

2001 - April 5/6 University of Bristol

BRISTOL MEETING 2001

A scientific meeting will be held at the Burwalls Centre for Continuing Education, University of Bristol on 5/6 April, 2001. The local organiser will be Professor M A Conway.

Burwalls offers accommodation and breakfast and stands in its own woodland near Brunel's beautiful Suspension Bridge, which is the most famous landmark of Bristol's best known quarter – Clifton. Mainly Georgian, Clifton Village is a most sociable place – with wine bars, excellent shopping, antique shops and a wide variety of restaurants.

Invited Lecture

Thursday 5 April 5.30-6.30

The relation between counterfactual and causal reasoning: experimental findings and implications for jurors' decisions

Barbara A Spellman, University of Virginia, USA

Symposium

Friday 6 April 10.00-1.00

Inhibitory processes in human memory

Organised by Martin A Conway

Presentations

Sessions will be held in the Lecture Hall and Room 1. Both lecture rooms have OHP and slide projector facilities and data projector available for Powerpoint presentations.

Presenters **must** provide their own laptops. In case of queries about projection arrangements, please contact Sue Chamberlain, Department of Experimental Psychology, University of Bristol, Tel: 0117 928 8327, email:

Sue.Chamberlain@bristol.ac.uk .

Wednesday 4 April

The bar at Burwalls will be open from 6.30pm.

There will be a drinks reception on Thursday evening at 6.30 in the lounge at Burwalls.

The conference dinner will be at 7.30 on Thursday, at The Muset, 16 Clifton Road, Clifton. A booking form is enclosed.

THUR 5 APRIL a.m.

Lecture Hall

9.00 Alastair D Smith* and Iain D Gilchrist (University of Bristol)

The workers control the means of production: mental imagery and drawing.

9.30 Jackie Chappell* and Professor A Kacelnik (Department of Zoology, University of Oxford)

The right tools for the job: Selectivity of tool length in new caledonian crows

10.00 Kenneth C Scott-Brown* and Timothy R Jordan (University of Nottingham)

Assessing the role of exterior, interior and initial letter pairs in reading.

10.30 Tim Jordan and Michelle Redwood* (University of Nottingham)

An examination of effects of word length on performance with lateralized displays.

11.00 COFFEE

THURS 5 APRIL a.m.

START OF PARALLEL SESSION

Session A

Lecture Hall

11.30 John F Culling and Chaz Yee Toh* (Cardiff University)

Effect of reverberation, spatial separation and variation of fundamental frequency on the understanding of speech against interfering speech.

12.00 Jeffrey S Bowers, Sid Kouider* and Astrid Schloerscheidt* (University of Bristol and CNRS, Paris)

Current evidence does not support the conclusion that syntax precedes phonology by 40ms: Challenging the Turenout et al. (1998) finding.

12.30 D V M Bishop (University of Oxford)

Individual differences in handedness and specific language impairment: evidence against a genetic link

1.00 LUNCH

Session B

Room 1

11.30 John Findlay and Valerie Brown* (University of Durham)

How do our eyes decide where to look next?

12.00 Eugene McSorley* and John M Findlay (University of Durham)

Visual search with depth

12.30 Casimir J H Ludwig* and Iain D Gilchrist (University of Bristol)

Stimulus-driven and goal-driven control over visual selection

END OF PARALLEL SESSION

1.00 LUNCH

THURS 5 APRIL p.m.

Lecture Hall

2.00 Catriona M E Ryan*, Stephen E G Lea, Anna-Sofia Alklind* and Winand H Dittrich (University of Exeter, Department of Computer Science, University of Skövde, Sweden and University of Hertfordshire)

Discrimination of natural movement categories by chickens using fully-detailed and point-light stimuli

2.30 Petroc Sumner* and J D Mollon (Division of Neuroscience, Imperial College School of Medicine, London and University of Cambridge)

Exogenous orienting of attention to stimuli visible only to short-wave-sensitive cones: A test of collicular mediation.

3.00 Chris Olivers* and Glyn Humphreys (BBSRC, University of Birmingham)

Visual marking modulates singleton capture: A case for inhibitory transfer.

3.30 TEA

4.00 Elaine Funnell and Diana Hughes* (Royal Holloway University of London)

Object co-ordinates and the processing of relative position in space

4.30 David A Lagnado* and David R Shanks (University College London)

Violations of the extension rule in hierarchical learning tasks

5.10 Business Meeting (Members only) Room 1

5.30 Barbara A Spellman (University of Virginia)

The relation between counterfactual and causal reasoning: experimental findings and implications for jurors' decisions

6.30 Reception – Burwall's

7.30 DINNER – The Muset (about 15 mins walk from Burwalls)

FRIDAY 6 APRIL a.m.

