

Abstracts From Peer-Reviewed Presentations at the Australasian Cognitive Neurosciences Conference (21st meeting of the Australasian Society for Psychophysiology), December 9-12, 2012, Macquarie University, Sydney, Australia

Clinical EEG and Neuroscience
43(3) 215-250
© EEG and Clinical Neuroscience Society (ECNS) 2012
Reprints and permission:
sagepub.com/journalsPermissions.nav
DOI: 10.1177/1550059412444821
http://eeg.sagepub.com


Keynote Presentations

The Prospective Brain: Using the Past to Imagine the Future

Donna Rose Addis¹

¹Department of Psychology, The University of Auckland

Recently, traditional theories of episodic memory have been extended to consider the role of memory in future thinking. In particular, patient and neuroimaging research suggests that episodic memory and associated neural structures such as the hippocampus may play a critical role in future simulation. I will describe a number of studies that examine how flexible and constructive memory processes, supported by the hippocampus and associated networks, allow us to construct detailed simulations that serve to guide and enhance our future behaviours.

Limits of Subliminal Processing and Signatures of Conscious Access

Stanislas Dehaene¹

¹INSERM-CEA Cognitive Neuroimaging Unit, Collège de France

The nature of conscious processing can be investigated by presenting subjects with stimuli below, at, or above the threshold for conscious reportability, and evaluating how their cognitive and cerebral processing differs. I will present new experiments that, on the one hand, extend the known limits of subliminal processing and, on the other hand, reveal specific processes that can only be deployed consciously. The results suggest that, non-consciously, evidence can be accrued in parallel and from multiple target stimuli, thus biasing even complex cognitive processes (e.g. addition or averaging). However, conscious processing is characterised by the flexible deployment of strategic top-down processes. Neural signatures of conscious processing are characterised by long-lasting and long-distance interactions in the beta and alpha frequency bands, compatible with the theory of a global neuronal workspace for conscious processing.

Temporal Processing in Neurodevelopmental Disorders Revisited

Joel B. Talcott¹

¹School of Life and Health Sciences, Aston University

Many neurodevelopmental disorders are characterised by a constellation of symptoms that extend well beyond the core cognitive deficit and which overlap highly with diagnostic features associated with presumed independent disorder phenotypes. One such instance of symptom overlap is a deficit in the perception and processing of those temporal dimensions of stimuli that occur on a timescale of milliseconds. Deficits of this kind are frequently reported in neurodevelopmental disorders. However, the effect-size correlations between measures of this construct and the core cognitive and behavioural symptoms of the disorder are rarely as large as those demonstrated in comparisons between deficit and non-deficit groups. This suggests that stimulus timing, a generic functional property of the nervous system, may help to explain the high diagnostic comorbidity of some of these neurodevelopmental disorders, though perhaps less so their unique symptom sets. Using developmental dyslexia and co-morbid disorders as a model, this presentation will evaluate some of central methodological and theoretical issues for current research and for future investigations of temporal processing deficits as candidate endophenotypes of developmental disorder.

Neural Oscillations in Schizophrenia and during Brain Development: Perspectives From Magnetoencephalography

Peter J. Uhlhaas¹

¹Department of Neurophysiology, Max-Planck Institute for Brain Research

Neural oscillations and their synchronisation may represent a versatile signal to realise flexible communication within and between cortical areas. By now, there is extensive evidence

to suggest that cognitive functions depending on the coordination of distributed neural responses, such as perceptual grouping, attention-dependent stimulus selection, working memory and consciousness, are associated with synchronised oscillatory activity. In addition to their role in normal brain functioning, there is increasing evidence that altered oscillatory activity may be associated with certain neuropsychiatric disorders, such as schizophrenia. In this lecture, I will summarise our recent work with Magnetoencephalography (MEG) which has examined the role of neural oscillations in the pathophysiology of schizophrenia and during brain development, particularly during adolescence. Perspectives for future research will be discussed in relationship to methodological issues, the utility of neural oscillations as a biomarker and the neurodevelopmental hypothesis of schizophrenia.

Measuring Auditory Processing in Children - Is MEG or Psychophysics Better?

Caroline Witton¹

¹Wellcome Trust Lab for MEG Studies, Aston Brain Centre, Aston University

There have been a large number of studies exploring links between auditory processing and language development in children. A potential limitation of psychophysical studies is that they depend on the compliance, working memory, and attentional skills of the child; and this may be especially problematic when investigating special populations. Magnetoencephalography (MEG) provides a potential alternative, allowing the noninvasive measurement of brain responses to sensory stimuli; but few MEG studies measure sensory thresholds in the way that psychophysical studies can. This talk will explore the relative merits of each approach, using data from auditory gap detection tasks - a pure measure of auditory temporal processing - in groups of children with and without literacy impairments. Approaches to extracting a 'threshold' measure from MEG data will be explored, and some important considerations for MEG experimental design will be discussed.

Symposia Abstracts

Neural Basis of Individual Differences in Cognitive and Behavioural Control

Chair: Frini Karayanidis

Mapping Individual Variability in Cognitive Flexibility: Converging Evidence from Cognitive Models of Behaviour, ERP and fMRI Measures

Frini Karayanidis^{1,2}, Elise Mansfield^{1,2}, Lisa Whitson^{1,2}, Andrew Heathcote^{2,3}, Patricia Michie^{1,2}, Birte Forstmann⁴

¹Functional Neuroimaging Laboratory, School of Psychology, University of Newcastle

²Brain and Mental Health Research Centre, University of Newcastle

³Newcastle Cognition Lab, School of Psychology, University of Newcastle

⁴Cognitive Science Center Amsterdam, University of Amsterdam

Task switching requires the ability to flexibly and efficiently shift between two or more tasks using contextual cues. Typically, performance is poorer on repeat trials in mixed-task blocks than single-task blocks (*mixing cost*) and on switch than repeat trials in mixed-task blocks (*switch cost*). Both costs vary as a function of opportunity for advance preparation, interference between task sets, task exposure and age. We show that, in young adults, task-switching performance is affected by individual variability in response threshold, a parameter derived from evidence accumulation models which represents the amount of information that needs to be accumulated before a decision can be made. Response threshold was linked to differential preparatory adjustment for a switch or repeat trial and was associated with activation in frontostriatal networks involved in decision making. Consistent with an age-related decline in cognitive flexibility, young adults flexibly adjusted response criterion from trial-to-trial, whereas older adults maintained a high criterion for all trials. This age-related decline in the ability to flexibly adjust response cautiousness was associated with reduced proactive control, as measured by cue-locked ERPs, and slowing of decision processes in task-switching.

Controlling the Impulse for Reward: The Neural Mechanisms Underlying Cognitive Control over Reward in Healthy and Opiate Dependent Participants

Rob Hester¹

¹Dept. of Psychological Sciences, University of Melbourne

Dependent drug users show a diminished neural response to punishment, in both limbic and cortical regions, though it remains unclear how such changes influence cognitive processes critical to the maintenance of addiction, such as cognitive control. We were particularly interested in examining the neural mechanism underlying control over a rewarding response, to examine the interaction between limbic and cognitive networks that is particularly relevant to addiction. Findings from two recent fMRI studies will be presented, examining the neural mechanisms underlying cognitive control in two novel paradigms that manipulated conditions of reward and punishment, in dependent opiate users and matched healthy controls. The dyscontrol identified in opiate users, including marked insensitivity to punishment and the failure to adapt performance following aversive outcomes, will be discussed in terms of the implications for treatment interventions.

The Neural Basis of Behavioural Control in Adults Diagnosed with Schizophrenia and Children with Elevated Risk of Schizophrenia

Matthew E. Hughes^{1,2,3,4}, **Ross Fulham**^{3,4},
Patricia Michie^{2,3,4}, **Kristin Laurens**^{4,5,6}

¹Brain and Psychological Sciences Centre, Swinburne University of Technology

²Functional Neuroimaging Laboratory, School of Psychology, University of Newcastle

³Brain and Mental Health Research Centre, University of Newcastle

⁴Schizophrenia Research Institute

⁵Institute of Psychiatry, King's College London

⁶School of Psychiatry, University of New South Wales

The neuropsychological profile of patients with schizophrenia is marked by executive control impairments (Barch et al., 2009). Among the executive control functions, increasing research efforts have targeted *response inhibition* as it may underpin impairments associated with other functions. Response inhibition refers to the ability to interrupt planned or on-going thought and behaviour and is commonly studied using the stop-signal task (Logan & Cowan, 1984) as it permits estimation of the speed of response inhibition processes (stop-signal reaction time, SSRT). Investigators have observed impaired SSRT in several schizophrenia-spectrum groups, but little is known regarding the neural basis of this impairment. Here we report the findings of a combined fMRI and ERP study of stop-signal task performance in adults with schizophrenia compared to healthy controls matched for age, sex and education level. We found that SSRT and ERPs elicited by stop-signals were slower in patients with schizophrenia, and that the SSRT slowing could be explained by reduced activation of right inferior frontal gyrus in patients. Additionally, we report the preliminary behavioural findings of an fMRI study of stop-signal task performance in children who may be at elevated risk of developing schizophrenia compared to typically developing children.

When it All Goes Wrong: Error Processing Dysfunction During fMRI and ERP in Children at Risk for Schizophrenia

Kristin R. Laurens¹⁻³, **Gisela Sugranyes**¹, **Alexis E. Cullen**¹, **Sheilagh Hodgins**¹, **Robin M. Murray**¹,
Steven C. R. Williams¹, **Eric A. Taylor**¹

¹Institute of Psychiatry, King's College London, London, United Kingdom

²School of Psychiatry, University of New South Wales, NSW, Australia

³Schizophrenia Research Institute, NSW, Australia

The ability to process errors and modify subsequent behaviour reflects complex self-regulatory functions mediated in part by the anterior cingulate cortex (ACC). In schizophrenia, the early error negativity (Ne) and later error positivity (Pe) potentials elicited during ERP recording are reduced in amplitude relative to healthy adults, and fMRI indicates relative hyperactivity in caudal and rostral ACC during error processing. This study used ERP and fMRI techniques

to determine whether children at risk for developing schizophrenia present similar brain function abnormalities during processing of errors elicited by an error-inducing Go/NoGo paradigm. At-risk children aged 9-12 years who presented multiple antecedents of schizophrenia (ASz; n=22) were compared with typically-developing (TD; n=26) children who presented no antecedents. In spite of comparable behavioural performance, ASz children were characterised by reduced Ne, but not Pe, on error trials during ERP recording, as well as relative hyperactivity of caudal ACC compared to TD children during fMRI. This research implies that a subset of brain function abnormalities is present well prior to the emergence of illness, even in the context of preserved behavioural performance. Intervention aimed at preventing schizophrenia may be most effective if targeted at specific, but modifiable, functional impairments that present during childhood.

Current directions in MEG research

Chair: Blake Johnson

Atypical Brain Responses to Illusory Auditory Pitch in Children with Autism

Jon Brock¹, **Melanie Reid**², **Samantha Bzishvili**¹,
Michael Hautus³, **Blake W. Johnson**¹

¹ARC Centre of Excellence in Cognition and Its Disorders, Macquarie University

²National Acoustics Laboratory

³University of Auckland

Atypical auditory perception is widely reported in association with autism. In the current study, we recorded the brain responses of children with autism to dichotic pitch stimuli, in which inter-aural timing differences result in the illusory perception of a pitch sound spatially segregated from a carrier white noise. MEG responses of ten 8- to 12-year-old children with autism and ten age-matched typically developing children were recorded as they viewed a movie while ignoring the auditory stimuli. MEG data were projected onto sources in bilateral auditory cortex and event-related fields for a control stimulus (no inter-aural timing difference) were subtracted from responses to the illusory pitch stimulus. Children with autism evidenced a component in this difference waveform at around 50 ms, which was not present in the control group. The results demonstrate that individuals with autism are sensitive to inter-aural timing differences and provide further evidence for atypical auditory processing in at least some individuals on the autism spectrum.

MEG in Melbourne

David P. Crewther¹

¹Swinburne University of Technology

The culmination of a 7 year program of applications to various internal and external bodies sees the installation of the last of

the major neuroimaging equipment installations – an Elekta Neuromag TRIUX system at Swinburne. This complements the 3 T Siemens TIM Trio MRI/fMRI installed in June, as well as upgrades to EEG and systems and acquisition of TMS capability. The talk will outline current progress in multimodal imaging and will demonstrate aspects of similarity and difference in the achieving brain derived MEG signal isolation.

Specialised Applications of MEG: Measurement of Brain Function in Young Children and in Patients with Cochlear Implants

Blake Johnson¹, Graciela Tesan¹, Stephen Crain¹

¹ARC Centre of Excellence in Cognition and Its Disorders, Macquarie University

MEG is now well-established as a non-invasive tool for measuring human brain function. However conventional MEG instruments are not suited for use in a variety of populations. We describe two novel MEG systems: one that has been custom built for use with pre-school aged children; and another for use with cochlear implant patients. We will discuss the specific problems associated with neuromagnetic measurements in each of these populations; the engineering solutions and trade-offs implemented in each MEG system; and new avenues for research opened by these new instruments.

MEG and Neurodevelopmental Disorders

Caroline Witton¹

¹Aston Brain Centre

MEG is an ideal tool for noninvasively studying the developing brain, and holds great potential for understanding how the brain may develop atypically in certain neurodevelopmental disorders. Yet there are a number of challenges associated with recording from children's brains and interpreting the resulting data. This talk will explore some of these challenges and discuss some examples of how paediatric MEG data can be used to inform clinicians.

h (>60 Hz) Gamma-Band Oscillations in Autism Spectrum Disorders

Peter J. Uhlhaas¹

¹Department of Neurophysiology, Max-Planck Institute for Brain Research

Autism spectrum disorders (ASDs) constitute heterogeneous neurodevelopmental syndromes for which yet no unifying etiology has yet been identified. Earlier accounts attempted to explain the pathophysiology of ASDs in terms of circumscribed deficits in cortical functioning. In contrast, current theories and research converge on the notion that the clinical and cognitive phenotype of ASDs is most likely the result of a disconnection between cortical regions (Uhlhaas and Singer, 2006). From this perspective, the final common pathway of the etiology of ASDs is abnormal cortico-cortical

connectivity. One possible mechanism to account for the observed deficits in anatomy, neuropsychology and brain activation in ASDs is neural synchrony (Uhlhaas and Singer, 2006, 2007). To examine this hypothesis, we investigated gamma-band oscillations during the presentation of Mooney faces in participants with ASDs and healthy controls. Mooney faces are degraded pictures of human faces where all shades of gray are removed, thereby leaving the shadows rendered in black and the highlights in white. Magnetoencephalographic (MEG)-data were analysed for evoked and induced oscillatory activity in the frequency range of 25-160 Hz. Behavioural results showed that participants with ASDs were significantly impaired in detection rates and reactions times to stimuli in the face condition relative to controls, suggesting a specific impairment in Gestalt perception. Perceptual dysfunctions in ASDs were associated with pronounced reductions in gamma-band oscillations across a wide frequency range (30-120 Hz) over parietal and occipital sensors. Reduced gamma-band activity was found for the early evoked component as well as for induced oscillations, suggesting impairments in early sensory processing and top-down mediated perceptual integration. A source localisation with a beamforming approach allowed us to identify the generators of abnormal gamma-band oscillations during perceptual organisation in ASS. Participants with ASS were characterised by reduced gamma-band power in an extended network, including occipital, parietal and frontal regions. These data suggest close relations between the occurrence of gamma-band oscillations and perceptual dysfunctions in ASDs, suggesting that impaired high-frequency oscillations may represent a pathophysiological mechanism underlying cognitive and perceptual dysfunctions in ASDs.

Mismatch Negativity (MMN): Why it belongs in your cognitive neuroscience toolbox

Chair: Juanita Todd

Mismatch Negativity and Cognitive and Functional Impairment in the Schizophrenia Prodrome. Preliminary results from the Minds in Transition (MinT) Study

Rebekah Atkinson^{2,3,4}, Vaughan Carr^{1,2}, Scott Clark⁸, Jackie Curtis⁶, Robyn Langdon^{2,5}, Carmel Loughland^{2,3,4}, Pat Michie^{2,3,4}, Maryanne O'Donnell⁶, Georgie Paulik^{1,2}, Paul Rasser^{2,3,4}, Marc Seal⁹, Helen Stain^{2,3,4,11}, Renate Thienel^{2,3,4}, Juanita Todd^{2,3,4}, Paul Tooney^{2,3,4}, Phillip Ward¹, Thomas Weickert^{1,2,6}, Paul Thompson¹⁰, Ulrich Schall^{2,3,4}

¹Schizophrenia Research Institute

²University of New South Wales

³Centre for Brain & Mental Health Research, The University of Newcastle

⁴Hunter Medical Research Institute

⁵ARC Centre of Excellence in Cognition and Its Disorders, Macquarie University

⁶South Eastern Illawara Area Health Service

⁷Prince of Wales Medical Research Institute

⁸Greater Western Area Health Service

⁹University of Melbourne

¹⁰University of California

¹¹Centre for Rural & Remote Mental Health, University of Newcastle

This project aims to gain a greater understanding of the changes in the brains of young people when they are developing a severe mental illness and to investigate the utility of an electrophysiological index of auditory sensory memory (mismatch negativity) as a predictor of transition to a schizophrenia spectrum disorder. Young people attending youth mental health centres in Newcastle, Orange and Sydney will be recruited over a 3.5-year period. Those meeting ultra-high risk (UHR) criteria as determined according to the Comprehensive Assessment of At Risk Mental States, will be followed up over a 12-month period. At baseline clinical, electrophysiological recordings, high-resolution structural and DTI magnetic resonance brain images, neurocognition and social cognition data are collected, with follow-up data collected after 12-months. This preliminary report describes correlations between baseline MMN amplitude data and symptoms and cognitive functioning. To date, baseline data have been obtained on 40 UHR participants. These preliminary results indicate associations between duration MMN and functional status, duration MMN and auditory verbal memory and frequency MMN and cognitive flexibility. Results suggest duration MMN may be tapping into underlying temporal lobe mechanisms, while frequency MMN may be tapping into underlying frontal lobe mechanisms and such deficits are occurring during the prodrome phase.

Mismatch Negativity (MMN) and Sensory Auditory Processing in Children aged 9-12 years Presenting with Putative Antecedents of Schizophrenia

Jason M. Bruggemann^{1,2}, Helen V. Stockill³, Glenn L. Mould³, Sheilagh Hodgins³, Rhoshel K. Lenroot^{1,2}, Eric A. Taylor³, Robin M. Murray³, Kristin R. Laurens^{1,3,4}

¹School of Psychiatry, University of New South Wales

²Neuroscience Research Australia

³Institute of Psychiatry, King's College London

⁴Schizophrenia Research Institute

Identification of markers of abnormal brain function in children at-risk of schizophrenia may inform early intervention and prevention programs. Individuals with schizophrenia are characterised by attenuation of MMN amplitude, which indexes automatic auditory sensory processing. The current aim was to examine whether children who may be at increased risk of schizophrenia due to their presenting multiple putative antecedents of schizophrenia (ASz) are similarly characterised by MMN abnormalities, relative to typically developing (TD) children. EEG was recorded from 22 ASz and 24 TD children aged 9 to 12 years (matched on age, sex, and IQ) during a

passive auditory oddball task (15% duration deviant). ASz children were those presenting: (1) speech and/or motor development lags/problems; (2) internalising, externalising, and/or peer-relationship problems in the clinical range; and (3) psychotic-like experiences. TD children presented no antecedents. MMN amplitude, but not latency, was significantly greater frontally in the ASz group than in the TD group. While MMN abnormalities were present in children at risk of schizophrenia, the nature of this abnormality differed from that observed in adults with schizophrenia. This may reflect developmental and disease effects in a pre-prodromal phase of psychosis onset. Longitudinal follow-up is necessary to establish the developmental trajectory of MMN in at-risk children.

