

**E|P|S**

Experimental  
Psychology  
Society

**OXFORD  
MEETING**

**31 March / 1 April 2004**



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A scientific meeting will be held at the Department of Experimental Psychology, University of Oxford on 31 March – 1 April, 2004. The local organiser is Dr Kate Nation.

**Thirty-second Bartlett Lecture**

**Dr Karalyn Patterson** (MRC-CBU Cambridge)

Awesome allies in the study of language and its disorders

**The Bartlett Lecture will take place at 6.00pm, Wednesday 31 March in the Lecture Theatre B, Department of Experimental Psychology.**

**Symposia:**

Wednesday 31 March 9.00-1.00

The role of perirhinal cortex in perception and memory

Organisers: Dr K S Graham and Dr D Gaffan

Thursday 1 April 9.00-12.30

The development and deterioration of conceptual knowledge

Organisers: Dr T Rogers and Professor M Lambon-Ralph

**Poster Session:**

Will be held on Wednesday 31 March, at 4pm in the Foyer area, Level B, Department of Experimental Psychology. Delegates may put up posters from 9am Wednesday.

**Presentations**

Sessions will be held in lecture theatres B and C. Both theatres have OHPs and data projectors for PowerPoint presentations. Presenters may provide their own laptops (and connector leads if Mac users) or bring, floppies, zips or CDs for the on-site computers which run PowerPoint under Windows. Any queries about facilities in the theatres should be sent to Faith Ayre, (faith.ayre@psy.ox.ac.uk or ring +44 (0)1865-271386).

Coffee will be served on level B in the reception area, close to the lecture theatres.

**Receptions and Conference Dinner**

The Department of Experimental Psychology welcomes EPS delegates to a drinks reception from 8.30pm on Tuesday evening, 30 March in the Beer Cellar, University College. On Wednesday, 31 March, there will be pre-dinner drinks at 7.30 and the conference dinner will be at 8.00pm in University College. A booking form for the dinner is enclosed.

**START OF PARALLEL SESSIONS***Session A***Lecture Theatre B****Symposium:** The role of perirhinal cortex in perception and memory

Organisers: Dr K S Graham and Dr D Gaffan

- 9.00            **J P Aggleton** (Cardiff University)  
Using immediate early gene expression to compare perirhinal and hippocampal contributions to recognition memory and spatial memory
- 9.30            **Mark J Buckley\* and David Gaffan** (University of Oxford)  
Functional specializations within the macaque medial temporal lobe.
- 10.00          **Timothy J Bussey\*, Lisa M Saksida\*, and Elisabeth A Murray\***  
(University of Cambridge and Laboratory of Neuropsychology, National Institute of Mental Health, USA)  
The role of perirhinal cortex in memory and perception: Conjunctive representations for object identification
- 10.30          COFFEE
- 11.00          **Robert R Hampton\*** (Laboratory of Neuropsychology, National Institute of Mental Health, USA)  
Memory impairment with intact perception following perirhinal cortex removal in rhesus monkeys
- 11.30          **J S Holdstock** (University of Liverpool)  
The role of the human perirhinal cortex in object matching within and between modalities.
- 12.00          **A C H Lee\*, M J Buckley\*, D Gaffan, T J Bussey\*, E Murray\*, J R Hodges and K S Graham** (MRC Cognition and Brain Sciences Unit, Cambridge, University of Oxford, University of Cambridge and Laboratory of Neuropsychology, National Institute of Mental Health, USA)  
The role of the medial temporal lobe in perception: evidence from human neuropsychological studies
- 12.30          **Elisabeth A Murray\*** (Laboratory of Neuropsychology, National Institute of Mental Health, USA)  
Discussant
- 1-2            LUNCH

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**START OF PARALLEL SESSIONS***Session B***Lecture Theatre C**

- 9.00 **Patrick Rabbitt, Christine Lowe, Mike Horan\*, Neil Pendleton\*, Marietta Scott\*, Neil Thacker\*, Charles Hutchinson\* and Alan Jackson\*** (Age and Cognitive Performance Centre, University of Manchester, Department of Psychology, University of Manchester, Hope Hospital, Eccles, Manchester and Department of Radiology, Manchester Royal Infirmary)  
Decision speed in old age, and the amazing shrinking brain
- 9.30 **Oliver Braddick, Janette Atkinson, Will Curran\*, John Wattam-Bell, Dorothy Cowie\*, Anna Barnett\* and Dee Birtles\*** (University of Oxford, Visual Development Unit, Department of Psychology, University College London and Queen's University, Belfast)  
Global form and motion processing in infancy
- 10.00 **Janette Atkinson, Shirley Anker\*, Marko Nardini\*, Oliver Braddick** (Visual Development Unit, Department of Psychology, University College London and University of Oxford)  
Attention deficits in children who had been detected with refractive errors in infancy: Infant vision screening to identify children at risk of cognitive problems in the preschool and early school years
- 10.30 COFFEE
- 11.00 **D V M Bishop and G M McArthur** (University of Oxford)  
Immature cortical responses to auditory stimuli in specific language impairment: evidence from ERPs to rapid tone sequences
- 11.30 **Courtenay Frazier Norbury\*** (University of Oxford) (Introduced by Dorothy Bishop)  
Use of context to resolve ambiguity: A comparison of children with language impairment and autistic spectrum disorder
- 12.00 **Lisa Archibald\* and Susan Gathercole** (University of Durham)  
Working memory in children with specific language impairments.
- 12.30 **Philip T Smith, Judy E Turner\*, Penelope A Brown\* and Lucy A Henry** (University of Reading and London South Bank University)  
Redintegrative processes in children's auditory word perception
- 1-2 LUNCH

*Session A***Lecture Theatre B**

- 2.00        **E A Gaffan, A N Healey\*, M J Eacott\*** (University of Reading, Department of Surgery, St Mary's, Imperial College London and University of Durham)  
Encoding of components and configurations in scenes: the role of perirhinal and postrhinal cortex in the rat
- 2.30        **Edmund T Rolls, Christian Hölscher, J-Z Xiang, L Franco and S M Stringer** (University of Oxford)  
Perirhinal cortex neuronal activity related to long term familiarity memory in the macaque
- 3.00        **L K Tyler, E A Stamatakis\*, K Acres\*, S Abdallah\*, P Bright\*, J Rodd and H E Moss** (University of Cambridge)  
Object processing and the perirhinal cortex
- 3.30        **P Bright\*, H E Moss, C Morgese\*, J Rodd, E A Stamatakis\* and L K Tyler** (University of Cambridge)  
It's not what you're naming, it's how you name it: Process-driven neural recruitment for objects in inferior temporal cortex
- 4.00        TEA
- 4-5.30      POSTER SESSION (Foyer Area, Level B foyer)
- 5.30        Business Meeting (Lecture Theatre C)
- 6.00        **Thirty-second Bartlett Lecture - Dr Karalyn Patterson** (MRC-CBU Cambridge)  
Awesome allies in the study of language and its disorders
- 7.30        DRINKS RECEPTION (University College)
- 8.00        CONFERENCE DINNER (University College)

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*Session B***Lecture Theatre C**

- 2.00        **Patrick Haggard, Marisa Taylor-Clarke\*, Pamela Jacobsen\* and Laura Brown\*** (Institute of Cognitive Neuroscience, University College London and University of Oxford)  
Size estimation in touch: A cross-modal contribution from body representation
- 2.30        **Salvador Soto-Faraco, Angelica Ronald\* and Charles Spence** (University of Oxford, CNG-Parc Cientific, Universitat de Barcelona, Spain and SGDP Centre, Institute of Psychiatry, London)  
Tactile selective attention and body posture: Assessing the multisensory contributions of vision and proprioception
- 3.00        **Charles Spence, Brigitte Röder\* and Frank Rösler\*** (University of Oxford, Biological Psychology and Neuropsychology, University of Hamburg, Germany and Experimental and Biological Psychology, Philipps University Marburg, Germany)  
Early vision impairs tactile perception in the blind
- 3.30        **S-J Blakemore\*, A Hamilton\* and J M Kilner\*** (Institute of Cognitive Neuroscience, University College London and Wellcome Department of Imaging Neuroscience, University College London) (Introduced by Uta Frith)  
Observing biological motion interferes with ongoing incongruent actions
- 4.00        TEA
- 4-5.30      POSTER SESSION (Foyer Area, Level B)
- 5.30        Business Meeting (Lecture Theatre C)
- 6.00        **Thirty-second Bartlett Lecture - Dr Karalyn Patterson** (MRC-CBU Cambridge)  
Awesome allies in the study of language and its disorders
- 7.30        DRINKS RECEPTION (University College)
- 8.00        CONFERENCE DINNER (University College)

*Session A***Lecture Theatre B**

**Symposium:** The development and deterioration of conceptual knowledge  
Organisers: Dr T Rogers and Professor M Lambon-Ralph

- 9.00        **James L McClelland\*** (Carnegie Mellon University, USA)  
A PDP approach to conceptual development
- 9.30        **Faraneh Vargha-Khadem, Anna R Adlam\*, Jenny Limond\*, and Mortimer Mishkin\*** (Developmental Cognitive Neuroscience Unit, Institute of Child Health, University College London, and Great Ormond Street Hospital for Children, London and National Institute of Mental Health, Maryland, USA)  
Semantic learning in developmental amnesia
- 10.00       **Richard Wise\*** (MRC Clinical Sciences Centre, Hammersmith Hospital, London)  
Neural substrates of conceptual knowledge
- 10.30       COFFEE
- 11.00       **John R Hodges** (MRC Cognition and Brain Sciences Unit, Cambridge)  
Semantic dementia: Cognitive and anatomical perspectives
- 11.30       **Timothy T Rogers\*** (MRC Cognition and Brain Sciences Unit, Cambridge)  
Coming together: A convergence theory of concept representation
- 12.00       **Matthew A Lambon Ralph** (University of Manchester)  
Revealing the basis of category-specific semantic disorders: evidence from semantic dementia, HSVE and a computational model.
- End of Symposium
- 12.30       **Elizabeth Jefferies\*, Roy Jones\*, David Bateman\*, Matthew A Lambon Ralph** (University of Manchester, Research Institute for the Care of the Elderly, Bath and Royal United Hospital, Bath)  
The role of semantics in phonological processing: Evidence from semantic dementia
- 1-2        LUNCH

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*Session B***Lecture Theatre C**

- 9.00        **V M Holmes** (University of Melbourne, Australia)  
Arithmetic fact retrieval and linguistic processing skill
- 9.30        **Luke A Jones\* and Marco Bertamini** (University of Liverpool)  
A closer examination of close-up: The effect of vantage point, magnification and object size on boundary extension
- 10.00       **Geoff G Cole\*** (University of Durham) (Introduced by Alan Cowey)  
Change blindness is attenuated by the appearance of a new object.
- 10.30       COFFEE
- 11.00       **E Poliakoff\*, C J S Collins\* and G R Barnes\*** (University of Manchester and Department of Optometry and Neuroscience, UMIST, Manchester) (Introduced by John Wearden)  
Attention and target selection for predictive smooth pursuit eye movements
- 11.30       **Hakwan C Lau\*, Robert D Rogers, Patrick Haggard and Richard E Passingham** (University of Oxford, Oxford Centre for Functional Magnetic Resonance Imaging of the Brain, Department of Psychiatry, University of Oxford and Institute of Cognitive Neuroscience, University College London)  
Motor intention: where and when
- 12.00       **Peter McLeod, Nick Reed\* and Zoltan Dienes** (University of Oxford and University of Sussex)  
The unified fielder theory: How fielders get to the right place in time to catch the ball
- 12.30       **Rachel Swainson, Stephen R. Jackson, Georgina M. Jackson** (University of Nottingham)  
Electrophysiology of cognitive control: predictability and precueing of task-switches
- 1-2        LUNCH

*Session A***Lecture Theatre B**

- 2.00        **EPS/BAAS Undergraduate Prize**  
**Sophie A George\*** (University of Sussex)  
The acute effect of alcohol on decision making in social drinkers
- 2.30        **T Duka and J M Townshend\*** (University of Sussex)  
The priming effect of alcohol pre-load on attentional bias to alcohol-related stimuli
- 3.00        **Ian Apperly, Dana Samson\*, Claudia Chiavarino\* and Glyn Humphreys** (University of Birmingham)  
False belief reasoning errors in brain-damaged adults: sensitivity to incidental task demands or failure to inhibit knowledge of the right answer?
- 3.30        **Merim Bilalic\*, Peter McLeod and Fernand Gobet\*** (University of Oxford and Brunel University)  
Rigidity? A cost of knowing too much? A study of Grand Masters.

