

E|P|S

Experimental
Psychology
Society

**LONDON
MEETING**

5-6 JANUARY 2004

A scientific meeting will be held at the Department of Psychology, University College London on 5/6 January, 2004.

EPS Prize Lecture

Monday 5 January 5.00-6.00

What can functional imaging tell the experimental psychologist?

Richard Henson, (Institute of Cognitive Neuroscience, University College London)

Symposium:

Tuesday 6 January 9.30-1.00

Seeing faces in the brain

Organiser: Richard Henson

Poster Session

Will be held on Monday 5 January at 3.30–4.30 in Room 305 (Third Floor Seminar Room). Delegates may put up posters from 9.00 and take them down by 5.30.

Platform Presentations

Sessions will be held in the Ground Floor and Lower Ground Floor Lecture Theatres of the Psychology Department (26 Bedford Way, WC1). Both theatres have data projectors available for Powerpoint presentations. Presenters may provide their own laptops and connector leads, or bring disks or CDs for the on-site computers which run Powerpoint 97 under Windows NT/2000. Any queries about facilities in the theatres should be sent to the local organiser, Rik Henson (r.henson@ucl.ac.uk)

Coffee will be served in Room 308 (Third Floor Common Room)

There will be a drinks reception on Monday evening at 6.40 in the third floor common room. The conference dinner will be at 7.30 at Bertorelli's, 19-23 Charlotte Street, London WC1 – (020-7636 4174). A booking form is enclosed.

START OF PARALLEL SESSIONS*Session A***Ground Floor Lecture Theatre**

- 9.30 **Linda M Moxey** (University of Glasgow)
Constraints on reference to more than one character in text
- 10.00 **Simon P Liversedge, Kevin B Paterson, Ruth Filik*, Barbara Juhasz* and Keith Rayner** (University of Durham, University of Leicester, University of Derby and University of Massachusetts)
Eye movements and the processing of focus structure during reading
- 10.30 COFFEE
- 11.00 **Michael B Lewis** (Cardiff University)
Can we ever find true effects in psycholinguistic research?
- 11.30 **Dermot Lynott* and Mark Keane** (Department of Computer Science, University College Dublin)
The effect of knowledge support on the production of novel, noun-noun compounds
- 12.00 **Louise Connell* and Mark T Keane** (Department of Computer Science, University College Dublin)
The effect of distributional distance on comprehension and plausibility decision times
- 12.30 **F Vallee-Tourangeau*, Robin A Murphy, Stefanie Schmeer*, Esther Mondragon* and D Hilton*** (Kingston University, University College London, University of Hertfordshire and Université de Toulouse, France)
Illusory correlation and minority group stereotyping: Novel predictions from an associative learning perspective
- 1-2 LUNCH

START OF PARALLEL SESSIONS

Session B

Lower Ground Floor Lecture Theatre

- 9.30 **John Morton** (Institute of Cognitive Neuroscience, University College London)
Some aspects of cognitive architecture in dissociation and repression
- 10.00 **Martin A Conway and Mihály Racsomány*** (University of Durham and University of Szeged, Hungary)
Episodic inhibition in retrieval induced forgetting
- 10.30 COFFEE
- 11.00 **J D Mollon, B C Regan*, R Foo* and B J Morris*** (Cambridge University and Clinical Pharmacology Unit, Department of Medicine, Cambridge University)
Sildenafil extends iconic storage
- 11.30 **H E Smithson and J D Mollon** (University of Cambridge)
Do masks terminate the icon?
- 12.00 **Juha Silvanto*, Vincent Walsh and Nilli Lavie*** (Institute of Cognitive Neuroscience, University College London and Department of Psychology, University College London)
V5/MT-V1 backprojection in visual perception
- 12.30 **J H Wearden** (Manchester University)
Stranger than you think: Feedback and calibration in verbal estimation of duration
- 1-2 LUNCH

Session A

Ground Floor Lecture Theatre

- 2.00 **Uwe Mattler***, **Arie van der Lugt** and **Dörte Kuhlicke*** (Otto von Guericke University, Magdeburg, Germany)
Dynamic online adjustment of motor readiness after disconfirmation of perceptual expectancies: Evidence from the lateralized readiness potential.
- 2.30 **Charity Brown*** and **Toby J Lloyd-Jones** (University of Kent)
Verbal facilitation of multiple face recognition
- 3.00 **Sarah V Stevenage***, **Elizabeth A Lee*** and **Nick Donnelly** (Centre for Visual Cognition, University of Southampton)
Warped space: The role of familiarity in the early visual processing of faces
- 3.30 TEA (Room 308)

POSTER SESSION (Room 305)
- 4.35 Annual General Meeting (Lower Ground Floor Theatre) (Members only)
- 5.00 **EPS Prize Lecture - R Henson** (Institute of Cognitive Neuroscience, University College London)
What can functional imaging tell the experimental psychologist?
- 6.00 **Michael Page** (University of Hertfordshire)
What CAN'T functional imaging tell the experimental psychologist?
- 6.20 **Timothy Shallice** (Institute of Cognitive Neuroscience, University College London)
Functional imaging and neuropsychology: how can they be linked?
- 6.40 DRINKS RECEPTION (Third Floor Common Room)
- 7.30 CONFERENCE DINNER, BERTORELLI'S

*Session B***Lower Ground Floor Lecture Theatre**

- 2.00 **Jon Brock* and Chris Jarrold** (University of Bristol)
Causes of verbal short-term memory difficulties in Down syndrome
- 2.30 **Susan E Gathercole, Claire Tiffany*, Josie Briscoe* and Annabel Thorn and the ALSPAC Team** (University of Durham, University of Bristol, Cardiff University and University of Bristol)
Episodic memory in children with poor phonological short-term memory skills
- 3.00 **Elizabeth Jefferies, Clive R Frankish, Matthew A Lambon Ralph** (University of Manchester and University of Bristol)
Lexical and semantic binding in short-term memory: Evidence from normal recall and semantic dementia
- 3.30 TEA (Room 308)

 POSTER SESSION (Room 305)
- 4.35 Annual General Meeting (Lower Ground Floor Theatre) (Members only)
- 5.00 **EPS Prize Lecture - R Henson** (Institute of Cognitive Neuroscience, University College London)
What can functional imaging tell the experimental psychologist?
- 6.00 **Michael Page** (University of Hertfordshire)
What CAN'T functional imaging tell the experimental psychologist?
- 6.20 **Timothy Shallice** (Institute of Cognitive Neuroscience, University College London)
Functional imaging and neuropsychology: how can they be linked?
- 6.40 DRINKS RECEPTION (Third Floor Common Room)
- 7.30 CONFERENCE DINNER, BERTORELLI'S

*Session A***Ground Floor Lecture Theatre**

9.00 **Bruno Rossion***, **Roberto Caldara***, **Mohamed Seghier***, **Christine Schiltz***, **Anne-Marie Schuller***, **Francois Lazeyras***, **Eugene Mayer*** (Unité de Neurosciences Cognitive et Laboratoire de Neurophysiologie, Université de Louvain, Belgium, Faculté de Psychologie et des Sciences de l'Education, Genève, Switzerland, Département de Radiologie, Hopital Universitaire de Genève, Switzerland and Unité de Neuropsychologie, Hôpital Universitaire de Genève, Switzerland) (Introduced by Richard Henson)
Functional neuroimaging of face processing in prosopagnosia

Symposium: Seeing faces in the brain
Organiser: Richard Henson

9.30 **Edmund Rolls** (University of Oxford)
How information about faces is represented in the brain, and its implications for computational theories of perception and attention

10.00 **Jim Haxby*** (Princeton University, USA)
Spatial and temporal distribution of face representations

10.30 COFFEE

11.00 **Patrik Vuilleumier*** (Neurology & Imaging of Cognition, Dept of Neuroscience & Clinic of Neurology, University Medical Center, Geneva)
Neural systems for recognition of face identity and familiarity

11.30 **Martin Eimer** (Birkbeck College)
The processing of faces and emotional facial expression: Evidence from event-related brain potentials

12.00 **Michelle de Haan*** (Institute of Child Health, University College London)
Processing of facial expressions of emotion during infancy

12.30 **Rob Jenkins*** and **Mike Burton** (University of Glasgow)
Robust representations for face recognition and face learning

1-2 LUNCH

*Session B***Lower Ground Floor Lecture Theatre**

- 9.00 **Matthew H Davis, Alexis Hervais-Adelman*, Lara Brent* and Ingrid Johnsrude*** (MRC Cognition and Brain Sciences Unit, Cambridge)
Learning to understand noise-vocoded speech
- 9.30 **Marie Rivenez* and Chris Darwin** (University of Sussex)
Speech processing under unattended conditions
- 10.00 **Clayton Fussell*, Quentin Summerfield and Deb Hall** (MRC Institute of Hearing Research, Nottingham)
General networks and individual differences in visual speech processing
- 10.30 COFFEE
- 11.00 **Chloe R Marshall* and Heather K J van der Lely** (Centre for Developmental Language Disorders and Cognitive Neuroscience, Department of Human Communication Science, University College London)
A challenge to current models of past tense acquisition: the impact of phonotactics
- 11.30 **Theo Marinis* and Heather van der Lely** (Centre for Developmental Language Disorders and Cognitive Neuroscience, University College London)
On-line processing of questions in children with G-SLI and typically developing children
- 12.00 **Brechtje Post*, Billi Randall*, Lorraine K Tyler and William Marslen-Wilson** (Centre for Speech and Language, University of Cambridge and MRC Cognition and Brain Sciences Unit, Cambridge)
Morphological and phonological factors in the processing of English inflections
- 12.30 **E Fonteneau*, J Palix* and U H Frauenfelder** Centre for Developmental Language Disorders and Cognitive Neuroscience, Department of Human Communication Science, University College London, Laboratoire du Développement et des Apprentissages Moteurs, University of Geneva, Switzerland and Laboratory of Experimental Psycholinguistics, University of Geneva, Switzerland)
Studying the word class distinction with Event-Related Potentials: Does the word frequency modulate the N280?
- 1-2 LUNCH

*Session A***Ground Floor Lecture Theatre**

- 2.00 **Rosalind Hill***, **Denis Mareschal*** and **Heather van der Lely**
(Birkbeck, University of London and University College London)
Metaphoric reasoning in typical and atypical development
- 2.30 **Paula J Lacey*** (Royal Holloway, University of London) (Introduced
by E Funnell)
Factors affecting children's performance in generating strategies to
deal with novel situations.
- 3.00 **Philip T Quinlan**, **Brenda R J Jansen*** and **Han van der Maas***
(University of York and University of Amsterdam, The Netherlands)
Re-thinking stages of cognitive development: On balance,
connectionist networks don't work.
- 3.30 TEA
- 4.00 **André Vandierendonck** and **Maud Deschuyteneer*** (Ghent
University)
In search of executive process components involved in simple
arithmetic
- 4.30 **Sebastian J Crutch*** and **Elizabeth K Warrington** (Dementia
Research Group, Institute of Neurology, University College London)
Pure anomia: The importance of an abstract vocabulary in spontaneous
speech
- 5.00 **Jules Davidoff** and **Debi Roberson** (Goldsmiths University of
London and University of Essex)
Preserved thematic and impaired taxonomic categorisation: a case
study.

END OF PARALLEL SESSIONS

End of Meeting

*Session B***Lower Ground Floor Lecture Theatre**

- 2.00 **Caroline Brown***, **Gina Rippon***, **Thomas Gruber***, **Jill Boucher**
(University of Bristol, School of Life and Health Sciences, Aston University, Institut für Allgemeine Psychologie, Universität Leipzig and University of Warwick)
Gamma EEG differences to perception of visual illusions in autism
- 2.30 **J O'Shea***, **N M Muggleton***, **A Cowey** and **V Walsh** (University of Oxford)
Timing of target discrimination in human frontal eye fields
- 3.00 **Guy Wallis*** (School of Human Movement Studies, University of Queensland) (Introduced by Roland Baddeley)
The influence of millisecond stimulus asynchrony on perceptual grouping can be explained by fixational eye movements
- 3.30 TEA
- 4.00 **Luc Boutsen*** and **Glyn W Humphreys** (Behavioural Brain Sciences Centre, University of Birmingham)
Dynamic interactive processes in figure-ground segmentation: Effects of occlusion, shape concavity, and contrast polarity
- 4.30 **Karina J Linnell**, **Glyn W Humphreys**, **Dave B McIntyre***, **Sauli Laitinen*** and **Alan M Wing** (Goldsmiths' College, University of London and University of Birmingham)
Action modulates object-based selection
- 5.00 **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

END OF PARALLEL SESSIONS

End of Meeting

POSTERS (Alphabetical order) (Abstracts see Pages 39-53)**Monday 5 January – 3.30pm****Room 305 (Third Floor Seminar Room)**

Melissa J Allman*, **Jasper Ward-Robinson*** and **R C Honey** (Cardiff University)
A connectionist analysis of configural learning

Wouter Braet*, **Glyn Humphreys** and **Peter Praamstra*** (Behavioural Brain Sciences Centre, University of Birmingham)
Parietal processes in the early stages of word recognition: a TMS study

Sarah J Casey* and **Fiona N Newell** (Trinity College Dublin)
Cross-modal face recognition

Julie Castronovo* and **Xavier Seron*** (Unité de Neurosciences Cognitives (NESC), Université Catholique de Louvain, Belgium and Centre de Rééducation Neuropsychologique, Cliniques Universitaires Saint-Luc, Belgium) (Introduced by Jules Davidoff)
The abstract nature of the numerical representation and the role of vision in its elaboration: evidence from a study with blind people in the auditory modality.

