



# OXFORD MEETING

13-15 April 2011

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A scientific meeting will be held at the Department of Experimental Psychology and St. John's College, University of Oxford on 13-15 April 2011. The local organiser is Kate Nation

### **Eighth Mid-Career Prize Lecture**

Thursday 14<sup>th</sup> April 6.00pm

Are there multiple memory systems? Tests of models of implicit and explicit memory

Professor David Shanks, University College London

### **Symposiums**

Thursday 14th April, 1.30pm – 5.00pm

Judgement and decision making

Organiser: Professor Koen Lamberts

Friday 15<sup>th</sup> April, 9am – 1pm

Morphological processing in visual word recognition

Organiser: Professor Kate Nation

### **Poster Session**

This will be held in conjunction with the drinks reception on Wednesday evening at 5.45pm. This will be held in Garden Quad Reception Room, St. John's College. Delegates may put up posters from 5pm and should take them down by the end of the session.

### **Platform Presentations**

Sessions will be held in Lecture Theatre B and C in the Department of Experimental Psychology, University of Oxford (South Parks Road, OX1 3UD). Both theatres have data projectors available for Powerpoint presentations. Presenters may provide their own laptops and connector leads, or bring USB keys for the on-site PC computers. Any queries about facilities in the theatres should be sent to the local organiser, Kate Nation ([kate.nation@psy.ox.ac.uk](mailto:kate.nation@psy.ox.ac.uk))

Coffee will be served in the Foyer area of Experimental Psychology.

The conference dinner will be at 7.15 p.m. at St. John's College. A booking form is enclosed.

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START OF PARALLEL SESSIONS

Session A

**Lecture Theatre B**

- 1.30            **Amélie Gourdon\* and Sarah R. Beck** (University of Birmingham)  
(Sponsor Dana Samson)  
Should the messenger be shot if something wrong happens? Judging  
responsibility of a speaker giving uncertain statements.
- 2.00            **Marie Juanchich\*, Miroslav Sirota\* and Christina Butler\***  
(Kingston Business School, University of Hertfordshire) (Sponsor  
Frederic Vallée-Tourangeau)  
Functions of linguistic risk quantifiers and related risk perception.
- 2.30            **Matthew Lim\* and Robert Rogers** (University of Oxford)  
Investigating the illusions of control in the dice-rolling behaviour of  
recreational gamblers.
- 3.00            **Miroslav Sirota\*, Lenka Kostovicova\*, Hanka Harencarova\* and  
Frederic Vallée-Tourangeau** (University of Hertfordshire, Comenius  
University, Kingston University)  
Mental representation of chances and natural frequencies in Bayesian  
reasoning.
- 3.30            TEA
- 4.00            **Gaëlle Villejoubert\*, Frederic Vallée-Tourangeau and Marlene  
Abadie\*** (Kingston University, University of Toulouse)  
Distributed Bayesian reasoning.
- 4.30            **Frederic Vallée-Tourangeau, Gaëlle Villejoubert\* and Anna  
Weller\*** (Kingston University)  
Distributed cognition and insight.
- 5.00            **Teresa McCormack, Victoria Simms\* and Tom Beckers\*** (Queen's  
University Belfast, University of Leuven)  
Cue competition effects in children's causal learning.
- 5.30            **A tribute to Professor Richard Gregory – Larry Weiskrantz**  
(Lecture Theatre B)
- 5.45-7.30      POSTERS AND DRINKS RECEPTION - Garden Quad Reception  
Room, St. John's College.

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START OF PARALLEL SESSIONS

*Session B*

**Lecture Theatre C**

- 1.30            **Deborah Talmi and Lucy M. McGarry\*** (University of Manchester, University of Toronto)  
Accounting for immediate emotional memory enhancement.
- 2.00            **Nathan Ridout\* and Saima Noreen\*** (Aston University, University of St Andrews) (Sponsor Luc Boutsen)  
Intentional forgetting of emotional words in induced and naturally occurring dysphoria.
- 2.30            **Deborah J. Wallis\*, Nathan Ridout\*, Yasmin Autwa\* and Jenna Sellis\*** (Loughborough University, Aston University) (Sponsor Helen Pattison)  
The influence of emotional intensity on facial emotion recognition in females with non-clinical disordered eating.
- 3.00            **Timothy J. Andrews, Jodie Davies-Thompson\* and Katherine Newling\*** (University of York)  
Image-invariant neural responses to familiar and unfamiliar faces.
- 3.30            TEA
- 4.00            **Rebecca Lawson and Lauren Edwards\*** (University of Liverpool)  
Looking in the direction of your hand helps to identify 2D pictures by touch but may not aid the haptic recognition of real, 3D objects.
- 4.30            **Katherine Roberts\* and Glyn Humphreys** (University of Birmingham)  
Action relations influence object perception.
- 5.00            **Elizabeth Lewis\*, Martin Farrell\* and Donna M. Lloyd** (University of Manchester)  
The missing finger: A method for eliciting phantom-like sensations in non-amputees.
- 5.30            **A tribute to Professor Richard Gregory – Larry Weiskrantz**  
(Lecture Theatre B)
- 5.45-7.30      POSTERS AND DRINKS RECEPTION - Garden Quad Reception Room, St. John's College.

*Session A***Lecture Theatre B**

- 9.00            **Dorothy V. M. Bishop, Mike Anderson, Corinne Reid\* and Allison M. Fox\*** (University of Oxford, University of Western Australia, Murdoch University)  
Auditory development between 7 and 11 years: An event-related potential (ERP) study.
- 9.30            **Alexandra Woodfield\* and Michael Akeroyd** (MRC Institute of Hearing Research)  
The effect of masker intelligibility on the rate at which speech identification improves with level.
- 10.00          **Jo S. H. Taylor\*, Kathleen Rastle and Matthew H. Davis** (MRC Cognition and Brain Sciences Unit, Newnham College, Royal Holloway University of London)  
Learning object names activates the visual word form area more than learning to read: Evidence from fMRI.
- 10.30          COFFEE
- 11.00          **Elizabeth Wonnacott\*** (University of Oxford) (Sponsor Kate Nation)  
Constraining generalization in artificial language learning.
- 11.30          **Kenny Smith\*, Andrew D. M. Smith\* and Richard A. Blythe\*** (University of Edinburgh, University of Stirling) (Sponsor Douglas Martin)  
Reconsidering human cross-situational learning capacities.
- 12.00          **Jennifer Rodd, Belen Lopez Cutrin\*, Alessandra Millar\* and Matthew Davis** (University College London, MRC Cognition and Brain Sciences Unit)  
Learning about the meanings of ambiguous words: The influences of recent and long-term experience.
- 12.30 – 1.30    LUNCH

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*Session B***Lecture Theatre C**

- 9.00           **Felice van 't Wout\***, **Stephen Monsell** and **Aureliu Lavric**  
(University of Exeter)  
Is it harder to switch among a larger set of tasks?
- 9.30           **James A. Grange\*** and **George Houghton\*** (Keele University,  
Bangor University) (Sponsor Dana Samson)  
Heightened conflict during cue encoding increases backward inhibition  
in task switching.
- 10.00          **Paloma Mari-Beffa** and **Alexander Kirkham\*** (Bangor University)  
How to tell the brain what to do: Interactions between language and  
cognitive control in Parkinson's Disease.
- 10.30          COFFEE
- 11.00          **Pat Rabbitt** and **Alison Fox\*** (University of Oxford, University of  
Western Australia)  
Correcting errors and judging how fast you have responded.
- 11.30          **Timothy L. Hodgson** and **Benjamin A. Parris\*** (University of  
Exeter, University of Bournemouth)  
The nature of the representation of abstract rules in the prefrontal  
cerebral cortex.
- 12.00          **Charles Spence**, **Alberto Gallace**, **Reeva Misra\*** and **Mary Ngo\***  
(University of Oxford, University of Milano-Bicocca, Wycombe  
Abbey School)  
Tasting shapes and words.
- 12.30 – 1.30   LUNCH

Session A**Lecture Theatre B**

**Symposium :** Judgement and decision making  
Organiser: Professor Koen Lamberts

- 1.30      **Peter Ayton, Meri Pesola\* and Lucy Freemantle\*** (City University London)  
Deal or no deal: Money, what might have been and human happiness.
- 2.00      **Richard J. Tunney and Timothy Mullett\*** (University of Nottingham)  
The value of experience: A double echo fMRI study of the modulation of value judgement by recent experience.
- 2.30      **Ben R. Newell and Tim Rakow** (University of New South Wales, University of Essex)  
On the morality of unconscious thought (research): When should we accept the null hypothesis?
- 3.00      TEA
- 3.30      **Andy J. Wills and Aureliu Lavric** (University of Exeter)  
Attention and the inverse base rate effect: Evidence from event-related potentials.
- 4.00      **Tim Rakow and Ben R. Newell** (University of Essex, University of New South Wales)  
Learning to explore and exploit in repeated risky choice.
- 4.30      **Nigel Harvey and Stian Reimers** (University College London)  
Using unaided judgment to make forecasts from time series: Sensitivity to autocorrelation.

**End of Symposium**

- 5.30      EPS Business Meeting – Members only (Lecture Theatre B)
- 6.00      **Mid Career Prize - Professor David Shanks** (University College London) Are there multiple memory systems? Tests of models of implicit and explicit memory.  
(Garden Quad Auditorium, St. John's College).

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*Session B***Lecture Theatre C**

- 1.30 **Courtenay Frazier Norbury and David J. Kelly\*** (Royal Holloway - University of London)  
Eye say! Language production processes in developmental disorders.
- 2.00 **Holly Joseph, Simon Liversedge\* and Kate Nation\*** (University of Oxford, University of Southampton)  
Differential effects of word frequency during reading in adults and children: Evidence from eye movements.
- 2.30 **Ian Mundy\* and Julia Carroll\*** (University of Warwick) (Sponsor Elizabeth Maylor)  
Representations of lexical stress in adults with developmental dyslexia.
- 3.00 TEA
- 3.30 **Marc Brysbaert, Emmanuel Keuleers\*, Paula Lacey\* and Kathleen Rastle** (Ghent University, Royal Holloway - University of London)  
The British Lexicon Project: A new database of lexical decision times for 28K monosyllabic and disyllabic English words.
- 4.00 **Andrew N. Kelly\*, Walter J. B. van Heuven, Nicola J. Pitchford\* and Timothy Ledgeway\*** (University of Nottingham)  
Lexicality effects in the masked priming same-different task.
- 4.30 **Davide Crepaldi\*, Lisa Saskia Arduino\* and Claudio Luzzatti\*** (University of Milano-Bicocca, LUMSA University) (Sponsor Kathy Rastle)  
Do 'deal' and 'dealer' really share their stem? Grammatical class and morphological priming in reading.
- 5.00 **Christos Pliatsikas\* and Theodoros Marinis\*** (University of Reading) (Sponsor Kathy Rastle)  
Using masked priming to investigate processing of past tense inflection in English as a first and a second language.
- 5.30 EPS Business Meeting – Members only (Lecture Theatre B)
- 6.00 **Mid Career Prize - Professor David Shanks** (University College London) Are there multiple memory systems? Tests of models of implicit and explicit memory.  
(Garden Quad Auditorium, St. John's College).

*Session A***Lecture Theatre B****Symposium:** Morphological processing in visual word recognition

Organiser: Professor Kate Nation

- 9.00            **Lynne G. Duncan\* and Elaine Gray\*** (University of Dundee)  
Form and meaning in learning to recognise morphologically complex words.
- 9.30            **Hei Won Ahn\*, Kate Nation and Elizabeth Wonnacott\*** (University of Oxford)  
Morphological decomposition in early visual word recognition: Differences between child and adult readers
- 10.00          **Kathy Rastle, Matthew H. Davis and Marjolein Merkx\*** (Royal Holloway - University of London, MRC Cognition & Brain Sciences Unit)  
The acquisition of morphological knowledge investigated through artificial language learning.
- 10.30          COFFEE
- 11.00          **Raymond Bertram\*** (University of Turku)  
One or two morphology worlds?
- 11.30          **Jonathan Grainger** (CNRS and Aix-Marseille University)  
Morphological constraints on orthographic processing: A dual-route perspective.
- 12.00          **Caroline M. Whiting\*, Yury Shtyrov\* and William D. Marslen-Wilson** (MRC Cognition and Brain Sciences Unit)  
Spatiotemporal dynamics of morphological processing in visual word recognition.
- 12.30          **Matt Davis** (MRC Cognition and Brain Sciences Unit)  
Discussant.

**End of Symposium**

End of meeting

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*Session B***Lecture Theatre C**

- 9.00            **Angela H Young\* and Johan Hulleman** (University of Hull)  
Eye movement patterns underlying robustness against item motion in visual search.
- 9.30            **Erin McWilliams\* and Johan Hulleman** (University of Hull)  
Velocity filtering is not used in visual search amongst moving items.
- 10.00          **Anne P. Hillstrom, Helen Scholey\*, Simon P. Liversedge and Valerie Benson** (University of Portsmouth, University of Southampton)  
Guidance of search through scenes based on scene gist and parafoveal and peripheral visual information.
- 10.30          COFFEE
- 11.00          **David J. Kelly\* and Courtenay Frazier Norbury** (Royal Holloway University of London)  
Aberrant eye movements in (some) children with autism spectrum disorders.
- 11.30          **Gaia Scerif\*, Andria Shimi\*, Duncan Astle\* and Anna C. Nobre\*** (University of Oxford, Royal Holloway - University of London) (Sponsor Charles Spence)  
How does attentional control constrain visual short-term memory?
- 12.00          **Magdalena Chechlacz\*, Pia Rotshtein\*, Peter Hansen\*, Shoumitro Deb\*, M. Jane Riddoch and Glyn W. Humphreys** (University of Birmingham)  
The central role of the temporo-parietal junction and the superior longitudinal fasciculus in visuospatial attention.

End of meeting

**Reserve List**

**Helena Matute, Ion Yarritu\* and Miguel A. Vadillo\*** (Deusto University)  
The role of action in the illusion of control.

