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<td>9:00am - 9:30am</td>
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| 9:30am - 9:35am | Introduction and Welcome  
*Professor William Forde Thompson, Director, Centre for Elite Performance, Expertise, & Training, Macquarie University, Australia* |
| 9:35am - 10:15am | **Intuition is implicit perceptual expertise: Theoretical foundations of expert decision-making**  
*Dr Michael Harré, University of Sydney, Australia* |
| 10:15am - 10:55am | **Beyond the intellect: The contribution of learning and self-regulation to cognitive performance trajectories**  
*Dr Damian Birney, University of Sydney, Australia* |
| 10:55am - 11:00am | Morning tea                                                                                                        |
| 11:00am - 12:00pm | **Keynote 1: Towards a new understanding of object perception**  
*Professor Mary Peterson, University of Arizona, USA* |
| 12:00pm - 1:00pm | **Building an understanding of holistic perception from domain-general object perception mechanisms**  
*Dr Kim Curby, Centre for Elite Performance, Expertise, & Training, Macquarie University, Australia* |
| 1:00pm - 2:00pm | Lunch                                                                                                               |
| 2:00pm - 3:00pm | **Keynote 2: Mathematical reasoning as a literally physical symbol system**  
*Professor Robert Goldstone, Indiana University, USA* |
| 3:00pm - 3:40pm | **Using the Cyber Glove to re-train normal visuo-motor co-ordination**  
*Professor Mark Williams, Centre for Elite Performance, Expertise, & Training, Macquarie University, Australia* |
| 3:40pm - 4:20pm | **Motor acquisition and expert skill in solo piano performance**  
*Dr Jennifer MacRitchie, The MARCS Institute, Western Sydney University, Australia* |
| 4:20pm - 4:30pm | Closing remarks and workshop close                                                                                   |
| 4:30pm - 6:00pm | Networking event: Drinks and pizza @ Macquarie University Ubar                                                        |
**Intuition is implicit perceptual expertise: Theoretical foundations of expert decision-making**

Dr Michael Harré, *University of Sydney, Australia*

9:35-10:15am

**Abstract:** 'Intuitive decision-making' in complex tasks by world class experts has sometimes had an aura of specialness; think of Grand Master chess players who can play many simultaneous games against good players with very little reduction in performance. The speed and accuracy of such experts is problematic for decision theory, complex decisions require more information and more time to process than simpler decisions. Experts seem to make such intuitive leaps in decisions better and more quickly than non-experts though. In this talk I will discuss what we know about the neuro-psychological foundations of such abilities and how my work integrated such psychological expertise in an Artificial Intelligence.

**Bio:** Dr Michael Harré studies how systems as diverse as financial markets and environmental ecosystems evolve and are affected by variations in human behaviour, with the aim of allowing us to better manage these systems and to thrive as a society in the complex environments in which we live. Dr Michael Harré suggests that we are not well equipped, cognitively speaking, to deal with the complexity of the systems that have come to dominate our world: financial and economic systems, climatic systems and even our social interactions and how information is spread. Everything depends on everything else, often leading to the impression that chaos and disorder dominate, and that trying to understand such systems is a lost cause. But if we scratch the surface, there are often some basic underlying principles. Understanding these is the biggest challenge we face today, and this is what Dr Michael Harré’s work aims to achieve.

**Beyond the intellect: The contribution of learning and self-regulation to cognitive performance trajectories**

Dr Damian Birney, *University of Sydney, Australia*

10:15-10:55am

**Abstract:** Many psychometric tests of ability are scored as some aggregate of the number of items answered correctly. In its use, this score is implied to be a unidimensional, relatively time-invariant indicator of cognitive ability, disconnected from the broader context from which it was derived. From the test-takers perspective, intelligence tests entail a contextualized interaction with a set of progressively difficult cognitive activities (i.e., items) over a period of around 20-40mins. The research I will describe is interested in what happens during that time. Personality (Openness, Extraversion and Neuroticism) and metacognitive factors have consistently been associated, albeit at low levels, with cognitive performance. 252 industry managers completed, inter alia, IQ tests either with or without confidence ratings. Using multi-level modelling, we investigated whether a) experiential factors emerge in individual performance trajectories, b) whether trajectories are associated with cognitive and personality factors, and c) whether requirements to externalize metacognitive reflection (provide confidence ratings) links to performance. Results suggest that metacognitive reflection impeded performance; that learning trajectories are separable from performance trajectories; and that trajectories are statistically moderated, most notably by Neuroticism, over and above cognitive ability.