E H Davelaar, **M Usher***, **Y Goshen-Gottstein*** and **A Ashkenazi*** (Birkbeck College)
A context/activation model of list memory

Jean-François Delvenne* and **Raymond Bruyer*** (Cognitive Neuroscience Unit (NESC), Université Catholique de Louvain, Belgium) (Introduced by Jules Davidoff)
Is encoding orientation and color features as different parts of an object in visual short-term memory really object-based?

E Eger*, **S Schweinberger**, **R Dolan*** and **R Henson** (Institute of Cognitive Neuroscience, University College London, University of Glasgow and Wellcome Department of Imaging Neuroscience)
View-specific versus view-independent priming in face perception: an fMRI study

Shona Falconer* and **Gerald Matthews** (University of Dundee and University of Cincinnati, USA)
Individual differences in stress reactions to a work related task

D N George and **A S Killcross** (Cardiff University)
Dissociation of limbic and frontal dopamine during conditional discrimination learning in rats.

V Goffaux*, **B Hault***, **C Michel*** and **B Rossion*** (Unité de Neurosciences Cognitives (NESC), Université Catholique de Louvain, Belgium) (Introduced by Rik Henson)
The critical role of low spatial frequencies in the configural processing of faces

J E Haddon* and A S Killcross (Cardiff University)

Behavioural control by multiple conditioning cues: A rat analogue of task interference.

J E Haddon* and A S Killcross (Cardiff University)

Incidental contextual control of biconditional task performance disrupted by reversible inactivation of the dorsal hippocampus.

Brett Huckstep* and Jamie Ward (University College London)

Effects of pitch and timbre in music-colour synaesthesia

Cathrine Jansson*, Nigel Marlow* and Brian Bointon* (London Metropolitan University) (Introduced by Nigel Harvey)

Cross-modal links between vision and touch upon aesthetic evaluation

Ryoko Matsumoto*, Taeko Wydell, Sophie Scott, Charvy Narain³, Richard Wise* and Paul Matthews* (Department of Human Sciences, Brunel University, University College London, Centre for the Functional Magnetic Resonance Imaging of the Brain (FMRIB), University of Oxford and MRC Clinical Sciences Centre, Cyclotron Unit, Hammersmith Hospital)

Neural correlates of reading Japanese kanji and English by Japanese-English bilinguals.

Julie E Meehan* and Ruth M J Byrne (University of Dublin)

Imagery in counterfactual thinking in pre-school children

Phillip Morgan* and Dylan Jones (Cardiff University)

Interruption of goal directed behaviour: Effects of interruption position, type and warning

Susumu Okumura* and Taeko N Wydell (Department of Human Sciences, Brunel University)

Case studies of compensated developmental dyslexia

Harry R M Purser and Chris Jarrold (University of Bristol)

Modality dissociations of serial position in a probed recall task: Evidence from Down syndrome and typical development.

S E V Rhodes* H L Muir* and A S Killcross (Cardiff University)

Reversal learning and extinction are differentially influenced by lesions of the infralimbic and prelimbic prefrontal cortex in rats

Katherine L Roberts*, Deborah A Hall and A Quentin Summerfield (MRC Institute of Hearing Research, Nottingham)

Alerting, orienting and executive control in vision and audition

Pia Rotshtein*, Richard Henson, Jon Driver and Ray Dolan* (Wellcome Department, Institute of Neurology, London and Institute of Cognitive Neuroscience, University College London)

When Margaret Thatcher becomes Marilyn Monroe: How does our brain detect the difference?

A L Saggerson* and R C Honey (Cardiff University)

Observational learning of instrumental discriminations in pigeons

D J Sanderson* and J P Aggleton (Cardiff University)

The effect of hippocampal lesions on a structural discrimination: Dissociating learning systems

Alastair D Smith*, Iain D Gilchrist and Bruce Hood (University of Bristol)

Children's search behaviour in an automated foraging task

Manos Tsakiris*, Angela Sirigu*, Patrick Haggard, Nelly Mainy* and Nicolas Franck* (Department of Psychology & Institute of Cognitive Neuroscience, University College London and Institut des Sciences Cognitives, CNRS, Lyon, France)

Afferent and efferent contributions to self-recognition

Joel Winston*, Richard Henson, Miriam Fine-Goulden* and Raymond Dolan* (Wellcome Department of Imaging Neuroscience, London and Institute of Cognitive Neuroscience, University College London)

fMRI-adaptation reveals dissociable neural representations of identity and expression in faces

Constraints on reference to more than one character in text

Linda M Moxey
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Research shows that it is relatively difficult to use a singular pronoun to refer to one individual when that individual has been introduced in a conjoined nounphrase, such as John and Mary. It is argued that such nounphrases lead the interpreter to construct a plural object which must then be taken apart for successful singular anaphoric reference. We report four experiments which explore the preferences for plural and singular pronouns following such split antecedents. Experiments 1 and 2 show that plural anaphoric reference is facilitated to the extent that the two characters share thematic roles, while the reverse holds for singular pronouns. Experiments 3 and 4 show that when the characters are introduced in different ways (name versus role description) this makes singular reference easier, but it does not make plural reference more difficult. These results are discussed in terms of Sanford & Moxey's (1995) role-mappings account.

Sanford A. J. & Moxey, L. M. (1995) Notes on Plural Reference and the Scenario-Mapping Principle in Comprehension, in G. Rickheit & C. Habel (eds.) *Focus and Coherence in Discourse Processing*, Walter de Gruyter, Berlin, New York.

Eye movements and the processing of focus structure during reading

Simon P Liversedge¹, Kevin B Paterson², Ruth Filik³, Barbara Juhasz⁴
and Keith Rayner⁴
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Focus requires that some aspects of a sentence are more prominent than others. Sentence constituents may be placed in focus using prosody, syntax or lexical items like 'only'. 'Only' directs readers to contrast a focused constituent with some alternatives. We report two eye-tracking experiments investigating the on-line computation of lexically specified focus. Experiment 1 used double object sentences (e.g., 1) with the indirect object (e.g., 'her mother') preceding the direct object (e.g., 'the salt'). For Experiment 2 the order of objects was reversed (e.g., 'Lucy passed the salt to her mother').

1. At dinner, Lucy passed | (PRE-CRITICAL) [only] her mother [only] the salt, | (CRITICAL) but not [the pepper / her father] | (POST- CRITICAL) as well because | she couldn't reach.

'Only' preceded either the direct or indirect object, and the sentence continuation provided an appropriate or inappropriate contrast. Readers preferentially assigned focus to the first object, with longer first pass reading times at the pre-critical region when 'only' preceded the second object. No effects were obtained at the critical region. At the post-critical region readers made more regressions and had longer

regression path reading times when the contrast was inappropriate, although reading time effects were restricted to contrasts with the indirect object in Experiment 1. We conclude that lexically specified focus is computed during normal reading but that its effects are delayed.

Can we ever find true effects in psycholinguistic research?

Michael B Lewis
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Many studies have addressed the issue whether age-of-acquisition and/or frequency affect particular lexical tasks. The methods of analysis typically employed in such studies are reviewed. The majority of methods employed are based on the general linear model (e.g., ANOVA or multiple regression). These methods assume manipulated independent variables. It is described how analysis of age-of-acquisition and frequency effects using estimated values violate the assumptions on the analyses. A simulation is provided that demonstrates how this violation can lead to erroneous conclusions of effects when none are present. Recommendations are made for a more correlational approach to analysis. It is considered whether this use of estimates of lexical-related data is problematic for all psycholinguistic research.

The effect of knowledge support on the production of novel, noun-noun compounds

Dermot Lynott and Mark Keane
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We present the first empirical study of novel noun-noun compound creation in adults using written protocols. Shared knowledge is central to efficient communication, and so we examined how it affects the compounds that people create. We established a set of materials that described objects that were either strongly or weakly supported by world knowledge; for example (a) A note for a milkman left on a doorstep (Strongly Supported), and (b) A note for a milkman left on a pole (Weakly Supported). Two experiments required participants to create a short label for each presented description. We found that knowledge support influenced the variability of the compounds produced and people's confidence in the communicative goodness of these compounds. Descriptions that were strongly supported by world knowledge gave rise to less variability in compound production (i.e., fewer unique compounds across the group). In addition, people had greater confidence in compounds they created for strongly supported descriptions. The second experiment used rephrased descriptions and replicated these results. These findings demonstrate that increased knowledge support can act as a constraint on the choice of words when producing novel compounds.

The effect of distributional distance on comprehension and plausibility decision times

Louise Connell and Mark T Keane
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We report two online experiments that investigate distributional effects on comprehension and plausibility judgements. Using the Latent Semantic Analysis model, we manipulate the distributional distance between sentences through the use of synonyms with different distributional properties. For example:

(a) “The pack saw the fox. The hounds snarled.” (distant)

(b) “The pack saw the fox. The hounds growled.” (close)

Both of these sentence pairs invite the same inference, but the different distributional properties of *snarled* versus *growled* means that the sentences in pair (a) are further apart than those of pair (b) in high-dimensional distributional space. Connell & Keane (in press) have shown that distributional distance has no effect on plausibility ratings. However, here we find that distributional distance *does* affect response times for comprehension and plausibility judgements. In general, we find that distributionally distant sentences were responded to more quickly. An account of these phenomena is outlined based on the notion that distributional distance influences how quickly inferences can be drawn during comprehension and judgement tasks.

Connell, L. & Keane, M. T. (in press). What plausibly affects plausibility? Concept-coherence & distributional word-coherence as factors influencing plausibility judgements. (To appear in *Memory & Cognition*.)

Illusory correlation and minority group stereotyping: Novel predictions from an associative learning perspective

F Vallee-Tourangeau¹, Robin A Murphy², Stefanie Schmeer³, Esther Mondragon² and D Hilton⁴

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The idea that our negative perceptions of minority groups and subsequently our stereotypes of them might be the function of an illusory correlation bias was first suggested by Hamilton & Gifford (1976). Participants read sentences that described Good or Bad behaviours performed by members of two Groups (A or B). Although both groups engaged equally in Bad activities, Group A members outnumbered Group B. Despite the absence of a correlation between type of behaviour and group membership, likeability ratings for the minority group were lower than for the majority group. Hamilton & Gifford suggested that the relative infrequency of the Group B-Bad behaviour pairings granted them an information processing advantage that distorted the detection of the actual degree of (non)correlation in the data. Recently Van Roy et al. (2003) have proposed a recurrent connectionist model of this effect. In contrast we cast this phenomenon as the byproduct of preasymptotic associative learning in a simple feedforward network. The relatively infrequent pairings of Group B with positive behaviour retards the learning. Critically, this

perspective suggests that the likeability ratings for Groups A and B should converge with sufficient training. We report results from a series of three experiments that provide data consistent with these novel predictions.

Hamilton, D. L. & Gifford, R. K. (1976): Illusory correlation in interpersonal perception: A cognitive basis of stereotypic judgments. *Journal of Experimental Social Psychology*, 12, 392-407.

Rooy, D.V., Van Overwalle, F., Vanhoomissen, Labiouse, C. and French, R. (2003). A recurrent connectionist model of group biases, *Psychological Review*, 110, 536-563.

Some aspects of cognitive architecture in dissociation and repression

John Morton

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People diagnosed with Dissociative Identity Disorder (DID) report discontinuity of time and place as a normal feature of their life. Effectively, the person reports dense amnesia for what happened moments before when a different personality, or 'alter', was in control. I have previously reported (EPS, @ Reading, 2003) lack of PI in paired associate learning using an A-B, A-C, A-D paradigm, switching alters between lists. The same result was also found with control subjects who adopted different personalities between lists.

