ASP2022

30th Annual Meeting of the Australasian Society for Psychophysiology

Conference Program

Held at King's College at the University of Queensland, Brisbane Australia

December 1st-3rd, 2022

…all the new forms of being that make their appearance are really nothing more than results of the redistribution of the original and unchanging materials. The self-same atoms which, chaotically dispersed, made the nebula, now, jammed and temporarily caught in peculiar positions, form our brains…

WILLIAM JAMES (1890)

Contents

Welcome to ASP2022!

It's been three years since we were last able to meet in person at ASP2019 in Wollongong, so we are very gad to have you join us this year!

This three-day conference brings together researchers from a range of disciplines, including psychology, psychiatry, neuroscience, and more to share new findings regarding the relationships between brain and behaviour.

Organising Committee: Eric Vanman, Jason Satel, Frances De Blasio, Rebecca St George, Alex Duda, Eleanor Moses, Roger Gamble, and Linda Yu.

We would also like to thank our sponsors for their contributions to ASP2022.

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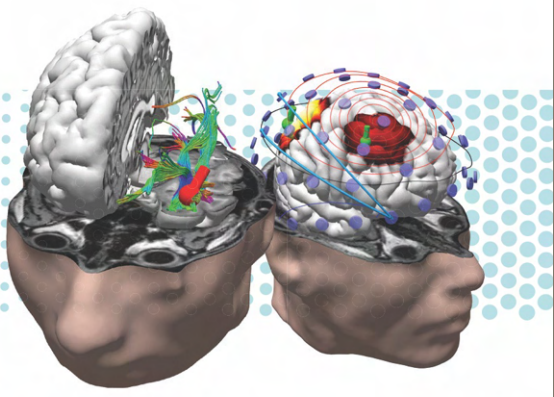

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- Oblique Image Data cutplanes
- Safety margin visualization

Security
- Password protection
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- Annual license support

Enhanced User Experience
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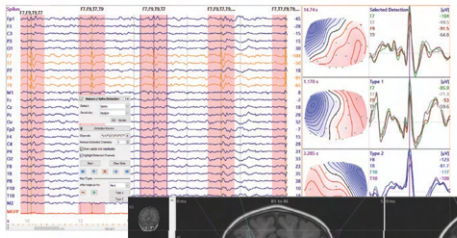
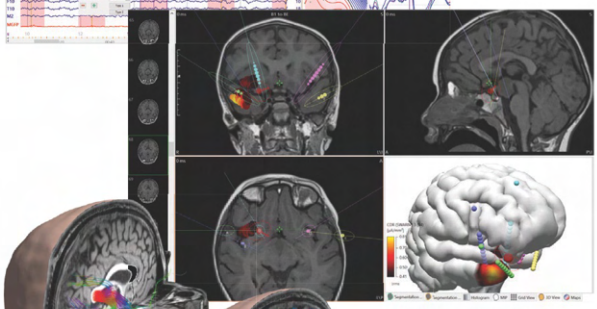
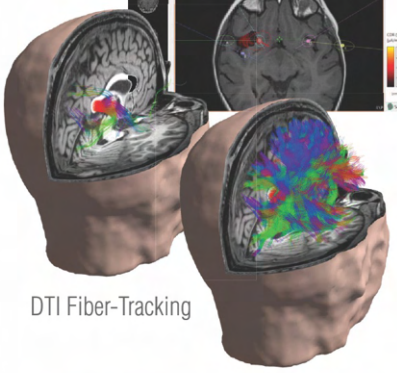
- Widescreen / compact layouts



Spike Detection & Review



Stereo-EEG Planning



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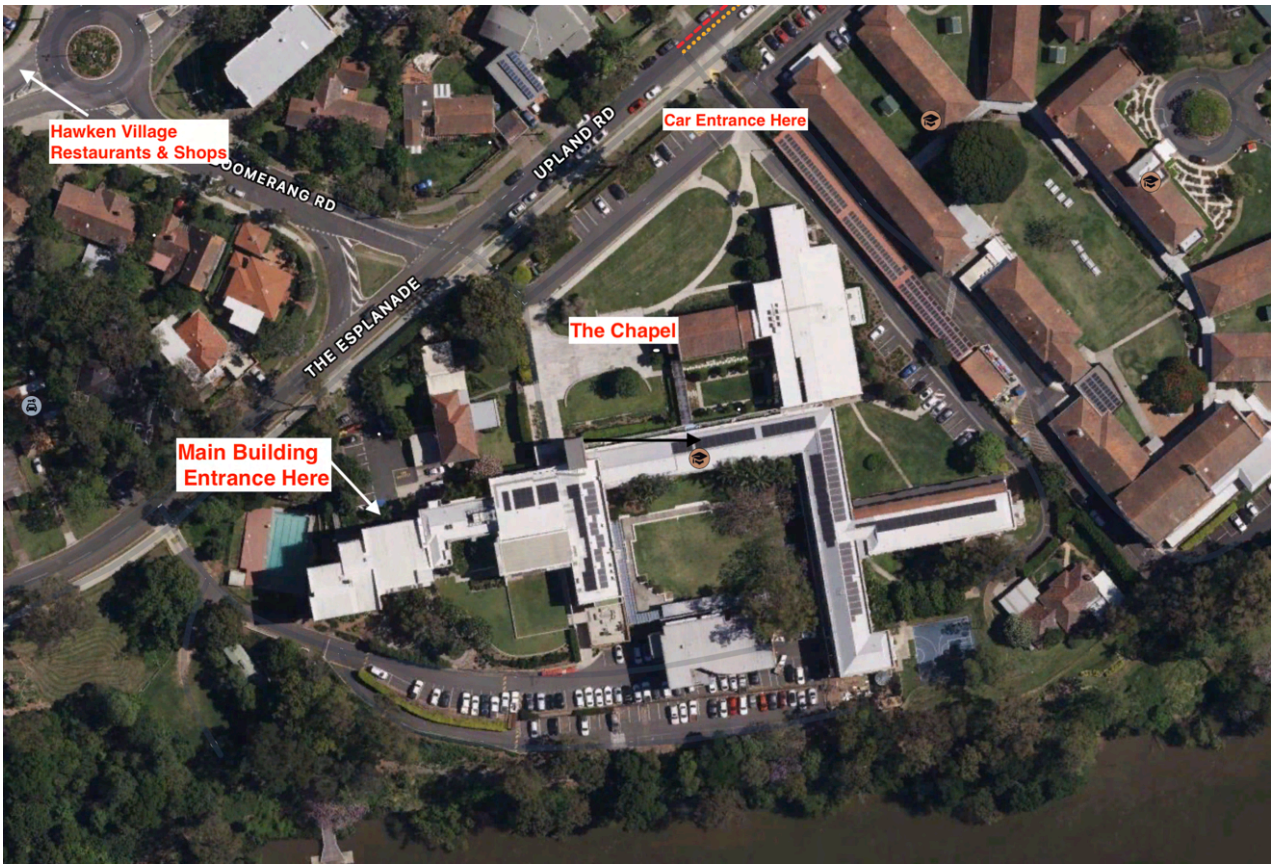
New in Source Localization
- Improved FEM models (white matter anisotropy)
- Improved beamformer models
- Improved simultaneous EEG/MEG
- Directional constraint for epileptic spike localization
- New epileptic spike localization algorithm

AJ539-0

Conference Venue Information

King's College is at 72 Upland Road. Parking is free on the King's grounds during the conference, so be sure to park only there. Those staying overnight at the college will be given a key to your room when you register—linen is included in your accommodation fees. The dining hall where all meals will take place is just past the main building entrance. The Chapel will be the site of all oral presentations. Please note that we will be a short walk from Hawken Village, which has an IGA, as well as several restaurants and coffee shops.



If you are on foot and wish to explore the UQ Campus or even go into the city, take a right on Upland Rd and follow it to the UQ campus, which is a 5-minute walk. One of the main bus stations is there and you can catch buses to the city and other suburbs. Elsewhere on campus there is a bus station called **UQ Lakes**, where you can catch an express bus to South Bank and the CBD, arriving there in about 10 minutes. More information about your transit options and a map of UQ will be provided at registration.

…The sole assumption of psychophysiological research is that the psychical can be represented as a function of certain physical variables or vice versa.

LELAND TROLAND (1929, THE PRINCIPLES OF PSYCHOPHYSIOLOGY)

Delegate Information

Registrations: The registration desk will be open from 3 pm on Thursday 1 December (Day 1), from 9 am on Tuesday 2 December (Day 2), and from 9:30 am on Saturday 3 December (Day 3).

Name Badges: Name badges will be provided to all delegates upon check-in at the conference registration desk. Please wear your name badge at all times while at the venue (and conference dinner) to facilitate interactions with other delegates, and to verify your access to the conference and your entitlement to refreshments (including dietary needs).

Breakfast, Lunch, Refreshments: Breakfast and Lunch will be provided on Friday and Saturday in the King's Dining Hall, with the cost included in your registration. Coffee and tea will also be available her during breaks. If nominated during registration, dietary requirements will be catered for.

Welcome Reception: Drinks and canapés will be served during the Welcome Reception & poster session from 6:00-8:00 pm on Thursday 1 December. The cost of this event is included in your registration.

Assistance and Advice: Should you require any assistance during the conference, please visit the registration desk or speak to any of our conference organising committee, who can be identified by the red sticker on their name badge.

I understand the mind to be indivisible by its very nature. I understand body to be divisible by its very nature. Therefore, the mind is completely different from the body.

RENÉ DESCARTES, 1642

Information for Presenters

Oral presentations: Oral presentations should not exceed 15 minutes, and will be followed by 5 minutes for questions. The session chair will warn you as you approach this time limit. The lecture theatre (i.e., "The Chapel") contains a Mac, document viewer, laptop connection facilities, and a presentation remote. Slides should be loaded onto the presentation Mac via a USB memory stick no later than 15 minutes prior to the start of the presentation session. You are also welcome to connect your own laptop, provided you have the necessary cables to do so.

Poster presentations: Posters should not exceed the poster board dimensions of 1.8 m (H) x 1.2 m (W). We recommend poster sizes up to A0 (841 x 1189 mm) in portrait orientation, or up to B1 (707 x 1000 mm) in landscape orientation.

