

2000 - January 6/7 University College London

LONDON MEETING 2000

A scientific meeting will be held at the Institute of Cognitive Neuroscience, University College London on 6/7 January, 2000. The local organiser will be Dr. S. Scott.

PROGRAMME

Thursday 6 January

START OF PARALLEL SESSIONS

Session A. Main Lecture Theatre, National Hospital

Symposium: Attention and Awareness. (Organised by Professors J. Driver and S. Jackson)

9.00 Stanislas Dehaene* and Lionel Naccache* (INSERM U.334, Service Hospitalier Frederic Joliot, France)

Behavioral and brain-imaging studies of subliminal calculation: A window into consciousness.

9.30 Geraint Rees* (California Institute of Technology, Pasadena)

Investigating the relationship between attention and awareness with functional brain imaging.

10.00 Martin Eimer (University of Cambridge)

Cross-modal links in spatial attention: Evidence from event-related brain potentials.

10.30 Coffee

11.00 R. Rafal* (University of Wales, Bangor)

Hemispatial neglect and the gates of consciousness.

11.30 Earl K. Miller* (RIKEN-MIT Neuroscience Research Center, Massachusetts Institute of Technology)

Prefrontal cortex and the top-down control of attention.

12.00 Roger Newport*, Stephen R. Jackson, Masud Husain* and John V. Hindle* (University of Nottingham, University of Wales, Bangor, Institute of Neurology, University of London and Llandudno General Hospital, Wales)

Sensory integration as revealed by proprioceptive matching in a patient with unilateral somatosensory impairment following central deafferentation.

12.30 Vincent Walsh* and Alan Cowey (University of Oxford)

The necessity and sufficiency of sensory areas for visual attention and visual awareness.

1.00 Lunch

Session B. Seminar Room B10, Alexandra House

9.00 J. N. Towse, G. J. Hitch, Z. Hamilton* and U. Hutton* (Royal Holloway, University of

London and University of Lancaster)

Waiting for a measure of children's working memory.

9.30 Evan Heit and Ulrike Hahn* (University of Warwick and Cardiff University)

Category-based induction and the diversity effect in children.

10.00 B. De Cara* and U. Goswami (Institute of Child Health, University College London)

The emergence of phonological awareness: Phonetic and lexical factors.

10.30 Coffee

11.00 Eraldo Paulesu*, Eamon McCrory* and Uta Frith (Scientific Institute H San Raffaele and Milan Institute of Cognitive Neuroscience, University College London)

Developmental dyslexia in Italy and England - same or different?

11.30 Anna Maria Di Betta* and Cristina Romani (University of Birmingham)

Learning new words: A problem for adult developmental dyslexics.

12.00 Andy Ellis and Matt Lambon Ralph (University of York and MRC Brain and Cognition Unit, Cambridge)

Age of acquisition effects in adult lexical processing reflect a loss of plasticity in maturing systems: Insights from connectionist networks.

12.30 Arie H. van der Lugt* (University of Exeter. Introduced by Professor S. Monsell)

What you hear is what you get: word-initial mismatches in spoken word recognition

1.00 Lunch

Session A. Main Lecture Theatre, National Hospital

2.00 Robert P. Carlyon, Rhodri Cusack*, Jessica M. Foxtan* and Ian H. Robertson (MRC Cognition and Brain Sciences Unit, Cambridge)

Effects of attention and unilateral neglect on auditory stream segregation.

2.30 Bettina Olk* and Monika Harvey* (University of Bristol)

Visual illusion processing in hemispatial neglect.

3.00 R.W. Kentridge*, C. A. Heywood* and L. Weiskrantz (University of Durham and University of Oxford)

Attention without awareness in blindsight.

3.30 Tea

4.00 D. A. Hall, M. A. Akeroyd, M. P. Haggard, A. Q. Summerfield A. R. Palmer*, M. R. Elliott* and R.W. Bowtell* (MRC Institute of Hearing Research, Nottingham and University of Nottingham)

Tone modulation and auditory attention activate different auditory areas.

4.30 Rhodri Cusack* and Robert P. Carlyon (MRC Cognition and Brain Sciences Unit, Cambridge)

Evidence for perceptual asymmetries in audition.

5.00 Amanda Parker, Alexander Easton*, Mark Buckley* and Edward Wilding* (University of Nottingham and University of Oxford)

Novelty and memory encoding in monkeys: Associative object and scene learning.
5.30 David R. Shanks and Annette Kinder* (University College London and Philipps-University, Marburg, Germany)
Single-process account of repetition priming and recognition memory in amnesia.
6.10 Annual General Meeting (members only) Room B10, Alexandra House
8.00 Dinner (Bertorelli1s, 19-23 Charlotte Street, W.1.)

Session B. Seminar Room B10, Alexandra House

2.00 Peter J. Lovatt* and John N. Williams (University of Cambridge)
Working memory and foreign language learning.
2.30 Marc Brysbaert* (University of Ghent. Introduced by Dr. D. C. Mitchell)
Visual word recognition in bilinguals: Evidence against the existence of two separate lexicons
3.00 Jane L. Morgan* and Linda R. Wheeldon (University of Birmingham)
A comparison between phoneme monitoring in external and internal speech.
3.30 Tea
4.00 Shelley Channon* and Sarah Crawford* (University College London. Introduced by Dr. David Shanks)
Real-life-type problem-solving and frontal lobe functioning.
4.30 Taeko N. Wydell and Tadahisa Kondo* (Brunel University and NTT Communication Science Research Laboratories, Japan)
Sub-word level of processing during Kanji word naming: Resolving the unresolved.
5.00 Jarrod Hollis* and Tim Valentine (Goldsmiths College, University of London)
Proper name processing: Are proper names pure referencing expressions?
5.30 Cordelia Fine* and James Blair (Institute of Cognitive Neuroscience, University College London)
Asperger syndrome following amygdala damage: Dissociating theory of mind from executive functioning.
6.10 Annual General Meeting (members only) Room B10, Alexandra House
8.00 Dinner (Bertorelli1s, 19-23 Charlotte Street, W.1.)

Friday 7 January Session A. Main Lecture Theatre, National Hospital

9.00 Emer M. E. Ford and Glyn W. Humphreys (University of Aston, Birmingham and University of Birmingham)
The semantics of action in everyday tasks.
9.30 Laura Shapiro and Andrew Olson (University of Birmingham. Introduced by Dr Koen Lamberts)
Category differences in naming performance: What's so special about living things?
10.00 Jon S. Simons*, Clare J. Galton*, Kim S. Graham, John R. Hodges, Karalyn Patterson* and Mieke Verfaellie* (MRC Cognition and Brain Sciences Unit, Cambridge,

Addenbrooke's Hospital, Cambridge and Boston University School of Medicine)
An exploration of recollection and familiarity-based recognition memory processes in semantic dementia.

10.30 Coffee

11.00 Chris McManus, Taha Amir*, Maharaj Singh* and Yukihide Ida* (University College London, UAE University, United Arab Emirates, Ch. Charan Singh University, Meerut, India and Osaka Gakuin Junior College, Osaka)
Cultural and historical differences in the incidence of left-handedness are due to differences in gene frequency not direct social pressure.

11.30 Martin A. Conway and Alison Holmes* (University of Bristol)
The self and the reminiscence bump: New evidence.

12.00 EPS prize lecture
Francesca Happé (Institute of Psychiatry)
Deficit and difference in autistic cognition.

1.00 Lunch

Session B. Seminar Room B10, Alexandra House

9.00 Angus Gellatly (University of Keele)
Spatial precues affect preattentive vision: attentional or motor effect?

9.30 Alan Wing and Jeff Pressing* (University of Birmingham and University of Melbourne)
Memory time scales and control processes in serial action.

10.00 Michael E. R. Nichols (University of Melbourne)
Asymmetries for tactile temporal resolution: a left hemisphere, not a right hemisphere advantage.

10.30 Coffee

11.00 Beatrice de Gelder (Tilburg University, The Netherlands and Université de Louvain-la-Neuve, Belgium)
Early stages of face processing: Contrasting acquired and developmental prosopagnosia.

11.30 Michael J. Morgan and Laura Parkes* (Institute for Cognitive Neuroscience, University College London)
Pre-attentive vision averages orientation over space.

12.00 EPS prize lecture (Main Lecture Theatre, National Hospital)
Francesca Happé (Institute of Psychiatry)
Deficit and difference in autistic cognition.

1.00 Lunch

Session A. Main Lecture Theatre, National Hospital

Symposium: Cognitive Neuroscience of Memory (Organised by Professors M.

Rugg and T. Shallice)

2.00 A. D. Wagner* (Harvard Medical School)

The cognitive and neuroanatomical architectures of memory: Insights from functional neuroimaging.