In this paper I report the results of a number of other tasks designed to explore the nature of the supposed amnesic barrier between alters. These tasks include implicit as well as explicit learning. The data are contrasted with that from hypnotised subjects. It turns out that in some cases the amnesia does not seem to be all that it is claimed to be.

Episodic inhibition in retrieval induced forgetting

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Four experiments examined the proposal that selecting an item for retrieval from long-term memory causes inhibition of highly associated competing items. In the first three experiments there was a study phase in which a list of category-exemplar pairs, e.g. Fruit-Orange were learned, a retrieval practice phase in which a subset of list items were recalled to category-plus-stem pairs, e.g. Fruit-Or____?, and a recall phase that included category cued recall and lexical decision tests. Powerful retrieval induced forgetting (RIF) effects were found in all three experiments and recall of highly associated unpractised items was consistently low. Retrieval induced forgetting effects were not present in lexical decision latencies unless the test contained strong cues to the study phase. In a final experiment it was found that recall of study items was unaffected by retrieval practice of items strongly related to study items but not themselves present in the study phase. This pattern of findings suggests that RIF is mediated by an episodic memory of the study list in which a particular pattern of activation/inhibition has been established by retrieval practice.

Sildenafil extends iconic storage

J D Mollon¹, B C Regan¹, R Foo² and B J Morris²

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Sildenafil citrate (Viagra®) has its primary action by inhibiting phosphodiesterase type 5 in the smooth muscle of the vasculature, but sildenafil also has a weaker affinity for enzymes of the PDE 6 family. Since the latter are central to retinal phototransduction, sildenafil might be expected to alter the strength or the duration of visual responses.

Using a performance measure, we have studied the effect of sildenafil on iconic storage. Since an *impairment* of performance could be attributed to non-specific factors (a recurrent problem in psychopharmacology), we designed a task in which enhanced visual persistence would lead to better performance. On each trial, two successive, apparently random, arrays of white dots were presented on a dark background. When the interval between the two arrays was brief, the subject could perceptually combine these two sub-arrays and identify a ring of dots randomly placed within the total array. His task was to report the position of a gap in the ring. The independent variable was the interval between the presentations of the two sub-arrays. The computer program adaptively adjusted this temporal separation to find the critical inter-stimulus interval (ISI_c) at which the subject failed to identify the position of the gap. We used a Latin-square, double-blind, cross-over design with five conditions, corresponding to oral doses of 25, 50, 100 and 200 mg of sildenafil, plus a placebo condition. There were 15 young healthy adult male subjects.

A repeated measures ANOVA showed a highly significant dependence of ISI_c on dose ($df=4$, $F=8.513$, $p<.001$). After ingestion of 100 mg of sildenafil citrate (the maximal clinical dose), the value of ISI_c was approximately 25% greater than in the placebo condition. The effects were fully reversible.

Do masks terminate the icon?

H E Smithson and J D Mollon
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Iconic memory is operationally defined by part-report experiments: if an after-coming cue prompts selective report from a briefly presented target array, recall performance is proportionately better than that achieved in whole-report (Sperling, 1960). If a mask is presented after the target, the mask is commonly thought either to be superposed on the target in the iconic representation, or to displace it from the representation (e.g. Gegenfurtner & Sperling, 1993). We tested such models by asking whether a cue presented *after* the mask might still allow selection within the target array.

We presented a target array of 3×3 letters within one 10-msec frame, followed by a random chequerboard pattern-mask, spanning two frames. The cue was presented 120 msec after the offset of the target. We compared two different target-mask ISIs: 0 msec and 100 msec.

At ISI=0 msec, performance was at chance, for part-report and for whole-report. At ISI=100 msec, observers demonstrated a part-report advantage of around 50% over the whole-report condition, even though the cue followed the mask. These results are inconsistent with an iconic memory that is automatically displaced or overwritten by new information. Our data provide operational evidence for a store that preserves separately the representations of the target and its after-coming mask, and we discuss the implications for a large body of work on memory, language and awareness where a mask is used to control the time a stimulus is available for central processing.

Gegenfurtner, K. R., & Sperling, G. (1993). Information transfer in iconic memory experiments. *Journal of Experimental Psychology*, 19(4), 845-866.

Sperling, G. (1960). The information available in brief visual presentations. *Psychological Monographs*, 74, 1-29.

V5/MT-V1 backprojection in visual perception

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Pascual-Leone and Walsh (2001) have recently shown that backprojections from V5/MT to V1 are necessary for conscious perception of moving phosphenes induced by transcranial magnetic stimulation (TMS). Here we used TMS to test the importance of V5/MT - V1 backprojections in detection of real motion. TMS was applied to V1 and V5/MT at various time windows while subjects detected the presence of motion in a random-dot display. The results showed a double dissociation in which the critical time window of V1 activity post-dates that of V5/MT activity, and stimulation of either site at the critical period of the other site has no effect on motion detection. Further experiments demonstrated that this double dissociation cannot be accounted for by general effects of masking, and that late stimulation of V1 remains disruptive even when following an early V1 stimulation (in a critical period for feedforward projections) thus suggesting that the importance of backprojections does not depend on undisrupted feedforward projections.

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Stranger than you think: Feedback and calibration in verbal estimation of duration

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The technique of verbal estimation of duration, where people assign verbal labels to the perceived duration of events, is a method used since the earliest days of time Psychology, and one that does good service even now. However, we have little or no idea how people produce the behaviour that is observed. Two obvious questions are why estimates are not perfectly accurate, and why two different individuals give different responses to the same duration. The commonsense answer to both questions

is that people have no previous experience to aid task performance or, more generally, are not “calibrated” to give correct estimates. This implies that feedback or calibration would have a marked effect on behaviour, but three experiments (one using a feedback method, two using various sorts of calibration) showed that performance was changed little by these manipulations. A proto-model of verbal estimation taking into account “raw” temporal scaling and “quantization” of verbal responses may help to understand these counter-intuitive findings.

Dynamic online adjustment of motor readiness after disconfirmation of perceptual expectancies: Evidence from the lateralized readiness potential

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When subjects use cues to prepare for a likely stimulus or a likely response, reaction times are facilitated by valid cues but prolonged by invalid cues. In studies on combined expectancy effects, two cues independently give information regarding two dimensions of the forthcoming task. Previous research showed that cueing effects on one dimension can be reduced on trials with invalid cues on the other dimension. This reduction has been accounted for by an adjusted expectancy model. This model assumes that cues affect different processing stages. In certain conditions a mechanism which is sensitive to the validity of the early stage cue, leads to an online adjustment of the cueing effect at later stages. In the present study, stimulus modality (visual vs. auditory) was cued in combination with response cueing (left vs. right). Expectancies interacted on behavioral measures in each participant. Electrophysiological measures of the lateralized readiness potential confirmed predictions of the model by showing that motor readiness was reduced on trials with invalid modality cues.

Verbal facilitation of multiple face recognition

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A substantial line of research shows that describing a face (compared to providing no description) can *interfere* with subsequent recognition of that same face or other faces (‘verbal overshadowing’, e.g., Brown & Lloyd-Jones, 2002, 2003). However, using a variant of our previously reported verbal overshadowing paradigm, we have found *facilitative* effects of describing multiple faces upon their later recognition. Experiment 1 shows that participants describing each of 12 faces in a series are better able to discriminate those faces from 12 distracters in a ‘yes/no’ recognition task, as compared with participants providing no description. In Experiment 2, participants were presented with 12 sequentially presented pairs of faces and were asked to describe (or not, in the control condition) the second face in each pair (the target face). Better discrimination performance was obtained in the description than no description condition for target faces, but not for other faces in the sequence. We suggest that under certain conditions verbal tags enable the successful differentiation of target from non-target faces. We also present additional data bearing

on this issue, in which we manipulate the distinctiveness of the verbal tags associated with each face.

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Warped space: The role of familiarity in the early visual processing of faces

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Within the face perception literature, it has long been noted that familiarity plays a role in the early visual processing of faces. The pattern of feature saliency is altered, as is the scanning pattern, and perhaps even the involvement of early visual centres within the brain. Here, we present two experiments which suggest that familiarity exerts its influence through *warping* our perceptual face-space. More specifically, it is believed that perceptual differences between instances of the same familiar individual become minimised, whilst perceptual differences between a familiar individual and another become magnified. Results are presented for two face-classification tasks, in which Thatcherisation was used to generate non-face versions of familiar and unfamiliar individuals. Using both a 2AFC (which is 'odd?') task to pairs of images, and an 'odd/normal' task to single images, results were consistent and indicated that familiarity with the target face facilitated face classification decisions. Decisions were faster and more accurate in Experiment 1, and in addition, showed greater discrimination and less bias in Experiment 2. These results accord with the literatures on categorical perception and caricaturing, and suggest that familiarity warps face space such that early visual processing is facilitated in a direct and bottom-up manner.

Causes of verbal short-term memory difficulties in Down syndrome

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Two studies compared the verbal short-term memory (VSTM) performance of individuals with Down syndrome (DS) and younger typically developing children. Study 1 used a touchscreen-based digit order reconstruction task. Performance on a matched visuo-spatial task, speed of digit identification, vocabulary knowledge, and nonverbal ability all accounted for significant individual variation in digit reconstruction. However, group membership accounted for further unique variation, indicating that poor VSTM in DS is not simply a consequence of difficulties in identifying or reproducing verbal stimuli. Study 2 tested memory for words and nonwords using two computerized immediate recognition tasks - an order memory task that was a relatively pure test of VSTM, and an item memory task that was assumed to be sensitive to language abilities. Performance on the item memory task

was relatively poor in the DS group, and individuals with DS showed a relatively large lexicality effect for item memory, suggesting that phonological discrimination difficulties rather than a reduced top-down influence of lexical knowledge on STM are the cause of poor item memory. Together, these findings indicate that individuals with DS have relative difficulties in maintaining verbal serial order information, and that these are compounded on some tasks by problems in item identification.

Episodic memory in children with poor phonological short-term memory skills

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Possible links between short-term memory and episodic long-term memory were explored in a study of 8-year old children with persistent and highly specific deficits of phonological short-term memory and matched controls. A wide range of measures of episodic memory function were administered. The phonological memory deficit group performed at comparable levels to controls on measures of repeated free recall, memory for meaningful verbal material, and memory for visual and spatial material including faces. They did, however, showed significant impairments on tasks that involved learning arbitrary associations between unfamiliar verbal material: recall of names associated with faces, and paired associate learning of word-nonword and (to a lesser extent) word-word pairs. These results suggest that phonological short-term memory provides direct and domain-specific inputs into episodic memory, and represents an important route for learning verbal material.

Lexical and semantic binding in short-term memory: Evidence from normal recall and semantic dementia

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This work explored the impact of lexical and semantic factors on the phonological coherence of items in verbal short-term memory, in both healthy participants and patients with semantic dementia. Previous studies have established that semantic dementia patients make numerous phoneme migration errors in immediate serial recall, particularly for words that they comprehend poorly. In this study, similar errors were induced in the word recall of healthy participants by presenting mixed lists of words and nonwords. This methodology revealed that lexicality, word frequency, imageability and the proportion of words to nonwords all influenced the stability of the phonological trace in normal participants. These factors impacted on the occurrence of phoneme identity and migration errors, suggesting that stable lexical and semantic representations constrain both the identity and ordering of phonemes in short-term memory. The lexical and semantic factors affected the phonological coherence of both the words themselves and the nonwords they were

presented with. These findings were compared with the predictions of the reintegration and interactive models of verbal short-term memory. The results were highly consistent with the view that lexical and semantic constraints are integral to the operation of phonological short-term memory and less consistent with the suggestion of late-stage reconstruction.

EPS Prize Lecture

What can functional imaging tell the experimental psychologist?