Posters should be set up on arrival on Thursday between 3 and 5 pm. You will have the option to use BluTack or pushpins to mount your poster, depending on which space you are assigned. Presenters should stand near their posters during the poster session, and they can leave their posters up until Saturday.

Keynote Presenters

Keynote 1- Associate Professor Fiona Kumfor

NHMRC Career Development Fellow and Clinical Neuropsychologist
Faculty of Science, School of Psychology and Brain and Mind Centre, University of Sydney

Dr Fiona Kumfor holds a Masters of Clinical Neuropsychology (Macquarie University) and a PhD in Neuroscience (University of New South Wales). She is currently an NHMRC Career Development Fellow (2019-2023), Associate Professor in the School of Psychology and registered Clinical Neuropsychologist with AHPRA. Combining her clinical training in neuropsychology and research expertise in cognitive neuroscience her work investigates social cognition in clinical syndromes with a focus on dementia, and aims to improve diagnosis and prognosis of dementia, while also informing neurobiological models of complex human behaviours.

Understanding the social brain: The potential application of psychophysiology in dementia
Thursday, 1 December, 5:00-6:00 pm; abstract on p. 24

Keynote 2- Professor Tom Johnstone

Director, Centre for Mental Health and Brain Sciences
Swinburne University of Technology

Professor Johnstone completed a BSc in Physics (Western Australia), postgraduate research in cognitive science and psychology (Western Australia & Geneva, Switzerland), postdoctoral research in cognitive neuroscience (University of Wisconsin-Madison, USA), and was Head of Brain Imaging (Reading, UK). His interests include the neural basis of cognition and emotion, in particular the role of cognitive and attentional processes in regulating emotion, brain-body interactions underlying emotional processes, and emotion regulation in healthy populations as well as in psychopathology, pain disorders and addiction. He is also an enthusiastic supporter of interdisciplinary, open and collaborative science.

Emotion, perception, the brain & the body
Friday, 2 December, 11 am - 12:00 noon; abstract on p. 23

Keynote 3- Professor Ottmar Lipp

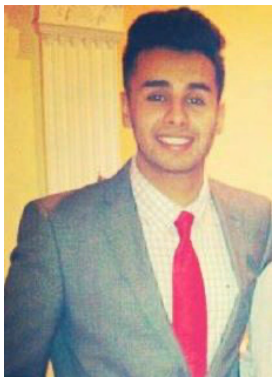
Professor, School of Psychology and Counselling, Queensland University of Technology
Director, Emotion, Learning, and Psychophysiology Laboratory

After receiving his PhD in psychology from Justus Liebig Universität, Giessen, Germany, Prof Lipp joined The University of Queensland's School of Psychology in 1991 and moved to Curtin University in Perth in 2014. He joined QUT's School of Psychology and Counselling as a Professor in 2020. His research, both basic and applied, is concerned with emotion, attention and their interaction. In particular, it is concerned with the manner in which emotionally salient stimuli are processed and how emotional responses such as likes, dislikes or fears are acquired, maintained and reduced.

Strengthening the extinction of human fear
Saturday, 3 December, 11 am - 12:00 noon; abstract on p. 26

Special Social Events

Student/Early Career Event



Following the Welcome Reception on Thursday evening, students and early-career researchers are invited to come to **St Lucy's on the UQ campus from 7:30 to 10 p.m.**, where complimentary beverages and food will be served. In addition, **Dr. Sumeet Farwaha** will be making a short presentation at this event to stimulate discussion about ECR issues. Dr Farwaha is a postdoctoral researcher affiliated with the School of Psychology at The University of Queensland. He conducts research in the field of developmental psychology, with a focus on the development of various socio-cognitive capacities such as automatic imitation, behavioural mimicry, and the sense of agency. Currently, he is exploring the developmental trajectory of imitation and pre-reflective agency in children using a combination of behavioural and psychophysiological methods.

Conference Dinner/Karaoke Party

Instead of a dinner at a fancy restaurant, this year we will have dinner together in the Kings Dining Hall (which is included in your registration). A short time after that we will set up the room for a karaoke and social gathering, complete with refreshments. This is your chance to see Frances or Genevieve (maybe Eric?) belt a Mariah Carey tune! Again, all of this is covered in your registration, so no additional fees are necessary, unless you're bringing a guest.

Every now and then I get a little bit nervous that the best of all the years have gone by (Turn around). Every now and then I get a little bit terrified and then I see the look in your eyes (Turn around, bright eyes).

BONNIE TYLER (1983)

Conference Program

	Day 1: Thursday, 1 December
15:00-17:00	**Registration Desk Open** at Kings College Poster and Exhibitor Set Up
17:00-18:00	**Keynote Address #1: Fiona Kumfor** *Understanding the social brain: The potential application of psychophysiology in dementia*
18:00-20:00	**Poster Session and Welcome Reception** (follow the signs) Poster #1: **Eunice Lui**, "The Missing Link Between Internal and External Emotion Recognition: How are Alexithymia and Facial Mimicry Related?" Poster #2: **Erin Mahon**, "A Multimodal Approach to Feeling and Physiological Responses to Emotional Videos in Alexithymia" Poster #3: **Danielle Mathersul**, "Psychological and mind-body interventions improve sleep in US Veterans undergoing treatment for posttraumatic stress disorder" Poster #4: **Yuya Maruo**, "Individual Differences in Behavioural Inhibition and Error Monitoring" Poster #5: **Nicholas Pawlenko**, "Heart rate variability and mean heart rate in healthy adults during eyes open resting after caffeine intake" Poster #6:**Phillip Watt**, "fNIRS Exploration of Frontal Haemoglobin Oxygenation Levels During Mind Wandering" Poster #7: **Kylie Hirst**, "An electromyographic differentiation between empathy and compassion in the 'cry for help'" Poster #8: **Joelle Metri**, "*CACNA1C* rs1006737 polymorphism is associated with altered high-frequency EEG activity and schizotypy in neurotypical adults" Poster #9: **Charlotte Russell**, "The Effect of Spontaneous Mimicry on Emotional Responses to Facial Stimuli: A Facial EMG Study" Poster #10: **Conrad Earney**, "Methodological Considerations for Facial Electromyography in Psychophysiological Research: Comparing Baselines" Poster #11: **Fiona Vallery,** "Caffeine effects on cardiovascular measures in an eyes closed resting state" Poster #12: **Katerina Christofides**, "Eyes closed resting state EEG component amplitudes in people with mild cognitive impairment compared to healthy older adults "
19:30-22:00	**Student/ECR Event** St Lucy's at UQ

	Day 2: Friday, 2 December
08:00-09:00	**Breakfast** at King's Dining Hall
09:00-10:30	**Oral Presentations #1. *Session Chair: Alex Duda*** Presentation #1: **Genevieve Steiner-Lim**, " Effects of 12-weeks Sailuotong (SLT) on resting EEG and plasma pro-inflammatory cytokines in people with mild cognitive impairment: an fPCA study" Presentation #2: **Scott Leimroth,** "Effect of rhythm change on heart rate variability (HRV) during music listening" Presentation #3: **Natalie Peluso**, "Breathing as Behaviour: Revisiting Evidence for "Ventilatory Personalities" Presentation #4: **Sarah Durrant**, "Yoga and Cognitive Behavioural Therapy Improve Transdiagnostic Emotion Regulation: A Pilot Study"
10:30-11:00	**Morning Tea** available in the Dining Hall
11:00-12:00	**Keynote Address #2: Tom Johnstone** *Emotion, perception, the brain & the body*
12:00-13:00	**Lunch** in King's Dining Hall
13:00-14:30	**Oral Presentations #2. *Session Chair: Charlotte Russell*** Presentation #5: **Bob Barry**, "Electrodermal and central measures of the phasic orienting reflex (OR)" Presentation #6: **Celine George**, "The Effect of Dynamic Films and International Affective Picture Systems on Explicit and Implicit Responses" Presentation #7: **Eric Vanman**, "When smiles are accompanied with tears: Facial EMG and the ambiguous face" Presentation #8: **Isabella Lynch**, "Sex differences in pink and white noise in the human electroencephalogram power spectrum"
14:30-15:00	**Afternoon Tea** available in the Dining Hall
15:00-16:30	**Oral Presentations #3. *Session Chair: Roger Gamble*** Presentation #9: **Beckett Munford**, "Sex differences in the resting EEG components of healthy young adults " Presentation #10: **Alex Duda**, "Impact of daily breath-focused mindfulness meditation vs. classical music listening on global EEG amplitudes in novice meditators" Presentation #11: **Frances De Blasio**, "Delta-beta amplitude coupling and its association with chronic pelvic pain in women with endometriosis compared to healthy controls: An fPCA study" Presentation #12: **Jessica Bartschi**, "Delta-beta cross-frequency amplitude coupling in Major Depressive Disorder compared to healthy controls"
16:30-17:30	**Panel Discussion** How should we be doing psychophysiology in the 2020s?
17:30-18:00	Break
18:00-19:00	**Dinner in King's Dining Hall**
19:30-22:00	**Karaoke/Social Gathering** in King's Dining Hall

	Day 3: Saturday, 3 December
08:30-09:30	**Breakfast** at King's Dining Hall
09:30-10:30	**Oral Presentations #4. *Session Chair: Linda Yu*** Presentation #12: **Philip Chalk**, "Neural Shortcuts: How the N170 is influenced by attention, expectation, and emotion" Presentation #13: **Grace Wang**, "The relationships between expressed emotion and EEG alpha asymmetry" Presentation #14: **Genevieve Steiner-Lim (on behalf of Adele Cave)**, "Naturally Elicited Frequency Components in Resting State EEG: Subjective Cognitive Decline versus Healthy Controls"
10:30-11:00	**Morning Tea** available in the Dining Hall
11:00-12:00	**Keynote Address #3: Ottmar Lipp** *Strengthening the extinction of human fear*
12:00-13:00	**Lunch** in King's Dining Hall
13:00-13:30	**ASP Annual General Meeting**
13:30-14:00	**Presentation of Awards**
14:00-14:30	**Keynote by 2022 ASP ECR Award Recipient**
14:30-15:00	**Afternoon Tea** & Farewells

At one time, every psychophysiologist had to construct electronic circuits for his particular recording needs, and even the electrodes had to be constructed by hand for each application. Today commercially available equipment is excellent and extremely reliable.

