CPCN

UQ Centre for Perception and Cognitive Neuroscience

CPCN Workshop
2nd – 3rd December 2010

School of Psychology

The University of Queensland

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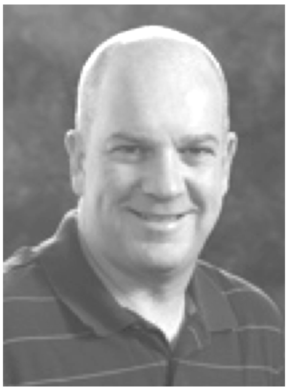
Keynote Speakers

Thursday 2nd December
16:00 – 17:00



Mark Williams
Macquarie Centre for Cognitive Sciences
Macquarie University, Sydney, Australia.

Dr. Williams completed his PhD, at Monash University Melbourne Australia, in 2003 before completing post-doctoral research fellowships at the University of Melbourne and the Massachusetts Institute of Technology (MIT). He took up a position at Macquarie University in 2007.

Dr. Mark Williams' research focuses primarily on the cognitive and neural mechanisms involved in face and facial expression perception. He is also interested in other aspects of perception, such as the processing of objects and complex scenes. He uses neuroimaging techniques such as fMRI and simultaneous MEG/EEG to explore questions concerning the location and timing of neural events.

Abstract
tba

Keynote Speakers

Friday 3rd December
16:00 – 17:00

René Marois
Department of Psychology, Vanderbilt University, USA

Dr. René Marois completed his PhD at Yale University in 1996, before completing a post-doctoral fellowship at Yale University (1997 – 1999). He took up a faculty position at Vanderbilt University in 1999.

Dr. Marois' research focuses on the neural bases of attention and information processing in the human brain, using a combination of fMRI and psychophysical tools. He is particularly interested in understanding the neural basis of attentional capacity limits (e.g. Why can we only attend to very few objects at a time? Why can't we select or execute more than one task at a time?), and in understanding the relationships between attention, working memory and awareness.

Abstract
tba

Talk Sessions

Session 1, Thursday 2nd December
09:30 – 10:30
Chair: Derek Arnold, CI: Perception Lab

09:30 – 10:00
Warrick Roseboom – Perception Lab
Learning to reach for 'invisible' objects: evidence of 'blindsight' in normal observers.
Blindsight refers to the ability of patients with visual cortex damage to detect, localise or discriminate visual stimuli that they deny 'seeing'. In this study we sought to create an analog of blindsight in normal observers using binocular masking via continuous flash suppression. Participants reached toward and pretended to grasp a pair of parallel lines oriented horizontally or vertically, made 'invisible' via masking. The dependent variable was the orientation of the hand at grasp. Over a period of training (six 100 trial sessions) during which trial-by-trial feedback was provided as to accuracy, participants showed a significant improvement in their ability to orient their hand to grasp the 'invisible' target. No improvement was evident when other participants simply provided verbal responses, even with matched training. Trial-by-trial reports of subjective visibility and confidence in performance revealed that, while participants never reported 'seeing' the target, performance was highly correlated with confidence. These data have important implications for the treatment of cortically blind patients, and highlight the indistinct boundaries between visible and invisible inputs.

10:30 – 11:00
David Painter - Cognitive and Behavioural Neuroscience Lab
Physiological mechanisms underlying feature-based attention
Through visual perception we gain a nuanced understanding of the objects in our environment. The functional organisation of the cerebral cortex underlies this profound ability. Retinal location, the timing of neuronal communication, and feature selectivity organise vast networks of visual neurons. Of all the objects that fall on the retina, however, very few are processed to the level of awareness. The objects we do notice tend to possess special features or be relevant to our behavioural goals. To meet these goals, the visual system can prioritise information appearing at relevant spatial locations (e.g., objects on the left) or with relevant features (e.g., red objects). This latter form of selection, termed feature-based attention, exploits the modular organisation of the visual system and is thought to reflect circuits linking frontoparietal and occipotemporal regions. Despite this, it remains unclear how the brain enables us to follow rules to prioritise some feature sets over others. To address this, this research aims to develop physiological measures of feature selectivity. We will apply these measures to investigate the neurophysiological basis of attention deficits following right hemisphere stroke. Additionally, we will seek causal evidence for the role of specific cortical sites in prioritising behaviourally relevant feature representations.