Chronic Effects of Cannabis use on the Auditory Mismatch Negativity (MMN)

Lisa-marie Greenwood¹, Samantha Broyd¹, Rodney Croft¹, Stuart Johnstone¹, Juanita Todd^{2,3}, Pat Michie^{2,3}, Nadia Solowij^{1,3}

¹School of Psychology, University of Wollongong

²School of Psychology and Priority Research Centre for Brain and Mental Health, University of Newcastle;

³Schizophrenia Research Institute

Cannabis use can trigger psychosis in vulnerable individuals. The auditory mismatch negativity (MMN) may be an index of vulnerability to psychosis and is associated with N-methyl-D-aspartate receptor (NMDAR) dysfunction. Cannabinoids modulate NMDAR functionality. Few studies have examined the effects of cannabis on the MMN. Long-term heavy cannabis users (n=42) and non-user controls (n=34) completed a multi-feature MMN paradigm with duration, frequency and intensity deviants (6% each). The MMN for each condition was extracted from difference waves between standards and deviants recorded at Fz. Cannabis use and symptomatic measures were examined in relation to MMN amplitude. Cannabis users showed smaller amplitude frequency MMN than controls (p=.023; marginally significant after Bonferroni adjustment). This was positively correlated with the age of onset of regular cannabis use and negatively with the quantity of cannabis smoked per month. Duration MMN amplitude correlated positively with positive symptom distress scores, but neither duration nor intensity MMN differed between groups. MMN amplitude was not greatly affected by chronic cannabis use, yet evidence for modulation according to age of onset and quantity of cannabis use (albeit in unexpected directions), suggests complex interactions in this otherwise healthy and carefully screened sample, the implications of which will be discussed.

Mismatch Negativity Study of Infant Siblings of Children With Autism

Jordy Kaufman¹, Angela Mayes¹, Sumie Leung¹, Joanne Tarasuik¹

¹Brain & Psychological Sciences Research Centre, Faculty of Life & Social Sciences; Swinburne University of Technology

In this presentation we describe research from the Swinburne Babylab investigating possible electrophysiological predictors of autism spectrum disorders in young infants (aged 4 to 14 months). Current data analysis reveals differences in duration mismatch negativity (MMN) amplitude when comparing 4-month-old ASD-siblings to a non at-risk group. The low-risk group shows an early slight negative MMN, whereas the high-risk group shows a larger positive response during this time over the same brain region. Also in the high-risk group, a large negative difference is apparent over the temporal region; this difference is not evident in the low-risk group. Similar patterns of brain activity are seen in infants tested at 14 months of age. This data along with measurements of gamma oscillatory activity strongly suggests that there are electrophysiological elements in the broader autism phenotype. Additional research needs to be done to determine the strength of this measure as a neuromarker that could lead to early diagnosis.

Using MMN for Tracking the basis for change in Cognitive Rehabilitation Programmes

S. Sharip¹, P. T. Michie¹, U. Schall², K. Drysdale¹, V. Case², R. Atkinson¹

¹School of Psychology, University of Newcastle

²Priority Centre for Brain & Mental Health Research, University of Newcastle

Cognitive training has been shown to be weakly to modestly effective in treating cognitive deficits in schizophrenia and healthy elderly. Information on whether improvement can be maintained, generalization of training as well as effects of training on brain neuroplasticity and learning skills in both groups, however, is still limited. Since mismatch negativity (MMN) has been recognized as an index for central auditory system plasticity, we investigated whether there are MMN changes following computerized cognitive rehabilitation using COGPACK. Twenty-two participants with schizophrenia/schizophrenia spectrum disorder and twenty-four healthy elderly underwent a battery of functional, neuropsychological and event-related potential (ERP) assessments at baseline, immediately after training and at 3 months follow-up. In schizophrenia, preliminary analysis indicates that MMN to frequency (but not duration or intensity) deviants in a passive oddball paradigm and N2 in an active paradigm increased after training and at 3-month follow-up. P300 was unaffected. Aging data are still being analysed. This is the first study investigating changes of ERP components following a cognitive remediation regime in schizophrenia. The preliminary findings of this study show that changes in MMN (and N2) can be used to monitor the effectiveness of such rehabilitation programs and possibly predict who will benefit.

Salience and the Mismatch Negativity (MMN)

Juanita Todd¹, Alexander Provost¹, Gavin Cooper¹

¹School of Psychology and Priority Research Centre for Brain and Mental Health, University of Newcastle; Schizophrenia Research Institute

Mismatch negativity (MMN) is automatically elicited to deviation from an established pattern of acoustic stimulation. Although the primary generators are located in auditory cortices, recent research and theoretical models emphasise a network involved in monitoring the environment for salient changes. In this study a simple two-tone sequence reveals how automatic salience attributions affect MMN size based on recent learning history. Twenty adults (18-39 years) were presented with sequences in which two tones (short and long) alternated roles as the regular standard ($p=0.875$) and rare deviant ($p=0.125$). The period over which a standard/deviant "rule" remained constant was varied over fast (0.8mins), medium (1.6mins) and slow change (2.4mins) conditions. Half the sample received a short-standard first order and half, long-standard first. A tone*condition*order interaction ($p<.05$) revealed a "primacy effect". MMN size to deviants incremented with rule stability but the data exposed a marked dependence on first rule. The short-standard first group produced a linear growth in (and overall larger) MMN to long-deviant tones while the long-standard first participants exhibited the opposite. The primacy effect exposes an order-dependent learning difference creating bias in the automatic filtering of sound relevance. Initial experience altered the perceived salience of subsequent events.

Using Decoding and Predictive Analysis Techniques to Investigate Cognitive and Perceptual Processing

Chair: Olivia Carter

Sensory Integration in the Rat Whisker System: Neuronal and Behavioural Performance in a Perceptual Decision Paradigm

J. Scott McDonald¹, Mehdi Adibi¹, Ehsan Arabzadeh¹

¹University of New South Wales

Perceptual decision making is often explained in terms of an integration process that accumulates sensory information over time towards a decision criterion. Here we investigate sensory integration in the whisker system; a highly efficient sensory apparatus that is actively used by rodents to navigate the environment. We designed a behavioural paradigm for vibro-tactile detection/discrimination. Rats initiated a trial by nose-poking into an aperture where their whiskers came into contact with two meshes. A continuous nose-poke triggered stimulus presentation. Rats indicated the target stimulus by choosing between two reward spouts. Stimuli consisted of either fixed-amplitude sine-waves or a sequence of discrete deflections of the mesh that increased linearly in amplitude over time. The target was the stimulus with the higher intensity. We further

compared the performance of rats with that of individual cortical neurons recorded in response to a similar stimulus set applied under anaesthesia. For fixed amplitude vibrations, neurons showed a characteristic sigmoidal response function, with an accelerating nonlinearity at low amplitudes. The behavioural performance followed the same trend as that of the population of individual neurons. For the ramp stimuli, rats' performance improved as a function of sampling duration and dropped with increasing task difficulty again paralleling neuronal performance.

Predicting Choices from Pupil Dilation 'eye-to-eye'

Olivia Carter¹

¹Psychological Sciences, University of Melbourne

A considerable body of animal research exists implicating a role for noradrenaline in behavioral/motor decision-making. Based on the known link between noradrenaline release and pupil dilation, we conducted a series of studies using pupil dilation to investigate the role of noradrenaline in perceptual and cognitive decisions. We first asked people to mentally select a number from a stream of 5 digits presented on a monitor. We then used a computer algorithm to confirm that pupil dilation does indeed occur at the time of a decision and that this can be used to predict a person's decision before they report it. This led us to speculate whether the pupil dilation signal could be detected by human observers and used to their advantage in a real-world scenario. To test this we adapted the simple childhood game of rock-paper-scissors and found that untrained observers were able to increase their chance of winning by an average of 50%. Performance was improved, both when participants were presented the entire eye, or a reconstructed image of the pupil surface with all other facial cues removed. This data will be discussed both in respect to the neuropharmacology of decision-making and to possible implications for social neuroscience.

Visual Consciousness Tracked with Direct Intracranial Recording from early Visual Cortices in Humans

Naotsugu Tsuchiya¹

¹Japan Science and Technology Agency, Japan; Advanced Telecommunication Research, Japan; RIKEN, Japan, Caltech, USA

A fundamental question in neuroscience is how neuronal representations are related to conscious experience. Two key questions are: where in the brain such representations are located, and at what point in time they correlate with conscious experience. A hotly debated question is whether primary visual cortex contributes to visual consciousness, or whether higher-order cortices only contribute to it. Here we investigated this issue by recording directly from early visual cortex in three neurosurgical patients undergoing epilepsy monitoring with intracranial electrocorticogram (ECoG) electrodes. We used Continuous Flash Suppression (CFS) to investigate the time

course of when 'invisible' stimuli broke interocular suppression. Participants were asked to watch faces presented under CFS, to push a button when they started to see any part of the face, and then to indicate its spatial location. This occurred over several seconds. During the task performance we recorded intracranial ECoG at high spatiotemporal resolution from all contacts in parallel. We used multivariate decoding techniques and found that the location of the invisible face stimulus became decodable from neuronal activity 1.8 sec before the subject's button press. We will discuss the neuronal dynamics associated with the break of inter-ocular suppression.

Decoding what the brain 'sees' independent of what the person 'sees'

Mark A. Williams¹

¹ARC Centre of Excellence in Cognition and Its Disorders, Macquarie University

Multi-voxel pattern analysis techniques allow us to infer what the brain encodes from neuroimaging scans. During scanning we briefly present stimuli to participants to examine neural responses to seen and unseen stimuli. We then examine the accuracy of a support vector machine to classify the stimulus category based on the pattern of neural activity. Previously we have shown patterns in particular brain regions involved in visual perception of novel objects carry information that corresponds to behavioral performance. Although the spatial pattern in both retinotopic and lateral occipital cortex (LOC) in humans contains information about the category of an object, only in the LOC is the neural pattern stronger for correct than for incorrect trials. This dissociation between early visual and higher visual areas demonstrates the way in which the brain encodes novel objects, with a particular role for LOC in determining behavioural responses. Here we examined the neural patterns to seen and unseen 'real' objects, faces and scenes. Interestingly the areas of the brain that encode these unseen stimuli include regions of the temporal lobe, much further along the processing stream than LOC. This suggests that unseen familiar stimuli are processed at a higher level than unseen novel stimuli.

Can Animal Models inform our Understanding of Traditional Human Psychophysiological Measures?

Chair: Patricia Michie

Auditory Event-Related Potentials (ERPs) in the rat to Rapid Sound Presentation: Identification of Human Homologies

Timothy W. Budd^{1,2}, Tamo Nakamura^{1,2}, Patricia Michie^{1,2}, William R. Fulham^{1,2}, Michael Hunter¹, Ulrich Schall^{1,2}, Deborah M. Hodgson^{1,2}

¹School of Psychology, The University of Newcastle

²Schizophrenia Research Institute

One of the major benefits of comparative ERP research is the potential to enhance our understanding of the neural basis of ERP measures in healthy populations as well as the alterations in ERPs in clinical populations such as schizophrenia. An important prerequisite for achieving this is the identification of ERP homologues in animal models. Prior auditory ERP research in the rat has identified some striking similarities between rat and human ERPs in terms of morphology, latency and sensitivity to stimulus interval and repetition. Despite this very little is known about the correspondence between the major components of human and rat ERP. This research uses parametric variations in stimulus interval that prior research has shown to differentially influence human auditory ERP components. Typically the human N1 and P2 components become progressively reduced as stimulus interval is decreased. However, at shorter intervals the N1 becomes paradoxically larger while the P2 remains unaffected. Results from a study in 12 adult rats will be presented which found no 'enhancements' of the rat auditory ERP components using similar experimental procedures and analyses as used in ERP studies in humans. These results are discussed in terms of the possible relationship between human and rat auditory ERPs.

Autonomic Changes in the Rat During Psychological Stress: Central Control

Pascal Carive¹

¹School of Medical Sciences, University of New South Wales

Conditioned fear to context is a pure form of psychological stress. In the rat, it is a good model to study the central pathways mediating the autonomic response to fear and anxiety. The cardiovascular response of conditioned fear in the rat (recorded by radiotelemetry) is characterised by an increase in mean arterial pressure (MAP, +25 mmHg), an increase in heart rate (+100 bpm) and a marked skin vasoconstriction in the tail (recorded by infrared thermography). The characteristic behavioural response is a freezing immobility. Anatomical experiments using the marker of neuronal activation c-Fos have revealed two important subcortical structures that are activated during conditioned fear: the dorsal tuberal hypothalamus (DTH) and the ventrolateral periaqueductal gray (VLPAG) in the midbrain. Physiological experiments using excitotoxic lesions or microinjection of neuronal blockers, indicate that the DTH, including the orexin neurons of the perifornical area, are crucial for the expression of the increase in blood pressure and heart rate while the tail skin vasoconstriction is mediated by the VLPAG. The VLPAG also mediates the freezing immobility response of conditioned fear. Although this remains to be verified, it is very likely that the same central network is activated in stressed and anxious humans.

Overt Language Production in fMRI

Chair: Hana Burianová

fMRI Evidence for Rival Models of Spoken Word Production

Greig de Zubicaray¹

¹School of Psychology, University of Queensland

Forty years of psycholinguistic research have demonstrated that saying a word, the most fundamental task in speaking, requires selecting from among a set of activated word candidates. Theories of spoken word production need to identify the nature of these candidates as well as the degree to which they interfere with target word production. We tested hypotheses from rival input and output accounts in two fMRI experiments using the picture-word interference (PWI) paradigm, in which participants named pictures with superimposed distractors that were high or low in frequency or varied in terms of age-of-acquisition (AoA). The distractor frequency effect (Experiment 1) was associated with increased activity in pre-motor and posterior superior temporal cortices, consistent with the operation of an articulatory response buffer and verbal self-monitoring system. Conversely, the distractor AoA effect (Experiment 2) was associated with increased activity in the left mid- and posterior-middle temporal cortex, consistent with the operation of lexical level processes such as lemma and phonological word form retrieval. The results support a post-lexical locus for the distractor frequency effect (Miozzo & Caramazza, 2003), and a lexical locus for the distractor AoA effect (Belke, Brysbaert, Meyer, & Ghyselinck, 2005). Thus, although hypotheses from two rival accounts of distractor interference in PWI were supported in each experiment, neither account is capable of providing a complete explanation.

Overcoming Susceptibility Artifacts from overt Speech using Arterial Spin Labelling

Julia Hocking¹

¹Center for Advanced Imaging, University of Queensland

The use of overt speech in conventional fMRI experiments is problematic due to the introduction of susceptibility artifacts. For example, speech-related movement causes signal changes in brain regions close to tissue boundaries. This can lead to false-positive results, where activation due to movement-related artifactual signal changes mimics task-related blood oxygen level dependent (BOLD) activation. Although covert speech is often used as a method to overcome these difficulties, there are reliable differences in activation patterns between overt and covert speech, and monitoring behaviour to ensure a participant is carrying out the required task during scanning is not possible. In this talk, I will discuss one method to overcome these difficulties: the use of perfusion-based Arterial Spin Labelling (ASL) fMRI as an alternative to BOLD contrast. ASL does not depend on susceptibility effects for contrast and is thus not influenced by overt speech artifacts. Moreover, ASL provides a direct rather than indirect measure of cerebral

blood flow. Experimental design, data acquisition and analysis methods for anyone wishing to use ASL will be presented.

Methodology for imaging language

Katie McMahon¹

¹Center for Advanced Imaging, University of Queensland

The successful imaging of language production involves a good understanding of the various methods that are available. This talk shall examine the physics behind the common techniques, such as SPARSE, BIG and continuous BOLD. The pros and cons of each will be discussed, as well as arterial spin labeling, which is an alternative method to BOLD. Each technique needs a specific approach when analysing the data. Additional MR compatible equipment is also needed, dependent upon the type of paradigm being implemented.

Other Presentations

Enhanced Startle Inhibition at Long Lead Intervals in a Spatial Cueing Task

Sakinah S. J. Alhadad¹, Ottmar V. Lipp¹

¹School of Psychology, University of Queensland

Short lead interval blink inhibition is an effect that decreases with increasing lead interval. Experiment 1 assessed startle modulation in a modified spatial cueing task with directional (80% valid) or neutral cues. Acoustic startle was elicited 120 and 800 ms after the onset of the 1 s cues. Startle inhibition did not differ between cue types. Unexpectedly, startle inhibition was larger at the 800 ms lead interval than at the 120 ms lead interval. Maximal inhibition of acoustic startle during visual stimuli has been shown to occur later (180 ms) than during acoustic stimuli (120 ms), though no evidence of enhanced inhibition has been shown to occur as late as 800 ms. Experiment 2 assessed whether this pattern of results reflected two distinct inhibitory processes, prepulse inhibition and target anticipation, or a unitary extended inhibition and whether it covaries with task demands. Startles were elicited at 120, 600, and 800 ms after stimulus onset during directional and neutral cues and during “NoGo” cues that did not require a response. Startle magnitude decreased linearly across lead intervals during directional and neutral cues, but remained unchanged across the lead intervals during the “NoGo” cues. These results indicate that target anticipation in a demanding task can result in blink startle inhibition that extends beyond the time window in which prepulse inhibition is usually observed.

Effective Processing of Masked Eye Gazes Requires Volitional Control

Shahd Al-Janabi¹, Matthew Finkbeiner¹

¹ARC Centre of Excellence in Cognition and its Disorders, Macquarie University

The aim of the present study was to investigate whether the validity effect produced by gaze cues should be ascribed solely to reflexive, bottom-up mechanisms or to volitional, top-down mechanisms. We find, in a central cueing paradigm, that masked eye gaze cues can indeed produce a validity effect; however, the efficacy of these masked gaze cues is sharply constrained by experimental context. Specifically, masked gaze cues only produced a validity effect when they appeared in the context of unmasked (clearly visible) and predictive gaze cues. In contrast, unmasked gaze cues produced reliable validity effects independent of experimental context, including Experiment 4 wherein 80% of the cues were invalid (i.e. counter-predictive). Collectively, these results suggest that the effective processing of masked gaze cues requires volitional control, whereas the processing of unmasked gaze cues benefits from both reflexive and top-down mechanisms.

Behavioural and MEG Studies of Perception of Low Spatial Frequency Faces

Bhuvanesh Awasthi¹, Paul F. Sowman¹, Jason Friedman¹, Mark A. Williams¹

¹ARC Centre of Excellence in Cognition and its Disorders, Macquarie University

A pivotal issue in the field of cognitive neuroscience of face perception has centered on the extraction and processing of relevant information from the visual environment. Previous research has documented distinct spatial frequency (SF) channels that process incoming visual information with selective properties. Low spatial frequency (LSF) is reported to support configural (global) processing while high spatial frequency (HSF) information aids fine-grained, featural (local) processing. While most research addresses individual roles of the SF scales (using just one SF band at a time), issues regarding the integration of these scales have remained unexplored. In order to better understand how faces are processed by the visual system, it is necessary to determine the relative contribution of LSF and HSF scales in the perception of faces. Recently, through a series of categorisation experiments, we demonstrated interference by LSF information while reaching for HSF targets. We also established the LSF supports stronger, faster and lateralised perception of faces. Magnetoencephalography (MEG) was then used to further probe the temporal and neural markers of LSF and HSF information processing the faces. Collated findings from the behavioural and MEG studies will be discussed in the context of the role of LSF in face processing.

Lateralisation of Language and Spatial Skills is not Affected by Task Difficulty: A Functional Transcranial Doppler Ultrasonography Investigation

Nicholas Badcock^{1,2}, Abigail Nye³, Richard Rosch⁴, Dorothy V. M. Bishop²

¹ARC Centre of Excellence in Cognition and Its Disorders

²Department of Experimental Psychology, University of Oxford

³Trinity College, University of Oxford

⁴Magdalen College, University of Oxford

We used functional transcranial Doppler ultrasonography (fTCD) to assess the effect of task difficulty on cerebral lateralisation during language and spatial tasks in typical adults. Auditory naming was used to examine language lateralisation: participants were presented with short auditory definition and asked to provide a speeded, verbal, single-word response of the defined word. Difficulty was manipulated by varying word frequency. A modified land-mark task was used to examine spatial lateralisation: participants were presented with series of backward-masked, inverted 'T' displays and asked to make a speeded response as to the left or right position of the vertical line. Difficulty was manipulated by the presentation duration and proximity of the vertical line to the centre of the display. Behavioural responses were consistent with the difficulty manipulations; for auditory naming, accuracy was higher and response times were faster for high frequency words; for the land-mark task, accuracy was higher and response times were faster for long presentation durations and wider spatial proximities. Despite the expected behavioural differentiation, fTCD lateralisation was not influenced by task difficulty for either ability.