END OF PARALLEL SESSIONS

End of Meeting

*Session B*

**Lecture Theatre C**

**NB** Session starts at 2.30

- 2.30            **Jules Davidoff and Volker Thoma\*** (Goldsmiths University of London and University College London)  
Priming of plane-rotated objects depends on attention and view familiarity
- 3.00            **J C Catling\* and R A Johnston** (University of Birmingham)  
The effects of Age of Acquisition on an object classification task
- 3.30            **Karen Lander and Lewis Chuang\*** (University of Manchester)  
Why are moving faces easier to recognise?

END OF PARALLEL SESSIONS

End of Meeting

**POSTERS** (Alphabetical order) (Abstracts see Pages 39-49)**Wednesday 31 March – 4pm**  
**Foyer area, Level B**

**Jane Aspell\*, Oliver Braddick, Janette Atkinson and John Wattam-Bell** (University of Oxford and Visual Development Unit, University College London)  
Interaction of spatial and temporal integration in the detection of intermediate global forms

**Marketa Caravolas, Maggie Snowling, Charles Hulme and Brett Kessler\*** (University of Liverpool, University of York and Washington University, USA)  
How orthographic consistency affects the development of spelling skills in English: Implications for theories of orthographic learning

**Alberto Gallace\* and Charles Spence** (University of Oxford and Università degli Studi di Milano Bicocca, Milano, Italy)  
Examining the crossmodal consequences of the visual perception of the Müller-Lyer illusion

**David N George** (Cardiff University)  
The representation of stimulus conjunction in associative models of animal learning.

**John Hodson\* and G W Humphreys** (University of Birmingham)  
Categorical orientation search

**Nicholas P Holmes\*, Gemma A Calvert and Charles Spence** (University of Oxford)  
Which part of a tool is used, and how often? Task-dependent modulation of visuotactile integration by tool-use

**David Lagnado\* and David Shanks** (University College London)  
Insight in multiple-cue probability learning

**Glynis Laws\*** (University of Oxford) (Introduced by Kate Nation)  
Contributions of phonological memory, hearing loss, and language comprehension to the expressive language abilities of adolescents and young adults with Down syndrome

**G M McArthur and D V M Bishop** (University of Oxford)  
Speech and non-speech processing in people with specific language impairment: A behavioural and electrophysiological study

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**M Menon\***, **E Pomarol-Clotet\***, **P J McKenna\*** and **R A McCarthy** (University of Cambridge)

Exploring memory control in schizophrenia using a modified Directed Forgetting paradigm

**Carmel Mevorach\***, **Glyn W. Humphreys** and **Lilach Shalev\*** (Behavioural Brain Sciences, School of Psychology, University of Birmingham and Department for Education & Psychology, The Open University, Israel)

Effects of saliency, not global dominance, in patients with left parietal damage

**Jose C Perales\*** and **David R Shanks** (University College London)

Biased causal judgments and unbiased probability estimates: A refutation of normative approaches to causal learning

**Daniel Sanabria\***, **Salvador Soto-Faraco** and **Charles Spence** (University of Oxford and Cognitive Neuroscience Group-Parc Cientific, Universitat de Barcelona, Spain)

Exploring visuo-tactile dynamic capture effects on auditory motion perception

**Sonia Sciama** and **Ann Dowker** (Oxford and University of Oxford)

Form specificity and abstraction in word identification: effects of multiple prime repetition

**Geoff Ward\*** and **Lydia Tan\*** (University of Essex) (Introduced by Rick Hanley)

The effect of the length of to-be-remembered lists and intervening lists on free recall: A re-examination of Shiffrin (1970) using overt rehearsal

**Louise Whiteley\***, **Steffan Kennett**, **Marisa Taylor-Clarke\*** and **Patrick Haggard** (Institute of Cognitive Neuroscience and Department of Psychology, University College London)

Facilitated processing of visual stimuli associated with the body

**Paul N Wilson** and **Marcin Stachurski\*** (University of Hull and University of Leicester)

Vertical asymmetry in human spatial memory.

**Symposium:** The development and deterioration of conceptual knowledge  
Organisers: Dr T Rogers and Professor M Lambon-Ralph

Using immediate early gene expression to compare perirhinal and hippocampal contributions to recognition memory and spatial memory

J P Aggleton  
Cardiff University  
[aggleton@cf.ac.uk](mailto:aggleton@cf.ac.uk)

Although the hippocampal formation and the perirhinal cortex are reciprocally connected, lesion studies have sometimes shown that these two adjacent areas have very different contributions to memory. One difficulty in using lesions to assess the relationships between these two regions is that there are parallel connections between the sensory association cortices and the hippocampus. These connections may provide alternate routes when the perirhinal cortex is lesioned, and so reduce the impact of the surgery. In order to compare these two areas in the intact brain we measured the activity of the immediate early gene *c-fos* following tasks taxing different aspects of memory. The performance of spatial memory tasks or exposure to a novel room led to increased hippocampal, but not perirhinal, Fos levels. Conversely, exposure to novel individual objects led to increased perirhinal, but not hippocampal, Fos levels. When, however, 'novelty' consisted of familiar individual stimuli placed in new spatial arrangements, the hippocampus but not the perirhinal cortex showed differential Fos expression. These data support the view that even though the perirhinal cortex and the hippocampus are interconnected, their contributions to spatial memory and recognition memory can be doubly dissociated. They also highlight a difference between forms of novelty.

Functional specializations within the macaque medial temporal lobe

Mark J Buckley and David Gaffan  
University of Oxford  
[mark.buckley@psy.ox.ac.uk](mailto:mark.buckley@psy.ox.ac.uk)

The primate medial temporal lobe (MTL) which includes the hippocampus, amygdala, and surrounding cortical areas has for along time been regarded as crucial for supporting episodic memory. Indeed, patients such as H.M. who received bilateral surgical lesions to the MTL, as an early form of epilepsy treatment, became profoundly amnesic as a result. Since then, animal models of human amnesia have sought to shed further light upon the mechanisms and functional anatomy within the region. One influential model (Zola-Morgan et al., 1994) regarded the MTL as a homogenous functional region. Furthermore, this model considered the MTL to be exclusively involved in memory (Buffalo et al., 1998). However this model can now be rejected on both counts. Firstly, it has been shown that there are functional double-dissociations within the macaque medial temporal lobe (Gaffan, 1994; Buckley et al., 1997). Secondly the perirhinal cortex within the MTL has been shown to have role in both perception and memory (Buckley et al., 2001). New data from our own laboratory regarding the different

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functional specializations of the perirhinal cortex in object processing and the fornix in spatial and temporal processing will be discussed.

Buckley MJ, Gaffan D, Murray EA (1997) Functional double dissociation between two inferior temporal cortical areas: perirhinal cortex versus middle temporal gyrus. *Journal of Neurophysiology* 77:587-598.

Buckley MJ, Booth MCA, Rolls ET, Gaffan D (2001) Selective perceptual impairments after perirhinal cortex ablation. *Journal of Neuroscience* 21:9824-9836.

Buffalo EA, Reber PJ, Squire LR (1998) The human perirhinal cortex and recognition memory. *Hippocampus* 8:330-339.

Gaffan D (1994) Dissociated effects of perirhinal cortex ablation, fornix transection and amygdectomy: evidence for multiple memory systems in the primate temporal lobe. *Experimental Brain Research* 99:411-422.

Zola-Morgan S, Squire LR, Ramus SJ (1994) Severity of Memory Impairment in Monkeys as a Function of Locus and Extent of Damage within the Medial Temporal-Lobe Memory System. *Hippocampus* 4:483-495.

The role of perirhinal cortex in memory and perception: Conjunctive representations for object identification

Timothy J Bussey<sup>1</sup>, Lisa M Saksida<sup>1</sup>, and Elisabeth A Murray<sup>2</sup>

1. University Cambridge

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It is now clear that the perirhinal cortex has functions that are distinct and dissociable from those of the hippocampus, and thus recent research has focussed on the question of how best to characterise these functions. I will present a model of perirhinal cortex function that accounts for extant data – and makes novel predictions -- regarding the effects of perirhinal cortex lesions on visual discrimination. The fundamental premise of the model is that perirhinal cortex can be thought of as an extension of the hierarchically organised ventral visual stream for object identification. The perirhinal cortex is thought to reside at the top of this hierarchy, containing complex conjunctive visual representations that are important for resolving ‘feature ambiguity’ in visual discriminations. I will describe novel predictions, generated by the model, which have been subsequently tested in our experiments with rhesus monkeys. These computer simulations and monkey experiments reveal a “perceptual-mnemonic” function for perirhinal cortex, and suggest that perception and memory may not be neatly organised into anatomically distinct modules in the brain.

Memory impairment with intact perception following perirhinal cortex removal in rhesus monkeys

Robert R Hampton  
Laboratory of Neuropsychology, National Institute of Mental Health, USA  
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Monkeys lacking perirhinal cortex are impaired on some tests of matching to sample and object discrimination learning. Interpretation of these impairments is complicated by the fact that accurate performance in these tests requires both perception and memory. Furthermore, the position of the perirhinal cortex in relation to the ventral visual processing stream appears ideal for contributions to both retention and perception of visual images. Thus, while perirhinal cortex removal impairs performance in tests typically used to measure learning and memory, it is possible that the impairments are due to instead to difficulties in perceptual processing of images. I will describe a simple framework for discriminating between perceptual and mnemonic processing. Experiments conducted using this framework demonstrate memory impairments under conditions in which perceptual ability appears to be intact. These results indicate that perirhinal cortex can contribute to retention of visual memories independent from contributions it may make to perception.

The role of the human perirhinal cortex in object matching within and between modalities

J S Holdstock  
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Patients with damage to the medial temporal lobe, including the perirhinal cortex, were unimpaired at matching-to-sample of patterns under conditions of minimal long-term memory load (Holdstock et al., 2000). In contrast, their performance after filled retention intervals was impaired. This memory deficit was unlikely to be due to hippocampal damage because a patient with selective hippocampal pathology was not significantly impaired on this task at any delay (Holdstock et al., 2000). The data are consistent with the view that the perirhinal cortex is critical for recognition memory (Aggleton and Brown, 1999) and suggest that it is not necessary for perceptual discrimination of the kinds of stimuli used in this task. To investigate whether the perirhinal cortex plays a role in object discrimination under other conditions, two patients, with common pathology to the perirhinal cortex, were tested on one cross-modal (tactile-visual) and two intra-modal (visual-visual and tactile-tactile) same/different discrimination tasks. The patients were impaired only on the cross-modal task. This suggests that, in addition to contributing to recognition memory, the perirhinal cortex plays an important role in integrating visual and tactile information about objects.

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Aggleton, J.P. and Brown, M.W., (1999) *Behavioral and Brain Sciences*, 22: 425-443

The role of the medial temporal lobe in perception: evidence from human neuropsychological studies

A C H Lee<sup>1</sup>, M J Buckley<sup>2</sup>, D Gaffan<sup>2</sup>, T J Bussey<sup>3</sup>, E Murray<sup>4</sup>, J R Hodges<sup>1</sup> and K S Graham<sup>1</sup>

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3. University of Cambridge
4. Laboratory of Neuropsychology, National Institute of Mental Health, USA

Lesion studies in non-human primates suggest that the perirhinal cortex processes conjunctions of object features while the hippocampus may play a particular role in spatial processing. To date, however, neuropsychological studies have failed to support these views in humans, leading some researchers to conclude that the human medial temporal lobe (MTL) subserves mnemonic processes only. To investigate this discrepancy in the literature, a series of experiments (based on oddity judgement and visual discrimination of images from different stimulus categories) were given to patients with different profiles of damage to the medial temporal lobe. Patients with static pathology selectively involving the hippocampus bilaterally, performed normally on all tasks except those that required the discrimination of spatial scenes. A similar performance profile was also observed in cases with early Alzheimer's disease. By contrast, patients with static lesions to the medial temporal lobe, in whom there was documented hippocampal and perirhinal cortex damage, were significantly poorer than controls in the discrimination of faces, objects and spatial scenes, but performed normally when asked to discriminate between abstract art, shape and colour. On the other hand, patients with semantic dementia, in which there is significant perirhinal cortex involvement but less hippocampal damage, showed poor discrimination of objects and faces, but not spatial scenes. These findings support proposals that the human medial temporal lobe is not specialised for mnemonic processing, and that the hippocampus and perirhinal cortex might be differentially involved in scene and object perception, respectively.