STERN, RAY, & DAVIS (1980, PSYCHOPHYSIOLOGICAL RECORDING)

Conference Abstracts

Electrodermal and central measures of the phasic orienting reflex (OR)

Robert J. Barry[1], Genevieve Z. Steiner-Lim[2], Frances M. De Blasio[1], Adele E. Cave[1,2]

[1]Brain & Behaviour Research Institute and School of Psychology, University of Wollongong, Wollongong, Australia

[2]NICM Health Research Institute, Western Sydney University, Penrith, Australia

Aims: For some years we have been seeking central measures of Sokolov's Orienting Reflex (OR). Currently the P300 event-related potential (ERP) is considered the most likely central OR measure, but systematic comparison with the "gold standard" electrodermal OR is sparse. Here we examine habituation, Significance, and inter-stimulus interval (ISI) effects in skin conductance responses (SCRs) and components of the P300 from single-trial ERPs in a simple dishabituation paradigm.

Method: Electrodermal and EEG data were recorded from two groups presented with innocuous auditory stimuli at different ISIs: Long (13–15 s) and Short (5–7 s). Within groups, two counterbalanced blocks were presented, where the stimuli had no task requirements (Indifferent stimuli) or required counting (Significant stimuli). Each stimulus block included 10 standards at one frequency, a deviant at a different frequency, followed by another standard stimulus; frequencies were counterbalanced between subjects within each group. Single trial ERP components were separated by temporal PCA, and components of the P300 were examined as potential phasic OR measures.

Results: Across the between-subjects factor of ISI and within-subjects factor of Significance, SCRs showed decrement over the initial 10 trials, recovery at the deviant, and dishabituation at the subsequent standard. This expected pattern was used as a template for the phasic OR. The general pattern (decrement, recovery, dishabituation) was not present in P3a, P3b, Novelty P3, or SW1 components of the P300. SCRs were also larger to Significant stimuli and at the Long ISI, but effects of these variables differed between the P300 components.

Conclusions: The electrodermal SCR shows the complete response profile over trials predicted for the phasic OR, and is also enhanced by stimulus Significance. It thus continues as the model measure of Sokolov's phasic OR. Components of the P300 fail to match this profile, but instead appear to reflect different aspects of the stimulus processing involved in OR elicitation. These different profiles should be explored in future research.

Delta-beta cross-frequency amplitude coupling in Major Depressive Disorder compared to healthy controls

Jessica G. Bartschi, Frances M. De Blasio, Robert J. Barry, David A. Camfield, & Rodney J. Croft

School of Psychology, Illawarra Health and Medical Research Institute and Brain & Behaviour Research Institute, University of Wollongong, Wollongong 2522, Australia

Aims: Cross-frequency amplitude-amplitude coupling between frontal delta and beta oscillations has been reported to reflect emotion and motivation processes. While this phenomenon has been largely explored in the context of anxiety, few investigations have considered whether delta-beta coupling occurs in other clinical populations, such as Major Depressive Disorder (MDD), that feature both emotion and motivation deficits. One recent study that assessed MDD concluded that delta-beta coupling may indicate a general predisposition to affective disorders. The current study thus aimed to investigate delta-beta coupling in individuals with MDD and healthy controls, and assessed their link to measures of psychopathology.

Methods: Continuous EEG data were recorded from 24 individuals (18 female) with MDD (Mage = 28.9, SD = 9.8 years) and 24 age and sex-matched healthy controls (Mage = 26.5, SD = 8.6 years) while they rested with their eyes-closed. Non-overlapping 2s epochs were extracted from the 3 min recording, with those without artefact subjected to Fourier Transformation to yield power spectra at 0.5 Hz resolution. Power in the traditional delta (0.5-3.5 Hz) and beta (13.5-30.0 Hz) bands were computed by summing the activity within their constituent frequency ranges. These were computed for each epoch to allow assessment of the within-subjects delta-beta coupling, and from the mean (across epoch) spectra to facilitate assessment of the between-subjects coupling. Spearman's rank order correlations were used to determine the delta-beta coupling at each level. Psychometric measures included the Beck Depression Inventory (BDI-II), Hamilton Anxiety Rating Scale (HAM-A), Perceived Stress Scale (PSS), and Positive and Negative Affect Schedule (PANAS). Fisher z-transformation was applied to the within-subject delta-beta coupling correlation coefficients, and their association with affect was assessed using Spearman's correlation both across the groups, and for each group separately.

Results: Compared to controls, MDD participants scored higher on the BDI-II, HAM-A, and PSS, and had higher negative affect and lower positive affect in the PANAS. Delta-beta coupling was identified both between- and within-subjects. Across the groups, within-subject delta-beta coupling showed positive associations with negative affect (PANAS). In the control group, delta-beta coupling was positively associated with the cognitive (but not somatic-affective) dimension of the BDI-II, with the PSS, and with the negative affect dimension of the PANAS but was negatively associated with the PANAS's positive affect dimension. In the MDD group, delta-beta coupling was positively associated with BDI-II scores, both within and across its dimensions, and with the negative affect dimension of the PANAS. No associations were found between within-subject delta-beta coupling and HAM-A scores either across or within the assessed groups.

Conclusions: The observed links between within-subject delta-beta coupling and affective measures differed between the groups, although all showed positive associations with affective disturbance. This interesting and novel pattern of results extends prior findings and provides insight into the affective correlates of delta-beta coupling in control and MDD populations. Further research is warranted to clarify the functional significance of delta-beta coupling, and its utility as an objective metric for the predisposition and/or early detection of affective disorders including MDD.

Naturally Elicited Frequency Components in Resting State EEG: Subjective Cognitive Decline versus Healthy Controls

Adele E. Cave[1], Frances M. De Blasio[1,2], Dennis H. Chang[1], Gerald W. Muench[1,3], and **Genevieve Z. Steiner-Lim**[1,4]

[1]NICM Health Research Institute, Western Sydney University, Penrith NSW 2751, Australia

[2]Brain & Behaviour Research Institute and School of Psychology, University of Wollongong, Wollongong NSW 2522, Australia

[3] School of Medicine, Western Sydney University, Penrith NSW 2751, Australia

[4]Translational Health Research Institute (THRI), Western Sydney University, Penrith NSW 2751, Australia

Aims: Subjective Cognitive Decline (SCD) is a recent self-perceived decline in cognitive functioning and is conceptualised as the preclinical asymptomatic phase of the cognitive decline continuum. SCD is associated with an increased risk of developing dementia, however, its neuronal mechanisms are not well understood. The present study aimed to identify the differences in eyes-closed (EC) and eyes-open (EO) resting EEG activity between older adults with SCD compared to healthy controls (HC) using a novel data-driven approach in order to elucidate neuronal changes associated with heightened dementia risk.

Method: Participants were 28 older adults (n= 14 per group: SCD, HC) matched on age (SCD: M= 67.9 SD= 5.3, HC: M= 68.2 SD= 5.2), sex, education, objective cognitive functioning, and pre-morbid functioning. Continuous resting EEG data was recorded from 60 scalp sites, and EOG corrected. Data from each 2-minute condition (EO, EC) were divided into 60 sequential 2-second epochs and artefact-free data were subjected to Discrete Fourier Transformation. DC to 30 Hz mean EEG spectral amplitudes were submitted to 4 separate fPCAs (1 for each condition and group), each using Promax rotation. Corresponding components carrying ≥ 2% of the data variance were assessed between conditions and groups at the region of interest where the amplitudes were maximal.

Results: Global cognition measured by the Montreal Cognitive Assessment (MoCA) did not differ between groups (SCD: M=27.3 SD= 1.7, HC: M= 27.0 SD=1.8, p=.685). Six frequency components were identified in EC for each group. Five further components were identified in EO for the SCD group, compared to six for HCs. Across groups, component amplitudes were larger in EC than EO for Delta-Theta (DT) ($p<.001$), Theta-Alpha (TA) ($p<.001$), and Alpha-Beta (AB) ($p<.001$). Across conditions, TA was larger for SCD compared to HCs ($p<.001$), particularly in EC ($p<.001$), while AB was larger in the HCs ($p=.030$). In EO, Delta was larger for SCD compared to HCs ($p=.032$), and in the HCs, Alpha was greater for EC compared to EO ($p<.001$).

Conclusions: Naturally derived frequency components demonstrated greater slow wave activity in older adults with SCD, compared to HCs, in both TA (across conditions) and EO Delta, as well as reduced fast wave AB activity. Alpha alone was largest in EC (cf. EO) for HCs. Across groups, DT, TA and AB were all larger in EC compared to EO. These results suggest that identification of increased slow-wave activity, particularly in EO for older adults with SCD, may provide direct and objective insight into the neuronal signature of increased dementia risk in an otherwise healthy population.

Neural Shortcuts: How the N170 is influenced by attention, expectation, and emotion.

Philip Chalk, Alan Pegna

School of Psychology, University of Queensland, Australia

Aims: Previous behavioural research has demonstrated that threat-related facial expressions (i.e., fearful or angry faces) capture our attention more readily than other facial expressions (i.e., happy or neutral faces). This phenomenon was termed the threat capture hypothesis and suggests that angry and fearful faces are prioritised above other facial expressions and thus can be processed independently of attention. However, electroencephalography (EEG) research has not corroborated the hypothesis: angry and fearful faces have not consistently elicited enhanced event-related potentials (ERPs) in the visual cortices compared to other facial expressions when unattended. To address this discrepancy, the current research considered how predictions could influence the relationship between attention and threat-related facial expressions. Indeed, unpredicted visual stimuli have been shown to elicit larger ERPs in the visual cortices than predicted visual stimuli. This relationship has been shown to interact with attention (such that predicted and unpredicted neural signals develop over 2 levels of attention) and threat-related facial expressions (such that unpredicted angry faces elicit stronger ERPs than predicted angry faces). Thus, it may be that case that threat-related facial expressions are only processed independently of attention when they are unpredicted. Accordingly, the current paper uses EEG to examine whether predictions modulate our spatial attention in the presence of threat-related facial expressions.

Method: The experimental task was a covert emotion detection task, where participants were required to respond to angry faces appearing in the covertly attended region. Angry faces were not relevant to the experimental design, but rather were a means to create a task that engaged participants attention. The experiment followed a 2 (attention: attended, unattended) x 2 (expectation: expected, unexpected) x 2 (emotion: happy, fearful) repeated measures factorial design. Attention was operationalised with written instructions which directed the participant's covert attention to one side of the screen, along with a cue to remind participants within trials. Stimuli would then appear on either the covertly attended or unattended side of the screen. Expectation was operationalised with written instructions which informed participants that when the word 'HAPPY' or 'FEARFUL' appeared, the associated face would be more common throughout the block. Emotion was operationalised with the presentation of a happy or fearful face. The dependent variable was lateralised N170 amplitudes.