Lecture Hall

9.00 Josephine Cock*, David R Shanks and Annette Kinder* (University College London and Philipps-Universität Marburg, Germany)

Manipulation of processing fluency in an artificial grammar learning task

9.30 Richard J Tunney* (Introduced by David Shanks) (University College London)

Implicit and explicit knowledge decay at different rates

Symposium

Inhibitory processes in human memory

Organised by Martin A Conway

10.00 Barbara A Spellman* and Elizabeth W Dunn* (University of Virginia)

From word lists to stereotypes: Inhibition in higher-order cognition

10.30 C Neil Macrae*, Jason P Mitchell*, Jonathan W Schooler* and Angela C Rowe* (University of Bristol, Harvard University and University of Pittsburgh)

Unintentional forgetting: Subliminal cues alter nonconscious memory strategies

11.00 COFFEE

11.30 C J A Moulin, T J Perfect, M A Conway, A S North* and A James* (University of Bristol; Research Institute for the Care of the Elderly, St. Martin's Hospital, Bath; and University of Plymouth)

Unintentional remembering and intentional forgetting in Alzheimer's disease:

Retrieval induced forgetting

12.00 T J Perfect, J Tree*, C J A Moulin, R Hutter* and L Stark* (University of Plymouth and Research Institute for the Care of the Elderly, St. Martin's Hospital, Bath)

What causes retrieval induced forgetting?

12.30 Mihaly Racsmany* and Martin A Conway (University of Bristol)

Intentional and automatic inhibition of memory processes

End of Symposium

1.00 LUNCH

FRIDAY 6 APRIL p.m.

Lecture Hall

2.00 Pilar Andres*, Fabrice Parmentier* and Martial Van der Linden* (University of Plymouth and University of Liege) (Introduced by Professor Tim Perfect)

Directed forgetting in working memory: Age related differences

2.30 John N Towse, Graham J Hitch and Una Hutton* (Royal Holloway and University of York)

Exclusive: Top secret memories of spy controller revealed! What children's game play tells us about working memory.

3.00 Sebastian J Crutch* and Elizabeth K Warrington (Dementia Research Group, National Hospital for Neurology and Neurosurgery, London)

Refractory-access dyslexia: evidence of multiple task-specific phonological output stores

3.30 TEA

4.00 Satoru Saito* and Alan D Baddeley (University of Bristol and Osaka University of Education)

Two irrelevant speech effects: Implications for short-term memory and speech production

4.30 Stian Reimers* and Stephen Monsell (University of Cambridge and University of Exeter)

Phonological working memory: two buffers or one?

End of Meeting

The workers control the means of production: mental imagery and drawing.

Alastair D Smith and Iain D Gilchrist

University of Bristol

In the model of drawing presented by van Sommers (1989), cognitive processes, such as imagery, are separate from production processes, such as where in the drawing to start or when to take the pen off the paper. Here we investigate whether such processes are indeed independent.

In Experiments 1-3 we focus on starting position in right-angled triangles (stimuli with a stereotypic starting point). When subjects mentally rotated the stimulus prior to copying there was a reliable shift in preferred starting position consistent with the direction of rotation (Experiment 1). There was no such effect for 'flip' imagery (Experiment 2). For 'reflection' imagery (Experiment 3) starting position was only reliably translated when the triangle to be copied was not occluded by the hand during drawing.

The number of pen lifts is dependent on the size of the drawing. In Experiment 4, subjects enlarged or reduced the shape to be copied ('size' imagery). Pen lifts did not

depend on the size of the shape produced but on the size of the original. These results suggest a far closer relationship between the cognitive and motor components of drawing, in which cognition processes, such as imagery, influence low level motoric factors, such as where in the drawing to start or when to take the pen off the paper.

van Sommers, P. (1989). A system for drawing and drawing-related neuropsychology. *Cognitive Neuropsychology*, 6(2), 117-164.