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1. **Sumyah Alnajashi\*, Richard Allen, Charity Brown and Mark Mon William\*** (University of Leeds) (Sponsor Chris Moulin)  
Investigating the role of the verbal code in visual imagery.
  2. **Kirsten E. Bartlett\*, Anna R. Weighall\* and Jane L. Morgan** (Sheffield Hallam University)  
Are txt msg shortcuts processed like words? Evidence from masked priming.
  3. **Arpita Bose\*** (University of Reading) (Sponsor Philip Beaman)  
Quantitative and qualitative change in neologisms in two individuals with jargon aphasia.
  4. **Jon Brock, Blake Johnson\*, Melanie Reid\*, Samantha Bzishvili\*, Michael Hautus\* and Caroline Witton\*** (Macquarie University, University of Auckland, Aston University)  
Segregation of auditory objects in children with autism.
  5. **Julia Carroll\*, Laura Shapiro and Jonathan Solity\*** (University of Warwick, Aston University, KRM: Psychological and Educational Research Consultants) (Sponsor Elizabeth Maylor)  
What skills are impaired in dyslexia at the onset of reading? A prospective study of children with reading difficulties.
  6. **Richard Carvey\*, Katherine Fielding\* and Chang Hong Liu** (University of Hull)  
Detecting facial beauty in groups.
  7. **Steven Chance\*, Eva Sawyer\*, Patrick Hof\* and Timothy Crow** (University of Oxford, Mount Sinai School of Medicine, POWIC for SANE research)  
Fusiform cortex word and face regions: Lateralisation differences between chimpanzees and humans.
  8. **Yi-Chuan Chen\* and Charles Spence** (University of Oxford)  
Naturalistic sounds and spoken words modulate the categorization of visually-presented pictures at multiple levels of human information processing.
  9. **Anne-Sylvie Crisinel\* and Charles Spence** (University of Oxford)  
The sound of lemon: Crossmodal associations between chemosensory and auditory stimuli
  10. **Katherine Fielding\*, Richard Carvey\* and Chang Hong Liu** (University of Hull)  
Rapid assessment of overall mood in a crowd.
  11. **Kiri Granger\*, Jose Prados\* and Andrew Young** (University of Leicester)  
Selective attention in relation to schizotypy.
  12. **Georgiana Juravle\*, Heiner Deubel\* and Charles Spence** (University of Oxford, Ludwig-Maximilians University)  
Endogenous attention modulates tactile suppression during goal-directed movements.

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13. **Cigir Kalfaoglu\***, **Tom Stafford\*** and **Elizabeth Milne** (University of Sheffield)  
What mistakes reveal about accurate, skilled performance: An EEG study of touch-typing.
  14. **Alexander James Kirkham\*** and **Paloma Mari-Beffa** (Bangor University)  
The impact of vocal and auditory task-cues on goal-directed response capabilities.
  15. **Pawel J. Matusz\*** and **Martin Eimer** (Birkbeck College - University of London)  
Audiovisual enhancement of attentional capture.
  16. **Betty Mousikou\***, **Markéta Caravolas** and **Samantha Crewe\*** (Bangor University)  
Can recent computational models of reading account for children's nonword reading strategies?
  17. **Mary Kim Ngo\***, **Michelle Cadieux\***, **Scott Sinnett\***, **Salvador Soto-Faraco** and **Charles Spence**. (University of Oxford, McMaster University, University of Hawaii at Manoa, Universitat Pompeu Fabra)  
Reversing the Colavita visual dominance effect
  18. **Ruth S. Ogden** and **Luke A. Jones** (Liverpool John Moores University, University of Manchester)  
Speeding up the brain? Evidence from an attentional blink and a visual search task.
  19. **Jessie Ricketts**, **Julie Dockrell\***, **Olympia Palikara\***, **Tony Chapman\*** and **Geoff Lindsay\*** (University of Warwick, Institute of Education - University of London)  
Overlap between specific language impairment and autism spectrum disorders: Oral language and reading.
  20. **Anna Samara\*** and **Markéta Caravolas** (Bangor University)  
Statistical learning of novel graphotactic regularities: Evidence from an English-speaking adult population.
  21. **Andria Shimi\***, **Duncan Astle\***, **Anna C. Nobre\*** and **Gaia Scerif\*** (University of Oxford, Royal Holloway - University of London) (Sponsor Charles Spence)  
Developmental changes in attentional orienting to perceptually available stimuli and stimuli maintained in short-term memory.
  22. **Elena Svirko\*** (University of Oxford) (Sponsor Michel Treisman)  
The association between native grammar acquisition and arithmetic learning.
  23. **Thomas Walton\***, **Peter Redgrave\*** and **Tom Stafford\*** (University of Sheffield) (Sponsor Elizabeth Milne)  
The effect of delayed feedback on action learning: Findings from a new behavioural paradigm.

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Should the messenger be shot if something wrong happens? Judging responsibility of a speaker giving uncertain statements.

Amélie Gourdon and Sarah R. Beck  
University of Birmingham  
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In three experiments we tested how a speaker predicting uncertain events using verbal probabilities or percentages is held responsible according to which uncertainty format s/he used. In experiment 1, the speaker used percentages, positive verbal probabilities or negative verbal probabilities in eight scenarios. Speakers were held more responsible if they used negative verbal probabilities rather than percentages or positive verbal probabilities. Speakers were also held more responsible when the outcome was negative than when it was positive. In experiment 2, speakers used round percentages (e.g., 70%) or precise percentages (e.g., 71%) within the same scenarios. Only speakers who used round percentages were held more responsible after a negative outcome. Across experiments 1 and 2 participants' judgements ignored the predicted likelihood of the uncertain event. Experiment 3 replicated experiment 2 with an additional measure of the intention to recommend to another. Speakers were held more responsible for positive than for negative outcomes and when the event's likelihood was high rather than low. Intention to recommend was rated higher after positive outcomes than after negative outcomes; this difference was bigger when the event's likelihood was high. Level of precision had no effect on the responsibility judgements or on the intention to recommend

Functions of linguistic risk quantifiers and related risk perception

Marie Juanchich<sup>1</sup>, Miroslav Sirota<sup>2</sup> and Christina Butler<sup>1</sup>  
1. Kingston Business School  
2. University of Hertfordshire  
[M.Juanchich@kingston.ac.uk](mailto:M.Juanchich@kingston.ac.uk)

When someone is told that “it is *possible* that you will lose your investment”, the risk quantifier “possible” can be interpreted to communicate a degree of certainty (i.e., likelihood communication device) but also to tactfully announce the *probable* occurrence of losses (i.e., face-management device). When “possible” is interpreted as a face-management device it is perceived as communicating a higher risk than when interpreted as a likelihood communication device. We suggested that, additionally, risk quantifiers could be interpreted as device to avoid responsibility, to prevent the hearer to blame the speaker in case the outcome would not occur. In this case the recipient will systematically adjust the risk perception upward. In three studies we investigated how individuals interpreted the function of risk quantifiers and the effect of this interpretation on risk perception. Results showed that the responsibility avoidance interpretation was the most common to describe negative outcomes in both British and Slovak samples (study 1 and 2). Furthermore, this preference held in the case of the communication of a positive outcome (study 3). Most important, the three studies consistently showed that each device interpretation resulted in different risk perception. Results are discussed within the framework of the politeness theory.

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Investigating the illusions of control in the dice-rolling behaviour of recreational gamblers

Matthew Lim and Robert Rogers  
University of Oxford  
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Cognitive theories posit that mistaken beliefs about probability and skill in chance-based games can contribute to problem gambling (PG). One frequently-cited set of examples include reports that players will throw (true) dice with different amounts of force when attempting to obtain certain outcomes or win specific bets. However, this phenomenon has not been examined experimentally. Fifty participants, with varying degrees of gambling involvement, were screened for an absence of PG and psychological disorders. Participants rolled a simulated, computerised (but true) die in order to win gambles of varying buy-ins, bets and odds, for monetary prizes. All participants played more games as odds of success increased. Shorter die rolls were found in frequent gamblers and in gamblers who endorsed higher numbers of gambling-related cognitive distortions. However, longer rolls were observed when attempting to win higher value bets, when trying to 'hit' higher face values on the die, and in gamblers who reported strong desires to recover 'buy-ins'. Critically, die rolls were longer in regular gamblers with heightened risk-appetites. The results suggest that gamblers attempt to increase their chances of winning in 2 ways: (i) shortening rolls to maximise rate-of-play; (ii) lengthening rolls to obtain particular game outcomes when taking risks.

Mental representation of chances and natural frequencies in Bayesian reasoning

Miroslav Sirota<sup>1</sup>, Lenka Kostovicova<sup>2</sup>, Hanka Harencarova<sup>2</sup> and Frederic Vallée-Tourangeau<sup>3</sup>  
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2. Comenius University  
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It is well known that people perform better in Bayesian reasoning tasks when the statistical information is given as natural frequencies rather than probabilities. However, the reason why natural frequencies improve performance remains a source of debate (ecological rationality vs. nested set). The goal of the research reported here was to determine whether the nature of the mental representation of statistical information can explain performance in Bayesian tasks. In two experiments, the mental representations of numerical information (chances and natural frequencies) were identified by means of think-aloud protocols. Both experiments showed that participants performed better when the tasks were presented with natural frequencies rather than with chances. Furthermore, we found that chances could be mentally represented as frequencies. Most importantly, participants representing chances as natural frequencies performed better than those representing chances as a single event probability. To summarize, not only natural frequencies improved performance in reasoning task compared to chances, but also the representation of chances as frequencies improved performance. These findings support the hypothesis derived from the theory of ecological rationality and thus challenge the theory of nested sets.

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Distributed Bayesian reasoning

Gaëlle Villejoubert<sup>1</sup>, Frederic Vallée-Tourangeau<sup>1</sup> and Marlene Abadie<sup>2</sup>

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2. University of Toulouse

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A key requisite for solving Bayesian tasks is the construction of an adequate representation of the relation between a reference set and its subsets. Past research has established that individuals perform poorly on these tasks. Attempts to improve performance have been relatively successful in increasing success rates although a large majority of individuals still remain unable to find the correct solution. We report two experiments where we examined whether providing individuals with an opportunity to interact with an external representation of the problem data would help improving performance. Individuals were asked to solve three Bayesian probability problems. All participants were presented with a standard paper-and-pencil questionnaire. Half of them, however, were also given playing cards representing individual elements of the problem reference set as a potential aid for solving the task at hand. Results revealed that the mere provision of cards had a radical effect on performance, especially with single event probabilities. This suggests that commonly observed poor levels of performance might originate from the impoverished environments provided to solve these tasks rather than from individual cognitive limitations. Future research will need to establish the underlying processes and limiting conditions that warrant the impact of external representations on performance.

Distributed cognition and insight

Frederic Vallée-Tourangeau, Gaëlle Villejoubert and Anna Weller

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From a distributed cognitive system perspective, problem solving is an emergent product of the strategic and opportunistic manipulation of artefacts populating a physical space. In the present study, insight problem solving was investigated with the matchstick algebra problems developed by Knoblich, Ohlsson, Haider, and Rhenius (1999). These problems are false equations expressed with Roman numerals transformed into true equations by moving one matchstick. Participants were allocated to one of two groups. In the paper group, they examined a static two-dimensional representation of the false algebraic expression and told the experimenter which matchstick should be moved. In the interactive group, participants manipulated a concrete three-dimensional representation of the false equation. Success rates in the paper group for different problem types closely replicated the pattern of data reported in Knoblich et al. (1999). However, participants in the interactive group were significantly more likely to achieve insight. In the paper group insight was best predicted by performance on a timed numeracy test, whereas in the interactive group, it was best predicted by performance on a visuo-spatial reasoning test. Different types of resources and skills were involved in the different versions of the task. Implications for process models of problem solving are discussed.

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Knoblich, G., Ohlsson, S., Haider, H., & Rhenius, D. (1999). Constraint relaxation and chunk decomposition in insight problem solving. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 25, 1534-1555.

Cue competition effects in children's causal learning.

Teresa McCormack<sup>1</sup>, Victoria Simms<sup>1</sup> and Tom Beckers<sup>2</sup>

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Studies of cue competition effects examine whether causal judgments are sensitive to the presence of competing cues. Developmental studies of these effects have yielded mixed findings about the age at which such effects can be observed (McCormack et al., 2009; Sobel et al., 2004). Theories of causal learning that emphasize the role of explicit reasoning processes would predict that such effects emerge with development as children acquire the necessary reasoning abilities, whereas associative learning accounts might predict such effects to be present early in development. Reasoning accounts also predict that such effects should be modulated by the nature of training participants are given, specifically by showing participants whether or not two causally efficacious cues yield a larger outcome than one causally efficacious cue (i.e., whether causes are additive or not). The current study used a new child-friendly version of the 'allergy' paradigm, with 5-year-olds and 6-year-olds being asked to determine which foodstuffs caused a robot's tummy to light up. The pattern of cue competition effects changed developmentally, and only those of older children were affected by additivity training. These findings will be discussed in the context of competing theories of causal learning.

McCormack, T., Butterfill, S., Hoerl, C., & Burns, P. (2009). Cue competition effects and young children's causal and counterfactual reasoning. *Developmental Psychology*, 45, 1563-1575.

Sobel, D. M., Tenenbaum, J. B., & Gopnik, A. (2004). Children's causal inferences from indirect evidence: Backwards blocking and Bayesian reasoning in preschoolers. *Cognitive Science*, 28, 303-333.

Accounting for immediate emotional memory enhancement

Deborah Talmi<sup>1</sup> and Lucy M. McGarry<sup>2</sup>

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2. University of Toronto

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Memory for emotional events is usually very good even when tested shortly after study, before the influence of emotional arousal on memory consolidation alters memory. Immediate emotionally-enhanced memory may stem from the influence of emotion on the cognitive processes at encoding and retrieval. Although emotional stimuli attract preferential attention, the contribution of attention to emotionally-enhanced memory has not been conclusively demonstrated. In two experiments, participants encoded negative-arousing and neutral pictures. In Experiment 1, under divided-attention conditions,

negative pictures were better attended and recalled even when they were matched with neutral pictures on semantic relatedness and distinctiveness, and attention at encoding predicted subsequent emotionally-enhanced memory. The memory advantage for emotional stimuli was abolished when attention to emotional and neutral stimuli was also matched, under full-attention in Experiment 1 and under divided-attention in Experiment 2. These findings suggest that attention is necessary to account for immediate emotionally-enhanced memory and that attention, organization and distinctiveness provide a sufficient account for this effect.