3.00 M.W. Brown* (University of Bristol)

Studies of the recognition memory system.

3.30 Tea

4.00 D. Gaffan (Oxford University)

Cholinergic denervation of temporal cortex, plus damage to the hippocampus-fornix system: a macaque model of dense amnesia in both Alzheimer's disease and medial temporal amnesia.

4.30 A. R. Mayes (University of Sheffield)

Complex memory and the medial temporal lobes: Lesion and neuroimaging approaches.

5.00 R. Henson, T. Shallice and R. Dolan* (Institute of Neurology, University College London, Institute of Cognitive Neuroscience, University College London)

Repetition priming for faces and symbols: influence of prior representations.

5.30 M. D. Rugg (University College London)

The role of the right prefrontal cortex in memory retrieval: Electrophysiological and functional neuroimaging evidence.

6.00 Meeting ends

Session B: Seminar Room B10, Alexandra House

2.00 Douglas D. Potter, Susan H. Jory*, Martin R.A. Basset*, Kenneth Barret*, and Bas Mychalkiw* (University of Keele, University of Dundee, Haywood Hospital and City General Hospital, Stoke on Trent)

Effect of mild head injury on reversed Stroop task performance: The role of attention, priming and inhibition.

2.30 B. R. Newell* and J. E. H. Bright* (University of New South Wales. Introduced by Professor D. C. Berry)

Differential Sensitivity of two measures of the knowledge acquired during artificial grammar learning.

3.00 David A. Oakley (University College London)

Hypnosis as a tool in experimental neuropsychology.

3.30 Tea

4.00 Elizabeth Gilman*, Geoffrey Underwood and John Morehen* (University of Nottingham)

Musicians' use of extrafoveal information during sight-reading.

4.30 David Reynolds*, Alan Garnham and Jane Oakhill (University of Sussex)

The role of stereotype gender information in a gender decision task.

5.00 Gery d'Ydewalle, Jo Thys*, and Filip Germeyns* (University of Leuven)

The perception of spatial relations between objects in scenes.

5.30 Session ends

ABSTRACTS

Behavioral and brain-imaging studies of subliminal calculation: A window into consciousness.

Stanislas Dehaene and Lionel Naccache

INSERM U.334, Service Hospitalier Frederic Joliot, France

Stimuli that are masked can enter into complex cerebral computations without ever being perceived consciously. We have used behavioral and brain-imaging methods (ERPs and fMRI) to measure the depth of processing of masked numerical primes. Our results indicate that an entire stream of perceptual, semantic and motor processes can occur without awareness (Dehaene et al., 1998b). When subjects engage in an overt semantic comparison task on a clearly visible target numeral, measures of covert motor activity indicate that they also unconsciously apply the task instructions to an unseen masked numeral. New analyses indicate that the right inferior parietal region, which is known to be involved in the semantic coding of numerical quantity, is also traversed by the masked prime since it shows a notation- independent effect of repetition priming. It will be argued that these results cannot be explained by a non- semantic motor association process or "direct motor specification". Rather, they imply that masked primes can be processed up to a semantic level and beyond.

Given that the same semantic code in the inferior parietal lobule can be recruited during both subliminal number comparison and during conscious calculation, what neural activity patterns distinguish conscious and unconscious calculation? Though we do not yet have a definitive answer, we note that when the task is simple, automatized, and can be performed in a subliminal mode, parietal activity is clearly present, but little or no prefrontal or cingulate activity is observed. During more complex and effortful calculation tasks, however, parietal cortex is systematically observed in coordination with anterior cingulate and prefrontal cortical networks (Chochon, Cohen, van de Moortele, & Dehaene, 1999; Dehaene, Spelke, Stanescu, Pinel, & Tsivkin, 1999).

These results will be discussed with the global workspace model of conscious information processing (Dehaene, Kerszberg, & Changeux, 1998a; see also Baars, 1989). The model distinguishes two main computational spaces within the human brain: a set of specialized modular processors that support multiple automatized processes running in parallel, and a unique global workspace composed of distributed and heavily interconnected neurons with long-range axons, that can rapidly and flexibly interconnect the modular processors in novel ways. Through these long-range connections, information encoded in the workspace is immediately accessible to a variety of

processes including verbal or non-verbal report, evaluation, and memorization. We postulate that workspace neurons are particularly mobilized in effortful tasks for which the specialized processors do not suffice. They selectively enhance or suppress, through descending connections, the contribution of specific processor neurons. Anatomical studies suggest that workspace neurons may be particularly dense in dorsolateral prefrontal and anterior cingulate areas, thus explaining the frequent activation of these areas during conscious tasks.

Baars, B. J., (1989). *A cognitive theory of consciousness*. Cambridge, Mass.: Cambridge University Press.

Chochon, F., Cohen, L., van de Moortele, P. F., & Dehaene, S., (1999). Differential contributions of the left and right inferior parietal lobules to number processing. *Journal of Cognitive Neuroscience*, in press.

Dehaene, S., Kerszberg, M., & Changeux, J. P., (1998a). A neuronal model of a global workspace in effortful cognitive tasks. *Proceedings of the National Academy of Sciences USA*, 95, 14529-14534.

Dehaene, S., Naccache, L., Le Clec H. G., Koechlin, E., Mueller, M., Dehaene-Lambertz, G., van de Moortele, P. F., & Le Bihan, D., (1998b). Imaging unconscious semantic priming. *Nature*, 395, 597-600.

Dehaene, S., Spelke, E., Stanescu, R., Pinel, P., & Tsivkin, S., (1999). Sources of mathematical thinking: Behavioral and brain-imaging evidence. *Science*, 284, 970- 974.

Investigating the relationship between attention and awareness with functional brain imaging.

Geraint Rees

California Institute of Technology, Pasadena

Recently there has been increasing interest in the relationship between attention and visual awareness. Patients with disorders of attention due to focal cerebral lesions may fail to report awareness of visual stimuli presented in the contralesional visual field. Similarly, normal subjects may show reduced awareness for ignored visual stimuli when attention is fully occupied elsewhere. Functional brain imaging has been used to characterise the neural mechanisms underlying these phenomena. In a patient with visual extinction caused by focal right parietal damage, extinguished and unseen visual stimuli nevertheless evoked neural activity in contralateral striate and early extrastriate cortex. Activity in these structures is therefore not sufficient to produce awareness. In normal subjects, progressively engaging attention leads to reduced activity in visual areas processing irrelevant stimuli. Moreover, if attention is fully engaged elsewhere, then even highly familiar stimuli presented foveally fail to evoke brain activity related to their identity. Such 'inattention blindness' shows that visual recognition is wholly dependent on attention even for highly familiar and meaningful stimuli at the centre of gaze. Taken together, these findings illustrate the strong relationship between visual awareness and attention, and show how brain imaging may illuminate some of the most enduring controversies in attention research.

Cross-modal links in spatial attention: Evidence from event-related brain potentials.

Martin Eimer

University of Cambridge

After a brief introduction to the basis and measurement of event-related brain potentials (ERPs), and ERP modulations reflecting selective processes in spatial attention, a series of recent ERP studies will be presented that investigated cross-modal links in spatial attention between audition, vision and touch. It was studied whether and how attentional orienting within one modality affects the processing of stimuli within another modality. These studies provide evidence for the existence of cross-modal links that affect primarily early stages of information processing. In contrast to vision and audition, it was found that touch can be selectively decoupled from attentional processes within another modality when tactile information can be entirely ignored.

Hemispatial neglect and the gates of consciousness.

R. Rafal

University of Wales, Bangor

A review of experimental studies in patients with hemispatial neglect, based on simple bedside observations, will address three basic questions: 1) What is neglect?; 2) What is neglected?; 3) What information is processed outside of conscious awareness?

Extensive visual processing proceeds in the absence of conscious awareness that parses the scene to extract figure from ground, groups objects, defines their primary axis and enables semantic classification. Neglect then acts at a level of selection for action determined both by what the stimuli are and by the task at hand. Neglect is:

- a) less when competing stimuli are different from one another - but only if they differ on the dimension to be reported;
- b) less for more meaningful information;
- c) greatest when patients are asked to report location than other features of objects, and least when they are asked to count the items.

Prefrontal cortex and the top-down control of attention.

Earl K. Miller

Massachusetts Institute of Technology, Cambridge, MA

The prefrontal (PF) cortex is thought to be a major source of top-down signals that modulate processing in other brain regions. I will review recent neurophysiological studies in monkeys that illustrate that PF neurons have properties ideal for providing the top-down signals that control the allocation of attention. Their activity can convey information about to-be-attended items by selecting and integrating information from diverse sources. They can maintain activity about to-be-attended items in the face of distractions. Finally, the PF cortex is important for learning behavior-guiding rules that dictate what is relevant and needs attending. This may stem from the ability of its

neurons to acquire and represent task "models" that describe important task information and their interrelations.