Results: Grand averages of lateralised N170 amplitudes at parieto-occipital electrodes P9 and P10 revealed that unattended, unpredicted fearful faces produced significantly larger N170 amplitudes compared to other unattended faces (i.e., unattended unpredicted happy, unattended predicted happy, and unattended predicted fearful faces). Additionally, unattended unpredicted fearful faces had non-significant mean lateralised N170 amplitudes compared to attended faces.

Conclusions: A three-way interaction was present between attention, prediction, and emotion. This interaction suggests that threat-related facial expressions are only processed independently of attention when they are unpredicted. Thus, there is a potential caveat to the threat capture hypothesis: It is not simply that threat-related visual stimuli are prioritised above other visual information and thus processed independently of attention, but unpredicted threat-related visual stimuli are prioritised and thus processed independently of attention.

Eyes closed resting state EEG component amplitudes in people with mild cognitive impairment compared to healthy older adults

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Aims: Neurodegenerative diseases such as Alzheimer's Disease (AD) and the prodromal phase, Mild Cognitive Impairment (MCI), are characterised by accelerated age-inappropriate cognitive decline. Cognitively healthy older ageing is associated with reductions in resting delta and alpha EEG amplitudes when compared with younger adults. However, in AD this is more pronounced and coupled with decreases in alpha spectral power that correlates with declines in global cognition. This suggests that age-related arousal/activational differences in healthy older adults are exacerbated in AD and may be contributing to (or associated with) cognitive decline. There are few EEG studies assessing cognitive ageing, MCI and AD, with inconsistent results and variations in methodologies and analyses. This study aims to address that gap using a standardised approach by comparing differences between frequency principal components analysis (fPCA) EEG component amplitudes in people with MCI and healthy controls in order to ascertain a spectral profile for people with prodromal AD.

Method: Fifty-six older adults with MCI (mean age 70.1 ± 6.4 years), and eighteen cognitively normal older adult control (HC) participants (mean age 67.8 ± 5.6 years) had continuous EEG recorded for 2 min with eyes closed. Spectral amplitudes were extracted at 0.5 Hz resolution from 2 s non-overlapping epochs using Discrete Fourier Transformations. The DC–45 Hz spectra for each group were subjected to separate fPCAs and amplitudes for corresponding components were compared between groups.

Results: Global cognition scores were significantly lower for the MCI group (mean MoCA 24.2 ± 3.2) compared to HCs (mean MoCA 27.0 ± 2.1; $p < .001$) Seven natural frequency components were identified across groups for analysis. When compared to HCs, the MCI group had global amplitudes that were significantly larger in 0.5 Hz delta ($p < .001$) and 9.5–10.0 Hz alpha ($p = .007$), and smaller in 0.5–7.0 Hz delta-theta ($p < .001$), 8.5–16.0 Hz theta-alpha-beta/alpha-beta ($p < .001$) and lower 9.0 Hz alpha ($p < 0.01$) components. There were no significant group differences observed in global amplitudes for 7.5–8.5 Hz theta/alpha and 37.5–38.0 Hz beta components. Upon visual inspection of the headmaps, there was a shift from the delta-dominant delta-theta component in HC to a prominent theta peak in the delta-theta component in MCI, consistent with greater slow wave alpha activity in MCI.

Conclusions: This study reveals a modest but distinct spectral profile, with differences in fPCA component amplitudes, observations of peak frequency and topographical shifts, in people with cognitive decline in MCI.

Delta-beta amplitude coupling and its association with chronic pelvic pain in women with endometriosis compared to healthy controls: An fPCA study

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Aims: Endometriosis affects approximately 10% of women worldwide, and is associated with chronic pelvic pain. Similar to other chronic pain conditions, neuroplastic alterations in pain processing and cognitive control networks have been observed in the so called 'endometriosis brain'. Despite having been widely studied across a range of chronic pain conditions, electroencephalography (EEG) spectral features and their associations with endometriosis-related chronic pelvic pain are yet to be assessed. Thus, the present study examined natural frequency components during an eyes-closed resting state in women with endometriosis and healthy controls, and investigated their association with chronic pelvic pain.

Method: Twenty women with symptomatic endometriosis including chronic pelvic pain (Mage = 28.5, SD = 5.2 years), and 20 individually-matched pain free control participants (Mage = 28.5, SD = 5.2 years) had continuous EEG recorded during a 2 min eyes-closed resting block. Discrete Fourier Transforms were used to extract amplitude spectra at 0.5 Hz resolution from artefact-free 2 s non-overlapping epochs, and the DC–30 Hz mean spectra for each group were subjected to separate frequency principal components analysis (fPCA). Components showing suitable spectral correspondence were assessed between groups and regressed against participants' mean pelvic pain scores.

Results: Three natural frequency components were identified for analysis. Frontocentral midline amplitudes in the delta (0.5 Hz) and beta (~28 Hz) components were each larger in the endometriosis sample relative to the controls, while the parietal amplitude of the alpha (~10 Hz) component was relatively reduced. Across the groups, pain severity showed a significant positive association with frontocentral midline amplitudes in both the delta and beta components. Delta-beta amplitude coupling was subsequently identified; once this was controlled, only the beta-pain association was retained.

Conclusions: Eyes-closed resting EEG frequency amplitude profiles differed between women with endometriosis and healthy controls. Interestingly, delta-beta amplitude coupling was identified between the frequency components peaking within these traditional bands, and appeared to be driven by beta rather than delta activity; a novel outcome. Greater pelvic pain severity was associated with larger frontocentral midline beta amplitudes across the groups, which may reflect interactions between emotional and attentional processing systems, and/or a reduction in cholinergic tone.

Impact of daily breath-focused mindfulness meditation vs. classical music listening on global EEG amplitudes in novice meditators

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Aims: Interest in mindfulness has risen considerably, with benefits reported across a range of contexts for health and well-being. Although the benefits have been extensively reported, research on the process underlying this change is fragmented. This study aimed to investigate the impacts of a breath-focused mindfulness meditation, a common meditation practice aimed at cultivating mindfulness, on global EEG spectral amplitude in novice meditators.

Method: Forty-two participants between 18 and 35 years of age (Mage = 21.05; 26 females) completed two testing sessions approximately six-weeks apart. In these, EEG data were recorded during eyes-closed resting and a guided breath-focused mindfulness meditation using a 19-channel cap. Between sessions, participants were randomly assigned to one of two training conditions, daily 15-minute breath-focused mindfulness training (n = 21) or daily 15-minutes of listening to classical music (n = 21; active-control group). Traditional bands of delta (0.5 – 3.5 Hz), theta (4.0 – 7.5 Hz), alpha (8.0 – 13.0 Hz), beta (13.5 – 24.5 Hz), and gamma (25.0 – 45.0 Hz) were used to explore changes in global EEG spectral amplitude.

Results: Participants reported completing an average of 5.7 exercises per week (range: 3.3 – 7.0; SD = 0.9) between sessions. Across sessions, Delta was somewhat greater during mindfulness than rest ($p = .079$). The music group had somewhat larger delta relative to the mindfulness group ($p = .053$). Theta increased significantly between sessions, and a significant interaction indicated that the increase was larger for the mindfulness group during meditation relative to rest. Alpha decreased significantly during meditation compared with rest, and a significant interaction indicated that this decrease was larger in the mindfulness group between sessions. Beta was significantly lower during meditation compared with rest, and there was some increase in this difference between sessions ($p = .076$), particularly in the music group ($p = .099$). No significant differences were found in gamma.

Conclusions: Increases in delta have consistently been associated with drowsiness and sleep. Although some differences were identified, the results suggest participants were actively engaged and alert throughout the tasks. In addition, these findings support previous research linking theta with cognitive processing (e.g., internalised attention) and awareness. The decrease in alpha during mindfulness meditation compared to rest suggests an increase in arousal. Similarly, decreases in beta during meditation have been linked to reductions in stress, as well as cognitive processing, highlighting the immediate benefits associated with breath-focused mindfulness meditation. Together these findings demonstrate that breath-focused mindfulness meditation increases arousal and reduces stress in a population of novice meditators, enhanced with regular practice. Future research should continue utilising an active-control condition to account for demand characteristics and delineate the effects associated with regular mindfulness meditation particularly arousal.

Yoga and Cognitive Behavioural Therapy Improve Transdiagnostic Emotion Regulation: A Pilot Study

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Aims: Mental health disorders often co-occur – or are “comorbid” – resulting in more severe and complex clinical profiles, distress, and impairment. Unlike current disorder-specific psychotherapies, transdiagnostic interventions target core underlying factors of mental health issues, such as emotion dysregulation, to accommodate psychological comorbidities and complexities. Emotion regulation defines the ability to modify the intensity and/or duration of emotions appropriately and is considered a core transdiagnostic factor across emotion-based disorders. Given that 65% of Australians with a mental illness don’t receive treatment (Australian Department of Health, 2013), yoga – an ancient mind-body practice combining meditation, breath regulation, and physical postures – may overcome current psychotherapy barriers to provide an accessible, cost-effective, and stigma-free transdiagnostic therapy to improve mental health.

Method: This study investigated the pilot efficacy of yoga for improving emotion regulation for a transdiagnostic sample of individuals with any emotional disorder(s) (N = 12). A pilot feasibility randomised controlled trial (RCT) design was used to compare 10-week manualised treatment interventions of yoga and an active transdiagnostic cognitive behavioural therapy (t-CBT) control. To increase ecological validity, both self-report measures and heart rate variability (HRV) biomarkers of emotion regulation were assessed. HRV is a feasible and valid cardiac measure of emotion regulation, indexing autonomic nervous system (ANS) balance.

Hypotheses: 1) self-reported and physiological (HRV) emotion regulation will improve following either yoga or t-CBT, 2) self-reported emotion regulation will improve similarly following either yoga or t-CBT, and 3) HRV will improve more following yoga than t-CBT, given the proposed additional physiological benefits of yoga.