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Pictures of “blobs on brains” are becoming more frequent at EPS meetings; words like “fusiform” and “dorsolateral” are appearing in psychology journals; many psychology departments are investing heavily in magnetic resonance imaging (MRI) scanners. Is this increasing interest in functional imaging justified? I will argue that, to some extent, it is: Under certain assumptions, imaging data can be informative to the experimental psychologist. The main assumption is that there exists a “consistent” function-to-structure mapping in the brain. In this case, imaging data simply comprise another dependent variable, along with behavioural data, that can be used to test competing theories. In other words, a qualitatively different pattern of activity over the brain under two experimental conditions implies different functions associated with the independent variable being manipulated. I will illustrate this type of inference with imaging studies of retrieval and encoding in long-term memory. Imaging data can also be used to induce new theories, which I will illustrate with imaging studies of short-term memory, and from recent developments that combine functional MRI data with magneto/electroencephalographic (M/EEG) data to produce spatiotemporal “movies” of activity over the brain. I will then return to the definition of a “consistent” function-to-structure mapping, and consider possible violations of this assumption. Despite these possibilities, I will argue that it is still a valid working assumption. I will finish by dismissing other assumptions like “pure insertion”, which are not unique to functional imaging, but raising other caveats, particularly over the statistical analyses typically performed on imaging data.

What CAN'T functional imaging tell the experimental psychologist?

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Many experimental psychologists thankfully choose to formulate the theories that they test as computational-style models. Indeed, this algorithmic formulation of psychological theories is one of the hallmarks of cognitive psychology. A slightly more hardline, and increasingly accepted, extension of this position is that although cognitive algorithms happen to be executed by brains, they needn't be. Given that the algorithmic specifications of cognitive theories are independent of the brain, they make no necessary predictions about where in the brain the corresponding processing is performed. Imaging data may well comprise “another dependent variable”, but very often not one the about which the theory under test makes any necessary predictions. Cognitive theories do, of course, acknowledge that, currently, cognition is carried out

somewhere in some brain. Finding that some part of the brain exhibits differential "activation" under performance of different tasks is, therefore, gratifying, but hardly surprising. Unlike some, I do concede some achievements to functional imaging, such as in the study of attention and, with reservation, in the consideration of single-/dual-route processes. But functional imaging will only become of more central interest to experimental psychologists when it clearly addresses how the brain achieves its processing, rather than where it does so. This requires a much clearer unravelling of the "activation-to-structure-to-function" mapping than is currently available. We should ask ourselves, would the large amount of money be better spent on traditional experimentation allied to computational modelling?

Functional imaging and neuropsychology: how can they be linked?

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It is argued that in poorly understood domains functional imaging and neuropsychological findings on cognitive processes can only be related through functional models of normal cognition. The psychological concept of "resource" can however be simply extrapolated to functional imaging. It is then argued that double dissociations can have analogous inferential power for extrapolation to models of normal cognition in functional imaging as in neuropsychology.

Functional neuroimaging of face processing in prosopagnosia

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In humans, neuroimaging studies have identified at least two bilateral areas of the visual extrastriate cortex that respond more to pictures of faces than objects: in the middle fusiform gyrus (the 'fusiform face area', FFA) and posteriorly, in the inferior occipital cortex ('occipital face area', OFA), with a right hemisphere dominance for both regions. However, the exact role of these regions and their interactions during in face processing is not known. To help clarifying these questions, a series of neuroimaging experiments were conducted in patient PS, presenting a deficit restricted to face perception (prosopagnosia), following lesions to the left FFA and the right OFA, but sparing the right FFA. Using fMRI, we first disclosed a normal activation of the right FFA of this patient in response to faces vs. objects despite her prosopagnosia and the absence of any possible feedforward inputs from the right OFA. Furthermore, a lateralized presentation paradigm showed that the normal

differential activation for faces and objects in the right FFA of PS could not originate from contralateral regions of the left occipital cortex (e.g. left OFA), spared by the lesions. Finally, despite a normal faces-objects differential activation in the right FFA of patient PS, there was no difference of activation in this region when presenting different faces compared to the exact same facial identity repeated during the blocks (adaptation paradigm). This last finding contrasted with the large effects of adaptation found in normal controls in the same region, and are in agreement with the patient's difficulties at discriminating faces. Together, these findings illustrate the necessary role of both the right FFA and OFA for recognizing faces at the individual level, and suggest that the face-sensitive responses observed at the level of the OFA in normal subjects arise from feedback connections from the FFA.

Symposium: Seeing faces in the brain
Organiser: Richard Henson

How information about faces is represented in the brain, and its implications for computational theories of perception and attention

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In the primate temporal cortical visual areas, there are separate representations of static faces, of moving heads with object-centered encoding, of face identity, and face expression. The distributed neuronal representation of identity uses encoding based on the number of spikes, with almost independent information conveyed by different single neurons (when tested in numbers up to 20), so that the encoding capacity of the system is very high (see Rolls and Deco 2002; Rolls 2000 and www.cns.ox.ac.uk). When operating in natural scenes, the output of the inferior temporal cortex is primarily about the face or object at the fovea, with small receptive fields of 10 degrees or less (Rolls et al, 2003). Some inferior temporal cortex neurons in these conditions have asymmetric receptive fields about the fovea, so that the location of the face with respect to the fovea, and multiple faces, can be represented in a scene (Aggelopoulos et al, 2003). There are in addition representations of faces in the primate amygdala and orbitofrontal cortex. In human neuroimaging studies, we have shown that the orbitofrontal cortex is specifically activated when the association between face identity and face expression is reversed (Kringelbach and Rolls 2003). In human neuropsychological studies, we have shown that even small circumscribed orbitofrontal cortex lesions can impair the recognition of face and/or voice expression (Hornak et al 2003). Fundamental computational problems in perception are thus solved by these representations (Rolls and Deco, 2002).

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Spatial and temporal distribution of face representations

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Functional brain imaging has revealed a complex, macroscopic organization in the functional architecture of the ventral object vision pathway. Numerous studies have found regions of ventral temporal cortex that consistently demonstrate category-related response preferences, most notably a region that responds maximally during face perception, the fusiform face area (FFA). Faces and numerous other object categories, however, also evoke distinct patterns of response across wider expanses of ventral temporal cortex, including distinct patterns of response in cortical regions that respond submaximally to the category being viewed, suggesting that the representation of faces extends beyond the regions defined by category preference. Thus, representations of faces are distributed locally within ventral temporal cortex. A second, locally distributed representation of objects exists in lateral temporal cortex, in the posterior superior temporal sulcus. Whereas the representation in ventral temporal cortex appears to contain information about the appearance of object form, the representation in lateral temporal cortex appears to contain information about how faces move and about aspects of faces that can change with movement, such as eye gaze direction and expression. Faces also evoke neural responses in cortical areas outside of the ventral object vision pathway. These responses indicate the spontaneous activation of other information associated with faces, such as the emotion associated with a facial expression, the direction of attention indicated by eye gaze, and the phonological content associated with speech-related mouth movements. Thus, the representation of faces appears to be distributed not only locally within the ventral object vision pathway but is also extended across other cortical areas. Neural responses to faces are also distributed across time. The early and late parts of responses to faces and objects show different effects of memory and attention and may reflect a differentiation between early feed-forward processing and later processing with stronger effects of inter-regional interactions. Thus, the neural representations of faces and objects appear to be distributed in time as well as in space.

Neural systems for recognition of face identity and familiarity

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Neuropsychological studies have shown that focal brain damage can result in a selective impairment in face identity recognition (prosopagnosia) or in face learning (prosopamnesia), usually attributed to deficits in the visual analysis and/or the stored representations of faces. Functional neuroimaging studies in healthy people have also pointed to a visual area in the fusiform cortex being specifically engaged during face processing. However, recent findings suggest that some patients may show impaired face recognition deficits that are characterized by impaired recognition of familiarity without deficits in visual processing or losses in stored representations (hyper or hypo familiarity such as misidentification syndromes), following lesions outside the fusiform cortex. In addition, some patients with prosopagnosia may still show residual fusiform activation by faces despite their deficit in recognition. These findings converge to suggest that face processing involves several brain areas in a specialized distributed network, allowing us to extract different types of facial information about identity, familiarity, and other social cues such as expression and gaze direction. Different areas within such a network may not only have a specific role, but also interact together and modulate each other.

The processing of faces and emotional facial expression: Evidence from event-related brain potentials

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This talk will review recent studies using electrophysiological recordings to investigate successive and parallel stages in face processing. Guided by the model proposed by Bruce & Young (1986), a series of studies are presented that investigated the pre-categorical perceptual processing of faces (structural encoding), the detection of facial identity, and the processing of emotional facial expression. In addition, the role of selective attention for the processing of emotional expression will be discussed.

Processing of facial expressions of emotion during infancy

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In this paper, the results of several studies will be presented that aim to characterize the neurocognitive mechanisms that underlie infants' processing of facial expressions, with a particular emphasis on fearful expressions. First, two behavioural experiments will be described that demonstrate that, by 7 months of age, infants appear to show categorical perception of facial expressions and show some evidence of configural processing of facial expressions. Next, results of several

event-related potential experiments will be described demonstrating that 7-month-olds show differential allocation of visual attention among certain expressions by approximately 600 ms after stimulus onset, and that the characteristics of this attentional response are modulated both by infants' temperamental characteristics and by their mothers' emotional dispositions. Together, the results of the different studies highlight both similarities and differences between infants' and adults processing of emotional expressions, and suggest that both endogenous and exogenous factors may influence infants' sensitivity to facial expressions of emotion.

Robust representations for face recognition and face learning

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Virtually all current models of familiar face recognition contain putative "face recognition units", or FRUs (e.g. Bruce & Young 1986; Burton et al, 1990; 1999; Brédart, Valentine, Calder & Gassi, 1995). These are units analogous to logogens (Morton, 1969), which become active on presentation of any recognisable view of a particular face. Despite being a key component of face recognition models, the detailed working of these units has always remained unspecified. Here we describe a prototype development system that offers a promising mechanism for the implementation of FRUs. Given the enormous range of images a single face can project (due to changes in lighting conditions, emotional expression, ageing etc.), it has previously been hard to suggest ways in which an abstraction of a particular face might develop. Here we propose a simple image-averaging technique that results in very sophisticated, and apparently robust, behaviour in computational face recognition systems. We also demonstrate that in some well-defined circumstances, human observers prefer our face prototypes to the constituent images. We suggest that averaging across different images of a particular face attenuates *image*-specific information while consolidating *identity*-specific information, leading to robust representations for face recognition and face learning that capture a major function of FRUs.

End of Symposium

Learning to understand noise-vocoded speech

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With practice, speech that has been noise vocoded (divided into frequency bands and resynthesised onto a noise carrier) can be understood, despite the loss of spectral detail and temporal fine structure (Shannon et al., 1995). In a series of experiments, we tracked changes in the intelligibility of 6-channel, noise-vocoded sentences, exploring the learning processes that allow report scores to improve from 0% to 70% words correct over the course of a 20-minute experiment. In Experiment 1, after reporting what they could understand of a vocoded sentence, listeners heard repetitions of the sentence, either as vocoded speech, clear speech or both. Report

scores on novel sentences improved more rapidly with sentence repetition, with most efficient learning observed in a condition (Vocoded-Clear-Vocoded, VCV) in which listeners knew the identity of the sentence before the vocoded speech was repeated compared to a matched condition in which such knowledge was absent (Vocoded-Vocoded-Clear). The enhanced learning provided by clear repetitions must depend on higher-level, non-acoustic information since written feedback was equally effective (Experiment 2). In Experiment 3, participants were tested on vocoded sentences following a period of pre-exposure to either real English or Jabberwocky (non-word) sentences. Learning was markedly impaired by training with Jabberwocky, even (Experiment 4) when written feedback ensured that short-term memory load was no longer a limiting factor. This pattern of results suggests that learning to understand noise-vocoded speech depends on the availability of higher-level (lexical, semantic and/or syntactic) information, a finding that is consistent with top-down, lexically driven learning. These factors that enhance such perceptual learning may have real world application for listeners hearing speech in an unfamiliar accent, or for individuals who receive a cochlear implant.

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Speech processing under unattended conditions

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This study addresses the question of speech processing under unattended conditions. Dupoux et al. (2002) have recently claimed that unattended words were not lexically processed. We test their conclusion with a different paradigm: participants had to detect a target word belonging to a specific category presented in a rapid list of words, in the attended ear. In the unattended ear, concatenated sentences were presented, some containing a repetition prime presented just before the target words. We found a significant priming effect of 22 ms (Experiment 1), for category detection in the presence of a prime compared with no prime. This priming effect was not affected by whether the right or the left ear received the prime (Experiment 2a and 2b). Finally, we found that the priming effect disappeared when there was no pitch range difference between attended and unattended messages (Experiment 3). Further experiments are being done in order to precise the effect of the pitch range difference, the effect of the lexical processing of unattended message and also to control that participants are not switching their attention to the unattended messages when they do the task.