Session 2, Thursday 2nd December
11:00 – 13:00
Chair: Ada Kritkos, CI: Perception and Action Lab

11:00 – 11:15
Dana Schneider – Attention & Control Lab
The Eyes Have It! Sustained Spontaneous Belief Processing
Crucially important to human social competency is the possession of a theory of mind (ToM), which refers to an ability to understand the mental states - beliefs, intensions and knowledge - of others. Belief-processing abilities are commonly measured using false belief reasoning tasks (e.g. Sally-Anne tasks). Here, in crucial false belief trials an actor – Anne – hides a ball in one box after Sally, another actor, has seen it being placed into a different box and left the room. The task is for participants to identify the box that is consistent with Sally's belief about the ball's location as opposed to the ball's actual location. The ability to pass this test is a developmental milestone and typically achieved by 4 years of age. However, recent eye-movement research has provided evidence that children as early as 13 months process beliefs of others. To accommodate these conflicting findings Apperly and Butterfill (2009) have proposed a two-path cognitive system of belief processing consisting of a late developing, cognitively more demanding, and flexible component and an early developing, cognitively less demanding, and efficient component. To date eye-movement findings have only been observed in experiments containing single belief trials. Thus, it is unknown to what extent automatic belief processing operations are sustained over time. Here we adapted a belief-processing eye-movement paradigm to a repeated trial design in order to replicate evidence supporting the existence of an efficient belief-processing system and explore the temporal nature of it. Strikingly, we found that implicit belief attributions sustained across multiple trials over a prolonged time period. This provides further evidence for a low-level/efficient belief-processing system and importantly, that its action is not transient in nature.

11:15 – 11:30
Stephanie Goodhew – Attention & Control Lab
Implicit semantic perception in object substitution masking
Decades of research on visual perception has uncovered many phenomena, such as binocular rivalry, backward masking, and the attentional blink, that reflect 'failures of consciousness'. Although stimuli do not reach awareness in these paradigms, there is evidence that they nevertheless undergo semantic processing. Object substitution masking (OSM), however, appears to be the exception to this rule. In OSM, a temporally-trailing four-dot mask interferes with target perception, even though it has different contours from and does not spatially overlap with the target. Previous research suggests that OSM has an early locus, blocking the extraction of semantic information. Here, we refute this claim, showing implicit semantic perception in OSM using a target-mask priming paradigm. We conclude that semantic information suppressed via OSM can nevertheless guide behaviour.

11:30 – 11:45
Andrew Bayliss – Perception & Action Lab
The influence of reciprocated joint attention bids on person perception
tba

11:45 – 12:00
Anjali Diamond – Perception Lab
Evidence opposing opponent facial coding
tba…

12:00 – 12:15
Anina Rich – Macquarie Centre for Cognitive Science
Irrelevant pitch cues visual attention in space
Integration of information across the senses occurs in a seemingly effortless fashion. Previous studies have demonstrated a cross-modal 'mapping' of pitch with spatial location (high pitch = upper, low pitch = lower) using tasks requiring response selection (e.g, forced choice). I will discuss some of our recent experiments exploring the extent to which this effect is due to attentional cueing (rather than response-level effects). We show that spatially non-predictive and non-lateralised auditory cues affect visual detection, suggesting they induce shifts of visual attention. In other experiments, we find this effect is context dependent, and differs from

reflexive attentional cueing effects.