Time-Frequency Analysis of EEG Activity and the Orienting Reflex to Auditory Stimuli

Robert J. Barry¹, Genevieve Z. Steiner¹, Frances M. De Blasio¹

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

EEG alpha desynchronisation was discussed in Sokolov's classic works as a measure of the Orienting Reflect (OR). Our early alpha desynchronisation studies found decremental trial effects with repeated auditory stimulation, but no intensity or significant effects. Recent advances in time-frequency analysis of event-related EEG oscillations have simplified such investigations, and increased data precision. Hence we presented a habituation series of innocuous tones at 5-7 s SOA: 10 standards; a change in frequency at trial 11; and a return to the standards at trials 12 and 13. These were presented under counterbalanced indifferent and significance (counting) conditions. Electrodermal responses (SCRs) showed decrement over the first 10 trials, recovery at the change, dishabituation at trial 12, and a main effect of significance. Subsequently this SCR pattern was used as our OR model to evaluate midline responses in EOG-corrected EEG. Event-related synchronisation (ERS) in four classic EEG bands was followed by desynchronisation (ERD) in all but delta. Decrement over trials, and response recovery, were substantial for ERS (in delta, theta, alpha) and ERD (in theta, alpha, beta). There were few effects of significance, and little evidence of dishabituation. The patterns of results are discussed in relation to Preliminary Process Theory of the OR.

What is Primed in Repeating the Target Feature Versus the Target Dimension: Attention or Response Selection?

Stefanie Becker¹

¹School of Psychology, The University of Queensland

In visual search for a pop-out target, response times are faster when the target feature repeats across trials than when it changes. Similar intertrial switch costs occur also when the stimulus dimension of the target changes (e.g., target differing in size and then colour from irrelevant items). A hotly debated question is whether these intertrial switch costs originate from an attentional bias to select the previously selected item, or from a response selection bias (to respond in the same way to same-dimension targets). The present study compared intertrial effects of changing the target feature versus the target dimension in an EEG and fMRI experiment. The results show that feature priming effects are indeed due to an attentional bias, as reflected in significant differences in the N2pc and BOLD signal changes in brain regions associated with the attention network. However, across-dimension switch costs are characterised by differences in the response-locked LRPs and brain regions that are not part of the attentional network, indicating that changes of the target dimension incur costs at the level of response selection.

Event-Related EEG Suggests Modality Rather than Material Specific Memory Lateralisation

Adam Bentvelzen¹, Genevieve McArthur¹, Blake Johnson¹, Megan Willis³, Stuart Lee⁴, Greg Savage^{1,2}

¹ARC Centre of Excellence in Cognition and its Disorders, Macquarie University

²Department of Psychology, Macquarie University

³Australian College of Applied Psychology

⁴Monash Alfred Psychiatry Research Centre, Monash University

Material-specific memory impairment can be observed in patients with unilateral temporal lobe dysfunction. Measures of verbal memory appear to predict memory loss with left temporal lobe damage, but nonverbal measures are poor predictors of memory impairment with right temporal lobe damage. Typically, cognitive neuroscience models of right hemisphere processing have not informed test development. Putatively "nonverbal" tasks are also frequently verbalisable, confounding their specificity to the right hemisphere. We measured event-related EEG during recognition memory in 24 healthy subjects. These measures were taken during learning of visually presented nonwords, auditorily presented (different) nonwords, and then cross-modal paired associations of the two. Similarly, measures were taken during learning of dot patterns, novel melodies, and then pairings. It was found that learning dot patterns was related to greater event-related desynchronisation in the right hemisphere, while auditory nonwords demonstrated a left hemisphere bias. Surprisingly, hemispheric biases to the right were shown by visual nonwords and to the left by

melodies, suggesting that the modality (visual or auditory) of novel materials has a stronger effect on hemispheric lateralisation than the material (verbal or nonverbal). Consistent with this view, crossmodal tasks lacked lateralisation. Findings from this study will guide development of clinical test materials.

Do kids see what adults see? A transient disadvantage

J. H. Bridie¹, R. Laycock¹, C. L. Hoysted¹, A. L. Shilton¹, A. Brown¹, D. P. Crewther¹, N. Goharpey¹, M. J. Murphy¹, S. G. Crewther¹

¹School of Psychological Science, La Trobe University

Electrophysiological and psychophysical evidence indicates a different developmental trajectory between the dorsal and ventral visual streams. To date it is not clear what impact a late-developing dorsal visual stream has on object recognition, given its suggested role in activating bottom-up attention mechanisms, prior to ventral-stream processing. Young-children (aged 4-9), older-children (aged 10-13) and adults (aged 18-30) were compared on a measure of the involvement of dorsal-stream driven attention-mechanisms in a traditionally ventrally-dominated object-recognition contrast-sensitivity task. Object presentation was modulated by abrupt (dorsal plus ventral) or ramped (ventral only) onset/offset conditions. A measure of the 'transient advantage' was determined as the difference between ramped and abrupt threshold scores. Results indicated a positive 'transient-advantage' (superior abrupt versus ramped performance) for older-children compared to a negative 'transient-advantage' in young-children. Interestingly, whilst adults outperformed both child groups in object-recognition per se, the transient-advantage was less than for older-children. These findings suggest that in young children an immature dorsal visual pathway may heighten reliance on ventral visual processing, and implies a reduced ability in directing attention to transient events.

Generalisation of Training of Global Visual Perception in Autism

Alyse Brown¹, David Crewther¹

¹Brain Sciences Institute, Swinburne University of Technology

This study examined the effects of global training on global/local processing in children (ages 7-11 yr) with Autism Spectrum Disorders (ASD) compared with matched controls. Diamond Illusion (percent global), Coherent Dot Motion threshold, a Simple/Complex form task (recognition and global/local inspection times) were measured at base line and after training using a novel computer game (Jack the Shark) in which a great white shark tried to eat as many fish as possible while avoiding global shapes made of little fish and coloured poisonous fish. This study was also designed to evaluate Magnocellular and Parvocellular processing by recording non-linear achromatic VEPs at high and low contrast. It was hypothesised that the ASD group would have poorer global processing

compared to the control group and that the training period would improve both groups' performances on the tasks' global aspects. The most interesting results came from the new Simple/Complex figures where the ASD group's performance was highly influenced by IQ. Lower scores resulted in slower global inspection times, however this relationship was not evident in the control group or the local inspection time. The VEP analysis showed considerably weaker parvocellular derived non-linearities at high contrast in the ASD group, possibly indicative of enhanced occipital processing efficiency.

Autistic Traits and Eye-Movements During Reading

Nathan Caruana¹, Jon Brock¹

¹ARC Centre of Excellence in Cognition and its Disorders, Macquarie University

According to the Weak Central Coherence (WCC) theory of autism, autistic individuals maintain a reduced ability to process contextual information. This theory has been proposed to explain the widely proposed reading comprehension difficulties of autistic individuals, and in particular, their problems in resolving lexically ambiguous words (homographs). The main aim of the current study was to develop eye-tracking measures that could be applied to future studies of reading skill in autism, as a test of the WCC account. Seventy-one undergraduates were assessed using two eye-tracking paradigms. Participants also completed measures of reading fluency and vocabulary knowledge, as well as the Autism Quotient (AQ), which captures individual variations in subclinical autistic traits. Significant effects of contextual facilitation on fixation times were observed as predicted, but did not interact with scores on the AQ. We also found a significant increase in fixation time for words that disambiguated homographs earlier in the sentence. This effect interacted with AQ scores, indicating that individuals with more autistic traits had greater difficulty in integrating contextual information to resolve lexical ambiguity. These findings are encouraging for future research aims to assess WCC in autistic populations.

Beyond Colour Perception: Auditory Synaesthesia Elicits Visual Experience of Colour, Shape, and Spatial Location

Rocco Chiou¹, Marleen Stelte¹, Anina N Rich¹

¹ARC Centre of Excellence in Cognition and its Disorders, Macquarie University

Auditory-visual synaesthesia, a rare condition in which sounds evoke involuntary visual experiences, provides a window into how the brain normally combines audition and vision. Previous research primarily focuses on synaesthetic colour, but little is known about other synaesthetic visual features. Here we tested a group of synaesthetes for whom sounds elicit visual experience of 'geometric objects' comprising colour, shape, and spatial location. In an initial session, we presented sounds and asked synaesthetes to draw their synaesthetic experiences.

Changes in auditory pitch and timbre affect synaesthetic experience in a manner similar to the cross-modal correspondences of non-synaesthetes (high-pitched sounds are associated with brighter, smaller, and spatially higher objects). To objectively measure these experiences, we devised a cross-modal multi-feature synaesthetic interference paradigm. Synaesthete participants performed colour/shape discriminations. The results show mismatches between display images and synaesthetic features can significantly slow reaction times. Moreover, voluntary attention modulates cross-modal interference of synaesthetic features: Attending to one feature reduces the impact of another mismatching feature. Our findings go beyond the typical focus on colour perception by showing shape and location are integral parts of visual synaesthetic experience. The similarity between auditory-visual synaesthesia and normal cross-modal correspondences implies they rely on the same cognitive/neural mechanisms.

Getting to Know You: The Acquisition of New Face Representations in Autism Spectrum Conditions

Owen Churches¹, Cara Damiano², Simon Baron-Cohen³, Howard Ring³

¹University of South Australia

²University of North Carolina

³University of Cambridge

Behavioural studies of face perception suggest that the recognition of familiar faces is impaired in autism spectrum conditions but the results of event-related potential studies have been mixed. In the typical population, the N250 event-related potential component is larger to familiar faces than unfamiliar faces. Hence this component is a potential means for investigating the processing of face familiarity in autism spectrum conditions. Fifteen adults with autism spectrum conditions and fifteen typical controls were asked to remember a previously unfamiliar face. This face was then used as the target in an odd-ball sequence with seven non-target faces and participants indicated with a button press whether each face was the target. The autism spectrum conditions group showed a smaller N250 component to the target face than the typical control group, suggesting that the development of face familiarity is impaired. That a decreased N250 was found in this study but not in previous studies of face familiarity in autism spectrum conditions may be because this paradigm deliberately directed the attention of participants toward the relevant face. This suggests that the impairments in familiar face processing found in autism spectrum conditions may be due to decreased attentional modulation of individual face representations.

Biased Attention in Function hand space is Modulated by Task Demands

H. A. Coleman¹, A. Kritikos¹

¹Perception and Action, School of Psychology, University of Queensland

We conducted two experiments to examine how the representation of hand space modulates the shifting of exogenous visual spatial attention. In a Posner cueing paradigm with predictable lateral cues, participants detected (Experiment 1: N=63) or discriminated (Experiment 2: N=57) target via mouse-click. Participants positioned their hand near the monitor such that targets appearing on the monitor occurred in perihand space – specially either in the grasping space (palm) or non-grasping space (back) of their hand and in the opposite hemisphere. In the detection task, there was a stronger cuing effect (difference between valid and invalid response times) for the grasping space compared to the non-grasping space for targets appearing in the opposite space. In the discrimination task, there was a stronger cuing effect for the non-functional space of the hand irrespective of target location. These results indicate that the processing of stimuli in the function and non-functional space of hands is modulated by task demands.

Effects of Anodal tDCS over the Primary Motor Cortex on Motor Function and Response Mechanisms

Alexander Conley¹, Jodie Marquez¹, Mark Parsons¹, Jim Lagopoulos¹, Frini Karayanidis¹

¹Functional Neuroimaging Laboratory, University of Newcastle

We are investigating the effect of the application of anodal tDCS over the primary motor cortex in healthy older participants. Specifically, we are trying to see whether anodal tDCS intervention will elicit an increase in performance on functional and behavioural tasks. To this effect, 22 healthy right handed participants completed the Jebsen Taylor Hand Function Test (JTT) as well as a Cued Go/Nogo task, the latter recorded by EEG. Participants completed two sessions, in which they received both active and sham intervention, they were also split into two hemispheric groups (dominant and non-dominant). Sessions were separated by three weeks to avoid carry over effects. Functional, behavioural and electrophysiological data was analysed using a 4 way repeated measures ANOVA. Preliminary results indicate that while there was an effect of the stimulation on performance, the effect that was found differed between the two hemispheric groups. In particular, participants who received stimulation over their non-dominant hemisphere experienced greater facilitation than those who had participants who were stimulated over their dominant motor cortex, who experienced a decrease in performance as a result of the stimulation.

White Matter Lesions Affect Planning Processes during Task-switching: A Combined MRI and EEG study in Older Adults

Patrick Cooper¹, Todd Jolly¹, Pat Michie¹, Mark Parsons¹, Christopher Levi¹, Frini Karayanidis¹

¹Functional Neuroimaging Laboratory, University of Newcastle

White matter lesions (WMLs) are a common radiological abnormality found on magnetic resonance images in older adults and have been associated with decline in cognition, particularly executive functions. This has been linked to reduced efficiency of neural transmission in frontal processing networks. We investigated the influence of WMLs in distinct neural pathways defined on the basis of DTI pathways on one component of executive function – cognitive flexibility. We used event-related potentials (ERP) to measure differences in preparatory processing during a cued task-switching paradigm in a sample of mild ischaemic stroke patients and healthy older adults (43-80 years). Patients showed higher WML load in cortico-subcortical and fronto-parietal pathways. Patients were slower and less accurate during task-switching than controls and did not appear to benefit from informative cues. Cue-locked ERPs indicated that patients prepared less efficiently in response to informative task cues, but showed large sustained general preparation to non-informative cues. We examine the relationship between behavioural and ERP measures of cognitive flexibility and WML load within fronto-posterior and cortico-subcortical white matter tracts. We discuss the implications for WML role in cognitive ageing.

A Neurophysiological Mechanism of Saccadic Suppression: Relevant to Abnormal Magnocellular Function in Autistic Tendency

Daniel Crewther¹, David Crewther¹, Sheila Crewther², Stephanie Bevan, Reneta Slikboer

¹Swinburne University of Technology

²La Trobe University

Recent data suggests that perceptual differences, present within autism, can be explained in terms of dysfunction of the magnocellular visual pathway. The uncanny ability of some autistic individuals to search for hidden objects across multiple eye fixations suggests that saccadic suppression (known to be a relative suppression of magnocellular/parvocellular function), may be altered in high autistic tendency. Thus this study aimed to compare the relative contributions of the magnocellular and parvocellular contributions to the nonlinear flash visual evoked potential (mfVEP) in adults. 10 high and 10 with low autistic tendency as measured by the autism spectrum quotient (AQ) test. Estimations of threshold contrast for gratings of low or high spatial frequency (0.2 cpd, 2.0 cpd) presented either during the saccade or after a 100 ms delay were made. mfVEPs using a horizontal rectangular stimulus pseudo-randomly flashing with temporal contrast of either 24% or 96% during central eye fixations or during 20° saccades of 2 Hz. The major physiological difference between saccade and no saccade conditions was a reduction in the magnocellular derived response at ~100 ms with a latency delay suggesting that the magnocellular system and hence transient attention was impaired during eye movements. Saccadic suppression was observed in all conditions except for high spatial frequency gratings in the High AQ group. Trends for interactions were found in the VEP data

between autism, spatial frequency and saccadic suppression. Such findings suggest a potential tie between autistic trends in VEP and resultant psychophysical differences.

A Role for Early Dorsal Stream Processing in Real-Word and Pseudo-Word Reading

Sheila G. Crewther¹, Felicity Dalle Nogare¹, Alana J. Cross¹, Robin Laycock¹

¹School of Psychological Science, La Trobe University

Word recognition and fluent reading have traditionally been thought of as ventral stream tasks. However, recent research suggests that visual area V5 and the dorsal stream contribute to accurate word recognition. To investigate this further a group of 75 university students were divided into tertiles on the basis of motion coherence detection ability (preferentially a dorsal stream task). The top and bottom thirds were then assessed on recognition of real-words and pseudo-words under abrupt and ramped onset conditions. All participants were significantly less accurate but not significantly slower at recognising pseudo-words compared to real-words. The results also indicated that the good motion detectors were significantly more accurate than the poor motion detectors at recognising pseudo-words, but not real-words, under both abrupt and ramped onset conditions. The association of superior dorsal stream processing (as assessed by motion coherence detection) with accurate word recognition suggests that rapid early dorsal stream activation of attention, might aid accuracy of reading.

Do Behavioural Characteristics Predict Quality of Visual Perception?

Alana Cross¹, Robin Laycock¹, Felicity Dalle Nogare¹, Sheila Crewther¹

¹School of Psychological Science, La Trobe University

The spectrum of Autism is increasingly being viewed as a continuum that extends into the general population, where normal individuals with high autistic tendencies are reported to show impairments in dorsal visual stream functioning. Such deficits could account for perceptual preferences for local visual information and difficulties in integrating global information in high functioning Autism. The current study compared two groups of tertiary students differentiated by either low or high (but non-clinical) levels of autistic behaviours using the Autism Spectrum Quotient (AQ), on visual tasks preferentially biased toward dorsal and ventral stream processing. As expected, high AQ participants performed worse on tasks expected to target the dorsal stream including motion-processing tasks, modified global Navon figure task and rapid onset object recognition task. There was no difference in performance between groups on tasks expected to rely on ventral processing, including a local Navon figure task, and ramped onset object recognition task. Such findings suggest that dorsal stream functions also challenge normal individuals who self-report high autistic behaviours. A

regression analysis indicated that the attention switching, social, skills, communication and imagination subscales of the AQ scale contributed most to predicting performance on dorsal stream tasks.

Movement Timing and Sequencing in the Basal Ganglia and Thalamus: High Resolution fMRI at 7.0 Tesla

Ross Cunnington¹, Ronald Sladky¹, Ewald Moser¹, Christian Windischberger²

¹Queensland Brain Institute, The University of Queensland;

²MR Centre of Excellence, Medical University of Vienna

Motor regions in the midline of the brain, including the supplementary motor area (SMA) and cingulate motor areas, form re-entrant loops with specific nuclei of the basal ganglia and thalamus that are crucial for the planning and control of voluntary action. Most of what is known about basal-ganglia-cortical motor circuits comes from direct neuronal recordings in monkeys, as human brain imaging studies typically lack the spatial resolution to delineate activation in different nuclei of the basal ganglia and thalamus. In this study, we use ultra-high field MRI at 7.0 Tesla for high-resolution functional imaging of the motor circuits involved specifically in motor timing compared with sequencing of voluntary actions. For complex sequencing, a region of the SMA-proper was significantly more active, together with dorsal premotor and parietal cortical regions bilaterally. For complex timing, a region more superior and anterior in the pre-SMA was significantly more active, together with bilateral activation in the head and body of the caudate nucleus of the basal ganglia. High-resolution fMRI was able to clearly delineate activation within different parts of the basal ganglia and thalamus, and suggest that basal ganglia motor circuits are most involved in co-ordinating complex timing of voluntary actions.

Role of Temporal Expectancy in Attentional Modulation of Visual Processing in Striate and Extrastriate Cortex

Tharaka Dassanayake¹, Patricia Michie¹, Ross Fulham¹

¹School of Psychology, University of Newcastle

ERP research shows peripheral non-informative visual cues facilitate extrastriate processing of targets (as indexed by enhanced contralateral P1 amplitude) at the cued location as opposed to those at uncued locations, at short SOAs. Recent research also suggests that attentional modulation also depends on perceptual load and temporal predictability of targets. We conducted two ERP experiments where exogenously-cued high-perceptual-load (HPL) targets were presented under two temporal expectancy conditions to examine whether HPL stimuli are amenable for attentional facilitation earlier in striate cortex (as indexed by the C1 component). In Experiment 1 (high-temporal-expectancy condition), 17 healthy subjects (18-26y) performed a line-orientation discrimination task on HPL targets presented in the periphery of the left upper or right

lower visual fields, validly or invalidly cued by peripheral cues. SOA was fixed at 160 ms. In Experiment 2 (low-temporal-expectancy condition), (n=11, 19-36y) we retained HPL stimuli but introduced additional Long-SOA trials (1000 ms) into task-blocks. In both experiments validly-cued targets elicited significantly faster reaction times, larger contralateral P1 and anterior N1. A significant attentional enhancement of C1 amplitude however was observed in the high-temporal-expectancy condition only. The findings suggest that exogenous visual attention can facilitate the earliest stage of cortical processing under HPL and optimal temporal expectancy.