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General networks and individual differences in visual speech processing

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Speechreading is an important visual language ability requiring the analysis of faces in action and their association with stored representations of heard speech. This skill usefully enhances speech perception when the auditory signal is degraded by noise, reverberation, or the distortions introduced by a sensori-neural hearing impairment. Up until now, neuroimaging evidence has indicated that silent speechreading of simple word lists is supported by pre-lexical phonemic processing in the bilateral superior temporal gyrus. However, we reveal that, when applied to sentences, silent speechreading not only engages bilateral superior and middle temporal gyri, but also strongly engages inferior frontal and inferior parietal regions, particularly in the left hemisphere. These latter regions have been implicated in the lexical stages of spoken language processing.

Understanding the brain areas that underpin normal visual speech analysis is a critical step towards identifying the key skills that support good speechreading since behavioural studies have been unsuccessful in this regard. Although natural speechreading involves multiple stages of the receptive spoken language system, the ability to speechread appears more closely associated with the amount of activation in the fusiform gyrus than anywhere within the language system. This result highlights the importance of visual skills in the analysis of facial information for successful speechreaders, perhaps in contributing to parsing the syllabic content of speech.

A challenge to current models of past tense acquisition: the impact of phonotactics.

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We present data concerning a phenomenon that has not been considered in studies of past tense acquisition: phonotactics of the inflected verb-end. Some regular verbs contain final clusters that also occur in monomorphemic words ('monomorphemically legal clusters', MLC) whereas others can only occur in inflected forms ('monomorphemically illegal clusters', MIC). If children store past tense forms based on their phonological form, they are predicted to perform better on MLC verbs because these clusters are more frequent. If children create past tense forms by applying a rule, they are expected to show no difference in performance as a function of phonotactics, or be better at MIC verbs as these clusters unambiguously signal a past tense form. Data previously collected in a past tense elicitation task from three populations - typically developing children and children with Grammatical-SLI (van der Lely and Ullman, 2001), and children and adults with Williams Syndrome (Thomas et al., 2001) - were analysed. G-SLI children perform better on MLC verbs and WS individuals perform better on MIC verbs, whereas in typically developing children phonotactics does not affect performance. We argue that the results elucidate the underlying nature of morphology in G-SLI and WS, and challenge current models of past tense acquisition.

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On-line processing of questions in children with G-SLI and typically developing children

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Previous research has shown that G(rammatical)-SLI children have a broad and persistent syntactic deficit. The RDDR hypothesis identifies the source of the deficit in the computational-syntactic system, affecting syntactic dependency relations. We test this hypothesis by investigating processing of Wh-Questions (e.g., *Who-did-Bart-kick-the-big-burger-to-[gap]-on-the-hill?*) using a cross-modal-priming paradigm. Specifically we investigated whether G-SLI and typically-developing children build dependency relations between the *wh*-word and the gap (syntactic-dependency) and/or the *wh*-word and the verb (lexical-dependency).

17 G-SLI subjects (10;2-17;2), 14 age-matched-controls (CA) and three groups of 38 language-controls (LA) (5;9-9;9) participated in this study. Overall, speed of processing increased with age in typically-developing children. The G-SLI subject's processing speed was slower than CA, but not LA controls. A significant priming effect was found at the gap but not at the verb for CA and LA3s, whereas the opposite pattern was found for the younger LA controls. The G-SLI children were not primed at the gap but were at the verb. Thus, processing in G-SLI children is lexically rather than structurally driven. In contrast, typically-developing children show both types of processing with syntactic processing taking precedence with age. Our results support the RDDR hypothesis. We will discuss the implications for accounts on SLI.

Morphological and phonological factors in the processing of English inflections

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Previous studies suggest that different processes may be involved in the analysis of irregular (*caught*) and regular (*filled*) past tense forms in English. In particular, the comprehension and production of regular forms is argued to require processes of morpho-phonological assembly and disassembly, analysing these forms into a stem plus an inflectional affix (e.g., {fill} + {-ed}). Such processes do not apply to irregular forms, which do not have an overt stem + affix structure and must be analysed as full forms. In earlier research with non-fluent patients known to have difficulties with inflectional morphology (Tyler et al, 2002), we showed that not only regular forms (such as *filled*) produced poor performance in a same/different

judgement task, but so did pseudo-regulars (e.g., *mild*) and even non-words modelled on regular forms (e.g., *nilled*). In a further experiment using unimpaired young adults, we used a speeded judgement task in which subjects decided whether the words in a pair sounded the same or different, and compared past, present and plural regular inflections with phonologically matched monomorphemic words and non words (e.g. *filled-fill* versus *mild-mile* and *nilled-nill*). We see slower responses across the board for items that can be interpreted as inflected forms, whether or not they are real words, pseudo-regulars, or nonwords. The critical factor is whether the word (or nonword) ends in a coronal consonant (t,d, s, z) and whether it agrees in voice with the preceding phoneme. Stimuli that did not meet these criteria did not elicit slower responses. We interpret this as evidence for a basic morpho-phonological parsing process that applies to all items with the criterial phonological properties.

Tyler, LK, Randall, B., & Marslen-Wilson,WD. (2002). Phonology and neuropsychology of the English past tense. *Neuropsychologia* 40, 1154-1166.

Studying the word class distinction with Event-Related Potentials: Does the word frequency modulate the N280?

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The dual mechanism theory for the visual processing of open- (OCWs) and closed-class words (CCWs) predicts that different neuronal generators are activated depending on word class. Previous research with event-related potentials (ERPs) has shown different components for CCWs (N280, 200-350 msec and LAN, 400-600 msec) as compared to OCWs (N400, 300-600 msec). However, since CCWs are shorter and more frequent than OCWs, it is unclear whether these effects are really attributable to word class. To untangle these factors we conducted two ERPs experiments in which twenty French participants read sentences presented word by word. In experiment 1, CCWs were more frequent and shorter than OCWs whereas, in experiment 2, they were matched in frequency and length. Experiment 1 replicated the classical N280 and LAN effects for CCWs, whereas experiment 2 showed only a N280. Moreover, in both experiments the N280 component appeared earlier for CCWs than OCWs. Given that lexical properties were matched in experiment 2, it is possible to infer: the LAN may at least in part be associated with lexical properties; topographical differences in the N280 time range and a delay on N280 are attributable to word class. These findings provide partial support for the dual mechanism theory.

Metaphoric reasoning in typical and atypical development

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Metaphoric reasoning can be defined as the process of drawing links across disparate conceptual domains. Developmentally this is a crucial skill as by engaging in metaphoric reasoning the child is able to 'remake their reality'. This talk will present data from an empirical investigation into metaphoric reasoning by drawing on developmental evidence from typical and atypical populations. The importance of several core linguistic and cognitive skills was investigated in 4 distinct groups of children with: (1) a relatively 'pure' language impairment: Grammatical-Specific Language Impairment $n = 10$. (2) a relatively 'pure' cognitive impairment: Asperger Syndrome $n = 10$; (3) Pragmatic Language Impairment $n = 11$; and (4) a group of children developing normally $n = 48$.

Two main hypotheses were tested: (1) that the 4 groups would display fundamentally different profiles of performance, and (2) that core language and cognitive skills would exert differing levels of impact on task success. Results indicate that when language ability was controlled for 3 main factors accounted for task success: (1) group type; (2) metaphor type with respect to conceptual complexity; (3) The child's knowledge of the concepts used to build the metaphors. The relative impact of these 3 factors differed across groups. It was concluded that empirical investigation into the development of metaphoric reasoning provides key evidence for the autonomy of the language and cognitive systems.

Factors affecting children's performance in generating strategies to deal with novel situations

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Studies into the development of executive function in children have consistently identified an age-related improvement in performance with adult levels of functioning being reached on different tasks at different ages. This study sought to investigate the development of some of the component processes using an approach based on Shallice & Burgess's (1996) model of the Supervisory System and using the concrete version of the Self-Ordered Pointing Test.

An initial study confirmed a significant age-related improvement in performance between the ages of eight and eleven years, with eleven-year-olds performing significantly less well than adults. A second study then investigated the effect of making a strategy easier to generate and of giving more explicit instructions, testing eight- and ten-year old children. As before, results showed that, in all conditions, ten-year old children performed better, and were significantly more likely to use a strategy, than eight year olds. The explicitness of instruction had no effect on performance for either age group. However, ten-year old children were significantly more likely to generate and use an appropriate strategy if such a strategy was more obvious. For eight-year old children, the salience of the strategy had no significant effect on performance. In summary, the study suggests that this approach offers a

useful way to investigate the development of specific sub-processes of executive function and shows that, even though children are aware of a need to utilise a strategy to deal with a particular task, their failure to do so is constrained by their ability to generate such a strategy and to monitor its effectiveness.

T. Shallice & P. W. Burgess. The domain of supervisory processes and temporal organization of behaviour. *Philosophical Transactions of the Royal Society of London B* 1996, 351, 1405-1412

Re-thinking stages of cognitive development: On balance, connectionist networks don't work

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The present paper provides a re-appraisal of connectionist attempts to account for a how human cognitive development appears to progress through a sequential series of stages. In particular, models of performance on the Piagetian balance scale task are the focus of attention. Limitations of these models are discussed and replications and extensions to the work are provided via discussion of the Cascade-Correlation algorithm. A relatively unknown statistical technique for analysing performance of the networks is described and following application of such methods fundamental characteristics of the networks are revealed. Evidence is provided that strongly suggests that the networks are unable to acquire a knowledge of torque and that although they do recover certain rules of operation that humans do, they also acquire rules never previously seen.

In search of executive process components involved in simple arithmetic

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Previous research has shown that verification of simple arithmetic tasks is affected by concurrent secondary tasks that call on executive processes. A conceptual analysis of the processes involved in particular tasks used to interfere with the central executive, suggest that processes such as input and output monitoring, response selection, memory updating and task-set switching may be involved in such tasks. The present paper reports a series of experiments on simple arithmetic problem solving. The main purpose was to find out whether simple arithmetic calls on particular executive processes by comparing performance under single-task and dual-task conditions. For the dual-task conditions, secondary tasks were selected that varied the involvement of one single component process. The effect of input monitoring was studied by varying the degree of input monitoring required by the secondary task. For the role of response selection a two-choice reaction task was compared with a simple reaction task. We found a modest influence of input monitoring and an important effect of response selection on the speed of the verifications. The implications of these findings are discussed for our views on executive functioning and its involvement in simple mental arithmetic.

Pure anomia: The importance of an abstract vocabulary in spontaneous speech

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We describe a detailed quantitative analysis of the propositional speech of a patient, FAV, who became severely anomic following a left occipito-temporal infarction. FAV showed a selective noun retrieval deficit in naming to confrontation and from verbal description. Nonetheless, his propositional speech was fluent and content-rich. To quantify this observation, three picture description-based tasks were designed to elicit spontaneous speech. These were pictures of professional occupations, real world scenes and stylised object scenes. FAV's performance was compared and contrasted with that of 5 age and sex matched control subjects on a number of variables including speech production rate, volume of output, pause frequency and duration, word frequency, word concreteness and diversity of vocabulary used. FAV's propositional speech fell within the range of normal control performance on the majority of measurements of quality, quantity and fluency. Only in the narrative tasks which relied more heavily upon a concrete vocabulary, did FAV become less voluble and resort to summarising the scenes in an abstract manner. This dissociation between virtually intact propositional speech and a severe naming deficit represents the purest case of anomia currently on record. We attribute this dissociation in part to the preservation of his ability to retrieve his abstract word vocabulary. Our account demonstrates that poor performance on standard naming tasks may be indicative of only a narrowly defined word retrieval deficit. However we also propose the existence of a feedback circuit which guides sentence construction by providing information regarding lexical availability.

Preserved thematic and impaired taxonomic categorisation: a case study

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The paper reopens a version of the oldest debate in cognitive neuropsychology. It seeks to understand more about categorisation and its relation to naming. A patient with language impairments (LEW) was examined in a three-part investigation of his ability to make classification decisions. The first part demonstrated LEW's inability to make taxonomic classifications of shape thus confirming his previously documented impaired perceptual categorisation. The second part demonstrated that, despite LEW's inability to perform simple taxonomic classifications, he could reason analogically as well as a 4/5 year-old child. It is therefore argued that taxonomic classifications cannot be driven by the development of analogical reasoning. The third part more directly contrasted thematic and taxonomic classification. LEW showed a preference for thematic classification. In fact, there was no evidence of any substantial ability to make taxonomic colour classifications despite evidence for good preservation of the associated object-colour knowledge.