12:15 – 12:30
Oliver Bauman – Cognitive & Behavioural Neuroscience Lab
Medial Parietal Cortex Encodes Perceived Heading Direction in Humans

The ability to encode and update representations of heading direction is crucial for successful navigation. In rats, head-direction cells located within the limbic system alter their firing rate in accordance with the animal's current heading. To date, however, the neural structures that underlie an allocentric or viewpoint-independent sense of direction in humans remain unknown. Here we used functional magnetic resonance imaging (fMRI) to measure neural adaptation to distinctive landmarks associated with one of four heading directions in a virtual environment. Our experiment consisted of two phases: a "learning phase," in which participants actively navigated the virtual maze; and a "test phase," in which participants viewed pairs of images from the maze while undergoing fMRI. We found that activity within the medial parietal cortex—specifically, Brodmann area 31—was modulated by learned heading, suggesting that this region contains neural populations involved in the encoding and retrieval of allocentric heading information in humans. These results are consistent with clinical case reports of patients with acquired lesions of medial posterior brain regions, who exhibit deficits in forming and recalling links between landmarks and directional information. Our findings also help to explain why navigation disturbances are commonly observed in patients with Alzheimer's disease, whose pathology typically includes the cortical region we have identified as being crucial for maintaining representations of heading direction.

12:30 – 12:45
Will Harrison – Remington Lab

Continuous coherent motion in the visual field can lead to reflexive eye movements called optokinetic nystagmus (OKN), where the eyes first pursue a moving element then saccade opposite to the direction of motion to pursue another. OKN can be suppressed by fixating on a stationary object. How is our perceptual organisation of the world affected during active suppression of OKN? After replicating previous findings that, during OKN suppression, briefly flashed targets are systematically mislocalised in the direction of motion, we showed, for the first time, that during OKN suppression eye movements were biased in the same direction. By varying the magnitude of OKN that needed to be suppressed, we found that mislocalisations occur mostly during more active OKN suppression, indicating that it is unlikely that visual motion alone explains these mislocalisations. We argue that distortions of visual space at least partly result from mechanisms invoked by OKN and its suppression.

12:45 – 13:00
Nonie Finlayson – Grove Lab
Taking a closer look at capture by stereomotion: is it attention to motion or depth?

Previous research has found that irrelevant motion in depth captures attention. However this research not only has conflicting results regarding attentional advantage and varying qualities of stimuli presentation, it also overlooks a major methodological confound. Using a search paradigm in which an irrelevant item moves forward or backward in depth to join other items in a search task, researchers have shown that motion in depth speeds reaction times to the target. This research overlooks the depth singleton nature of the motion in depth item before it starts moving, and any capture effects attributed the motion in depth may in fact be due to the unique depth of the item. My present research addresses this issue and also discusses the capture differences between approaching and receding motions.

Session 3, Thursday 2nd December
14:30 – 15:30
Chair: Greig de Zubicaray, CI: fMRI Lab

14:30 – 15:00
Derek Arnold – Perception Lab
Recalibrating Perceived Time
tba…

15:00 – 15:30
Paul Dux – Attention & Control Lab
tba…
tba…

Session 4, Friday 3rd December
09:00 – 10:30
Chair: Ottmar Lipp, CI: Psychophysiology Lab

09:30 – 10:00
Joyce Vromen – Psychophysiology Lab
Does the Spider always win the Fight for Attention? Top-Down Modulation in Fear-Relevant Interference
tba…

10:00 – 10:30
Stefanie Becker – Remington Lab
How the relational properties of objects guide attention.
What factors guide visual attention? Traditionally, theories posit that attention is guided by activity in separate visual feature maps. Recent visual search studies support, instead, a relational account in which attention and eye movements are guided by information about target-distracter relationships (e.g., redder, larger; Becker, 2010, Becker, Folk, & Remington, in press). In the Relational Theory, features are represented in a continuous feature space (instead of, e.g., separate feature maps) and target-distracter relationships are described by the direction of vectors pointing from the target to the distracter features. If this view is correct, observers would be tuning attention to a direction in feature space rather than to a specific feature or feature category. Here, I will present some new evidence in support of this view, arguing that relational search can explain a multitude of findings that were previously attributed to a categorical or a saliency-based mechanism of visual search.