Using TMS to Prime Word Processing

Chris Davis¹, Chris Skaroupka¹, Bronson Harry¹, Tim Paris¹, Jeesun Kim¹

¹MARCS Auditory Laboratories, University of Western Sydney

Transcranial Magnetic Stimulation (TMS) has been used to explore functional interactions between motor areas and action verbs. In a classic study (Pulvermüller, Hauk, Nikulin, & Ilmoniemi, 2005.) it was shown that lexical decisions to leg related action words were faster when a TMS pulse was delivered to the leg region of the motor cortex compared to when delivered to the arm region. This data was interpreted as indicating that, at least in part, the meaning of any motor properties of a verb may be processed in the primary motor cortex. A more recent interpretation has suggested that the primary motor cortex is only critically involved in processing action verbs when participants mentally simulate verb motions. We used a single-pulse TMS design in which the hand area of participant's left primary motor cortex was stimulated at 150 ms or 350 ms after he/she was visually presented with a single word, to contrast performance on lexical and action/non-action decision tasks (the control condition was vertex stimulation). Results showed a TMS priming effect in both tasks suggesting that explicit simulation of verb motion is not necessary for priming.

ERP Determinants: Contributions from Prestimulus Alpha and Beta in an Auditory Go/No/Go Paradigm

Frances M. De Blasio¹, Robert J. Barry¹

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

The nature and extent of ongoing EEG contributions in ERP genesis remains unresolved. Research has indicated a complex pattern involving contributions from both ongoing EEG and 'evoked' activity, varying with EEG band, ERP component, and task-related processing requirements. Investigations have typically explored various EEG-ERP combinations in isolation. The present study is a continuation of a project aiming to quantify the nature of the prestimulus EEG-ERP relationship across four traditional EEG bands and five auditory ERP components (P1, N1, P2, N2, P3/LPC). Here, an equiprobable auditory

Go/NoGo paradigm was utilised to assess the impact of alpha and beta bands for both Go and NoGo trials. For each band, accepted trials were sorted according to ascending level of prestimulus activity at Cz, with prestimulus band level (High, Low) ERPs derived from the highest and lowest trial thirds at 9 inner electrode sites. High alpha was generally associated with increased positive component amplitudes, particularly the LPC. Beta modulated the exogenous components, with high beta predominantly increasing P1 amplitude. Topographic increases in N1 and P2 amplitudes were also found, as were stimulus interactions with P1 amplitude and N1 latency. These findings are discussed in terms of cortical activation, optimal processing states, and ERP genesis.

Early Face Processing Impairments in Bipolar Disorder: The P80 and Vertex Positive Event-Related Potentials

Racheal Degabriele^{1,2}, Jim Lagopoulos³

¹School of Psychiatry, University of New South Wales

²Schizophrenia Research Unit, Liverpool Hospital

³Brain and Mind Research Institute, University of Sydney

Individuals with Bipolar disorder (BD) principally present with mood symptoms of mania and depression, along with symptom-free states of euthymia. In addition to mood symptoms, BD patients often exhibit cognitive deficits which include face processing impairments, as have been identified in behavioural and neuroimaging studies. However, there is a paucity of studies which have investigated the time course of these impairments through the use of event-related potentials (ERPs). The aim of this study was to identify the specific stages of face processing which are impaired in BD by employing an emotional go/no-go paradigm comprising happy and sad face stimuli. Amplitude and latency values in response to 'go' stimuli were analysed from a fronto-central montage incorporating P80, N120, vertex positive potential (VPP) and N200 ERP components. Across groups, VPP latencies were reduced and N200 amplitudes increased to sad compared to happy face stimuli. Moreover, individuals with BD exhibited overall increased latencies in the early P80 and VPP ERP components compared to the control group. The evidence suggests that BD patients exhibit early visual processing deficits. Delayed neural responses may originate from white matter deficits which have been previously identified, and early visual impairments may result in behavioural and social symptoms.

Reading New Words in Context: Investigating Orthographic Learning Using Fixation-Related Potentials

Peter de Lissa¹, Genevieve McArthur¹, Anne Castles¹

¹ARC Centre of Excellence in Cognition and its Disorders, Macquarie University

The repeated reading of a novel word typically leads to an increased recognition of its written form. This process - which can be called orthographic learning - often occurs while

reading paragraphs of text. Most neuroscientific techniques cannot measure brain responses to novel words in paragraphs because it is not clear when a reader is looking at the novel word of interest within a paragraph. To avoid this problem, the current study used an eye-tracker in combination with EEG recordings to measure fixation-related potentials (FRPs) to novel words (pseudonyms) and real words (high frequency names) within paragraphs of text. The novel words and real words were presented four times within each paragraph. The novel words elicited a different pattern of brain activity compared to real words when read for the first time over the left posterior-parietal region. This difference was no longer evident by the fourth exposure. Further, a linear attenuation of early occipital peaks in response to repeated reading of both the real names and pseudonyms was also found.

The relationship between orthographic familiarity and attention will be discussed in light of the results, as well as the relationship between eye-movements and electrophysiology.

Like the Back of my Hand: Greater Shifts in Self-location away from the Body than Towards the Body in the Rubber Hand Illusion

H Dempsey-Jones¹, Ada Kritikos¹

¹School of Psychology, University of Queensland

The Rubber Hand Illusion (RHI) paradigm provides insights into the representation of self through the integration of visual and tactile information. Traditionally, shifts in self-location have been induced in towards the body from hands positioned at the periphery (i.e. shifts towards central body space). The current study investigates whether RHI can be produced away from the body: outwards, towards extrapersonal space. Prior research indicates prioritisation of attention to events occurring in the visual space where most manual behaviours occur, central peripersonal space (Losier & Klein, 2004; Lloyd, Azanon & Poliakoff, 2010) suggesting reorientation of self-location in RHI might be reduced for a position that is away from the body, compared to one towards body space. Outward RHI as well as inward RHI was found - indicating for the first time illusory shifts in self-location towards peripheral space. More importantly, a) the magnitude of RHI was considerably greater for changes in felt location outwards compared to inwards, and b) RHI scores increased over time in the inward experiment but decreased over time in the outward experiment. These surprising results suggest that the sense of self is more susceptible to location manipulations that draw the locus of selfhood towards peripheral space compared with towards corporeal space.

Abnormal Event Related Brain Potentials Generated while Processing Emotional Information in Anxious Parkinson's Disease Patients

Nadeeka Dissanayaka^{1,2}, Tiffany Au², Anthony Angwin^{2,3}, David Copland^{2,3}, John O'Sullivan^{1,2},

Gerard Byrne⁴, Rodney Marsh⁵, George Mellick^{1,6}, Peter Silburn^{1,2}

¹Neurology Research Centre, Royal Brisbane & Women's Hospital

²University of Queensland, UQ Centre for Clinical Research

³School of Health & Rehabilitation Sciences, University of Queensland

⁴School of Medicine, University of Queensland

⁵Department of Psychiatry, Royal Brisbane & Women's Hospital

⁶Eskitis Institute for Cell & Molecular Therapies, Griffith University

Anxiety is common in Parkinson's disease (PD), yet very little is known about the clinical presentation and mechanisms underlying anxiety in PD. This study aims to advance understanding of anxiety disorders in PD using novel psycholinguistic and psychophysiological approaches. Twenty three (23) PD patients were recruited from Neurology outpatient clinics. A diagnosis of anxiety and depression were made using the DSM-IV criteria and the severity was assessed using the Hamilton anxiety and depression rating scales. Patients were instructed to respond to an affective priming task while their brain waves were recorded using high density Geodesic 300 EGI 128 channel EEG system. The affective priming paradigm allows identification of abnormalities in brain function when automatically processing emotional information. It involves presentation of two words (negative or neutrally valenced) one after the other in a 150 millisecond interval. Participants evaluated the valence of the second word (target word) as fast as they could by pressing a button. Event related brain potentials generated when responding to target words were examined. E-PRIME software package was used for experimental presentation and behavioural data acquisition. Net station software was used for EEG data acquisition and analysis. Repeated measures ANOVA 2X2 models for N1, N400 and LPC components of the ERP against either anxiety or depression rating scale scores were computed for the midline brain regions. Difference waves were calculated for congruency or target valence effects. Partial correlations between the difference wave and anxiety, adjusted for depression scores were computed. An enhanced N400 for parietal ($F_{Pz}=10.22$; $p=0.004$; $r=0.56$; $p=0.007$) and occipital regions ($F_{Oz}=7.07$, $p=0.015$; $r=0.43$; $p=0.044$), and an LPC for the parietal region ($F_{Pz}=12.39$; $p=0.002$; $r=0.58$; $p=0.005$) were observed when evaluating congruent neutral compared to negative target words for PD patients with high anxiety, independent of depression. Similar results were observed when participants were divided into two groups of with or without a current DSM-IV diagnosis of anxiety disorder. Results suggested an abnormality in brain waves of anxious PD patients. Such abnormalities can potentially be used as more sensitive markers for early detection of anxiety disorders in PD.

Using Reaching Trajectories to Reveal the Dynamics of Stimulus Categorisation

Matthew Finkbeiner¹, Jason Friedman¹, Genevieve Quek¹, Shahd Al-Janabi¹

¹ARC Centre of Excellence in Cognition and its Disorders, Macquarie University

In categorisation tasks, such as lexical decision, the standard dependent measure in cognitive psychology is mean reaction time (RT). While mean RTs are certainly informative, they are relatively insensitive to the dynamics of the categorisation process under investigation. To address this, some researchers have begun using reaching trajectories as their dependent measure. The promise of this continuous measure is that it can reveal effects while stimulus processing is still unfolding. In this talk I will discuss a series of experiments in which we use reaching trajectories to investigate the effects of spatial and temporal attention in two different categorisation tasks: lexical decision and face (male/female) categorisation. Replicating earlier work, our results indicate strong modulatory effects of attention on stimulus categorisation. Looking at the time course of these modulatory effects, we see that they arise very early (~200 ms) and that they are remarkably short-lived.

The Effect of Speed and Accuracy Demands on a Perceptual Categorisation Reaching Task

Jason Friedman¹, Matthew Finkbeiner¹

¹ARC Centre of Excellence in Cognition and its Disorders, Macquarie University

Most studies of perceptual decision making use reaction times and accuracy as dependent measures. In this study, we instead decomposed arm movements made by subjects towards targets while the decision making process was ongoing, and used these to track the evolving decision making process. In this task, subjects were required to classify faces as male or female, with varying noise levels. They indicated their response by reaching out and pointing to a target on a touchscreen in front of them. The arm movements during the response were recorded with a motion capture system. We tested four groups of subjects with different instructions / demands. The first group was required to begin moving within 350 ms of stimulus onset. The second group had a long movement onset deadline (1 s), and instructions only to be as fast and accurate as possible. The third group had no liftoff deadline but rather a deadline for touching the screen (1.1 s), while the fourth group had no time constraints but accuracy was emphasised. We observed systematic changes in the initial direction of movement, the speed of the decision process and the accuracy as a result of the different time / accuracy requirements.

Event-rate Effects in the Flanker test: ERPs and Task Performance in Children with and without AD/HD

Daniel Galletta¹, Stuart Johnstone¹

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

Demanding tasks require a greater amount of effort, in which case individuals are required to alter their energetic-state to a level appropriate to perform the task. According to the Cognitive-Energetic Model (CEM), children with AD/HD are unable to effectively modulate their energetic state, leading to task underperformance. Using an Eriksen flanker task with three ISIs (2500 ms, 5500 ms, 8500 ms), the current study compared the ability of typically-developing children ($N = 15$) and children with AD/HD ($N = 14$) to modulate their energetic state. Reaction time, error rates, and the N2 and P3 ERP components were examined in order to infer state regulation differences between groups. The AD/HD group performed the flanker task at a lower level than the control group, particularly at the fast and the slow event-rates. However, these differences were not manifest in either the N2 or P3 ERP components. The implications of these findings will be discussed in terms of the CEM.

An ERP investigation into gender differences in affective prosody processing and its relationship to empathy

**Matthew Gerathy¹, Jacqueline Rushby¹,
Skye McDonald¹, Aneta Dimoska¹, Wan Yi Ho¹,
Emily Andersson¹**

¹Neuropsychology, University of New South Wales

Changes in affective prosody (e.g. pitch, intensity) are essential for the communication of vocal emotion. An acoustic MMN 'oddball' paradigm was employed investigating gender differences in pre-attentive auditory emotional processing of angry, disgusted and neutral stimuli. Topographical results indicated a tendency for females to produce larger MMN amplitudes than males in response to angry stimuli only. However males showed increased bilateral fronto-temporal activity in response to emotional stimuli, whilst females did not. Analyses that included explicit gauges of affective and cognitive empathy showed that the two constructs were unrelated to each other and that females were more efficient emotional but not cognitive empathisers than males. Furthermore, only females produced a noteworthy number of relationships between empathy and ERP components, suggesting increasing amplitudes (N1/P3a) were related to affective empathy but also that decreasing amplitudes (N1/MMN) related to enhanced cognitive empathy. In general, the results suggest that females are more sensitive than males to emotional (in particular threatening) acoustic change than males; however differences in affective empathy may have social, as well as biological causes. Clinical and research implications are discussed.

What is Salient in Children with Intellectual Disability and Typically Developing Children of Similar Non-Verbal and Receptive Verbal Mental Age?

**Nahal Goharpey¹, Sheila G Crewther²,
David P Crewther¹**

¹Brain Sciences Institute, Swinburne University of Technology

²La Trobe University

This study set out to investigate sensory discrimination in low functioning children with Autism compared to children with Idiopathic Intellectual Disability (ID) and typically developing (TD) children of similar non-verbal mental age (as measured by Raven's Coloured Progressive Matrices) and receptive language (as measured by Peabody Picture Vocabulary Test-Third Edition). The TD group demonstrated a relatively larger short-term and working memory capacity as measured by Visual Forward and Visual Backward Digit Span. Results showed comparable reaction time and accuracy performance in the single stimuli auditory discrimination tasks and the visual change detection tasks (colour and identity) in all groups. The TD group was also faster than the clinical ID group (LF Autism and Idiopathic ID group combined) in detecting colour change. However, this difference was no longer present when groups were matched on short-term and working memory capacity, suggesting that children with LF Autism or Idiopathic ID do not preferentially allocate their attention to colour changes as readily as TD children of similar non-verbal and receptive verbal mental age. Findings have implications for the education of children with ID, as they suggest that an object's identity may be more useful than its colour when teaching children with ID.

Quantifying Stimulus Dissimilarity and Familiarity in Binocular Rivalry: Wheatstone Revisited

Anastasia A Gorbunova¹, Jakob Hohwy¹

¹School of Philosophical, Historical & International Studies, Monash University

Binocular rivalry, a phenomenon referring to changes in perceptual dominance while viewing incompatible monocular stimuli, is an important tool for studying the neurocognitive mechanisms involved in conscious perception. The relative contribution to binocular rivalry of low level sensory properties and higher level stimulus interpretation, as well as their possible interaction, are not well understood. The present study quantifies the effects of stimulus dissimilarity and familiarity on switch rate and dominance duration in binocular rivalry. The stimulus pairs used in this study were either familiar letters, unfamiliar letters and symbols, or both. The dissimilarity measure was computed by adapting a technique proposed by Anderson and Thibos (2004). It was found that while dominance duration was sensitive to stimulus pair familiarity, switch rate was lowest for highly similar pairs. Implications for the nature of binocular rivalry and conscious perception as well as possible cognitive mechanisms of the phenomenon are discussed.

Sensory Gating in Long-Term Cannabis Users

Lisa-Marie Greenwood¹, Rodney J. Croft¹, Anna Dalecki¹, Stuart Johnstone¹, Nadia Solowij¹

¹School of Psychology, University of Wollongong

Sensory gating deficits are consistently found in schizophrenia. P50 suppression, an event-related potential derivation, is one such measure that is impaired in schizophrenia. This has been linked with α -7-nicotinic receptor (AEA-R) dysfunction, and is modulated by endogenous and exogenous cannabinoid activation. Schizophrenia patients typically use high levels of cannabis. In order to determine whether their impaired P50 suppression may relate to their cannabis use, the current study collected this and psychiatric symptom ratings from regular long-term cannabis users ($n=30$) and age- and gender-matched non-user controls ($n=16$). Cannabis users remained abstinent for a minimum period of 12 hours prior to testing. The present study failed to replicate previous findings of reduced P50 suppression in cannabis users. Groups did not differ on S2 amplitude, however healthy subjects showed a trend towards larger S1 amplitudes relative to cannabis users ($p=.062$), and a significant difference was found when heavy cannabis users ($n=15$) were compared to controls ($p<.05$). Results indicate that heavy cannabis users may be deficient in evoked responses to S1 rather than in 'gating'. Further consideration of psychiatric symptoms and their relationship with P50 amplitude (and gating) in cannabis users will be discussed.

Choice of Reference in Analysis of CAEPs to Auditory and Audiovisual Stimuli

Pia Gyldenkaerne^{1,2}, Mridula Sharma², Suzanne C. Purdy³, John Seymour^{1,4}, Harvey Dillon^{1,4}

¹HEARing CRC, Australia

²Macquarie University, Australia

³University of Auckland, New Zealand

⁴National Acoustic Laboratories, Australia

A general principle of EEG measurements is that each recorded channel represents the difference in activity between two electrodes on the head. Use of different reference schemes between studies may contribute, among other factors, to inconsistencies of findings (Hagemann, 1998). This study investigates the effect of choice of reference on the CAEPs to auditory and audiovisual stimuli in normal hearing adults. The CAEPs were recorded to natural speech tokens presented as auditory, visual and audiovisual stimuli. The CAEPs were recorded with FCz as a reference and re-referenced offline to right mastoid, left mastoid, mean mastoids and an average reference respectively. The amplitude of the average reference waveforms were significantly smaller compared to the other references. Three of the four references (right, left and mean mastoids) showed a temporal facilitation with shorter latencies for N1 in the audiovisual condition. No latency differences were found for the average reference. All references showed a modality effect with audiovisual stimuli resulting

in significantly enhanced N1/P2 amplitudes compared to auditory. The results suggest that the choice of reference has a significant effect on the temporal analysis of CAEPs and emphasise the importance of indication and justification of any choice of reference.

Attention to Actions, Goals and Agency Influences Neural Activity during action Observation

Veronika Halasz¹, Jason B. Mattingley¹, Ross Cunnington¹

¹Queensland Brain Institute, The University of Queensland

When we observe an action performed by another individual the brain rapidly processes that action to provide an understanding of "who", "how", "what" and "why". Observation of even the simplest movements involves the recruitment of several brain areas that are collectively called the action observation network. While participants watched video clips depicting simple object-directed hand movements changes in the BOLD signal were measured. Using a repetition suppression paradigm we found that during action observation the different aspects of actions (e.g. goals, kinematics, agency) recruit the action observation network nearly identically. Additionally, to investigate the effect of attention, participants were asked to focus exclusively on different aspects of the video clips in separate blocks, monitoring either the identity of the acting agent, the movement kinematics or the goal of the action. Analyses revealed enhanced repetition suppression effect in task-specific areas of the brain. Contrary to previous results, our data indicated that attention can be a strong modifying factor of the brain processes related to action observation.

Multi-voxel Pattern Analysis Shows Differential Response in the left Fusiform Face Area to Emotional Expressions

Bronson Harry¹, Mark A. Williams², Chris Davis¹, Jeesun Kim¹

¹MARCS Auditory Laboratories, University of Western Sydney

²ARC Centre of Excellence in Cognition and Its Disorders, Macquarie University

It is widely assumed that the fusiform face area (FFA), a face selective brain region located in the ventral temporal lobes, is not involved in processing emotional expressions. This proposal is based on the idea that the FFA is part of a visual pathway involved in face identification that analyses features that are invariant across emotional expressions. The present study used multi-voxel pattern analysis to examine whether viewing different emotional expressions elicited distinct patterns of activity within the FFA. Brain imaging data were collected while observers ($n = 12$) viewed images of faces expressing six different emotions and images of houses. Multi-voxel pattern analysis showed that between category classification (faces vs. houses) was accurate in both the left

and right FFA. In contrast, accurate classification of different emotional expressions was only reliable for patterns evoked in the left FFA. These results suggest that the left FFA processes features that vary across emotional expressions.