Gamma EEG differences to perception of visual illusions in autism

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Gamma EEG around the 40Hz band has been associated with a marker signal for binding within and across networked brain regions. Autism presents as a many faceted disorder which may be a result of impaired binding. To test this, fourteen adolescents aged 11-17 were tested, six (Mean Age 14.7) with a diagnosis of autistic spectrum disorders (ASD) and eight (Mean Age 14.0) with moderate learning difficulties (MLD), matched for age and both verbal and non-verbal ability. EEG was recorded during a task in which the youngsters were required to discriminate between 'present' where a Kanizsa shape was present in the display and 'absent' when a random display was shown. Both groups performed the task equivalently. However, comparison of induced gamma EEG over parietal regions in the first 500ms after onset of the task showed significant differences. In the target-absent condition both groups showed the equivalent patterns of gamma activity. In the target-present condition, the ASD group had significantly increased overall gamma power (0-400ms), a very early burst of induced gamma (80-120ms) and a significantly shorter latency for the induced burst (250-300ms ASD, cf 300-350ms MLD). It is suggested that binding in non-autistic individuals may be the learnt ability to suppress high-frequency activity in cell assemblies not involved in processing, and that in autism this inhibition cannot be learnt, possibly because of anatomic structural differences or functional connectivity in the autistic brain.

Timing of target discrimination in human frontal eye fields

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Frontal eye field (FEF) neurons fire in response to behaviourally relevant stimuli that are potential targets for saccades. Distinct visual and motor processes have been dissociated in the FEF of macaque monkeys, but little is known about the visual processing capacity of FEF in humans. We used transcranial magnetic stimulation (TMS) to investigate perceptual processing in human FEF. We used signal detection theory to compare subjects' performance on difficulty-matched visual feature and conjunction search tasks in which eye movements were neither useful nor required. Repetitive-pulse TMS (10Hz, 500ms) was applied over FEF and control sites, V5 and vertex. Performance (d') was significantly impaired when TMS was applied over FEF during conjunction search. This finding confirmed the hypothesis that human FEF is important for target selection, regardless of the need to generate a saccade. In a second experiment, we used double-pulse TMS to investigate the timing of this effect. We applied dual TMS pulses separated by 40ms over right FEF and Vertex. These were applied in five timing conditions to sample separate time windows within the first 200ms of visual processing. d TMS impaired search performance (d') and the effect was limited to a time window between 40 and 80ms after search array

onset. These parameters correspond with single-cell activity in FEF that predicts monkeys' behavioural reports on hit, miss, false alarm and correct rejection trials. Our findings demonstrate a critical early role for human FEF in visual target discrimination that is independent of saccade programming.

The influence of millisecond stimulus asynchrony on perceptual grouping can be explained by fixational eye movements

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If two images are shown in rapid cyclical order, two percepts are possible. At slow rates the two images remain distinct and are seen to flicker, whilst at faster rates they fuse. Despite our lack of awareness of distinct images, recent studies have revealed that visual ordering and grouping can be influenced by presentation rates well beyond that of perceptible flicker. The mechanism for this sensitivity is still not known. It has, however, sparked excitement in the broader neuroscience community as it may reveal the presence of a 'temporal binding mechanism'. This mechanism would serve to keep multiple mental representations of one object distinct from those of other objects. An alternative explanation is that involuntary eye movements are responsible for converting the temporal offset of the two images into a minor spatial offset in the compound, test image. To test this hypothesis I replicated one of the recent studies over several viewing distances and discovered a significant increase in performance as viewing distance increased ($p < 0.01$). Further studies using an eye tracker confirmed the link between eye movement amplitude and sensitivity to the temporal offset. Hence, the work reveals a role for involuntary, fixational eye and head movements in the perception of temporally asynchronous stimuli. As a result, our sensitivity to very brief temporal asynchrony is open to reinterpretation in terms of a purely spatial mechanism, thereby undermining support for the temporal binding hypothesis.

Dynamic interactive processes in figure-ground segmentation: Effects of occlusion, shape concavity, and contrast polarity

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We investigated how figure-ground segmentation is affected by occlusion cues, surface information and contrast polarity of the search elements. Observers searched multi-element displays for a convex shape among concave distractors, or the reverse. Targets and distractors were presented either with or without flanking surfaces which acted as a local ground. When there was no local context, search was more efficient for concave than for convex targets. This held also when there was a local contextual "ground" with opposite contrast polarity to the search stimuli. However, overall search performance was reduced when the elements were embedded in a local ground. The presence of an occlusion cue between the central surface and the local ground in the items only moderately improved search performance compared to when there was no occlusion. Removing contrast between figure and ground (by using line-drawn elements) resulted in a cost in detecting shape concavity (rather than

a benefit), indicating a critical role for surface contrast information in figure assignment. Finally, varying contrast polarity between local surfaces and the background reduced the benefit for shape concavity. The results suggest that figure-ground coding in visual search is particularly influenced by contrast and polarity differences between surfaces.

Action modulates object-based selection

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Cueing attention to one part of an object can facilitate discrimination in another part (Experiment 1; Duncan, 1984; Egly, Driver & Rafal, 1994). We show that this object-based mediation of attention is disrupted when participants make a pointing movement to the cued part; when a pointing response is made, discrimination does not differ between (i) stimuli at locations in the same object as the pointing movement and (ii) stimuli at equidistant locations outside the object (Experiment 2). This remains true even when the pointing movement cannot be performed without first coding the whole object (Experiment 3). Our results indicate that action either (i) emphasizes spatial selection at the expense of object-based selection, or (ii) changes the nature of the representation(s) mediating perceptual selection. The results also indicate there can be a distinct effect on attention of movement to a specific location, separate from the top-down cueing of attention to another position (Experiment 3). The data highlight the interactivity between perception and action.

Duncan, J. (1984). Selective attention and the organization of visual information. *Journal of Experimental Psychology: General*, 113, 501-517.

Egly, R., Driver, J. & Rafal, R.D. (1994). Shifting visual attention between objects and locations: Evidence from normal and parietal lesion subjects. *Journal of Experimental Psychology: Human Perception and Performance*, 123, 161-177.

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.

A connectionist analysis of configural learning

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Three experiments with rats investigated how the associative strengths of the representations that underlie configural learning change when they are presented in compound. The results of each experiment suggest that the representation whose associative strength is most discrepant from the asymptote supported by the outcome of the trial undergoes the greatest change in associative strength. These results parallel those from simple Pavlovian conditioning (e.g., R. A. Rescorla, 2000), are inconsistent with unique-cue and configural accounts of conditional learning, and support a connectionist analysis of learning in which a “winner-takes-all” rule applies to the hidden units that can be activated and acquire associative strength at a given point in time.

Rescorla, R. A. (2000) Associative changes in excitators and inhibitors differ when they are conditioned in compound. *Journal of Experimental Psychology: Animal Behavior Processes*, 26, 428-438.

Parietal processes in the early stages of word recognition: a TMS study

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We investigated the role of the right parietal lobe in reading using Transcranial Magnetic Stimulation. Evidence from functional imaging has indicated activation of the right superior parietal lobe in word reading, particularly for words presented in mIxEd-cAsE (Mayall et al., 2001). TMS was applied to the right superior parietal lobe and to a control area when participants had to read out-loud words presented either in lower case or in mIxEd-cAsE. The words were presented either with unlimited duration and high contrast (experiment 1), or with brief presentation and low-contrast (experiment 2). In both experiments, TMS over the parietal area was found to disrupt the reading of both same-case and mIxEd-cAsE words. This suggests that the right parietal lobe mediates reading of same and mixed case alike, and is not recruited specifically to read mIxEd-cAsE words.

Mayall, K. A., Humphreys, G. W., Mechelli, A., Olson, A., & Price, C. J. (2001). The effects of case mixing on word recognition: evidence from a PET study. *Journal of Cognitive Neuroscience*, 13, 844-853.

Cross-modal face recognition

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Until very recently, face recognition has been studied almost exclusively within the domain of vision. Visual research has largely concentrated on familiar face

recognition, something at which we have become very expert. Visual recognition of faces has been found to activate an area in the right fusiform gyrus termed the 'fusiform face area' (FFA) and it is debated whether this is a special face area or an area of general object processing expertise. Our own faces are highly familiar to us visually, however, we also regularly touch our own faces, and research has shown that learning allows for sufficient haptic recognition of live faces. This study investigated participants' ability to recognise a model of their own face from a "line-up" of distractor face models, using active touch. Recognition of the models was significantly better through vision than touch. This may be because a) we have not built up an expertise in haptic face recognition and b) haptic processing also relies on material properties of the face that were absent from the models. Results also indicated that we don't have a haptic representation of our own faces in memory that is adequate for recognition without being facilitated by learning. Learning that enhanced recognition performance was found not to be due to practice at the task. Instead, learning may allow us to engage a feature comparison strategy to recognise a target model, a strategy also used in visual object recognition. Considering our lack of haptic face expertise, the results of this study have implications as to the location of possible neural substrates underpinning haptic face recognition. Rather than finding activation in the FFA during a haptic face recognition task, activation may instead be found in the lateral occipital complex (LOC), a site that is activated during both visual and haptic object recognition.

The abstract nature of the numerical representation and the role of vision in its elaboration: evidence from a study with blind people in the auditory modality

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In numerical cognition, it is largely assumed that human beings possess an abstract representation of numbers (e.g.: Dehaene, Dehaene-Lambertz & Cohen, 1998). However, many questions remain about the nature of this representation and its elaboration during childhood. The majority of studies and theoretical numerical proposals rely on the visual modality. Furthermore, Simon (1999) suggested a prevalence of vision by making the assumption that, in infants, the pre-attentional subitizing process plays a critical role in the apprehension of small numerosities. Therefore, although some researches have been devoted to the process of numerosity in the auditory modality (e.g.: Barth, Kanwisher, & Spelke, 2003), the role of auditory inputs in the apprehension of numerosity is clearly less documented. In order to investigate more precisely the impact of this modality in number processing, we decided to submit a group of early blind subjects and of blindfolded sighted subjects to auditory comparison and parity judgement tasks on small numbers (1-9). The question addressed was: "Does the representation of numbers constructed in the absence of vision present the same basic characteristics as the ones elaborated from visual inputs?" In the two groups of subjects, all the classical effects of numerical processing, such as the distance, the size and the SNARC effects were found. These results give further evidence to the hypothesis concerning the abstractness of the numerical representation, but also suggest that the absence of vision early in life did

not prevent blind subjects to elaborate numerical representation, at least in the range of the small numerosities.

Barth, H., Kanwisher, N, & Spelke, E. (2003). The construction of large numbers representations in adults. *Cognition*, 86, 201-221.

Simon, T.J. (1999). The foundations of numerical thinking in a brain without numbers. *Trends in Cognitive Sciences*, 3 (10), 363-364.

Dehaene, S., Dehaene-Lambertz, G., & Cohen, L. (1998). Abstract representations of numbers in the animal and human brain. *Trends in Neurosciences*, 21 (8), 355-361.

A context/activation model of list memory

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We present a computational model for list memory formulated within a Hebbian framework based on two components: an episodic contextual system with changing context and an activation-based short-term memory buffer which drives the encoding of item-to-context associations. We apply this model to account for serial-position data in immediate free- and cued-recall as well as for continuous-distractor free recall. In particular, the model explains short- and long-term recency effects as well as a series of dissociations between the immediate and the continuous-distractor free recall including directed output order, amnesic deficits and predicts a dissociation between short- and long-term recency due to proactive interference, which is confirmed in an experiment.

Is encoding orientation and color features as different parts of an object in visual short-term memory really object-based?

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The question of whether features from different parts of an object can benefit from an object-based encoding in visual short-term memory (VSTM) is investigated. According to Xu (2002), such an object-based encoding benefit is observed for features from different dimensions (colour and orientation), but not for features from the same dimension. However, the use of orientations in Xu' study is questionable, since an orientation change in a display does not only modify the feature itself, as it is the case for a colour change, but might also disrupt the whole spatial configuration of the display. Using the change detection paradigm, we provide evidence that, as soon as the change detection cannot be based, or at least with more difficulty, on a spatial configuration change, the object-based benefit observed for colour and orientation when they come from different parts of an object is significantly reduced. These findings suggest important limits of bottom-up perceptual organization on binding in VSTM, as memory for individual visual features might not benefit from an object-based encoding when they come from different parts of an object.

Xu, Y. (2002). Limitations of object-based feature encoding in visual short-term memory. *Journal of Experimental Psychology: Human, Perception and Performance*, 28, 458-468.

