network, related to cognitive performance. When interpreting our results as a whole, the nucleus accumbens and the parahippocampal gyrus emerged as 'hub' regions of the maternal brain, showing the highest nodal degree (number of connections). These results highlight the importance of these brain regions for maternal caregiving, social cognition, and cognitive performance in the postpartum period.

{Clinical}

Noradrenergic modulation of saccades in Parkinson's disease

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Oculomotor performance in reflexive prosaccade and voluntary controlled antisaccade tasks can provide insight into cognitive control, executive function and response inhibition. In Parkinson's disease they can also act as markers of motor and cognitive impairment. Treating cognitive decline in Parkinson's remains a challenge, as standard dopaminergic therapy fails to address the extensive non-dopaminergic pathology. Specifically, the noradrenergic locus coeruleus, which is typically involved in attention and task engagement, undergoes significant degeneration. Modulating the noradrenergic system using the reuptake inhibitor atomoxetine could improve oculomotor and cognitive control in Parkinson's.
Here, we test the hypothesis that atomoxetine improves response inhibition and voluntary control in prosaccade and antisaccade tasks. Participants with Parkinson's (n=19) completed oculomotor and cognitive tasks under 40 mg of atomoxetine or placebo in a double-blind placebo-controlled randomised crossover study. Controls (n=26) completed the task battery without the drug manipulation. Locus coeruleus integrity was imaged in all participants at ultra-high field 7T.
We found that atomoxetine significantly reduced prosaccade response latency and increased errors in the antisaccade task in Parkinson's patients. Atomoxetine significantly raised resting pupil diameter of Parkinson's participants but did not change its temporal derivative. Antisaccade peak velocity was significantly reduced on atomoxetine, however the results were highly varied across participants. These results demonstrate the variable nature in which noradrenaline functions, consistent with the non-linear inverted-U shaped responses observed across monoaminergic and cholinergic systems. Together, they suggest that 40mg of atomoxetine improves certain aspects of oculomotor function and visual attention, highlighting the importance of noradrenergic treatment strategies in Parkinson's.

{Memory}

Australian and Scottish intracultural comparisons of the explicit self-reference effect

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The self provides the lens through which people view and interpret the world around them. It is unsurprising that research suggests the self strongly modulates cognition. For example, the self-reference effect (SRE) is the ability to correctly recall self-related information more accurately than non-self-related information, such as a celebrity or a stranger. The difference between self- and other-referent memory accuracy can be considered an objective index of the psychological distance between the self and other. Typically, cross-cultural SRE research has compared Western and Eastern countries when investigating how self-concept modulates memory. However, recent research suggests individuals' self-concept may differ across Western countries. Â In our study, we are investigating intracultural SRE modulation in Australian and Scottish samples. For both recognition and source memory, we predicted a stable SRE for both Australian and Scottish individuals. Additionally, culture will modulate the self-memory advantage, such that Scottish individuals will have a greater self-memory advantage compared with Australians. Trials consisted of the participant's or a stranger name (Sam) and a concrete object (e.g., ball or apple). Australian (n = 16) and Scottish (n = 12) participants indicated whether the presented name liked the co-presented object. In line with predictions, preliminary analyses suggest an advantage for self-paired items in both recognition and source memory across Australian and Scottish individuals. However, contradictory to predictions, a non-significant two-way interaction suggested Australian and Scottish individuals benefited similarly from self-referencing. Findings are discussed in reference to implications and further directions.

{Perception}

Face detection from patterns of shading and shadows

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Here we investigate how characteristic patterns of shading and shadows that occur across the human face act as a cue for face detection. We use 3D-graphical rendering to isolate facial shading under controlled lighting conditions. The rendered images are converted to two-tone images ('Mooney faces') to isolate broad patterns of contrast. We measured human performance in discriminating faces from non-face objects when rendered in identical lighting conditions. We find that the production of recognizable sensory patterns depends strongly on the lighting direction relative to the face. In particular, light arriving from above the brow tends to facilitate face detection, consistent with the statistics of real-world lighting environments, in which light commonly arrives more strongly from above. Indeed, in a further experiment, we find that asymmetries in lighting that occur in complex and naturalistic lighting environments produce contrast patterns across the face that facilitate face detection. Comparison with the performance of an image classifier trained to discriminate faces from non-faces suggests that these effects might in part be due to differences in image information across conditions as well as to human familiarity with overhead lighting. These results demonstrate that the sensory features that define a face to the human visual system depend on the interaction between the characteristic 3D shape of human faces and lighting direction.

{Social}

Investigating the relationship between Research Domain Criteria Social Processes, and GABA and glutamate concentrations in the superior temporal sulcus

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Like other cognitive functions, social processing requires functional neurotransmission within relevant micro-circuitries. A balance between the brain's primary excitatory (glutamate) and inhibitory (gamma aminobutyric acid; GABA) neurotransmitters appears to support social functioning. Social processing dysfunction has been linked to aberrant excitation-inhibition in the superior temporal sulcus (STS), a recognised social processing region. Magnetic Resonance Spectroscopy (MRS) measures neurochemical concentrations, such as GABA and glutamate. The relationship between glutamate and GABA concentrations and Research Domain Criteria (RDoC) Social Processes is unknown.

In 12 healthy adults (7 female) aged 18-40 years, GABA and glutamate+glutamine (Glx) were quantified from the right STS using MEGA-PRESS, a GABA-editing MRS sequence, during rest. MRS data were also collected from a control voxel in the visual cortex. RDoC Social Processes were measured using the Social Responsiveness Scale (SRS), Penn Emotion Recognition (PER) Task, and Reading the Mind in the Eyes (RME) Task.

While not significant, SRS scores were moderately associated with STS Glx (Spearman's rho=0.494, $p>0.05$) and Glx/GABA ratio (rho=0.486, $p>0.05$). Similarly, STS Glx were moderately associated with PER Inverse Efficiency Scores (IES; rho=0.429, $p>0.05$), with weak associations between resting Glx/GABA ratio and PER IES (rho=0.286, $p>0.05$). No relationships between RME accuracy and resting GABA, Glx, or Glx/GABA ratio were observed.

This pilot study was the first to investigate GABA and Glx concentration relations with RDoC Social Processes. The preliminary data exemplify the value in utilizing MRS to investigate the mechanisms that underly this domain. The current methodology remains a promising avenue for identifying neurochemical concentrations during social processing.

{Decision Making}

Foraging for the self: environment selection for agency inference

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Choosing the right environment is crucial for learning about the world and achieving goals. But before an agent can do either of these things, they need to model the effects of their own actions on the world. There is little uncertainty about agency when foraging in an environment where all areas are easily accessible, and rewards are easy to collect when encountered. However, uncertainty mounts when the mapping from actions to outcomes becomes ambiguous. This approach contrasts with research focusing on the effects of uncertainty on choosing patches for foraging in the form of unknown availability and depletion of extrinsic rewards. In this talk, I focus on an online experiment in which participants can freely move between two environments which pit model complexity against irreducible variability. We first explore which type of environment agents prefer when trying to infer agency. Further, we are able to measure moment to moment prediction error and hypothesise that increasingly erroneous predictions about the expected outcome of agency-exploring actions can be a driver of switching environments in an effort to quell rising uncertainty. We find that participants more frequently occupy the variable environment, which is predicted by greater accuracy and higher confidence than the complex environment. Further, we show that participants actively switch between the two environments following increases in prediction error, and that the tolerance for prediction error before switching is modulated by individuals' autism traits. This demonstrates how participants forage to reduce uncertainty of action-outcome contingencies and support agency inferences.

{Attention}

A longitudinal investigation of the impacts of sleep on sustained attention in children

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Sustained attention enables children to maintain their focus without disengaging or becoming distracted, making it a foundational skill for learning.Â In adults restricted sleep is detrimental to sustained attention, but in children this relation is not fully understood. Two-hundred and forty-eight children were tested three times, one year apart, from the age of six years. They completed the fixed Sustained Attention to Response Task, teachers completed a questionnaire on behavioural measures of inattention and hyperactivity/impulsivity, and parents completed a sleep habits questionnaire. A previous study examining year two data observed that shorter sleep duration predicted a haphazard response profile, characterised by poorer sustained attention - more omission errors, very slow responses, behavioural inattention, and faster and less variable responding. The current study investigated if this profile occurred in years one and three, and if sleep in earlier years impacted sustained attention in later years. The haphazard profile was not observed cross-sectionally in years one or three, but a shorter sleep duration in year one predicted haphazard responding in year two, and error performance in year three performance. Sleep quality did not consistently predict performance within or across years. The cross-sectional findings in year two may indicate this is a sensitive period for the development of sustained attention. Alternatively, children may have experienced shorter sleep durations particularly that year. The longitudinal findings indicate a cumulative effect of short sleep resulting in the haphazard responding. Shorter sleep may disrupt cognitive development, possibly resulting in dysfunctional arousal regulation producing haphazard responding.