Discussant

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End of Symposium

Decision speed in old age, and the amazing shrinking brain

Patrick Rabbitt<sup>1</sup>, Christine Lowe<sup>2</sup>, Mike Horan<sup>3</sup>, Neil Pendleton<sup>3</sup>, Marietta Scott<sup>4</sup>, Neil Thacker<sup>4</sup>, Charles Hutchinson<sup>4</sup> and Alan Jackson<sup>4</sup>

1. Age and Cognitive Performance Centre, University of Manchester
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A main aim of Cognitive Gerontology has been to relate behaviorally assessed changes in mental abilities to age-related changes in the brain. Another aim has been to discover biological indices that are good markers for cognitive and for brain changes. The first aim has been hard to achieve because marked declines in information processing speed that may mask differential effects on neuropsychological tasks designed to detect local rather than global changes. The second aim has also been hard to achieve because simple correlations between cognitive performance and markers such as balance or visual and auditory acuity may reflect the progress of processes proceeding independently in time rather than functional associations.

When elderly individuals' calendar Ages are and Measurements of gross brain changes, such as age-related atrophy, dynamic blood flow and gross numbers of White Matter Lesions are entered into regression equations as predictors of their performance on 20 different cognitive tasks, Age becomes a non-significant predictor of information processing speed after variance in gross brain changes has been taken into consideration. These gross indices account for up to 95% of that part of the variance in cognitive performance between individuals that is associated with their ages. We conclude that changes in information processing speed can be completely accounted for by gross brain changes.

Balance and Visual acuity, independently, are significant predictors of cognitive performance in older people, accounting for up to 90% of age related variance between them. However these predictions disappear when measures of gross brain changes are taken into consideration. We conclude that the associations between these biological markers and cognitive performance reflect a common dependency on brain status rather than an accidental synchrony between the time courses of changes in functionally unrelated processes.

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Global form and motion processing in infancy

Oliver Braddick<sup>1,2</sup>, Janette Atkinson<sup>2,1</sup>, Will Curran<sup>3,2</sup>, John Wattam-Bell<sup>2</sup>, Dorothy Cowie<sup>1</sup>, Anna Barnett<sup>1</sup> and Dee Birtles<sup>1,2</sup>

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The form coherence test measures performance of global visual processes integrating static form information, believed to operate in extrastriate areas of the ventral cortical stream. Within a background of randomly oriented short line segments, a circular region on one side contains line segments tangentially oriented to concentric circles. Percentage coherence is varied by varying the proportion of segments within this region which are randomly oriented. The measure is analogous to motion coherence, a measure of global integration of motion information within the dorsal stream

We have investigated whether infants aged 8-20 weeks show such integration of local orientation information. A first experiment using preferential looking showed statistically significant detection of the concentric region in 16-20 week infants, for coherence levels of 80% and above, but no evidence of detection in 8-12 week infants. Habituation potentially may provide a more sensitive method that is less dependent on intrinsic preferences. In a second experiment, we habituated infants to displays of random line segments and tested subsequent looking preference between a random array and one containing concentric organization (100% coherent). Again, we find significant evidence for discrimination of coherent concentric form in infants over 12 weeks of age, but not in the younger group (who show a wide divergence of performance).

We conclude that the ventral stream processes integrating local orientation information are generally after 8-12 weeks, even though local orientation processing can be demonstrated in younger infants. However, the visual preference driven by these processes appears relatively weak, compared to that driven by motion coherence. We will discuss the possibilities and implications of comparing these two domains in development, in relation to the hypothesis of 'dorsal stream vulnerability' in neurodevelopmental disorders (Gunn et al, 2002; Braddick, Atkinson & Wattam-Bell, 2003).

A Gunn, E Cory, J Atkinson, O Braddick, J Wattam-Bell, A Guzzetta, G Cioni "Dorsal and ventral stream sensitivity in normal development and hemiplegia" *Neuroreport*, 13: 843-847 (2002).

Braddick, O., Atkinson, J., & Wattam-Bell, J. (2003). Normal and anomalous development of visual motion processing: motion coherence and 'dorsal stream vulnerability'. *Neuropsychologia* 13: 1769-1784.

Attention deficits in children who had been detected with refractive errors in infancy:  
Infant vision screening to identify children at risk of cognitive problems in the preschool  
and early school years

Janette Atkinson<sup>1,2</sup>, Shirley Anker<sup>1</sup>, Marko Nardini<sup>1</sup>, Oliver Braddick<sup>2,1</sup>

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Our two refractive screening programmes on total populations (N= 9000) have detected infants who have hyperopic (long-sighted) refractive errors at 8-11 months of age. From a randomised control trial we have shown that if these refractive errors are not corrected with spectacles, these children have persistent deficits of visual acuity (amblyopia) and binocularity (squint /strabismus) (Atkinson et al, 1996). In the second of these screening programmes, we have followed up hyperopic infants and controls with a range of linguistic, visuo-motor, visuo-cognitive measures (spatial cognition), and shown that at 2-6 years, these children have mild delays that extend beyond basic visual measures (Atkinson et al, 2002). Here we report results with these groups at age 6-7 years with the Test of Everyday Attention for Children (TEA-Ch), whose subtests are designed to assess selective attention, sustained attention, response inhibition, and executive control of attention switches.

79 children who had been significantly hyperopic at 9 months, and 95 control children, were tested. The hyperopic group (with any residual refractive error corrected at the time of testing) showed significantly poorer performance than controls on an overall standardised score of attention and specifically on the subtests 'sky search' (requiring selective attention in a crowded array) and 'opposite worlds' (requiring inhibition of prepotent responses), but not on the 'score' (sustained auditory attention) and 'walk/don't walk' (response inhibition with sustained auditory attention).

Thus hyperopia in infancy is an early marker for poorer performance on some attention tests, but not on those where information is presented in the auditory domain. It is possible that visual deficits (the 'crowding' phenomena of amblyopia) could impair performance on the Sky Search task, but the visual demands of 'Opposite worlds'(identifying large, separated digits) are minimal.

Infant hyperopia reflects a failure of the development of the eyes towards emmetropia, a process partially under neural control. In the present study hyperopia was initially detected by incomplete accommodation, a possible indicator of poor visual attention in infancy. Thus hyperopia need not necessarily play a direct causative role in later cognitive performance; it may alternatively be an indicator of subtle neurodevelopmental delays which are also manifested in cognitive and motor performance at school age, including frontal function. The potential relation of these delays to learning difficulties will be discussed.

J Atkinson, O Braddick, et al. "Two infant vision screening programmes: prediction and prevention of strabismus and amblyopia from photo- and videorefractive screening". *Eye*, 10 (2) 189-198 (1996).

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J Atkinson, S Anker, et al “Infant vision screening predicts failures on motor and cognitive tests up to school age” *Strabismus*, Vol 10 no 3: 187-198 (2002).

Immature cortical responses to auditory stimuli in specific language impairment: evidence from ERPs to rapid tone sequences

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Event-related potentials (ERPs) to tone pairs and single tones were measured for 16 participants with specific language impairment (SLI) and 16 age-matched controls aged from 10 to 19 years. The tone pairs were separated by an inter-stimulus interval (ISI) of 20, 50 or 150 ms. The intraclass correlation (ICC) was computed for each participant between the ERP to a single tone and the ERP to the tone pair, to give an index of how far the brain responded to the second tone in the tone pair. The ICC values were significantly higher for younger than for the older participants, indicating less differentiation between ERPs to single tones and to tone pairs. This developmental trend showed an interaction with SLI status. Although the brain responses of older participants with SLI differed from their age-matched controls, they did not differ significantly from younger controls, which is consistent with a theory of immature maturation of central auditory processing in SLI.

Use of context to resolve ambiguity: A comparison of children with language impairment and autistic spectrum disorder

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Previous investigations have suggested that high functioning individuals with autism have difficulty processing verbal context (Happe, 1997); (Jolliffe & Baron-Cohen, 2000). However, non-autistic individuals with language impairment also experience difficulties using context (Gernsbacher, Varner and Faust, 1990), suggesting that underlying linguistic abilities contribute to use of context in different disorders.

Sixty-three children with communication disorders aged 8 to 15 were grouped according to diagnosis and language test scores as follows: language impairment only (LI), autistic disorder only (AD), and combined (ADLI). Children listened to sentences and judged whether a picture matched sentence meaning. Context was manipulated so that some sentences were biased toward a particular interpretation. For example, typically developing children were faster to accept BUS in response to ‘Peter DROVE the coach’ compared with ‘Peter SAW the coach.’

I predict that the LI and ADLI groups will be less accurate and slower to respond in both conditions. Of greater interest is the performance of the AD group. One possibility is that they will not show equivalent levels of enhancement as typically developing peers, in line with Weak Central Coherence theory. A second possibility is

that they will show typical levels of enhancement, highlighting the importance of core linguistic ability in contextual processing.

Happe, F. (1997). Central coherence and theory of mind in autism: Reading homographs in context. *British Journal of Developmental Psychology*, 15, 1-12.

Jolliffe, T., & Baron-Cohen, S. (2000). Linguistic processing in high-functioning adults with autism or Asperger's syndrome. Is global coherence impaired? *Psychological Medicine*, 30(5), 1169-1187.

Gernsbacher, M. A., Varner, K. R., & Faust, M. (1990). Investigating differences in general comprehension skill. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 16(3), 430-445.

#### Working memory in children with specific language impairments.

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Investigations of the cognitive processes underlying specific language impairment have implicated deficits in working memory, and in particular the storage and processing of phonological information. This study investigated working memory function and related cognitive processes in SLI. Sixteen children with SLI, 16 age-matched controls and 16 language-matched controls completed tasks to assess the phonological loop, visuospatial sketchpad, central executive and phonological awareness. The entire SLI group performed poorly on verbal measures of central executive, and the majority on phonological loop measures. Consistent deficits in phonological awareness were not found. The SLI group performed similarly to their age-matched controls on all of the visuospatial measures, and significantly better than their language-matched controls on one visuospatial complex working memory measure. The findings of these studies indicate that the phonological loop and verbal central executive components of working memory may play important roles in supporting language learning. A specific deficit in the storage and processing of verbal information in SLI is indicated, and domain-specificity of the central executive is suggested.

#### Redintegrative processes in children's auditory word perception

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Five-, seven- and ten-year-old children and adults carried out an auditory lexical decision task to assess their redintegration abilities (abilities to use long-term knowledge in a perceptual task when the stimuli are impoverished). Even our youngest children showed word length effects and neighbourhood density effects, indicating that redintegrative processes in speech perception are well developed by 5 years of age. The effect of a word's Age of Acquisition grew weaker with the older age groups, but was

present even in adults, indicating that early acquired words exert a long-term influence on phonological representation. There were imageability effects in the youngest children which disappeared in the oldest children and adults, probably because the imageable semantics on which the young child depends is replaced by a more sophisticated semantics in adulthood. We present a model in which early acquired words largely determine the phonological *representation* used by the child, and in which frequency influences the distribution of *processing* resources. The independence of Age of Acquisition and Frequency was attested not only by their statistically separate contributions to predicting performance in all groups, but also by the different pattern of interactions in predicting performance: Age of Acquisition interacted with a word's syllable length, but Frequency interacted with Neighbourhood Density.

Encoding of components and configurations in scenes: the role of perirhinal and postrhinal cortex in the rat

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We examined rats' encoding of simple visual 'scenes' each of which consisted of a single large 'object' (abstract shape) displayed at a certain position within a pair of adjacent monitor screens. The environment was a large computer-controlled Y-maze. Experiment 1 assessed encoding of the appearance and position of the objects in 2 different scenes, Experiment 2 assessed encoding of the shape and fill-pattern of the objects in 2 scenes where the position was constant. Both experiments tested encoding of configurations of scene components (object-plus-position or shape-plus-fill). They were assessed through rats' ability to discriminate familiar scenes from ones which had been changed in some respect, the 'constant-negative' paradigm (Healey & Gaffan 2001). Perirhinal cortex lesions impaired encoding of objects (Expt 1) and their shape (Expt 2); postrhinal lesions only impaired encoding of egocentric position in Expt 1. All groups could detect configural change, and the two lesioned groups did not differ from controls in any configural tests. The effects seen with components (shape etc) are understandable given the anatomy and physiology of these cortical regions and are consistent with earlier findings on perirhinal cortex (e.g. Gaffan et al 2000). The failure to find an effect on configural encoding is more surprising, and possible reasons will be discussed.