Inhibitory Control Training and the Effect of Reward: A Behavioural and Event-related Potential Investigation

Melinda Hickey¹, Stuart Johnstone¹

¹School of Psychology, University of Wollongong

Response inhibition (RI) plays a central role in flexible behavioural control in everyday life. As deficient RI is implicated in a number of clinical disorders (e.g. ADHD), a means of improving RI through training would be of great potential benefit. The current study investigated effects of short-term RI training with an adaptive visual Go/Nogo task on task performance and event-related potentials (ERPs). To ascertain optimal RI training parameters, the effect of a performance contingent monetary reward during training was also examined. In the context of subtle performance improvements, the Nogo P3 showed increased amplitude and anteriorisation at the end of training, effects which were larger for 'good' compared to 'poor' improvers (based on post-training task performance improvement). These effects are interpreted as a training-related increase in activation of the RI process. The N2 Nogo effect showed no changes with training, with an overall reduction in N2 amplitude interpreted as an increase in efficiency of processing response conflict elicited by the task. Moderating effects of reward on performance and ERPs were subtle, showing differential effects for 'good' and 'poor' improvers.

Multisensory Integration of Somatosensory and Auditory Stimuli as Revealed by the Steady-state Evoked Response to Periodic Stimulation

S. Hoad¹, T. W. Budd¹

¹School of Psychology, University of Newcastle

The brain's ability to integrate information across sensory modalities is a fundamental process responsible for the creation of a meaningful representation of the world. Our aim in this study was to investigate auditory-somatosensory multisensory integration (MSI) as a function of stimulus modulation rate. Following previous research, 'super-additivity' was used as the primary measure of multisensory integration. Super-additivity is observed when the neural response to multimodal stimuli presentation exceeds the linear sum of the respective unisensory responses (Foxy et al., 2000). In addition to transient event-related-potential (ERP) activity used in prior MSI research, the present study used the steady-state evoked response (SSER); a traditional measure of cortical entrainment to unisensory periodic stimulation. Continuous EEG from 64 scalp electrodes was recorded while participants were presented with auditory, vibrotactile or simultaneous

auditory-vibrotactile stimulation at eight separate sinusoidal amplitude modulation rates between 2 and 64 Hz. ERP analyses revealed evidence of super-additive responses from the N1 peak, however, only 'sub-additive' responses were found for the P2 peak. While significant SSER entrainment was found for several modulation rates, only 'sub-additive' SSERs for multimodal stimulation were apparent. This complex pattern of results is discussed in terms of the use of super-additive models in MSI ERP research.

The Relationship Between Pursuit Eye Movements and Perception During Binocular Rivalry

Laila Hugrass¹, David Crewther¹

¹Centre for Human Psychopharmacology, Swinburne University of Technology

It has recently been shown that action-percept congruency plays a role in binocular rivalry, a form of bistable perception that occurs when incompatible images are presented to the two eyes. Here, we investigated the degree to which smooth-pursuit eye movements can bias perceptual competition. In the first experiment, six observers pursued a horizontally oscillating dot that was superimposed on rivalrous, leftward and rightward drifting gratings. Perceptual dominance was consistently biased in the direction of smooth-pursuit and tended to switch when pursuit direction switched. The strength of this relationship increased with speed, especially when the pursuit speed matched the grating speed. In a second experiment, we investigated the interaction between pursuit and intentional control on rivalry dynamics. Relative to non-volitional viewing, percept-pursuit coupling was weakened when observers were instructed to selectively maintain one percept or to mismatch their percept with pursuit. However, instructions to match percept with pursuit did not further increase the strength of coupling. Our results contribute to converging evidence that self-generated actions can influence perception. We have provided insight into how this affects binocular rivalry, by showing that percept-pursuit coupling can be suppressed at the observer's will.

Contrast Response Functions for Nonlinear Visual Evoked Potentials vary as a Function of Autism Spectrum Quotient

Brianna Jackson¹, Ellie Blackwood¹, Julieanne Blum¹, Seam Carruthers¹, Sabrina Nemorin¹, Brett Pryor¹, Shannon Sceneay¹, Stephanie Bevan¹, Renata Slikboer¹, David Crewther¹

¹Swinburne University of Technology

Autistic tendency has often been associated with impaired visual motion sensitivity, global/local recognition and visual discrimination of facial emotion. However, the neurophysiological mechanisms underlying this impaired visual perception have yet to be established. Nonlinear multifocal visual evoked

potentials mfVEP (VERIS) have demonstrated delayed magnocellular processing for high stimulus contrast in populations scoring high on Baron-Cohen's autism spectrum quotient (AQ). Here we investigated the contrast response functions of the main peaks of the first order and first two slices of the second order multifocal VEP with (central unstructured patch subtending 4°) with temporal contrasts of 10%, 25%, 50%, 70% and 96% in 29 participants (8 High AQ, 12 Middle AQ, 9 Low AQ). The contrast response function for the first slice 2nd order (K2.1) showed high contrast gain and response saturation, K2.2 showed lower contrast gain and little saturation – giving support for generation by the magno- and parvocellular systems respectively. Interestingly, the High AQ group showed greater K2.1 amplitudes > Middle > Low AQ, while the K2.2 amplitudes were similar. Also High AQ showed a delay in the K2.1 positivity at high contrast. This evidence suggests that the magnocellular system in High AQ individuals has more difficulty recovering after stimulation.

A Multimodal Approach to Quantify White Matter Tract Disruption

Todd Jolly¹, Frini Karayanidis¹

¹University of Newcastle, John Hunter Hospital

There are two major approaches to investigating white matter pathology in normal ageing and disease. The first quantifies macrostructural pathologies while the second analyses the diffusion properties of the white matter. These measures have shown to be associated with cognitive decline, but the precise pattern of associations varies in both domain and extent, possibly due to variations in methodology. The present study presents a novel and more sensitive quantitative measure of white matter functionality by uniting information derived from multiple magnetic resonance imaging techniques. Using a Diffusion Tensor Imaging (DTI) tract atlas, we parcellated white matter into 18 separate regions of interest (ROI). Lesion volumes and average Fractional Anisotropy (FA) was calculated for each ROI. The mean FA was then multiplied by the inverse of the proportion of the tract affected by lesions to quantify overall tract functionality. Preliminary analyses has revealed that in seven of the 8 white matter tracts tested, this novel measure of white matter efficiency has shown stronger associations with cognitive assessment scores when compared to lesion volumes and measures of FA alone. In conclusion, lesion volumes and FA measures provide non-overlapping information and this novel approach has enabled us to consolidate these to provide a more sensitive measure of white matter disruption.

Imaginary Strength Drives Accuracy and Capacity in Visual Working Memory

Rebecca Keogh¹, Joel Pearson¹

¹School of Psychology, University of New South Wales

Visual working memory provides an essential link between past and future events. Despite recent efforts, capacity limits, their genesis and the underlying neural structures of visual working memory remain unclear. Here, we demonstrate that individuals with strong mental imagery, as measured by priming in binocular rivalry, have greater visual working memory accuracy and capacity. Modulating the background luminance reduced visual working memory accuracy and capacity, but only for individuals with strong visual imagery. Modulating luminance on a number working memory task had no significant effects on number memory accuracy or capacity. This suggests that luminance signals were disrupting sensory-based (imagery) mechanisms and not a general working memory system. Our results suggest a dichotomy in strategies for visual working memory: individuals with strong mental imagery rely on sensory-based imagery to support mnemonic performance, while those with poor imagery rely on different strategies. These findings could help reconcile current controversy regarding the mechanism and location of visual mnemonic storage.

Neural Processing of Visual Attention: Modulation of the Orientation-Induced Gamma Response

Loes Koelewijn^{1,2}, Anina N. Rich¹, Suresh D. Muthukumaraswamy², Krish D. Singh²

¹ARC Centre of Excellence in Cognition and its Disorders, Macquarie University

²Cardiff University Brain Research Imaging Centre, School of Psychology, Cardiff University

Stimulus-induced gamma oscillations are a general neuronal feature, and are thought to play a functional role in visual processing. If gamma oscillations indeed reflect cortical processing, their degree of synchronisation should be modulated by attention. Using magnetoencephalography, we investigated how oscillatory responses to a stimulus optimal for inducing gamma in visual cortex changes with spatial attention. In separate blocks, subjects traced the orientation of either a parafoveal grating patch or a small line at fixation that each unpredictably and independently rotated up to 40 degrees around one of four angles, but were both always present. We observed a sustained attention-related increase in gamma power (30–70 Hz) in early visual cortex contralateral to the grating, supporting a role for gamma in visual processing, even as early as V1/V2. In addition to gamma, we also investigated modulations in other frequency bands, and found the classic decrease in alpha power (5–15 Hz) with attention, strongly supporting our attentional manipulation. We subsequently investigated how actively inhibiting a stimulus affects the gamma response, by manipulating the behavioural relevance to grating stimuli, providing further insights in the functional significance of gamma oscillations in visual processing.

Autistic Tendency as a Predictor of Joint Attention

Michelle Lamblin¹, David Crewther¹

¹Swinburne University of Technology

Joint attention is one of the most sophisticated and unique subtleties of human inter-personal interaction, aided by intricate visual responses to socially cohesive eye gaze shifts; a behaviour which is delayed or severely impaired in autistic populations, despite relatively intact processing of facial emotion and eye gaze direction. This pilot study suggests a new model of joint attention consisting of two critical components to successful attention sharing: a speeded and reflexive physiological shift response to the initiation of the joint attention triad followed by a qualitative assessment of gaze projection which determines each partner's target accuracy to the third party object of interest. Integrating a video game task with infra-red eye tracking, psychophysical differences were revealed between cohorts of the normal population using scores derived from the Autism Spectrum Quotient. Results indicate that there is a significant difference in initiation latency of the primary saccade between solo and joint attention tasks $F(1,38) = 60.663$, $p < .001$ as well as mean reaction time to locate a target $F(1,38) = 45.090$, $p < .001$. Qualitative findings further suggest that subtle psychophysical differences may exist in the saccadic mechanisms between groups when sharing joint attention, without causing significant detriment to task performance. Psychophysical and qualitative differences between groups are symptomatic of atypical compensatory visual perception mechanisms often reported within the Autistic Spectrum.

Expert Video Game Players Demonstrate Earlier Occipital N1 Latencies

Andrew J. Latham¹, Lucy L. M. Patston¹, Lynette J. Tippett¹

¹Department of Psychology, University of Auckland

Increasing behavioural evidence suggests that video game players show generalised enhancement in a range of visuospatial abilities, but what underlies these enhancements remains unclear. In this study we used electroencephalography (EEG) to measure the latency of occipital N1 accompanying simple visual stimulus presentation. Participants comprised 15 right-handed male expert video game players (VGPs) and 15 matched controls. VGPs began playing before the age of 10, had a minimum of 8 years experience, and maintained a play-time of at least 20 hours per week. Control participants, who had less than 1.5 years of game play experience, were matched to the VGPs for age, handedness, years of education, and WASI-R estimated Full-Scale IQ. Participants were required to respond by pressing the spacebar as soon as they detected a black and white checkerboard circle stimulus presented to the left or right visual field. Evoked potentials were recorded using a 128-channel EEG system. The latency of the occipital N1 in VGPs was significantly earlier (10 ms) than controls ($p = .038$). No significant group differences were observed for amplitude. Occipital N1 is thought to reflect visual processing of attended stimuli, suggesting expert VGPs may detect and process visual information before controls.

A Differential Critical Role for the Temporoparietal Junction in Abrupt- Versus Ramped-Onset Object Recognition

Robin Laycock¹, Bonnie Alexander¹, David P. Crewther², Sheila G. Crewther¹

¹La Trobe University

²Swinburne University of Technology

Recent evidence suggests the dorsal stream plays a role in rapid activation of attention mechanisms in parietal cortex, prior to object recognition in the ventral stream. We asked whether the temporo-parietal junction (TPJ) – part of a ventral frontoparietal network related to direction of attention to novel or salient events – could be a termination point of the dorsal stream in parietal cortex, prior to ventral stream object processing. Participants completed an object recognition task, with line drawings of objects briefly presented in left or right visual field having either abrupt or ramped onset/offset. Paired-pulse TMS was delivered at one of three stimulus onset asynchronies (SOA) (66 & 93 ms; 120 & 146 ms; 173 & 200 ms). TMS to TPJ reduced accuracy of abrupt object recognition at SOA = 66-93 ms and 120-146 ms in the contralateral compared with the ipsilateral visual field, but only at SOA = 173-200 ms for ramped object recognition. The current data suggests a relatively early (66 ms) critical involvement for TPJ in abruptly presented objects. When objects had no transient onset (ramped condition) the critical involvement of TPJ was later (173-200 ms). It is possible that dorsal stream activation of a ventral frontoparietal attention network is initiated faster for stimuli with salient onsets.

If the Tool Fits, use it; Response Priming for Functionally Related Objects

Joel Lewis¹, Sieu Khuu¹, Joal Pearson¹

¹University of New South Wales

Visual object recognition research has identified a few highly selective object processing areas, such as the fusiform face area, parahippocampal place area and extrastriate body area. These findings suggest that objects are organised throughout the brain based on the similarity of their features, yet numerous studies have shown this is not the only way people group objects. Thematic categorisation, the grouping of objects based on how they interact or co-occur, is a common and natural method used by most people. However, what role thematic categorisation plays in visual object recognition is unclear. A series of four experiments were conducted to assess the strength of thematic relationships for visually presented objects from different taxonomic categories (hands and tools). Using a response priming procedure, prior presentation of a thematically related prime resulted in significantly faster reaction times during an object categorisation task. This facilitation occurred despite the fact that the thematically related prime stimuli (hands) were taxonomically unrelated to the target stimuli

(tools). These findings suggest that object concepts can be organised in a real-world functional manner, as well as by the visual similarity of their features.

The Role of Attention in Rapid Presentations of Facial Expressions: An Investigation using the Repetition Blindness Paradigm

Jenny Li¹, Skye McDonald¹, Jacqueline Rushby¹

¹School of Psychology, University of New South Wales

When a stimulus is presented twice at a rapid speed and in close succession, individuals often have difficulties in recalling two occurrences of the stimulus. This phenomenon has been referred to as repetition blindness (RB). RB has been argued to reflect a limit in attentional capacity whereby the system is unable to encode spatiotemporal information for a single stimulus type within a short time, thus leading individuals to believe that the stimulus was only presented once. The current study examined whether facial expressions are subject to RB. 39 students were presented with emotional facial expressions (sad, disgust, angry, fearful) using rapid serial presentations. In line with previous evidence that has found an attenuation of RB for personally significant stimuli, the current study found no RB for facial expressions. Moreover, recall was significantly superior for threat relevant faces (angry and fearful) than the non-threat expressions. Using skin conductance responses and heart rate changes as psychophysiological indices of orienting and attention, this study found that more attention was allocated to angry and fearful expressions than sad and disgust, and that attention was positively correlated with accuracy. These findings support the role of attention in the processing of rapid presentations of visual stimuli.

The Extinction of Human Fear Learning: Differences Across Domains of Fear

Ottmar Lipp¹, Kimberley Mallan²

¹School of Psychology, The University of Queensland

²Institute of Health and Biomedical Innovation, Queensland University of Technology

Prepared learning, learning that is resistant to extinction, selective, evident after one CS-US pairing, and encapsulated from cognition, is said to underlie the fear of snakes and spiders and of threatening conspecifics (angry faces or faces that look different – other race faces). Whereas there is considerable evidence that fear conditioned to snakes and spiders fulfills all four criteria of prepared learning, fear conditioned to angry or other race faces has only been shown to be resistant to extinction. We present evidence using the instructed extinction paradigm that, unlike fear conditioned to snakes and spiders, fear conditioned to angry and other race faces is not encapsulated from cognition but was abolished by verbal instructions. This is inconsistent with the proposal that the resistance to extinction that is observed for fear conditioned to snakes and spiders and for fear

conditioned to angry or other race faces reflects on prepared learning. We suggest that fear conditioned to social stimuli like angry or other race faces is better explained as an extension of an individual's social learning about pervasive negative stereotypes rather than as an instance of prepared learning.

An Investigation of Perceptual Processing in Autistic Spectrum Disorder using Mis-Tuned Harmonics

Veema Lodhia¹, Jon Brock², Blake Johnson², Jeff Hamm¹, Michael Hautus¹

¹Research Centre for Cognitive Neuroscience, Department of Psychology, University of Auckland

²ARC Centre of Excellence in Cognition and Its Disorders, Macquarie University

Time-shifted dichotic pitch (DP) elicits Object Related Negativity (ORN; associated with object segregation) and Positive 400 (P400; associated with response formation) components in the auditory event related potential (AERP). Our recent work shows that autistics, when compared to matched controls, do not exhibit the ORN but do exhibit a P400 component, when listening to DP stimuli. The aim of this study was to investigate whether components of interest (ORN and P400) are elicited in the AERP of autistics by mistuned harmonics. Participants were ten 18-to-47-year-old adults with ASD and ten matched controls. A mixture of tuned (0%) and mis-tuned (0.5% & 1.5%) harmonic stimulus types were presented. Both controls and autistics obtained ORN and P400 components in the AERP. Group differences were only found for the autistics for the N1 and N2 in interactions when the location (left/centre/right) and level (0%, 0.5%, & 1.5%) of the mis-tuned harmonic were factors. This may reflect timing processing deficits in autism. The findings from this study will expand our knowledge on how the brain systematically organises simultaneous incoming auditory information and allow for greater understanding about perceptual processing in Autism.

Problem Gamblers are Less Sensitive to Losses in a Gambling Task: An ERP Study

Lisa Lole¹, Craig Gonsalvez¹

¹Brain & Behaviour Research Institute, School of Psychology, University of Wollongong

It is well established that amplitudes of the feedback-related negativity (FRN) ERP component are greater following negative compared to positive outcomes. This sensitivity of the FRN to outcomes along the reward/non-reward continuum has major implications for gambling research. The reinforcement learning theory posits that FRN amplitudes reflect changes in the mesencephalic dopamine system, with higher dopamine levels associated with larger FRN amplitudes. Psychological theories of gambling have proposed that problem gamblers (PGs) may be hypersensitive to rewards and/or hyposensitive to losses. However, differences in reward and non-reward

processing between PG and non-PGs have rarely been examined. The link between FRN amplitudes and negative outcomes provides an opportunistic means to test such a prediction, namely that compared to non-PGs, PGs will evidence smaller FRN amplitudes to losses in a gambling task. The current study investigated the impact of win and loss events on the FRN while 12 non-PGs and 12 PGs played a computer-simulated gambling task. As predicted, compared to non-PGs, PGs exhibited smaller FRN amplitudes following loss outcomes. These results are consistent with the notion that PGs are hyposensitive to losses, and that this processing deficit may contribute to the development and/or the maintenance of problematic gambling behaviours.

Sex Differences in Affective Processing: Valence or Semantic Category?

Bethany Lusk¹, Frances Martin¹

¹School of Psychology, University of Tasmania

This study investigating attentional processes involved in affective processing aimed to examine whether males and females differ in their emotional responses to the valence of affective stimuli, and if so to determine whether this processing depends on the semantic qualities of the stimuli. Event-related potentials (ERP) were recorded from 40 (n=20 female) participants during a dual-task which involved the manipulation of attention priority. The hypothesis, in accordance with the negativity bias hypothesis, that all ERP component amplitudes would be higher for unpleasant relative to pleasant and neutral stimuli was not supported. In accordance with the approach-withdrawal model of emotional processing, lateralisation of pleasant and unpleasant stimuli was most prominent in the left and right frontal regions respectively in males but the results were less clear for females. Overall females showed greater right hemisphere activation and males showed greater left hemisphere activation. As predicted, males showed greater P3b and LPC component amplitudes to all forms of erotica compared to other semantic content stimuli and this effect was larger in the dual task condition than in the single task condition. However, contrary to predictions, these components were also larger for erotica compared to unpleasant stimuli for females.