{Ageing and Development}

Investigating predictive coding in younger and older children using MEG and a multi-feature auditory oddball paradigm

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How do children come to know about the world? This question has sparked one of the most heated controversies in the history of philosophy""namely, the 'nature versus nurture' debate. Yet the distinct 'nature' and 'nurture' perspectives fail to reflect what most researchers have come to accept today: that the mind is a product of both. Recently, a new theory has emerged that promises to bridge the theoretical divide. This theory, known as 'predictive coding', offers a compelling explanation of how knowledge can be both innately specified and later developed via interactions with the environment.
Here, we sought to test a predictive coding account of early neurocognitive development at the neural level. We used paediatric MagnetoEncephaloGraphy to record the evoked fields of 18 younger and 19 older children (aged 3.1 - 5.3 and 5.6 - 6.9 years, respectively) as they listened to a multi-feature auditory oddball paradigm. For each child, we subtracted evoked responses to the 'standard' from the 'deviant' pure tones to compute the mismatch field 'MMF': an electrophysiological component that is widely interpreted as a neural signature of predictive coding.
We hypothesised that children would become increasingly proficient at predicting the high-probability 'standards' relative to the lower-probability 'deviants', as indexed by an increase in the MMF amplitude across development- which is indeed what we found, $r = .33$, $p = .049$. This increase was evident in the right-hemisphere temporal and frontal regions. We interpreted this increase as evidence of optimised predictive brain function across early childhood development.

{Attention}

Real-time neurofeedback training of spatial and feature-based attention selectively enhances visual processing

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An organism's ability to perceive and interact with the world is contingent upon efficient allocation of processing resources across a wide array of sensory inputs. In the visual system, selective attention facilitates this by prioritising the processing of behaviourally relevant subsets of visual inputs. Here, we asked whether participants could be trained to upregulate spatiotemporal patterns of neural activity associated with prioritisation on the basis of either spatial locations or visual features, and if so, whether such training leads to more efficient engagement of visual selective attention. To this end, we developed, pre-registered, and implemented a novel, decoded-EEG neurofeedback training protocol. Over four days, participants (N = 108) performed a frequency-tagged attentional cueing task which shifted dynamically in difficulty according to participants' real-time decoded attentional state. In three separate groups of participants, this neurofeedback signal reflected the patterns of neural activity associated with spatial selectivity, feature-based selectivity or, in a sham control condition, the attentional selectivity of a past participant. All three neurofeedback groups viewed identical displays, received identical instructions, and were blind to the specific training regime. Thus, the only differences between neurofeedback groups were the contingencies regulating task difficulty. We found that EEG decoded neurofeedback induced multivariate changes in visual activity specific to the targeted attentional state. Further, neurofeedback training resulted in general gains in behavioural performance. These gains were evident as an optimized deployment of attention over a relatively stable pool of processing resources, rather than as an increase in overall attentional capacity.

{Clinical}

External speech processing and auditory verbal hallucinations: A systematic review of functional neuroimaging studies

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It has been documented that individuals who hear auditory verbal hallucinations (AVH) exhibit diminished capabilities in processing external speech. While functional neuroimaging studies have attempted to characterise the cortical regions and networks facilitating these deficits in a bid to understand AVH, considerable methodological heterogeneity has prevented a consensus being reached. The current systematic review investigated the neurobiological underpinnings of external speech processing deficits in voice-hearers in 38 studies published between January 1990 to June 2020. AVH-specific deviations in the activity and lateralisation of the temporal auditory regions were apparent when processing speech sounds, words and sentences. During active or affective listening tasks, functional connectivity changes arose within the language, limbic and default mode networks. Some evidence of subcortical involvement was evident. However, poor study quality and lack of replicable results plague the field. As such, the systematic review provided a detailed list of recommendations to improve the quality of future research on this topic.

{Clinical}

Anxiety Attenuates the Behavioural and Neuronal Learning Advantages Conferred by Statistical Stability

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Pathological anxiety can alter an individual's perception of their external sensory environment. Previous studies suggest that the neural responses to unexpected (or surprising) stimuli are boosted in anxious individuals, and more so during stable compared to volatile environments. To investigate this, we used Bayesian Model Selection (BMS) to pinpoint the brain areas where different models of anxiety displayed the highest evidence. For this, we combined BMS with functional Magnetic Resonance Imaging (fMRI) in healthy individuals and induced transient states of anxiety using threat-of-shock during an auditory oddball paradigm in which the regularity could be stable or volatile. Behaviourally, we found that threat-of-shock eliminated the accuracy advantage conferred by stability over volatility. Next, we used BMS to compare nine families of models of the neural responses to surprising stimuli under the 2 x 2 levels of volatility (stable and volatile) and threat (safe and threatening). We found that threat-of-shock led to attenuation of neural activity evoked by surprising sounds across most subcortical and limbic regions including the thalamus, basal ganglia, claustrum, insula, anterior cingulate, hippocampal gyrus and superior temporal gyrus. Conversely, within two small clusters in the left medial frontal gyrus and extrastriate area, threat-of-shock boosted activity to levels observed during safe and stable blocks. Taken together, our findings support the idea that threat eliminates learning advantages conferred by statistical stability compared to volatility. Thus, we propose that anxiety disrupts behavioural adaptation to environmental statistics, and that multiple subcortical and limbic regions are implicated in this process.

{Perception}

Does conscious expectation influence adaptation to repeated auditory stimuli?

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Humans have a remarkable ability to discriminate sounds by frequency, or pitch; for instance, through conversation or listening to music. When presented with a repeated sound, the perceptual system quickly stores and retains a memory of the sound to optimise listening. The current understanding is that this memory is accessed entirely implicitly - i.e., distinct from conscious processes. In this study, we examine whether conscious expectation of a repeated sound can improve auditory perception. We employed a two-alternative forced-choice frequency discrimination task with two phases: In one phase, random, the frequency of the tones is randomly selected from a defined distribution. In another phase,Â repeated,Â the frequency of the first tone is the same throughout the task. The variable of expectation was introduced by instructing one group to expect a repeated tone before the repeated phase, while a second group did not receive this instruction. We used a staircase procedure to calculate thresholds, reversals, and errors; and an electroencephalograph headset to record neurophysiological responses. We find some evidence of conscious expectation improving frequency-discrimination performance. Participants given an expectation learned to minimise errors across phases and produced faster elicitations of auditory ERP component N1. These results suggest that, given sufficient task-related information, top-down conscious processes can improve predictive coding of auditory stimuli. Findings are discussed in the context of prevailing models of psychoacoustics.

{Clinical}

Characterising anatomical heterogeneity in psychiatric disorders using normative models

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Case-control study designs comparing group mean differences characteristically ignore neuroanatomical heterogeneity in psychiatric disorders. A normative modelling framework has been developed to quantify and map brain changes at an individual level. Here we use normative modelling to model and statistically characterize the degree of spatial overlap in individual-level anatomical brain changes associated with six different psychiatric disorders.

We collated T1-weighted MRI data from 14 independently acquired datasets (1465 controls, 1294 patients). We modelled age-, sex-, and site-related variation in regional GMV in a training set of controls (n=1196) using the PCNToolkit. Individual-specific deviation maps were then calculated for the patient cohort and the remaining 269 controls. To characterise the degree of spatial overlap in extreme deviations (z-score>|2.6|) for each disorder, we calculated the difference in percentage overlap in the extrema between the held-out controls and each patient

group. We then performed permutation testing to assess the statistical significance of the overlap.
We found that individual deviations were common but highly heterogenous in all disorders. There was very little overlap within any brain region for any specific disorder. The maximum overlap in participants for any given region was less than 10% for all disorders. Furthermore, after correcting for multiple comparisons, there were very few regions in which the degree of overlap differed significantly between controls and patients ($p<0.05$ FDR).
Our findings emphasize the considerable individual heterogeneity in structural brain changes observed in patients with the same psychiatric diagnosis and suggest that group-level changes are poorly representative of individual patients.

{Perception}

Examining potential enhancements in higher order functioning through observing cABR's in response to polyphonic musical stimuli in musicians and non-musicians

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Musical interaction can change cortical functioning. Research surrounding experience-dependent plasticity effects in the auditory brainstem, has seen musicians develop an increased reliance on bottom-up processing strategies to interpret musical sounds. Complex auditory brainstem responses (cABR's) are optimal to observe these experience-dependent plasticity effects. Historically, these changes have been investigated using simple stop-consonants and monophonic musical pieces. The primary aim of the current study is to observe genre specific effects (jazz, classical and folk music) on the cABR's of professional musicians compared to non-musicians via EEG. Eight participants (aged 18-35) listened to nine polyphonic musical pieces in the three genres. Each stimulus was limited to 1 second, and was randomly played fifty times. Analysis focused on the V-A complex at the beginning of the cABR. Using linear mixed effect models, a comparison of the two groups established a significant relationship between musicianship and cABR amplitudes, but no significant effect of genre. These results provide an indication that cABR use can be extended to complex (polyphonic) stimuli and thereby more naturalistic settings. With this knowledge, there are potential implications for current models of information processing to consider sub-cortical differences at the level of the auditory brainstem. Furthermore, this study adds to an emerging body of literature aiming to demonstrate the differential effects of experience-dependent plasticity in the brainstem and factors facilitating this. Finally, clinical implications of this research could potentially aid in the treatment of externally unresponsive populations, through a deeper understanding of bottom-up and top-down processing interactions at a sub-cortical level.