Psychometric complexity (ψC) and psychometric learning (ψL) are proposed as a theoretically derived, empirical basis to ground investigations of statistical moderation. Together they may provide a bridge to causal accounts of the divide between intelligence and personality. I discuss new research in our lab that further investigates the implications of these findings.
**Bio:** Dr Damian Patrick Birney was awarded his PhD (University of Queensland, Australia) in December 2002. He has since held positions researching intelligence and memory at Yale University, the University of Sydney, and the University of New South Wales. He served as the Director of the Accelerated Learning Laboratory (University of New South Wales), a research group that investigated the development of leadership expertise in senior managers. Damian has provided psychometric and statistical consulting on various Australian and international research projects and has been a co-chief investigator on Australian Research Council and industry grants in excess of $5million. He currently holds a teaching and research position at the University of Sydney. Damian teaches in the areas of statistics and intelligence and his research interests are in measurement, psychometric assessment, and training of working-memory, fluid intelligence and cognitive flexibility. He is currently leading a team of researchers at the University of Sydney exploring the motivational and cognitive factors underlying cognitive training.

**Keynote 1**

**Towards a new understanding of object perception**

Professor Mary Peterson, *University of Arizona, USA*

11:20am-12:20pm

**Abstract:** Visual perception was long understood as a serial feedforward process in which, at a very early stage of processing, borders between regions in the visual input were assigned as bounding contours to the region on one side; this constituted object detection (aka figure assignment). The other region, lacking a shaping contour, was perceived as a locally shapeless ground to the object. On this feedforward view, object memories and semantics were accessed only after object detection occurred and only for objects ("figures"), not for grounds. Research in my laboratory shows that this traditional view is incorrect, and favours the alternative view that before object detection, a fast pass of processing accesses object memories and activates multiple possible object hypotheses that could fit both sides of borders. These hypotheses compete for perception at high and low (V1 and V2) levels of the visual hierarchy. The winner is detected/perceived; the loser is suppressed. In my talk, I will review some history and then summarize recent experiments consistent with the view that object detection occurs via hierarchical Bayesian inference.

**Bio:** Professor Peterson investigates how we perceive the world visually. She uses cognitive neuroscience techniques (e.g., ERPs, fMRI, and behavioural methods) to investigate: (a) the competitive processes producing object perception, and how they are affected by context; (b) the reciprocal relationship between perception and memory; (c) feedforward and feedback mechanisms in perception; (d) how unconsciously activated knowledge affects attention and perception; and (e) how brain damage and aging affect the perception of, and memory for, objects. Professor Peterson is a Fellow of the American Association for the Advancement of Science (AAAS); of the American Psychological Association (APA); the Association for Psychological Science (APS), and the Psychonomic Society. She is an elected member of the International Neuropsychological Symposium (INS) and the Society of Experimental Psychologists (SEP), and has served on the Governing Boards of the Vision Sciences Society.

**Building an understanding of holistic perception from domain-general object perception mechanisms**

Dr Kim Curby, *Macquarie University, Australia*

12:20pm-1:00pm

**Abstract:** I will present a framework for understanding expert holistic perception that proposes that extensive experience with a stimulus category renders objects of expertise into highly coherent units that foster strong object-based selection. This object-based selection is bolstered by over-learned patterns of distributed attentional prioritisation across the stimulus. I argue that these qualities – strong grouping between features and the resulting cohesive object-based representations, in
conjunction with a learned distributed prioritisation of features across the stimulus – facilitate interactive encoding of features and their object context and underlie the demonstrated failures of selective attention to features within objects of expertise (i.e., “holistic” effects). This framework builds on well-established findings that perceptual grouping of features plays a critical role in determining the units (or “objects”) available for attentional selection and that a stimulus’ status as an object provides numerous perceptual advantages that are strengthened by experience. It also builds on literature suggesting that learned patterns of attention prioritisation operate very rapidly and shape the manner in which information is extracted from a stimulus. In my presentation, I will draw on this work as well as recent evidence from my lab and that of others to evaluate this framework.

Bio: Dr Curby is a Senior Lecturer in the Department of Psychology at Macquarie University. Her research focuses on the extent to which effects of visual learning and/or perceptual expertise permeate even the most basic cognitive functions. Her research also aims to more broadly elucidate the cognitive and neural mechanisms of successful learning in the visual domain. Dr Curby moved to the USA from Sydney to obtain her PhD in Psychology from Vanderbilt University in 2006. She then accepted a post-doctoral position within Yale University’s School of Medicine. From Yale, Dr Curby moved to Temple University to head her own lab. In 2012, she moved back to Sydney to start a position at Macquarie University and soon after she was awarded a Discovery Early Career Award (DECRA) from the Australian Research Council (ARC). Dr Curby has served on the editorial boards of the journals *Psychological Science, Attention, Perception, & Psychophysics, Frontiers in Cognitive Science* and the soon to be launched, *Journal of Expertise*.