Single-trial ERPs and Autonomic Responses to Indifferent Tones in an Auditory Dishabituation Paradigm

Brett MacDonald¹, Robert J. Barry¹

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

Traditionally, studies of the Orienting Reflex (OR) have examined autonomic measures at long interstimulus intervals (ISIs), while ERP research generally utilises short ISIs, averaging to increase signal/noise ratios – but this is unsuitable for OR studies. In a simple auditory dishabituation paradigm, we

compared response patterns of single-trial ERPs and HR responses to the phasic skin conductance response (SCR) commonly used as a model of the Orienting Reflex (OR). Twelve 80 dB tones (1000/1500 Hz, 50 ms with 15 ms rise/fall times) were presented with random ISIs (45 to 70 s), without task requirements. The first 10 standard trials were of one frequency, followed by a change trial at the other frequency, and subsequent dishabituation trial at the initial standard frequency. The evoked cardiac response (ECR), SCR, and single-trial ERPs from 19 sites, were collected. EOG-corrected ERP data were submitted to principal components analysis (PCA). SCR displayed decrement over trials, response recovery at the change trial, and dishabituation at the following standard. ECR showed no trials effects. Six identifiable ERP components were extracted: P1, N1, processing negativity, P2, P3b, and the slow wave (SW); only SW showed decrement over trials. The results are discussed in relation to Preliminary Process Theory of the OR.

Can Children's Atypical Passive Auditory ERPs be Normalised by Training?

G. M. McArthur¹, C. M. Atkinson¹, D. Ellis¹

¹ARC Centre of Excellence in Cognition and Its Disorders, Macquarie University

The aim of this study was to test – for the first time – if non-speech or simple-speech training normalises atypical passive auditory ERPs in the N1-Ps window in children with SLI and SRD. At Time 1, we tested children with SRD or SLI and age-matched controls for their behavioural responses and passive ERP responses to tones, backward-marked tones, vowels, and consonant-vowels. Twenty-five children with SRD and SLI, who had a poor behavioural response to one of these sounds, were trained to discriminate the same sound for ½ an hour a day, 4 days a week, for 6 weeks. After training (Time 2), we retested these 25 trainees and 33 untrained controls for their behavioural and passive ERP responses to the same found sounds. The training successfully treated the behavioural responses of 19 of the 24 trainees. However, it did not normalise atypical N1-P2 ERPs in successful or unsuccessful trainees. Nor did it shift typical N1-Ps ERPs in successful or unsuccessful trainees. This suggests that non-speech and simple-speech training modifies the brain at a “higher” level of processing than automatic auditory perception.

Segregation of Two Alternating Tones is Constrained by their Frequency Separation Even under Strongly Focused Attention

David N. McKenzie¹, Juanita Todd¹

¹University of Newcastle and Priority Research Centre for Brain and Mental Health

When two sounds of different frequencies (A and B) rapidly alternate (ABABAB...), listeners automatically segregate

them into streams (i.e. hear A_A_A... or B_B_B...) if the A-B frequency separation is large. This segregation (or “streaming”) is reflected in the mismatch negativity (MMN) component of the event-related potential (ERP). If A is briefer than B, a duration deviant at A’s frequency elicits earlier peaking MMN than one at B’s frequency, reflecting the in-stream standard duration. Duration MMN was used to investigate segregation changes with frequency separation. Binaural sounds of 50 and 100 ms alternated. Participants attended one sound throughout a block. “Low” sounds were always 1000 Hz. “High” sounds were 1250 Hz in some blocks (“Small” separation) or 1800 Hz (“Large” separation blocks). Duration MMN latency was measured to occasional 250 ms deviants at both frequencies. Sensitivity and RT measures suggested participants found it easier to attend the High sounds, irrespective of frequency separation. MMN peaked earlier when attended than unattended and largely reflected the in-stream standard duration. This in-stream influence was greater for the larger frequency separation. For two sounds differing in pitch, the pitch separation sets the lower limit on segregation even under strongly focussed attention.

Maturation of T-complex Brain Response Across Adolescence

Yatin Mahajan¹, Genevieve McArthur¹

¹ARC Centre of Excellence in Cognition and its Disorders, Macquarie University

Adolescence is a landmark period of transition from childhood to adulthood that is marked by changes in both brain structure and function. The aim of the current study was to track the development of the brain’s function processing of sounds across adolescence. To this end, we measured the t-complex event-related potential to tones and speech at left and right temporal sites in 90 children and adolescents aged 10 to 18 years, as well as 10 adults. Across adolescence, Na amplitude increased to tones and speech at the right, but not left, temporal site. Ta amplitude decreased at the right temporal site for tones, and at both sites for speech. The Tb remained constant at both sides. The Na and Ta appeared to mature later in the right than left hemisphere. In addition, the Na and Ta t-complex peaks matured at an earlier age in the left hemisphere than the right hemisphere. This data, combined with that of previous studies, show the functional processing of sound continued to develop across adolescence into adulthood, particularly in the right hemisphere.

SigMate: An Automated Comprehensive Software Tool for Analysis Neuronal Signals

Mufti Mahmud^{1,2} Alessandro Bertoldo¹, Stefano Girardi¹, Marta Maschietto¹, Stefano Vassanelli¹

¹University of Padova, Italy

²Jahangirnagar University, Bangladesh

In recent years neuroscientists have developed various devices and/or probes to solve enduring research challenges, and to contribute to better prevention and treatment strategies for neural disorders. Many of these devices are ready to be used in clinical studies. With the exponential growth of these probes neuroscientists now face a new challenge: processing and analysing the data acquired by them. To perform the analyses manually are very time consuming and thus pushed the community towards development of automated software tools. Here we present a comprehensive, automated, and multichannel software package to process and analyse data from multiple signal acquisition sources. Named as ‘SigMate,’ the software package bundles together our in-house modules and existing standard tools. Present features include: data visualisation (2D/3D), stimulus artifact removal including baseline correction, noise characterisation, file operations (file splitting, concatenation, and column rearranging), latency estimation in local field potentials (LFPs), current source density (CSD) analysis, determination of cortical layer activation order from LFPs and CSDs, spike detection, spike sorting, single LFP sorting, EEG based brain-machine interfacing, neuronal simulation environment, and are gradually growing. Correctness and accuracy confirmed through testing with signals acquired by different means, the tool will be made available to the community shortly.

The Role of Cortico-Basal Ganglia Networks in Adjusting Response Threshold during task Switching

Elise Mansfield¹, Frini Karayanidis¹, Sharna Jamadar², Andrew Heathcote¹, Birte Forstmann³

¹University of Newcastle

²Olin Neuropsychiatric Research Center

³University of Amsterdam

In two-choice decision-making tasks, response threshold adjustments for speed compared with accuracy instructions are associated with activation in both pre-supplementary motor area (pre-SMA) and striatum (Forstmann et al., 2008). In contrast, the sub-thalamic nucleus (STN) responds to demands for increased response caution (Frank et al., 2007). Using fMRI with an ROI approach, we examined whether these networks were also responsible for higher-order, preparatory threshold shifts within a cued-trials task-switching paradigm that included both fully and partially informative switch cues. Both switch cue types produced higher threshold estimates than repeat cues. In pre-SMA and striatum, increased activation was found for repeat relative to switch cues. In addition, while pre-SMA activation was inversely related to threshold estimates for all cue types, this relationship was found in striatum for repeat cues only. This indicates that the pre-SMA biases striatum specifically under more liberal response regimes. In contrast, increased threshold estimates for switch cues were associated with increased activation in right STN, suggesting a role in raising threshold under more conservative response regimes. Our findings support previous neural

models of threshold adjustment while showing that these models can also be extended to higher-order threshold adjustments in tasks requiring more strategic control processes.

Components of Preparatory Control Revealed in the Alpha band using a Novel Pattern Misclassification Approach

Elise Mansfield¹, Frini Karayanidis¹, Michael X. Cohen²

¹School of Psychology, University of Newcastle

²University of Amsterdam

Switching between tasks produces slower and less accurate performance compared to repeating the same task. Behavioural and neuroimaging studies have so far been unable to determine whether switching involves a distinct cognitive process or an amplification of general processes involved in both switching and repeating. Here we attempt to answer this question using a novel multivariate pattern misclassification analysis of EEG data. First, a pattern classifier was trained to differentiate fully-informative switch cues (switch-to cues) from non-informative cues based on frequency-band-specific local topographical patterns. The classifier was then given partially-informative switch cues (switch-away cues) and fully-informative repeat cues, so that it was forced to *misclassify* each of these cue types as either switch-to or non-informative cues. Early in the cue to target interval (CTI), right frontal alpha-band activation patterns were similar between cues allowing for switch preparation (switch-away reliably misclassified as switch-to). Later in the CTI, during target anticipation, right parietal activation patterns were similar between cues allowing for task preparation (repeat reliably misclassified as switch-to). These findings show temporally and spatially distinct processes associated with switch-specific and general task preparation. They also provide the first direct evidence for a frontally mediated switch-specific preparation process.

Physical Exercise and Cognitive Processing in Adults: A Behavioural and Event-Related Potential Investigation

Frances Martin¹, Kate Lennox¹

¹University of Tasmania

The aim of this study was to investigate the association between habitual physical exercise and executive control mediated inhibitory processing in young and middle-aged adults. Young ($n=22$, $M(\text{age})=21$ years) and middle-aged ($n=20$, $M(\text{age})=51$ years) exercisers and young ($n=20$, $M(\text{age})=21$) and middle-aged ($n=20$, $M(\text{age})=50$) non-exercisers completed two involving inhibitory processing, the stop signal task and the flanker task. Contrary to the hypothesised benefit of exercise on RT, there were no significant effects of exercise on RT. However, partial support for the hypothesis that exercise would be associated with ERP indices reflecting enhanced executive control functioning was found.

Relative to non-exercisers, exercisers exhibited speeded cognitive processing as indexed by shorter N2 and P3b latency, and enhanced attentional resource allocation as indexed by P3b amplitude during a response inhibition task (stop signal task). More selective benefits of exercise on interference control processing (flanker task) were revealed, with exercise related benefits in attentional control limited to females, and speed of cognitive processing limited to middle-aged exercisers under difficult task conditions. These findings suggest the benefit of exercise in young and middle-aged adults is limited to brain activity reflecting enhanced inhibitory processing and is moderated by a number of variables including sex and age.

Conscious and Non-conscious Judgements of Trustworthiness in Adults with Asperger's

Danielle Mathersul¹, Skye McDonald¹, Jacqueline Rushby¹

¹School of Psychology, University of New South Wales

Past research suggests individuals with Asperger's judge others as more trustworthy than controls (Adolphs et al., 2001), implying amygdala deficits due to similarities with lesion patients (Adolphs et al., 1998). Given the role of the amygdala in mediating autonomic responses, corresponding differences in heart rate (HR) and skin conductance (SCR) might be proposed. The current study investigated the relationship between judgment ratings, HR and SCR under explicit, implicit and subliminal conditions. Twenty adults with Asperger's were matched to 21 controls. Stimuli were happy and angry facial expressions from Ekman and NimStim. The explicit condition presented faces for 6 s; subliminal presented the emotional face for 30 ms, followed by a neutral face (total 6 s). Participants judged trustworthiness (7-point likert scale). For implicit, participants rapidly identified the gender of the face. Adults with Asperger's judged faces as less trustworthy than controls (explicit and subliminal), which was associated with greater HR acceleration. In contrast, controls had positive associations between higher ratings and greater HR acceleration and deceleration. Asperger's were less accurate at labelling gender (implicit), reflected in greater HR deceleration, whereas accuracy in controls was associated with greater maximum change in SCR. Findings suggest disruptions in neural networks mediating autonomic responses to affective stimuli.

Static and Dynamic Face Emotion Processing in Adults along the Autism Spectrum: an fMRI Study

Angela Mayes¹, Matthew Hughes¹, David Crewther¹, Andrew Pipingas¹, Richard Silberstein¹, Patrick Johnston²

¹Swinburne University of Technology

²University of York, United Kingdom

There is substantial evidence indicating that individuals within the normal population display autistic traits to varying degrees

(Baron-Cohen et al., 2001). Differences between individuals that report Low and High autistic traits have been shown in studies investigating many areas of cognition (e.g. eye gaze, Bayliss et al., 2005), and in studies investigating differences in functional brain activity (e.g. Di Martino, et al., 2009). Currently it is unknown if the atypical neural processing of face emotions seen in ASD populations extends to autistic traits within the normal population. The current study aimed to investigate the neural differences or similarities between an ASD group, a Low autistic trait group and a High autistic trait group, in response to both static and dynamic face emotion stimuli. Here we present functional magnetic resonance imaging data from 10 individuals diagnosed with an ASD and 28 neurotypical individuals, 15 in the High autistic trait group. The results from the study showed a different pattern of activation across groups, predominately localised to the STS and IFG. The current study illustrates that individuals' from the normal population that report High autistic traits show a similar pattern of neural activation to facial expressions as ASD individuals.

Serum Testosterone Levels and Cognition in Men with Chronic Schizophrenia

Loretta Moore^{1,2}, Merribel Kyaw³, Ans Vercammen^{1,2,4}, Rhoshel Lenroot^{2,4}, Maryanne O'Donnell⁵, Jackie Curtis⁵, Jayashri Kulkarni⁶, Vaughan J. Carr^{1,4}, Cynthia Shannon Weickert^{1,2,4}, Thomas W. Weickert^{1,2,4}

¹Schizophrenia Research Institute, Sydney

²Neuroscience Research Australia, Sydney

³School of Medicine, University of New South Wales

⁴School of Psychiatry, University of New South Wales

⁵Kiloh Centre, Prince of Wales Hospital, Sydney

⁶Monash Alfred Psychiatric Research Centre, Melbourne

Oestrogen and testosterone are strong neurodevelopmental hormones that also contribute to neuromodulation and neuroprotection in the mature brain. Sex steroids may also be involved in the pathophysiology of schizophrenia as some evidence exists of altered brain sex steroid receptors and reduced circulating sex steroid levels in patients with schizophrenia compared to controls. In men with schizophrenia, recent studies have documented an inverse correlation between serum testosterone and negative symptoms, but its effect on cognitive deficits is unclear. Our study sought to determine whether reductions in testosterone levels were related to increased symptom severity and impaired cognition in schizophrenia. Circulating testosterone, oestrogen, and prolactin levels, cognitive function and symptoms were assessed in 29 men with chronic schizophrenia. Twenty healthy men were recruited as controls. We did not find a significant difference in serum testosterone levels between groups. However, circulating testosterone levels were correlated with verbal memory and processing speed in men with schizophrenia. No significant correlations between testosterone and cognitive function were observed in healthy men. Testosterone levels were not related

to symptom severity in our sample. The results suggest that sex steroid pathways may play a role in cognitive deficits associated with schizophrenia.

Visual and Auditory Alpha-enhancement EEG Biofeedback in Generalised Anxiety Disorder (GAD) and in Health

Norman C. Moore¹, Mary Walker¹, Tracy Wilson¹, Susan Wallace¹

¹Quillen College Medicine, East Tennessee State University, Tennessee, USA

Alpha-enhancement is an effective treatment of GAD. Most training is done eyes-closed in a laboratory, whereas anxiety is usually experienced eyes-open. We compared eyes-open with eyes-closed training in both patients and controls. Participants (15 GAD patients; 11 controls) underwent 15 one-hour sessions; 5 per protocol. Treatments were: eyes-open visual (A); eyes-closed auditory (B), and eyes-open auditory + visual (C). Practice effects were controlled by using 6 orders of treatment: ABC, ACB, BAC, BCA, CAB and CBA. A Likert Visual Analog Scale of Anxiety and the Hamilton Anxiety Scale (HAM-A) were administered at baseline and at the end of each of the three types of feedback. During eyes-closed auditory feedback, healthy controls significantly increased alpha by 6.3+1.95 mV (mean + standard error), whereas during eyes-open combined auditory/visual feedback their alpha decreased by 0.03+1.3 mV ($p=0.01$ two-tail). Anxiety levels did not differ between different types of feedback. In GAD patients neither visual nor auditory NT increased alpha or decreased anxiety. Five sessions of eyes-closed auditory feedback were sufficient to increase alpha in healthy controls, but were insufficient for anxious patients. This is in accordance with previously reported data stating that 30 sessions are necessary.

Do Kids see what Adults see Without a Dorsal Stream Advantage?

M. J. Murphy¹, C. L. Hoysted¹, R. Laycock¹, N. Goharpey¹, J. H. Bridie¹, D. Faragalla¹, K. G. Fithall¹, K. Hodge¹, A. Hodgson¹, Z. Koyu¹, A. L. Shilton¹, K. Tsoutsoulis¹, C. Ucarli¹, A. Brown¹, D. P. Crewther¹, S. G. Crewther¹

¹School of Psychological Science, La Trobe University; Brain and Psychological Sciences Research Centre, Swinburne University of Technology

The impact of later development of the dorsal, in comparison to the ventral, visual stream was investigated within a framework of the Magnocellular Advantage model of the mature visual system. Typically developing (or developed) participants ($N = 110$) grouped as Younger Children (4-7 yrs), Older Children (10-13 yrs) and Adults (18-30 yrs), completed a series of customised computer motion and form coherence detection tasks designed to provide a functional measure of

dorsal/ventral pathway performance. Dorsal involvement in a traditionally ventrally-dominated object-recognition task was achieved by biasing onset/offset conditions to preferentially stimulate the temporal characteristics of both pathways. Adults performed better than children on all tasks except motion coherence thresholds. A significant improvement in performance was seen between younger children and older groups on dorsal tasks (Motion Coherence and Navon Global Accuracy) but not on all ventral tasks (Form Coherence and Navon Local Exposure Time). Results support earlier psychophysical and electrophysiological investigations indicating that the dorsal stream matures later than the ventral stream. Thus suggesting that in young children the underdeveloped dorsal visual pathway may rely more on ventral stream visual processing, which has important implications for the perception and attentional processing of transient events.

Increased Indirect Priming for an Explicit Task? A Surprising Schizophrenia Finding

Erica Neill¹, Susan Rossell²

¹Monash Alfred Psychiatry Research Centre, Monash University

²Swinburne University of Technology

Investigations of explicit semantic access in schizophrenia (Sz) are scarce. Traditional priming studies have made some attempt in their investigations of ‘controlled’ processing; achieved by increasing SOA and relatedness proportion. Review and meta-analyses of such studies conclude that under ‘controlled conditions’ priming is eliminated reflecting a failure to utilise strategy. This is not necessarily true of explicit access because while the above methods increase the likelihood that participants will *notice* the semantic relationships, they do not guarantee it - controlled processes are not synonymous with explicit access. Explicit access is ensured through instruction, a technique rarely used in the Sz literature. One study using instruction found no significant explicit direct or indirect priming in sz while two others, investigating directly related pairs only, found intact explicit priming. The current study compared implicit and explicit semantic priming for both direct and indirect stimuli so that more definite conclusions could be made about semantic access in Sz. The results showed that implicit direct priming was evident with no indirect priming found. Explicit results found intact direct and enhanced indirect priming. These results are discussed in light of semantic hyper priming and with regard to the potential for memory training.

Temporal Dynamics of Motor Coordination in Bimanual Load Lifting

Tommy H. B. Ng¹, Paul F. Sowman¹, Jon Brock¹, Blake W. Johnson¹

¹ARC Centre of Excellence in Cognition and its Disorders, Macquarie University

When a waiter lifts a glass of wine from a tray of drinks balanced on one hand, the change in load on the load-bearing arm must be anticipated and pre-emptively countered with spatiotemporal precision. This means that neural processes associated with *movement* in one arm must be precisely coordinated with *anticipatory postural adjustments* (APA) in the other, in order to maintain postural stability and avoid spillage. Little is currently known about the neural underpinnings of movement-APA coordination in humans. We measured brain activity with whole-head magnetoencephalography while participants performed a bimanual load-lifting task. Results indicated that motor structures subserving such coordination were activated in a distinct, temporal order – first in the primary motor cortex contralateral to the load-lifting arm, then, in the cerebellum, and lastly, in the basal ganglia, supplementary motor area, thalamus, primary- and pre- motor cortices contralateral to the load-bearing arm. These data contribute to our understanding of the underlying mechanisms supporting movement-APA coordination in healthy adults. Information about the timing of signature neural events is likely to be useful in elucidating motor coordination problems in a variety of motor and cognitive syndromes.