Results: Self-reported emotion regulation results suggested a statistically significant and clinically meaningful reduction in participants’ self-reported emotion dysregulation ($p = .003$, Cohen's $d = 1.12$) and similar reductions following yoga and t-CBT. Similarly, HRV indices demonstrated significant treatment-related improvements in emotion regulation, with no differences between yoga and t-CBT. HRV improvements were strongest for ANS function (standard deviation of NN intervals [SDNN ms]; $p = .04$, Cohen's $d = -0.71$) and more subtle for parasympathetic activity (high-frequency HRV [HF-HFV (FFT ms2)]; Cohen's $d = -0.35$) and sympathovagal balance (low-to-high frequency ratio [LF/HF]; Cohen's $d = -0.51$) to confirm the treatment-related cardiac changes.

Conclusions: This study provides the first investigation into yoga as a transdiagnostic mental health therapy. Together, these results suggest that 10-week yoga and 10-week t-CBT interventions consistently improved self-reported and physiological (HRV) emotion regulation. Whilst replication with larger-scale RCTs is required, these preliminary findings suggest that yoga provides comparable benefits to current first-line CBT interventions through a combination of top-down and bottom-up regulatory mechanisms. Adjunct or discrete yoga practice thus provides an efficacious and feasible therapy option to alleviate mental health issues and their associated distress, impairment, and costs.

Methodological Considerations for Facial Electromyography in Psychophysiological Research: Comparing Baselines

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Aims: Some aspects of facial electromyography (EMG) methodology have been standardised in psychophysiological research. However, there has been much variability in the different baselines used when quantifying affective responses. I aimed to investigate whether using different baselines impacted the results of, and thus the inferences that could be drawn from, a facial EMG experiment. To this end, I compared four baseline approaches. Specifically, expressing responses without a baseline, expressing responses as a difference score from a pre-stimulus baseline, expressing responses as a proportion of a pre-stimulus baseline, and expressing responses as a proportion of participants' maximal voluntary contraction.

Method: To facilitate this comparison, participants viewed static visual stimuli (i.e., photographs) that differed on two dimensions, emotional valence (positive vs negative) and psychological arousal (high vs low), while EMG activity was recorded from the corrugator supercilii muscle. Participants also rated the valence and arousal of these stimuli on 7-point scales.

Results: The notion that the results and inferences of a facial EMG experiment can change depending on the baseline received mixed support from the present study. All baselines yielded an effect of emotional valence, and three of the four baselines yielded an unexpected effect of psychological arousal. Counter to expectations, the hypothesised valence and arousal interaction observed in previous studies was not found when using any of the four baselines. Moreover, participants' valence and arousal ratings of the stimuli did not always align with their psychophysiological responses.

Conclusions: The present study demonstrated that the results and inferences of a facial EMG experiment changed depending on the baseline used. However, because of the observed unexpected effect of arousal, firm conclusions regarding the superiority of a specific baseline are not possible. Nevertheless, based on maximising effect sizes, I suggest that facial EMG responses to static visual stimuli should be expressed relative to a pre-stimulus period via a difference score or as a proportion.

We're not who we used to be. We're just two ghosts swimming in a glass half empty. Trying to remember how it feels to have a heartbeat.

HARRY STYLES, 2017

The Effect of Dynamic Films and International Affective Picture Systems on Explicit and Implicit Responses

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Aims: The capacity for films and pictures to elicit an emotional response has been a topic of contention. Currently, no study has investigated the direct comparison of films and pictures on explicit and implicit responses. Therefore, this study aims to investigate whether a significant difference exists between dynamic films and international affective picture system (IAPS) images in eliciting explicit and implicit emotions.

Method: For this study, 113 participants were recruited. For implicit responses, facial electromyography (EMG) in corresponding facial sites for positively- and negatively-valenced stimuli was used. The three facial sites examined were zygomaticus major, orbicularis oculi and corrugator supercilii. Conversely, for explicit responses, self-reported ratings of positively- and negatively-valenced stimuli were measured. Participants underwent two conditions, dynamic films, and IAPS, where facial EMG and self-reported ratings were collected for each individual stimulus. EMG signals were segmented into the average of the last 2000ms epoch for both IAPS and dynamic films.

Results: The implicit findings showed that dynamic films elicited a higher EMG activity across zygomaticus major and orbicularis oculi within positively-valenced stimuli than IAPS images. However, no difference was found in EMG activity across corrugator supercilii within negatively-valenced dynamic films and IAPS images. Across explicit findings, no difference was found between positively-valenced dynamic films and IAPS images across self-reported ratings of happiness. A significant difference, however, was found between negatively-valenced dynamic films and IAPS images across self-reported ratings of sadness, where IAPS demonstrated higher ratings.

Conclusions: These results follow previous literature on how positive and negative emotions are elicited implicitly. Similar results can be found where there is a discrepancy between explicit and implicit responses for individuals. Not only can these differences be seen across positive and negative stimuli across facial sites and self-reports, but it also provides insight into possible theories that may account for this. Therefore, these findings explore how individuals perceive emotion implicitly and explicitly within films and pictures, moreover, provide an informed structure for future research and rudimentary insight into the relationship between films and pictures on human emotions.

An Electromyography Differentiation between Empathy and Compassion in the "Cry for Help"

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Aim: Emotional victim effect states that victim's emotional demeanour is more readily believed than non-emotional victims on the creditability of their statement (Ask & Landström, 2010). In the courtroom, litigants' emotional tears are a request for help often signalling respondence to express empathy and sympathy (Murube et al., 1999). Empathy provides emotional sharing and understanding of litigants' mental states (Cuff et al., 2016). Whereas compassion produces empathic concern that transpires to a person's willingness to help when people are in distress (Eisenberg & Eggum, 2009). This current study explores the tearing effects on empathy and compassion within a negative emotional situation through participants' emotional and facial responses.

Method: An eCourtroom (electronic courtroom) was replicated through a Zoom video which portrays an external negative emotional scenario with the targets' facial expression (tears or neutral) and five bystanders. A facial electromyography (EMG) was used on 74 participants to measure corrugator signals of recipients' expressions. Empathy and prosocial behaviour (comfort) self-reports indicated recipients' feelings on the targets displaying tears or neutral facial expression.

Results: A Wilcoxon signed-rank test revealed that the recipient's corrugator did not significantly change for tearing and neutral facial expression when a person is experiencing an emotional situation. As expected, paired-sample t-tests revealed that people felt empathy towards a target person displaying a neutral facial expression. Moreover, tearing expressions showed significant higher feelings of empathy and the willingness to comfort a person in an emotional situation.

Conclusions: Tearing demeanour is an important cue for compassion, as it obtains empathy and attains assistance for a negative emotional event in online teleconferencing platforms. Merely watching a person displaying a neutral expression does provides understanding when befallen by an emotional situation. Yet, recipients convey concern emotions equally for people who were either displaying a tearing or neutral expression, suggesting that negative emotional events play an important role for emotion. These indifferences between the facial EMG and self-report measure could also be due to sensitivity within the measure of the bystander's variable. Future research in facial EMGs should explore whether bystanders' facial expressions (concern and not concern) can modify observers' facial responses.

Emotion, perception, the brain, and the body

Tom Johnstone

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Emotions have long been regarded as intrinsically connected to the way we perceive the world around us, our cognitions, feelings, and the physiological changes in our bodies that prepare us to react to particularly relevant events. It has proved a great challenge to study these multiple components together, partly for practical, methodological reasons, and partly due to a lack of underlying theory. In both cases, a large part of what has been lacking is a sufficiently interdisciplinary approach. In recent times this has changed. In this talk, I will present methods and results from my collaborative research, as well as research by others, that are casting light on how the brain and body respond to highly significant, emotional stimuli, and how these responses are regulated spontaneously and through intentional reappraisal. I will show how combining EEG and fMRI provides information about the time course of neural responses to emotionally significant stimuli, starting less than 100ms after stimulus onset. I will also discuss the role interoception may play in emotion regulation and anxiety, with examples from two recent studies that make use of a new questionnaire to assess an individual's attitudes and beliefs about their bodily sensations. I will end by presenting a new, portable and fully open analysis platform for cognitive neuroscience and psychophysiology researchers.

When it comes to proposing a strictly neurological explanation for psychological activities, we stumble against the cold fact that such an explanation is of no use because it does not apply to human experience.

MAGDA ARNOLD (1961)

Understanding the social brain: The potential application of psychophysiology in dementia

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Can psychophysiology help us understand or even potentially treat dementia? Younger-onset dementia, which occurs before age 65, currently affects ~30,000 Australians. Frontotemporal dementia is one of the most common forms, which is characterised by changes in personality, behaviour and language. Diagnosis has been inherently challenging due to the overlap of symptoms with primary psychiatric disorders and other dementia syndromes such as Alzheimer's disease. This has been compounded by an over-reliance on clinical judgements for detecting diagnostic features. In this talk, I will present a series of studies demonstrating how measures of eyetracking, skin conductance, facial electromyography and neuroimaging are sensitive to the earliest socioemotional symptoms of frontotemporal dementia. I will discuss how adopting these measures in clinical settings can improve early diagnosis, and potentially detect responses to treatment in pharmacological trials. Finally, I will present recent work on interoception, which suggests that mechanisms underpinning socioemotional symptoms differ across dementia subtypes, opening up new avenues for individually-tailored intervention strategies. From a theoretical perspective, studying individuals with frontotemporal dementia can help in refining neurobiological models of socioemotional functioning.

Effect of rhythm change on heart rate variability (HRV) during music listening

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Aims: Changes in frequency domain measures of Heart Rate Variability (HRV) appear to result from cognitive processing during music listening. Known musical works are commonly used as stimuli, however, confounds arise due to individual differences in prior learning and emotional response, as well as changes in multiple musical elements such as pitch, harmony, rhythm, timbre, or expression. Rhythmic elements are considered the major determinants of physiological changes to music, so our study aimed to control for confounds by changing only a single rhythmic element to modulate information processing, in order to assess the impact on frequency domain measures of HRV.

Method: Thirty-five participants (age M = 21.8, SD = 4.3 years) completed the musical contour and rhythm recognition subscales of the Montreal Battery of Evaluation of Amusia, and their HRV data were assessed for three 3 min blocks during eyes-open rest, and while passively listening to two stimuli (Music A & Music B), each consisting of inverse arrangements of two types of 32 s repeating chord patterns that differed via a single rhythm change but were otherwise identical. The Music B stimulus consisted of five repetitions of the rhythmic change (a syncopation) pattern and was therefore considered more complex than the Music A stimulus which contained only one instance of this pattern.