Gaffan EA, Simpson E, Eacott MJ (2000) Perirhinal ablation in rats selectively impairs object identification in a simultaneous visual comparison task. *Behavioral Neuroscience*, 114, 18-31.

Healey A, Gaffan EA (2001) Configural learning without configural training. *Journal of Experimental Psychology: Animal Behavior Processes*, 27, 373-393.

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Perirhinal cortex neuronal activity related to long term familiarity memory in the macaque

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To analyze the functions of the perirhinal cortex, the activity of single neurons in the perirhinal cortex was recorded while macaques performed a delayed matching-to-sample task with up to 3 intervening stimuli. Some neurons had activity related to working memory, in that they responded more to the sample than to the match image within a trial, as shown previously. However, when a novel set of stimuli was introduced, the neuronal responses were on average only 47% of the magnitude of the responses to the familiar set of stimuli. Moreover, it was shown in eight different replications in three monkeys that the responses of the perirhinal cortex neurons gradually increased over hundreds of presentations (mean=400 over 7-13 days) of the new set of (initially novel) stimuli to become as large as to the already familiar stimuli. Thus perirhinal cortex neurons represent the very long-term familiarity of visual stimuli. Part of the impairment in temporal lobe amnesia may be related to the difficulty of building representations of the degree of familiarity of stimuli. A neural network model of how the perirhinal cortex could implement long-term familiarity memory is proposed.

Hölscher,C., Rolls,E.T. and Xiang,J.-Z. (2003) *European Journal of Neuroscience* 18: 2037-2046.

Object processing and the perirhinal cortex

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How objects are represented and processed in the brain is a central topic in cognitive neuroscience. Previous studies have shown that knowledge of objects is represented in a feature-based distributed neural system primarily involving occipital and temporal cortical regions. Research with non-human primates suggest that these features are structured in a hierarchical system with posterior neurons in inferior temporal cortex [IT] representing simple features and anterior neurons in perirhinal cortex representing complex conjunctions of features [Murray & Bussey, 1999; Bussey, & Saksida, 2002]. On this account, perirhinal cortex plays a crucial role in object identification by integrating information from different sensory systems into more complex polymodal feature conjunctions. We tested the implications of these claims for human object processing in an event-related fMRI study in which we presented coloured pictures of common objects for 19 subjects to name at two levels of specificity – basic and domain-levels. We reasoned that domain-level naming requires access to a coarse-grained representation of objects, thus involving only posterior regions of inferior temporal

cortex. In contrast, basic level naming requires more fine-grained discrimination to differentiate between similar objects, and thus should involve the perirhinal cortex. We found that object processing always activated the fusiform gyrus bilaterally, irrespective of the task, whereas the perirhinal cortex was only activated when the task required fine-grained discriminations. These results suggest that the same kind of hierarchical structure which has been proposed for object processing in the monkey temporal cortex functions in the human.

Murray, E. A., & Bussey, T. J. (1999). Perceptual-mnemonic functions of the perirhinal cortex. *Trends in Cognitive Sciences*, 3, 142-151.

Bussey, T. J., & Saksida, L. M. (2002). The organization of visual object representations: A connectionist model of effects of lesions in perirhinal cortex. *European Journal of Neuroscience*, 15, 355-364.

It's not what you're naming, it's how you name it: Process-driven neural recruitment for objects in inferior temporal cortex

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How conceptual representations are instantiated in the brain remains a key issue in cognitive neuroscience. Recent work carried out in primates (Murray and Bussey, 1999) and humans (Tyler *et al*, *JOCN* in press) suggests that objects are processed within a hierarchically-organised feature-based distributed system in ventral temporal cortex, extending from posterior fusiform to anteromedial regions. Neurons within anteromedial temporal cortices represent complex conjunctions of features which enable fine-grained differentiation (Simmons & Barsalou, 2003). On this account, tasks requiring fine-grained discrimination among objects should engage these anterior regions, relative to those requiring more coarse-grained analysis. Since living things generally have more shared, and fewer distinctive, visual features than do artefacts, and therefore require more fine-grained discrimination to differentiate between objects (Tyler & Moss, 2001), we predict that living things will involve anteromedial regions more than artefacts in tasks requiring fine-grained discrimination. We tested this prediction in an *ef*MRI study in which subjects named coloured pictures of common objects (animals, fruits, vehicles, tools), at two levels of specificity (basic and domain level). Basic naming [eg cat, axe] requires more fine grained differentiation than domain naming [eg living thing].which relies on shared properties. Consistent with our predictions, basic naming generated significantly greater activation in anteromedial temporal cortex for animals and fruits relative to vehicles and tools. There was no consistent evidence that this region is recruited during domain naming. These results suggest that neural regions involved in object processing reflect the nature of processing demands imposed by the task rather than stimulus-specific activations.

Murray, E. A., & Bussey, T. J. Perceptual-mnemonic functions of the perirhinal cortex. *Trends in Cognitive Sciences*, 3, 142-151, 1999.

Simmons K & Barsalou, L. The similarity in topography principle: reconciling theories of conceptual deficits. *Cognitive Neuropsychology* 20, 3/4/5/6, 2003

Tyler LK, Stamatakis EA Bright. P, Acres K., Abdallah, S., Rodd, J. & Moss HE. Processing objects at different levels of specificity. *Journal of Cognitive Neuroscience* [in press]

Tyler, L.K. & Moss, H. Towards a distributed account of conceptual knowledge. [2001] *Trends in Cognitive Science*, 5(6), 244-252

#### Size estimation in touch: A cross-modal contribution from body representation

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There are few convincing theories of how we perceive the size of external objects. In the case of touch, the primary perceptual representation occurs via a distorted sensory homunculus. These distortions imply that the neural signals generated when similar objects touch different body parts should be quite different. Therefore, to calculate and compare the size of tactile objects, the brain must transform the homuncular representation according to the true size of body parts. An illusion originally reported by Weber suggests that this rescaling is slightly underpowered: for example, the distance between two tactile contacts applied to the finger feels slightly greater than an identical tactile distance on the forearm.

We suggest that a visual representation of the size of one's own body parts mediates this transformation between "feeler-centred" and object-centred touch. We asked blindfolded subjects to compare tactile distances on finger and forearm. We found the expected bias to judge finger distances as larger than forearm distances. Subjects then viewed their body via distorting mirrors which made the finger appear shrunken and the forearm enlarged. Subsequent tactile distance testing found the bias towards the finger was significantly reduced. Control tests showed no change in primary tactile acuity with distorted vision. Undistorted vision of the body had no effects. These results suggesting that vision of the body modulates tactile distance perception at a secondary stage of tactile interpretation. We report several further experiments in which sensorimotor experience modulates tactile distance judgement. An implicit representation of one's own body plays a key role in the neural interpretation of touch. This is a new form of cross-modal interaction in perception.

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Tactile selective attention and body posture: Assessing the multisensory contributions of vision and proprioception

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We report a series of five experiments designed to investigate the role of proprioceptive and visual cues to body posture during the deployment of tactile spatial attention. Participants in our studies made speeded elevation judgments (up vs. down) to vibrotactile targets presented to the finger or thumb of either hand, while attempting to ignore vibrotactile distractors presented to the opposite hand. Our initial experiments demonstrated that congruency effects (worse performance on incongruent than congruent distractor trials) were more pronounced when the target hand was uncertain than when it was certain. Varying the orientation of the hands (prone vs. supine) revealed that the congruency effects in our study were determined by the position of the target and distractor in external space and not by the particular skins sites stimulated. Congruency effects increased as the hands were brought closer together in the dark, demonstrating the role of proprioceptive inputs in modulating tactile selective attention. This spatial modulation of the congruency effect was also found when a mirror was used to alter the visually-perceived separation between the hands illusorily. Our results suggest that tactile spatially-selective attention can operate according to an abstract spatial frame of reference, one that is modulated by multisensory contributions from both proprioception and vision. Our results also provide support for the controversial recent claim that we may become aware of the external spatial location from which tactile stimuli are presented before we are aware of the particular skin site that has been stimulated (e.g., Kitazawa, 2002).

Kitazawa, S. (2002). Where conscious sensation takes place. *Consciousness and Cognition*, **11**, 475-477.

Early vision impairs tactile perception in the blind

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Sighted people find it more difficult to judge the temporal order in which two tactile stimuli, one applied to either hand, are presented when their hands are crossed over the midline as compared to when they adopt a more typical uncrossed hands posture. This result has been attributed to a conflict between an externally-defined reference frame

predominantly determined by visual input and a body-centered reference frame determined primarily by somatosensory/proprioceptive inputs. To test this hypothesis, congenitally blind, late blind and sighted participants were tested in a tactile temporal order judgment task under both postures. The performance of late but not of congenitally blind people was impaired by crossing the hands. Moreover, we provide the first empirical evidence for an enhanced spatio-temporal resolution in the congenitally blind. This finding suggests a critical role of early childhood vision in ‘confusing’ our perception of touch that may arise from the emergence of specific cross-modal links during development.

Observing biological motion interferes with ongoing incongruent actions

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It has been proposed that actions are intrinsically linked to perception and that observing an action excites the same motor programs used to execute that action. There is neurophysiological evidence that certain brain regions involved in executing actions are activated by the mere observation of action (the so-called mirror system). Recent evidence suggests that the mirror system causes interference between observed and simultaneously executed movements. Specifically, observing another human, but not a robot, making incongruent movements had a significant interference effect on executed movements. The current experiment was performed to investigate whether this interference is due to the form of observed mover (human or robot) or to the movement itself (biological or linear). Subjects made arm movements while observing a video showing an effector making movements that were either in the same (congruent) or a different direction (incongruent). The effector in the video was either a human or a dot; and the motion made by the effector was either biological, with the velocity of a typical human arm movement, or linear. Variance in the executed movement was measured as an index of interference to the movement. The results indicate that observing incongruent biological motion, whether performed by a human or a dot, has a significant interference on executed movements.

**Symposium:** The development and deterioration of conceptual knowledge

Organisers: Dr T Rogers and Professor M Lambon-Ralph

A PDP approach to conceptual development

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The pattern of conceptual disintegration seen in semantic dementia (as reflected in the work of Patterson, Hodges, and collaborators) complements a pattern of conceptual

differentiation seen in development as described by Jean Mandler and others. A computational model that addresses both differentiation and disintegration will be described, and four particular phenomena in conceptual development will be the focus of the presentation: (1) Progressive differentiation of conceptual knowledge in pre-verbal infants; (2) Overextension of frequent basic level names during development (3) Acquisition of the understanding that different properties are important in different concepts; and (4) Reorganization of conceptual knowledge in development.

#### Semantic learning in developmental amnesia

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Studies in children with selective bilateral damage to the hippocampus associated with hypoxia/ischaemia have revealed a pronounced dissociation between episodic memory, which is markedly impaired, and semantic memory, which is relatively preserved (Vargha-Khadem et al., 1997; 2003). We have labelled this syndrome 'developmental amnesia' (DA) and have proposed that in DA the preserved parahippocampal region subjacent to the hippocampus subserves the relatively normal acquisition of semantic knowledge (Mishkin et al., 1997).

New semantic learning in DA was examined in two studies. The first aimed to replicate the findings of Baddeley et al., 2001 in Jon (a patient with DA) by examining a group of 11 patients with the same diagnosis and their matched controls. The findings in Jon indicated that both recall and recognition improved substantially across different delays as a function of repeated exposure to videotaped information. In the second study, acquisition of general knowledge based on reading of texts was examined over short and long delays in three patients with DA and their matched controls.

Results of both studies indicated marked impairment in semantic learning in the patients with DA, raising the question as to how such patients have acquired their nearly normal fund of general knowledge.

Mishkin, M., Suzuki, W., Gadian, D. and Vargha-Khadem, F. (1997) Hierarchical Organization of Cognitive Memory. In *Philosophical Transactions: Biological Sciences. The Royal Society*, 352, 1461-1467.

Vargha-Khadem, F., Gadian, D.C., Watkins, K.E., Connelly, A., Van Paesschen, W. and Mishkin, M., (1997) Differential effects of early hippocampal pathology on episodic and semantic memory. *Science*. 277, 376-380.

Vargha-Khadem, F., Salmond, C. H., Watkins, K. E., Friston K. J., Gadian D. G. & Mishkin, M. (2003) Developmental Amnesia: Effect of Age at Injury, *PNAS* - USA. Vol 100, No. 17, 10055-10060.