Application of EEG-fMRI Methods: Investigate Neural Processing of Faces

Vinh T. Nguyen¹, Ross Cunnington¹

¹The University of Queensland

EEG and fMRI studies have reliably identified a face-selective neural signal, respectively the N170 component and at least two regions in the fusiform gyrus – the fusiform face area (FFA) and the occipital face area (OFA). However, most neuroimaging studies have studied ERP and fMRI face-selective process separately, so the relationship between N170 and the network of the fusiform gyrus is not yet completely understood. In this study, we concurrently measured EEG and fMRI responses to upright faces, inverted faces and objects to investigate the correlation between the variation of ERP face-selective responses and BOLD signals. The estimate of N170 amplitudes in single trials was used to construct additional regressors in the general linear model to calculate BOLD responses. Our results show that N170 for upright faces mainly correlates with voxels in the FFA region. N170 for objects correlates with the medial area of the fusiform gyrus, which does not overlap with active voxels of upright faces. On the other hand, a widespread activation in the parietal, occipital and fusiform regions are found to strongly correlate with N170 of inverted faces.

Error-related Anterior Cingulate Cortex Activity and the Prediction of Error Awareness

Catherine Orr¹, Mark A. Bellgrove², Robert Hester¹

¹Department of Psychological Sciences, University of Melbourne

²The University of Queensland

Research has consistently identified dorsal anterior cingulate activity (ACC) as necessary but not predictive of conscious awareness of errors. Two recent studies (Steinhauser and Yeung, 2010; Wessel et al. 2011) have suggested that the greater activity may instead reflect task influences (e.g., response conflict, error probability) and/or individual variability (e.g., statistical power). We re-analysed fMRI BOLD data from participants (n=46) who had completed the Error Awareness Task, a motor Go/No-go task in which subjects' awareness of errors of commission is assessed. Activity in a number of cortical regions, including bilateral inferior parietal and left insula cortices, was predictive of error awareness. In contrast to previous studies, however, including our own smaller sample studies using this task, error-related dorsal ACC activity was significantly greater during aware errors than unaware errors. Although RT for aware errors was significantly faster than for unaware, suggesting a role for response conflict in driving the ACC activity, this finding was not associated with differential dorsal ACC activity. The data suggests that individual variability in error awareness is associated with error-related dorsal ACC activity, and therefore this region may be important to conscious error detection, but it remains unclear what task and individual factors influence error awareness.

Cross-Modal Influences of Stimulus Interval on Auditory and Somatosensory ERP Components

J. Pace¹, T. W. Budd¹

¹School of Psychology, University of Newcastle

Multisensory Integration (MSI) represents a fundamental process for the production of coherent behaviour, cognition and perception. Recent neuroscientific investigations have provided evidence that MSI is initiated early in sensory processing and within low-level cortical regions traditionally thought to be exclusively unisensory. A popular index of MSI in neuroscience studies is super-additivity, although the suitability of this model for functional and electrophysiological neuro-imaging methods has been questioned. To address this limitation the present study exploited an established event related-potential (ERP) measure of early sensory processing to examine the cross-modal influence of stimulus interval and repetition on the N1-P2 ERP components. Using randomised sequences of rapid auditory and vibrotactile stimulation, ERP component sensitivity to variable stimulus onset asynchronies (SOA) between 60-510 ms and regular asynchronies at 1, 2 and 4 s were analysed for uni-modal (auditory-auditory, somatosensory-somatosensory) and cross-modal (auditory-somatosensory, somatosensory-auditory) stimuli sequences. Our results replicate previous ERP research demonstrating N1-P2 sensitivity to stimulus repetition and SOA for both auditory and somatosensory stimuli. However, we found little evidence of cross-modal interactions, suggesting that these ERP effects may be exclusively uni-modal. These findings underscore the complexity and specificity of multisensory interactions, implying that that these ERP phenomena may only subserve unisensory temporal processing.

A Behavioural Analogue for Early Audiovisual Interactions in the N100

Tim Paris¹, Jeesun Kim¹, Christopher Davis¹

¹MARCS, University of Western Sydney

Recent electrophysiological studies have shown that seeing a talker in addition to hearing their speech can bring an evoked N100 response forward in time and reduce its size. This result has been taken as evidence for a visual influence that occurs early in auditory processing. To date, no study has investigated whether there is a behavioural analogue to this electrophysiological finding. The current study aimed to do this by adopting the design of one of these neurophysiological studies [van Waseenhove, Grant & Poeppel, 2005] and using identification response time as a dependant measure. Participants watched videos that consisted of the sounds /pa/, /ka/ and /ta/, with matched and mismatched videos that showed the talker's whole face or still face (control). The task was to vocally repeat what was heard. In order to dissuade participants from simply using lip movements as a response cue most videos (85%) had mismatched sounds and lip movements. The results showed a similar pattern to the electrophysiological findings: Seeing the talking face (in AV matched movies) lead to faster responses and this effect was modulated by the degree of visual salience ('pa' > 'ka'). These results provide behavioural evidence that visual speech speeds up the processing of auditory speech.

Using Language Models and Latent Semantic Analysis to Characterise the N400 m Neural Response

Mehdi Parviz¹, Mark Johnson¹, Blake Johnson², Jon Brock²

¹Macquarie University

²ARC Centre of Excellence in Cognition and its Disorders, Macquarie University

In this paper we build a computational model to predict N400 m response which is the neuromagnetic version of the N400. Stimuli consisted of 180 sentences presented to 22 listeners. There were 90 examples of "constraining context" sentences, and 90 examples of "non-constraining context" sentences. Besides the manually-annotated context predictor, we investigate 4 additional predictors based on Latent Semantic Analysis, a 4-gram language model, an incremental parser, and a novel pairwise-priming language model based on the IBM Model 1 translation model. Statistical analysis shows that all the predictors are significant. Moreover, we show that predictors based on the 4-gram language model and the pairwise-priming language model are highly correlated with the manual annotation of contextual plausibility, suggesting that these predictors are capable of playing the same role as the manual annotations in prediction of the N400 m response. We also show that the proposed predictors can be grouped into two clusters of significant predictors, suggesting that each cluster is capturing a different characteristic of the N400 m response.

Predictive Coding and Continuous Flash Suppression

**Bryan Paton¹, Jakob Hohwy¹, Joshua Skewes¹,
Torben Lund¹**

¹School of Philosophical, Historical and International Studies/School of Psychology & Psychiatry, Monash University

Continuous flash suppression (CFS) is a visual phenomenon closely related to binocular rivalry. Like binocular rivalry, a different image is presented to each eye and perception alternates between these two percepts. In CFS, one eye is presented with a changing pattern that suppresses the image in the other eye. The depth of the suppression is thought to be a function of the strength of the stimulus and the parameters of the flashing pattern. We employed a CFS paradigm to investigate the suppression and dominance periods and associated BOLD responses of a face stimulus when co-presented with a flashing Mondrian pattern. Our aim was to not only capture a BOLD response related to activity changes associated with the suppressed and dominant stimulus. This talk will outline the results of 11 participants with a view towards contextualising these results in light of a predictive coding theory of neural function.

Statistical MMN: A tale of Two Distributions

**Bryan Paton¹, Joshua Skewes¹, Ivana Konvalinka¹,
Jakob Hohwy¹**

¹School of Philosophical, Historical and International Studies/School of Psychology & Psychiatry, Monash University

The Mismatch Negativity (MMN) is characterised as a specific ERP response to an odd or deviant stimulus in a train of stimuli. There is still some debate over what the exact mechanism is that best explains the MMN but the most popular theory is one based on a sensory memory mechanism. The key elements of this theory are the memory neurons thought to construct some form of model of the standard stimuli. When an incoming deviant stimulus violates this model, the MMN is elicited. When this kind of model is interpreted in the context of a broader theory of neural function, the Free Energy framework by Karl Friston, the MMN comes to represent a paradigmatic example of prediction error. One consequence of this interpretation is that the MMN should respond to statistical regularities in the environment. We present data from 28 individuals who completed a fully statistical frequency deviant MMN where standards were drawn from one distribution and deviants from another distribution. Thus, the relationship between standard stimuli was determined only by their co-membership in a shared distribution, similarly for deviant stimuli. We discuss the results in the light of the Free Energy framework.

Pre-Movement Activity and Intentional Binding: Measuring Readiness Potentials during Shifts in Perceived Timing of Actions and their Sensory Consequences

Simandeeep Poonian¹, Ross Cunnington¹

¹Queensland Brain Institute, University of Queensland

Intentional binding occurs when there is perceived shortening of the time interval between a goal-directed action and its sensory consequence. This phenomenon is thought to result from the action and its consequence being causally bound together in time (Haggard, Clark, & Kalogeras, 2002). Recent research has suggested that the neural mechanisms of intentional binding are located in supplementary motor area (SMA), an area that is a well-known source of pre-movement activity such as readiness potentials. The aim of this research was to investigate whether readiness potentials were a possible correlate of intentional binding. ERP measurements were conducted on participants who performed an interval judgment task between tone-tone pairs, self-made action-tone pairs and observed action-tone pairs. Our behavioural results indicate a perceived shortened interval between the two events in both of the action conditions (self-made and observed) in comparison to no action tasks (tone). However, anticipatory ERP activity was not found to occur across the conditions that elicited intentional binding. This finding suggests that pre-movement neural processes of the SMA, reflected in the readiness potential immediately prior to movement initiation, may not be a correlate for intentional binding.

Evidence for Two Routes to Expertise in Mental Rotation of Images

**Alexander Provost¹, Blake Johnson², Frini
Karayanidis¹, Scott Brown¹, Andrew Heathcote¹**

¹The School of Psychology, The University of Newcastle

²ARC Centre of Excellence in Cognition and Its Disorders, Macquarie University

One's ability to imagine a spatial transformation of an object (e.g. "mental rotation") can be improved with practice. Some researchers propose that practice speeds the rate of mental rotation; others suggest that performance improvements arise through the adoption of an alternative, memory-based cognitive strategy. Thus far, it has not been possible to adjudicate between these alternatives with behavioural evidence alone. We measured behavioural responses and brain activity in two experiments designed to assess the evidence for these two pathways to improvement in mental rotation; one with a small set of stimuli to encourage direct memory retrieval strategies and another with a much larger set designed to discourage memory-based strategies. Before practice participants displayed two well-established signatures of mental rotation: both response time and EEG negativity increased linearly with rotation angle. After extensive practice with a small stimulus set, both signatures of mental rotation had all but disappeared. In contrast, after the same amount of practice with the large stimulus set, both signatures remained even though performance improved markedly. Taken together these results constitute compelling evidence for the existence of two routes to expertise in mental rotation.

Covert Orienting Task Performance is Influenced by Non-Attentional Processes

Stephen Provost¹, Bethany Lusk², Frances Martin²

¹Southern Cross University

²University of Tasmania

The covert orienting task has recently been used as a method for analysing attentional processes thought to underlie psychological disturbances, such as phobias. The study described here was designed to seek psychophysiological evidence for these attentional processes. Participants detected two target stimuli (tall or wide rectangles) cued by pictures located on the same side of the screen as the target (valid: 80% of trials) or on the opposite side (invalid: 20% of trials). Cues were either neutral or mildly arousing pictures from the IAPS. Event related potentials obtained indicated that processing of cues was influenced by expectancies generated by the length of “runs” of consistent trial types. Reaction time performance was consistent with this, and there was evidence for both a “hot-hand” (expect the next trial to be the same as the last) and a “gambler’s fallacy” (expect the next trial to change after a run) operating within individual subjects’ data. These idiosyncratic effects of within-session variables that are not related to attention suggest that use of the covert orienting task for understanding psychopathology may be somewhat more complex than is usually acknowledged, and that psychophysiological measurement provides a useful adjunct to behavioural experimentation in this area.

Pointing it Out: Processing Faces in the Absence of Attention

Genevieve Quek¹, Matthew Finkbeiner¹

¹ARC Centre of Excellence in Cognition and its Disorders, Macquarie University

Masked priming is a phenomenon in which subliminal stimuli modulate responses to subsequent visible targets. In congruence priming paradigms, subjects typically respond faster to congruent targets (i.e. of the same category as the preceding prime) than to incongruent targets. Such effects are generally only observed when the prime stimulus is attended. This is not the case for faces, which produce priming effects both when attended and unattended. But is face processing truly invulnerable to attentional modulation, or simply more robust to it than other stimuli? We hypothesised that congruence priming should be evident earlier when the face is attended, and tested this possibility using a reaching paradigm that indexes priming at a stage in which stimulus processing is still ongoing. Using this sensitive measure, we find converging evidence that the visual system is able to process masked faces in the absence of attention, and speculate on the nature of attentional effects on this processing.

Bistability of Sodium Channels Increases the Safety Factor at the Neuromuscular Junction

Mohammed Mostafizur Rahman¹, Mufti Mahmud^{1,2}, Stefano Vassanelli¹

¹University of Padova, Italy

²Jahangirnagar University, Bangladesh

Neuromuscular Junction (NMJ) is the place where the functionality of motor neuron terminal and muscle end plate meets to perform a smooth electro chemical transmission creating a synapse. The remedies of several NMJ diseases (i.e., Myasthenia Gravis, Lambert-Eaton Myasthenic Syndrome) are not yet known due to our limited understanding of the transmission process at the NMJ. The extracellular potential in the narrow extracellular space between nerve cell and muscular fiber (cleft) is affected by the current flow generated by the opening of sodium channels; consequently, voltage-dependent processes may be affected in the adjacent membranes. This phenomenon of current passing through weakly opened sodium channels and decreasing the potential of the extracellular space by boosting channels activation and by a positive feedback is termed “self-gating”. According to this hypothesis applied to NMJ, the extracellular voltage drop in the cleft may modify the voltages across the muscle fiber membrane, thus increasing the probability of opening the voltage-gated ion channels. We show that the proposed transmission model considering the contribution of sodium channels at the muscle membrane infolds and extracellular voltages in the cleft will increase the safety-factor of the NMJ by 15%.

Electroretinography as a Measure of Behavioural Plasticity

Nina Riddell¹, Mel Murphy¹, Sheila Crewther¹

¹School of Psychological Science, La Trobe University

The refractive state of the eye is actively refined throughout early childhood by cues from the visual environment. Deprivation of visual cues and prolonged near-work during childhood can trigger excessive ocular growth and the development of myopia. However, the mechanisms by which the eye detects visual defocus and initiates an appropriate growth response, independently of the brain, remains unclear. There is strong evidence implicating the balance of activation of the ON and OFF visual pathways. Thus, this study aimed to test whether electroretinographic (ERG) responses to short dark/light transitions could be used to predict the direction of ocular growth in response to signed defocus. Chicks were first intravitreally injected with pharmaceutical agents known to inhibit ON or OFF pathway activity and either raised with ± 10 D defocusing lenses or no defocus and measured biometrically, or the ERG responses of the outer retina monitored over the same time period in a subgroup of no-lens chicks. Comparison of the biometric measures obtained from chicks subject to defocus, with electroretinogram recordings over the same time period, revealed that the ratio of ON response to OFF response was predictive of the sign and degree of ocular growth.

Nutritional Status and Stress Response: Do B Vitamins Buffer the Response to Stressful Situations?

Renee Rowsell¹, Andrew Scholey¹, Andrew Pipingas¹

¹Centre for Human Psychopharmacology, Swinburne University of Technology

Recent links between nutritional status and mood has been made in the literature, suggesting a protective effect of B vitamins against undesirable mood states. Little research has focused on the protective effects of B vitamins and response to a stress inducing situation. The current study investigated the associations between vitamin B status and stress reactivity, in a group of healthy adults aged over 50 years. It was expected that vitamin status would buffer stress response, anxiety and fatigue after completing a computerised stressor task.

The Purple multi-tasking framework (Purple Research Solutions Ltd, UK) was used to induce a stress response. Visual analogue scales (Bond & Lader, 1974) were completed both pre and post the Purple battery. Fasting blood samples were taken to measure levels of B12, B6, folate and homocysteine. Results indicated that participants felt significantly greater stress, and more fatigued than prior to the Purple battery. Furthermore, participants reported significantly less contentedness and calmness after completing the task. Vitamin status was not related to changes in stress, anxiety or fatigue. These results suggest that the Purple multitasking framework is effective in inducing mild levels of stress in participants aged over 50 years, and that this response is not buffered by B vitamin status.

Mechanisms of the Relationship Between Essential Fatty Acid (EFA) Blood Status, Cognitive Performance and Cardiovascular Function

Laura Sellick¹, Andrew Pipingas¹, Isabelle Bauer¹, Matthew Pase¹, David Crewther¹

¹Centre for Human Psychopharmacology, Swinburne University of Technology

Essential fatty acids (EFAs), which must be obtained through dietary sources, are an important part of a balanced diet. Typical n-3 to n-6 ratios in a Western population average around 16:1, an extremely high ratio. Research suggests a healthy EFA status can improve cognitive performance and cardiovascular health. However, little is known about the connection between these variables. This study investigated the relationship between EFA status, cognitive performance and cardiovascular function in a young adult population and aimed to investigate the mechanisms of this relationship. It was hypothesised that a higher ratio of n3 to n6 would be associated with improved cognitive performance as demonstrated by faster reaction times and higher accuracy rates, and increased blood flow velocity, and that improved cognition would be mediated by increasing blood flow velocity. Blood flow velocity through the common carotid artery, measured by the transcranial Doppler device, significantly correlated with multiple EFA measures, and many

EFA levels correlated with cognitive performance. However, no significant relationship was detected between cardiovascular variables and cognitive performance. Participants with a better EFA status displayed better cognitive performance and faster cerebral blood velocity, suggesting that n3 PUFA's benefit cardiovascular health and cognitive performance. However, these effects appear to be independent, indicating cognitive improvements are not mediated by blood flow.

BOLD Evidence for a Relationship Between Contextual Processing and Delusional Beliefs in the Normal Population

Kiley Seymour¹, Timo Stein¹, Lia Sanders¹, Ines Häke¹, Philipp Sterzer¹

¹Charité-Universitätsmedizin Berlin

Contextual processing deficits have been considered to underlie many of the cognitive impairments associated with Schizophrenia. For instance a failure of context to guide processing has been attributed to the emergence of delusional beliefs (e.g. Frith, 1979). Here we examined delusional ideation in a non-clinical population and asked whether the extent of cortical processing allocated to contextual visual stimuli relates to one's propensity to report delusions (as measured with Peter's et al Delusion Inventory). Our fMRI study found evidence for a significant correlation between the level of contextual modulation of the BOLD signal in retinotopic cortex and a subject's measure of delusional ideation. These results reinforce the idea of the schizotypal nervous system (e.g. Claridge and Hewitt, 1987) and a proposal that contextual processing deficits are the manifestation of a larger disturbance of cognitive coordination in schizotypy and schizophrenia (e.g. Uhlaas et al., 2004).

Movement Interference in Imitative Rhythmic Arm Movements

Usha Sivaranjani Sista¹, Jason Friedman¹, Mark Williams¹

¹ARC Centre of Excellence in Cognition and its Disorders, Macquarie University

Previous studies have shown that observing an action interferes with the performance of a similar but non-identical action. This interference effect may occur while observing some effectors (e.g., humans, dots) and not others (e.g., humanoid robots). In one experiment we examined what aspect of movement causes the interference effect. Subjects made arm movements in two opposite diagonal directions while watching a video of either a human making similar arm movements or a dot moving on the screen following the path of the fingertip. The human video and the dot moved at either the natural velocity (NV) or at a constant velocity (CV). The subjects executed either congruent (same direction) or incongruent (opposite direction) movements with respect to the stimuli. In the other experiment we looked at whether the perspective of observing

the movement affected interference. We looked at interference from observing the mirror-arm (specular view) and observing the anatomical arm (third-person view). These studies will help us understand the key determinants of this interference effect (such as the congruency, velocity profile or stimulus type) as well as shed light on the different pathways engaged by the Action Observation Network when involved in imitation.