The right tools for the job: Selectivity of tool length in new caledonian crows

Jackie Chappell and Professor A Kacelnik

Department of Zoology, University of Oxford

New Caledonian crows (hereafter, crows) are unique amongst birds in their tool using and manufacturing abilities. In the wild they use tools habitually, manufacture distinct tool types by shaping the raw material, and show population level specialization in how tools are manufactured. However, it is not known whether they have a functional understanding of tools, with the ability to recognise the requirements of a particular task, and to select or manufacture tools that fulfil the specifications. Here, two captive crows were presented with a novel task in which inaccessible food was placed at a range of distances, and could only be obtained using tools above a certain minimum length. Both birds chose tools that matched the minimum length significantly more often than expected by chance. In a further experiment, one of the crows was tested with the tools placed in a location which was visually inaccessible from the location of the food, so that tool selection had to be done from memory. The crow chose a tool of the minimum required length or longer significantly more often than expected by chance. The results suggest that the crows are selective, and do not choose tools independently of the task.

Assessing the role of exterior, interior and initial letter pairs in reading.

Kenneth C Scott-Brown and Timothy R Jordan

University of Nottingham

A substantial body of research using single word presentations indicates that exterior letter pairs play an unusually important role in word recognition (e.g., Humphreys et al. 1990; Jordan, 1990, 1995; Jordan, Thomas & Scott-Brown, 1999). However, Briihl and Inhoff (1995) measured the effect of parafoveal disruption of specific letter groups on fixation durations and found no evidence in support of this role in reading text. To explore the role of exterior letter pairs in reading more directly, we employed a letter degradation technique in extended passages of prose. Three different types of letter pair (exterior, interior and initial) were degraded by Gaussian filtering. Text passages were presented on a computer screen and the time taken to read each passage recorded. Performance in each condition was compared to performance with matched undegraded passages. Results show that reading overall was slower when words were presented in degraded formats. More importantly, degrading exterior letters produced a greater decrement in performance relative to degrading other letter pairs. These findings indicate that, contrary to the findings of Briihl and Inhoff (1995) but consistent with the findings from single word research, the exterior letter pairs of words play an unusually important role in reading.

- Briihl, D., & Inhoff, A. W. (1995). Integrating Information Across Fixations During Reading: The Use of Orthographic Bodies and of Exterior Letters. *Journal of Experimental Psychology: Learning Memory and Cognition*, 21, 55-67.
- Humphreys, G. W., Evett, L. J., & Quinlan, P. T. (1990). Orthographic processing in visual word identification. *Cognitive Psychology*, 22, 517-560.
- Jordan, T. R. (1990). Presenting words without interior letters: Superiority over single letters and the influence of postmask boundaries. *Journal of Experimental Psychology: Human Perception and Performance*, 16, 893-909.
- Jordan, T. R. (1995). Perceiving exterior letters of words: Differential influences of letter-fragment and non-letter-fragment masks. *Journal of Experimental Psychology: Human Perception and Performance*, 21, 512-530.
- Jordan, T. R., Thomas, S. M., & Scott-Brown, K. C. (1999). The illusory-letters phenomenon: An illustration of graphemic restoration in visual word recognition. *Perception*, 28, 1413-1416.

An examination of effects of word length on performance with lateralized displays.

Tim Jordan and Michelle Redwood

University of Nottingham

Previous research indicates that increasing word length (i.e., number of letters) affects performance with words presented in the left visual field (LVF) but not the right visual field (RVF). A number of researchers have suggested this finding reflects parallel orthographic processing by the left hemisphere and sequential processing by the right. However, previous findings may be contaminated by non-central fixations and sophisticated guesswork which conspire to reduce the impact of increasing length on performance with RVF stimuli. We examined whether the effect of word length on performance with LVF stimuli prevailed when these problems were overcome using controlled central fixations and a forced choice procedure (the Reicher-Wheeler task) to suppress influences of sophisticated guesswork. Substantial RVF advantages and word-nonword effects obtained but no effect of length on performance in either hemifield was observed. These findings provide no support for the parallel-sequential distinction previously drawn between the way in which the hemispheres process words.

Effect of reverberation, spatial separation and variation of fundamental frequency on the understanding of speech against interfering speech.

John F Culling and Chaz Yee Toh

Cardiff University

Reverberation has little effect on sound localisation, but can severely disrupt listeners' ability to exploit differences in spatial location between speech and noise in a speech understanding task. Previous research using concurrent synthesised vowels has also shown that listeners ability to exploit differences in fundamental frequency (F0) between voices is disrupted when the vowels modulate in F0 and are presented in a reverberant environment [Culling et al. (1994) *Speech Communication*, 14, 71-96]. The present experiment tested these findings using continuous speech. Speech reception thresholds were measured for male speech against a single interfering voice of higher mean F0. The voices were either unprocessed or artificially monotonised and then presented in

different virtual acoustic listening environments. These simulations did not include the effects of head-shadow. In these environments, the voices were either co-located in front of the listener or separated to left and right by 120 degrees, and were either in an anechoic or a reverberant room. In anechoic conditions, thresholds were 2-3 dB higher when the voices were monotonised and 2-3 dB lower when they were in separate spatial locations. In reverberant conditions, thresholds were higher overall and did not show any effects of spatial separation or monotonisation.