Neural substrates of conceptual knowledge

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There have been many functional neuroimaging studies that have investigated access to meaning. The results are potentially confusing for three reasons. The first is that most studies have used tasks that require controlled access to meaning, with the result that there has been more emphasis on the role of the left inferior frontal gyrus than on temporal lobe regions. The second is that functional magnetic resonance imaging (fMRI) is relatively insensitive to signal in the rostral and medial temporal lobe, a problem confounded by increasing magnet strength. The third is that the signal (an increase in regional cerebral blood flow) is dependent on a contrast between an activation and a baseline task; and the 'wrong' baseline task can attenuate signal in medial temporal lobe structures. I will show data from positron emission tomographic (PET) studies (which are not confounded by insensitivity to signal from certain temporal lobe regions) on automatic (i.e. normal) language comprehension, spoken or written. Access to meaning is dependent on the caudal and rostral superior temporal sulcus, the temporal pole and inferotemporal cortex. This accords with unimodal auditory and visual streams of processing converging on heteromodal cortex, the 'transmodal areas' of Mesulam. However, Mesulam emphasised the role of caudal temporal and inferior parietal regions in speech comprehension, which accords with localisation from the neuropsychological literature on stroke aphasia. Our PET data relate much better to studies on patients with semantic dementia, and also relates well to the auditory 'streams' of processing that are emerging from studies on non-human primate auditory physiology and anatomy. The mild consequences of left rostral temporal lobectomy on language comprehension appear to contradict a central role for the temporal pole and the rostral fusiform gyrus in language comprehension, but the potential pitfalls of inferring normal functional organisation from patients with chronic epilepsy will be discussed.

Semantic dementia: Cognitive and anatomical perspectives

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Taking as a starting point our initial paper on semantic dementia (Hodges JR, Patterson K et al 1992), my talk will focus on progress over the past 14 years related to two inter-related aspects of the syndrome. First, evidence for our assertion that patients show progressive breakdown of an "amodal integrative" semantic system which manifests initially as a deficit in word production and comprehension, although subtle deficits in non-verbal semantics are invariably present and worsen as the disease progresses. This will be illustrated by recent data using a range of non-verbally mediated tasks. Second, advances in our understanding of the neuroanatomy of semantic dementia. Recent structural imaging in semantic dementia points to a key role for the perirhinal cortex, anterior fusiform gyri and polar temporal regions, with the left hemisphere

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typically more involved than the right. Moreover, the degree of semantic impairment appears to correlate with the degree of left perirhinal/fusiform atrophy. Metabolic FDG-PET studies have confirmed this distribution of pathology. Interestingly, there is involvement of the left anterior hippocampus but (in contrast to Alzheimer's disease) associated changes in other limbic structures are absent. I will attempt to synthesise the cognitive and anatomical findings and relate them to other participants in the symposium.

Hodges JR, Patterson K et al (1992) *Brain*, 115, 1183-1806

Coming together: A convergence theory of concept representation

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Cognitive and neural theories of human conceptual abilities tend between two poles. One view posits that knowledge about the meanings of words, objects, and events is distributed across several anatomically segregated processing modules, each specialised to represent and process a particular kind of information, and each capable of functioning more-or-less autonomously. The other suggests that conceptual abilities depend critically upon a single homogeneous cognitive and neural system, which encodes representations for all conceptual domains and all varieties of conceptual knowledge. I will describe a "convergence" theory of conceptual representation that reconciles these seemingly contradictory positions. The convergence theory suggests that the content of conceptual knowledge is encoded in various modality-specific representations distributed throughout cortex; but that outputs from these regions converge on a common set of representations in the anterior temporal cortex, which critically supports the human ability to generalise on the basis of conceptual similarity. The theory provides an intuitive account of certain puzzling dissociations of semantic abilities in neuropsychology, and suggests one reason why convergence might be important: convergent representations make it possible for the semantic system to learn the "right" conceptual representations.

Revealing the basis of category-specific semantic disorders: evidence from semantic dementia, HSVE and a computational model

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Since the seminal study of Warrington and Shallice (1984) there have been over 100 cases of category-specific deficits for living or nonliving things published in the neuropsychological literature. This large body of single-case studies has given us fascinating, clinical observations and associated theories for these disorders. The literature is complicated, however, by inconsistencies across patients and test materials. Such variation makes it difficult to evaluate the theories effectively. In recent work we have adopted a comparative, case-series approach in an attempt to understand when brain damage leads to a generalised semantic deficit versus impairments that affect some

categories more than others. This difference can be found when comparing the conceptual deficits of patients with semantic dementia versus HSVE, respectively. Intriguingly, both diseases affect the anterior temporal lobes bilaterally. Subtle variations in the distribution of damage may be critical in explaining the behavioural differences. Alternatively, the type of damage might also be important. Using a computational model of semantic memory that learns conceptual representations through the convergence of verbal and sensory experience (Rogers et al., 2004), we have been able to show that these two patterns may reflect the type of damage rather than simply its location.

Rogers, T. T., Lambon Ralph, M. A., Garrard, P., Bozeat, S., McClelland, J. L., Hodges, J. R., & Patterson, K. (2004). The structure and deterioration of semantic memory: A neuropsychological and computational investigation. *Psychological Review*, *111*, 205-235.

Warrington, E. K., & Shallice, T. (1984). Category specific semantic impairments. *Brain*, *107*, 829-854.

End of Symposium

The role of semantics in phonological processing: Evidence from semantic dementia

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Patients with semantic dementia typically make frequent phonological errors in their immediate serial recall of words that they no longer fully understand. Previous studies have argued that these errors result from a reduction in the normal contribution made by semantics to the coherence of items in the phonological system. It is possible, however, that the errors might reflect additional subtle phonological deficits. Six patients with semantic dementia were tested on a variety of phonological processing and short-term memory tasks, in order to explore these possibilities. For the most part, the patients showed normal performance in tests of phonological processing but the more severely semantically impaired patients did show some weakness on tests of nonword repetition and recall. Nevertheless, every patient showed better recall of words that were still relatively well understood, compared with more semantically degraded words; even those patients without signs of additional phonological deficits. This difference extended to nonwords that were phonologically similar to the known and degraded words, suggesting that the patients' semantic deficits could account for their impairments in nonword recall. These data are consistent with the view that phonological processing cannot proceed normally in the face of semantic degradation.

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Arithmetic fact retrieval and linguistic processing skill

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Basic multiplication facts are thought to be learned by rote and stored in the form of abstract phonological representations. Addition facts are thought to be either rote learned or computed by a semantic process dependent on an understanding of the quantities involved. Studies of brain-damaged individuals have indicated that rote memory for non-numerical sequences and memory for multiplication facts can be either jointly damaged or jointly spared, whereas memory for addition facts patterns with multiplication in some cases but not others. Such studies have also shown that numerical processing in general can be spared in the presence of deficient verbal memory for everyday concepts, and damaged when semantic memory for concepts is intact. The present study investigated normal young adults' skill in rapid retrieval of basic addition and multiplication facts. People who were good at retrieving both addition and multiplication facts were also good at retrieving well-learned non-numerical sequences, such as letters of the alphabet. Skill in retrieving addition facts, and to a lesser degree, skill in retrieving multiplication facts, was also associated with skill in retrieving lexical-semantic information, such as that an eagle is a bird. As a contrast, ability to make magnitude approximations on random dot patterns was related to neither linguistic skill. The findings not only confirm the role of rote memory in retrieval of multiplication facts, but they suggest that for most people, there may be a common representational format for basic arithmetic facts, particularly addition facts, and everyday non-numerical concepts.

A closer examination of close-up: The effect of vantage point, magnification and object size on boundary extension

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Boundary extension (BE) is the tendency to remember close-up scenes as if they included information beyond the occluding boundaries (Intraub, 1997). We tested boundary extension effects with computer-generated images and brief retention intervals. We confirm that BE occurs for near vantage point (<3.5m), and also for far vantage point (5m) when the image is magnified. By contrast, an unmagnified image of an object at 3.5m or more never produced BE. We also found that BE is not dependant upon the presence of occluded objects at the picture boundary. Thus the necessary condition for BE appears to be a close-up image of an object. We further tested the meaning of 'close-up' in this context. Firstly, we used a large object viewed at 5m (matched visual angle of object viewed at 2m), this elicited BE. Secondly, we used a small object viewed at 2m (matched visual angle of object viewed at 5m) under these circumstances there was no BE. These data are consistent with the perceptual schema hypothesis but clarify the role of different factors that make an image appear as a close-up. However, under conditions of high uncertainty there was also evidence that memory averaging takes place.

Intraub, H. (1997). The representation of visual scenes. *Trends in Cognitive Science*, 1, 217-222.

Change blindness is attenuated by the appearance of a new object.

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In a standard visual search task, an item that appears later than others tends to accrue an attentional facilitation. By contrast, items that are unique in terms of colour, luminance, or motion, do not receive search priority. Some authors have taken these findings as evidence that the visual system is particularly sensitive to the appearance of new objects. Others however argue that object onset has no special status in attentional capture. In a series of experiments the onset-priority hypothesis was investigated using the change detection paradigm. If object onset is indeed particularly effective in attracting attention new onsets should be less susceptible to 'change blindness' compared with other stimulus events. Detectability of onsets was compared with changes in luminance and colour of already present 'old' objects. Results showed that onsets attenuated change blindness relative to both of these changes. Additionally I assessed whether the detection advantage seen for onsets relative to offsets (Cole et al. 2003) is a facilitation for *object* onset or onset *per se*. Results showed that the onset effect only occurred for onsets that formed an object. These data are taken as evidence for the special status of new objects in visual attention.

Cole, G. G., Kentridge, R. W., Gellatly, A.R.H., & Heywood, C. (2003). Detectability of onsets versus offsets in the change detection paradigm. *Journal of Vision*, 3, 22-31.

Attention and target selection for predictive smooth pursuit eye movements

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Humans cannot produce smooth eye movements in the absence of a moving stimulus. However, they can produce predictive smooth eye movements if they expect a target of known velocity to reappear. Here, we investigated whether subjects can extract relevant velocity information from two simultaneously presented moving targets and use this information to produce a subsequent predictive smooth eye movement for one of the two targets.

Subjects fixated a stationary cross during the presentation of two targets, moving rightward at different velocities. In the next presentation, a single target was presented, which subjects tracked with their eyes. A static cue, presented 700 ms before the moving

target, indicated which of the two targets would be presented. Performance was compared under divided attention (cued target not known in advance), selective attention (cued target always the same) and single (only one target presented during fixation) conditions. Results indicated that subjects were able to use the cued velocity to make a predictive eye movement, even in the divided attention condition, where they were uncertain during fixation which of the two targets would subsequently be cued for tracking. However, the scaling of predictive eye velocity was less accurate in the divided attention condition.

#### Motor intention: where and when

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Intention is central to the concept of voluntary action. An action is voluntary if and only if it is intended. We have studied the neural mechanisms underlying intention by fMRI to investigate how attention modulates these mechanisms. We specifically compared conditions in which participants made self-paced actions and attended to their intention. We confirmed our hypothesis that, when they attended to their intention, there would be an enhancement of activity in the pre-supplementary motor cortex (pre-SMA).

We then tested the effect of single-pulse transcranial magnetic stimulation (TMS) on the pre-SMA under the same behavioural paradigm. Capitalising on the temporal resolution afforded by single-pulse TMS, we tested whether stimulation applied immediately 'after' the production of action has any effect on of judgement of the onset of the experience of intention. We found that intention is perceived as starting earlier when TMS is applied either immediately or 200 ms after the production of action. This effect is specific as it was not observed in control studies where participants were asked to judge the onset of the movement itself or the onset of an external tactile stimulus. We discuss whether under these circumstances intention can be thought of as causing the action.

#### The unified fielder theory: How fielders get to the right place in time to catch the ball

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Studies ranging from insects mating in flight to batsmen hitting an approaching ball have shown how the signals generated by tracking an object moving in three dimensions can provide the spatial and temporal information required to intercept it. Fielders reach the place where a ball can be caught by running so that their angle of elevation of gaze to the ball increases at a decreasing rate and their horizontal angle of

gaze to the ball changes at a constant rate. Children may acquire this strategy because it reproduces the signals they get when stationary, watching balls that hit them, and avoids those produced by watching balls that miss them.