{Perception}

Capacity for movement is a major organisational principle in object representations

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The ability to perceive moving objects is crucial for survival and threat identification. Perception of animate movement appears to be an important organisational principle in the brain. Recent neuroimaging evidence has shown that the visual system processes objects on a spectrum according to their ability to engage in self-propelled, goal-directed movement (Thorat et al., 2019). The association between the ability to move and being alive is learned early in childhood, yet evidently not all moving objects are alive. Natural, non-agentive movement (e.g., in clouds, or fire) cause confusion in children and adults under time pressure (Goldberg & Thompson-Schill, 2009). In the current study, we investigated the relationship between movement and aliveness using both behavioural and neural measures. We examined electroencephalographic (EEG) data recorded while participants viewed static images of moving or non-moving objects that were either natural or artificial (e.g., waterfall, horse, car, rock, tree). Participants classified the images according to aliveness, or according to capacity for movement. Behavioural classification showed two key categorisation biases: moving natural things were often mistaken to be alive, and often classified as not moving. Neural data revealed the brain contained information about whether the object could move, during both a classification task and passive viewing. These results

highlight that capacity for movement is an important dimension in human visual object perception.

{Social}

Moment-by-Moment Prediction of Emotional Arousal and Physiological Responses

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Emotion is not a categorical state, but a constantly changing experience. Existing datasets for emotion reactivity include only small sample sizes and overall labels of emotion. However, a more ecologically valid context to test the role of the variability of emotion should follow the constantly changing context. A new multimodal dataset (EMAP) for analysing the human affective states includes electroencephalogram (EEG) and peripheral physiological signals of 145 participants' moment-by-moment reactions to emotional video clips. As the EMAP dataset presents the data between individuals, predicting emotion from these features is anticipated to be difficult. For this reason, we modelled arousal ratings and peripheral physiological changes (i.e. heart rate and skin conductance response) by EEG frequencies using machine learning techniques. Specifically, using Particle Swarm Optimization (PSO) to select important features for the Decision Tree and Linear Regression techniques. The error in predicting arousal and physiological changes was reduced with both algorithms when combined with PSO, which shows that certain features serve as better predictors for each of these algorithms. In addition, the error was lower when the physiological change prediction was made across different participants than within some participants, which is evidence that individual difference, while important, might not be the only factor that influences the moment-by-moment perception of these measures.

{Memory}

Cognitive changes in early parenthood: A focus on male parents

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Pregnant women experience subtle cognitive deficits, including decreases in memory, executive function, and processing speed. However, it is unclear whether pregnancy-related cognitive deficits persist into the postpartum, and if cognitive changes generalise to other parents, including fathers. The relationships between cognitive changes and differences in mood, sleep, and amount of time spent in primary care remain uncharacterised. In our study, 77 participants, including 7 male parents, 18 male non-parents, and 52 birth-giving parents completed an online survey and cognitive tasks (immediate and delayed recall, processing speed and working memory). Male parents showed slower processing speed than male non-parents, which remained significant after controlling for age, education, income, depression, anxiety and sleep. However, no difference in processing speed was found between male parents and birth-giving parents. For parents, poor sleep explained the most variance in processing speed, suggesting that the parenting environment impacts cognition, regardless of parental sex, and gestational experience. Male parents showed no difference to male non-parents, or birth-giving parents, on tasks of recall and working memory. This suggests that cognitive decline in the postpartum may be a subjective experience noticed by parents themselves, rather than an objective deficit. These results are the first to show that male parents also experience cognitive decline, which could aid in normalising this experience, and increasing support for all parents during the postpartum period. This study provides new parents with a further understanding of the normal cognitive changes they may experience.

{Perception}

Can mental images compete with visual input?

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Vision involves extracting meaningful information from the images we see. In contrast, imagining seems to involve the reverse process: using known information to construct mental images. Accordingly, mental imagery has been modelled as a process which uses the same neural architecture as vision, yet with information flowing in the opposite direction (Breedlove et al., 2020). However, if this is the case, why can't we seem to conjure mental images of our thoughts with the same fidelity as in vision? Here, we propose a model which answers this question by considering mental imagery as a process that occurs in the presence of competing visual input. To understand how sensory input might interfere with representations of imagined stimuli, we constructed a serial hierarchical network with bidirectional information flow where each network layer combines weighted bottom-up and top-down information. When simulating either vision or imagery alone, the corresponding input dominated the representations of all upper, middle, and lower network layers. In contrast, if imagery occurred during vision, sensory input dominated only lower network layers while imagined representations dominated upper layers, with mixed representations in between. Given that lower layers may represent stimuli with more modality-specific information than upper layers, we therefore argue that imagined percepts might lack fidelity because representations of imagined stimuli fail to outcompete sensory input at the low-level neural regions best suited to support high-fidelity stimulus representations. We consider these findings in relation to phenomena such as daydreaming, hallucinations, and mental imagery in other modalities (e.g. auditory imagery).

{Attention}

Spatial Attention Does Not Modulate the Processing of a Motion Ensemble

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The visual system represents vast arrays of information through the formation of ensemble codes, summary representations that arise from the pooling of local detail. There is an ongoing debate about the extent to which ensemble representations depend on attentional resources. A potential driver of this debate is that researchers do not always make it clear how they are manipulating attention, and this has led to the mixed evidence regarding the role of attention in ensemble processing. In this study, we examined the effects of Posner cueing""a well-established method of manipulating spatial attention""on the processing of a global motion stimulus, a naturalistic ensemble. In Experiment 1, we used a centrally presented, predictive attentional cue, and found no effect of spatial attention on global motion performance: Accuracy was equivalent between validly cued and invalidly cued trials, where attention was directed to the location of the ensemble or misdirected, respectively. In Experiment 2, we used a more sensitive, threshold-based measure of global motion performance; despite this change, performance on the task was again unaffected by spatial attention. Together, our results show that a naturalistic motion ensemble is remarkably impervious to misdirected attention, which speaks to the efficiency with which it is processed.

{Other}

The structural and functional connectivity of neuromodulatory systems underpins dynamic landscape shifts in brain topology

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The human brain is capable of complex cognition due to its ability to dynamically reconfigure its network structure. The ascending arousal system plays a crucial role in modulating brain network reorganization, with a balance between segregation and integration being crucial for cognitive function. Previous research has highlighted the role of the cholinergic system (Basal Nucleus of Meynert) in facilitating segregation and the noradrenergic system (Locus Coeruleus) in integration of network topology. Hence, we aimed to establish the relationship between structural and functional connectivity between the cholinergic and noradrenergic system. Using multi-modal imaging data from the Human Connectome Project, we extracted white matter streamlines from 50 subjects. We used anatomically derived region of interests for Basal Nucleus of Meynert (BNM) and Locus Coeruleus (LC). We calculated weighted white matter streamlines between the BNM and LC, that exclusively terminated in either ROI. We used graph theoretical measures to summarise system level features of brain network topology from the resting-state data. To gain further insight into the interaction of BNM and LC, we applied a novel attractor landscape mathematical approach. We found a significant relationship between the strength of weighted connections between BNM and LC, related to the ability to flexibly shift between different brain states. The results indicate that a strong structural connectivity between the cholinergic and noradrenergic system infers greater flexibly to shift between integrated and segregated brain states. In conclusion, we have proposed that underlying structural connectivity between two neuromodulatory systems could result in a more flexible brain network configuration.

{Other}

Combining information theoretic metrics with electrophysiological measures to characterise early statistical learning mechanisms

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The ability to learn structured sequence information within artificial grammar (AG) paradigms has been attributed to statistical learning (SL). Behavioural work on SL commonly involves exposing participants to an AG corpus followed by a test phase measuring performance on grammaticality judgements. Although this approach can dissociate learnability rates for different types of structured sequences, it does not address early learning processes involved specifically during AG exposure. As a novel approach to tracking SL during AG exposure, we examined the effects of pseudoword surprisal (log-probability of occurrence) on the N400 event-related potential (ERP). We also explored the role of individual alpha frequency (IAF) in modulating the surprisal-N400 relationship.

21 English speakers (15 female) completed a 5-minute passive AG exposure phase followed by an approx. 2hr test phase. The test phase involved identifying whether pseudoword sequences were correct or incorrect over 8 test blocks. EEG was recorded throughout the exposure and test phases. Single trial ERPs were calculated for individual participants in the N400 time window (300-500ms).

A significant main effect of surprisal was found, suggesting the presence of early SL mechanisms during AG exposure. This effect was modulated by pseudoword position within a sequence, whereby pseudowords occurring at non-adjacent deterministic positions were more learnable (as defined by a stronger N400-surprisal relationship) than those occurring at adjacent non-deterministic positions. Additionally, IAF significantly modulated the surprisal -N400 relationship suggesting inter-individual differences in SL mechanisms. Our findings thus offer an integrative perspective on generalised learning mechanisms potentially involved in AG and naturalistic paradigms.