Sensory integration as revealed by proprioceptive matching in a patient with unilateral somatosensory impairment following central deafferentation.

Roger Newport¹, Stephen R. Jackson², Masud Husain³ and John V. Hindle⁴.

1. University of Nottingham
2. University of Wales, Bangor
3. Institute of Neurology, University of London
4. Llandudno General Hospital, Wales

During reaching movements, sensory signals must be transformed into appropriate motor command signals. For movements directed to visually defined targets, this will involve translating visual information signalling the spatial position of the target, into a motor plan which specifies the sequence of postural changes required to bring the hand to the target. Understanding the nature of these visuomotor transformations, particularly how different kinds of sensory cues may be combined to produce the motor plan, remains a critical, but largely unresolved issue, in motor neuroscience. Recent anatomical and neuropsychological evidence suggests that the frame of reference used to guide reaching movements may vary according to whether movements are directed to visually-defined or proprioceptively-defined target locations 1,2. In the current study we report a series of experiments which investigate how the accuracy of reaching movements varies, in a patient (CT) recovering from unilateral somatosensory impairment, including tactile extinction, when executing reaches toward visually-defined or proprioceptively-defined targets. A key feature of the reaching task that we used was that the patient was required to reach, using her non-impaired limb, above a table surface to target positions defined proprioceptively by passively placing the patient's impaired hand in position beneath the table, and thus out of view. Our findings demonstrate the following: (a) when the target location of a reach is defined proprioceptively by an unseen hand which has been passively positioned by the experimenter, access to visual cues significantly increases end-point accuracy of the reach, even though such cues cannot possibly signal the position of the target. (b) our patient shows a limb-specific loss of accuracy such that she only exhibits large spatial inaccuracies when reaching to proprioceptively-defined targets using her non-impaired hand (targets are defined by her impaired hand). (c) these limb-specific errors are substantially reduced when visual cues are made available, even though such cues cannot signal the spatial position of the target hand.

Rushworth M. F. S, Nixon P. D., and Passingham R. E., (1997). Parietal cortex and movement I. Movement selection and reaching. *Exp. Brain Research* 117, 292- 310.

Jackson S. R., Newport R., Husain M., Harvey M., and Hindle J. V., (in press) Reaching movements may reveal the distorted topography of spatial representations after neglect. *Neuropsychologia*.

The necessity and sufficiency of sensory areas for visual attention and visual

awareness.

Vincent Walsh and Alan Cowey

University of Oxford

Several areas of visual cortex are functionally specialised for processing a limited range of the many attributes in the visual image. Recently the nature of these specialisations has been extended to include voluntary attention to these attributes and even conscious experience of them. For example area V4 is involved in attending to colour and form, and V5 to motion. It has been suggested that activation in V5 is sufficient for the experience of movement in the absence of activity in, say, V1. Using transcranial magnetic stimulation to stimulate area V5 in human subjects we have shown that this area is necessary for the detection and discrimination of motion when the task places high perceptual demand (i.e. requires more selective attention). However, we have also shown that activity in area V5 alone, or originating there, is insufficient to create the perception of motion. TMS was applied over area V5 in a patient who was totally blind as a result of an accident that severed both optic nerves. He reported vivid sensations of movement similar to those reported by sighted subjects when this area was stimulated. Stimulation of the same region in a patient with a lesion in area V1, however, failed to produce any reports of movement in the contralateral hemianopic defect despite dense sampling and high levels of stimulation. Faint stationary phosphenes were produced but in the normal sighted hemifield, suggesting that they were produced by interhemispheric interaction between the V5 of each hemisphere.

Waiting for a measure of children's working memory.

J. N. Towse¹, G. J. Hitch², Z. Hamilton¹ and U. Hutton¹

1. Royal Holloway, University of London
2. University of Lancaster

The dominant way of measuring the limits of working memory involves the use of a span procedure. A series of items must be remembered whilst carrying out tasks such as arithmetic or reading, with the memory stimuli often being the product of the processing task (e.g., the solution to an arithmetic problem). The number of processing operations and consequently the number of memory items is gradually increased until recall fails. The point at which memory error frequencies cross a threshold defines the individual's span.

We consider the conceptual utility of always calculating working memory capacity in terms of the size of the storage space, and contrast this with an alternative approach emphasising the length of time that transpires before representations become inaccessible. Memory durability can be estimated by adjusting the time to complete the processing elements - affecting the retention interval - while holding constant the number of memory items. Data are reported that compare size- and durability-based measures of children's working memory, examining both experimental effects and individual differences. We show that it is feasible to measure the durability of working memory and present data to indicate that this technique has predictive value for

children's scholastic attainment.

Category-based induction and the diversity effect in children.

Evan Heit¹ and Ulrike Hahn²

1. University of Warwick
2. Cardiff University

One of the hallmarks of inductive reasoning by adults is the diversity effect, namely that subjects draw stronger inferences from a diverse set of premise categories than from a homogenous set of categories (Osherson et al., 1990). However, past developmental work (Lopez et al., 1992; Gutheil & Gelman, 1997) has not found diversity effects with children age 9 and younger. In our own two experiments, we found robust and appropriate use of diversity information in children in the range of 5 years to 8 years. For stimuli we used pictures of people and the everyday objects they possessed such as clothing and chocolates, rather than stimuli concerning animals and their hidden biological properties as in past studies. We discuss implications of these results for models of inductive reasoning.

Gutheil, G., & Gelman, S. A., (1997). Children's use of sample size and diversity information within basic-level categories. *Journal of Experimental Child Psychology*, *64*, 159-174.

Lopez, A., Gelman, S. A., Gutheil, G., & Smith, E. E., (1992). The development of category-based induction. *Child Development*, *63*, 1070-1090.

Osherson, D. N., Smith, E. E., Wilkie, O., Lopez, A., & Shafir, E., (1990). Category-based induction. *Psychological Review*, *97*, 185-200.

The emergence of phonological awareness: Phonetic and lexical factors.

B. De Cara and U. Goswami

Institute of Child Health, University College London

Although phonological awareness and its relation to reading and spelling have been studied intensively, the origins of phonological awareness have received little attention. We have investigated two factors that might be expected to affect the emergence of phonological awareness: (1) the sonority hierarchy, and (2) phonological neighbourhood density. Cross-linguistic studies have shown that the dispersion in sonority within 'optimal' syllables (i.e. frequently represented across languages) is maximised before the vowel and minimised after the vowel (Clements, 1990). Thus awareness of phonological segments like rimes within optimal syllables might be expected to emerge first. In addition, the need to distinguish similar-sounding words during language acquisition requires a fairly accurate specification of constituent phonological segments. Thus, words from dense phonological neighbourhoods (i.e. words with lots of similar-sounding neighbours, e.g. race, face, rate, rice) should incur the greatest pressure towards the awareness of segmental phonology (Metsala & Walley, 1998). Awareness of phonological segments like rimes within dense neighbourhoods might be expected to emerge first. We present a study examining rime awareness in 5 and 6 year old children

when sonority and phonological neighbourhood density are crossed, based on the oddity task of Bradley & Bryant (1983), and the same-different judgement task of Treiman & Zukowski (1991).

Developmental dyslexia in Italy and England - same or different?

Eraldo Paulesu¹, Eamon McCrory² and Uta Frith²

1. Scientific Institute H San Raffaele, Milan
2. Institute of Cognitive Neuroscience, University College London

Dyslexia is much less of a handicap in Italian since the transparent orthography enables even dyslexic readers to learn to read and spell quickly and accurately. Hence there is less awareness of dyslexia and the incidence is reported as lower (1 to 2% vs. 5 to 10% in English speaking countries). Despite this, we found a number of striking similarities between English and Italian dyslexic university students. The WAIS-R profile of participants in both countries was highly similar. Performance on phonological tests in both dyslexic groups was impaired relative to controls. So was speed of single word recognition. Italian readers, dyslexics and controls were significantly faster than their English counterparts. Two PET scan studies investigated brain activation during explicit and implicit reading. English and Italian dyslexics showed significantly reduced activation in the inferior basal temporal region and in the middle temporal gyrus. Hence, dyslexia can be universally defined as a neuro-cognitive developmental disorder that implicates phonological processing. However, its behavioural manifestation is dependent on language and orthography.

Learning new words: A problem for adult developmental dyslexics.