Electrophysiology of cognitive control: predictability and precueing of task-switches

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We used event-related brain potentials (ERPs) to examine the timing of neural processes involved in switching between tasks. Subjects responded to left- or right-pointing arrow target stimuli with a left- or right-hand button-press respectively. In the GO task (green arrows), responses were required immediately upon target onset; in the WAIT task (red arrows), responses had to be withheld for 1000 msec until target offset.

We manipulated the predictability of trial order and the availability of a task precue in order to examine the effects of these two different types of advance task information upon behaviour and neural activity. In the Unpredictable condition no advance information was available; target colour alone indicated the required task. In the Fixed condition task sequence was highly predictable, with 2-trial alternating runs of the GO and WAIT tasks. In the Precued condition task sequence was random but the fixation cross (displayed for 1500 msec prior to target onset in all conditions, and white in the Fixed and Unpredictable conditions) was displayed in the same colour as the subsequent target.

The two forms of advance task information produced contrasting beneficial effects upon performance. Predictability of task sequence had no effect upon switch trials but led to much improved non-switch RTs. Conversely, precueing had no effect on non-switch trials but triggered huge reductions on switch trial RTs.

The ERP data revealed that a parietal positivity (for switch versus non-switch trials, around 600 msec after stimulus onset) was triggered by the target in the Fixed and Unpredictable conditions but by the fixation cross in the Precued condition. This component appears to index externally-driven task-switching processes. A central positivity on GO trials (around 400 msec after target onset) was increased in amplitude on non-switch trials and decreased on switch trials, but only in the Fixed condition. This component may reflect the current activation level of task-specific stimulus evaluation processes.

**EPS/BAAS Undergraduate Prize**

The acute effect of alcohol on decision making in social drinkers

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Many studies have reported the long-term adverse effects of alcohol on executive cognitive function in chronic alcohol abusers, yet little research has investigated the acute effects of alcohol in social drinkers. The present investigation examined the acute effects

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of alcohol on a decision-making task that involved participants making a forced choice between two simultaneously presented gambles. Alcohol (0.6g/kg) or placebo was administered to 32 social drinkers. Participants completed the gambling task in which the gambles vary, differing in the magnitude of expected gains, losses and the probability with which these outcomes were delivered. Alcohol impaired decision-making in participants compared to controls. The results indicated that the alcohol group had an impaired ability to factor in the magnitude of losses when the gains were small, and to account for the magnitude of losses appropriately when the losses were large. Deliberation times were not affected. These data suggest that alcohol impairs executive cognitive functions. In particular, one's ability to trade off potential gains from potential losses in order to make favourable decisions is impaired by alcohol, independent of its effects on behavioural disinhibition.

The priming effect of alcohol pre-load on attentional bias to alcohol-related stimuli

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Previous research has shown attentional bias toward drug-related stimuli in non-dependent social drinkers. The aim of this study was to investigate whether non-dependent social drinkers would show increased attentional bias towards alcohol-related stimuli after priming with either one of two doses of alcohol (0.3g/kg or 0.6g/kg) or placebo. Attentional bias was assessed using a dot probe detection task and a modified Stroop task. Questionnaires were used to measure alcohol use and mood states, craving for alcohol and alcohol outcome expectancies. Mood ratings showed dose dependent increases in positive mood after the alcohol pre-load. In the dot probe task all subjects showed a reliable attentional bias towards the alcohol-related stimuli, although the attentional bias was significantly positive only at the low alcohol dose. In the Stroop task a reliable attentional bias was also found with all subjects requiring more time to read the alcohol-related words than the neutral stationary-related words under all pre-load conditions. In addition a dose related priming effect was found with subjects making more errors for alcohol-related words under the high alcohol dose. A negative correlation between the intensity of alcohol use and attentional bias under the high alcohol dose was also found. These data support ideas derived from the incentive learning theories of drug addiction. Furthermore these data suggest that history of alcohol exposure may influence the priming effects of an alcohol pre-load on attentional bias.

False belief reasoning errors in brain-damaged adults: sensitivity to incidental task demands or failure to inhibit knowledge of the right answer?

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We tested two reasons why brain-damaged adults might make false belief reasoning errors. Firstly, patients could be particularly sensitive to the high incidental processing demands of typical false belief tasks (language, executive function/working memory). Secondly, false belief reasoning could be caused by difficulties in resisting interference from one's own knowledge of the objectively correct answer.

We devised a false belief task that eliminated many incidental demands, involved no language and did not require the participant to inhibit interference from their own knowledge of the correct answer. There were 12 false belief trials mixed with 12\*4 control trials designed to control for residual incidental demands.

Seven of thirteen patients performed at or below chance level on the false belief trials indicating difficulties in false belief reasoning even when the participant does not know the objectively correct answer. More importantly, 3 out of these patients performed above chance on the control trials. Therefore, these patients' belief reasoning errors could not be explained by incidental task demands.

It is possible that participants who made errors have damage to a domain-specific belief reasoning mechanism. Alternatively, belief reasoning *necessarily* may place certain (specific?) executive demands that these participants cannot meet. We discuss ways in which our new method will help distinguish between such accounts.

Rigidity? A cost of knowing too much? A study of Grand Masters

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It is well known that with an increase in expertise performance becomes more accurate and faster. However, it is also believed that increase in expertise leads to inflexibility due to automation of procedures - once confronted with a situation that requires a different behavioural pattern from the standard one, experts often fail to adapt to the situation. This inflexibility of experts view is especially widespread in research on creativity while research on expertise suggests the opposite prediction. We tested these conflicting predictions coming from the two different traditions of research using the set effect paradigm in the game of chess. Chess players, ranging from skilful candidate masters over masters to grand masters, were asked to find the shortest way to solve a problem that contained a well known non-optimal solution and a less familiar optimal solution. All participants possessed the necessary knowledge to find the optimal solution but only the most skilful participants found it. This results indicated that it is possible to diagnose inflexibility in skilful participants but not in the most skilful participants. In

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addition to the knowledge and flexibility controversy in research on creativity and expertise, the importance of the results in an educational setting is discussed.

Priming of plane-rotated objects depends on attention and view familiarity

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Attended images of common objects prime themselves as well as their left-right reflection, whereas ignored images only prime themselves but not their reflections (Stankiewicz, Hummel, & Cooper, 1998). In three experiments we extended these findings to investigate rotations in the picture plane. Using no-base objects, an identical pattern of priming was found as in Stankiewicz et al. Attended objects primed themselves in the same as well as in the rotated view whereas ignored images only primed themselves in the same view. The effects of attention and orientation on priming for no-base objects were strictly additive. Using base objects, it was found that there was priming in the ignored condition only when objects were depicted in a familiar (upright) view, indicating that ignored images make contact with object memory. These data do not fit theories of object recognition that rely on a single (part-based or view-based) format of representation. The findings, however, corroborate a model in which both an analytic (view-independent) and a holistic (view-dependent) component of object representation support the recognition of attended images, but only the holistic component is involved in the recognition of ignored images.

Stankiewicz, B. J., Hummel, J. E. & Cooper, E. E. (1998). The role of attention in priming for left-right reflections of object images: Evidence for a dual representation of object shape. *J. Exp. Psychol. Hum. Percept. Performance* 24, 732-744.

The effects of Age of Acquisition on an object classification task

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The age at which an item is acquired (AoA) has been shown to affect naming latencies for words, objects and faces. Ellis and Lambon-Ralph (2000) offer an explanation for these findings, but their model also predicts that we should find AoA effects across any task where one is required to retrieve stored information. Previous research has found AoA effects in non-naming tasks with faces (e.g., Lewis, 1999) and words (e.g., Brysbaert, Wijnendaele & Deynes, 2000) but not with pictures (e.g., Morrison, Ellis & Quinlan, 1992). The current study explored the effect of AoA on a manmade/natural picture classification task, but extended previous work by controlling how readily items could be assigned to the correct category. It was found that early acquired objects were classified significantly faster than later acquired objects. A second experiment collected naming latencies for the same picture stimuli in order to allow a

comparison of the magnitude of the AoA effect for semantic classification and naming. The AoA effect was significantly greater for the naming task than the classification task. The implications of these findings in relation to accounts of AoA and its locus of effect are discussed.

Brysbaert, M., Van Wijnendaele, I., & De Deyne, S. (2000). Age-of-acquisition in semantic processing tasks. *Acta Psychologica*, 104, 215-226.

Ellis, A.W., & Lambon Ralph, M.A. (2000). Age of acquisition effects in adult lexical processing reflects loss of plasticity in maturing systems: Insights from connectionist networks. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, Vol. 26, No. 5, 1103-1123.

Lewis, M.B. (1999). Age of acquisition in face categorisation: is there an instance-based account? *Cognition*, 71, B23-B39.

Morrison, C.M., Ellis, A.W., & Quinlan, P.T. (1992). Age of acquisition, not word frequency, affects object naming, not object recognition. *Memory and Cognition*, 20, 705-714.

### Why are moving faces easier to recognise?

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Seeing a famous face move aids the recognition of identity, especially when viewing conditions are degraded (Knight & Johnston, 1997; Lander, Christie & Bruce, 1999). Here we describe several experiments that investigate whether the recognition advantage is related to a particular type of facial motion, and is uniform across identity. Preliminary results suggest a beneficial effect of expressive and talking movements for recognition, but no clear advantage for rigid motion, compared with a single static image. Interestingly, the beneficial effect for face motion was much larger when the motion displayed was particularly distinctive. Results support the idea that familiar faces have characteristic motion patterns, which act as an additional cue to identity.

Knight, B. & Johnston, A. (1997). The role of movement in face recognition. *Visual Cognition*, 4(3), 265-273.

Lander, K., Christie, F. & Bruce, V. (1999). The role of movement in the recognition of famous faces. *Memory & Cognition*, 27(6), 974-985.

Interaction of spatial and temporal integration in the detection of intermediate global forms

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The mechanisms of local form processing have been well characterised, but much less is known about intermediate form processing which extracts global structure from local orientation information, and is believed to be a function of extrastriate areas such as V4. Sensitivity to global structure can be investigated with the use of global form stimuli of varying complexity, e.g. parallel and concentric arrays of oriented elements.

Recent work has suggested that there are different spatial constraints in the processing of concentric and parallel organization (Braddick et al. ECVF 1999, Wilson et al. 1997). The present study investigated temporal integration in the detection of these forms and its interaction with spatial integration. The stimuli used were arrays of short line elements within which a coherent central region could be created by aligning a variable percentage (0-100%) of the segments to either parallel lines or concentric circles. Subjects were required to discriminate between 0% and other coherence values in a 2IFC design with threshold coherence determined by an adaptive method, for different stimulus durations and a variety of diameters for the coherent region. Critical durations were determined by double-linear functions fitted to the plot of log threshold vs log duration.

For large region sizes, detection of concentric patterns shows shorter integration time than for parallel, suggesting that the apparently more complex concentric configuration is detected by a faster system. However, this relation is reversed for small region sizes. Thus the two types of global processing show quite different spatio-temporal relations, implying that the neural mechanisms involved have quite different properties and are unlikely to represent serial stages in the processing of form information. These psychophysical findings will be discussed in light of imaging evidence for brain areas differentially activated by the different types of global pattern information.

Braddick, O.J., Lin, M.H., Atkinson, J., O'Brien, J., Wattam-Bell, J. & Turner, R. (1999) 'Form coherence: a measure of extrastriate pattern processing.' (ECVP abstract) *Perception* 28 59

Wilson, H.R., Wilkinson, F. & Assad, W. (1997) 'Concentric orientation summation in human form vision.' *Vision Research* 37(17): 2325-2330

How orthographic consistency affects the development of spelling skills in English:  
Implications for theories of orthographic learning

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The effects of vowel grapheme consistency on the development of spelling skills in a cohort of 150 British children were examined. Children's spelling of 100 monosyllabic words was monitored at three time points over the first two years of schooling. All vowel spellings were scored for conventional accuracy. The unconditional and conditional consistencies (i.e. consistencies weighted by the adjacent graphemes) of all graphemes in the word set were computed. Within-subjects regression analyses showed that word frequency and unconditional grapheme consistency had a significant additive effect on vowel spelling by the end of the first year of schooling. The variance accounted for by these two variables increased in the second year of schooling. In addition, the conditional consistency (i.e. the consistency of the vowel given the ensuing coda grapheme) accounted for unique variance in vowel spelling by the middle of year 2. These findings suggest that children's orthographic representations are influenced from very early on by the statistical properties of the English orthography. Moreover, in spelling development, the properties of smaller (grapheme) units appear to affect performance earlier than do properties of larger (orthographic rime) units.