**Keynote 2**

**Mathematical reasoning as a literally physical symbol system**

Professor Robert Goldstone, *Indiana University, USA*

2:00-3:00pm

**Abstract:** Much of the power of mathematics comes from its generality and ability to unify prime face dissimilar domains. The same combinatorics formula applies to sealing wax, cabbages, and kings with no customization needed, or even permitted. By one account, analytic thought in math and science requires developing deep construals of phenomena that run counter to untutored perceptions. This approach draws an opposition between superficial perception and principled understanding. In this talk, I advocate the converse strategy of grounding mathematical reasoning in perception and action. I will describe empirical evidence for perceptual changes that accompany learning in mathematics. In arithmetic and algebraic reasoning, we find that proficiency involves executing spatially explicit transformations to notational elements. People learn to attend mathematical operations in the order in which they should be executed, and the extent to which students employ their perceptual attention in this manner is positively correlated with their mathematical experience. People produce mathematical notations that they are good at reading. Perception, attention, and action routines are tailored to fit mathematical requirements. Thus, for reasoning in mathematics (and science, but that’s another talk), relatively sophisticated performance can be achieved not only by ignoring perceptual features in favour of deep conceptual features, but also by adapting perceptual processing so as to conform with and support formally sanctioned responses. These “Rigged Up Perception and Action Systems” (RUPAS) offer a promising general strategy for achieving educational reform. Based on the theoretical foundation of RUPAS, we have begun to design, implement, and assess virtual, interactive sandboxes for students to explore algebra.

**Bio:** Robert Goldstone is Distinguished Professor in the Psychological and Brain Sciences department and Cognitive Science program at Indiana University. His research interests include concept learning and representation, perceptual learning, educational applications of cognitive science, decision making, collective behaviour, and computational modeling of human cognition. He won the 2000 APA Distinguished Scientific Award for Early Career Contribution to Psychology, and a 2004 Troland research award from the National Academy of Sciences. He was the executive editor of *Cognitive Science* from 2001-2005. He has been elected as a fellow of the Society of Experimental Psychologists, the Cognitive Science Society, and the American Academy of Arts and Sciences.
Using the Cyber Glove to re-train normal visuo-motor co-ordination

Professor Mark Williams, Macquarie University, Australia

3:00-3:40pm

Abstract: The Cyber Glove is a wireless motion capture device that can record from 22 finger joints continuously capturing hand and finger movements. Using the Cyber Glove technology, we can detect the precise movement of all joints in the hand. Integrating this technology with 3D rendering we are able to create a virtual hand in the same location and with the same motion as the real hand. Using this device, we are then able to alter how the virtual hand responds to normal finger movements. I will describe a series of experiments in which we altered the direction of movement of the index finger. That is, if a person moved their finger up they would see their virtual hand move down and vice versa. This allowed us to firstly explore how quickly one can adapt or re-train to this abnormal visuo-motor plan and secondly to examine the influence of the visual and haptic feedback on motor planning.

Bio: Following his PhD, Professor Williams worked at the University of Melbourne as a Postdoctoral Scientist supervised by Professor Jason Mattingley for 2.5 years. Subsequently, he was awarded an NHMRC CJ Martin Travelling Postdoctoral Fellowship to go to Massachusetts Institute of Technology (MIT) supervised by Professor Nancy Kanwisher for two years, beginning in August 2005. Professor Williams returned to Australia in September 2007 to complete the NHMRC Fellowship, taking up a Senior Lecturer position at Macquarie Centre for Cognitive Science (MACCS), Macquarie University. In 2009, he was awarded an ARC Queen Elizabeth II Fellowship for five years to further develop his research in the neural underpinnings of perception.

Motor acquisition and expert skill in solo piano performance

Dr Jennifer MacRitchie, Western Sydney University, Australia

3:40-4:20pm

Abstract: Performance on a musical instrument requires multiple cognitive skills, coordinating both gross and fine motor movements in order to play a series of notes. Piano professionals spend decades training their fingers to produce various sequences accurate to minute time-scales and velocity changes. These skills allow not only reproduction of musical material, but also the communication of expressive interpretation. This talk will detail the development of fine motor skill in piano performance from novice to professional, and how musical material influences gross and fine motor movement from both a technical and expressive standpoint. Research will also be discussed that uses piano training as a form of health intervention for maintaining fine motor skills of older adults.

Bio: Dr Jennifer MacRitchie is a Research Lecturer in Music Perception and Cognition at the MARCS Institute for Brain, Behaviour and Development in Western Sydney University. With a background in both electrical engineering and music, her research focuses on the acquisition and development of motor skills in piano performance. Studies range from looking at movements of novices to experts, from those who have studied music from a young age to those who are rediscovering music in retirement. She is also an experienced pianist, having performed several concertos with amateur orchestras in Glasgow, UK, as well as regular performances with chamber groups in the UK, Switzerland and Australia.