Anna Maria Di Betta and Cristina Romani

University of Birmingham

Phonological short-term memory (PSTM) is believed to play an important role in vocabulary acquisition. Romani and Stringer (1994) reported the case of AW, an adult developmental surface dysgraphic, who had difficulties learning nonwords and Dutch words, yet had a normal PSTM. We investigated the acquisition of new words in a group of adult dyslexic subjects. All our patients, so far, have performed poorly on new word learning tasks. However, a defective PSTM has not always been correlated to such impairment. The possible underlying causes of such difficulties will be discussed.

Age of acquisition effects in adult lexical processing reflect a loss of plasticity in maturing systems: Insights from connectionist networks.

Andy Ellis¹ and Matt Lambon Ralph²

1. University of York
2. MRC Brain and Cognition Unit, Cambridge

Early learned words are recognised and produced faster than later learned words in a range of lexical processing tasks. We show that such age of acquisition effects are

readily accounted for in terms of connectionist models trained by the back propagation algorithm when learning is cumulative and interleaved. Under such conditions, associations between patterns that are introduced early into training retain an advantage over patterns introduced later, even after extensive further training. Simulations explore the relationship between age of acquisition and frequency of training, the effects of vocabulary size and loss of early items, the acquisition of very late items, and the consequences of damage to the network. Analysis of hidden unit activations indicates that age of acquisition effects reflect a gradual reduction in the plasticity of a maturing system.

What you hear is what you get: word-initial mismatches in spoken word recognition.

Arie H. van der Lugt (Introduced by Professor S. Monsell)

University of Exeter

How tolerant is the human listener with respect to word initial mismatching information? McQueen, Norris and Cutler (1994) found that it is harder to spot a word like mess in /d@mEs/, which is the beginning of domestic, than in /n@mEs/, which is not the beginning of an English word. This competition effect was here utilised in two identity priming experiments and two word-spotting experiments with three critical conditions: a word onset condition (e.g., /xolEs/ which is the beginning of the Dutch word cholesterol and which contains the word les (lesson)); a minimal mismatch condition where the initial phoneme only differed from the word in place of articulation (e.g., /folEs/), and a maximal mismatch condition where the initial phoneme differed in place, manner and voice (e.g., /bolEs/). Overall, the results showed that the word recognition system is rather intolerant of word-initial phonetic mismatches. However, the results also suggest that mismatches involving only a single feature are less distinctive than mismatches involving several features. These results are discussed with respect to two important factors that are thought to modulate the listener's tolerance: lexical extent (Connine, 1994) and listening conditions.

Connine, C. M., (1994). Vertical and horizontal similarity in spoken word recognition. In C. Clifton, Jr., L. Frazier, & K. Rayner (Eds.), *Perspectives on sentence processing* (pp. 107-120), Hillsdale, N. J.: Erlbaum.

McQueen, J. M., Norris, D. & Cutler, A. (1994). Competition in spoken word recognition: Spotting words in other words. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 20, 621-638.

Effects of attention and unilateral neglect on auditory stream segregation.

Robert P. Carlyon, Rhodri Cusack, Jessica M. Foxtan, and Ian H. Robertson

MRC Cognition and Brain Sciences Unit, Cambridge

Two pairs of experiments investigated the effects of attention and of unilateral neglect on auditory streaming. The first pair showed that the build-up of auditory streaming in normal subjects is greatly reduced or absent when subjects are attending to a competing

task in the contralateral ear. It was concluded that the effective build-up of auditory streaming requires attention. The second pair demonstrated that patients with an attentional deficit towards the left side of space ("unilateral neglect") show less stream segregation of tone sequences presented to their left than to their right ear. Streaming in their right ears was similar to that observed for stimuli presented to either ear of healthy and of brain-damaged controls, who showed no across-ear asymmetry. This result is consistent with a role for attention in auditory streaming, imposes some constraints on the neural sites involved, and demonstrates a qualitative difference between the perception of left- and right- sided sounds by neglect patients.

Visual illusion processing in hemispatial neglect.

Bettina Olk and Monika Harvey

University of Bristol

The study investigates the effect of hemispatial neglect on the perception of variations of the Mueller Lyer and Judd illusory figures.

Fourteen patients with hemispatial neglect and two matched control groups were asked to bisect different versions of both illusions. On every trial they were first asked to describe how they perceived the figure and then asked to bisect its shaft. Contrary to previous studies all neglect patients spontaneously described the leftside of the illusion before marking it.

Results show that neglect patients exhibited illusory effects in so far as bisection judgements are shifted towards outward-projecting fins (-<) and away from inward-projecting fins (<-) relative to baseline judgements. For both directions the bias proved larger when double (<-<) as opposed to single sided fins (-<,<-) were presented.

Leftsided fins had an impact on bisection behaviour as well as rightsided fins.

Additionally, bilateral inward-projecting fins (<->) decreased perceived line length resulting in a reduced bisection error and bilateral outward- projecting (>-<) fins increased perceived line length resulting in an increased bisection error.

These results strongly suggest that neglect patients, like control groups, are influenced by perceptual illusions. There was as, however, one neglect patient, L.C. who despite consciously reporting all fins failed to show illusory effects in her bisection behaviour. Interestingly this patient's lesion included the occipital as well as the temporal lobe. It might thus be possible that perceptual mechanisms responsible for coding these elementary features were destroyed in this patient.

Attention without awareness in blindsight.

R.W. Kentridge¹, C. A. Heywood¹ and L. Weiskrantz²

1. University of Durham

2. University of Oxford

The act of attending has frequently been equated with visual awareness. We examined this relationship in 'blindsight' - a condition in which the latter is absent or diminished as a result of damage to primary visual cortex. Spatially-selective visual attention is

demonstrated when information that stimuli are likely to appear at a specific location enhances the speed or accuracy of detection of stimuli subsequently presented at that location. In blindsight subject GY, we show that attention can confer an advantage in processing stimuli presented at an attended location, without those stimuli entering consciousness. Attention can be directed both by symbolic cues in the subject's spared field of vision or cues presented in his blind-field. Cues in his blind-field are even effective in directing his attention to a second location remote from that at which the cue is presented. These indirect cues are effective whether or not they themselves elicit non-visual awareness. We conclude that the spatial selection of information by an attentional mechanism and its entry into conscious experience cannot be one and the same process.

Tone modulation and auditory attention activate different auditory areas.

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Active listening elicits a different sensory response than passive listening. In neuroimaging, this is generally observed as an increase in the magnitude of activation. Sensory activation differences may therefore be masked by the effect of attention. We report a study that measured activation induced by static and modulated tones, whilst controlling attention by using target detection and passive listening tasks. The factorial design enabled us to determine whether the stimulus-induced activation in auditory cortex was independent of the information-processing demands of the task. Listening conditions induced widespread activation in the temporal cortex, including Heschl's gyrus (HG), planum temporale, superior temporal gyrus (STG) and superior temporal sulcus. The primary auditory area is located on HG, while secondary auditory areas surround it. No additional auditory areas were recruited in the analysis of modulated tones compared to static tones. However, modulation increased the amplitude of the response in the STG, anterior to HG. Relative to passive listening, the active task increased the response in the STG, posterior to HG. The active task also recruited a network of regions in the frontal and parietal cortex and sub-cortical areas. These findings indicate that preferential responses to stimulus modulation and the attention-demanding, active listening task involve distinct, non-overlapping areas of the secondary auditory cortex. Thus, in this study, differences in sensory activation were not masked by effects of attention.

Evidence for perceptual asymmetries in audition.

Rhodri Cusack and Robert P. Carlyon

MRC-Cognition & Brain Sciences Unit, Cambridge

Many studies have investigated perceptual asymmetries in visual search tasks, but comparatively little work has been done in audition. Here, we present three experiments

suggesting strong perceptual asymmetries in the auditory domain. We show that a target warble (frequency modulated tone) is much easier to detect amongst steady distractors than vice-versa. In one paradigm, all sounds were presented sequentially, and the target was close to threshold. In the second, directly analogous to visual search experiments, many sounds were randomly distributed in both frequency and time, and the target was highly supra-threshold. Little peripheral masking was expected in either case. To investigate whether this effect is specific to frequency modulation (perhaps through adaptation or interference in a modulation filterbank), we conducted a third experiment in which the target was distinguished by duration. Again, a strong perceptual asymmetry was found, with long targets being much easier to select from short distractors than vice-versa. The most parsimonious explanation for all three experiments is that it is much easier to selectively attend to a target when it either contains a feature not present in the distractors, or when its magnitude on a relevant dimension (e.g. duration) exceeds that of the distracting stimuli.

Novelty and memory encoding in monkeys: Associative object and scene learning.