Current evidence does not support the conclusion that syntax precedes phonology by 40ms: Challenging the Turenout et al. (1998) finding.

Jeffrey S Bowers¹, Sid Kouider² and Astrid Schloerscheidt¹

1. University of Bristol

2. CNRS, Paris

Based on ERP data, Turenout, Hagoort, & Brown (1998) argued that syntax is accessed prior to phonology by approximately 40 ms in language production. This conclusion was based on ERPs associated with the process of generating Dutch noun phrases of the form "red bear" (/rode beer/) when presented with a picture of a red bear. Lateralized readiness potentials suggested that participants accessed grammatical gender of the objects 40ms prior to accessing the first phoneme of the nouns.

One problem with making any general conclusions based on these findings, however, is that adjectives in Dutch are marked for gender, and colour names precede nouns in Dutch. Thus, the faster access to gender might simply reflect the fact that gender is marked in the phonological output of Dutch speakers prior to the production of the first phoneme of the noun, and participants monitor their phonological outputs in order to respond in the experiment. In order to test this alternative hypothesis, we carried out a behavioral analog of the ERP study in French, where colour names typically follow the nouns such that gender was marked after the first phoneme of the noun. In this situation, participants were faster to respond to the first phoneme of the noun rather than its gender.

Van Turenout, Hagoort, P., & Brown, C.M. (1998). Brain activity during speaking: From syntax to phonology in 40 ms. *Science*, 280, 572-574.

Individual differences in handedness and specific language impairment: evidence against a genetic link

D V M Bishop

University of Oxford

Data from two twin studies were used to address two related questions. First, is there any association between handedness and specific language impairment (SLI) in children? Second, is there genetic influence on individual differences in handedness, and if so, are the same genes implicated in causing SLI and non-right-handedness? The first study used data from 58 MZ and 26 DZ pairs previously recruited for an investigation into the genetic origins of SLI. All pairs contained at least one child with SLI. A control group of 173 singleborn children was also tested. Handedness was assessed using a preference inventory, and a tapping task from which a laterality quotient (LQ) was derived. Data on hand preference were also available from some

parents. Twins and singleborn controls did not differ on handedness, and neither measure revealed any association between handedness and SLI. Model-fitting gave evidence for weak genetic influence on both hand preference and tapping LQ. Bivariate analysis indicated no overlap in genetic influences on SLI and handedness. The second study used a general population sample of 48 MZ and 44 DZ twin pairs aged 7 to 13 years. Handedness was assessed using a preference inventory and a pegmoving task. A subset of children was also given a Quantification of Hand Preference (QHP) test that assessed persistence of hand preference when reaching across the midline. The latter was the only measure to relate to children's language status, with language-impaired children showing less midline crossing. This appears to reflect neurodevelopmental immaturity, rather than a stable trait. In study 2, the QHP task was the only handedness measure to show any hint of genetic influence. Overall, it is concluded that genes may play a small role in determining stable individual differences in hand preference, but their influence is overshadowed by the substantial effect of environmental influences specific to the individual. There is no evidence of shared genetic influence on handedness and SLI.

How do our eyes decide where to look next?

John Findlay and Valerie Brown

University of Durham

In normal vision, the eyes make saccadic movements at a rate of three or four per second. For each movement, a miniature decision is made about where the eyes are next to be directed. To further our understanding of the nature of these decisions, a task was devised that required an observer to scan through a set of randomly positioned elements in a display. On different trials, the set might contain 3, 6, 9 or 12 items. Analysis of the eye scans demonstrated a number of factors that influence eye scanning: a) the eyes are very accurately directed towards display items unless more than one item happens to be present in a relatively narrow 'beam' which has been chosen for the saccade direction, b) display items are very rarely scanned more than once. This is attributed to a combination of an 'inhibition of return' like factor and an ability to keep track of items scanned, up to at least 9, c) moving to the closest item not already scanned appears to be used as an effective heuristic, d) some, although not all, observers show clear evidence for idiosyncratic scanning strategies. Although these factors all have demonstrable influence, a large amount of residual variability is also present and repeat eye scans by the same individual on the same display will frequently differ.