{Clinical}

Characterisation of the Psychopathology of Autoimmune Encephalitis

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Background: In autoimmune encephalitis (AE), patients demonstrate neuropsychiatric features, frequently resulting in misdiagnosis with a primary psychotic disorder. Thus, there is a need to define the psychopathology at different disease stages to clarify the course of the illness and ensure accurate diagnosis and rapid initiation of treatment.
The primary objective of this study is to characterise the psychiatric and psychopathological manifestations of AE at initial presentation and last follow-up.
Methods: Psychiatric and psychopathological manifestations were analysed retrospectively in 30 patients diagnosed with AE between 2007 and 2019 at Royal Melbourne Hospital and Monash Medical Centre. The psychopathological manifestations were subjected to frequency analyses.
Results: 25 lower-level features were identified and stratified into 5 higher-order categories (mood, behaviour, sleep, psychosis and suicidality). In NMDAR encephalitis (n=8), initial presentations were mainly behavioural (87.5%), with agitation being most common, while presentations at last follow-up were mainly mood changes (87.5%), with fatigue being most common. In non-NMDAR encephalitis (n=12), initial presentations and presentations at last follow-up were mainly behavioural (83.3% and 75.0% respectively), with memory loss being most common in both. In encephalitides with antibodies against intracellular epitopes (n=11), initial presentation and presentation at last follow-up were mainly mood changes (54.5% and 72.7% respectively), with fatigue being most common in both.
Conclusion: This was the first study to characterise the progression of psychiatric and psychopathological manifestations of AE. This study demonstrates the core psychopathological features of different types of AE and hence, identifies clinical features that assist clinicians in the earlier recognition and diagnosis of AE.

{Perception}

Investigating the encoding of predictive sensory representations in EEG frequency spectra

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It takes time for the brain to process incoming sensory information. This means that there is a lag between when an event happens in the 'outside world' and when it is registered in the brain. Growing evidence suggests that the visual system predictively 'pre-activates' visual representations to help overcome this lag and better align neural representations with the outside world. Here, we investigated how such predictive representations are encoded in EEG time-frequency spectra. Across two separate experiments, participants viewed an apparent-motion stimulus moving along a circular path, while EEG was recorded. First, we demonstrate that it is possible to decode the on-screen location of the stimulus, from the phase angle of alpha-band oscillations (~8-12Hz) over occipital cortex. Then, we show that a predictive representation of the expected location of a stimulus can be decoded from occipital phase angles when the stimulus suddenly disappears from screen. Preliminary analyses suggest that the specific frequency in which this predictive information is encoded depends on the rate at which visual information is presented. For stimuli presented at slower rates, predictive representations are encoded in lower frequencies, suggesting somewhat flexible predictive mechanisms. Collectively these findings help to reveal how predictive visual representations are encoded in the phase EEG oscillations, and suggest that predictive mechanisms are sensitive to the timing of incoming sensory information.

{Other}

Capitalising on inter-individual differences in aperiodic activity to evaluate the exclusion of left-handers in EEG language research

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Differences in handedness have long been associated with inter-individual differences in language neurophysiology. Thus, left-handedness is a common exclusion criterion in cognitive neuroscience language research with the aim of maintaining homogeneity in neural activity measures. An alternate predictor of inter-individual differences in the neurophysiological organisation of language is the aperiodic 1/f component, commonly extracted from electroencephalographic (EEG) data. Archival data from a language processing EEG study was used to determine whether handedness or the 1/f component is a more accurate predictor of differences in language neurophysiology. Forty participants aged 18-30 completed an antonym paradigm task while their EEG was recorded. Results did not show a significant main effect of handedness, nor a significant interaction effect of handedness and condition on semantic prediction error, quantified as the N400 time window. The 1/f component (i.e., resting state 1/f slope), when included in a linear mixed effects model provided a better model fit than handedness alone. Individuals with a steeper 1/f slope also produced more distinguishable N400 amplitude differences for prediction errors (e.g., "The opposite of black is yellow / nice") and more distinguishable P300 responses for prediction fulfilment (e.g., "The opposite of black is white") in comparison to individuals with a flatter 1/f slope. Results suggest that the validity of handedness as an exclusion criterion for neuroscience language research requires evaluation and that resting aperiodic neural activity may influence inter-individual differences in effective cognitive processing over and above that of individual handedness.

{Methods}

Metabolic and functional connectomes show domain generality in cognition-connectome relationships: a simultaneous MRI-PET study

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How cognition maps onto the brain as a functional network remains a formidable challenge in current contemporary neuroscience. Blood oxygenation level dependent (BOLD) functional magnetic resonance imaging (fMRI) has been the dominant tool to investigate how cognition maps onto functional brain connectivity. However, fMRI provides only one viewpoint of neural communication, and fMRI-based measures are confounded by non-neuronal contributors. Positron Emission Tomography (PET) using F18-fluorodeoxyglucose (FDG) provides the opportunity to characterise metabolic elements of brain connectivity based on cerebral glucose uptake. FDG-PET is a quantifiable index of neuronal activity and with the advent of 'functional' FDG-fPET, which provides a within-subject time-course of glucose uptake at a high temporal resolution (i.e., 16 seconds), it is now possible to examine region-region metabolic connectivity for the first time. How functional and metabolic connectivity differ in their contribution to cognition and behaviour is unclear. Here we used simultaneous resting-state FDG-fPET/fMRI to investigate how hemodynamic connectivity and metabolic connectivity relate to cognitive function by applying partial least squares analyses. Results revealed that while for both modalities the frontoparietal anatomical subdivisions related the strongest to cognition, using hemodynamic measures this network expressed executive functioning, episodic memory, and depression, while for metabolic measures this network exclusively expressed executive functioning. These findings demonstrate the unique advantages that simultaneous FDG-fPET/fMRI has to provide a comprehensive understanding of the neural mechanisms that underpin cognition and highlights the importance of multimodality imaging in cognitive neuroscience research.

{Ageing and Development}

Cerebrovascular Health and Task Switching Variability in Healthy Ageing

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Subtle cognitive changes are common with increasing age, especially in higher-order cognitive control processes that are crucial for independent living. The prefrontal cortex (PFC) shows age-related changes in structure and function associated with cognitive control decline. The association between white matter health, cognitive control ability and cerebral arterial pulsatility (e.g., Jolly et al., Front. Hum. Neurosci 2013, HBM 2017) suggests a close link between our cerebrovascular health and cognitive control ability, especially in healthy older adults with cardiovascular risk factors. Pulse Diffuse Optical Tomography (Pulse-DOT) leverages the arterial pulse signal that would typically be filtered out in near infra-red spectroscopy (NIRS), providing indices of regional cerebrovascular health across the cortex. Pulse-DOT parameters (i.e., Pulse Relaxation Function (PReFX), Pulse Amplitude (PA), Pulse Transit Time (PTT)) show negative associations with age, and positive associations with cardiorespiratory fitness, white matter health and cognition measured on the Wisconsin Card Sorting Task and Operation Span Task (Tan et al., Neurobiol. Aging, 2019). The current study examines whether variability in cued-trials task switching - a paradigm that taps into distinct cognitive control processes and produces robust age-effects - is associated with decline in localised arterial health of the PFC. In a large sample of 60-70 yr-old healthy adults (n=142), we examine whether pulse-DOT measures of arterial health are associated with task switching and mixing cost (measures of set-shifting and working memory load). We expect significant negative correlations between behavioural costs and pulse measures particularly over the left hemisphere that is more strongly activated during task switching.

{Decision Making}

Investigating individual differences in impulsivity in relation to varied risky decision-making

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Personality factors influence aspects of decision-making and vary between individuals. This study investigated how the five components of impulsivity assessed by the Urgency, Perseverance, Premeditation, Sensation-Seeking scale (UPPS-P) short-version (positive urgency, negative urgency, sensation-seeking, lack of perseverance, and lack of premeditation) impacted the loss and risk aversion aspects of risky decision-making assessed by a monetary risky choice task. We used a hierarchical multivariate regression analysis to assess how the facets of impulsivity associate with risky decisions in 50 healthy participants. The results indicated that increased risky decision-making behaviours are associated with decreased negative urgency and increased positive urgency. Sensation-seeking was found to be lower in individuals with higher risk aversion. No other facets of impulsivity had a significant effect on the aspects of risky decision-making. These findings indicate that those who avoid risk are less likely to pursue thrills, exhibit fewer negative emotions and more positive emotions when behaving impulsively.

{Perception}

Motion Extrapolation in the Twinkle-Goes Illusion: Effects of Speed, Duration, and Visibility

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Neural delays are inherent in processing and transmitting visual information from the retina to the cortex. However, humans do not typically experience perceptual lags when interacting with moving objects. The theory of motion extrapolation explains this is because the human visual system uses the past trajectory of a moving object to predict its current position. A recently discovered motion-position illusion, the "twinkle goes" illusion, provides a new opportunity to investigate the perceptual consequences of motion extrapolation. In this illusion, when the disappearance of a moving stimulus is masked by the onset of dynamic noise, the perceived point at which the stimulus disappeared is extrapolated forwards along its initial trajectory. The present study investigated this illusion by manipulating the speed, duration, and visibility of the moving stimulus prior to its disappearance. We anticipated greater extrapolation with increasing speed, as object speed should be incorporated into predictions for precise compensation. Additionally, we hypothesised there would be greater extrapolation with decreasing duration, and decreasing visibility, due to greater positional uncertainty of the moving stimulus. We found increasing speed was generally associated with greater extrapolation, replicating previous findings. Likewise, extrapolation decreased with increasing motion duration, as expected, except at the longest duration. Finally, we observed that extrapolation was independent of moving stimulus visibility, perhaps due to an insufficient range of visibilities used. Overall, our findings were largely consistent with motion extrapolation mechanisms; however more complex predictive coding models may be required to fully explain the relationships observed.