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2. University of Oxford

Using modified associative learning tasks which control the relative novelty of test stimuli, we report findings from two groups of unoperated control monkeys, two groups with bilateral perirhinal lesions and two groups of monkeys with crossed unilateral lesions of frontal cortex and inferior temporal cortex. Subjects studied lists of 2-dimensional visual object or scene stimuli. In each daily list one study item (the novel or isolate item) and its associated foil differed from the others (the homogenous items) along one stimulus dimension (colour). In scene learning backgrounds were from one end of colour space, and two identical choice objects were from the opposite end. In object learning one of the pairs to be learned in each daily list were isolate items, in scene learning both background and choice objects were reversed for one scene. The critical experimental measure was the comparison of the visual object or scene error rates for isolate and homogenous test items. For both control groups, error rates for both tasks were reliably lower for isolate than for homogenous stimuli (the von Restorff effect). Each task was then administered to groups of monkeys who had either bilateral perirhinal lesions or frontal / inferior temporal disconnection. In all four groups there was no evidence of a von Restorff effect. The results, in combination with similar findings for DMS (Parker et al, 1998), suggest that novelty detection is a fundamental stage in the encoding of many forms of memory.

Parker, A., Wilding, E. L., & Akerman, C., (1998) *J. Cog. Neurosci.* 10; 691-703

Single-process account of repetition priming and recognition memory in amnesia.

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A key claim of current theoretical analyses of the memory impairments associated with amnesia is that certain distinct forms of learning and memory are spared. A compelling example is that amnesic patients and controls are indistinguishable in repetition priming (e.g., for nonwords), but the amnesics are impaired at recognising the study items. We show that this pattern of results is predicted by a single-system connectionist model of learning in which amnesia is simulated by a reduced learning rate. We conclude that the performance of amnesic patients in implicit memory tasks is better understood in terms of a general, rather than a selective, memory deficit.

Working memory and foreign language learning.

Peter J. Lovatt and John N. Williams

University of Cambridge

The nature of the association between auditory-verbal short-term memory (AVSTM) and second language learning of Italian vocabulary and grammar was examined in a series of laboratory tasks. The subjects had no prior knowledge of Italian, none had studied languages beyond GCSE level, but they did vary in the number of languages studied. In a vocabulary learning phase subjects learned 16 Italian nouns to criterion. In a rule-learning phase subjects were exposed to pairings of nouns and articles in a simple memory task, and we tested their ability to induce the rules relating to article usage (specifically the role of the noun's number and grammatical gender). Generalisation tests were administered at intervals during learning. We took multiple measures of AVSTM, including: immediate serial recall (ISR) of foreign words, intermediate term memory for article-noun pairings during the rule-learning phase (ITM) and speech rate for words and nonwords. We found that: 1. ISR and speech rate correlated with number of languages known; stepwise regressions showed that 2. ISR and speech rate made independent contributions to rate of vocabulary learning whereas number of languages known made no independent contribution, and 3. The number of languages known strongly predicted generalisation test performance at all points in the rule-learning phase, whereas ISR and speech rate made no independent contribution. In addition, 4. ITM at the start of the learning phase made an independent contribution to rule learning - it significantly predicted generalisation performance at the end of the learning phase, even when number of languages known was partialled out. However, there was no effect of ITM when generalisation to new vocabulary was tested. These findings suggest that: 1. There is a dissociation between the processes underlying vocabulary learning and rule learning, at least for the domain examined here, 2. Phonological memory processes are important for vocabulary learning but not for rule learning, and 3. Whilst domain knowledge (here indexed by number of languages known) is important for rule learning, ITM processes also make an independent contribution. Existing theories, which posit a relationship between memory and language learning, are critically discussed in the light of these findings.

Visual word recognition in bilinguals: Evidence against the existence of two separate lexicons.

Marc Brysbaert (Introduced by Dr. D. C. Mitchell)

University of Ghent

Evidence is accumulating that the first stages of visual word processing in bilinguals are language-independent. Early findings that seemed to point to the existence of independent lexicons and a language selective access mechanism, can be explained either because participants were able to use low-level orthographic cues about the language of the stimulus, or because the dependent variable was not sensitive enough to reveal the interactions. In this talk, I will first show that target words from one language can be primed by tachistoscopically presented (pseudo)homophones from the other language. This is true not only for primes of the native language (Brysbaert et al., 1999), but also for primes of the second language and targets of the native language. Phonological priming from L2 on L1 is already present for speakers who are far from proficient in their second language. On the basis of a second series of experiments, I will show that in a lexical decision task, bilinguals activate the two meanings of homographs (i.e. words that have the same spelling but different meanings in two languages), even though the decision times to the homographs do not differ from the decision times to unambiguous control words. The activation of the meaning in the non-target language can be demonstrated by presenting the translation of the non-intended meaning on the subsequent trial. For instance, if a Dutch-English bilingual does an English lexical decision task, the reaction latency to the word "step" is faster if on the previous trial the word "tree" was presented (tree in Dutch means step).

Brysbaert, M., Van Dyck, G., & Van de Poel, M., (1999). Visual word recognition in bilinguals: Evidence from masked phonological priming. *Journal of Experimental Psychology: Human Perception and Performance*, 25, 137-148.

A comparison between phoneme monitoring in external and internal speech.

Jane L. Morgan and Linda R. Wheeldon

University of Birmingham

Wheeldon and Levelt (1995) introduced an internal speech monitoring task which enabled the time course of phonological encoding to be traced. The present pair of experiments aimed to replicate this methodology in English and to compare the timing of internal speech monitoring with that of external speech. For the internal speech task participants were trained to silently generate carrier words in response to semantically related prompt words and to monitor these productions for the consonants and vowel which made up the initial CVC syllable. The external speech task simply required participants to monitor auditorily presented carrier words. It was predicted that the internal and external speech versions of the task would yield a different pattern of results. Specifically, the monitoring of external speech should be governed by phonetic/acoustic influences whereas the monitoring of the more abstract internal speech code should not. This was found to be the case. The monitoring of the internal

speech code progressed in a left-to-right manner. When monitoring the external speech code, however, latencies to the vowel and final consonant did not differ suggesting that the detection of the vowel was delayed. These differences are discussed in terms of the availability of the information in the two codes.

Wheeldon, L. R., & Levelt, W. J. M., (1995). Monitoring the time course of phonological encoding. *Journal of Memory and Language*, 34, 311-334.

Real-life-type problem-solving and frontal lobe functioning.

Shelley Channon and Sarah Crawford (Introduced by Dr. David Shanks)

University College London

Frontal lobe dysfunction has been associated with executive dysfunction and impaired everyday life problem-solving. The "Predicaments" test was designed to assess real-life-type problem-solving using videotaped scenarios covering a range of everyday interpersonal situations. This was used to examine performance in people with altered frontal lobe functioning. In one study, participants with unilateral anterior or posterior lesions showed impairment relative to controls in both everyday problem-solving and on more abstract tests involving executive function and memory. The anterior group was impaired on more aspects of everyday problem-solving than the posterior group. In another study, adults with Tourette's syndrome showed impaired performance on aspects of the Predicaments test, and on some tests of executive function given. In a third study, healthy adults of different ages were impaired on tests of executive function in the older group, but showed relatively preserved performance on the Predicaments test. The implications for our understanding of impairments in everyday life problem-solving will be considered.

Sub-word level of processing during Kanji word naming: Resolving the unresolved.

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Computation of Kanji word phonology during reading, in particular, sub-word level of contribution was examined in a word-naming experiment with 1,000 two-character Kanji word stimuli. A statistically-defined character-to-sound consistency and a character-to-pronunciation plausibility (subjective ratings on pronunciation plausibility for Kanji characters) were used as the means of evaluating the sub-word level of processing. The results revealed that the statistically-defined consistency effect was significant only with ON-reading (of Chinese origin) words, while the subjective plausibility effect was significant both with the ON-reading and KUN-reading (of Japanese origin) words. Further the plausibility effect was modulated by word familiarity, while the consistency effect (on ON-reading words) was not. It was also found as a by product of the study that ON-reading words were named significantly faster than the KUN-reading words,

suggesting that these two kinds of words may be intrinsically different from each other. The study thus showed that both sub-word and whole-word levels of processing contribute to the computation of Kanji word phonology, but that the statistically- defined consistency was not the right tool for evaluating the sub-word level of processing.

Proper name processing: Are proper names pure referencing expressions?

Jarrold Hollis and Tim Valentine

Goldsmiths College, University of London

Theoretical models of proper name processing have been primarily derived from studies of memory for people's names, however they are thought to generalise to all classes of proper name. Three experiments are reported which use a repetition priming technique to explore the cognitive phenomena associated with three classes of proper names: people's names, landmark names and country names. It was found that for people's names and landmark names: a) production of a name in response to seeing a picture primed a subsequent familiarity decision to the same item's written name b) making a familiarity decision to an auditory presentation of a name primed a familiarity decision to the same item's written name. No comparable facilitation was found for the country name stimuli. Theoretical views that proper names are unique, meaningless labels and that they are pure referencing expressions, are evaluated in the light of the data reported.