Visual search with depth

Eugene McSorley and John M Findlay

University of Durham

Disparity has been identified as one feature allowing a target to pop-out in a visual search task. We report an experiment examining oculomotor responses (version and vergence) to a disparity defined target. Subjects were required to move their eyes to the target, defined solely by its stereo depth, when it was presented amongst a set of distractors in a ring configuration with eight elements equidistant at an eccentricity of 4

deg from fixation. Eye movements were recorded with two DPI eye trackers. On nearly all occasions, a version response (eye saccade) was correctly directed to the target, showing that disparity pop-out allows rapid ocular orienting. In general, these saccades were disconjugate in an appropriate manner and on average 41% of the required vergence was carried out during the saccade. The results suggest that this saccadic disconjugacy was directed by stereo depth information from the saccade target, implying rapid peripheral pre-processing of disparity information exclusively from the target location. However, there were a number of notable instances when the saccade was correctly directed but the vergence was not. These mismatches between saccade and vergence movements suggest implications for target selection.

Stimulus-driven and goal-driven control over visual selection

Casimir J H Ludwig and Iain D Gilchrist
University of Bristol

Previous research in visual attention has shown that stimulus-driven factors can override goal-driven control in visual selection. The present study was designed to explore the extent to which stimulus-driven capture by irrelevant abrupt onsets is modulated by goal-driven factors (target similarity).

Observers searched for a colour target amongst distractors and indicated its location either manually or with a saccade. On some trials, an additional distractor was presented, either with or without an abrupt onset and either similar or dissimilar to the target. For saccade programming, irrelevant distractors were most disruptive when similar to the target and onsets were more disruptive than no onset distractors. In contrast, the manual responses were mainly affected by similarity to the target. The discrepancy between the two types of response is explained in terms of differences in the resolution of target localisation and in terms of the extent to which the distractor afforded a response. The results are discussed in terms of a model in which both stimulus-driven and goal-driven factors contribute to a salience map that determines target selection.

Discrimination of natural movement categories by chickens using fully-detailed and point-light stimuli

Catriona M E Ryan¹, Stephen E G Lea¹, Anna-Sofia Alklind² and Winand H Dittrich³

1. University of Exeter

2. Department of Computer Science, University of Skövde, Sweden

3. University of Hertfordshire

Bantam hens were exposed to a discriminated autoshaping procedure in which categories of moving stimuli, presented on computer, were differentially associated with reinforcement. All stimuli depicted pigeons making defined responses. One category consisted of several different scenes of pecking and the other consisted of scenes of walking. For some birds, the movements were recorded in full light and shown in full detail; for others, the movements were represented only by a small number of point lights (Johansson's "biological motion" displays). Eleven of the 16 birds reached criterion, with a final performance of at least 80% correct within 27 sessions; the remaining birds reached at least 60% correct within 30 sessions. Fifteen of the birds

were then transferred to a second discrimination, in which the alternative kind of stimuli were used. For seven of the birds, the second discrimination was compatible with the first (e.g. fully-detailed stimuli with walking as the positive category were followed by point-light stimuli with walking also positive), for the remaining eight the second discrimination was incompatible (e.g. fully-detailed stimuli with walking positive were followed by point-light stimuli with pecking positive). Performance on the first session of the second discrimination was better for the birds experiencing compatible transfer than for those experiencing incompatible transfer, demonstrating that some transfer of training between the two discriminations did occur. Four of the 'compatible' birds and five of the 'incompatible' ones attained a final performance of at least 80% correct in the second discrimination: however the 'compatible' birds did so rather faster, in a mean of 13 sessions compared with 17.8 sessions for the 'incompatible' birds. The remaining birds had a mean final performance of 67% correct (compatible) and 63% correct (incompatible) when training was stopped at 30 sessions.

We conclude that chickens, like humans, are able to learn video discriminations based on movement cues alone, despite the manifest differences in the organisation of the avian visual system.

Exogenous orienting of attention to stimuli visible only to short-wave-sensitive cones: A test of collicular mediation.

Petroc Sumner¹ and J D Mollon²

1. Division of Neuroscience, Imperial College School of Medicine, London

2. University of Cambridge

Much of the output from the retina does not project to the visual cortex, but forms the phylogenetically older retinotectal pathway. One subcortical destination is the superior colliculus, SC, which is especially implicated in involuntary orienting of attention and the initiation of eye-movements. The SC is thought to receive no projections from short-wave sensitive cones (S cones), but we here show that peripheral stimuli visible only to S cones elicit normal involuntary attentional effects on responses to subsequent targets. We can therefore conclude one of two things, both contrary to current belief: either involuntary attentional shifts do not require signals in the direct collicular pathway, or else this retinotectal pathway does in fact include projections from S cones. Our arguments apply equally to the alternative theory that attentional capture is driven by signals in the magnocellular division of the geniculostriate pathway: this channel is also thought to be devoid of S cone input. To select stimuli that are visible only to S cones, we exploited the phenomenon of transient tritanopia: our method may be generally useful whenever the cardinal axes of colour space must be determined for individual observers and at particular retinal positions.