{Clinical}

A 1H MRS study investigating the relationships between cortical GSH and cognition and negative symptoms in chronic schizophrenia

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Evidence suggests that the major intracellular antioxidant glutathione (GSH) may be reduced in schizophrenia, potentially contributing to the pathophysiology of the disorder. The present study aimed to investigate whether cortical GSH concentrations derived from proton magnetic resonance spectroscopy (^{1}H MRS) were altered in a homogenous group of chronic, treatment-resistant schizophrenia participants. In addition, we explored correlations between cortical GSH concentrations, and both cognition and negative symptoms. 15 chronic schizophrenia participants and 12 age- and gender-matched healthy controls took part in the study. Levels of GSH were obtained through a 30x30x30mm voxel placed in the occipital lobe, positioned using an axial T1-weighted gradient-echo image. A long echo (TE=131) acquisition MEGA-PRESS pulse sequence was performed using a Siemens scanner at 3T (TR=2000ms). Spectral processing was performed using jMRUI. Clinical variables were assessed through the positive and negative syndrome scale (PANSS) and the scale for the assessment of negative symptoms (SANS). Cognitive performance was measured using the MATRICS consensus cognitive battery (MCCB). Cortical GSH concentration was not different between individuals with schizophrenia and HCs $F(1,25)=0.00$, $p=0.997$. Additionally, there were no significant associations between negative symptoms or cognition and cortical GSH concentrations. Given all schizophrenia participants had chronic and treatment-resistant residual symptoms, the findings of no difference in GSH concentrations from the present study are particularly pertinent. A number of possible reasons for this finding are discussed, including the suggestion that oxidative stress in schizophrenia may arise from peripheral GSH abnormalities.

{Clinical}

Neural Correlates of Co-Occurring Pain and Depression: A Systematic Review and Activation Likelihood Estimation (ALE) Meta-Analysis

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The relationship between pain and depression is thought to be bidirectional and the underlying neurobiology 'shared' between the two conditions. However, pharmacological treatment targeting comorbid pain and depression yields only moderate effects. In this systematic review, we aimed to delineate brain regions associated with primary pain with concomitant depression, primary depression with concomitant pain, and simultaneous pain and depression comorbidity, using activation likelihood estimation (ALE) meta-analysis. This allows us to address the direction of comorbidity as a factor which might explain individual differences in the neural correlates of co-occurring pain and depression. Neuroimaging studies published from inception to August 2020 were evaluated using PRISMA guidelines. A total of 68 studies were included, of which 25 reported significant stereotactic coordinates and were analysed with ALE. Our results revealed paucity of studies that directly investigated the neurobiology of simultaneous pain and depression comorbidity. The ALE analysis indicated that pain with concomitant depression was associated with the right amygdala, while depression with concomitant pain was associated with the left dorsolateral prefrontal cortex (DLPFC) and the thalamus. We therefore provide evidence that neural correlates of co-occurring pain and depression are qualitatively distinct depending on the patient's primary diagnosis.

{Social}

Natural vs forced language switching: free selection and consistent choices eliminate significant performance costs and cognitive demands in the brain

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Bilinguals are known to switch language spontaneously in everyday conversations, even if there are no external requirements to do so. However, in the laboratory setting, language control is often investigated using forced switching tasks, which result in significant performance costs. The present study assessed whether switching would be less costly when performed in a more natural fashion, and what factors might account for this. Mandarin-English bilinguals engaged in language switching under three different contexts with varied task demands. We examined two factors which are characteristic of natural switching: i) freedom of language selection; ii) consistency of language used to name each item. Participants' brain activities were recorded using magnetoencephalography (MEG), along with behavioural measures of reaction speed and accuracy. The natural context (with both free selection and consistent language used for each item) produced better performance overall, showing reduced mixing cost and no significant switch cost. The neural effect of language mixing was also reversed in this context, suggesting that freely mixing two languages was easier than staying in a single language. Further, while switching in the forced context elicited increased brain activity in the right inferior frontal gyrus, this switch effect disappeared when the language used to name each item was consistent. Together, these findings demonstrate that the two factors above conjointly contribute to eliminating significant performance costs and cognitive demands associated with language switching and mixing. Such evidence aligns with lexical selection models which do not assume bilingual production to be inherently effortful.

posters

{Other}

Effective Connectivity Within the Visual Network in Variants of Young-Onset Alzheimer's Disease

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Young-onset Alzheimer's disease (YOAD) is a less common but more aggressive form of AD with symptom onset at less than 65 years. Characterised by heterogeneous clinical presentations, YOAD can be classified into typical AD (primarily characterised by memory impairments) and Posterior Cortical Atrophy (PCA; primarily characterised by higher-order visual impairments). Studies report decreased functional connectivity, defined as correlations in neuronal activity, in distinct brain networks, including the visual network in YOAD. This study aimed to examine differences in effective connectivity, defined as directed influences among brain regions, of the visual network (consisting of primary visual cortex, middle occipital gyri, and fusiform gyri) between healthy controls, typical AD, and PCA patients. Resting-state functional magnetic resonance imaging data were used, collected at University College London, from 24 controls (M=60.08, SD=5.74), 26 typical AD (M=61.04, SD=5.11), and 14 PCA (M=61.71, SD=5.03) patients. Using spectral-dynamic-causal-modelling, YOAD variants showed both increased and decreased effective connections compared to controls, with greater disruptions in PCA. In PCA patients, decreased bottom-up connections from the right MOG to the bilateral FFG were observed. However, most disrupted connections were increased, which could be explained as an initial sign of network dysfunction. Both positive and negative correlations between EC and performances on a visual task was also observed in YOAD patients, representing a relationship between the brain and behaviour. These findings demonstrate that disruptions in the hierarchical organisation of the network may underlie impairments in visual processing.

{Attention}

Spatial and feature expectation violations to visual trajectories modulate event-related potential amplitudes across the visual processing hierarchy

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During visual perception the brain adopts prediction and attention processes by simultaneously combining its expectations with relevant information in the surrounding visual environment. The event-related potentials which index these cognitive mechanisms are the focus of the present study. This was motivated by recent research that identified the N170, N2pc, and N300 are, in part, prediction error signals. Participants viewed a display of a series of shape stimuli, whereby a salient shape changed position (in a clockwise or anticlockwise trajectory) across a set of eight locations occupied by distractor shapes. The final salient stimuli were manipulated in one of four possible outcomes: predictable position and shape, predictable position but unpredictable shape, unpredictable position but predictable shape, and unpredictable position and shape. Results revealed enhanced N170 amplitudes to unpredictable positions and shapes compared to N170 amplitudes in predictable trials. The N2pc amplitude was not modulated by expectation violations for shape or position changes. Interestingly, the results suggested enhanced N300 amplitudes to unpredictable positions, and enhanced P1pc amplitudes to unpredictable shapes, compared to their predictable counterparts. These results indicate these early to mid-latency evoked potentials belong, in part, to a group of prediction error signals.

{Motor}

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

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When we move our articulator organs to produce overt speech, the brain generates a corollary discharge to suppress neural and perceptual responses to our speech sounds. Recent research suggests that inner speech - 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. The aim of the present study was to determine whether this corollary discharge contains information about the volume of inner speech. Participants watched an animation which provided them with precise knowledge about when they should produce a 'loud' or 'quiet' inner phoneme. At the same time, they heard an audible phoneme that either matched or mismatched the volume of the inner phoneme. We found that producing a loud inner phoneme attenuated the N1 component of the event-related potential - an index of auditory cortex processing - compared to producing a quiet inner phoneme. However, this attenuation occurred regardless of whether the volume of the inner phoneme matched or mismatched the audible phoneme, suggesting that corollary discharges do not contain information about the volume of inner speech. We speculate this might be because one of the functions of corollary discharge is to protect our auditory receptors from desensitization caused by audible sounds, and this might be redundant in the context of inner speech because inner speech does not produce an audible sound. We conclude that there is a functional difference between the neural processes that underlie the production of inner and overt speech.

{Other}

Multilayer community detection for functional brain networks via hierarchical Bayesian modelling

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The identification of brain states, and community detection in network neuroscience is important to characterise spatiotemporal dynamics of brain function. However, there are only a few techniques available in literature that can capture the dynamics of brain networks not only at individual but also at the group level by considering between subject variations in BOLD time series. One of the popular community detection methods for group-level analysis is based on multilayer modularity. In the same vein, a stochastic block model combined with a non-overlapping sliding windows was applied to infer dynamic functional connectivity for networks, where edge weights were only binary. Recently, we proposed a Bayesian (Gaussian) latent block model using the group-averaged adjacency matrix as observation which can preserve complete information about the time series of the subjects. Here, we present a new method using the hierarchical Bayesian modelling to estimate the brain states and the community architecture that underlie those states at the group level. We first evaluated our group-level hierarchical Bayesian model using synthetic data simulated using multivariate Gaussian generative model. Then we applied our method to working memory task-fMRI data from Human Connectome Project to estimate the community structure of the discrete brain states and the (weighted) connectivity at the group level with known external stimuli.