Asperger syndrome following amygdala damage: Dissociating theory of mind from executive functioning.

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Institute of Cognitive Neuroscience, University College London

We present findings from a patient, BM, with congenital unilateral left amygdala damage and who developed Asperger's Syndrome. In line with his diagnosis, BM showed severe difficulty on tasks assessing Theory of Mind. However, in contrast to models suggesting that Theory of Mind can be reduced to executive functioning, he presented with normal executive function development. This data strongly supports the contention that Social Cognition, in particular Theory of Mind, is developmentally and functionally independent of executive functioning. Speculations will be made concerning the role of the amygdala in the development of the neural circuitry for Theory of Mind.

The semantics of action in everyday tasks.

Emer M. E. Ford¹ and Glyn W. Humphreys²

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2. University of Birmingham

We present a single case study of a patient, HG, who was severely impaired on routine everyday tasks, such as cleaning his teeth and preparing a cup of tea. We used the Action Coding System developed by Schwartz et al. (1991) to provide quantitative and

qualitative measures of his performance in a number of experimental manipulations: (a) with task-congruent objects only, (b) with task-congruent objects and semantic distractors, (c) with a set of written commands to follow, (d) when he was given 1 command at a time, (e) when he was shown how the task should be performed before starting himself and (f) when the task was divided into smaller subgoals. These conditions were designed to assess the relative importance of a number of cognitive skills that could contribute to successful performance on everyday tasks: generating a plan, following a plan, keeping a goal in working memory and accessing semantic information about the objects. In general, the majority of HG1s errors were step omissions, perseverations, sequence errors and semantic errors. These semantic errors are particularly interesting since HG was able to name, gesture to and define all the objects when they were presented in isolation or in task-congruent arrays. We explore the relationship between semantic memory and performance on everyday tasks in some detail.

Schwartz, M. F., Reed, E. S., Montgomery, M., Palmer, C. & Mayer, N. H., (1991). The quantitative description of action disorganisation after brain damage: A case study. *Cognitive Neuropsychology*, 8(5), 381-414.

Category differences in naming performance: What's so special about living things?

Laura Shapiro and Andrew Olson (Introduced by Dr Koen Lamberts)

University of Birmingham

This study uses the normal population to examine the extent to which the living/non-living dissociation that occurs in category specific disorders can be explained by structural similarity. 10 undergraduates rated pairs of the living drawings from the Snodgrass and Vanderwart, 1980, stimuli set as significantly more structurally similar to each other than the non-living pairs of drawings, $p < 0.001$. In order to ascertain whether similarity alone can explain category specific effects, the effects of similarity and category (living/non-living) on naming performance were compared for a set of stimuli where these two factors were controlled for independently. 16 undergraduates were trained to learn names for similar or dissimilar imaginary animals or artifacts and then undertook a name-verification task without time pressure followed by the same task under time pressure. No significant effects of similarity were found. However, participants in the living conditions were faster and made fewer errors. The effect of category on RT was nearly significant for both tasks together and significant for the time pressure task only, $p < 0.005$. Although structural similarity may influence results obtained with the Snodgrass and Vanderwart picture set, it does not appear to be the only factor determining differences in processing pictures of living and non-living things. We consider whether differences in category structure may be an important factor in these results.

Snodgrass, J. G. & Vanderwart, M. (1980). A standardised set of 260 pictures: Norms for name agreement, image agreement, familiarity and visual complexity. *Journal of Experimental Psychology: Human Learning and Memory*, 6, 174-215.

An exploration of recollection- and familiarity-based recognition memory processes in semantic dementia.

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2. Addenbrooke's Hospital, Cambridge
3. Boston University School of Medicine

It has been convincingly demonstrated that patients with semantic dementia can show normal recognition memory for pictorial stimuli; but as yet there have been no proper investigations in this syndrome of more detailed aspects of episodic memory, such as the influence of recollection and familiarity processes. Here, we tested eight patients with semantic dementia and employed a source monitoring paradigm to measure their success in recollecting an item's source as well as detecting the fact that it had occurred previously. Most patients showed normal item detection, with only the two most semantically impaired cases exhibiting a significant deficit. On the source discrimination component, although some patients were impaired, others performed as well as the control participants, and importantly performance did not correlate with degree of semantic memory deficit. These results are interpreted in the light of current theories about the nature and organisation of various memory systems, and also with reference to volumetric assessments of structural damage in each patient's medial and lateral temporal lobes.

Cultural and historical differences in the incidence of left-handedness are due to differences in gene frequency not direct social pressure.

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3. Ch. Charan Singh University, Meerut, India
4. Osaka Gakuin Junior College, Osaka

Genetic models of handedness (e.g. Annett, McManus) typically assume a constant gene frequency for all populations, differences in manifest incidence principally reflecting direct social pressure, with genotypic left-handers, manifesting as phenotypic right-handers. In the absence of a model of social influence, the assumption has remained untested. In 1996, Bryden and McManus developed a formal model of handedness incorporating genetic and social influences. An important consequence of the model is that although differences in social pressure and gene frequency cannot be distinguished merely from population incidences of left-handedness, they are distinguishable if family data are available: a low incidence of left-handedness due to social pressure is associated with reduced familiarity, whereas a low incidence due to reduced gene frequency is associated with increased familiarity. In this paper we compare data from

Canada, the United Kingdom, United Arab Emirates, India and Japan and show that lower incidences of left-handedness mainly reflect differences in gene frequency, not social pressure. Historically, data collected in Western societies has also shown large increases in the incidence of left-handedness over the past one hundred years. A re-analysis of those data shows that changes principally reflect alterations in gene frequency rather than changes in direct social pressure. Lower gene frequencies are probably a result of indirect social pressure affecting breeding success. Data will be presented which show that in the early twentieth-century, Western left-handers produced fewer offspring than did right-handers. The subsequent rise in incidence resulted from removal of indirect social pressure.

The self and the reminiscence bump: New evidence.

Martin A. Conway and Alison Holmes

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A group of older adults (60+ years) recalled as many memories as they could in 5-minute periods from each decade of their lives. Categorisation rules based on Erikson's (1985) description of themes of psychosocial stages of development were constructed and used to classify memories in terms of psychosocial themes. The lifespan distribution of memories classified as being of events relating to childhood themes, identity, intimacy, generativity, integrity, or unclassified, were then plotted. We found that peak recall of memories related to events featuring the childhood themes of trust, autonomy, initiative, industry, occurred in first decade of life, peak recall of identity-related events was in the second decade, intimacy-related memories dated to the third decade, and generativity-related memories peaked in the fourth decade. Memories of integrity-related events were evenly distributed over all ages after the age of 10 years and unclassified memories, of which there were few, were more common for recent events. These findings show that there are several 'reminiscence' bumps and these are related to the overall goals that preoccupy the self during different phases of the lifespan (as Erikson proposed). Interestingly when we collapse our data and plot the resulting curve we recover the traditional lifespan retrieval curve with a large and reliable reminiscence bump occurring in the second and third decades of life. This suggests that memories of events related to the themes of identity and intimacy are, overall, more accessible than memories related to other themes and this may be because events related to these are crucial in the formation of a stable self.

Spatial precues affect preattentive vision: attentional or motor effect?

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Theories of visual perception generally assume that the detection of primitive features occurs preattentively, in parallel across the visual field.

Visual search data showing that time to determine the presence or absence of a target defined by a primitive feature has been taken as evidence that preattentive vision

operates free of attentional capacity limits. However, it has recently been reported by Theeuwes, Kramer and Atchley (1999) that the allocation of attention can have a reliable effect on the speed of search performance. If attention was drawn to a particular region of the field by visual precues, then detection responses were markedly faster to targets in that region than to targets presented elsewhere in the visual field. The finding seems directly contrary to the general assumption of capacity unlimited preattentive processing. It is possible, however, that the precuing effect is mediated by settings within the motor system rather than by visual attention. This paper will report experiments intended to distinguish between these two possibilities.

Memory time scales and control processes in serial action.