View-specific versus view-independent priming in face perception: an fMRI study

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We studied repetition effects in face perception depending on whether they are image specific or generalise across views. 15 healthy young subjects were scanned at 3T while performing a sex judgement task on famous or unfamous faces preceded by either the same image, a different image of the same face, or another (unprimed) face. Reaction times for immediate repetition revealed priming in the same and different view conditions independent of fame, priming effects being more pronounced for same views. Imaging data were analysed in a random effects group analysis in SPM2. The main effect of priming revealed activations in bilateral fusiform gyrus and orbitofrontal regions, whereas a main effect of fame was found in the precuneus, orbitofrontal cortex, and hippocampus. A right anterior fusiform region expressed an interaction of priming and fame with more pronounced priming for famous faces. In bilateral mid-fusiform regions, repetition decreases were significantly stronger for same than for different views, while in a left anterior fusiform region, BOLD decreases were also found for different views compared to unprimed faces. The findings support a general pattern of posterior image-specific priming effects independent of familiarity, and more anterior view-independent priming effects, mainly for familiar faces, in fusiform cortex.

Individual differences in stress reactions to a work related task

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Employment trends show an increasing tendency for people to work in call centres, dealing with customer queries and complaints by telephone. Such work may be stressful for a variety of reasons, including time pressure, having to deal with difficult customers, and lack of social interaction. The present study aimed to investigate individual differences in stress reactions in customer service personnel, using a simulation of the actual task performed at work. It was expected that personality characteristics associated with stress vulnerability, such as neuroticism, would be associated with subjective distress and performance impairment. Participants were 86 personnel working in the billing department of a major British corporation. They completed measures of personality and coping style prior to the study. Each participant performed a simulated task requiring them to handle typical customer queries about billing. Errors in explicit knowledge and in use of a computerized database were assessed. Before and after performance participants completed the

Dundee Stress State Questionnaire (DSSQ: Matthews et al., 2000), a scale which provides comprehensive assessment of affective, motivational and cognitive states. Following performance, they also completed the Coping Inventory for Task Stress (CITS: Matthews & Campbell, 1998), which assesses situational coping. Results showed that the task was intrinsically stressful, in that performance increased emotional distress and cognitions of loss of control. Neuroticism was associated with greater distress, and self-efficacy with reduced distress, and greater engagement with the task. Individuals who used emotion-focused and avoidance coping strategies also tended to experience more unpleasant subjective states. These coping strategies were also associated with a greater incidence of errors on the task. Theoretical and practical implications of the data will be discussed.

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Dissociation of limbic and frontal dopamine during conditional discrimination learning in rats

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Patients with schizophrenia perform poorly on a diverse range of tasks including the continuous performance task and the Stroop task. These deficits have been successfully modelled using a connectionist network in which abnormalities in prefrontal dopamine (DA) were related to the effectiveness with which contextual information was manipulated (Cohen & Servan-Schreiber, 1992). To investigate directly the role of DA in the retrieval of contextual information, we trained rats on either a biconditional (Context A:X+ Y-; Context B:X- Y+), or simple discrimination (Context A:X+ Y-; Context B:X+ Y-). For animals learning the biconditional discrimination, the context signals the set of relationships between stimuli X and Y and reinforcement, whereas for animals learning the simple discrimination, context is irrelevant. We have previously reported that concentrations of extracellular DA in the core of the nucleus accumbens are lower in rats performing a conditional discrimination task than in those performing a simple discrimination (George, Jenkins & Killcross, 2002). In the current experiment, following acquisition, microdialysate samples were collected from the prelimbic and infralimbic cortices while animals were performing the discrimination task. Higher levels of DA in animals performing the conditional discrimination again supported the hypothesis that forebrain DA is involved in the use of contextual cues to guide behaviour. The interactions between prefrontal and nucleus accumbens DAergic systems and the implications of these findings for network models of DA function in schizophrenia are considered.

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The critical role of low spatial frequencies in the configural processing of faces

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A distinctive feature of face processing, as compared to other categories, is thought to be the large reliance on configural cues, i.e. the spatio-metric relations among facial features. Although it is generally assumed that configural cues are predominantly provided through low spatial frequencies (LSF), whereas local cues are related to high spatial frequencies (HSF), this hypothesis has never been tested directly.

To test this hypothesis, triplets of faces filtered in LSF (below 8 cpi), HSF (above 32 cpi) and in full spectrum were presented simultaneously, asking subjects to match one of two probe faces with a third target face. One of the two probes differed from the target (1) either configurally (by manipulating the eyes position), (2) either locally (by changing the shape of the eyes shape while preserving the face configuration), or (3) both locally and configurally. In Configural condition, subjects were as accurate but faster with LSF faces than HSF and full spectrum faces. In contrast, Local and Local+Configural conditions revealed a strong advantage in accuracy for HSF as compared to LSF faces. Interestingly, the Local-Configural condition led to significantly better accuracy than Local condition, in LSF only. Altogether, these results provide a clear empirical demonstration of the critical role of LSF in the configural processing of faces.

Behavioural control by multiple conditioning cues: A rat analogue of task interference.

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Rats were trained to acquire two biconditional lever press discriminations, auditory and visual, in two different contexts (A and B), e.g. A: Tone_Left lever rewarded, Clicker_Right lever rewarded; B: Flashing light_Left lever rewarded, Steady light_Right lever rewarded. Rats received 12 trials per day of one discrimination (Undertrained) and 36 trials of the other (Overtrained), counterbalanced between animals. Correct responses were rewarded with pellets. After achieving comparable performance of the two discriminations, rats received two test sessions, one in each of the training contexts, during which they were presented with compounds of the auditory and visual training stimuli. The elements of these audiovisual test compounds had required either the same or different lever press responses during the acquisition phase, forming congruent and incongruent stimulus pairs respectively. Rats demonstrated accurate responding to the congruent stimulus pairs in both the undertrained and overtrained test contexts. Correct responding to the incongruent stimulus pairs was dependent upon the relationship between the elements

of the test compound and the test context. Previous studies with equivalently trained discriminations have demonstrated that rats preferentially respond according to the stimulus element previously trained in the test context. Following differential training, when tested in the overtrained context the same effect was observed. When tested in the undertrained context greater numbers of errors were seen to the incongruent stimulus compounds, indicating increased interference from the overtrained or dominant response-set, a result which is comparable to task interference such as that seen in the Stroop effect in humans.

Incidental contextual control of biconditional task performance disrupted by reversible inactivation of the dorsal hippocampus.

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Rats were trained concurrently on two biconditional discriminations, auditory and visual, in two discriminable contexts A and B, (e.g. A: Tone_Left lever, Clicker_Right; B: Flashing light_Left, Steady light_Right, counterbalanced between animals). Correct responses were rewarded with pellets in one context and sucrose in the other. Following acquisition, rats received test presentations of audiovisual compounds of the training stimuli in both contexts. The elements of these compounds required either the same (e.g. Tone and Flashing_Left) or different lever press responses (e.g. Tone and Steady_Left/Right) during initial training, termed congruent and incongruent stimulus pairs respectively. Rats demonstrated correct responding to the congruent stimulus pairs. Responding to the incongruent stimulus pairs was dependent upon the relationship between the elements of the audiovisual compounds and the test context, such that rats responded preferentially to the stimuli previously trained in the test context. For example, when tested in context A they responded based on the auditory cues (e.g. Tone and Steady_Left, Clicker and Flashing_Right) but in context B their responding was in accordance with the visual stimuli (e.g. Tone and Steady_Right, Clicker and Flashing_Left).

Previous evidence suggests that damage to the hippocampus impairs incidental learning about contextual cues. Our preliminary findings indicate that reversibly inactivating the hippocampus during the test sessions resulted in responding to incongruent cues that was not contextually governed, whereas responses to congruent cues, and hence solution of the biconditional discrimination, remained unimpaired. Parallels between this hippocampal effect and the role of cortical learning systems in conditional discrimination will be explored.

Effects of pitch and timbre in music-colour synaesthesia

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Synaesthesia is a condition where stimuli presented to one sensory modality evokes a response in another modality. This study reports on the phenomenon of coloured music synaesthesia, a condition where individuals report seeing colour in response to hearing musical tones. A group of eight synaesthetes and ten controls were presented with a series of 80 different auditory stimuli, consisting of different

pitches and musical timbres. Upon presentation of each stimulus they were required to select an accompanying colour that they felt best represented the stimuli.

The results revealed that synaesthetes were significantly more consistent than controls in associating colours to different pitches and musical timbres, with synaesthetes employing a more extensive search pattern than controls when selecting colours. There was a positive correlation between pitch and luminance for both groups of participants; with higher pitches significantly associated with greater luminance values.

This study has produced an objective test that demonstrates music-colour synaesthesia as a genuine and consistent phenomenon. Synaesthetes are more consistent over time and have a more specific search strategy than controls. However, both synaesthetes and controls map tones to colours in a qualitatively similar way. This implies that music colour synaesthesia may be an exaggeration of normal cross-modal mechanisms common to us all.

Cross-modal links between vision and touch upon aesthetic evaluation

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This study set out to explore whether different textures have the capacity to alter overall aesthetic evaluation of a stimuli. Previous studies have supported the theory that perceptual processing within one modality (e.g. vision) can be influenced by stimuli presented within another modality (e.g. touch), but it has not been applied to overall aesthetic evaluation. A control condition and two kinds of different textures were used on a DVD and a video box in order to investigate if haptic evaluation would influence the visual evaluation. A total of 126 participants had to visually evaluate one of the boxes and at a later date they had to evaluate the same box again, but whilst holding it. The two results were then compared, and the overall findings indicate that haptic interaction does alter overall aesthetic evaluation. Furthermore it was found that if the stimuli had been rated positively upon visual evaluation, the overall rating decreased upon physical interaction. The reverse was found when the visual evaluation was of a negative nature.

Neural correlates of reading Japanese kanji and English by Japanese-English bilinguals.

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The aim of this study is to investigate the universality and specificity of neural representation of reading processes of two languages in the bilingual population. We designed a functional Magnetic Resonance Imaging (fMRI) study using silent reading tasks of two contrasting types of orthographies, the Japanese kanji and English

alphabet so as to maximize visual and linguistic differences between the two scripts. Ten Japanese-English late bilinguals with a postgraduate level of literacy in both languages participated. Stimuli were (a) two-character Kanji concrete nouns, (b) their translated English words and (c) 4 digit numbers, and were presented under three different conditions – (1) a single word (2) a string of five unrelated words, and (3) a single digit. Kanji words were presented vertically, while English words were presented horizontally. Digits were presented both vertically and horizontally so that they serve as a baseline of each language condition. This was because the digits differ in reading depending on how they are presented, yet sharing the same semantic representation. .

The results show that reading Japanese words activated the right occipital and parietal lobes more than English words, indicating that greater visual processing might be required for Japanese kanji. The data have not revealed significant activation in the language areas of the left hemisphere (e.g., Wernicke's or Broca's area) for processing English. This could be due to the baseline (i.e., digits), as they have both phonological and semantic representations just like real words. Furthermore, the comparisons of string and single word conditions within each orthography activated different cortical areas apart from the occipital cortices. These differences are more likely due to different eye movements associated with vertically and horizontally written orthographies rather than language specificity.

Imagery in counterfactual thinking in pre-school children

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We report the results of an experiment on counterfactual thinking in young children. We examined pre-schooler's answers to questions about the facts of a story and about its counterfactual possibilities. We tested whether instructions to form a picture in their minds about the facts, or about the counterfactual possibilities, affected the accuracy of their answers. The 48 children who participated in the experiment were aged 2.11 to 4.10 years old. Each participant listened to four scenarios, and answered questions about the facts and the counterfactual possibilities in each. We assigned the children to three groups. We gave one group instructions to form a mental image of the actual cause of the outcome mentioned in the story (e.g., the outcome of Scenario 2 is that Millie the monkey is able to eat a banana, and the actual cause is that a bunch of bananas grew on the banana tree). We gave a second group of children instructions to form a mental image of the earlier and now-counterfactual possibility mentioned in the story (e.g., Millie the monkey's banana tree was bare), and we gave no instructions about imagery to the control group. The results show that instructions to imagine events helps pre-school children to answer questions about counterfactual possibilities. We discuss the implications of the findings for understanding the development of counterfactual thinking.