#### Intentional forgetting of emotional words in induced and naturally occurring dysphoria

Nathan Ridout<sup>1</sup> and Saima Noreen<sup>2</sup>

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This study examined intentional forgetting in experimentally induced and naturally occurring dysphoria. Experiment 1: Fifty, never depressed participants learned 36 adjective-noun pairs and then practiced responding with the targets to some cues and withholding their responses to others. Subsequently, participants were asked to recall targets to all cues. Following (positive or negative) mood induction (MI) they were tested on a parallel version of the forgetting task. Prior to MI, both groups exhibited normal forgetting. Post MI, participants in the positive group successfully suppressed negative, but not positive, targets. The negative group exhibited impaired forgetting and actually demonstrated enhanced memory for suppressed negative targets. Importantly, repeated attempts at suppressing negative words resulted in greater recall of these items. Experiment 2: forty dysphoric participants (DP) and forty non-dysphoric (NDP) were assessed on the forgetting task from experiment 1 and a working memory (WM) task (Operation Span). Regardless of valence, NDP demonstrated intact forgetting, whereas DP exhibited impaired suppression and actually demonstrated enhanced memory for suppressed words. As with the negative MI group, repeated attempts by the DP at suppression led to enhanced recall. Within the dysphoric group only, poor WM was associated with greater recall of to-be-forgotten words.

#### The influence of emotional intensity on facial emotion recognition in females with non-clinical disordered eating

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The aim of the study was to investigate the effect of emotional intensity on facial emotion recognition (FER) in participants with subclinical disordered eating. Eighty females were assigned to one of two groups based on their scores on the Eating Disorders Inventory (EDI). This produced 40 high scorers (scoring 18+) and 40 low scorers (17 or less). Participants were presented with a series of faces, each featuring one of five emotional expressions (happiness, sadness, fear, anger & disgust) at one of four emotional intensities (50%, 75%, 100% & 125%), and were asked to identify the emotion

portrayed. They also completed self-report measures of mood (Hospital Anxiety & Depression Scale; HADS) and the personality trait, alexithymia (Toronto Alexithymia Scale; TAS-20). Results revealed that the high EDI group exhibited impaired FER, with particular deficits in fear and anger. Fear recognition was related to scores on the depression subscale of the HADS, whereas anger recognition was related to scores on the “*drive for thinness*” subscale of the EDI. The FER deficit exhibited by the high EDI group was particularly evident for expressions at lower emotional intensities. The pattern of FER errors was also analysed. The implications of these FER deficits are discussed.

#### Image-invariant neural responses to familiar and unfamiliar faces

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The ability to recognize familiar faces across different viewing conditions contrasts with the inherent difficulty in the perception of unfamiliar faces. We used a fMR-adaptation paradigm to ask whether this difference might be reflected by an image-invariant neural representation for familiar faces and an image-dependent representation for unfamiliar faces. In the first experiment, participants viewed blocks of 8 face images with the same identity. There were 4 conditions: (1) 8 repetitions of the same image, (2) 4 repetitions of 2 different images, (3) 2 repetitions of 4 different images, (4) 8 different images. We found a gradual release from adaptation in face-selective regions as the number of different face images within a block increased. In the second experiment, the same design was used, but the images were taken from different identities. In this instance, there was a complete release from adaptation when different images were presented. Paradoxically, the pattern of response to familiar faces was very similar to the pattern observed for unfamiliar faces. This suggests that differences in the perception of familiar and unfamiliar faces may not depend on varying levels of image invariance within face-selective regions of the human brain.

#### Looking in the direction of your hand helps to identify 2D pictures by touch but may not aid the haptic recognition of real, 3D objects

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Normally, object exploration by touch benefits from simultaneous visual information. If shape processing by vision and active touch (haptics) is interdependent, does uninformative vision improve haptic shape identification? Scocchia, Stucchi and Loomis (2009) found that 11% more raised line pictures of familiar objects were recognised if people looked towards the pictures as they felt them, although they could not see their hand or the picture. In Experiment 1, we replicated their finding for 2D pictures (14% advantage for looking towards the stimuli compared to looking 90° away) and extended it to 3D, small-scale models of familiar objects (11%). However, this benefit was reduced (to 2% and 5%) if the hand did not cross the midline. In Experiment 2, we tested haptic recognition of real objects placed in front, beside or behind the participant, who always looked forward. There was no benefit for recognising objects in

the normal, front position. Thus spatially congruent but uninformative vision may only provide substantial help to 2D and 3D haptic object recognition when the hand crosses the body midline and in the absence of non-shape cues to identity, such as texture. These results suggest that haptic object recognition is not usually mediated directly by vision.

Scocchia, L., Stucchi, N., & Loomis, J. M. (2009). The influence of facing direction on the haptic identification of two-dimensional raised pictures. *Perception*, 606-612.

#### Action relations influence object perception.

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Possibilities for action influence the way in which we perceive and act upon the world. Individual objects ‘afford’ actions associated with their use, producing activation in visuomotor regions and facilitating compatible responses. In addition to this visuomotor response, there is also evidence that object affordances influence perception. Patients with extinction are better able to identify pairs of objects when they are positioned to interact with one another (e.g. a jug tilted towards a glass), suggesting that interacting objects are perceptually grouped. We investigated whether the perceptual response to action-related objects is mediated by a visuomotor response. The results indicate two separate effects of positioning objects for action: a visuomotor response which is influenced by the strength of the object affordance (e.g. the position of objects relative to each other and to the viewer’s dominant hand); and a perceptual response which is influenced by the action relationship between the objects (e.g. whether they could plausibly be used together in an action). There was no evidence that the perceptual response was mediated by the visuomotor response. Neuroimaging data support this finding, showing increased activation to interacting (versus non-interacting) objects in ventral-stream regions (LOC and fusiform gyrus) but not in dorsal-stream visuomotor areas.

#### The missing finger: A method for eliciting phantom-like sensations in non-amputees

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Following the amputation of a limb, many amputees report that they can still vividly perceive its presence despite conscious knowledge that it is not physically there. Here, we present a method for eliciting phantom-like experiences in non-amputees using a variation of the rubber hand illusion in which a finger has been removed from the rubber hand. An interpretative phenomenological analysis revealed that the structure of this experience shares a wide range of sensory attributes with subjective reports of phantom limb experience. For example, when the space where the fourth finger should have been on the rubber hand was stroked, 94% of participants reported the vivid presence of a finger that they could not see and 62% reported additional sensory qualities such as size alterations, tingling, and feeling texture through the missing finger. However, even though 32% of participants found the experience to be mildly aversive, none

reported a painful experience. Using this method we can interrogate the embodiment system underlying phantom limb phenomena, independent of the damage caused by amputation, and show how factors such as the environment contributes to the continued presence of the phantom limb.

#### Auditory development between 7 and 11 years: An event-related potential (ERP) study

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For many years it was thought that the auditory system reached maturity in the first few years of life. Although auditory detection and discrimination are not always adult-like in children, this seemed attributable to problems with task demands. More recent imaging and neuropathological studies, however, suggest that brain development continues into adolescence. We studied auditory development using auditory event-related potentials (ERPs) elicited by tones in 105 children on two occasions two years apart. Just over half of the children were 7 years initially and 9 years at follow-up, whereas the remainder were 9 years initially and 11 years at follow-up. We used conventional analysis of peaks in the auditory ERP, independent component analysis, and time-frequency analysis. We demonstrated maturational changes in the auditory ERP between 7 and 11 years, both using conventional peak measurements, and time-frequency analysis. The developmental trajectory was different for temporal vs. fronto-central sites, which mapped onto independent components with distinct dipole sources. Temporal sites showed lateralisation of responses and no increase of low-frequency phase-resetting with age, whereas responses recorded from fronto-central sites were not lateralised and showed progressive change with age. These data suggest that different regions of secondary auditory cortex have different developmental trajectories.

#### The effect of masker intelligibility on the rate at which speech identification improves with level

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Understanding speech in noise can be difficult for many listeners, especially those with a hearing impairment. While intelligibility can be improved by amplifying the target speech, the magnitude of this improvement tends to be greater in noise backgrounds than in speech backgrounds. The aim of this study was to investigate whether the presence of intelligible content in the masking sound is, at least in part, responsible for this difference. This was tested using vocoded speech maskers whose intelligibility could be smoothly varied from completely intelligible to completely unintelligible. Twenty-four listeners heard target sentences presented in either intelligible or unintelligible maskers at a range of target-to-masker ratios. Listeners were asked to identify key words from the target sentences and from this data 7-point psychometric functions were measured. The

rate at which intelligibility improved with target level was found to be shallower in the intelligible maskers (4.9%/dB), than in the unintelligible maskers (6.0%/dB). An analysis of the stimuli, however, suggests that this difference may reflect differences in amplitude modulations rather than the intended intelligibility manipulation. It was noted that attentional factors were also likely to be moderating performance in the task. Current research is considering these effects.

### Learning object names activates the visual word form area more than learning to read: Evidence from fMRI

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Dehaene and colleagues (2002) propose that left fusiform gyrus (LFG) is specialised for representing visual word forms. Conversely, Price and Devlin (2003) argue that LFG processes both visual objects and words, attributing word-specific responses to task modulations. We combine an artificial language paradigm with fMRI to examine ventral-temporal specialisation during novel word and object learning. This maximises task differences; words must be decoded using systematic spelling-sound mappings whereas objects must be arbitrarily associated with their names. Twenty healthy adults learned new names for 24 novel objects and to read 24 new words written in novel symbols, whilst in an MRI scanner. Learning involved interleaved training (paired visual-spoken forms) and testing (read words/name objects) phases. Participants learned the trained items (words-69%, objects-68% correct) and generalized their orthographic knowledge to untrained words (62% correct). Cross-modal associative learning of visual-spoken form pairings activated bilateral superior parietal cortices, fusiform gyri and left hippocampus ( $p < .01$  whole-brain corrected). LFG was more active when learning object-name associations than when learning to read words. The reverse contrast revealed activation in bilateral superior parietal cortices. LFG was less involved in learning a new orthography than in learning new object-label associations, challenging the idea that this region is specialised for word reading.

Dehaene, S., Le Clec'H, G., Poline, J.-B., Le Bihan, D., & Cohen, L. (2002). The visual word form area: A prelexical representation of visual words in the fusiform gyrus. *NeuroReport*, *13*, 321-325.

Price, C. J., & Devlin, J. T. (2003). The myth of the visual word form area. *Neuroimage*, *19*, 473-481.

### Constraining generalization in artificial language learning

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Successful language acquisition involves generalization, but learners must balance this against the acquisition of lexical constraints. For example, native English speakers know that certain noun-adjective combinations are impermissible (e.g. *strong winds, high winds, strong breezes, \*high breezes*). Another example is the restrictions imposed by verb sub-categorization, (e.g. *I gave/sent/threw the ball to him; I gave/sent/threw him the ball; I donated/carried/pushed the ball to him; \* I donated/carried/pushed him the ball*). How do children learn these exceptions? (Baker, 1979). The current work addressed this question via a series of Artificial Language Learning experiments with 6 year olds. The results demonstrated that children are sensitive to distributional statistics in their input language and use this information to make inferences about the extent to which generalization is appropriate (cf. Braine, 1971; Wonnacott, Newport & Tanenhaus, 2008). In particular, there was evidence that children assessed whether the choice of linguistic structures depended upon the particular words with which they had occurred, and this affected their learning of arbitrary exceptions. The results are interpreted in terms of a rational Bayesian perspective on statistical learning (Perfors, Tenenbaum & Wonnacott, 2010).

Baker, C. L. (1979). Syntactic theory and the projection problem. *Linguistic Inquiry*, 10, 533-581.

Braine, M., D.S. (1971). On two types of models of the internalization of grammars. In D. I. Slobin (Ed.), *The ontogenesis of grammar: A theoretical symposium*. (pp. 153-186), New York: Academic Press.

Perfors A, Tenenbaum JB, Wonnacott E. (2010) Variability, negative evidence, and the acquisition of verb argument constructions. *Journal of Child Language* 37, 607-642.

Wonnacott, E., Newport, E.L., & Tanenhaus, M.K. (2008). Acquiring and processing verb argument structure: Distributional learning in a miniature language. *Cognitive Psychology*, 56, 165-209.

### Reconsidering human cross-situational learning capacities

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Cross-situational learning allows word learning despite exposure-by-exposure uncertainty about a word's meaning, by combining information across exposures to a word. A number of experimental studies demonstrate that humans are capable of cross-situational learning. The strongest claims are made by Yu and Smith (2007), who provide experimental data suggesting that adult humans are capable of using cross-situational learning to learn the meanings of multiple words 1) rapidly, 2) simultaneously and 3) despite considerable uncertainty at each exposure. We identify flaws in their testing regime and choice of null hypothesis which throw their conclusions into doubt. Yu & Smith adopt a test regime which does not enable them to differentiate between genuine cross-situational learning and learning from a single (partially-remembered) exposure; furthermore, they compare performance against a baseline of memoryless 'learning', whereas learners must outstrip single-exposure learning in order to demonstrate cross-

situational learning. We conduct three experiments which remedy these flaws. Our data from support a more limited view of the ability of adults to do cross-situational learning: cross-situational learning under high levels of referential uncertainty is only possible if both rapidity and simultaneity are sacrificed. This suggests that the role of word-learning heuristics in eliminating referential uncertainty should not be underestimated.

Yu, C., Smith, L. B. (2007). Rapid word learning under uncertainty via cross-situational statistics. *Psychological Science*, 18, 414–420.

### Learning about the meanings of ambiguous words: The influences of recent and long-term experience

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Comprehension of semantically ambiguous words (e.g., “bark”) is strongly influenced by our long-term knowledge about the relative frequencies of their meanings, such that listeners are biased towards retrieving the most frequent meaning. These biases are often assumed to reflect a highly stable property of an individual’s long-term lexical-semantic representations. We present two experiments that support an alternative view and suggest that these biases reflect a highly flexible aspect of lexical representations. We show that a single encounter with an ambiguous word in context is sufficient to bias a listener’s interpretation of that word after an average delay of more than 20 minutes. The magnitude of this meaning priming effect is not affected by changes to the speakers’ identity between initial exposure and later testing. This result provides evidence for a top-down influence of sentential context in retuning abstract lexical/semantic representations, and illustrates how semantic retuning can improve the comprehension of ambiguous speech input.