Results: High-frequency (HF) HRV was significantly reduced during passive listening compared to eyes-open rest, and while listening to the more complex (Music B) compared to less complex (Music A) stimulus. No significant difference was found in Low-Frequency (LF) HRV. The relative difference in HF HRV between passive listening blocks (more complex – less complex) correlated significantly with rhythm discrimination ability. As rhythm discrimination ability increased, so did the relative difference in HF HRV between passive listening blocks, suggesting that those with greater rhythm discrimination ability were more sensitive to the rhythm change and this sensitivity was reflected in their HF HRV response.

Conclusions: The observed relationship between HF HRV and musical complexity supports assumptions that reduced HF HRV reflects cognitive processing of auditory information. The correlation between HF HRV and rhythm discrimination ability suggests HRV may be a possible biomarker for musical ability, and future research exploring this relationship could be of value.

Strengthening the extinction of human fear

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Fear and anxiety disorders are highly prevalent with 7% of the Australian population affected in 2019. The good news is that effective (psychological) treatments exist to address these. The bad news is that relapse of fear after successful treatment is common with rates between 10-60%. This is not unexpected given that Pavlovian learning processes are critical in the acquisition, maintenance, and reduction of human fear. Extinction, the process thought to mediate the reduction of human fear in exposure based treatments, does not eliminate the fear association acquired during initial learning, but adds a new association, which then competes with the fear association to determine behaviour. As this second learning is usually weaker than the initial learning, return of fear is likely. Using human fear conditioning paradigms, current work in our lab tests interventions aimed at strengthening the extinction of human fear, including the presentation of paired or unpaired unconditional stimuli during extinction. This work translates insights from work in animal learning to human learning with the ultimate goal of informing the development of treatments that have a more lasting effect.

The Missing Link Between Internal and External Emotion Recognition: How are Alexithymia and Facial Mimicry Related?

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Aims: Alexithymia is a personality trait characterised by internal deficits of emotion processing and recognition of one's own emotions. Despite being associated with abnormal social functioning and worsened outcomes in multiple physical and psychiatric illnesses, alexithymia research remains scarce. To better understand how the internal inability to recognise emotions translates to external and interpersonal impairments, such as facial expression recognition, I investigated the relationship between alexithymia and facial mimicry, a mechanism by which emotional expressions are mimicked and interpreted via biofeedback. In order to facilitate emotion recognition, facial mimicry requires intact ability to perceive emotional faces and relate the information to one's internal knowledge of emotions, which is impaired for alexithymic people. Categorically, high alexithymia has been demonstrated to lead to impaired facial mimicry, however this does not capture the entire relationship, as alexithymia is a continuous construct in reality. In addition, past research suggests that alexithymia could relate to positive or negative stimuli processing differently. The current research aimed to examine the correlation between alexithymia and facial mimicry, and to explore whether that relationship differs depending on stimuli valence.

Method: In the present study, facial mimicry was measured by recording the facial muscle activity of 84 participants using electromyography (EMG) as they watched dynamic videos of joyful and sad facial expressions. The zygomaticus major and orbicularis oculi were measured for positive mimicry, and the corrugator supercilii was measured for negative mimicry. The EMG signals elicited from positive and negative stimuli were analysed for correlation, respectively, to alexithymia scores as measured by the Toronto Alexithymia Scale (TAS-20), collected via a questionnaire.

Results: Contrary to past research, no significant correlation was found between alexithymia and facial mimicry of positive stimuli, whereas the negative stimuli was unable to elicit facial mimicry, hence was not included in the correlation analysis.

Conclusions: As a novel study of the correlation between alexithymia and facial mimicry, the unexpected lack of significant results indicate that the relationship is possibly more nuanced than previous literature suggests. One explanation could be that mimicry impairment in alexithymia is limited to negative stimuli as an attempt to avoid amplifying the already negative affective state of alexithymic people. Another possible explanation would be that mimicry impairment is not linked to alexithymia in a sample population of university students with normally distributed TAS-20 scores because the relationship can only be detected in highly alexithymic people. Ultimately, these findings provide valuable insight into the mechanism by which alexithymia, marked by internal emotional deficits, relate to external emotion recognition. As an under-researched transdiagnostic trait linked to multiple physical and psychiatric illnesses, understanding alexithymia is of interest to academics and clinicians alike and benefits many clinical populations. Therefore, this study serves as a building block towards a clearer picture of alexithymia.

Sex differences in pink and white noise in the human electroencephalogram power spectrum

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Aims: Human electroencephalographic (EEG) recordings contain an ill-defined mixture of periodic oscillatory activity and aperiodic non-oscillatory noise. This aperiodic component is further delineated into pink (1/f; f = frequency) and white (k at all f; k = constant) noise forms, with established neural origin. Interest in noise quantification has emerged in the literature, however, prominent approaches deviate from these defined noise forms in their estimation of an atheoretical '1/f-like' parameter associated with problematic theoretical and mathematical implications. An alternative algorithm offers a valid quantification approach used to illustrate changes in pink and white noise as a function of sagittal topography and resting condition; however, little is known about sex-specific influences. Despite biological sex being the most common individual-difference variable in human samples, only one study to-date has attempted to examine sex differences in the aperiodic component of EEG power spectra. The current study investigated sex-related differences in pink (PN) and white (WN) noise, during eyes-closed (EC) and eyes-open (EO) resting, and across frontal and parietal topographic brain regions, in a sample of healthy young adults using a validated quantification approach.

Method: Raw electrophysiological data from 60 age- and sex-matched healthy young adults, ranging from 18.3 to 25.6 years of age (Mage = 19.9, SD = 1.8), were used in the current study. Following DC correction and automatic artefact rejection, consecutive non-overlapping 2 s epochs underwent spectral decomposition using Discrete Fourier Transforms (DFTs), yielding spectral data at 0.5 Hz resolution. Replicating previous approaches, 2-24 Hz spectra were submitted to the Pink and White Noise Extraction (PaWNextra) algorithm to obtain PN and WN noise power estimates for each participant and electrode site. To assess the between-subjects factor of sex (female, male) and the within-subjects factors of resting condition (EC, EO) and sagittal topography (frontal, parietal) on both PN and WN, separate univariate repeated-measures Multivariate Analyses of Variance (MANOVAs) were conducted. Planned polynomial contrasts were used to assess main and interaction effects.

Results: PN differed significantly by sex, where global power was greater in females compared to males. In addition, both PN and WN differed significantly by resting condition, in which global power was greater in EC compared to EO resting, and this effect interacted with sagittal topography, revealing that this EC enhancement was greater in the parietal compared to the frontal region. No main effect of topography was found for either pink or white noise, nor was a sex effect revealed for white noise.

Conclusions: These findings, which were partially consistent with prior research, facilitate a greater understanding of the neurobiological correlates and functional significance of pink and white noise, especially in regard to sex-related differences.

A Multimodal Approach to Feeling and Physiological Responses to Emotional Videos in Alexithymia

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Aims: When asked to reflect on their experience of watching a film, most people reflect on how it made them feel. However, this may not be quite as simple for individuals with alexithymia, a personality trait characterised by difficulty identifying, communicating and expressing one's feelings. To understand the origins of this trait, research, especially in the field of social neuroscience, has turned to the use of physiological measures of emotion. Nonetheless, there remains a gap in the field's knowledge; do the emotional reactions, or facial expressions, of individuals with alexithymia match their emotional appraisals of emotional stimuli?

Method: I conducted a multimodal investigation on low and high levels of alexithymia with happy and sad videos using facial electromyography to examine this question. One hundred and thirteen psychology students were recruited through the University of Queensland for this study.

Results: Mixed ANOVAs on the emotional video valence and the alexithymia levels found that facial expressions between individuals with low and high levels of alexithymia are the same. The appraisal ratings of video happiness and sadness across the two levels of the trait were also the same.

Conclusions: The combined use of facial EMG and self-report provided an illuminating way to explore whether emotional reactions and evaluations of emotional stimuli are matched in alexithymic individuals. Facial EMG allowed for the distinction between positive and negative affective states beyond a purely descriptive emotional account. The level of alexithymia between-subjects did not produce stronger ratings of the negatively valenced stimuli. These EMG findings provide a novel contribution to the non-arousal-based physiological literature on alexithymia.

Individual Differences in Behavioural Inhibition and Error Monitoring

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Aims: This study investigates the effect of monetary reward on error monitoring by recording error-related negativity (ERN) and error positivity (Pe). Previous studies have reported that ERN and Pe reflect the motivational significance of error. In addition, some studies have assumed that ERN amplitude is determined by the interaction between the significance of errors and individual differences in the approach/avoidance motivation. We examined the relationship between individual differences in the approach/avoidance motivation and ERN/Pe.

Method: A total of 28 participants performed a Go/No-go task. They performed four blocks of 120 trials under two conditions. In the reward condition, each correct rejection of the No-go stimulus was rewarded with 10 yen (~7 cents). In the neutral condition, neither monetary reward, nor punishment was contingent on response outcomes. We evaluated individual differences in the approach/avoidance motivation using the behavioural inhibition system (BIS) and behavioural activation system (BAS) scales. EEGs were recorded from 128 scalp sites using the Biosemi Active Two system. EMG-synchronized ERPs were averaged separately for overt-errors and partial errors (i.e., correct rejections contaminated with erroneous muscle activities). Amplitudes of ERN and Pe were subjected to two-way ANOVAs, including factors condition (reward/neutral) and trial type (overt error/partial error). Two-sided Pearson's correlations were calculated among ERN, Pe, and the BIS/BAS scores.

Results: Reaction time was significantly longer in the reward condition than the neutral condition. The error rate was significantly smaller in the reward condition than the neutral condition. Moreover, post error slowing tended to be longer in the reward than in the neutral condition. ERN and Pe amplitudes did not differ between the conditions. However, we found significant negative correlations between BIS scores and ΔERN amplitudes. We found significant negative correlations between BAS-Fun scores and Pe amplitudes in the neutral condition.