Session 5, Friday 3rd December
11:00 – 13:00
Chair: Jason Mattingley, CI: Cognitive & Behavioural Neurosci. Lab

11:00 – 11:15
David Butler – Early Cognitive Development Unit
The Dorian Gray Effect: Recognizing Pictures from Across the Lifespan As Measured by Event Related Potentials
tba…

11:15 – 11:30
Shashenka Milston – Brain & Action Lab
tba
tba

11:30 – 11:45
Katherine Baker – Brain & Action Lab
tba
tba

11:45 – 12:00
Tarrant Cummins – Cognitive Neuroscience Lab
The dopamine transporter gene, DAT1
tba

12:00 – 12:15
Pascal Molenberghs – Cognitive & Behavioural Neuroscience Lab
The Influence of Context on Action Observation
A controversial topic is the role of the mirror system in action understanding. Some authors have suggested that the mirror system has an important role in action understanding (Rizzolatti and Sinigaglia, 2010) but others have claimed that direct evidence to support this view has been lacking (Hickok, 2009). If mirror neurons just have a passive role in action observation, they should always respond in a similar way to the observation of actions irrespective of the mindset of the observer. In this fMRI study, participants showed different patterns of activation in ventral premotor cortex and inferior parietal lobule during observation of identical actions, when the task was either to understand the actions, identify the physical features of the actions or passively observe the actions. Our results suggest that these areas, which have been previously associated with the mirror system, respond differently to perception of actions depending on the relevance to the observer.

12:15 – 12:30
Merryn Constable – Perception & Action Lab
Grasping the concept of personal property
The concept of property is integral to personal and societal development. Despite this, very little research has investigated ownership from a cognitive perspective. Here I outline evidence that suggests that the visuomotor system represents property at multiple stages of object processing. We first gave participants a mug to decorate, retain and use. We then compared their interactions with Participant-owned, Experimenter-owned and Unowned mugs. Participants lifted the Experimenter's mug with greater care compared with other mugs. Further, they lifted their own mug more forcefully and drew the in-flight mug closer to their own body. In a second experiment, we utilized a computer-based Simon task that showed that the usual compatibility effects elicited by graspable objects are absent for the Experimenter's mug - as if the action system is blind to the potential for action towards another person's property. This data provides the first evidence that the concept of ownership is represented in the visuomotor system.

12:30 – 12:45
Claire Naughtin – Perception & Action Lab
Linking Prior Emotional Behaviour to Face Identities: An fMRI Study
Faces can communicate a remarkable amount of information through a few simple features, and as social beings, we can use this knowledge to navigate social interactions. During social encounters, it is crucial that we not only perceive how others behave, but also remember this information and associate it with the

relevant face identities. As a result, we can use knowledge from prior encounters to guide our behaviour towards the same people when they are re-encountered in future situations. For example, if someone displayed inappropriate facial expressions during your first encounter with them (e.g., smiling towards something unpleasant), it would be useful to associate this behaviour that person's identity so that you know to avoid them in subsequent situations. Behavioural studies provide evidence that peoples' judgements about others can be influenced by their prior experiences with them, however, the neural regions that mediate this ability are largely unknown. My presentation will discuss my honours research project which examined the neural structures that underlie our ability to associate prior social experiences with face identities by manipulating whether a face displayed appropriate or inappropriate emotional behaviour during initial social encounters.

12:45 – 13:00
James Retell. Remington Lab
No surprise, rare motion singletons capture attention
Understanding the role of top-down mechanisms in attentional capture has important consequences for understanding attentional control. Spatial cueing experiments have shown that involuntary shifts of attention are contingent on top-down attentional control settings. However, recent results suggest that task-irrelevant rare events can capture attention in the absence of active control settings for them. We explored this further by introducing a motion singleton into the cue frame of a spatial cueing experiment as a surprise event to see if it would override existing attentional control settings. The motion singleton was presented in competition with a valid target-colour cue. Results (n=20) showed a motion singleton at a non-target location led to elevated response times to validly cued targets. It appears that surprising and rare motion singletons can capture attention even when they compete with a task-relevant colour cue.