### Is it harder to switch among a larger set of tasks?

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Task-cueing experiments find slower responses and more errors when the task changes. This “switch cost” is thought to reflect task-set reconfiguration: a process that includes activating/suppressing S-R rules, or retrieving them into procedural working memory. In other domains retrieval from memory is influenced by the number of alternatives (e.g. the fan effect, Hick’s law). Is this true of task-set retrieval? Previous studies varying the number of tasks have yielded inconclusive results, but have confounded the number of tasks with their frequency and recency of usage. We required participants to switch among three or five tasks involving classification of a perceptual attribute of an object (Exp 1) or a lexical/semantic attribute of a word (Exp 2), with a 100 or 1300 ms cue-stimulus interval. For two of the tasks (“probe tasks”) recency and frequency was identical in the three- and five-task conditions. Overall, there appeared to

be an extra task-switch cost in the five-task condition with no time for preparation. But for the recency-controlled probe tasks, there was no effect of number of tasks on the switch cost, suggesting that retrieval time for task-sets is not influenced by the number of alternatives (but is determined by recency or frequency of usage).

### Heightened conflict during cue encoding increases backward inhibition in task switching

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Backward inhibition (BI) in task switching is a performance cost that occurs when an individual returns to a task after 1 (vs. more than 1) intervening trial, and it may reflect the inhibition of task-set components during switching. In 2 experiments, we support the theory that inhibition can target cue-based preparatory stages of a task. Participants performed a cued target-localization task that had been previously shown to produce BI. In Experiment 1, reassignment of arbitrary cue-target pairings midway through the experiment doubled the size of BI, though cue, target, and response sets remained unchanged. In Experiment 2, we demonstrated that the effect depends on re-pairing members of the same cue and target sets. The results are attributed to heightened conflict (and hence greater inhibition) during cue-target translation when a previously learned cue-target mapping is remapped.

### How to tell the brain what to do: Interactions between language and cognitive control in Parkinson's disease.

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The aim of this study is to investigate the interaction between language and cognitive control and its neuropsychological substrate. To do so we compared Hemi-Parkinson patients and Aged Matched controls in a task switching paradigm using words as instructional cues. During the experiment, participants had to respond to either the colour or the shape of a figure presented on the centre of the screen. We compared performance in pure task blocks with that in repeat and switch trials from a mixed block. In order to explore the role of language on both mixing and switch costs, we asked all the participants to either read aloud the instructional word as presented (i.e., “Blue/Red”, “Colour/Circle”), or to articulate an irrelevant utterance during the trial (i.e., “Blah, Blah,...”). The results showed that language strongly interacted with the mixing cost, but not with the switch cost. More importantly, right-hemisphere PD benefited from reading aloud more than the controls, while left-hemisphere PD showed marked deficits when reading aloud. The results support a functional connectivity between Broca’s area and the Basal Ganglia that is relevant for the use of articulatory working memory on task control.

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Correcting errors and judging how fast you have responded.

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We humans can very rapidly and accurately detect or correct nearly all of the errors that we make during continuous tasks. One hypothesis has been that most errors are much faster than average correct responses and so are, plausibly, premature responses after which accumulation of information continues, allowing recognition, and very rapid production of the response that should have been made. A corollary of this hypothesis is that the ability to detect and correct fast errors also allows us to become aware of the limits to accurate performance and so to regulate our response speed within safe limits. This explanation does not comfortably account for commission and correction of “slow errors” that are  $\geq 1.5sd$  longer than most correct responses. The issue as to whether or not such slow errors can also be corrected seems not to have been examined, possibly because slow errors are so rare that it is necessary to collect many hundreds of responses before any are observed. If slow errors can also be detected the corollary hypothesis that we regulate our speed mainly, or entirely by recognizing and avoiding fast errors also becomes questionable since, evidently, slow errors must be recognized only by their inaccuracy rather than by the unusually short time taken to make them. A first series of experiments found that slow errors, though rare, can be corrected as reliably as fast errors when they occur. Examination of responses immediately preceding and following these slow errors, suggest a framework for better models. Finally, two series of experiments directly examine, we believe for the first time, people’s actual accuracy thresholds for discrimination of differences in the speeds of successive responses response that they make during continuous tasks.

The nature of the representation of abstract rules in the prefrontal cerebral cortex

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Abstract behavioural rules are often considered as existing independent of sensory or motor representations in a manner similar to linguistic and semantic information, but how such supra-modal rules might be represented in the human brain is not clear. The current study investigated this issue using a rule switching task which participants performed using two effector modalities. In some blocks participants responded with left / right button presses, whilst in other blocks leftward / rightward saccades were required. On each trial a cue instructed a left or right response based on a rule which remained the same or reversed from trial to trial. Group level analyses indicated activity in several prefrontal and parietal regions which was independent of effector modality, indicative of processing rules supra-modally. However, at the individual subject level, participants showed activations within the prefrontal cortex that varied with response type. More surprisingly, in the majority of participants voxels were also observed which coded specific rule sets. It is suggested that this pattern of organisation explains how populations of neurons within the prefrontal cortex could

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simultaneously encode rules both supra-modally and in terms of specific stimulus-response associations.

### Tasting shapes and words

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We report a series of quick and simple demonstrations illustrating the reliable crossmodal correspondences that exist between food and drink items and both visually-presented shapes and nonsense words. The foodstuffs tested included still and sparkling water, Brie cheese and cranberry juice, and various kinds of chocolate. Participants were given paper-based line scales, anchored at either end with a nonsense word or simple outline shape. They were instructed to taste the foodstuffs and to indicate whether their perception of the flavour matched more one or other of the items anchoring the scales, and then mark the appropriate point on the scale. The results highlight the fact that certain of these foodstuffs are better associated with angular shapes and high-pitched meaningless words, such as ‘kiki’ and ‘takete’, whose pronunciation requires sharp inflection of the mouth. By contrast, other foodstuffs were more strongly associated with rounded shapes and softer sounding, lower-pitched pseudo-words, such as ‘bouba’ and ‘maluma’. These results, which build on the classic literature on ‘sound symbolism’, have both theoretical and applied implications: They both demonstrate that the phenomenon of sound symbolism extends beyond the visual modality, and may also provide helpful guidelines for companies when designing novel brand names and graphics.

### **Symposium: Judgement and decision making**

**Organiser: Professor Koen Lamberts**

### Deal or no deal: Money, what might have been and human happiness

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That people’s utility for money depends on its relation to a malleable reference point receives support from diverse empirical sources (cf. Tversky and Kahneman, 1992; Boyce et al, 2010). Here we explored how the happiness of TV game show contestants varies as a function of monetary winnings - and money that contestants discover they would have won if they had chosen differently. The TV game show “Deal or No Deal” permits study of the effects on emotions of risky outcomes and their alternatives from simple risky decisions involving real large stakes. Three studies evaluated the rated and reported happiness of real contestants. Unsurprisingly, the happiness of contestants was influenced by the amounts of money won. However the happiness of contestants was also strongly moderated by the magnitude of the discrepancy between winnings and the amount they would have won had they chosen differently. Different kinds of

counterfactual outcomes had different effects: spurned riskless winnings that were declined in a failed gamble for higher winnings hurt more than wins missed when contestants accepted a riskless amount rather than gamble for more. Our results confirm the notion that the impact of money on people's happiness is not absolute but context dependent.

Boyce, C.J., Brown, G. D. A. & Moore, S. C. (2010). Money and happiness: rank of income, not income, affects life satisfaction. *Psychological Science*, 21, 471-475.

Tversky, A. and Kahneman, D. (1992). Advances in Prospect Theory: Cumulative Representation of Uncertainty. *Journal of Risk and Uncertainty*, 5, 297-323.

The value of experience: A double echo fMRI study of the modulation of value judgement by recent experience.

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New models of decision making emphasize the effect of recent experience upon value judgements. Mounting behavioural evidence supports this assumption, yet there have been few studies employing imaging techniques to identify underlying neural representations of these effects. We report an fMRI study investigating the neural response to objectively identical monetary rewards when presented in blocks with either comparatively higher or lower average reward value. Results show that BOLD response for the critical overlap value was not modulated by recent experiences. However, initial analyses suggest an activation in the Posterior Cingulate Cortex where BOLD response is higher during high value blocks. This activation is not modulated by the absolute values of individual stimuli on a trial by trial basis, which suggests a representation of long term average value which changes with the environment.

On the morality of unconscious thought (research): When should we accept the null hypothesis?

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Unconscious thought is described as task-relevant cognitive processing that occurs whilst conscious attention is directed elsewhere. It is typically operationalized by interpolating information acquisition and responding with a period of distraction (e.g., solving anagrams). Claims for the benefits of unconscious thought, relative to a period of conscious deliberation, are multifarious, and include proposed improvements in multi-attribute choice, judgment, forecasting and creativity. We first focus on one claim – that unconscious thought leads to more utilitarian decisions in the domain of moral decision making – and find no supporting evidence. We then review several studies (15+) from our labs, across a range of tasks, none of which found significant advantages for unconscious thought. Rather than dismissing these null findings as inconclusive, we re-

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analyse these data using Bayesian t-tests (Rouder et al., 2009), which, unlike traditional significance tests, compute the probabilities of the null and (a distribution of plausible) alternate hypotheses given the data. This analysis revealed that, without exception, the odds for the null always exceeded those for the alternate (typically by a factor of 2) suggesting that a period of distraction has no noticeable improving effect on a range of decision making tasks. However, the evidence for the null also implies little benefit for deliberation – a (perhaps) concerning finding that this talk will address.

Rouder, J.N., Speckman, P.L., Sun, D., Morey, R.D, & Iverson, G. (2009). Bayesian t-tests for accepting and rejecting the null hypothesis. *Psychonomic Bulletin & Review*, 16, 225-237.

### Attention and the inverse base rate effect: Evidence from event-related potentials.

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In the inverse base rate effect, participants are trained that cue compound AB predicts a commonly occurring outcome, whereas cue compound AC predicts a rarer outcome. Participants subsequently state that compound BC predicts the rarer outcome— a response opposite to what one might expect, given the relative frequency of the outcomes and the fact that both B and C are perfect predictors of their respective outcomes. We report an electrophysiological investigation of the inverse base rate effect that supports an explanation in terms of early attentional differentiation driven by differences in prediction error.

### Learning to explore and exploit in repeated risky choice

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We present data from two experimental paradigms each involving repeated choice between two risky options. In the binary prediction task (probability learning paradigm), participants bet on which one of two options will “win” on a given trial and earn (lose) money for correct (incorrect) predictions. We used two variants of this task: one in which participants also knew the relevant win/loss probabilities for each option; another in which participants could only learn through observing outcomes on trials in which they elected to make no prediction. A separate series of experiments used the repeated-decisions-from-feedback paradigm, which is analogous to repeatedly selecting to play one of two slot machines. We used a version of this task in which the probabilities of winning/losing could alter gradually as the trials progressed, so that the better (higher average value) option switched over time. We review these studies highlighting the factors that affect optimal choice and optimal information acquisition. Together the findings suggests that although participants learn to choose effectively in these tasks, factors which might be expected to improve choice (such as the provision of information about payoff distributions or a history of previous choices) can have deleterious effects.

Moreover, other factors that are normatively irrelevant sometimes affect performance. The implications of these findings for models of how people learn to explore and exploit risky choice environments will be discussed.

Using unaided judgment to make forecasts from time series: Sensitivity to autocorrelation.

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Many natural time series are autocorrelated: observations at time  $t+1$  are correlated with the observations at time  $t$ . We investigated whether people incorporate autocorrelation information into their judgmental forecasts from time series data? In Experiment 1, participants saw 12 trials in which autocorrelation varied within-subjects. Participants showed some sensitivity to the degree of autocorrelation, but also implicitly assumed autocorrelation in uncorrelated time series. Experiment 2 used a one-shot single trial completely between-subjects design and found similar results. Experiment 3 investigated how between-trials context influenced forecasting. Results suggest that, although people are sensitive to autocorrelation when making forecasts, they are not sensitive enough: they make predictions for highly autocorrelated time series that are under-correlated with the last observation and predictions for an independent time series that are positively correlated with the last observation. Implications for heuristic and 'Bayesian' models of the cognitive processes underlying judgmental forecasting are discussed.

**End of symposium**

Eye say! Language production processes in developmental disorders

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Language difficulties are common across developmental disorders. Until recently, we have only been able to study the end product of language rather than the process itself; consequently, we are uncertain whether similar language output reflects similar underlying processes. The present study investigated this issue by simultaneously recording verbal output and eye-movements while children describe pictured events. We asked whether language deficits reflect differences in event apprehension or difficulties formulating sentences. Children completed (a) picture description, and (b) patient detection tasks, with (b) requiring minimal linguistic responses (cf. Griffin & Bock 2000). Participants included children with language impairment (LI); autism language impairment (ALI), autism language normal (ALN) and typical development (TD). We predicted that (a) would be more challenging for children with LI, because of formulation problems, whereas (b) would be more challenging for children with ALI/ALN, due to difficulties extracting gist information. Despite comparable levels of response accuracy across language-matched groups, children with ALI and ALN showed markedly different eye-movement patterns, often focusing on only one aspect of the scene and poor co-

ordination of eye-movements with speech. Children with LI showed typical eye-movement patterns, but these were significantly delayed in both tasks. This suggests that rather than event apprehension guiding production processes, language abilities may be crucial to understanding visual events.

Griffin, Z. & Bock, K. (2000) What the eyes say about speaking. *Psychological Science*, 11, 274-279.

Differential effects of word frequency during reading in adults and children: Evidence from eye movements

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While word frequency effects are well-documented in adult readers (Inhoff, 1984; Rayner, 1977), these effects are more controversial in children (Blythe et al., 2006; 2009; Huestegge et al., 2009; Hyönä & Olson, 1995). In two experiments, children's and adults' eye movements were monitored as they read sentences containing high and low frequency words as indexed by counts from either child or adult corpora. Target words were also controlled for Age of Acquisition. Results showed that adults exhibited reliable frequency effects using adult, but not child, norms; while children showed reliable effects using child, but not adult, norms. These results show that while word frequency is a fundamental characteristic in the organization of the lexicon for children as well as adults, exposure-based learning fundamentally shapes the developing lexicon such that frequency representations change over time. Furthermore, the data show that the frequency with which a word is encountered, independent of the age it was acquired, has a direct impact on the time needed to lexically identify a word. Finally, word frequency counts derived from adult texts are not suitable for use with developing populations (and vice-versa).