{Motor}

Controlling for motor-related activity in the self-stimulation paradigm

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Neural responses to sensory input caused by our own actions are smaller than when the same inputs are caused by an external agent. This phenomenon is known as sensory suppression, and is usually investigated with event-related potentials (ERPs) and the self-stimulation paradigm: in the self-generated condition, participants press a button to hear a tone, in the externally-generated condition, participants passively listen to tones, and in the motor condition, participants press a button but do not hear a tone. To control for motor-related activity present in the self-generated condition but not in the externally-generated condition, the motor ERP is subtracted from the self-generated ERP. However, this subtraction assumes that the neural processes associated with the action are identical in the self-generated and motor conditions. To test this assumption, we used a novel condition in which a random half of the button-presses produced a tone. Because participants did not know which button-presses would produce a tone, the neural processes associated with the action were identical. Consistent with previous research, we found that self-generated tones elicited a smaller N1 - an ERP brain signature of auditory processing - than externally-generated tones. We also found that the magnitude of this N1-suppression effect was not different from two control conditions: one for differences in task instructions and one for differences in stimulus-onset-asynchronies. This suggests that the subtraction procedure is not responsible for the N1-suppression effect, which is usually attributed to action-effect predictive processes.

{Clinical}

Inflammation as a moderator of the relationship between obesity and white matter microstructure in bipolar disorder

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Obesity is a leading comorbidity in bipolar disorder (BD), known to worsen functional and behavioural outcomes. However, its correlations with analogous biological substrates of BD, such as peripheral inflammation and altered white matter microstructure are lesser known. This exploratory study aimed to examine the relationship between obesity and white matter microstructure in BD and determine if these associations were influenced by inflammation. 63 participants undertook body mass index (BMI) assessment and plasma cytokine analysis of pro and anti-inflammatory marker profiles (C-reactive protein, tumor necrosis factor-a, interferon-gamma, interleukin-6 and interleukin-8, interleukin-4 and interleukin-10 respectively). Fractional anisotropy, axial diffusivity, radial diffusivity and mean diffusivity were also measured using diffusion tensor imaging. Multivariate regression modelling was applied to probe relationships, with BMI specified as the primary predictor, the pro-inflammatory/anti-inflammatory profiles as the moderator, and white matter microstructural measures (fractional anisotropy, axial diffusivity, radial diffusivity and mean diffusivity) defined as the outcome. Overall, BMI and whole-brain white matter microstructure were not significantly correlated and there were no significant interactions between BMI and the proinflammatory profile upon white matter microstructure. Increased BMI did, however, predict decreases in axial diffusivity, in BD participants with lowered concentrations of the anti-inflammatory profile. In sum, this study demonstrates an interplay between BMI and the anti-inflammatory cytokines interleukin-4 and interleukin-10 upon axial diffusivity, indicating the potential impacts of peripheral biology upon brain structure. Whilst this exploratory finding requires confirmation in larger cohorts, it points to the importance of considering physical health factors when exploring the pathophysiology of BD.

{Perception}

Sensory suppression from predicted and unpredicted sounds

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Sensory suppression refers to the phenomenon that sensory input generated by our own actions elicits smaller neural responses than sensory input generated by external agents. It is often explained via the internal forward model in which an efference copy of the motor command is used to compute a corollary discharge, which acts to suppress sensory input. In the present study, we sought to determine whether corollary discharges produce suppression of the specific sensory consequences of our actions, or whether they produce suppression of all sensory input. To investigate this, we measured the N1, Tb, and P2 components of the event-related potential (ERP) elicited by self- and externally-generated sounds that were either predicted or unpredicted. To manipulate predictability, the sounds had an action-effect probability of 100% in some blocks (i.e., the predictable condition) and 50% in others (i.e., the unpredictable condition). We found that predictable sounds yielded N1-, Tb-, and P2-suppression, in that self-generated sounds elicited a significantly smaller N1, Tb, and P2, respectively, than externally-generated sounds. In contrast, unpredictable sounds yielded P2-suppression, but not N1- or Tb-suppression. This suggests that the N1 and Tb reflect suppression of the specific sensory consequences of our actions, and that the P2 reflects suppression of all sensory input. We conclude that the action-effect processes that suppress the N1 and Tb - which are thought to index auditory processing - are functionally different to those that suppress the P2 - which might index participants' sense of agency.

{Attention}

Sensitive to a T: Testing two types of computer-aided detection and two user response types in a visual search task

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Spatial computer-aided detection (CAD) systems help radiologists detect tumours by marking suspicious regions in mammography images. When CAD cues are correct, observers find more tumours than when searching without CAD. However, when CAD cues are absent or incorrect, observers miss more tumours than without CAD. Kunar et al. (2017) suggest this is due to relying too much on CAD cues (the overreliance hypothesis). In addition to an overreliance on the *information* that CAD cues provide, *attentional capture* by CAD cues may aid or impair the observer. We conducted three visual search experiments where participants searched for a T among Ls embedded in noise to simulate mammography images. The first two experiments tested non-spatial CAD cues (removing attentional capture), with participants making present/absent (Experiment 1) or localisation (Experiment 2) responses. CAD increased overall performance only for present/absent responses. Experiment 3 used spatial CAD cues to compare the impact of response type (present/absent vs localisation). Miss rates were higher in the present/absent than the localisation condition, suggesting this type of response encourages a less complete search than localisation. As radiologists use localisation, we suggest future research on medical imaging and CAD do the same. Changes in miss rates (compared to No CAD) in Experiment 2 demonstrate that observers are influenced by the information provided by CAD systems. A comparison of Experiments 2 and 3 suggests that attentional capture contributes to increasing overall performance. Thus, both information content and attentional capture by CAD appear to be responsible for altering observer behaviour. ARC DP170101780.

{Perception}

Inner speech or expectation: What is causing the N1-attenuation effect?

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When we move our articulator organs to produce overt speech, the brain generates a corollary discharge that acts to 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. Evidence for this comes from multiple studies showing that producing an inner phoneme attenuates the N1 component of the event-related potential (ERP) - a brain signature of auditory processing - compared to passive listening, but only when the inner and audible phonemes match on content. If the inner phoneme does not match the content of the audible phoneme, there is no attenuation of the N1. However, an alternative explanation for this effect is expectation: when participants are told to produce an inner phoneme, they might expect to hear that phoneme, resulting in a smaller N1 when their expectation is fulfilled. To investigate this, we designed a novel paradigm in which participants were given prior knowledge about the identity of the audible phoneme. If inner speech is responsible for N1-attenuation, then it should only occur when the inner and audible phonemes match on content. If, however, expectation is responsible, then it should occur when participants know the identity of the audible phoneme, even when the inner phoneme mismatches the audible phoneme. Our results support the former possibility. This suggests that the N1-attenuation effect is a neural correlate of inner speech.

{Methods}

Machine-learning-generated EEG neuromarkers discriminate between high and low posttraumatic growth in healthy adults with and without PTSD symptoms

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Debilitating impacts of posttraumatic stress have become increasingly familiar. However, trauma-exposed individuals also report advantageous, transformative changes, known as posttraumatic growth (PTG). Our objective, neuroimaging study examined the representation of PTG in healthy human brain activity. We aimed to identify neuromarkers for future clinical use and address neurocognitive debate regarding whether PTG represents actual or illusory change. Deep data explorations of electroencephalogram (EEG) frequencies, electrodes, and principal components were undertaken with 67 university students. Brain activity was measured using a laboratory-grade, 64-channel, gel-cap EEG system. PTG was measured using the Posttraumatic Growth Inventory (PTGI). Supervised support vector machine learning (SVM) classification algorithms were devised and performed using EEGLab and MatLab, to identify patterns in resting-state and on-task brain dynamics. EEG neural correlates for high versus low PTG were identified, producing the first known EEG whole-brain group profiles of PTG. Significant classification accuracies were found in resting-state alpha power (98-89% accuracy), on-task alpha power (82% accuracy), and on-task high gamma power (81% accuracy). Findings offer neuroscientific proof of concept for the cognitive model of PTG, indicating individuals reporting high PTG, exhibited significantly different neural activity to those reporting low PTG. Methodological advancement is offered by way of classification machine learning algorithms using novel neural decoding methods. The SVM models generated, successfully predicted from EEG power alone, whether individuals reported high versus low PTG. Identification of PTG neuromarkers in whole-brain, correlative EEG profiles, and predictive classification methods, provides a foundation for future neural-based post-trauma treatments, health promotion interventions and applications supporting PTG.