Examining the crossmodal consequences of the visual perception of the Müller-Lyer illusion

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The Müller-Lyer illusion has long been studied as a purely “visual” illusion, but as for many other optical illusions, the evidence now shows that it can also be demonstrated when the stimuli are presented tactually (e.g., Fry, 1975). In the present study, we investigated whether the visual perception of the Müller-Lyer illusion would have any crossmodal consequences for haptic perception. The convergent and divergent versions of the Müller-Lyer illusion were placed end-to-end sharing a central fin. The illusion was presented visually on a screen in front of participants who had to compare the “felt” length of two sticks placed on the back of the screen, one behind either part of the illusion. The results showed that the presentation of the visual illusion modified the judged length of the haptically presented sticks. In particular, the stick presented on the side of space perceived visually as being shorter was perceived as longer and vice versa for the stick mounted behind the space perceived visually as longer. These results

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highlight the crossmodal consequences of the visual perception of the Müller-Lyer illusion for the haptic perception of line length.

Fry, C. L. (1975). Tactual illusions. *Perceptual & Motor Skills*, 40, 955-960

The representation of stimulus conjunction in associative models of animal learning.

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A number of conditional (e.g., AX+ AY- BX- BY+) and patterning (e.g., A+ B+ AB-) discriminations require that an animal is sensitive to conjunctions of stimuli. Wagner & Rescorla (1972) proposed a modification to the Rescorla-Wagner model which suggested that when a stimulus compound is presented, *configural cues* represent the conjunction of stimuli, in addition to the cues that represent the separate stimuli. In contrast, Configural Theory (Pearce, 1987, 1994, 2002) assumes that whenever an individual cue, or a combination of cues is presented, it activates its own *configural unit* which is the only unit that is learned about on that trial. These two models make profoundly different predictions in certain situations and the predictions of each model are supported by numerous experiments conducted by their respective authors. Recently, Wagner has proposed an alternative model of learning, the Replaced Elements Model (Brandon, Vogel & Wagner, 2000; Wagner & Brandon, 2001; Wagner, 2003) which assumes that configural cues generated by the conjunction of stimuli replace some cues that would otherwise represent the separate stimuli. Whilst Wagner's new model has enjoyed considerable success in reconciling the differing results from his and from Pearce's laboratories, it has failed to explain some of Pearce's data and simulations of the model become extremely cumbersome when faced with more than a few stimuli. Here I describe a mathematically less complex model in which the activation of configural cues lowers the activation level of, but does not replace, stimulus cues. I also present experimental and simulation data which support the predictions of this normalized added elements model over those of Wagner's Replaced Elements Model.

Brandon, S. E., Vogel, E. H., & Wagner, A. R. (2000). A componential view of configural cues in generalization and discrimination in Pavlovian conditioning. *Behavioural Brain Research*, 110, 67-72.

Pearce, J. M. (1987). A model for stimulus generalization in Pavlovian conditioning. *Psychological Review*, 94(1), 61-73.

Pearce, J. M. (1994). Similarity and discrimination: A selective review and a connectionist model. *Psychological Review*, 101(4), 587-607.

Pearce, J. M. (2002). Evaluation and development of a connectionist theory of configural learning. *Animal Learning and Behavior*, 30(2), 73-95.

Wagner, A. R. (2003). Context-sensitive elemental theory. *Quarterly Journal of Experimental Psychology*, 56B(1), 7-29.

Wagner, A.R., & Brandon, S.E., (2001) A componential theory of Pavlovian Conditioning. In R.R. Mowrer and S.B. Klien (Eds.) *Handbook of Contemporary Learning Theories* (pp. 23-64) Mahwah, NJ. Erlbaum.

Wagner, A.R., & Rescorla, R.A. (1972). Inhibition in Pavlovian conditioning: Application of a theory. In R.A. Boakes & M.S. Halliday (Eds.), *Inhibition and learning* (pp. 301-336). London: Academic Press.

Categorical orientation search

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Two experiments investigated the nature of categorical facilitation of orientation search found by Wolfe, Friedman-Hill, Stewart and O'Connell (1992). Specifically that search for categorically separable steep or shallow orientation targets is more efficient than non-categorically separable targets given equivalent target-distractor angular separation. Experiment 1 showed that in contrast to known search, unknown search for 'steep' and 'shallow' targets showed no advantage over non-categorically separable. Top-down processes appear to regulate the categorical effect. To assess facilitatory and inhibitory aspects of categorical guidance, Experiment 2 compared the effects of the target appearing at the same location, at a previously blank location and at a previous distractor location on the previous trial. Both positive and negative effects were found. Although the positive guidance component varied according to search difficulty, the negative component (previous trial blank locations vs distractor locations) was approximately the same in all search conditions. In particular, there was no difference whether distractors were categorically separable from the target or not (on the previous trial). In this case, categorical guidance appears to be a top-down facilitatory process.

Wolfe, J. M., Friedman-Hill, S. R., Stewart, M. I., & O'Connell, K. M. (1992). The role of categorization in visual search for orientation. *Journal of Experimental Psychology: Human Perception and Performance*, 18, 34 - 49

Which part of a tool is used, and how often? Task-dependent modulation of visuotactile integration by tool-use

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The skilled use of certain tools by animals and humans has been claimed to cause an extension of the neural representation of visuotactile peripersonal space. We examined this putative extension using a behavioural index of visuotactile integration in normal human observers. Participants performed the visuotactile crossmodal congruency task interleaved with a secondary tool-use task involving two hand-held tools. In the first three experiments, the handle, shaft, or tip of the tools were used to perform the secondary button-pushing task. In two further experiments, participants used the tip of the tools in the secondary task, but the frequency and predictability of the tool-use task was varied.

In all five experiments, visual distractors near the hands influenced vibrotactile performance the greatest. When participants used the tool-handle for the secondary task,

crossmodal congruency effects decreased with distance along the tool. When participants used the shaft or tip of the tool, however, crossmodal congruency at the tip was greater than during the handle task. Additionally, when tool-use occurred randomly and unpredictably throughout the experiment, the crossmodal congruency effects were greater than when tool-use was performed regularly and predictably. We conclude that the modulation of visuotactile peripersonal space by tool-use occurs in a task-dependent manner.

Insight in multiple-cue probability learning

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In multiple-cue learning tasks people acquire information about cue-outcome relations and combine these into predictions or judgements. Previous studies suggest that people can perform well on such tasks, but often lack insight into their own judgement processes. Recent work by Gluck et al. (2002) seems to reinforce these conclusions, and also claims that people use a variety of implicit strategies. However, these studies rely on insensitive measures of self-insight and coarse-grained analyses of individual learning. In two experiments we re-examine these conclusions by measuring self-insight on a trial-by-trial basis, and using ‘rolling regression’ methods to analyze individual learning profiles. Participants successfully learned a four-cue probabilistic environment, and demonstrated explicit knowledge of both the task structure and their own judgement processes. Rolling regression analyses also suggested that their revealed judgement weights tracked the actual environment weights, and that the apparent use of simple judgement strategies emerged from the more basic ability to track statistical features of the environment. Overall these findings suggest that performance in multiple-cue learning is not achieved in the absence of self-insight, and that a regression model is sufficient to describe the dynamics of individual learning.

Gluck, M., Shomany, D., & Myers, C. (2002). How do people solve the ‘Weather Prediction’ task? Individual variability in strategies for probabilistic category learning. *Learning & Memory*, 9, 408 - 418.

Contributions of phonological memory, hearing loss, and language comprehension to the expressive language abilities of adolescents and young adults with Down syndrome

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Down syndrome is associated with language impairment. Language profiles are uneven with language expression typically more severely affected than language comprehension, and there is considerable variation in levels of impairment. This study investigated the contributions that phonological memory, hearing loss and language comprehension made to variation in the expressive language abilities of 30 young people

with Down syndrome, aged from 10 to 24 years. A story narrative was used to calculate mean length of utterance (MLU) as a measure of expressive language. Sentence recall was also assessed. Nonword repetition was assessed as a measure of phonological memory. Hearing thresholds were measured using pure tone audiometry. After adjusting for chronological age, nonverbal abilities and word repetition, phonological memory made a substantial and statistically significant contribution to MLU and to sentence recall. The associations were not accounted for by mutual output constraints on memory and language tasks. Hearing did not contribute to expressive language scores of the individuals included in the analysis, but was an important factor in discriminating between them and seven individuals who were excluded because the narratives they produced were insufficiently intelligible for transcription. Unexpectedly, there was little correlation between language comprehension and expressive language measures.

Speech and non-speech processing in people with specific language impairment: A behavioural and electrophysiological study

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We have previously found that people with specific language impairment (SLI) up to the age of around 14 years have poor behavioural frequency discrimination (FD) thresholds for 25-ms pure tones, while people with SLI up to 20 years have abnormal auditory event-related potentials (ERPs) for 25-ms pure tones (McArthur & Bishop, 2004). The present study expanded these findings by testing six young and 10 old teenagers with SLI (SLI-young and SLI-old groups respectively) and seven young and nine older teenagers with normal language (control-young and control-old groups respectively) for their FD thresholds and auditory ERPs to 25-ms and 250-ms pure tones, vowels, and non-harmonic complex tones. The results indicated that (1) there was an association between abnormal processing of pure tones and vowels in people with SLI; (2) abnormal vowel processing related to the spectral complexity rather than phonological significance; and (3) poor discrimination in people with SLI was not limited to brief sounds.

McArthur, G. M., & Bishop, D. V. M. (in press). Which people with specific language impairment have auditory processing deficits? *Cognitive Neuropsychology*.

Exploring memory control in schizophrenia using a modified Directed Forgetting paradigm

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Memory impairment is common in schizophrenia. We wished to determine whether problems with memory were more prevalent in deluded schizophrenics than people who had recovered from their delusions. Secondly, we wished to explore whether

any memory problems were attributable to a problem of tagging information for salience. We used a modified 'directed forgetting' paradigm. Groups of deluded schizophrenics, non-deluded schizophrenics and normal controls were shown lists of words. After each word was presented, participants were instructed that the word was either 'to be remembered' (TBR) or 'to be forgotten' (TBF). Participants were first asked to recall the 'to be remembered' (TBR) words. This was followed by a recognition task, of discriminating previously seen words from novel distracters, and identifying whether the words they recognised had been shown as TBR or TBF words.

There were no differences between deluded and non-deluded participants on any measure. The schizophrenics showed poorer recall than the controls with an excess of intrusion errors but they were equivalent to the controls on recognition. The schizophrenics showed comparable 'directed forgetting' effect to the controls on recognition. However, the schizophrenics were extremely poor at identifying whether the TBF words they recognised had originally been shown as TBF or TBR. These results indicate that basic judgments of item familiarity may be spared in schizophrenia, and that while they may be able to use information about salience at encoding, they may have problems with the inhibition or tagging of irrelevant material during storage or retrieval.

Effects of saliency, not global dominance, in patients with left parietal damage

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Neuropsychological and functional imaging studies have shown a general right hemisphere advantage for processing global visual information and a left hemisphere advantage for processing local information. In addition, neuropsychological and brain imaging studies have associated the left parietal lobe with switching attention between levels. In Experiment 1 here five left parietal patients were asked to identify either the local or global identity of a compound letter (focused attention) under two size conditions. These patients failed to ignore the irrelevant level of the compound letter when it was more salient (i.e., the local level in the large size condition and the global level in the small size condition). The effect was diminished when the irrelevant level did not compete for response (Experiment 2) and, for large letters, it was reversed when the global level became more salient (Experiment 3). In summary, patients with damage to the left parietal lobe appear to be abnormally affected by stimulus saliency and not just biased towards one level of processing. The relations between the present results and previous studies will be discussed.

Biased causal judgments and unbiased probability estimates: A refutation of normative approaches to causal learning

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Normative biases in causal strength estimation (Perales and Shanks, 2003) have been explained by (1) a faulty computation of contingency, caused by excessive memory demands, and (2) probe question ambiguity (Buehner, Cheng, and Clifford, 2003). In each of our experiments, reasoners were required to make unambiguous estimates of the influence of a candidate cause (a new fertilizer) on a given effect (plants? blooming), in three different scenarios. In Experiment 1 the information about the covariation between the cause and the effect in each scenario was presented in an interleaved manner whereas in Experiment 2 instances exposed to the candidate cause and instances not exposed to the candidate cause were segregated into two different clusters. Both cause-effect cooccurrence estimates and causal estimates were sensitive to the presentation format manipulation, but judgments of conditional probabilities  $P(\text{effect}/\text{cause})$  and  $P(\text{effect}/\sim\text{cause})$  were accurate in both cases. Despite the accurate perception of probabilities, causal judgments tended to show a marked sufficiency bias ?an overweighting of the probability of the effect given the presence of the cause, which is at variance with the normative theories? prescriptions.