Blythe, H. I., Liversedge, S. P., Joseph, H. S. S. L., White, S. J., Findlay, J. M., & Rayner, K. (2006). The binocular co-ordination of eye movements during reading in children and adults. *Vision Research*, 46(22), 3898-3908.

Blythe, H. I., Liversedge, S. P., Joseph, H. S. S. L., White, S. J., & Rayner, K. (2009). The uptake of visual information during fixations in reading in children and adults. *Vision Research*, 49(12), 1583-1591.

Huestegge, L., Radach, R., Corbic, D., & Huestegge, S. M. (2009). Oculomotor and linguistic determinants of reading development: A longitudinal study. *Vision Research*, 49(24), 2948-2959.

Hyönä, J., & Olson, R. K. (1995). Eye fixation patterns among dyslexic and normal readers: Effects of word-length and word-frequency. *Journal of Experimental Psychology: Learning Memory and Cognition*, 21(6), 1430-1440.

Inhoff, A. W. (1984). Two stages of word processing during eye fixations in the reading of prose. *Journal of Verbal Learning and Verbal Behavior*, 23, 612-624

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Rayner, K. (1977). Visual attention in reading: Eye movements reflect cognitive processes. *Memory & Cognition*(4), 443-448.

### Representations of lexical stress in adults with developmental dyslexia

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This study investigated the ability of adults with developmental dyslexia to accurately represent the lexical stress patterns of words stored in the mental lexicon. 16 adults with developmental dyslexia (mean age = 24, 8 males) and 24 age/IQ matched controls (mean age = 19, 4 males) completed a cross-modal priming task in which visually presented target words were preceded by stress-congruous, stress-incongruous and control primes. In the congruous condition the spoken prime was the first two syllables of the target word (e.g. *próse/cutor* → *PROSECUTOR*). In the control condition the spoken prime was the first two syllables of a word phonologically unrelated to the target (e.g. *accél/erate* → *PROSECUTOR*). In the incongruous condition the spoken prime was the first two syllables of a word derived from the same root as the target, with matching segmental phonology but contrasting stress assignment in the first two syllables (e.g. *prose/cútion* → *PROSECUTOR*). In both reading groups, priming for stress-congruous primes was more than twice as strong as for stress-incongruous primes, indicating that adults with developmental dyslexia represent lexical stress accurately. This contrasts with their imprecise encoding of segmental phonology. Future reading interventions may exploit intact prosodic representations to improve gains in literacy performance.

### The British Lexicon Project: A new database of lexical decision times for 28K monosyllabic and disyllabic English words

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We present a new database of lexical decision times for English words and non-words, in which two groups of British participants each responded to 14,365 monosyllabic and disyllabic words and the same number of non-words for a total duration of 16 hours (divided over multiple sessions). This database, called the British Lexicon Project (BLP), fills an important gap between the Dutch Lexicon Project (DLP) and the English Lexicon Project (ELP), because it applies the repeated measures design of DLP to the English language. The high correlation between the BLP and ELP data indicates that a high percentage of variance in lexical decision datasets is systematic variance rather than noise, and that the results of word recognition megastudies are rather robust with respect to the selection and presentation of the stimuli. Because of its design, BLP makes the same analyses possible as DLP, offering researchers with a new interesting dataset of word processing times for mixed effects analyses and mathematical modeling. In the talk we will illustrate a number of research questions that can be addressed with the database.

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Lexicality effects in the masked priming same-different task

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When investigating orthographic processes that operate prior to visual word recognition, tasks are needed that are not affected by lexical whole-word representations. Recently, Kinoshita and Norris (2009) used the robust priming of nonwords in the masked-prime same-different task to argue that the task operates at the level of abstract letter identities and is thus not influenced by lexical processes. However, in same-different tasks there is always a processing advantage for words over nonwords, suggesting a lexical effect. We investigated the locus of this advantage for words over nonwords in a series of three experiments using the masked-prime same-different task, in which reference stimuli were presented visually in the first two experiments and verbally in the third experiment. Together, our results suggest that the processing advantage for words over nonwords is due to the activation of whole-word representations stored at the lexical level. Furthermore, results suggest that a different representation is used for nonwords, most likely based on one-trial learning. These results have implications both for theories of letter order encoding and the utility of same-different tasks in investigating prelexical processes.

Kinoshita, S., & Norris, D. (2009). Transposed-letter priming of prelexical orthographic representations. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 35(1), 1-18.

Do 'deal' and 'dealer' really share their stem? Grammatical class and morphological priming in reading

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It is not clear from previous research (e.g., Caramazza et al., 1988; Deutsch et al., 1998; Frost et al., 1997) whether morphological stems that sub-serve the formation of both nouns and verbs (e.g., 'deal-') have a unique, grammatical class-independent representation in the visual word identification system, or rather feature two separate, grammatical-class specific representations. In a first experiment, participants were asked to read aloud nouns and verbs that were anticipated by morphologically-related primes belonging to the opposite grammatical class (e.g., partenza-PARTIRE, departure-TO LEAVE). In order to disambiguate genuine morphological priming from semantic facilitation, the same target words were also paired in a second condition with semantically related, but morphologically unrelated primes (e.g., viaggio-PARTIRE, trip-TO LEAVE). Morphological and semantic primes were contrasted with separate sets of control primes. The results showed reliable cross-class morphological priming. This effect was also shown to be independent from whether nouns primed verbs or vice versa, and from SOA (100 ms vs. 300 ms). In a second experiment, cross-class morphological

priming was shown to emerge even when the related primes were compared with control words that shared their orthographic and phonological onset (e.g., abbraccio-ABBRACCIARE, (the) hug-to hug vs. abbazia-ABBRACCIARE, abbey-to hug), thus proving to hold independently of orthography and phonology.

Caramazza, A., Laudanna, A., & Romani, C. (1988). Lexical access and inflectional morphology. *Cognition*, 28, 297-332.

Deutsch, A., Frost, R., & Forster, K.I. (1998). Verbs and nouns are organized and accessed differently in the mental lexicon: Evidence from Hebrew. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 24, 1238-1255.

Frost, R., Forster, K. I., & Deutsch, A. (1997). What can we learn from the morphology of Hebrew: A masked priming investigation of morphological representation. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 23, 829-8.

#### Using masked priming to investigate processing of past tense inflection in English as a first and a second language

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Behavioural studies have suggested a dual-route processing of English past tense: regular forms are decomposed into their stem and affix (*play=play+ed*), whereas irregular forms (*kept*) are retrieved directly from the mental lexicon. Consequently, the same stem is used for present and past tense in regular verbs, while two morphologically unrelated stems underlie irregular verbs. However, Crepaldi et al. (2010) argued that irregular forms bear a relationship with their stem at the lemma level. Silva & Clahsen, (2008) suggested that second language (L2) learners do not have decomposing abilities, so regular past tense forms are processed as separate forms too. In the present study, Greek-English learners and native English speakers were tested in three masked-priming tasks with regular and irregular prime-target verb pairs (*played-play/kept-keep*). For regular pairs, native speakers showed priming effects, compared to unrelated pairs, indicating decomposition; conversely, L2 learners showed increased RTs for regular pairs. Moreover, all groups revealed priming effects for irregular pairs, confirming Crepaldi et al.'s suggestion that irregular forms are related to their stems. We propose that proficient late L2 learners have similar decomposing abilities to native English speakers, and that additional cognitive load inflicted by L2 decompositional processing obscures any priming effects for regular verbs.

Crepaldi, D., Rastle, K., Coltheart, M., & Nickels, L. (2010). 'Fell' primes 'fall', but does 'bell' prime 'ball'? Masked priming with irregularly inflected primes. *Journal of Memory and Language*, 63, 83-99.

Silva, R. & Clahsen, H. (2008). Morphologically complex words in L1 and L2 processing: Evidence from masked priming experiments in English. *Bilingualism: Language and Cognition*, 11, 245-260.

**Eighth Mid Career Prize**Are there multiple memory systems? Tests of models of implicit and explicit memory

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Memory can be probed in numerous different ways, and the properties and features of memory seem to vary dramatically depending on the probing method. This has led many researchers to conclude that distinct memory systems exist (e.g., implicit/explicit, procedural/declarative). Formal models of memory can contribute to this debate by offering a means of contrasting the predictions that arise from different assumptions about underlying systems. I develop this idea here in the context of a general model of implicit and explicit memory based on signal detection theory, within which single- and multiple-systems versions can be instantiated. Using maximum-likelihood methods, these models were fit to data sets from several continuous-identification-with-recognition (CID-R) experiments. This paradigm allows recognition judgments and identification reaction times (RTs; which form the basis of priming measures) to be evaluated concurrently for each item at test. The models differ in the extent to which they predict that recognition judgments are related to RTs. The results favour a version of the general model which assumes that one memory strength signal drives recognition and priming, rather than multiple independent implicit/explicit signals. This model proves surprisingly powerful in simultaneously modelling data from priming and recognition tests, including examples of dissociations arising in individuals with amnesia. The results demonstrate the potential to move the memory systems debate forward by the exploration of formal models.

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**Symposium: Morphological processing in visual word recognition**  
**Organiser: Professor Kate Nation**

Form and meaning in learning to recognise morphologically complex words

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Developmental associations between oral awareness of derivational morphology (MA) and reading comprehension suggest that children with good MA may underpin their orthographic knowledge at the morphemic level. However, evidence of morphemic recognition unit usage is lacking and it may be that children with good MA are simply better at interpreting complex words after decoding. For adults, morphological decomposition is not secondary to semantic access since early morpho-orthographic decomposition is observed in word recognition (Rastle, Davis & New, 2004). Our study uses primed visual lexical decision to examine morphological processing by English-speakers (n=50) between Grades 4-7. Three prime-TARGET combinations are compared: (1) morphologically transparent (e.g. worker-WORK); (2) morphologically opaque (e.g. corner-CORN); and (3) orthographic (e.g. turnip-TURN). Prime duration (57 ms or 250ms) and suffix type frequency are manipulated. Reliable priming is only observed at 250 ms. Older children show stronger facilitation for transparent relative to orthographic and (marginally) opaque primes, and sensitivity to suffix frequency. The outcome is compared with adult findings and the contrasting results concerning morpho-orthographic and morpho-semantic processing are discussed in relation to the emergence of oral MA and the role of morphemic form and meaning in shaping the development of complex word reading skills.

Rastle, K., Davis, M. H., & New, B. (2004). The broth in my brother's brothel: Morpho-orthographic segmentation in visual word recognition. *Psychonomic Bulletin & Review*, *11*, 1090–1098.

Morphological decomposition in early visual word recognition: Differences between child and adult readers

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A well-established finding in the visual word recognition literature is morpho-orthographic decomposition, a process posited to operate in the early processing stages of visual word recognition, whereby all words bearing the appearance of morphological complexity are argued to be parsed into their plausible morphemic constituents, regardless of their actual morphological status. This view stems from visual masked priming studies which suggest that genuinely morphologically complex words, such as 'builder', and those displaying pseudomorphological complexity, such as 'corner', are both decomposed into their plausible base and suffix constituents. The vast majority of research on morphological decomposition is restricted to skilled adult readers, and the present study aimed to investigate this in child readers with a view to directly compare

their behaviour with that of adults'. 40 English 9-10 year old typical readers and forty English typical adult readers were run on a visual masked prime lexical decision task. Consistent with the literature, adult readers demonstrated morpho-orthographic decomposition. In contrast, child readers showed no evidence of such decomposition. Instead, the decomposition process in child readers appeared to be truly morphological and sensitive to the semantic correspondence between the whole word and its components even in the earliest stages of visual word recognition.

### The acquisition of morphological knowledge investigated through artificial language learning

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Morphological knowledge plays a key role in word recognition and provides the primary means for lexical productivity. This research investigated how this knowledge is acquired using an artificial language paradigm in which undergraduate participants were trained on novel suffixes (e.g. –nept) presented in novel word contexts (e.g. sleepnept). Participants were tested immediately after training or two days after training on a variety of tasks including a speeded auditory repetition test that assessed performance on trained items as well as items comprising an untrained suffix, an untrained stem or both (e.g. sleepnept vs sleepnule, or sailnept vs sailnule). Results of the auditory repetition task showed an advantage for trained items immediately after training, as these were repeated significantly faster than items with trained stems but untrained suffixes. Critically, this advantage generalised to untrained items comprising the novel suffixes (e.g. sailnept) but only in the group of participants tested two days after training. This study demonstrates that participants can acquire morphological representations in a laboratory context that are sufficiently robust to generalise to the interpretation of novel exemplars. It also suggests that this process of linguistic generalisation may require a period of overnight consolidation consistent with complementary systems theories of lexical learning.

### One or two morphology worlds?

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In the morphological literature, there seems to be a schism between inflectors-derivators and compounders. The former group is hardly citing the latter one in their scientific presentations and articles and vice versa. Moreover, models are devised on the basis of research on inflections/derivations only or on compounds only. Yet, most morphological processing models claim to account for the processing of all morphologically complex words. In this talk, I will go over a number of studies on inflections/derivations and compare them to studies on compounds in order to explore the question whether we live in one or two morphology worlds. Concretely, I will discuss whether factors that drive the processing of inflected/derived words are similar to those

that drive compound word processing and I will explore to what extent morphological processing models can account for results across the morphological board.

#### Morphological constraints on orthographic processing: A dual-route perspective

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Independent lines of research have led to dual-route accounts of various phenomena related to skilled reading. Here I will present a general architecture for single word reading that integrates dual-route accounts of phonological and morphological processing. The adoption of this general dual-route perspective begins by considering how the processing of orthographic information might be optimized during reading acquisition, with this optimization being constrained by prior knowledge of phonology and morphology. The resulting dual-route approach to orthographic processing draws a key distinction between a coarse-grained and a fine-grained processing route that involve two fundamentally different types of orthographic code. Processing along the coarse-grained route optimizes fast access to semantics by using minimal subsets of letters that are determined by the constraints imposed by letter visibility on the one hand, and by the relative diagnosticity of letter combinations on the other. Processing along the fine-grained route, on the other hand, is sensitive to the precise ordering of letters, as well as to position with respect to word beginnings and endings. This enables the chunking of frequently occurring contiguous letter combinations that form relevant units for morpho-orthographic processing (prefixes and suffixes) and for the prelexical translation of print to sound (multi-letter graphemes).