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2. University of Melbourne

Serial production tasks tend to exhibit fluctuations on short and long time scales. Thus Stevens (1886) described both slow and rapid changes in interresponse interval, ascribing the two to different levels of processing. Gildea et al (1995) used spectral analysis to characterise the form of the fluctuations in a number of cognitive domains including response timing and reported that spectral power decreased linearly with frequency on a log/log plot, a characteristic termed $1/f$ noise. Subsequently, Pressing and Jolley-Rogers (1997) showed an important departure from $1/f$ noise at high frequencies for template guided productions which they showed is predicted by extensions to the Wing- Kristofferson (1973) timing model. The low frequency components of $1/f$ noise appear to reflect memory processes operating on multiple time bases (Pressing, 1998). To examine such processes further we asked ten participants to produce series of brief force pulses to a target of 5N bilaterally with the two hands. A series comprised 250 force pulse pairs, each pair made in response to a computer generated tone which occurred approximately every 3-4 s. By providing feedback on only one of the two synchronous force pulse series we sought to differentially manipulate control processes. Spectral analysis on the time series of peak force values showed decreasing power with frequency which was linear on a log/log plot. For every subject the slope was greater in the hand where feedback was provided. We interpret this finding as a memory time scale effect reflecting enhanced control processes operating over shorter time scales.

Asymmetries for tactile temporal resolution: a left hemisphere, not a right hemisphere advantage.

Michael E. R. Nichols

University of Melbourne

Hemispheric asymmetries for tactile temporal discriminations were examined in two experiments. In Expt 1, vibrations lasting 120 ms were delivered unilaterally to the hands, half of which contained a gap lasting between 6 and 18ms. Participants indicated

whether or not the vibration contained a gap. The effect of hemispace was investigated using midline and lateral hand placements. Reaction time, response error and response bias measures revealed a left hemisphere advantage for gap detection. The asymmetry was reduced in the midline condition for the error data only. In Expt. 2, pairs of vibrotactile stimuli with simultaneous or successive onsets were delivered unilaterally to the left or right hands. The effect of hemispacial attentional biases was investigated using ipsilateral (arms uncrossed) and contralateral (arms crossed) hand placements. Trials presented to the right hand were associated with fewer errors and faster response times than the left hand. There was no asymmetry in response bias. Manipulations of hemispace did not affect the right hand advantage. These experiments confirm the existence of a left hemisphere temporal processing advantage within the tactile modality and demonstrate that it is not due to a rightward attentional bias.

Early stages of face processing: Contrasting acquired and developmental prosopagnosia.

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The performance of two patients with face deficits is compared on tasks examining face detection and face recognition. Both patients are capable of performing face detection even at very short latencies but they are severely impaired in face recognition. On the other hand, the pattern of their performance on recognition tasks is quite different. The performance of patient AV (developmental prosopagnosia) does not show the normal inversion effect while patient RP (acquired prosopagnosia) shows paradoxical effects (better performance for matching inverted than normally faces and objects). A similar contrast between the two patients is found for a part to whole matching task. AV does not show the normal face context effect while RP shows a significantly stronger negative effect of a normal face and object context in matching a part. These results suggest that different routes may be implicated in face detection and face recognition.

Pre-attentive vision averages orientation over space.

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Observers were shown arrays of gabor patches containing a single tilted target patch. They had to decide whether the target was tilted clockwise or anti-clockwise. (Figure 1). The spatial position of the target was randomised from trial to trial. Previous work has shown that orientational acuity in these conditions gets worse as the number of distractors increases (Morgan, Ward & Castet, 1998). In long exposures, the effect of distractors is accurately accounted for by a statistical spatial uncertainty model (Palmer, Ames & Lindsey, 1993). But in brief (100 msec) masked displays the effect of distractors is greater than that predicted by spatial uncertainty. We suggest that in the absence of focal visual attention to the target, observers base their decisions on the average tilt of all the stimuli in the array. The averaging model correctly predicts that acuity will be

higher than normal if the distractors have subthreshold tilts in the same direction as the target, and that acuity will be lower if the subthreshold tilts are in the opposite direction to the target. If the clusters were presented at 2.5 deg eccentricity, acuity for tilt improved with the number of target stimuli. Observers were unable to identify the position of targets within clusters of distractors, even when they could use the orientation information they provided. We present a model for these data using a recurrent-activation network in which orientation-tuned analysers support neighbours with a similar orientation preference.

We have carried out further investigations of the geometry of the higher-order receptive fields involved in the putative averaging of the orientation cue across space. The most surprising result was that a distractor placed between the target and the fixation point was less deleterious than one placed on the opposite side of the target from the fixation point.

Morgan, M. J., Ward, R. M. & Castet, E. (1998) Visual search for a tilted target: tests of spatial uncertainty models. *Quarterly Journal of Experimental Psychology*, 51A, 347-370.

Palmer, J., Ames, C. T. & Lindsey, D. T. (1993) Measuring the effect of attention on simple visual search. *Journal of Experimental Psychology: Human Perception and Performance*, 19, 108-130

The cognitive and neuroanatomical architectures of memory: Insights from functional neuroimaging.

A. D. Wagner

Harvard Medical School

Until recently, insights into the nature of memory have primarily derived from cognitive-behavioural and electrophysiological (e.g., ERP) studies with healthy individuals and patient populations, and from experimental studies with non-human animals. Over the past 8 years, the study of memory has been furthered through the application of advanced neuroimaging techniques (fMRI and PET) that permit in vivo investigation of memory in the human brain with high spatial resolution. This presentation will consider neuroimaging contributions to our understanding of both the cognitive and neuroanatomical architectures of memory. An emphasis will be placed on recent evidence for "cross-talk" or interactions between different forms of memory (e.g., implicit-explicit and working memory-explicit interactions).

Studies of the recognition memory system.

M.W. Brown

University of Bristol

Many studies indicate that recognition memory involves at least two separable

processes, recollection and familiarity discrimination. Evidence will be presented that familiarity discrimination for individual items is effected by a system based on perirhinal cortex. The fundamental change that encodes the prior occurrence of visual stimuli is a reduction in the response of neurones in anterior inferior temporal (including perirhinal) cortex from the first to subsequent presentations of stimuli. This system is fast, and neuronal network modelling indicates that it is potentially highly efficient in information theoretic terms. The speed and efficiency of novelty detection by this system provides an obvious evolutionary advantage, and hence explanation for its existence. Other, more complex aspects of recognition memory, involving spatial and contextual information and associative recollection, appear to be dependent on a system based on the hippocampus.

Brown M. W., & Xiang, J. Z., (1998) *Prog. Neurobiol.* 55: 140-189.

Aggleton, J. P., & Brown M.W., (1999) *Behav. Brain Sci.* 22: 425-498.

Cholinergic denervation of temporal cortex, plus damage to the hippocampus-fornix system: a macaque model of dense amnesia in both Alzheimer's disease and medial temporal amnesia.

D. Gaffan

Oxford University

The traditional explanation of dense amnesia in the human organic amnesic syndrome is that it is entirely attributable to lesions in the hippocampus, fornix or anatomically related structures. This view has been falsified, however, by accumulated evidence both in patients and in experimental animals, showing that selective lesions of those structures produce a significant but mild impairment of episodic memory, which does not amount to dense amnesia. Similarly, a traditional explanation of dense amnesia in Alzheimer's disease has attributed it to cholinergic denervation of cortex, but this explanation faces the difficulty that experimental cholinergic lesions in rats have little effect on their memory. With Easton, Parker, Ridley and Baker I have now tested in groups of macaque monkeys the effects of three surgical interventions, all of which have the effect of combining damage to fornix with disruption of the cholinergic innervation of temporal cortex. All three interventions produce dense amnesia.

Complex memory and the medial temporal lobes: Lesion and neuroimaging approaches.

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University of Sheffield

It is currently controversial whether the different structures of the medial temporal lobes (MTL) work as a unified functional memory system or whether different subcomponents not only serve different subfunctions, but that these subfunctions can be dissociably disrupted by selective lesions of the MTL. The specific controversy concerns whether the perirhinal cortex mediates memory for items and associations between similar kinds of item and the hippocampus only mediates memory for associations between different

kinds of information represented in distinct neocortical regions or whether both structures mediate all these kinds of memory. The issue needs to be addressed using convergent evidence from both lesion and functional neuroimaging studies. Evidence including that from two patients with selective hippocampal and selective fornix lesions respectively will be discussed. This evidence supports the proposed MTL functional dissociation. My group's functional neuroimaging studies agree with other evidence that shows MTL activations are frequently produced not only by episodic retrieval, but also by encoding into memory associations between items. These activations are mainly found in the MTL cortices rather than the hippocampus. However, a major problem, often ignored, is whether, until greater attention is paid to accurate spatial localisation and specifically problems of susceptibility artefact, functional neuroimaging can dissociate activations in closely adjacent small structures such as those in the MTL. Once this limitation is overcome, there are certain key predictions of the functional dissociation view that need to be tested. These will be discussed.

Repetition priming for faces and symbols: influence of prior representations.