Inferring Causality using Timelag Analysis of fMRI BOLD Data

Ben Smith^{1,2}, Ian Kirk¹, Sarina Iwabuchi¹, Patrice Delmas²

¹Research Centre for Cognitive Neuroscience, Psychology Department, University of Auckland

²Computer Science Department, Vision Lab, University of Auckland

Brain region interactions could reveal much about the structure of cognitive systems, and might be measurable using time-lagged correlation of BOLD data collected using fMRI. Previous researchers have described methods for detecting time-lagged correlation between region of interest (ROI) activation – primarily variants on ‘Granger causality’ (GC). With appropriate caveats, GC can draw inferences from temporal precedence about effective connectivity between ROIs in a way methods like SEM and DCM do not. Some studies examined circumstances where time-lagged correlation between ROI activation can help draw causal inferences from BOLD data, and tested the limits of poor temporal resolution of fMRI on this method. The current project examines whether time-lag analysis can estimate the direction of causation in frontal and parietal areas known to act together in spatial working memory tasks. Independent Component Analysis is used to identify components whose interactions are then examined using the GC method. The method successfully identified causal relationships on replicated, artificially simulated data, but has not yet significantly detected GC relationships between ROIs in the spatial working memory task. Changes under way to better detect GC relationships include multivariate Granger analysis, a frequency-domain approach, and optimising selection of components.

‘Filling-in’ of Stimuli at the Physiological Blind Spot Reflects Lateral Connections Rather than Feedback

Felice C. Smith¹, Anina N. Rich², Stuart L. Graham³, Peter de Lissa², Kevin R. Brooks⁴, Mark A. Williams²

¹Department of Biological Sciences, Macquarie University

²ARC Centre for Cognition & its Disorders, Macquarie University

³Australian School of Advanced Medicine, Macquarie University

⁴Department of Psychology, Macquarie University

The region where the optic nerve exits the eye is ‘filled in’ by the brain to prevent perception of a blind spot. The

mechanism of this perceptual filling-in has been hotly debated, primarily between feedback from higher visual areas and spreading from adjacent cortex via lateral neuronal connections. Previous research has demonstrated that stimuli presented to one border of the physiological blind spot are perceived as elongated into the blind spot, providing a measure of filling in (Dilks et al. 2009; Araragi et al. 2009). We used a two-alternative forced choice width judgement task to examine whether this partial filling-in reflects lateral connections in early visual cortical neurons. In a series of experiments, we first replicate the finding that stimuli presented around the blind spot are elongated into this region relative to stimuli presented at control sites away from the blind spot. We then demonstrate that rotating the stimuli to optimally stimulate lateral connections results in maximal elongation whereas presenting stimuli rotated tangentially (which should avoid stimulating lateral connections across the blind spot) eliminates the elongation. These data provide novel support for the lateral connection hypothesis, and rule out a feedback mechanism for perceptual filling-in of the physiological blind spot.

Motor and Non-Motor Inhibition in the Go/NoGo task: An ERP and fMRI Study

Janette L. Smith^{1,2}, Sharna Jamadar^{1,3}, Alexander L. Provost¹, Patricia T. Michie¹

¹School of Psychology, University of Newcastle

²National Drug and Alcohol Research Centre, University of New South Wales

³Olin Neuropsychiatry Research Center, Institute of Living, Hartford, USA

The contribution of movement-related activity to Go/NoGo ERP differences has been debated for 25 years. In particular, some researchers have argued that the P3 NoGo effect reflects not inhibition-related positivity on NoGo trials, but movement-related negativity on Go trials. In this study, we examined ERP and fMRI measures of activity in twenty adults performing non-motor (count) and motor (right-handed button press) trials of the Go/NoGo task. Task performance was highly accurate and similar in the ERP and fMRI environments. No significant task-related effects were observed for the N2 component, nor were there differences in the P3 range between Press Go and Count Go trials. However, we observed a substantial increase in positivity for Press NoGo compared to Count NoGo trials, contrary to the movement-related potentials argument. The fMRI results also revealed significant deactivations for Press NoGo relative to Count NoGo trials in several left-lateralised motor-related areas, including the inferior frontal gyrus, precentral gyrus and supplementary motor area. Together, the results indicate that the P3 NoGo effect in motor tasks is caused not by movement-related negativity on Go trials, but by inhibition-related positivity on NoGo trials, and that this is associated with deactivation of motor areas involved in the Go response.

EEG and MEG Markers of Vocal Inhibition in Fluent and Non-fluent Speakers

Paul F. Sowman¹, Andrew Etchell¹, Stephen Crain¹, Elisabeth Harrison¹, Blake W. Johnson¹

¹ARC Centre of Excellence in Cognition and Its Disorders, Macquarie University

Overactivation of the right inferior frontal gyrus, an area of the brain that underpins voluntary arrest of action, has been associated with stuttering. While there has been much research conducted on manual response inhibition, very few studies have examined vocal response inhibition and to date, no study has examined the temporal neurodynamics of vocal inhibition. Therefore, the first part of the present study identified, in a group of control participants, the temporal neural correlates of vocal response inhibition by recording electroencephalographic activity during a modified version of the stop signal task. Behavioural results showed that participants were able to inhibit a vocal response within approximately 324 ms. Analysis of ERPs revealed that a positive component around 324 ms was significantly larger in amplitude during successfully stopped trials compared to in an ignore condition. The second part of this study applied the methodology of the first part to a group of stuttering participants in a magnetoencephalographic (MEG) study. The results of this allow us to examine the temporal neurodynamics of vocal response inhibition in stutterers and to examine these in relation to the brain structures known to exhibit functional activation anomalies in stuttering.

Age Related Cognitive Change: An ERP Analysis

Tara Spokes¹, David Shum¹, Tim Cutmore¹, Nancy Pachana²

¹School of Applied Psychology, Griffith University

²University of Queensland

Although there are a number of theories that describe the progression of age-related cognitive decline, there is a continued need to better understand the underlying mechanisms of cognitive ageing. Event-Related Potentials (ERPs) offer alternative information that may contribute to the development of these theories. A growing body of evidence suggests that although older adults are able to maintain performance on automatic cognitive tasks, neural processing of these tasks is impaired. In particular, a wider spread of neural activity is accompanied by reduced amplitude and increased latency in ERP waveforms. Further, older adults show similar neural activity for automatic and controlled tasks, where younger adults demonstrate different neural activation between the two tasks. Another finding of interest is that intra-individual variability on reaction time precedes cognitive decline in older adults. Intra-individual variability of ERP data demonstrates the impact of increased neurological variability on behavioural outcomes and successful task completion. This research aims to explore these applications of ERP data to identifying

underlying mechanisms of age-related differences in both automatic and controlled cognitive tasks.

Does the Target-to-target Interval Determine Multiple Components of the Event-related Potential?

Genevieve Z. Steiner¹, Craig J. Gonsalvez¹, Robert J. Barry¹, Michelle L. Brennan¹

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

The target-to-target interval (TTI) is a principal determinant of the amplitude of the late positive complex (LPC) of the event-related potential (ERP), where systematic increases in TTI linearly augment LPC amplitudes. The aim of this study was to ascertain whether other ERP components are influenced by TTI in a fashion analogous to the LPC. We employed a three-stimulus visual oddball task with equiprobable targets and infrequent nontargets, and frequent standards. Electroencephalographic activity was recorded from 27 participants. As expected, longer TTIs evoked larger LPC amplitudes. A similar pattern of results emerged for P1 and P2, where increases in TTI systematically enhanced P1 and P2 amplitudes. N1, however, evidenced no effect of interval, and N2 decreased in amplitude as TTI increased. Together, these findings suggest that some exogenous ERP components are sensitive to temporal manipulations of target stimuli in a manner comparable to that of later endogenous components. It is thus feasible that TTI is modulating the cognitive systems that are involved in processing target stimuli, such as attention and working memory. Theoretical implications are discussed.

Is Aloud Allowed? Differentially Impaired Meaning Attribution in Schizophrenia

Eric Tan¹, Susan Rossell^{1,2}, Gregory Yelland¹

¹Monash-Alfred Psychiatry Research Centre, Monash University

²Swinburne University of Technology

Thought disorder (TD) in schizophrenia is characterised by impaired semantics, that is, processing of meaning. Building on Burstein (1961), we sought to uncover if differential impairments related to word type exist in meaning attribution within schizophrenia; specifically how antonyms and homophones affect synonym identification in schizophrenia. We devised a 102-item semantic meaning task (SMT) to examine the effect of antonyms (51-items) and homophones (51-items) on synonym identification. 42 schizophrenia/schizoaffective disorder patients (age $M = 42.81$, $SD = 10.30$) completed the SMT and Wechsler Test of Adult Reading (WTAR). Current symptoms were assessed using the Positive and Negative Symptom Scale (PANSS). Patients incorrectly selected more homophones than antonyms when asked to identify synonyms, $F(1,40) = 23.33$, $p < .001$. They also selected more homophones than completely

unrelated responses, $F(1,40) = 10.97$, $p < .01$. Significant positive correlations were also established between thought disorder on the PANSS (Bell et al., 1994) and the total number of homophone errors but not antonym errors. This data reveals an interesting differential response in schizophrenia; that when faced with unclear meaning attribution, schizophrenia patients are more likely to choose a semantically unrelated word that sounds similar to the target. This suggests that persons with TD use phonological cues as a compensatory mechanism when engaging in meaning attribution.

Evidence for Automatic Linguistic Processing in Preschool Children: A Magnetoencephalography Study

Graciela Tesan¹, Blake Johnson¹, Stephen Crain¹

¹ARC Centre of Excellence in Cognition and its Disorders, Macquarie University

This study used magnetoencephalography (MEG) to investigate which brain areas four-year old children activate to process grammatical anomalies. Using MEG, we were able to localise brain areas involved in semantic and syntactic integration processes in the brain of normally developing children. Subjects: we report data from 19 English-speaking, right-handed, 4 year olds (mean age = 53 months, S.D. = 3 months). Children listened to spoken sentences. To ensure children were paying attention to the stimuli, their task was to repeat a catch phrase contained in filler. Neuromagnetic fields were recorded with a child-sized whole-head, 64-channel axial gradiometer MEG system (KIT/Yokogawa, Japan) at the KIT-Macquarie Brain Research Lab (Macquarie University, Sydney, Australia). To identify neural generators, we used the distributed inverse method LORETA (BESA 5.3). Our region-of-interest analysis revealed a significant larger response of the posterior superior temporal lobe between 380 to 530 ms bilaterally to ungrammatical contexts. In comparison to analogous studies with adults, we found that children's brains activate a similar network while processing linguistic anomalies. Our results provide evidence in favor automatic semantic and syntactic processes to be in place earlier than predicted by constructivist views of language development.

Differential Effects of Risperidone Versus Haloperidole on Brain Activation in first Episode Schizophrenia Patients: A Multicenter fMRI Study

R. Thienel¹, T. Kircher², U. Habel², T. Kellerman³, M. Reske⁴, W. Wolwer⁵, I. Frommann, E. Meisenzahl, S. Ufer, D. F. Braus, A. Schmitt, M. Wagner, A. Rapp, T. Stoecker, N. J. Shan, R. Schloesser, S. Ruhrmann, M. Riesbeck, W. Gaebel, F. Schneider

¹Priority Centre Brain & Mental Health, University of Newcastle, Australia

²Department of Psychiatry and Psychotherapy, University of Aachen, Germany

³Department of Psychiatry, Lab of Biology, Dynamics & Theoretical Medicine, University of California, USA

⁴Department of Psychiatry and Psychotherapy, Georg-August University of Göttingen

⁵Institute of Neuroscience and Biophysics, Research Centre Jülich GmbH, Germany

Cognitive impairments like working memory deficits are core symptoms of schizophrenia occurring in the early phases of the disease. They are not caused by chronic sequelae of the illness, medication, or institutionalisation but by the illness per se. Moreover, a growing body of evidence indicates that these deficits contribute to functional outcome impairment (Green, 1996; Green et al., 2000). The comparative effect of typical and atypical antipsychotic medications on neurocognition is controversial, and based primarily on studies with small samples and large doses of typical comparator medications (Keefe, et al., 2006). Our aim was therefore to determine the effect of risperidone versus haloperidol on functional dysfunction in a double blind randomised control study using functional magnetic resonance imaging (fMRI) in a sample of first-episode schizophrenia patients during a working memory task. Thirty-six first episode schizophrenia patients (DSM IV) were recruited from the Departments of Psychiatry of the Universities Bonn, Cologne, Düsseldorf, Mainz, München, Tübingen, and the Central Institute of Mental Health Mannheim, as part of the German Research Network of schizophrenia. Patients received either risperidone (N=17, mean daily dose: 4.5 ± 1.7) or haloperidol (N=19, mean daily dose: 2.9 ± 1.5) in a double blind treatment regime. The task during fMRI data acquisition (1.5 Tesla scanner) consisted of an n-back paradigm with a randomised sequence of 0-back and 2-back conditions arranged in a block design. During '0-back', subjects saw a sequence of letters and had to respond to a target letter (X). '2-back' required subjects to press the button whenever the occurring letter was the same as the last but one letter. The data was analysed using a flexible factorial design (SPM8) including medication dose (in mg) and gender as a covariate.

Non-linear Electroencephalographic Measures of Higher Order Perceptual and Cognitive Events

K. C. D. Tyler¹, D. T. J. Liley¹

¹Brain and Psychological Sciences Research Centre, Swinburne University of Technology

A non-linear dynamical analysis of neural mean fields allows the neural underpinnings of consciousness to be understood as a formation of evolving patterns without recourse to rule like operations circumscribed to a discrete functional component of the brain. In this study, the non-linear dynamics of cortical mean fields are investigated for the extent to which they are able to operate as a measurable signature of higher order perceptual and cognitive events. Electroencephalographic (EEG) data was analysed for nonlinearities, in conditions of both the

presence and absence of specific higher order perceptual events. Participants were shown ‘magic eye’ random dot autostereograms. Comparisons were then made between EEG data acquired in conditions in which the embedded three-dimensional image was perceived versus conditions in which the image was not perceived. The presence of nonlinearities in the data was assessed on the basis of event related phase synchronisation. Pilot data has indicated significantly greater alpha-beta synchrony in conditions in which the embedded three-dimensional image was consciously perceived compared to condition in which the embedded image was not perceived. On the basis of these preliminary results there is a strong indication that analysis carried out on a full data set will confirm that phase synchronisation and nonlinear activity can extrapolate a measure for the presence and nature of conscious, higher order perpetual events.

An Examination of the Magnocellular Pathway in Object Boundary Detection and Luminance Contrast in High and Low Autistic Quotients

Lucinda Vainer¹, David Crewther¹

¹Swinburne University of Technology

Autism Spectrum Disorder (ASD) is typically accompanied by abnormalities in sensory modalities, specifically visual processing. It has been suggested that everyone encompasses autistic traits to some extent. Tendencies such as these can be measured by the Autistic Spectrum Quotient (AQ). Those who score highly on the AQ tend to have more traits that are archetypal of a person with autism than those who have a low AQ score. It has been suggested that altered perception in individuals exhibiting autistic traits is due to abnormal function of the Magnocellular pathway. There is a lack of a neurobiological explanation for these visual disturbances. We show evidence from Visual Evoked Potential (VEP) data from 40 subjects (20 with high scoring AQs) aged 19-45years for a deficit in the Magnocellular pathway in regards to luminance and contrast. It has also been shown through inspection time and threshold data that there is a specific delay in object boundary detection in those with high scoring AQs. It was shown that object boundary detection was increased with a higher contrast of stimuli. These results are in line with previous research showing specific neural irregularities in ASD coinciding with evidence for an anomaly of horizontal processing. We suggest that luminance and contrast of textured stimuli is vital in exploring these visual anomalies in clinical and non-clinical populations.

The Effects of Repetition on the Simulation of Past and Future Events

**Valerie van Mulukom^{1,2}, Reece P Roberts^{1,2},
Donna Rose Addis^{1,2}**

¹Department of Psychology, University of Auckland

²Centre for Brain Research, University of Auckland

Previous fMRI work in our lab has examined the effect of novelty on future event simulation with a repetition suppression paradigm, and has shown that repetitions decrease reaction times for event construction, as well as producing an fMRI adaptation effect in a number of regions recruited by episodic simulation. These findings were attributed to the effects of novelty inherent to imagining future scenarios. It is not clear, however, if these effects are specific to the repetition of future event simulation or whether they would also occur to the same extent when repeatedly recalling past events. To this end, we conducted an adjusted behavioural version of the experiment that requires repeatedly simulating both past and future events. The experiment followed a 2x3 factorial design: *condition* (future/past) x *repetition* (1st/2nd/3 rd). Main effects of *condition* and *repetition* revealed that participants took longer to construct future events than past events and that the time taken to construct a scenario decreased linearly from the 1st to 3 rd presentation. Importantly, a significant interaction showed that the effect of repetition was greater for future event construction than for past events. The current study provides evidence that the effect of novelty on simulation is greater for future events.

Multi-voxel Coding in Frontal, Parietal and Visual Cortices: The Effect of Top-down Attention on the Representation of Novel Objects

Alexandra Woolgar¹, Anina N. Rich¹, Mark A. Williams¹

¹ARC Centre of Excellence in Cognition and Its Disorders, Macquarie University

To cope with the complex visual world around us, we can select particular aspects of visual input by directing our attention to them. This ability is fundamental, yet the mechanism remains elusive. One influential hypothesis is that frontal and parietal brain regions exert control over the visual cortices by biasing processing in favour of relevant information (Duncan and Miller, 2002). Accordingly, the overall level of activation in visual cortical areas increases with attention (e.g. Hopfinger et al., 2000). However, it remains unclear how this overall increase leads to improved performance. Recent advances in analysis techniques for fMRI have made it possible to assess attentional processing changes in greater detail, by considering what information is carried in patterns of activity across voxels. We used fMRI to record the BOLD response to three novel objects. Strength of coding was assessed by calculating the discriminability of patterns for different objects. We found that when participants directed attention towards one of two objects in a visual display, the representation of the attended object was enhanced, relative to the less-attended object, in both frontoparietal and visual cortices. Our results suggest that selection of visual information is mediated by enhanced multi-voxel coding of attended information.

Neuromagnetic Responses to Speech and Nonspeech Sounds and Autism: An MEG Pilot Study

Shu Yau¹, Jon Brock¹

¹ARC Centre of Excellence in Cognition and its Disorders, Macquarie University

The present study aims to further investigate the neural basis of speech perception in children with Autism Spectrum Disorders (ASD). Within ASD, communication is impaired and language functioning varies. Our research uses Magnetoencephalography to measure brain responses to matched speech and nonspeech stimuli. In our pilot study with healthy adults, we used a source localisation technique, known as Event-Related Beamforming and looked at the auditory Mismatch Field (MMF). The MMF provides a neuronal index of speech sound discrimination - crucial for language processing and development. Preliminary data from the pilot study with adults will be discussed. Based on previous research using other techniques, we predict aberrant brain responses in children with ASD, which is related to the child's degree of language impairment in autism.

Reproducing the Müller-Lyer Illusion in a Computational Feed-Forward Object Recognition Model**Astrid Zeman¹, Oliver Obst², Anina N. Rich¹**

¹ARC Centre of Excellence in Cognition and Its Disorders

²CSIRO ICT Centre

The Müller-Lyer illusion is where the perceived length of lines is altered when the shafts are terminated by various fins. Lines appear shorter in a 'wings-in' configuration versus longer in a 'wings-out' configuration. Explanations for this effect range from low level signal processing to the misapplication of rules from higher cognitive areas. Computer models that mimic visual processing allow for some of these proposed contributing factors to be tested in isolation. The HMAX model is a current

state-of-the-art object recognition model that is also biologically plausible [Mutch and Lowe, 2008 International Journal of Computer Vision 80(1) 45–57]. We trained this model to perform a dual categorisation task based on relative line lengths within an image. We then measured the accuracy of the system in categorising control images versus illusory images. Our results indicate this feed-forward model replicated an overall illusory effect.

Representations of Visual Information with respect to Body Parts in the Human Brain: An fMRI Study**Regine Zopf¹, Mark A. Williams¹**

¹ARC Centre of Excellence in Cognition and its Disorders, Macquarie University

Visual information of our own body and other bodies is an important source of information which guides our actions and perception. Using fMRI we study the location and characteristic of brain areas which process visual body information. The investigation of body- and body-part-selective brain areas has so far focused on areas in the occipitotemporal cortex [such as extrastriate body area(s) (EBA)]. In this study we specifically focus on the parietal cortex which is known to be involved in action planning and multi-sensory perception. In a first experiment, we employed an fMRI block design and presented images of hands, feet, objects and faces. We found that in addition to the known occipitotemporal areas, also parietal areas were more active when pictures of body parts were presented as compared to objects and faces. In a second experiment, we investigated the coding for body-part orientation in parietal and occipitotemporal body-part-selective areas. The results from both experiments will be discussed.