#### Spatiotemporal dynamics of morphological processing in visual word recognition

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Extensive behavioural evidence points to a process of automatic blind decomposition for any visual form which is potentially morphologically complex. It is likely that the presence of morphological structure drives this process, since both a stem and an affix are necessary to trigger segmentation, regardless of word meaning (*corner* as well as *farmer*). Our goal was to delineate the patterns of neural activity that support the recognition of morphologically simple and complex words in English using magnetoencephalography (MEG). Effects associated with processing of orthographic structure emerged prior to 200ms in bilateral posterior fusiform and inferior temporal cortex in contrasts between words and pseudowords with consonant strings. Morphological effects, reflecting the presence of stem + affix, emerged at 320ms in left anterior middle temporal cortex. Processing linked to morphological structure was not modulated by semantic transparency, consistent with previous masked priming results. Multiple linear regression analyses revealed a hierarchical processing stream moving from occipitotemporal cortex into left anterior temporal cortex, showing early sensitivity to length and orthographic structure followed by stem and affix processing, which emerged prior to word frequency and semantic transparency effects. These results support

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claims for blind morphological parsing, pointing to early and automatic processing based on the presence of orthographic cues to morphological structure.

### End of symposium

#### Eye movement patterns underlying robustness against item motion in visual search

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Hulleman (2010) found that item movement caused a decrease in search performance only for very difficult search tasks. Here, we investigate the relationship between eye movements and performance in search tasks of varying difficulty, using static and moving (7.2 deg/s) items. Easy search consisted of searching for a diagonal line amongst vertical lines, medium search was for a T amongst Ls and difficult search was for a square with a notch in the top left corner amongst squares with a notch in any other corner. Fixation durations, fixation counts and saccade amplitudes mainly depended on difficulty rather than motion. However, there were some effects of speed, even for present trials. For difficult search, fixation durations were shorter for moving items. Re-examination rates revealed that moving items were revisited more often than static. Since this did not influence reaction times, this suggests parallel processing of items. Most importantly, for moving items at all difficulties, there was a larger distance between the end point of one saccade and the start point of the next. This suggests that moving items were tracked over short distances, probably to prolong processing times, contributing to the robustness of visual search against item motion.

Hulleman, J. (2010). Inhibitory tagging in visual search: Only in difficult search are items tagged individually. *Vision Research*, 50(20), 2069-2079.

Supported by The Leverhulme Trust (F/00 181/T)

#### Velocity filtering is not used in visual search amongst moving items.

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McLeod et al. (1988, 1991) proposed that the visual system can filter items by their speed during search for a conjunction of motion and shape. Filtering improves search by attenuating the representation of items that do not have the target speed. This effectively decreases the number of search items and thus speeds up reaction times. We tested this proposal in an eye movement study. Participants searched for a T amongst L's. In half of the trials the target was static (0°/sec) and in the other half the target was moving (7.2°/sec). The distractor items either all moved with the target speed (uniform condition) or half of the distractors were static and the other half moved with 7.2°/sec (mixed condition). If filtering plays a role in this type of search, we would have expected to find decreased reaction times in the mixed condition relative to the uniform condition. Reaction times were indeed faster in the mixed condition for target absent trials.

However, this was due to an increased willingness to terminate search early. Moreover, there was no difference in reaction times between the mixed and uniform condition for the target present trials. Therefore, we conclude that velocity filtering was not used.

McLeod, P., Driver, J., & Crisp, J. (1988). Visual Search for a conjunction of movement and form is parallel. *Nature*, 332, 154-155

McLeod, P., Driver, J., Dienes, Z. and Crisp, 1991. J. Filtering by movement in visual search. *Journal of Experimental Psychology: Human Perception and Performance* 17(1) 55-64.

Supported by The Leverhulme Trust (F/00 181/T)

Guidance of search through scenes based on scene gist and parafoveal and peripheral visual information

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The “gist” of a complex scene – a coarse understanding of the spatial and conceptual layout of the scene – can be determined after very brief exposures to the scene. We tracked eye movements while observers searched the scene for a target. We either primed or did not prime the scene by presenting the photo of the scene for 250 ms before informing them of the target, and the scene was either presented fully (full - scene - search) or through a small gaze - contingent window (windowed search) during search. The windowed search conditions replicated Castelhana and Henderson’s (2007) finding that with a brief prime of a scene, targets were found after fewer and more direct saccades. This shows that the information gleaned from the prime allows some guidance of eye movements. Priming in the non-windowed search condition, on the other hand, improved the aim of the first few saccades but did not result in fewer fixations overall or faster response time. This demonstrates that when the visual system has the choice of guiding saccades either based on a mental representation of a scene or based on parafoveal and peripheral information currently available, guidance is strongly dominated by the currently available visual information.

Castelhana, M. S., & Henderson, J. M. (2007). Initial scene representations facilitate eye movement guidance in visual search. *Journal of Experimental Psychology: Human Perception & Performance*, 33, 753-763.

Aberrant eye movements in (some) children with autism spectrum disorders.

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Eye-movements are increasingly used to study higher level cognitive processes in children with autism (Boraston & Blakemore 2007); however there is little systematic

investigation of basic oculo-motor processes in children with different neurocognitive phenotypes. Three eye-movement tasks (1) Gap/Overlap; (2) Antisaccade; and (3) Visual Search, were administered to children aged 8-14 from four populations: Autism Language Impaired (ALI), Autism Language Normal (ALN), Language Impairment (LI), and Typically Developing (TD). Tasks assessed the ability to direct accurate saccadic eye-movements and maintain stable fixations and were designed to identify population-specific irregularities in eye-movement control that could contribute to observed difficulties in more complex eye-movement tasks such as scene description (Kelly & Norbury, 2010). For tasks (1) and (2), fixation accuracy and saccade latencies to target in TD and ALN children were comparable and consistent with previous results (Pia Bucci et al., 2005). In contrast, children with language impairments were delayed in overlap trials, suggesting difficulties disengaging from a currently fixated object. In task (3), ALI children were slower than all other groups to make first fixations and to land on target. Children with language difficulties display mild eye-movement differences that should be considered when interpreting eye-movement data from more complex tasks.

Boraston Z., Blakemore S.J. (2007) The application of eye-tracking technology in the study of autism. *Journal of Physiology*, 581, 893-898.

Kelly, D. J. & Norbury, C. F. (2010). EyeSay! Language Production Processes in Developmental Disorders. Poster presented at AmLap, York, UK.

Pia Bucci, M., Pouvreau, N., Yang, Q., & Kapoula, Z. (2005). Influence of gap and overlap paradigms on saccade latencies and vergence eye movements in seven-year old children. *Experimental Brain Research*, 164, 48-57.

#### How does attentional control constrain visual short-term memory?

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The mechanisms by which attentional control biases representations held in memory have attracted much interest but remain poorly understood. As both attentional control and memory develop gradually over childhood, assessing how participants of different ages orient attention to mnemonic contents can elucidate their interplay. Six-, 10-year-olds and adults were presented with four items and were later asked to report whether an item had been part of the initial array. The array could either be uncued, preceded or followed by a cue directing attention to a location within the array. Although age groups differed in their basic recall ability in the absence of an attentional cue, participants' performance across groups was significantly improved by orienting their attention to the array voluntarily. We then investigated whether the semantic relatedness of items modulated attentional benefits differently across groups. Ongoing analyses suggest that children and adults are differentially able of exploiting the semantic relatedness of items to orient attention. The findings suggest that there are substantial developmental differences in the ability to control attention to items in visual memory and in turn that these interact with developmental changes in the semantics of the to-be-remembered items.

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The central role of the temporo-parietal junction and the superior longitudinal fasciculus in visuospatial attention.

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The current study examined the relations between the lesions linked to visual and tactile extinction and those related to visual field defects and spatial neglect. We found both common and distinct neural substrates associated with different visuospatial deficits. Damage to angular and middle occipital gyri and superior temporal sulcus were linked to visual extinction. Lesions involving supramarginal gyrus, intraparietal sulcus, middle frontal and superior temporal gyri were associated with spatial neglect. Lesions affecting temporo-parietal junction (TPJ), middle temporal region, middle frontal area (BA46) as well as insula and putamen were linked to both spatial neglect and visual extinction. Analysis of the relations between visual and tactile extinction highlighted TPJ as the common site in both modalities. These findings suggest that TPJ play a general role in identifying salient events in the sensory environment across multiple modalities. White matter analyses pointed to superior longitudinal fasciculus (SLF) as a chief pathway interconnecting components of visuospatial attention network. We provide evidence that functional disconnections resulting from SLF damage contribute to altered performance on attention tasks measuring not only neglect but also visual and tactile extinction. We propose that SLF supports interaction between functionally specialized regions involved in attentional control across multiple sensory modalities.

**End of meeting**

**Reserve List**

The role of action in the illusion of control

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The illusion of control occurs when people believe that their behavior is producing outcomes that are actually uncontrollable. This effect is known to be stronger when participants are more actively involved in trying to obtain the outcome, which has been traditionally interpreted as a result of a need to protect self-esteem. More recent research, however, suggests that the effect of action on the illusion of control could be due to participants exposing themselves to different information when they are very active. In Experiment 1 participants observed a fictitious patient who took (or did not take) a fictitious medicine and felt better (or not). In Experiment 2, half of the participants were active and administered the medicine, while the other half were yoked to the active ones and simply observed the same sequence of events. The results supported the latter account: The illusion that the medicine was effective increased with the number of times it was taken, but this result did not depend on whether participants were agents or observers.

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Investigating the role of the verbal code in visual imagery

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Some researchers suggest that verbal labelling of shapes creates a verbal overshadowing effect, that is an impairment of visual memory caused by verbalization' (Brandimonte, Hitch and Bishop, 1992). In contrast, assimilation theory suggests the creation of verbal-visual associations in long-term memory that enable the use of verbal cues to retrieve visual shapes. We examined whether a verbal code is used to encode and retrieve both easy-to-name shapes and hard-to-name shapes. We extended the Brandimonte visual imagery paradigm to a computer-based paradigm and added various concurrent verbal tasks (e. g., articulatory suppression: repeating irrelevant sound while performing the central task) at either encoding or retrieval in order to suppress verbal coding. We found higher performance for easy-to-name shapes relative to hard-to-name shapes, indicating a verbal facilitation effect, rather than verbal overshadowing. We also show that the use of the verbal code is essential for performance on both easy-to-name shapes and hard-to-name shapes. Performance decrement on both types of shapes was observed when verbal coding was suppressed during either encoding or retrieval.

Brandimonte, M. A., Hitch, G. J., & Bishop, D. V. (1992). Verbal recoding of visual stimuli impairs mental image transformations. *Memory & Cognition*, 20, 449-455.

Are txt msg shortcuts processed like words? Evidence from masked priming.

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Existing research suggests that novel words can be added to the orthographic lexicon after relatively few exposures (Bowers, J.S., Davis, C.J. & Hanley, D.A., 2005). SMS shortcuts, for example txt (text) and l8r (later), are novel representations of words but they already have lexical representation in the form of their base words (text, later) and it is, therefore, unclear how they access the lexicon. This research investigated whether shortcuts access the lexicon rapidly and automatically, in the same way as familiar words and looked at differences between the orthographic (txt) and phonologically plausible (l8r) styles of shortcut. A masked priming paradigm was used in two experiments comparing lexical access of familiar words (text), familiar shortcuts (txt) and novel shortcuts (rsk - risk). In Experiment 1, shortcuts were the prime stimuli (txt – TEXT) but in Experiment 2 the shortcuts became the target stimuli (text – TXT). Surprisingly across both experiments no differences were found between the orthographic and the phonologically plausible shortcuts. Additionally familiar words and shortcuts successfully accessed the lexicon whereas the novel shortcuts did not. However, in Experiment 1 familiar shortcuts were less effective than words whereas in Experiment 2 no differences between words and shortcuts were found, suggesting that familiar shortcuts can access the lexicon as effectively as familiar words.

Bowers, J.S., Davis, C.J. & Hanley, D.A. (2005) Interfering neighbours: The impact of novel word learning on the identification of visually similar words, *Cognition*, 97, B45–B54

Quantitative and qualitative change in neologisms in two individuals with jargon aphasia

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Neologisms (i.e., novel nonword utterances) are hallmark feature of jargon aphasia. This research reports two patients with jargon aphasia (P9 and FF) who produced a high proportion of neologisms and had similar clinical manifestations. They underwent identical phonological therapy to improve their anomia. Despite similar clinical profiles and identical treatment, they responded differently to the therapy-P9 did not show any positive gains but FF showed improved naming abilities. The main objective of this research is to compare the quantitative and qualitative change in neologisms for P9 and FF following therapy. Errors made pre- and post- therapy on a naming task were analyzed to explore the characteristics of the neologisms. Change in the proportion of neologisms from pre- to post-therapy was used as a marker for quantitative change and the quality of neologisms was measured using the phonological overlap index (Bose et al., 2007). FF showed a significant decrease in the number of neologisms (from 44% pre- to 3% post-therapy) along with an increase in phonological overlap post-therapy (0.23 pre- to 0.44 post-therapy). No such change was observed for P9. Theoretical discussion will focus on the importance of exploring the quality and quantity of neologisms for describing jargon aphasia.

Bose, A., Raza, O., & Buchanan, L. (2007). Phonological relatedness between target and error in neologistic productions. *Brain and Language*, 103, 120-121.

Segregation of auditory objects in children with autism

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The current experiment set out to investigate the hypothesis that auditory perceptual disturbances in autism reflect a failure to adequately segregate incoming stimuli into distinct auditory objects. Participants heard binaural noise bursts, half of which contained a 0.5 millisecond inter-aural timing difference in a narrow frequency band. These stimuli are typically perceived as a lateralized pitch segregated from centrally perceived noise. Brain responses were recorded via 160 channel whole-head MEG and projected onto virtual sources in bilateral auditory cortex. In typically developing 8- to 12-year-old children (N = 16), we observed a difference in brain responses to the pitch versus control stimuli at 250 milliseconds after stimulus onset. This corresponds, we believe, to the Object Related Negativity identified in previous ERP studies of adults. We had predicted that this effect would be absent in age-matched

children with autism. Strikingly, however, seven of the eight autistic children tested thus far have demonstrated sensitivity to the presence of the pitch from as early as 40 milliseconds. In ongoing analyses, we are attempting to determine more precisely the electrophysiological mechanisms responsible for this early response. We speculate that this finding may be related to reports of heightened sensitivity to pitch in a subset of autistic individuals

What skills are impaired in dyslexia at the onset of reading? A prospective study of children with reading difficulties.