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Repetition priming has been characterised neurophysiologically as a decreased response following stimulus repetition. Using event-related fMRI, we demonstrated that the neural response following repetition is sensitive to stimulus familiarity. In an indirect monitoring task, healthy volunteers viewed randomly-intermixed stimuli, pressing a key only for a prespecified target stimulus (target events were subsequently ignored). A left fusiform region showed greater responses to familiar than unfamiliar stimuli for both faces and symbols, regardless of repetition. A right midfusiform region however exhibited an attenuated response to repetition of familiar stimuli, but an enhanced response to repetition of unfamiliar stimuli. Moreover, both repetition effects were modulated by the lag between successive presentations. In further experiments we replicated the interactions between repetition, familiarity and lag, and demonstrate the persistence of these effects over multiple repetitions. We conclude that priming-related neural responses are not unitary but reflect the presence or absence of prior stimulus representations.

The role of the right prefrontal cortex in memory retrieval: Electrophysiological and functional neuroimaging evidence.

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A common finding in the literature on the functional neuroimaging of memory concerns activation of the right prefrontal cortex during episodic memory retrieval. Two key questions are whether this activation reflects processing engaged by the presentation of individual test items (item-related processing) and, if so, whether it varies according to

the nature of the retrieval cue (e.g. old vs. new items in a recognition memory test). The findings from studies employing event-related brain potentials (ERPs) suggest that the answer to both of these questions is positive, but this interpretation depends upon the validity of the methods employed to localise the sources of the ERP effects. Converging evidence is required from methods that localise item-related neural activity with higher spatial resolution than is possible with ERPs. Findings from studies using 'event-related' fMRI confirm that right prefrontal activity during recognition memory is item-related, and that this activity varies according to the judgements accorded different test items. Notably, items attracting non-confident judgements were found to elicit higher levels of activity in the right dorsolateral prefrontal cortex than items which received confident judgements. These findings, together with those from ERP studies, suggest that one role of the right prefrontal cortex is to monitor the results of attempts to retrieve information from episodic memory.

Effect of mild head injury on reversed Stroop task performance: The role of attention, priming and inhibition.

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In this study we have explored the effect of mild head injury on event-related potential (ERP) correlates of Stroop task performance with the aim of further elucidating the basis of processing impairments after mild head injury. Trails, digit symbol, digit span and auditory verbal learning tests (AVLT) were administered. Head injured were impaired only on the AVLT. A computer based and a card based reversed Stroop task were employed to demonstrate impaired attention function. This involved the presentation of an incongruent sequence of colour words prior to a congruent sequence (consisting of colour words printed in congruent colours). The reversed Stroop paradigm was used to induce negative priming of stimulus level word representations. Consistent with previous research, mild head injured were slower on the card based incongruent task than the controls. The mild head injured group showed evidence of enhanced negative priming or inhibition of congruent sequence responses that followed incongruent sequences. This inhibitory effect was shown to be generalizable in a second study on a further group of control subjects. ERP correlates of the card based Stroop task performance suggested a greater allocation of attention resources in the incongruent task in both groups in the form of relatively greater negativity in the latency range 400-500msec with a distribution consistent with the activation of the anterior cingulate gyrus. In addition the mild head injured group showed relatively greater enhancement in this latency range in both congruent and incongruent conditions. There was also some limited evidence of enhanced P1, N1 and N2 deflections in the mild head injured consistent with other findings in this population. The hypothesised greater allocation of attention resources in the head injured in the initial incongruent task is suggested as a cause of the enhanced

negative priming observed in the following congruent task performance. The slower responses in the congruent task would be consistent with a greater dependence on the colour naming route caused by abnormally high levels of inhibition of colour word representations. The results of this study are consistent with a pattern of impaired inhibition of response level representations and abnormally high stimulus level representation inhibition after mild head injury. These findings are also consistent with the view that interference takes place at both levels in normal Stroop performance.

Differential sensitivity of two measures of the knowledge acquired during artificial grammar learning.

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Three experiments are reported that examine the sensitivity of two measures of the knowledge acquired in an artificial grammar task. Following exposure to grammatical letter strings, subjects were required to rate the degree to which they liked novel strings, and to judge strings for rule conformity. A small but consistent effect of grammaticality was found on subjects' liking ratings in all experiments, but only when encoding and testing conditions were consistent. A change in the surface representation of strings between encoding and test (experiment 1); exposure to fragments of strings and testing on whole strings (experiment 2); and a change in processing operations between encoding and test (experiment 3), all removed the effect of grammaticality on liking ratings. In contrast, the effect on rule judgements remained intact in the face of these manipulations. It is suggested that both measures access the same knowledge base to different degrees. The less sensitive liking ratings seem to reflect the fluency with which test items are processed. The rule judgements may reflect a combination of processing fluency and attempts to explicitly recall information from the initial exposure phase.

Hypnosis as a tool in experimental neuropsychology.

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Hypnotic procedures are capable of producing, and reversing, profound subjective experiences and apparently involuntary responses in a significant proportion of individuals. There is an increasing realisation, particularly where functional imaging techniques are employed, that this provides a potentially powerful means of exploring neurological mechanisms associated with a wide range of normal and abnormal psychological processes which occur outside the hypnotic context. Some actual and potential applications of hypnotic procedures in the neuropsychological investigation of pain, involuntary movement, functional paralysis, memory processes and hallucinations will be described briefly and the advantages and disadvantages of using hypnotic procedures will be discussed. The view will be offered that irrespective of differences of opinion as regards the nature of hypnosis itself the well-established procedures it offers for manipulating psychological processes will prove to be invaluable research tools in

the next decade of neuropsychological investigation.

Musicians' use of extrafoveal information during sight-reading.

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Experiments using moving window techniques have shown that musicians extract information from notation up to one bar ahead of the fixation point when reading a single-line melody. However, the nature of this information is not yet known. For example, it may be that the musician gains preview of the notes about to be fixated. Alternatively, the musician might just process information about the contour of the melody.

This experiment investigates the nature of information processed when musical notation is presented extrafoveally. 20 skilled sight-readers and 20 less skilled sight-readers were presented with a triad in the centre of a computer screen while a different triad was presented 1.9o, 3.8o or 5.7o to the right or to the left of the central triad. The musicians were required to match the triads on the basis of inversion (i.e. shape) or harmony (i.e. constituent notes), before recalling the central triad. The results showed that sight-readers can make use of contour information even when location of notes can no longer be effectively encoded. Skilled sight-readers encode information within a much wider window of eccentricities than do less skilled sight-readers. Finally, musicians were more accurate at the task when extrafoveal information was presented in the right visual half-field which supports previous findings that the left hemisphere is more important for the processing of musical notation.

The role of stereotype gender information in a gender decision task.

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Five experiments investigated how background knowledge about the stereotypical gender of a character is incorporated into the mental representation for that character, and its later influence in a gender decision task. Ss had to decide whether two presented stimuli, one a kinship term (e.g. uncle) and the second a role name (e.g. typist) could apply to the same person. In Experiment 1 role name and kinship term appeared on the same target line. In Experiments 2 to 5 role name was presented with varying delays before the kinship term was presented. Experiments 1 to 4 demonstrated an incongruity effect. Ss made more errors and had slower decision times when the gender bias of a stereotype term did not match the gender of the kinship term (typist/uncle) than when it did (farmer/uncle) or when there was no gender bias (singer/uncle). In Experiment 5 a speeded response technique resulted in the incongruity effect appearing in error and time-out data but not for decision time. The implications for our understanding of the mental representation of gender invoked by a stereotype, the consequent processes involved in the decision task and more generally the ramifications for text processing are discussed.

The perception of spatial relations between objects in scenes.

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The present study contains three experiments investigating the means by which observers identify spatial relations between objects in a scene. Some theories on perception assume that spatial perception is not mediated by mental representations, while others assume it to be influenced by immediately preceding mental representations of the environment. Recent experiments (Sanocki & Epstein, 1997), using a priming paradigm, suggest that immediately prior experience can induce representations of spatial layout that facilitate the rapid spatial processing of pictures. The goal of the present experiments was to replicate the findings by Sanocki & Epstein and to rule out some alternative explanations. In the basic experiment, observers respond to line-drawings of scenes by indicating which of two critical objects was closer in the pictorial space. The images were preceded by different types of prime images without the critical objects. The results obtained by Sanocki & Epstein (1997) were replicated. However, the priming of local spatial relations by a preceding global spatial layout is also partly to be explained by an attentional capture, due to the sudden appearance of the target objects in the scene.

Sanocki, T., & Epstein, W., (1997). Priming spatial layout of scenes. *Psychological Science*, 8, 374-378.