Buehner, M.J., Cheng, P.W. and Clifford, D. (2003). From covariation to causation: A test of the assumption of causal power. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 26, 1119-1140.

Perales, J.C. and Shanks, D.R. (2003). Normative and descriptive accounts of the influence of power and contingency on causal judgment. *Quarterly Journal of Experimental Psychology: Human Experimental Psychology*, 56, 977-1007.

Exploring visuo-tactile dynamic capture effects on auditory motion perception

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Recent studies have demonstrated that the perception of the direction of an auditory apparent motion stream can be modulated by the synchronous presentation of a visual apparent motion stream moving in a different direction. However, to our knowledge, no one has yet explored the effect of incongruent tactile or bimodal visuo-tactile apparent motion streams on the perception of auditory apparent motion. Participants in our study were required to judge the direction in which an auditory apparent motion stream moved (left-to-right or right-to-left) while trying to ignore one of a range of distractors, including unimodal tactile or visual, and bimodal (visuo-tactile) apparent motion streams. Our results demonstrate significant crossmodal dynamic

capture effects from both unimodal and bimodal distractors. Crucially, bimodal visuo-tactile distractor motion was shown to have a stronger effect on the perception of auditory apparent motion than either of the unimodal distractor streams.

Form specificity and abstraction in word identification: effects of multiple prime repetition

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Four experiments were performed to measure the effects of multiple prime repetition on priming and form specificity in visual word identification using mixed-case words (e.g. bRoOM). If repetition strengthens visual representation in the systems responsible for word identification, then multiple prime repetition should cause prime specificity to increase. In the first experiment, with 30 participants, words were presented for as long as was required for identification and there were no effects of multiple prime repetition or the match between visual word forms at study and test (i.e. there was no form-specificity effect). The second, third and fourth experiments each included 36 participants. In the second experiment, divided visual-field presentation was used at test. Here, multiple prime repetition produced more priming than a single prime repetition, but again there was no form-specificity effect. The third and fourth experiments, using divided visual-field presentation at test and smaller sets of words, did yield a form-specificity effect as well as a repetition effect, but the form-specificity did not increase with the number of prime repetitions. These results are discussed with regard to their implications for abstractionist and episodic theories of the role of repetition priming in word recognition.

The effect of the length of to-be-remembered lists and intervening lists on free recall: A re-examination of Shiffrin (1970) using overt rehearsal

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Three experiments investigated the effects of list length on free recall of to-be-remembered (TBR) and intervening lists. Of interest was whether a selective rehearsal explanation could account for the previous finding that recall was only affected by the size of the TBR list. In Experiments 1 (covert rehearsal) and 2 (overt rehearsal), participants were presented with lists of 5 and 20 words and were required to recall the list prior to that which was last presented. In Experiment 3 (fixed rehearsal), participants saw either one or two 5- or 20-word lists and following presentation were cued as to which to recall. Consistent with previous findings, the proportion of words recalled decreased with increased TBR list length. Contrary to previous findings, extended recency effects were found when recall was replotted by when words were last rehearsed (Experiments 2 and 3), and an effect of intervening list length was found when rehearsal was effectively eliminated (Experiment 3).

Shiffrin, R. M. (1970). Forgetting, trace erosion or retrieval failure? *Science*, 168, 1601-1603.

Facilitated processing of visual stimuli associated with the body.

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Recent work on tactile perception has revealed enhanced tactile acuity and speeded reaction times when viewing the stimulated part of the body (Kennett et al., 2001, Tipper et al., 1998). In this experiment we examined whether this body-view enhancement effect extends to visual targets, using the apparatus shown in Figure 1. Participants performed a speeded spatial discrimination between two lights attached to either their own left index-finger or to a wooden finger-shaped object. Subjects made a distal-proximal decision, and responded accordingly with the right hand. A camera filmed either the finger-mounted or the object-mounted lights in separate experimental blocks. Either video image could then be projected at the same location in front of the participants. An occluding collar prevented direct vision of the stimuli. Thus, participants responded to identical visual targets varying only in their context; on the body or not. Results revealed a significant performance advantage for the finger-mounted stimuli: reaction times were substantially reduced, while discrimination accuracy was unaffected. Bimodal neurons in the parietal cortex respond to visual stimuli in the space around the tactile receptive field, and may contribute to manual object-oriented actions. This system may be responsible for the facilitated processing of visual stimuli linked to the body (Maravita & Iriki, 2004).

Kennett, S., Taylor-Clarke, M., Haggard, P., (2001). Noninformative vision improves the spatial resolution of touch in humans. *Current Biology*, 11, 1188-1191

Maravita, A., & Iriki, A. (2004). Tools for the body (schema). *Trends in Cognitive Sciences*, 8, 79-86.

Tipper, S.P., Lloyd, D., Shorland, B., Dancer, C., Howard, L.A., & McGlone, F. (1998). Vision influences tactile perception without proprioceptive orienting. *Neuroreport*, 9, 1741-1744.

Vertical asymmetry in human spatial memory.

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Wilson, Foreman, Stanton, & Duffy (in press) asked participants to explore a computer-generated virtual building that comprised three similar-sized rooms, arranged vertically. When participants were asked to point toward previously seen locations in

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rooms above and below the test site, pointing accuracy was greater for downward than upward judgements. The present experiments were designed to investigate whether this vertical asymmetry is a more general feature of spatial learning. In both real and virtual-environment conditions, participants were asked to study two arrays of four objects located within the same room: one array was located above and one below the viewing point. In Experiment 1, participants were required to count while viewing the arrays, and no difference was found in recall accuracy for the higher and lower arrays. In Experiment 2, participants were not required to count while viewing the arrays, and recall was found to be significantly more accurate for the lower than higher array in the real condition, and a non-significant tendency in the same direction was found in the VE condition. The real environment difference supports the hypothesis that recall accuracy may be greater for lower regions of space.

Wilson, P. N., Foreman, N., Stanton, D., & Duffy, H. (in press). Memory for targets in a multi-level simulated-environment: Evidence for vertical asymmetry in spatial memory. *Memory and Cognition*.

## OXFORD INFORMATION

### College Accommodation

Accommodation has been reserved for the nights of 30 and 31 March in University College, all rooms are non en-suite. Links to alternative accommodation is shown below and should be booked directly with the hotel or guest house. Reservations for University accommodation and/or the Conference Dinner, can be made on the enclosed booking form, which should be returned to Faith Ayre, Department of Experimental Psychology, University of Oxford, South Parks Road, Oxford OX1 3UD (Tel: 01865 271386) before **16 March, 2004**.

**\*\*\*Cheques must be made payable to St John's College\*\*\***

### Hotels and guest houses close to campus

Alternative accommodation can be found at:

- <http://www.smoothhound.co.uk/oxford.html>
- <http://www.visitoxford.org>

Early booking is strongly recommended if you wish to use alternative accommodation.

### Messages

Messages for those attending the meeting can be left at Psychology Reception, tel: 01865 271444.

### Travel

#### By Air

London Heathrow and Gatwick airports have regular bus services to Oxford. For information telephone 01865 785400 or see website <http://www.theairline.info/>

#### **By Rail**

A frequent direct service operates between Oxford and London Paddington (approximately every 30 minutes), and between Oxford and Birmingham New Street via Banbury and Coventry. Other services operate from the north via Birmingham New Street; from the South via Reading; and from the west via Didcot or Reading. For information contact National Rail enquiries; tel: 08457 484950. See also <http://www.rail.co.uk/>

#### By Coach

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Frequent 24-hour direct services connect Oxford with London (peak times every 10-20 minutes). The Oxford Express X90 service includes Victoria Coach Station, Grosvenor Gardens, Marble Arch, Baker Street/Gloucester Place and Hillingdon. (tel: 01865 785410, website: <http://www.oxfordbus.co.uk/london.html>). The Oxford Tube service includes Grosvenor Gardens, Marble Arch, Notting Hill Gate, Shepherd's Bush, and Hillingdon (tel: 01865 772250, website: <http://www.stagecoach-oxford.co.uk/oxfordtube/>). The nearest bus stop is on the High Street, very close to University College and a short walk from the Department. Ask the driver for the Queens Lane stop.

For information on coaches to other major cities and airports contact National Express (tel: 08705 808080, website: <http://www.nationalexpress.com/neh.cfm>).

### By Car

London-Oxford: A40/M40/A40

Birmingham-Oxford: M40/A34

Bristol-Oxford: M32/M4/A34

See also: <http://www.ox.ac.uk/aboutoxford/how.shtml> for maps

### **Parking**

Parking near the Department and University College is impossible. Many Oxford streets are now closed to traffic. Visitors are encouraged to use the Park and Ride bus services which operate between the city centre and parking areas on the outskirts at Pear Tree, Woodstock Road (north); Water Eaton (north); Seacourt, Botley Road (west); Redbridge, Abingdon Road (south); and Thornhill, London Road (east). See the Oxford Bus Company website <http://www.oxfordbus.co.uk/> for details.

### **Local Taxis**

Taxi ranks are located at Oxford Railway Station, Gloucester Green Coach Station and St Giles' in the city centre.

- Radio Taxis, Tel: +44 (0)1865 249743 or 242424
- ABC Taxis, Tel: +44 (0)1865 770077

### **Eating and Drinking**

No special lunches are being provided in the Department, although the *Psychology Snack Bar* on level C will be open for the sale of sandwiches, pastries and drinks etc from 8.00am – 2.00pm and *Darwins* on level C in the Zoology department (same building) provides a range of hot and cold food, sandwiches and pastries and is open from 8.15 – 4.30.

Excellent sandwiches are also available from various locations in the town, including *The Alternative Tuck Shop* (at the junction of Holywell Street and Mansfield Road); *Morton's* (Broad Street and several shops in the *Covered Market*).

There are numerous places to eat in the Town Centre.

### **Pubs**

The two nearest pubs which serve food are the *Turf Tavern* (Bath Place off Holywell Street) and *The King's Arms* (junction of Parks Road and Holywell Street).

### **Restaurants**

The closest restaurants to University College are *The Quod*, *The Elizabeth*, *Chiang Mai* (good value Thai) and the *Bath Place Hotel*. Alternatives include *Gee's* (just north of Norham Gardens on the Banbury Road), *15 North Parade* (just around the corner from *Gee's*), *Le Petit Blanc* (Walton Street, just past the Phoenix Cinema), and the *Luna Caprese* (North Parade). A good Chinese restaurant is the *Liaison* Castle Street – at the west end of Queen Street). *Café Zhouk* (upstairs at 135 High Street) is a good Indonesian restaurant. *Brown's* (at the St Giles end of the Woodstock Road) is very popular but you may have to queue.

See also <http://www.dailyinfo.co.uk> and <http://www.oxfordrestaurantguide.co.uk> for a comprehensive list of restaurants.

### Places of Interest

**First Time Visitors to Oxford** – see also <http://oxforduk.ags.myareaguide.com/>

Pleasant walks can be found in the area to the east of the Department of Experimental Psychology through the University Parks and across the Cherwell in Addison's Walk reached through Magdalen College, and in Christchurch Meadow leading down to the Thames.

The Ashmolean Museum, at the junction of Beaumont Street and St Giles, holds one of the country's major collections of art and archaeology. The University Museum, on Parks Road opposite Keble College, contains a major collection of natural history and the Pitt Rivers anthropological collection.

The biggest bookshop in Oxford is Blackwell's, at the east of Broad Street. Other notable bookshops are Waterstones (Broad Street) and Borders (Magdalen Street) where you can have a coffee and it is open from 9.00am to 11.00pm.

### **Conference Dinner**

This will be held at University College. The cost for four courses including wine will be £35. Postgraduates may attend the dinner for a subsidised cost of £17.50. In this instance the Booking form must be accompanied by a statement from an EPS member confirming Postgraduate status. Please book, and indicate any dietary requirements, on the enclosed form which should be returned to Faith Ayre, Department of Experimental Psychology, South Parks Road, Oxford, OX 1 3UD, Tel: 01865 271386 before **16 March, 2004**