{Memory}

To recall or to recognise? How memory task design affects binding and associative memory performance

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Binding objects with their features (conjunctive binding) and objects with other objects (relational binding) underlies how we learn and remember associations. Methods for assessing associative memory are variable, with different tasks and numbers of to-be-remembered items used across studies, and most studies only look at one type of binding. Here, we examined how variations in task and set size interact with conjunctive versus relational binding. We tested memory for conjunctive bound and relational bound stimuli in a recall task and recognition task in an online study with Zoom supervision. Participants completed either a cued recall task (n = 20) or an old-new recognition task (n = 20). For both tasks, participants remembered 2, 3, or 4 coloured shapes (conjunctive binding condition) or shapes paired with a colour patch (relational binding condition). For recall, participants had to select the associated colour for a single probed shape. For recognition, participants were shown a coloured shape probe or shape-colour patch pair probe and were asked whether it had been shown in the previous display (Old) or not (New). For recall, Bayes analysis showed evidence that the conjunctive binding condition was more difficult than the relational binding condition at set size 3 only. For recognition, there was evidence that the binding conditions were of equal difficulty, with similar decreases in accuracy as set size increased for both binding conditions. These data form the basis for investigating binding and associative memory in people with synaesthesia.

{Ageing and Development}

Can functionally 'exercising' the prefrontal cortex improve the arterial and structural health of the brain?

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Mahmoud Abdolhoseini, University of Newcastle

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Sharna Jamadar, Monash University

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The integrity of the cerebrovascular system is essential for healthy aging. Age-related declines in arterial health are thought to induce a series of neurophysiological changes which impact both brain structure and cognition. The current study aims to experimentally establish the link between arterial, brain and cognitive systems using innovative measures of regional cerebral arterial health using optical imaging. Specifically, we aim to show that intensively 'exercising' the prefrontal cortex will improve regional arterial elasticity in these areas. Community-dwelling, older adults (50-85yrs) will be pseudo randomly allocated to either the cognitive control or waitlist condition (n=295). To engage and 'exercise' the prefrontal cortex, participants will complete intensive practice on tasks known to engage cognitive control processes and to activate prefrontal cortex regions over a 12-week period. Data will be analysed using a 2 Training Condition (Brain training, Waitlist) x 2 Test (Pre, Post) Mixed Design. We predict that intensive practice on these tasks will selectively improve the health of the regional arteries that supply the prefrontal cortex, as well as the structure and function of these brain areas. Specifically, we hypothesise that adults in the cognitive control condition will produce greater improvement in measures of arterial health, brain structural health, and cognition compared to the waitlist control condition. Successful completion of the study will establish proof-of-principle, where engagement in cognitive control processes provide regional protection or improvement to cerebral arterial health in older adults.

{Other}

White matter tracts underlying verbal fluency after ischaemic stroke

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Verbal fluency performance is associated with both stroke risk and post-stroke cognitive impairment. While lesion-symptom mapping studies have identified grey matter regions associated with verbal fluency, little is known about the link between verbal fluency and white matter structure. We examined white matter correlates of semantic (Category Fluency Animals) and phonemic fluency (COWAT FAS) after stroke, accounting for stroke severity, age, sex and level of education. White matter fibre density and cross-section measures were extracted from 72 tracts, using MRTRIX and TRACTSEG software in 72 participants assessed 3 months after their event. We conducted regression analyses separately for COWAT FAS and Category Fluency Animals for each tract.
Phonemic fluency was associated with decreased fibre density in the left superior longitudinal fasciculus and left arcuate fasciculus, but these results did not survive correction for multiple comparisons. Stroke severity was significantly linked with phonemic fluency in most tracts. Semantic fluency was specifically associated with decreased fibre density in the arcuate fasciculus, superior longitudinal fasciculus, inferior occipito-frontal fasciculus, inferior longitudinal fasciculus, optic radiation, striato-occipital, thalamo-occipital tracts and inferior cerebellar peduncle (FDR-corrected), in addition to the effects of education, stroke severity and age.
We conclude that semantic and phonemic fluency both rely on the left arcuate fasciculus and superior longitudinal fasciculus microstructure. However, phonemic fluency performance is primarily associated with stroke severity rather than specific white matter tracts. In contrast, although semantic fluency is dependent on stroke severity, age and education level, it specifically relies on fronto-temporal tracts integrity.

{Methods}

Visual impairment can hinder the accurate measurement of cognition

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Assessing cognition is an important part of the diagnosis and management of disorders affecting the brain. However, comorbid conditions in older adults, such as visual impairments, may impact cognitive test performance such that lower test scores may be caused by difficulties seeing the task material. We conducted an experiment to explore the impact of macular degeneration on cognitive testing. Twenty-four normally sighted participants (aged 18-60) completed two cognitive tasks: a vision-dependent reaction time task and vision-independent verbal fluency test. Each task was administered twice, under normal and simulated vision conditions. Macular degeneration was simulated with a ten-degree central scotoma in a set of 6/60 visual acuity goggles. Repeated measures ANOVAs revealed significantly slower responses ($p<0.001$, $n^2=0.14$), by up to 25 percentile ranks, for the reaction time task in the simulated macular degeneration condition, compared with normal vision. There was no significant difference ($p=0.78$) between conditions for the verbal fluency test. Our findings, that simulated visual impairment negatively affects performance in a vision-dependent cognitive test, but not the vision-independent test, corroborates previous paper-and-pencil studies. The findings suggest that low test scores, obtained in tests where sight is essential to the task should be interpreted with caution, as the scores may only partly reflect cognitive impairments. Unless precautionary measures are taken to account for individual differences in vision (e.g., vision screening prior to cognitive assessments), inaccurate test scores could contribute towards the misdiagnosis of conditions such as mild cognitive impairment.

{Clinical}

Psilocybin-Induced Changes in Effective Connectivity within Default Mode Network and its contributions to Dissolution of Self

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Psychedelics are known to induce self-dissolving states, such as experiences of unity (i.e., blurred boundaries between self and other) and disembodiment (i.e., loss of bodily awareness). Investigations using functional-magnetic-resonance-imaging (fMRI) showed dysconnectivity and disintegration within Default Mode Network (DMN), a large-scale resting-state brain network associated with various self-related processes, under the influence of psychedelics. However, directed influences, called effective connectivity, within this network and the associations with self-dissolving states remain unclear. This study used spectral dynamic causal modelling, in a cohort of 22 healthy participants, to infer psilocybin-induced modulations in effective connectivity within DMN, consisting of medial prefrontal cortex (mPFC), posterior cingulate cortex (PCC), and bilateral inferior parietal lobule (IPL), and its contributions to experiences of unity and disembodiment. Participants showed reduced effective connectivity from mPFC to PCC, and from mPFC to right-IPL after receiving psilocybin, compared to placebo. Moreover, the association analysis discovered that disembodiment was negatively associated with the hypoconnectivity from mPFC to right-IPL. Furthermore, the involvement of mPFC in these hypoconnectivity suggests that psilocybin may be beneficial in the treatment of various "self-experience" mental disorders, such as depression. These findings extend the understanding of the neural mechanisms underlying psychedelic-induced dissolution of self. Further research should investigate the putative value of psilocybin in depression and a broader range of self-dissolving experiences.

{Ageing and Development}

Age-related white matter microstructural organisation and fluid ability: the effect of controlling for crystallised ability

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It is well documented that fluid abilities decline with age, whereas crystallised abilities are relatively resilient to ageing. Due to its stability, crystallised ability can serve as a proxy for premorbid ability, and the discrepancy between fluid and crystallised ability can indicate cognitive decline associated with disease processes. However, most cross-sectional studies assess the relationship between age-related decline in fluid ability and neurodegeneration without controlling for crystallised ability. The present study examined if the relationship between fluid ability and white matter microstructural organisation is retained when using a discrepancy measure that controls for crystallised ability. We compared the relationship between whole brain and tract-specific white matter microstructural organisation with level of fluid intelligence and percentage decline in fluid ability relative to crystallised ability. We used mediation analyses to determine whether white matter microstructural organisation mediated the relationship between age and the discrepancy measure, relative to age and fluid ability alone, in 70 community dwelling older adults. Crystallised ability showed little to no change with age, whereas fluid ability declined. As a result, the discrepancy between fluid and crystallised ability increased with age reflecting cognitive change. White matter microstructural organisation mediated the relationship between age and fluid ability. However, when controlling for crystallised ability (i.e., using the ability discrepancy) the mediating effect was no longer significant. Therefore, controlling for crystallised ability weakened the relationship between age-related white matter microstructural organisation and fluid ability. These findings show the importance of controlling for premorbid ability in cross-sectional analyses assessing age-related neurodegeneration and cognition.