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Purpose: Cognitive deficits have been shown in dyslexic children in many areas, including phonological, short-term memory, motor skills, balance, auditory awareness and speed of processing. This study examines whether children who later become dyslexic show these difficulties prior to the onset of literacy tuition. Method: 444 children representing the full range of abilities in their first school term completed a large battery of tasks measuring phonological awareness, verbal short-term memory, rapid naming, speech rate, auditory perception, motor skills, print knowledge, balance, IQ and speed of processing. Reading skills were retested at the end of year 1, year 2 and year 3. Poor readers were designated as children who showed reading scores one standard deviation below the mean on at least two of the three test points. Results: Poor readers showed significantly lower scores on each of the Time 1 measures, except balance, and were significantly more likely to have deficits in each area. Only a small minority showed no cognitive deficits. However, no single deficit was a necessary precursor to reading difficulties. Conclusions: Results are in line with theories suggesting that dyslexia has multiple causes.

Detecting facial beauty in groups

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Prior research has shown that facial beauty can be appraised at a glance when a single face image is briefly presented at central fixation. Because similar appraisal can be carried out for a crowd in social interaction, we investigated how well people can derive simple statistical information about attractiveness from a group of faces. In a series of experiments, participants saw two sequentially displayed groups of faces. Both groups of faces were displayed for either 500ms or 250ms. The task was to judge which group contained the greater number of attractive faces. All face stimuli were pre-rated for attractiveness. We manipulated the proportion of attractive faces in each face group, which ranged from 25% to 100%. We measured how well the participants were able to make their judgement based on the difference between the proportions in the two groups. Results show that the accuracy performance was a function of proportion difference.

More importantly, even the smallest proportion difference (25%) was detected better than chance. This suggests that participants were sensitive to small statistical differences between the proportions of attractive faces in the two groups.

Fusiform cortex word and face regions: Lateralisation differences between chimpanzees and humans

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The fusiform gyrus plays a central role in word recognition and reading. The visual word form area is more common in the left fusiform cortex, whereas the human fusiform face area is activated more strongly in the right hemisphere. Better literacy enhances left fusiform activation, inducing competition with face processing in the same region. Brain asymmetries have been linked to language lateralisation in the auditory domain: wider connective spacing between mini-columns of neurons in the human planum temporale is not found in other primates. However, this has not been investigated in fusiform cortex. Furthermore, the specialised processing of visual word forms is characteristically human, whereas face processing is performed by other primates in which lateralisation is not clear. We measured microanatomy in post-mortem mid-fusiform cortex in 14 humans and 14 chimpanzees. Minicolumn and neuronal size asymmetry distinguished humans from chimpanzees and the direction of human asymmetry was the same as in other language areas. Uniformly narrow minicolumns in chimpanzees and in the human right hemisphere fit with mechanistic models of face processing. Enhanced expansion of pyramidal neuron size and minicolumn width in the left fusiform cortex in humans, but not chimpanzees, are putative correlates of visual word form processing.

Naturalistic sounds and spoken words modulate the categorization of visually-presented pictures at multiple levels of human information processing

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Crossmodal semantic interactions between pictures and both naturalistic sounds and spoken words were compared using a picture categorization task. The results demonstrated that both types of auditory stimulus induced semantic congruency effects (i.e., facilitation by semantically-congruent sounds and inhibition by semantically-incongruent sounds, as compared to noise) when the onset of the sound led that of the picture by 240 ms or more. Both types of sound also gave rise to inhibition irrespective of their semantic congruency when they were presented within approximately 100 ms of the onset of picture, with the peak of the inhibition occurring somewhat earlier for spoken words than for naturalistic sounds. These results suggest that audiovisual semantic interactions occur at multiple levels of human information processing, including semantic access and decision making. The different timecourses of late inhibition observed for

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naturalistic sounds and spoken words are attributed to their different processing pathways to access semantic representations.

The sound of lemon: Crossmodal associations between chemosensory and auditory stimuli

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We investigated crossmodal associations between various food-related stimuli (water-based solutions, milk-based flavoured solutions, and odours) and sounds varying in pitch and played by four different types of musical instruments. Participants tasted or smelled stimuli before choosing a sound to match it. We demonstrate that participants preferentially match certain pitch and instrument type to specific stimuli. Through participants' ratings of the stimuli along a number of dimensions (e.g. pleasantness, complexity, familiarity, or sweetness), we explore the psychological dimensions involved in these crossmodal associations, using principal components analysis (PCA). While pleasantness and familiarity seem to play an important role in the choice of instrument associated with tastes/flavours, the pitch seems to also depend on the quality of the taste (bitter, salty, sour, or sweet). Only 3 out of 20 odours tested elicited a significant preference in terms of instrument type, while pleasantness and complexity had a strong impact on the choice of pitch matched to odours.

Rapid Assessment of overall mood in a crowd

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The ability to rapidly extract the mood of a crowd is vital in social interaction. It prepares the observer for imminent dangers and proper course of actions. In this research we investigate the ability to detect emotional signals from multiple faces. Observers were instructed to judge which of the two sequentially presented groups of faces contained greater number of faces with a happy/sad/disgusted expression. The group size varied from 4 to 16 faces. The faces in a group were shown simultaneously for 500 ms or less to prevent the observer from scanning each face individually. We manipulated the ratio of faces with different emotional expressions in a group (e.g., 25% happy faces and 75% sad faces). We measured how performance was affected by the degree of discrepancy between the ratios of emotional categories in the two groups. The results showed that accuracy performance is a function of the discrepancy between the ratios of emotional categories. More importantly, observers were able to detect a small mood difference between the two groups of faces. The results suggest that statistical information of the emotional signals in groups can be extracted in a rapid and quasi-parallel fashion.

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Selective attention in relation to schizotypy

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Schizotypy is a personality dimension which portrays a continuum of characteristics in the normal population, and may reflect characteristics similar to those seen in schizophrenia. Research has been conducted assessing whether deficits in selective attention portrayed in schizophrenia are also evident in high-schizotypy individuals. We used an overshadowing task (Prados, 2010) and a latent inhibition task (Evans et al., 2007) to measure differences in selective attention related to scores on the four dimensions of schizotypy assessed by the O-LIFE questionnaire. For latent inhibition, we replicated Evans' findings at least in part: we found a significant negative correlation between latent inhibition score and two of the dimensions of schizotypy, unusual experiences and cognitive disorganisation. With overshadowing, we saw, for the first time, a significant negative correlation between the extent of overshadowing and the schizotypy dimension, unusual experiences. These results confirm and extend previous findings showing reduced selective attention in people scoring highly on schizotypy dimensions which are linked to positive symptoms in schizophrenia. They also demonstrate the application of our novel overshadowing task in assessing variations in selective attention linked to personality traits.

Evans, L. H., Gray, N. S. & Snowden, R. J. (2007). A new continuous within-participants latent inhibition task: Examining associations with schizotypy dimensions, smoking status and gender. *Biological Psychology*, 74, 365-373.

Prados J (2010) Blocking and overshadowing in human geometric learning. *Journal of Experimental Psychology*, In press.

Endogenous attention modulates tactile suppression during goal-directed movements

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Reaching with the hand is characterized by a decrease in sensitivity when tactile stimuli are presented to the moving hand. Here, we investigated whether directing attention toward a moving or stationary hand gives rise to different patterns of tactile suppression. Participants performed a dual-task involving a goal-directed movement paired with the speeded detection of a tactile pulse. The pulse was either delivered to the moving or stationary hand, during movement preparation, execution, or the post-movement phase. Furthermore, stimulation could be delivered with equal probability to either hand, or with a higher probability to either the moving or resting hand. Tactile reaction times (RTs) were slower for stimulation delivered to the moving hand, as compared to the resting hand, demonstrating the existence of sensory suppression. Moreover, faster tactile RTs were found for higher probability stimuli, regardless of whether the stimulus was delivered to the moving or stationary hand, as compared to the control condition. Therefore, attention can modulate sensory suppression in an additive

manner. RTs also decreased from motor preparation, through execution, to the post-movement phase. These results are discussed in the context of motor planning, dual-task performance, as well as the different measures that are used to assess tactile perception.

What mistakes reveal about accurate, skilled performance: An EEG study of touch-typing.

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We studied skilled performance and performance monitoring using a highly practiced real-world task: touch-typing by expert touch-typers. Many studies of error detection use discrete trial choice reaction time tasks. These have typically shown that error responses tend to have faster reaction times than correct key presses, and that there is an increase in reaction time in the trial following the error trial (post-error slowing, PoES). We asked our participants to type sentences presented visually. Our results show not only PoES, but also *slower* error responses and slowing of responses preceding the errors (pre-error slowing). Pre-error slowing has not been reported for typing-performance before, although it was recently reported for another continuous performance tasks – piano playing (Ruiz, Jabusch & Altenmuller, 2009). Pilot experiments with EEG resulted in replication of well established findings of error related EEG activity during error responses. These results contrast with those from discrete trial tasks and suggest that during naturalistic task performance anticipatory error-monitoring and conflict detection may play a greater role than reactive error-monitoring, as has been suggested by previous findings. We offer an interpretation of these findings which relates current cognitive control theories to the notion of internal forward models and the conflict detection account of error detection.

Ruiz, Jabusch & Altenmuller, 2009. Detecting Wrong Notes in Advance: Neuronal Correlates of Error Monitoring in Pianists. *Cerebral Cortex*, 19(11), p.2625- 2639

The impact of vocal and auditory task-cues on goal-directed response capabilities.

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In the present work we investigate the use of verbal, visual, and auditory task-cues in cognitive control. Studies conducted in our lab demonstrate that when participants perform a bivalent task-switching paradigm they are able to complete it in conditions of silence, silence with audio task-cues, reading aloud of task-cues and articulatory suppression. However, some conditions result in significantly faster reaction times (RTs) than others. It was to be expected from previous literature that articulatory suppression would result in the slowest RTs, but it has become apparent that there are also significant differences between other conditions too. Despite the common belief that to perform a task well you should perform it in silence, our research indicates that this may not always be the case. Conditions in which auditory processes are used result in faster RTs than those of silence, despite the presumed use of inner-speech. This leads us to the belief that

although the task (and goal-directed behaviours, in general) can be performed adequately without auditory involvement, there are additional benefits to performing in this manner.

#### Audiovisual enhancement of attentional capture

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A series of experiments investigated whether multisensory integration can enhance attentional capture by increasing the bottom-up salience of visual events, and whether this enhancement depends on top-down task-set. We adapted the cueing paradigm developed by Folk et al. (1992) for an audiovisual context. Search display with a colour-defined target bar was preceded by spatially uninformative colour changes in the cue display. Crucially, these cues were presented with a concurrent tone on half of all trials. Under singleton-detection mode, audiovisual cues eliciting larger spatial cueing effects than purely visual cues. This same effect was also found when a feature-specific top-down colour task set was active, both for task-set matching and non-matching cues, but only when high-intensity tones were used. These results provide strong evidence for multisensory enhancement of attentional capture. This effect is independent of top-down task set, suggesting that multisensory integration increases the bottom-up salience of visual events.

Folk, C. L., Remington, R., & Johnson, J. C. (1992). Involuntary covert orienting is contingent on attentional control settings. *Journal of Experimental Psychology: Human Perception and Performance*, 19(3), 676–681.

#### Can recent computational models of reading account for children's nonword reading strategies?

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The ability to generate plausible pronunciations of nonwords is particularly important for beginning readers, who often need to decode novel words to extract their meanings. Understanding how children pronounce nonwords is crucial for advancing theories of reading that aim to explain how the human reading system develops. We investigated to what extent children's nonword pronunciations reflected decoding of smaller (graphemes) and/or larger (body) orthographic units. A sample of 170 British, Year 2 children read aloud a list of three types of monosyllabic nonwords that varied in the regularity and/or consistency of their rime pronunciations in real words. A list of words that shared the body-rime units with the nonwords was also administered. The children's nonword pronunciations were consistent with use of smaller (grapheme-phoneme) as well as larger (body-rime) correspondences. The extent to which body-rime correspondences were preferred depended on the children's familiarity with the analogous words. Simulations of the data with the CDP++ model (Perry et al., 2010) and a new version of the DRC model (Coltheart et al., 2001) which implements body-rime and GPC rules in its

nonlexical route will be presented. Implications of the findings for refinements of computational models of reading will be discussed.

Coltheart, M., Rastle, K., Perry, C., Langdon, R., & Ziegler, J. C. (2001). DRC: A computational model of visual word recognition and reading aloud. *Psychological Review*, 108, 204–256.

Perry, C., Ziegler, J. C., and Zorzi, M. (2010). Beyond single syllables: Large-scale modeling of reading aloud with the Connectionist Dual Process (CDP++) model. *Cogn. Psychol.* 61, 106–151.

### Reversing the Colavita visual dominance effect

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The Colavita visual dominance effect occurs when people sometimes fail to respond to an auditory target if they have to respond to a simultaneously-presented visual target. We report a series of experiments aimed at not only eliminating, but, more importantly, reversing the Colavita effect. We used variations of a repetition detection task, in which participants had to respond to repetitions (either immediate or N-1, in separate experiments) of events in any modality (a picture, sound, or both) within simultaneously-presented streams of unrelated auditory and visual stimuli. We demonstrate that the Colavita effect can be eliminated in an immediate repetition detection task. What's more, for the first time since the effect was first reported in the 1970s, we demonstrate a reversal of visual dominance, whereby auditory responses are given more often than visual responses to audiovisual targets in an N-1 repetition detection task. These results suggest that varying the difficulty of the repetition detection task, which appears to affect the reliability of the visual information, gives rise to different patterns of responding to audiovisual targets (i.e., visual dominance, an elimination of the Colavita effect, or auditory dominance).