Session 6, Friday 3rd December
14:30 – 15:30
Chair: Paul Dux, CI: Attention and Control Lab

14:30 – 15:00
Gabriella Blokland, fMRI Lab
Genetic Influences on Working Memory Brain Activation: A Twin fMRI Study

Using a genetically informative sample including both monozygotic (who share all their genes) and dizygotic (who share, on average, 50% of their genes) twins, we examined the extent to which task-related brain activation is influenced by genetic (heritability) and environmental factors. We did this separately for cerebrum and cerebellum and report maps of sources of variance in cognitive brain function. Whole-brain BOLD functional MRI (fMRI) data were acquired during the 0-back and 2-back conditions of a spatial *n*-back working memory task on a 4T scanner. We excluded twins with <30% accuracy on either *n*-back condition, and those with insufficient scan quality. The cerebrum sample consisted of 319 healthy twins; 75 MZ pairs (46F/29M), 66 DZ pairs (30F/11M/25FM), and 37 unpaired twins (22F/15M), aged 23.6±1.8 years. The cerebellum sample consisted of 189 twins; 27 MZ (25F/2 M) and 26 DZ pairs (18F/3M/5FM), and 83 unpaired twins (69F/14M), aged 22.6±3.4 years. Using SPM5, GE-EPI were realigned, co-registered with the twin's 3D T1-weighted scan, spatially normalised in MNI atlas space, smoothed with an 8 mm FWHM Gaussian kernel, and detrended. For the cerebellum processing, GE-EPI were realigned, smoothed, detrended, co-registered, and then spatially normalised using the SUIT Toolbox (Diedrichsen, 2006). Separately for the cerebrum and cerebellum, *t*-scores were extracted on a voxel-by-voxel-basis from 2>0-back contrast images generated at the single-subject level in each of the voxels comprising a mask created from a group random effects analysis irrespective of zygosity. We estimated maximum likelihood twin correlations, and genetic and environmental variance components, using structural equation modelling (Mx; Neale et al., 2004). Significant estimates at the voxel level are cluster thresholded based on Monte Carlo simulation (AlphaSim).

The group random effects analysis showed a significant increase in BOLD signal during the 2-back compared to the 0-back condition ($p < 0.05$, FWE-corrected) in the bilateral middle frontal, inferior frontal, supramarginal, superior parietal, and middle occipital gyri, right lateral orbitofrontal, superior frontal, middle and inferior temporal gyri, left insular cortex, bilateral precuneus, right angular gyrus, and bilateral caudate nuclei. In the cerebellum we found significant activation of the left Crus I, VI, and IX, bilateral Crus II, right lobules VIIb, I_IV, and IX, and vermis lobule VI. Overall, the twin correlations for task-related brain activation were greater between MZ twins than between DZ twins, especially in frontal and parietal areas in the cerebrum, and in left Crus I and VI in the cerebellum, suggesting genetic control of brain function is greatest in those regions. Indeed, the genetic brain maps indicate several areas with a moderate to high genetic influence on working-memory-related cerebral activation, in particular in the left supplementary motor area, frontal and temporal gyri, middle cingulate cortex, superior parietal lobule, and precuneus (>40% of the variance), as well as a moderate heritability of activation in the cerebellar left hemisphere lobules VI and VIII, left Crus I, right Crus II and right lobule VII. The genetic influence on the cerebellum appears more modest than on the cerebral cortex, suggesting that the mechanisms underlying cerebellar activation during working memory may differ from those underlying the activation of the cerebral cortex. Although there are also sizeable environmental influences on brain activation, the genetic determination may be sufficiently strong for future studies to detect individual genes contributing to task-related brain activation.

15:00 – 15:30
Grieg de Zubicaray, fMRI Lab
Mechanisms of cognitive control in language production

Despite several decades of research into spoken word planning, most theoretical models of speech production continue to omit a role for attentional control mechanisms. I will review evidence from neuroimaging and computational modelling investigations of interference paradigms indicating lexical selection is biased by top-down mechanisms in order to overcome competition introduced by lexical neighbours.