Visual marking modulates singleton capture: A case for inhibitory transfer.

Chris Olivers and Glyn Humphreys

BBSRC, University of Birmingham

When observers are given a 1000 ms preview of a set of distractors in a visual search task, then these distractors can subsequently be excluded from the search process. It is argued that this preview effect is (partially) caused by a top-down inhibitory process

which suppresses the old visual information - a process called visual marking. In the present study we investigated what effect visual marking has on the selection of new items, while suppressing the old items. If old items are inhibited, for instance on the basis of their colour, then new items may suffer from this inhibition if they are very similar (i.e. possess the same colour). The results show that feature singletons that normally have a strong capacity to facilitate or interfere with search, lose this capacity under preview conditions, when they match the already ignored distractors in colour, orientation, or both. This suggests an inhibitory carry-over from old to new items on the basis of similarity. Follow-up experiments indicate that the singleton modulation stems from a mixture of trials. On about half the trials, attention is successfully captured, leading to fast responses. On other trials, however, singletons still capture attention, but further processing is delayed or disrupted. We propose a late disruption account of singleton modulation: Old items are inhibited and some of this inhibition may transfer to new items. However, this transfer is relatively slow, allowing successful initial capture, but causing disruption in further processing.

Object co-ordinates and the processing of relative position in space

Elaine Funnell and Diana Hughes

Royal Holloway University of London

We report the case of a child with a processing disorder for the relative position and orientation of objects in space associated with an early history of viral encephalitis. Presenting symptoms included letter reversals in reading and writing, left-right confusions, and problems with copying. Tests revealed normal location of objects in space but significant difficulties with discriminating pairs of reversible shapes and locating and copying objects in similar positions. Right-left reversible objects were most confused if placed side by side and top-bottom reversible objects were most confused if placed one above the other. Reversible objects with salient features on the side nearest the other object were most vulnerable to errors. We suggest that the pattern of the disorder reflects a failure to develop object co-ordinates that encode the relative spatial position and orientation of objects in space. When available, the co-ordinates provided by the arrangement of the objects on the page constrain a tendency to reverse positions in favour of symmetry.

Violations of the extension rule in hierarchical learning tasks

David A Lagnado and David R Shanks

University College London

Despite intense debate about the applicability of the laws of probability to human judgment, the inconsistency of people's probability judgments remains a robust finding. Research in a separate learning/judgment paradigm suggests that after exposure to structured learning environments people give judgments more closely related to predictiveness than to a normative representation of probability. In a set of experiments we introduced a simple hierarchical structure into this paradigm, enabling us to set up a conflict between predictiveness and consistency. Thus a target cue was more predictive of a subordinate outcome than of its superordinate category, even though the latter included the former. Under a probability response format participants tended to violate

consistency and rate the subordinate outcome higher than its superordinate. However, with a frequency response format their ratings were more normative. These results are difficult to explain within a unitary model: a frequency-encoding device cannot account for the inconsistencies under the probability format, a simple associative mechanism cannot account for the frequency format effect.

The relation between counterfactual and causal reasoning: experimental findings and implications for jurors' decisions

Barbara A Spellman

University of Virginia

People often engage in causal reasoning -- that is, trying to discover the causes of the events around them. For example, they might ask why their child behaves a certain way or why their football (or soccer) team lost. People also often engage in counterfactual reasoning -- that is, imagining the world other than it is and playing out the consequences. In its most common guise people choose to imagine an early event ("antecedent") being different (e.g., a player wasn't injured) so that the outcome ("consequent") would be different (e.g., their team wins). Our legal system requires jurors to make decisions about causality in many kinds of cases. Obviously, the idea of causality is essential in law: in general, we do not wish to punish or impose liability on someone unless he or she caused the damage at issue. In fact, the legal system often asks jurors to do causal reasoning by virtue of doing counterfactual reasoning. For example, the American Model Penal Code states that: "Conduct is the cause of a result when it is an antecedent but for which the result in question would not have occurred..." My talk focuses on research dealing with two specific questions regarding the relation between counterfactual and causal reasoning that are relevant to legal causal judgments. First, is counterfactual reasoning really the basis for causal judgments? Psychology's answer to that question has changed over time and research involving legally complex situations (i.e., cases of multiple sufficient causes) demonstrates that counterfactual reasoning cannot be the basis for all causal judgments. Second, in what way does counterfactual reasoning affect causal reasoning? Quite a bit of research has been amassed showing that making a counterfactual judgment can affect later causal judgments. I will make some suggestions as to when and why it does so - and that, in fact, it should do so. Finally, I will consider the implications of this research for jurors' causal decisions.