Conclusions: We found a longer reaction time and lower error rate in the reward condition compared to the neutral condition. These results suggest a strong tendency to avoid error responses and to gain the monetary reward. It is likely that a monetary reward may enhance behavioural error monitoring. In addition, ERN may be modulated by both reward-induced motivation and individual differences in BIS scores. As individuals high in BAS-Fun scores showed a stronger impulsiveness to novelty stimulus and reward, their error evaluation was decreased in the neutral condition.

CACNA1C rs1006737 polymorphism is associated with altered high-frequency EEG activity and schizotypy in neurotypical adults

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Aims: The single nucleotide polymorphism, rs1006737, within the L-type voltage-gated calcium channel subunit alpha1C (CACNA1C) gene is associated with increased risk of psychiatric disorders. Further, schizotypy is linked with a heightened risk of schizophrenia, with similar neurobiological mechanisms implicated. The present study sought to interrogate the association between rs1006737 and schizotypy in neurotypical adults using electroencephalogram (EEG) to identify the neurophysiological mechanisms underpinning psychosis risk.

Method: Participants (N = 92) were genotyped for rs1006737, had their eyes-open resting-state EEG recorded, and completed the Schizotypal Personality Questionnaire (SPQ); rs1006737 A allele carrier and non-carrier groups were compared.

Results: The A allele carrier group showed significantly higher alpha-2 amplitudes over the right hemisphere relative to the left hemisphere than non-carriers. A-carriers also showed significantly lower beta-1 amplitudes over central-left regions than non-carriers. Bivariate correlations between EEG amplitudes and SPQ scores showed a significant positive relationship between parietal beta-1 amplitudes and interpersonal and constricted affect scores, and a significant negative relationship between parietal beta-1 amplitudes and magical thinking scores.

Conclusions: These findings provide insights into the electrophysiological differences associated with CACNA1C rs1006737 and how they relate to schizotypy in neurotypical individuals. Moving forward, this may shed light on potential neurophysiological and molecular mechanisms which underpin schizotypy that could be further explored in clinical populations.

Sex differences in the resting EEG components of healthy young adults

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Aims: The magnitude of EEG activity in the eyes-closed resting condition has been found to differ between the sexes. Previous studies of these differences in healthy young adults suggest that females have greater global eyes-closed (EC) activity in the traditional alpha and beta bands, however findings regarding the delta and theta bands are inconsistent. Sex differences in eyes-open (EO) resting EEG do not appear to have been investigated independently of EC. These inconsistencies may reflect differences in the frequency ranges used between studies to define each traditional EEG band. Frequency principal components analysis (f-PCA) does not rely on pre-determined frequency ranges to quantify EEG data and allows for more detailed examination of the spectral distribution than traditional band analysis. The aim of this study was to use f-PCA to investigate sex differences in the global magnitude of eyes-closed and eyes-open resting EEG in greater detail than traditional band analysis allows.

Method: The present study used 60 age matched healthy young adults (30 female) who had their EEG activity recorded during 2-min blocks of EC and EO resting EEG in counterbalanced order. The EEG magnitude spectra from two resting blocks from each participant were submitted to four separate f-PCAs, one for each sex in each condition. The components within each condition were screened for topographical and spectral congruence between sexes. For each between-sexes pair of matching components the mean global amplitudes were calculated and compared.

Results: Every component that met the criteria to be considered for analysis was a reasonable match to at least one component from the opposite sex in the same condition. Females had greater magnitude in the EC delta and lower beta components, while males had higher magnitude in the EC delta-theta-alpha and 10 Hz alpha components. The EO 10 Hz alpha component also had greater magnitude for males, and the EO male delta-theta-alpha component had greater magnitude than either the female delta or delta-theta-alpha components it was matched to.

Conclusions: The greater global magnitude of the EC lower beta component for females is consistent with the findings of greater beta activity for females reported in previous studies in this population. The novel finding of opposing sex effects in the EC delta and delta-theta-alpha components may correspond to the inconsistent findings regarding the effect of sex on activity in the delta and theta bands. The EC 10 Hz alpha component with a greater magnitude for males was not predicted as greater alpha activity for females has been consistently reported in the prior studies. This study demonstrates that separate f-PCAs are suitable for investigating differences in resting EEG activity between age-matched groups, including sex differences, and that the additional level of detail captured by this approach can yield novel insights.

Heart rate variability and mean heart rate in healthy adults during eyes open resting after caffeine intake

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Aims: Caffeine is a popular stimulant consumed worldwide. This psychoactive substance promotes many beneficial results relevant to everyday living, such as increased alertness and decreased drowsiness. However, many people report subjective feelings of increased cardiovascular responses. This has raised concern towards the possible negative impact of caffeine consumption on cardiovascular health. Previous research illustrates Mean Heart Rate (HR) is primarily unaffected through caffeine consumption. However, the effect of caffeine on Heart Rate Variability (HRV) presents as inconsistent in the literature, with a that suggestion caffeine may affect the high frequency (HF), but not low frequency (LF) HRV. However, the majority of research into this relationship has investigated clinical populations. Thus, the current study aimed to investigate the relationship between caffeine and cardiovascular measures in a sample of healthy participants.

Method: The current study investigated university students' data (N = 20, Mage = 20.85, SD = 3.17, 13 female) from a double-blind randomised placebo control study. Participants were screened for health issues and the consumption of problematic substances 24 hours prior to recording. Participants underwent two separate sessions of recording. In the first session, participants were administered either placebo or 250mg caffeine in an order that was blind to both participants and researchers and were then fitted with recording equipment. An electrocardiogram (ECG) was recorded whilst participants completed a simple eyes open/eyes closed task over the course of an hour. Within the task, 30 individual blocks were presented that alternated between eyes open and eyes closed in 2-min intervals. After the first recording session was completed, participants were invited back 1 week later and completed the task again, with the other substance. Problematic data was manually corrected if possible or removed if unsalvageable. Seventh and eighth eyes open blocks that occurred around 30 min post-ingestion were chosen for analysis and mean HR, LF HRV, and HF HRV were derived using Kubios software. Separate MANOVAs were used for each cardiovascular variable to compare placebo to caffeine conditions using an alpha of .05.

Results: After confirming the assumption of normality and the absence of outliers, the MANOVAs indicated that mean HR ($p = .761$), LF HRV ($p = .943$), and HF HRV ($p = .592$) did not significantly differ between caffeine and placebo conditions 30 min after pill ingestion during eyes-open blocks.

Conclusions: The outcomes suggest that caffeine fails to produce significant effects on cardiovascular activity in acute sedentary settings for healthy individuals. Findings imply screening for caffeine consumption prior to ECG testing may be unnecessary in research. However, the current study is limited as the study was not designed for analysis of HRV and findings can only be generalised to acute settings of caffeine intake. Future research may wish to examine long term health effects between caffeine and cardiovascular measures and ensure the study is properly designed to assess HRV and other autonomic measures.

Breathing as Behaviour: Revisiting Evidence for "Ventilatory Personalities"

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Our emotional and cognitive states affect the way we breathe, and our breathing also moderates how we feel and think. Our breathing patterns are highly variable due to both autonomic homeostatic demands and higher cortical behavioural influences. However, there is evidence that individuals appear to favour one particular breathing pattern. Such characteristic "breathing personalities" are curiously understudied in psychophysiology, despite their potential consequences for behaviour and cognition.

Aim: I conducted a detailed literature review investigating the test-retest reliability of individual breathing patterns in healthy adults. The primary aim was to contextualise standards for the recruitment of participants, experimental methodology, statistical analyses, and identify any gaps in existing knowledge.

Method: A literature search was conducted using the terms breathing and respiration, separately combined with pattern, rhythm, personality, reliability, individuality, and variability. The criteria for inclusion were explicit test-retest measurement of breathing patterns with non-invasive breathing equipment and minimal extrinsic stimulation, in healthy adult participants, breathing spontaneously without instruction or manipulation. Five studies were selected, using conditions of seated or supine relaxed wakefulness, and stage IV sleep. I summarised each study's methodological and analytical details, together with the reported findings.

Results: Individuals were found to breathe more similarly to themselves than to each other when measured on different days in identical conditions. This variability was not reduced by controlling for either average PETCO2 (end tidal carbon dioxide) or metabolic rate as measured by body surface area. These idiosyncratic patterns were found to be stable over 4-5 years, despite changes in body weight and smoking behaviour. Further, there is evidence that monozygotic twins share similar breathing patterns, suggesting there is a potential genetic determinant. Importantly, clear individual differences in breathing patterns during stage IV sleep could not be explained by physical characteristics such as age, height, and weight, nor lung function, as measured by FVC (forced vital capacity) or FEV1.0 (forced expiratory volume in 1 second). Finally, these distinct breathing patterns are identified by airflow shape rather than respiratory variables in isolation. Such analysis includes (1) multivariate harmonic analysis of respiratory frequency, and (2) by a trivariate description of volume shape using tidal volume, mean inspiratory time, and mean expiratory time. This suggests future studies should seek to quantify breathing variability as non-dimensional or time-scale-invariant.

Conclusion: My review uncovered empirical support for the claim that we have a "ventilatory personality", yet the mechanisms behind why we breathe in different ways demand further research. Reliable differences in breathing pattern are missed by averaging respiratory variables across individuals, suggesting a need for future research to capture, analyse, and model respiration as a multivariate pattern of breathing behaviour. Understanding why we breathe differently from others may be significant for other affective, emotional, interoceptive, and cognitive processes.

The Effect of Spontaneous Mimicry on Emotional Responses to Facial Stimuli: A Facial EMG Study

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Aims: Mimicking the behaviour of others is often an automatic response. Facial mimicry is the matching of others' facial expressions. Like behavioural mimicry, this response is spontaneous and can occur at an unconscious level. Some researchers theorise that mimicking another's emotional facial expressions leads to shared affect in the perceiver, however, this idea is contested in the literature. The International Affective Picture System (IAPS) is a standardised set of images used in emotion research and contains facial stimuli. Few studies have investigated whether facial stimuli from the IAPS leads to different emotional responses than non-facial stimuli. I examined whether facial stimuli from the IAPS are spontaneously mimicked and the resulting effects on participants' emotional responses.

Method: I used facial EMG to record facial expression responses of participants while they viewed stimuli from the IAPS and from a set of dynamic facial expression videos that were used to measure spontaneous facial mimicry. Participants rated their emotional responses to the IAPS stimuli using a 7-point scale.