Interruption of goal directed behaviour: Effects of interruption position, type and warning

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Interruptions of complex cognitive activities are typically most disruptive when they occur within rather than between subtasks. This effect was further explored in a setting calling upon goal directed cognition in the Tower of Hanoi (ToH) task. Experiment 1 revealed that ToH interruptions were more disruptive the earlier they appeared within primary task solution sequences. Larger disruptive effects for interruptions placed within subtasks were confirmed in Experiment 2. However, the impact of interruption was broadly similar in tasks that had characteristics similar (ToH tasks) or dissimilar (number recall tasks) to the interrupted task if positioned between subtasks. Experiment 3 revealed that a warning shortly before the onset of the interruption increased rather than diminished the impact of the interruption. Results provide support for the Goal Activation Model (Altmann & Trafton, 2002) by highlighting the importance of availability of priming cues for successful goal retrieval.

Altmann, E. M., & Trafton, J. G. (2002). Memory for goals: An activation-based model. *Cognitive Science*, 26, 39 – 83.

Case studies of compensated developmental dyslexia

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We present two case studies of English speaking adults with compensated developmental dyslexia. Both are female (in their late 20s) with normal IQ - one was a postgraduate student and the other was an office clerk working in London. Impaired phonological processing remains the most consistent finding in all studies of dyslexia. Much research on dyslexia also revealed that impairments experienced by dyslexics in childhood persist into adulthood even though their reading skills may fall within the normal range.

We conducted many reading and reading related and visuo-spatial experiments on these cases. The results revealed that significantly lower scores were observed in their performance on the tasks investigating phonological awareness skills (e.g., nonword reading, homophone/rhyme judgements, phoneme deletion tasks, phonological lexical decisions where participants were required to say YES to pseudohomophones (*brane*), and digit span tasks) compared to age-matched normal controls. Thus, the data indicate that both cases might be compensated phonological dyslexic.

However, in addition to the phonological deficits, the second case also revealed impaired performance on visuo-spatial tasks, in particular, recall tasks using Rey's complex figure, thus showing deficits in visual modality. As discussed by Ramus et al. (2002), visuo-spatial and phonological deficits may co-exist in some dyslexics. The results further highlighted the heterogeneity of developmental dyslexia, however, the core deficits appeared to be phonological rather than visuo-spatial.

Ramus, F., Rosen, S., Dakin, B., Day, J., Castellote, M., White, S., & Frith, U. (2002). Theories of developmental dyslexia: insights from a multiple case study of dyslexic adults. *Brain*, 126, 841-865.

Modality dissociations of serial position in a probed recall task: Evidence from Down syndrome and typical development

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Individuals with Down syndrome suffer from relatively poor verbal short-term memory. Recent work has indicated that this deficit is not caused by problems of audition, speech or articulatory rehearsal. This experiment examined whether abnormally rapid decay underlies the deficit. We varied the time available for decay, while keeping interference constant, using a modified probed recall procedure involving memory for both verbal and visuospatial material, presented at fast and slow rates. 12 people with Down syndrome and 25 typically developing individuals were assessed. Individuals with Down syndrome had particular problems on the verbal version of the task, but showed no indication of abnormally rapid decay. In both groups marked differences were found in the serial position data for the two modalities, with a linear increase in recall with serial position emerging for the visuospatial condition at both presentation rates. In the verbal condition, conventional primacy and recency were evident at fast presentation, but no serial position effects emerged from slow presentation. These modality differences of serial position can be explained by differential distinctiveness of the within-list items from those from outside the list, along with a modality-specific primacy gradient. Such explanations are supported by error patterns in the data.

Reversal learning and extinction are differentially influenced by lesions of the infralimbic and prelimbic prefrontal cortex in rats

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Recently, a picture has emerged of the prefrontal cortex (pfc) as a heterogeneous structure, having several functionally distinct regions. Each region is considered to play a different role in cognitive functioning. An experiment was carried out to investigate the effect of prelimbic (PL) and infralimbic (IL) lesions of the rat medial prefrontal cortex on learning, reversal and extinction of a Pavlovian and an Instrumental appetitive discrimination. The tasks initially required rats to discriminate between two stimuli of the same modality. Once the discriminations were learnt, the stimulus-reward associations were reversed. Finally both stimuli were extinguished. Whereas in the Pavlovian task, rats simply acquired a reflexive magazine approach response on the basis of the stimulus-reward association, the Instrumental task required rats to learn a stimulus-response-reward association based on discriminated lever pressing. Three groups of lesioned rats (PL, IL, PL+IL) and appropriate shams were tested. PL lesions also lead to a deficit in reversal of the Instrumental task, and both PL and IL lesions led to deficits in Pavlovian reversal, although the effect was more enhanced in IL lesioned rats. Furthermore, IL lesions

produced enhanced reinstatement of Pavlovian approach in extinction. These findings are discussed with respect to underlying reflexive and goal directed performance.

Alerting, orienting and executive control in vision and audition

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A behavioural study was conducted to determine whether three different types of attention play similar roles in vision and audition. An auditory analogue of Fan et al.'s (2002) Attention Network Test was developed and used in conjunction with the visual test to examine the attentional skills of 20 normal adults. Incongruent stimuli slowed responses relative to neutral stimuli in both vision and audition. This effect was of a similar magnitude in the two modalities, and consistent across subjects. However, while strong benefits were found from alerting and orienting cues in the visual modality, these effects were not found in the auditory modality. Possible reasons for the absence of auditory cueing effects could result either from our experimental methodology or from the differential mechanisms for spatial processing across modalities. Preliminary fMRI data investigating the neural basis of conflict resolution address the question of whether the comparable behavioural results across modalities reflect a single processing mechanism or separate mechanisms that exert a similar influence on behaviour.

Fan, J., McCandliss, B.D., Sommer, T., Raz, A., & Posner, M.I. (2002)
Testing the Efficiency and Independence of Attentional Networks. *Journal of Cognitive Neuroscience*, 14(3), 340-347

When Margaret Thatcher becomes Marilyn Monroe: How does our brain detect the difference?

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One route to understanding face recognition concerns the manner in which familiar faces are represented in the brain. In the current study, we asked whether familiar faces are represented along a continuum of physical characteristics, or represented categorically. We generated 36 continua of different levels of morphing between pairs of famous faces. When subjects were asked to name each morph, their responses suggested that perception was categorical. Using the fMR adaptation paradigm, we presented 13 subjects with sequences of two faces from the same continuum. The critical manipulation was whether the second face matched the first face in 1) both physical and identity terms, 2) identity terms but not physical terms, or 3) neither identity nor physical terms. Importantly, the second and third conditions involved the same shift along the physical morph continuum, differing only in whether they crossed the categorical boundary. Right fusiform gyrus and left inferior frontal sulcus showed greater adaptation when identity was repeated than when it changed. Right inferior occipital gyrus showed less adaptation when the physical

characteristics of the face changed. Interestingly, the level of familiarity of each face interacted with the sensitivity to identity changes in bilateral temporal poles. These findings suggest that familiar faces are represented in the brain in several forms, where posterior regions represent the physical characteristics of the face and more anterior regions represent faces based more on conceptual knowledge.

Observational learning of instrumental discriminations in pigeons

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A novel automated procedure for studying observational learning in pigeons is described which builds upon recent work by Dorrance and Zentall (2002). Observer pigeons were placed in a Perspex box from which they could see a conventional operant chamber, where a demonstrator pigeon was successfully performing an instrumental discrimination. For example, when a red light was illuminated pecking a manipulandum on the chamber's floor was reinforced by the delivery of grain, and when a green light was illuminated stepping on the same manipulandum was reinforced. These different responses were automatically recorded using software that measured the durations for which the hinged panel of the manipulandum was depressed; durations of less than 250 msec were designated pecks and those that were longer were designated steps. Scores generated using this software correlated well with scores obtained from video footage. In Experiment 1, following observation, observers were transferred to the operant chamber and received presentations of the red and green lights and were free to respond to the manipulandum, but were not reinforced for doing so. Observers were more likely to step (and to peck) during the light that they had observed the demonstrator stepping during (e.g., the green light) than during the other light (e.g., the red light). This finding suggests that the observers' behaviour was influenced by that of the demonstrators, but that in naïve pigeons there is an asymmetry between what is learnt during exposure about the two types of response. Hence in Experiment 2, the observers first acquired the conditional discrimination described above (e.g., red -> peck and green -> step) and then either observed a demonstrator successfully performing the same discrimination (group Same) or the reverse discrimination (red -> step and green -> peck; group Reverse). The observers were then tested in the same way as in Experiment 1. Observers from group Same continued to respond appropriately (e.g., pecking during the red stimulus and stepping during the green stimulus), whereas those in group Reverse were less likely to do so. These results replicate those of Dorrance and Zentall (2002) and pave the way for a more systematic analysis of learning by observation in pigeons.

Dorrance, B.R., & Zentall, T.R. (2002). Imitation of conditional discriminations in pigeons (*Columba livia*). *Journal of Comparative Psychology*, 166, 277-285.

The effect of hippocampal lesions on a structural discrimination: Dissociating learning systems

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In a series of experiments the role of the hippocampus in visual discriminations was examined. Rats were tested on concurrent discriminations of two-dimensional patterns. Testing was carried out in a watertank, where rats received reinforcement by escape to a platform that was located underneath the correct visual stimulus. Hippocampal lesions resulted in an impaired ability to solve an AB+ BA- structural discrimination when the absolute location of a stimulus was equally reinforced and non-reinforced and therefore, only when A was to the left of B was the configuration reinforced. To exclude alternative strategies for solving this task, rats were trained on two other concurrent discriminations, BC+ CB-, CA+ AC-. Surgeries were given after animals had acquired the task. Hippocampal lesioned rats were able to learn an elemental discrimination, although at a slower rate to that of control rats. To ascertain whether the structural learning deficit is due to impaired encoding of structural relationships, or due to the complexity of the task, the role of the hippocampus in configural learning paradigms needs to be further investigated. These results have implications for learning systems that may be responsible for the spatial learning deficit shown by hippocampal damaged animals.

Children's search behaviour in an automated foraging task

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Visual search paradigms have traditionally been used to study attentional processes in both adults and children. Links have also been drawn between mechanisms observed in visual search and those that contribute to searching in a real world environment (e.g. Klein & MacInnes, 1999). However, this has not been specifically tested with human subjects. Here we present data on a new paradigm that seeks to assess human search behaviour using an automated foraging apparatus. Participants (aged 70-105 months) searched for a hidden target amongst a randomised display of lights by activating a switch at each potential location. The cost of search was manipulated by requiring children to search with either their dominant or their non-dominant hand. When children searched with their non-dominant hand they made significantly more revisits to previously checked locations than they did when using their dominant hand. This suggests that when the motor response is more effortful children have less cognitive resources available to efficiently guide their search. Participants with a higher visuo-spatial working memory span performed the task more quickly and with fewer visits, demonstrating the role of spatial working memory in planning and executing an efficient search.

Klein, R. M. and MacInnes, W. J. (1999). Inhibition of return is a foraging facilitator in visual search. *Psychological Science*, 10, 346-352.

Afferent and efferent contributions to self-recognition

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We investigated the relative contributions of afferent and efferent information in self-recognition. Subjects experienced a passive extension of the right index finger, either as an effect of a movement of their own left hand, or imposed externally by the experimenter. Subjects viewed the effect of the action, as a visual display of the right hand. The visual feedback was manipulated so that subjects could see either their own right hand (subject condition) or someone else's right hand (experimenter condition) undergoing an equivalent passive extension of the index finger. Participants were asked to judge whether the right hand they saw was theirs or not. Self-recognition was significantly more accurate when participants were the authors of the action, even though there was a perfect matching between the proprioception and the visual feedback across conditions, and despite the fact that it was the effect and not the action *per se* that the subjects were watching. Efferent information therefore plays a key role in self-recognition, even when subjects judge the effect of an action on a spatially remote body part. Differences in the performance across conditions reflect the distinctive contribution of efferent information on action- and self-recognition.

fMRI-adaptation reveals dissociable neural representations of identity and expression in faces

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The distributed model of face processing proposes an anatomical dissociation between brain regions responsible for encoding invariant aspects of faces, such as identity, and those regions responsible for encoding changeable aspects of faces, such as facial expression. A problematic finding with regard to this model is that functional imaging studies using emotional faces consistently show greater activation in fusiform cortex to emotional relative to neutral faces. We explored the neural basis for face perception using a functional magnetic resonance imaging (fMRI) adaptation technique. Repeating the identity across a pair of faces led to reduced fMRI signal in fusiform cortex and posterior superior temporal sulcus (STS), whereas repeating the emotional expression across the face pair led to reduced signal in a more anterior region of STS. These results represent direct evidence in support of the distributed model, though highlighting a possible dissociation within STS between a posterior portion coding identity and a more anterior region coding emotional expression.

NOTES