{Perception}

Thinking Laterally: A Novel Methodology to Examine Lateralization Effects in Facial Expression Perception

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Among all visual phenomena, facial expressions are considered the most socially relevant. To conceptualise how the visual system maps different facial expressions, lateralisation effects of emotion processing have been argued. Recent literature suggests support for a right hemispheric advantage, albeit no systematic and consistent lateralisation effects have emerged. To investigate this debate, healthy participants (*N* = 37) concentrated on a central fixation task with facial expressions presented peripherally in the left and right visual hemifields. The facial expressions used (neutral, anger, fear and happy) were dynamic and displayed morphological changes in facial musculature. Using Electroencephalography (EEG), a Fast Periodic Visual Stimulation (FPVS) methodology was employed in which predetermined frequencies for each visual stream (1.07Hz and1.50 Hz) allowed for precise periodic responses to be extracted and analysed in the frequency domain. It was expected that unattended facial expressions would elicit greater activation in the right hemisphere than the left hemisphere. It was also hypothesised that negatively valenced expressions (i.e. anger and fear) would elicit greater activation when compared to a positively valenced expression (i.e. happiness). As expected, neural activation was elicited in the right hemisphere for each expression, but this pattern was significant only for anger. Further, anger was the only emotion to elicit significant activation when compared independently to fear and happiness. Together, these findings suggest a specialised neural network for anger and highlight its social and evolutionary importance. Future studies should use a bilateral stimulation paradigm for a more sensitive measurement of lateralisation effects of expression perception.

{Perception}

A layered network with spike-timing-dependent plasticity can localise a moving object in real-time despite neural delays

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Because it takes time for incoming visual information to ascend the visual processing hierarchy, representations of the visual world are outdated by the time they reach higher levels of cortical processing. This constitutes a challenge to our ability to accurately perceive the true location of moving objects. To overcome this, it has been proposed that the visual system utilizes the predictive nature of motion to extrapolate moving objects along their trajectory.

Burkitt and Hogendoorn (2021, https://doi.org/10.1523/JNEUROSCI.2017-20.2021) addressed the possible role of spike-timing dependent plasticity (STDP) in motion extrapolation, by simulating a two-layer hierarchical network of velocity-tuned neurons with a neural transmission delay between layers. They showed that allowing the network to learn its connections via STDP caused the receptive fields of neurons to shift in the opposite direction to a moving stimulus, thereby partially compensating for the neural transmission delay.

The current study extends this work by implementing two changes to the network to bring it more into line with biology: expansion of the network to multiple higher layers to better reflect the depth of the visual hierarchy, and introduction of the time constants associated with biological neural processing. We explore the parameter space associated with the neural time constants, assessing their effect on the network representation of object position and building our understanding of the biophysical models of visual processing.

{Ageing and Development}

Does cerebrovascular status mediate the relationship between Mediterranean Diet and cognition?

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The Mediterranean diet (MedDiet) has been linked to improvements in cardiovascular and cognitive domains, as well as lower dementia risk. Vascular risk factors are associated with increased likelihood of cognitive impairment and dementia. Emerging research suggests that the neuroprotective benefits of the MedDiet may be linked to improvements in vascular health. However, common measures of cerebrovascular health are limited to global cerebrovascular metrics or peripheral measures of arterial function. Pulse-Diffuse Optical Tomography (pulse-DOT) is a novel method that measures regional properties of cerebral vasculature.

The current experiment aims to assess whether the effect of the MedDiet on cognition is explained by effects on cerebral vasculature, and more specifically cerebrovascular reactivity and arterial elasticity; two important characteristics of cerebrovascular health (estimated via pulse-DOT). We will evaluate the cross-sectional relationship between MedDiet, cognitive control and cerebrovascular status in a sample of 160 healthy, older Australian adults (aged 60-70 yrs). Data from the Australian Eating Survey (AES) will be used to extract a MedDiet adherence score, a healthy diet score and an estimate of the total energy from nutrient-poor, energy-dense foods. Cerebrovascular measures will be measured over the frontal lobes that are particularly vulnerable to age-related cognitive decline and play a critical role in cognitive control processes crucial for healthy ageing. Cognitive control processes will be evaluated using behavioural data from a task-switching paradigm. We expect that cerebrovascular status of the frontal cortex will partially mediate the effect of the MedDiet on cognitive control processes.

{Perception}

Let's be in touch: EEG decoding of touch location on the body within and across visual and tactile modalities

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The location of touch provides essential information when perceiving touch to self and others. For example, the rubber hand illusion only occurs when the same location on the participant's and the rubber hand is stimulated. Fine-grained information about the location of touch on the body must be encoded not just in the tactile modality, but also in the visual domain. Here, we used multivariate pattern analyses to explore the representation of touch location, and the extent to which there are shared representations for feeling touch and seeing touch. We found clear decoding of touch location (thumb vs little finger) from ~50ms after touch onset. Decoding in the visual signal was less clear, presumably because of the dynamic video, but still present, and occurred while the touching object was approaching the hand. We then tested whether training the classifier on tactile information could cross-generalise to visual representation of the same touch using a time-generalisation approach. Bayesian analysis indicated some evidence for similarity in the representation of which finger was touched between the modalities, which suggests that seeing someone else being touched and feeling touch oneself recruits similar neural mechanisms to some extent. This could facilitate the localisation of touch based on multisensory signals, such as in the rubber hand illusion, and our understanding of the sensations experienced by others.

{Other}

Biomarkers of Emotional Regulation under Psilocybin

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Psychedelics are mind altering substances that when used in conjunction with psychotherapy report significant improvements to psychosocial functioning in a range of pathologies including drug addiction, anxiety and depression. Moreover, these improvements are sustained well after treatment [4]. Investigation of connectivity changes between limbic structures involved in emotion and cortical structures involved in cognition under psychedelics may help elucidate therapeutic mechanisms which lead to sustained outcomes. Using resting state functional MRI (fMRI) data acquired from individuals under the influence of psilocybin, we investigate the changes in effective (or directional) connectivity between major cortical and limbic regions using spectral dynamic causal modelling (DCM). The networks and structures investigated are the core default network (cDN) comprising the posterior cingulate cortex (PCC. [-3 -57 21]) and medial prefrontal cortex (mPFC, [3 54 18]); the salience network (SN) comprised of dorsal anterior cingulate cortex (dACC, [-3 15 42]) and bilateral anterior insula (AI, left [-36 15 6], right [33 18 6]); and limbic structures including the bilateral parahippocampus (PHC, left [-27, -49, -14], right [29, -47, -14]), bilateral hippocampus (HC, left [-26, -19, -17], right [27, -18, -17]) and bilateral amygdala AMG (left [-20, 4, -15], right [22, -2, -15]). Our findings demonstrate patterns of AMG effective connectivity to the cortex that suggest similarity between connectivity changes under psilocybin and the circuitry of emotional regulation identified in well being following various therapies.

{Other}

Neuroimaging signatures of hallucinations in Parkinson's disease

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Visual hallucinations are a common nonmotor symptom in Parkinson's disease and are associated with dysregulation in relative brain activity. A novel approach to understand the relationships between brain networks uses gradient techniques. These techniques can offer new insight into altered brain function in neuropsychiatric symptoms. In this study, we test the hypothesis that Parkinson's patients with hallucinations will demonstrate an altered gradient of brain activity, where unimodal (sensory) regions are closer related to heteromodal (associative) regions. The study involved 60 Parkinson's patients identified as hallucinators and non-hallucinators, based on their clinical presentation. These individuals undertook neuropsychology tests and underwent resting-state functional magnetic resonance imaging. We applied gradients analyses to the resting state data to explore how brain connectivity patterns differed between the hallucinating vs. non-hallucinating patients. At the individual node level, there was a significant difference between the two groups, where the hallucinators' gradient scores were more positive than their counterparts in non-hallucinators. At the network level, we found significant differences in gradient scores between the two groups in the dorsal attention, frontoparietal control and visual networks. These results demonstrate an altered gradient in hallucinators where the dorsal attention, frontoparietal control and visual networks are more associated with heteromodal regions compared to their counterparts in non-hallucinators. This suggests that these networks are related to producing hallucinations and are possible targets for nonmotor symptom treatment in Parkinson's disease. More broadly, these results provide further support that adaptive visual perception relies on a balance between 'bottom-up' sensory processes and 'top-down' endogenous processes.

{Decision Making}

Exploratory factor analysis does not identify a theoretically plausible latent structure for task switching processes.

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A central goal within the healthy ageing agenda is to develop sensitive measures of cognitive control processes that accurately detect subtle changes in cognitive control ability within a healthy population. The cued task switching paradigm detects such changes across the lifespan, with older adults performing more poorly when required to maintain active task sets (mixing costs), but not when shifting between tasks (switch-cost; Whitson et al., 2012). However, mixing and switch cost are not independent measures and do not represent pure cognitive processes. In this study, we seek to derive latent behavioural measures of task-switching ability by applying exploratory factor analysis; EFA on 21 behavioural measures including mean and variance RT, and error rate from single-task and switch-task blocks under prepared and unprepared task conditions. In an adult lifespan sample of highly practiced participants (18-80, n=95), variables loaded onto only two latent factors: an error rate factor and a response time factor. The results remained consistent when using z-scored and mean-centred data, and probit transformed error rates to account for skew. These results suggest that summary statistics from behavioural data are not sufficiently sensitive for EFA to derive latent constructs underlying the cognitive control processes of interest. Investigating behaviour in conjunction with temporally sensitive neurophysiological methods, like EEG, may provide greater clarity of the latent structures. Furthermore, approaches that more accurately tap into the latent processes at play, such as cognitive modelling, should be explored to identify cognitive control parameters specific to task-switching.