### Speeding up the brain? Evidence from an attentional blink and a visual search task.

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Previous research suggests that information processing speed and temporal judgements can be altered when the stimulus being judged is preceded by the presentation of a repetitive stimulus e.g. 5-seconds of 5Hz clicks, otherwise known as a click-train (Droit-Volet, 2010; Jones et al., 2010; Penton-Voak et al., 1996; Treisman et al., 1990). Jones et al. (2010) demonstrated that, performance on an iconic memory task, reaction times on

mental arithmetic tasks and simple and choice reaction time tasks were reduced when individual trials were preceded by click-trains. The evidence so far suggests that these effects are unique to *repetitive* stimulation. The current study sought to further explore the effect of repetitive pre-stimulation on attentional processing. Experiment 1 explored the effect of click-trains on the Attentional Blink (AB). A modified version of Raymond et al's. (1992) RSVP task was employed in which half of all trials were preceded by 5-seconds of 5Hz a click-train. Comparison of click-train and silence trials indicated that the AB was attenuated on click-train trials. Experiment 2 examined the effect of pre-stimulation on visual searching. Participants were required to search for a target defined by a singular or conjunction of features amongst an array of distracters. Comparison of click and silence trials indicated that click-trains reduced reaction times in some instances. The results are discussed in relation to the potential mechanisms by which repetitive pre-stimulation may affect attentional processing.

Droit-Volet, S. (2010). Speeding up a master clock common to time, number and length? *Behavioural Processes*, 85, 126-134.

Jones, L.A., Allely, C. S., Wearden, J. H. (in press). Click trains and the rate of information processing: Does "speeding up" subjective time make other psychological processes run faster? *The Quarterly Journal of Experimental Psychology*.

Penton-Voak, I.S., Edwards, H., Percival, A., & Wearden, J.H. (1996). Speeding up an internal clock in humans? Effects of click trains on subjective duration. *Journal of Experimental Psychology: Animal Behavior Processes*, 22, 307-320.

Raymond, J. E., Shapiro, K. L., Arnell, K. M. (1992). Temporary suppression of visual processing in an RSVP task: An attentional blink? *Journal of Experimental Psychology. Human Perception and Performance*, 18, 849-60.

Treisman, M., Faulkner, A., Naish, P. L. N., & Brogan, D. (1990). The internal clock: Evidence for a temporal oscillator underlying time perception with some estimates of its characteristic frequency. *Perception*, 19, 705-748.

### Overlap between specific language impairment and autism spectrum disorders: Oral language and reading

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There is increasing interest in investigating potential overlap between specific language impairment (SLI) and autism spectrum disorders (ASD; Williams, Botting, & Boucher, 2008). We identified 40 children with SLI and 40 children with ASD. Children were aged 7-12 years and groups were matched for age and nonverbal reasoning ability. Children completed standardised measures of oral language, word recognition and reading comprehension. It was expected that on average, the ASD group would obtain higher scores than the SLI group (cf. Lindgren, Folstein, Tomblin, & Tager-Flusberg, 2009). In line with the Simple View of Reading (Gough & Tunmer, 1986) we also

hypothesised that both word recognition and oral language would be unique predictors of reading comprehension. The ASD group obtained significantly higher scores than the SLI group on the majority of oral language measures and on tests of word recognition and reading comprehension. Regression analyses indicated that for the ASD group, reading comprehension was uniquely predicted by both word recognition and a composite measure of oral language (after controlling for age and nonverbal reasoning). In contrast, when the same analysis was run for the SLI group, oral language was a unique predictor of reading comprehension while word recognition was not.

Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading, and reading disability. *Remedial and Special Education, 7*, 6-10.

Lindgren, K. A., Folstein, S. E., Tomblin, J. B., & Tager-Flusberg, H. (2009). Language and reading abilities of children with autism spectrum disorders and specific language impairment and their first-degree relatives. *Autism Research, 2*(1), 22-38.

Williams, D., Botting, N., & Boucher, J. (2008). Language in autism and specific language impairment: Where are the links? *Psychological Bulletin, 134*(6), 944-963.

Statistical learning of novel graphotactic regularities: Evidence from an English-speaking adult population

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Statistical learning mechanisms are known to operate in various domains of human cognition, including language. For example, adults become sensitive to novel phonotactic constraints embedded within aurally presented speech sequences following brief exposure, without engaging deliberate effort (Onishi, Chambers, & Fisher, 2002; Chambers, Onishi, & Fisher, 2010). Using an adaptation of Onishi et al.'s paradigm, we investigated whether a similar effect could be obtained in the written language domain with graphotactic constraints. We tested adults' sensitivity to novel constraints on the *position* (Experiments 1 and 2) and *context* (Experiments 3, 4, and 5) of letter distributions in word-like strings. Positional constraints were acquired reliably following short exposure to stimuli that embedded them (Experiments 1 and 2). Moreover, a trend for stronger effects emerged when the exposure set contained a greater *variety* of tokens (Experiment 2) than when fewer tokens were presented more *frequently* (Experiment 1), suggesting that learning involved sensitivity to 'sublexical' patterns, not merely frequency-based whole-stimulus memorization. Sensitivity to contextual constraints was reliable when the number of exposure trials was doubled (Experiments 4 and 5) relative to Experiments 1, 2, and 3. Our results provide preliminary evidence of a role for statistical learning in the acquisition of untaught graphotactic conventions.

Chambers, K. E., Onishi, K. H., & Fisher, C. (2010). A Vowel Is a Vowel: Generalizing newly learned phonotactic constraints to new contexts. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 36*, 821-828.

Onishi, K. H., Chambers, K. E., & Fisher, C. (2002). Learning phonotactic constraints from brief auditory experience. *Cognition, 83*(1), B13-23.

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Developmental changes in attentional orienting to perceptually available stimuli and stimuli maintained in short-term memory.

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This study examined developmental changes in the neural mechanisms through which we orient attention towards perceptually present stimuli or stimuli maintained in visual short-term memory. Adults and 10-year-olds completed an attentional orienting task while event-related potentials (ERP) were recorded. Participants were shown an array of four differently coloured stimuli followed by a probe stimulus, and had to indicate whether the probe matched one of the four stimuli in colour. In pre-cue trials, a cue was presented before the array and guided participant's attention to one of the upcoming stimuli. In retro-cue trials, an informative spatial cue was shown after the array. In neutral trials, uninformative cues were shown before and after the array. Analyses compared accuracy and latency for responding in pre-cue, retro-cue and neutral trials to determine commonalities and differences in the deployment of attentional processes in the three conditions. Neural responses to cues, as well as to the location of targets in upcoming and memory arrays, will highlight mechanisms through which younger and older participants orient attention spatially and represent the spatial distribution of items in the arrays. Behavioural data demonstrate clear attentional benefits in both children and adults, although ongoing ERP differences remain for discussion.

The association between native grammar acquisition and arithmetic learning

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The basis for the human capacity for mathematics is not fully understood yet. Children with specific language impairment (SLI) display problems with arithmetic, as well as deficits in language, particularly grammar acquisition (Fazio, 1996; Donlan et al., 2007). A longitudinal study was conducted to explore whether there is a connection between grammar development and arithmetic in normally developing children and whether this relationship is accounted for by domain-general factors, such as reasoning ability and working memory. 128 children from four primary schools were tested twice a year for three and a half consecutive years, starting from Year 1. A mixture of established and newly developed measures were administered, including the new tests of conditional sentence acquisition and arithmetic story problem solving. Grammar acquisition was significantly related to arithmetic performance, even after controlling for age, non-verbal ability, verbal short-term and working memory. In fact, complex grammar development in Year 2 significantly predicted performance on arithmetic story problems in Year 4, independently of these factors ( $R^2=0.078$ ,  $F(1,87)=12.98$ ,  $p=0.001$ ). Thus the link between grammar development and arithmetic performance is not specific to children with SLI and is not completely accounted for by the obvious domain-general factors. Therefore, it deserves further investigation.

Donlan, C., Cowan, R., Newton, E., & Lloyd, D. (2007). The role of language in mathematical development: Evidence from children with specific language impairments. *Cognition*, *103*, 23–33.

Fazio, B.B. (1996). Mathematical abilities of children with specific language impairment: A 2-year follow-up. *Journal of Speech and Hearing Research*, *39*, 839–849.

The effect of delayed feedback on action learning: Findings from a new behavioural paradigm.

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Previous investigations concerning the effects of reinforcement delay have produced a range of estimates of the point at which performance deteriorates. This duration would seem to lie in the order of one to two seconds when feedback is success contingent (Black, Belluzzi & Stein, 1985; Elsner & Hommel, 2004; Shanks, Pearson & Dickinson, 1989) and around 50-300ms when feedback is continuous (Held, Efstathiou, & Greene, 1966; Kitazawa, Kohno & Uka, 1995; Miall, Weir, & Stein, 1985). Here we present data from two versions of a location finding task, designed to investigate action learning (Redgrave and Gurney, 2006). Discrete instances of auditory feedback were provided, contingent on a joystick being moved into a target location. We found a greater sensitivity to delay when feedback was repeated within trials than when repeated between trials, with delays as short as 150 milliseconds having an effect in the former design. This result differs from previous studies of feedback delay in operant conditioning paradigms and suggests that our task offers the potential to investigate novel aspects of action learning.

Black, J., Belluzzi, J. D. & Stein, L. (1985). Reinforcement delay of one second severely impairs acquisition of brain self-stimulation. *Brain Research*, *359*, 113-119.

Elsner, B. & Hommel, B. (2004). Contiguity and contingency in action-effect learning. *Psychological Research*, *68*, 138-154.

Held, R., Efstathiou, A., & Greene, M. (1966). Adaptation to displaced and delayed visual feedback from the hand. *Journal of Experimental Psychology*, *72*(6), 887-891.

Kitazawa, S., Kohno, T. & Uka, T. (1995). Effects of delayed visual information on the rate and amount of prism adaptation in the human. *The Journal of Neuroscience*, *75*, 7644-7652.

Miall, R., Weir, D., & Stein, J. (1985). Visuomotor tracking with delayed visual feedback. *Neuroscience*, *16*(3), 511-520.

Redgrave, P. & Gurney, K. (2006). The short-latency dopamine signal: A role in discovering novel actions? *Nature Reviews Neuroscience*, *7*, 967-975.

Shanks, D. R., Pearson, S. M. & Dickinson, A. (1989). Temporal contiguity and the judgement of causality by human subjects. *The Quarterly Journal of Experimental Psychology*, *41B*, 139-159.

## NOTES

## **Local Information**

### **College Accommodation**

Bed and breakfast accommodation has been reserved for the nights of 12-15th April at St. John's College, where rooms are £47 per night, including breakfast. No double or en-suite rooms are available. St. John's is located on St. Giles, a 10 minute walk from railway station and bus station; from the back gate (see map) the Department of Experimental Psychology is only 2 minutes walk away. Rooms will be available from 12 noon and keys should be collected from the Porters' Lodge at the College on arrival.

Those attending the EPS meeting can make reservations for accommodation and/or the conference dinner using the enclosed booking form, which should be returned before 25th March 2011. Cheques must be made payable to "St. John's College" and sent to Professor Kate Nation, St. John's College, Oxford, OX1 3JP. Please mark envelopes "EPS".

### **Hotels and Guest Houses**

For details of hotels and B&Bs in Oxford, see the "Visit Oxfordshire" website, [www.visitoxfordandoxfordshire.com/accommodation](http://www.visitoxfordandoxfordshire.com/accommodation). Other Colleges may be able to offer reasonably priced B&B accommodation for attendees wishing to stay in a double or en-suite room, for details, see [www.conference-oxford.com/?p=individual\\_conf](http://www.conference-oxford.com/?p=individual_conf) and [www.oxfordrooms.co.uk/](http://www.oxfordrooms.co.uk/)

### **Travel**

For information on directions and maps you are invited to consult the Oxford University website at: [http://www.ox.ac.uk/visitors\\_friends/maps\\_and\\_directions/index.html](http://www.ox.ac.uk/visitors_friends/maps_and_directions/index.html). There is no parking available at the University or College. If you wish to use your car and are not staying overnight, we recommend you use the Park and Ride sites instead of bringing your car into the city centre.

Both bus and rail stations are located centrally, approximately 10 minutes walk from St. John's and a 15-20 minute walk from the Department. Taxi ranks are nearby and a reliable local minicab service is 001, telephone 01865 240000

The meeting will be taking place in the Department of Experimental Psychology, South Parks Road. The Mid-career award lecture and the poster session/drinks reception will be at St. John's College.

A printable map showing the stations, the Colleges and the Departments can be downloaded from [www.ox.ac.uk/visitors\\_friends/visiting\\_the\\_university/index.html](http://www.ox.ac.uk/visitors_friends/visiting_the_university/index.html).

## **Local Information**

### **Eating and Drinking**

Sandwiches and snacks will be available for purchase in the Department. There is a good sandwich shop, the Tuck Shop, close to the department on the corner of Mansfield Road and Hollywell Street. A variety of good lunch venues and cafes are located in the covered market in the City Centre, as well as Pret, Starbucks etc., and supermarkets.

There are a number of restaurants close by, [www.dailyinfo.co.uk/food/index.html](http://www.dailyinfo.co.uk/food/index.html). Some Oxford notables:

For modern Italian, Jamie's on George Street (no bookings, can be a long queue) or Branca, Walton Street. Great Thai at the Chang Mai kitchen on High Street (booking recommended) and best Chinese is SoJo on Hythe Bridge Street. For pizza, there's Pizza Express off Cornmarket, and ASK on George Street. Very close to St. John's is Browns on Woodstock Road and Café Rouge, Pierre Victoire and Tapas on Little Clarendon Street. Round the corner on Walton Street you'll find Loch Fyne, Petit Blanc and a number of Indian possibilities. Wagamama is on Market Street. The Cowely Road area has lots of choice, including some cheaper offerings. More upmarket are Gee's and The Old Parsonage (both Banbury Road) or the Cherwell Boat House. A bit of a trek but worth it for a gastropub food is the Magdalen Arms on Iffley Road.

### **Conference Dinner**

The conference dinner will be held at St. John's College on Thursday 14th April at 7.15pm. The cost will be £30.00 for three courses and includes wine paid for by the EPS. Those attending the EPS meeting, please book and indicate any dietary requirements on the enclosed form which should be returned before 25th March 2011. Cheques must be made payable to "St. John's College" and sent to Professor Kate Nation, St. John's College, Oxford, OX1 3JP. Please mark envelopes "EPS".