Results: There were significant correlations between responses to the spontaneous facial mimicry stimuli and to the IAPS stimuli that contained faces. This was found for both positive and negative emotional stimuli. Contrary to what was expected, facial expression responses to the IAPS stimuli did not predict participants' emotional ratings of the images. Furthermore, there was no difference between the emotional ratings of facial and non-facial IAPS stimuli.

Conclusions: The results of the present study suggest that people may spontaneously mimic the emotional expressions of faces in the IAPS. The findings also provide further evidence that static and dynamic facial stimuli produce similar facial expression responses.

Effects of 12-weeks Sailuotong (SLT) on resting EEG and plasma pro-inflammatory cytokines in people with mild cognitive impairment: an fPCA study

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Aims: Mild cognitive impairment (MCI) is a clinical syndrome that increases the risk of dementia >5 fold and currently there are no treatments. Sailuotong (SLT), a standardised herbal formula, has been shown to modulate pathophysiological mechanisms underlying MCI and dementia syndromes, including neuroinflammation. The aim of this study was to characterise changes in spontaneous electroencephalography (EEG) and plasma pro-inflammatory cytokines in people with MCI following chronic SLT administration.

Method: This was a sub-study from a randomised, double-blind, placebo-controlled, parallel group phase II pilot trial testing the efficacy of 12-weeks 180 mg/day SLT or placebo on cognition in people with MCI. Resting eyes-closed EEG, plasma IL-1β, IL-6, and TNF-α, and a neuropsychological test battery were measured at baseline and endpoint. Separate frequency principal components analyses (fPCAs) were used to decompose DC–30 Hz EEG for each timepoint (baseline, endpoint) and group (SLT, placebo); for brevity, only group × time interactions are reported. EEG fPCA component amplitudes were correlated with neuropsychological test scores and plasma cytokine concentrations.

Results: Six fPCA components were identified across groups and timepoints: delta, delta-theta, low alpha, high alpha, low beta, high beta. Group × time interactions were observed for low ($p = .002$) and high ($p = .003$) alpha components, with alpha amplitudes reducing from baseline to endpoint in the SLT group, while remaining unchanged in the placebo group; no significant group × time effects were observed for plasma cytokines. In the SLT group, high alpha and low beta amplitudes were inversely correlated with WAIS-IV Coding scaled scores ($p = .034$ and $.016$), low alpha was inversely correlated with IL-1β concentrations ($p = .006$), and high alpha was positively correlated with IL-6 ($p = .021$).

Conclusions: SLT modulated eyes-closed resting EEG. Treatment-related reductions in alpha may reflect enhanced neuronal activity (via increased arousal), associated with enhanced perceptual processing speed in people with MCI.

Trial registration: ACTRN12617000371392; Funding: NHMRC-ARC Dementia Research Development Fellowship (APP1102532).

When smiles are accompanied with tears: Facial EMG and the ambiguous face

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Aims: Recent research on emotion has seen a renewed interest in how people judge the genuineness of others' facial expressions, particularly with respect to smiling. In this paper we report the results of two lines of research, one focused on smiling and the other on crying, which examined how subjective ratings of genuineness are affected by features of the face and mimicry.

Method: In three facial EMG experiments of smiling we found that people mimicked the perceived intensity of smiles, somewhat independently of what was actually featured in the face, but that this perceived intensity predicted ratings of genuineness regardless of whether mimicry occurred. We also conducted three experiments on the social perception of sadness using a set of pictures of people crying with visible tears or with the tears digitally removed..

Results: The first two experiments demonstrated that judgements of genuine sadness were affected by the presence of tears, even when they were presented for just 100 msec in a backwards masking task. The final experiment involved the use of facial EMG to measure brow activity while participants viewed the sad pictures and made ratings. Participants exhibited greater brow EMG activity when viewing photos with tears than photos without tears, and again this activity was related to ratings of how genuinely sad the photo appeared.

Conclusions: We conclude from these sets of studies that it is the perception of the underlying intensity of a facial expression that determines judgments of genuineness, irrespective of whether mimicry takes place or a "cue of genuineness" (e.g., the Duchenne marker) is present

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All along the Western front, people line up to receive. She got the power in her hand to shock you like you won't believe. Saw her in the Amazon with the voltage running through her skin. I said "ooh, girl, shock me like an electric eel."

MGMT (2008)

Caffeine effects on cardiovascular measures in an eyes closed resting state

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Aims: Caffeine is one of the most commonly consumed stimulants in the world and affects the central and autonomic nervous systems, responsible for regulating a variety of unconscious processes such as arousal and activation. The effects of caffeine on cardiovascular measures such as heart rate (HR), and in particular, heart rate variability (HRV), are not clear due to inconsistent results, and this may reflect the variations in study designs and methodologies. Some studies have shown a decrease in HRV measures, and other studies have found no effects in any cardiovascular measures. The aim of this study was to examine the effect of caffeine on HR and frequency domain HRV measures during an eyes closed resting state.

Method: In a randomised double-blind placebo-controlled repeated measures cross over study, 250 mg of caffeine or placebo were administered orally on two occasions, 1 week apart, to 20 university students (Mage = 20.85 yrs; 65% female). Electrocardiogram (ECG) data were recorded in order to measure mean HR and HRV parameters. Mean HR and HRV data from a 2 min eyes-closed resting state, in an alternating eyes-closed/eyes-open paradigm, were analysed 30 min after capsule ingestion. HRV was analysed in the frequency domain, specifically low-frequency (LF; 0.04 - 0.15 Hz) and high-frequency (HF; 0.15 - 0.40 Hz) power.

Results: A univariate MANOVA was conducted to analyse any significant differences between the placebo and caffeine condition using mean HR, and the log transformed values of LF HRV and HF HRV. Results from the analyses indicated that there was no significant difference between the caffeine and placebo condition in mean heart rate, low frequency HRV, or high frequency HRV (all $p \geq .493$).

Conclusions: Findings from this study suggest that caffeine has no effects on mean heart rate, LF HRV or HF HRV. The non-significant results are consistent with recent heart rate and HRV studies on caffeine. A possible explanation for no significant differences could be due to the body attempting to establish a sympathovagal equilibrium after consumption of caffeine. However, sex differences and sleep quality were not controlled, both of which are potential confounds in HRV research and can possibly explain the inconsistency in findings in the literature. Further research needs to consider controlling for confounds identified in this investigation, in order to establish a standard methodology for caffeine research and to allow for better comparison of studies. Results from this investigation suggest that caffeine is not a confound in the case of cardiovascular measures.

The relationships between expressed emotion and EEG alpha asymmetry

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Aims: Expressed emotion (EE), is a rating of criticism, hostility, and emotional over-involvement expressed by family towards a person with or at risk of mental health problems. Evidence suggests that perceived EE is one of the major psychological stressors and it predicts clinical outcomes in various psychological disorders. However, these observations are predominantly based upon correlations, and the psychophysiological mechanism underlying this link needs to be clearly delineated. The aim of this research was to investigate the relationship between frontal alpha asymmetry (FAA) and subjective ratings of criticism.

Method: Using a repeated-measures design, non-clinical participants (n=26) were asked to listen to one of three categories auditory comment (criticism, neutral or praise), in a random order (counterbalanced) through headphones and rate the arousal (emotionally demanding) and relevance of the comments on an 11-point Likert scale. Resting EEG were recorded prior to and following the auditory comments.

Results: No significant change in FAA was found. However, FAA were negatively correlated with self-report anxiety.

Conclusions: Our findings suggest that criticisms expressed by audio comments may not be explicitly perceived as an acute emotional stressor in healthy participants, at least when the comment is made by a person lacking personal connections.

fNIRS Exploration of Frontal Haemoglobin Oxygenation Levels During Mind Wandering

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Aims: Prefrontal cortex activity has been measured using functional near-infrared spectroscopy (fNIRS) to detect haemoglobin oxygenation levels. Electroencephalographic (EEG) research reports prefrontal theta/beta ratio reductions during mind wandering (MW). The present pilot study aimed to explore prefrontal cortical activity in MW using fNIRS to detect haemoglobin oxygenation levels when the concurrent use of EEG limits optode placement. We employed a breath-counting paradigm and predicted that MW would be associated with reductions in frontal oxygenated haemoglobin, followed by a return to baseline as counting resumed, with no hemispheric difference.

Method: The present study employed fNIRS to measure oxygenated haemoglobin (02Hb) as a percentage of total haemoglobin (02Hb and deoxygenated haemoglobin, HHb), expressed as the tissue saturation index (TSI). Two fNIRS devices were positioned over the left and right hemispheres, with receivers at AF9 and AF10 and transmitters at AF7 and AF8. TSI change thus reflects activity in Brodmann's area 45. A lowpass fifth order 0.18Hz Butterworth filter was applied to the data to reduce respiratory and heartbeat contaminations. The 20 min breath-counting task required the participant to sit with eyes closed in a darkened room and count breath cycles, restarting the count after reaching 10. If the count was lost, exceeded 10, or was uncertain, the participant pressed a button indicating MW and restarted the count. TSI was analysed within a time window of 20 s pre and post each button-press. One subject completed two 20 min blocks in each of four weekly sessions, totalling eight blocks.

Results: The mean number of button press indications across all blocks was 7, with a maximum of 11, a minimum of 4, and 56 total. Mean MW TSI profiles were analysed for the eight blocks, and a reduction in TSI was apparent before the button press, signalling recognition of MW. Maximum pre-response TSI in the -10 s to 0 s period was compared with minimum response TSI in the -5 s to 5 s period, and a significant reduction was found in each hemisphere. Response magnitude (minimum response TSI subtracted from pre-response maximum TSI) was compared between the hemispheres; no significant difference was found. Mean pre-response TSI in the -20 s to -5 s period was compared with mean post-response TSI in the 12.5 s to 20 s period, and no significant difference was found in either hemisphere.

Conclusions: Results were in line with our predictions. Frontal oxygenation levels decreased during MW before returning to baseline, and no hemispheric difference was present. Results suggest that fNIRS reliably measures frontal oxygenation when the presence of electrodes limits optode placement, and there is no difference in frontal activity between the hemispheres. It is unclear whether these results reflect MW alone or include button-press effects. Future research may benefit by adding a tapping task to address alternate sources of frontal haemoglobin de-oxygenation. The simultaneous use of fNIRS and EEG may aid future research.