Manipulation of processing fluency in an artificial grammar learning task

Josephine Cock¹, David R Shanks¹ and Annette Kinder²

1. University College London

2. Philipps-Universität Marburg, Germany

It is controversial in artificial grammar learning studies whether participants classify novel strings via rule abstraction or via an attributional process in which familiarity is fundamental. The latter view proposes that test items composed of familiar components are processed more fluently and that, given the task requirements, participants attribute this fluency to grammatical status. Two experiments are reported in which processing fluency is artificially manipulated. The first provides evidence that, as well as component

familiarity, processing fluency differences induced at test can affect classification. The second investigates the degree to which participants can exert deliberate (explicit) control over this effect.

Implicit and explicit knowledge decay at different rates

Richard J Tunney

University College London

A key claim of theories of implicit cognition is that implicit and explicit knowledge decay at different rates. I examined whether priming for sequences generated by a finite-state grammar was preserved after recognition of those sequences had decayed. In a training phase participants responded to sequences of letters generated by a finite-state grammar. A control group responded to randomised sequences. Participants were tested immediately following training and after an interval of seven days. During each test participants were asked to respond to each letter of both old and new sequences, and concurrently whether they recognised them from the training phase. Priming was indexed by the time taken to respond to the sequences. In the immediate test both priming and recognition were substantially greater than the control group. In the delayed test the level of priming remained unchanged but recognition had fallen to the level of controls. The data indicate that knowledge can affect behaviour after it has become unavailable to direct tests of memory even when administered concurrently. The data are discussed with reference to both single and dual process models of implicit cognition.

From word lists to stereotypes: Inhibition in higher-order cognition

Barbara A Spellman and Elizabeth W Dunn

University of Virginia

Recent research theorizes that inhibitory mechanisms play an important role in many aspects of higher order cognition including categorical memory, metaphor comprehension, eyewitness memory, person perception, and stereotype use. Various studies demonstrate that when people attempt to activate or use (i.e., "select") only some subset of their knowledge about a topic, making that knowledge more accessible results in other related knowledge becoming less accessible (i.e., some would say "inhibited").

But when does such an impairment count as evidence for actual inhibitory mechanisms? From previous research using categorized word lists (Anderson & Spellman, 1995), we believe that to demonstrate inhibitory mechanisms one needs: appropriate baseline conditions against which to measure impairment (to show that it is specific to competing representations rather than general to all non-selected information) and an independent probe method (to show that representations are actually suppressed and not just less accessible to particular cues). We will illustrate the use and misuse of these methods with several examples. Then we will present two new studies involving memory for stereotype-related traits that ask (1) whether selectively using information relevant to one aspect of identity (e.g., profession) may inhibit memory for information related to another aspect of identity (e.g., race) and (2) whether selectively using individuating traits may inhibit memory for stereotype-related traits (and vice versa). Finally we ask

whether, given the different structure of stereotypes and typical categories, we should, in fact, expect inhibition to work the same on both of them.

Unintentional forgetting: subliminal cues alter nonconscious memory strategies

C Neil Macrae¹, Jason P Mitchell², Jonathan W Schooler³ and Angela C Rowe¹

1. University of Bristol
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Research on forgetting has generally focused on strategies through which people can disregard irrelevant or unwanted information (i.e., directed forgetting). In everyday life, however, the dismissal of unwanted information typically occurs without conscious intent, thereby suggesting an alternate nonconscious route through which forgetting can occur. Following Chartrand and Bargh (1996), we suggest that situation-specific cues may automatically trigger unconscious mnemonic strategies that produce enhanced memory for useful information and impaired memory for unwanted material. Two experiments are reported that replicate the standard pattern of item-based directed forgetting on recognition memory, but using subliminal "remember" or "forget" cues to trigger the relevant mnemonic strategies. These forgetting effects are traced to the operation of a covert strategy of selective rehearsal.

Unintentional remembering and intentional forgetting in Alzheimer's disease: Retrieval Induced Forgetting

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Alzheimer's disease (AD) is typified not only by very low levels of recall on tests of episodic memory, but also high levels of recall of non-presented items (intrusion errors). Using the Retrieval Induced Forgetting (RIF) procedure in AD patients and older adult controls we explored the possibility that the high levels of intrusion errors in AD may be due to a deficit in inhibitory processes in episodic memory. Participants studied lists of category-exemplar pairs, then practised retrieval for a subset of items from a subset of categories before taking a final memory test for all studied items. Inhibition was measured as the difference between final memory performance for unpractised items from practised categories (RP-) and unpractised items from unpractised categories (U). The AD participants showed the standard pattern of lower recall of RP- items relative to U items. With both explicit (cued recall) and implicit tests (category generation) of memory, we found no evidence of an inhibitory deficit in episodic memory in AD. This indicates that intrusion errors are not due to a deficit in inhibition as measured by the RIF procedure. Interestingly, a test of stem completion implies that the underlying activation of RP- and U items was higher than baseline, indicating that although recall of an item is inhibited, its registration in memory is actually facilitated. We compare this apparent conflict between availability and accessibility in terms of intrusion errors in AD.

What causes retrieval induced forgetting?

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The retrieval induced forgetting effect is the inability to recall a previously studied word following repeated retrieval of a related item. Anderson and Spellman (1995) argued that an inhibitory account is required because the effect is independent of the cue used at test. Under their account the repeated activation of one competitor at practise causes lateral inhibition - and so forgetting - of the related, but non-practised item. However, we present 3 experiments that are incompatible with this view. Experiment 1 shows that retrieval induced forgetting can occur between unrelated items. Experiment 2 shows that repeated retrieval of the practised item without its cue does not produce forgetting of a competitor. In Experiment 3 the practised and unpractised items shared 2 cues at study, only one of which was used at practise. If the cue used at practised was used at test, the forgetting effect was observed. However, if the alternate- or both-cues, were used at test, there was no forgetting. Thus, in all 3 experiments the presence of the cue at practise and test is critical for the effect. These data contradict the idea that retrieval induced forgetting is due to lateral inhibition of the non-practised item.

Anderson, M. C. & Spellman, B. A. (1995). On the status of inhibitory mechanisms in cognition: memory retrieval as a model case. *Psychological Review*, 102, 68-100.

Intentional and automatic inhibition of memory processes

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A range of current theories assume that individual differences in inhibitory capacity are responsible for performance in many cognitive abilities. For instance, subjects who are able to suppress irrelevant elements, inappropriate meanings or incorrect forms of homophones show better performance in text comprehension and have larger working memory capacity. The focus of our research was whether memory inhibition is a unitary process or different kinds of inhibitory processes underlie the well known experimental paradigms. We have investigated two widely used inhibitory paradigms, directed forgetting (DF) and retrieval induced forgetting (RIF). The application of these procedures could be theoretically interesting because DF is an intentionally elicited inhibitory task while in RIF inhibition probably emerges automatically as a result of practice. In our first experiment 120 subjects took part in a DF (list method) and in a RIF experiment. Although we found significant inhibitory effects in both procedures there was no correlation between inhibitory performances in DF and RIF. This result supports the view that two different kinds of inhibition operate in these tasks. The second experiment involved 111 subjects who took part in a standard DF, a RIF and a modified RIF procedure. As in the first experiment we found no correlation between any of these inhibitory effects. These results are consistent with the assumption that memory inhibition is not a unitary process.

Directed forgetting in working memory: Age related differences

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This study explored the effects of aging on working memory by means of the directed forgetting procedure designed by Reed (1970). Memory for a consonant trigram was compared in conditions where it was either presented alone (single-item), or followed by a second trigram to be recalled (interference), or followed by a second trigram to be forgotten (directed forgetting). The results clearly indicated that elderly participants were more sensitive to interference from no-longer relevant information they failed to inhibit, as predicted by the model of Hasher and Zacks (1988). However, the results also demonstrated that sensitivity to interference increased in a condition in which no inhibition was directly required. The concept of interference will be discussed with regard to the hypotheses of inefficient inhibitory mechanisms and of a reduction of working memory capacity.

Exclusive: Top secret memories of spy controller revealed! What children's game play tells us about working memory.

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Recent research has led us to question the prevalence of resource-based models of working memory span (e.g. Towse, Hitch & Hutton, 2000). Here, we consider a somewhat-related interpolated-task paradigm developed by Posner & Rossman (1965), long regarded as showing a trade-off among adults between processing difficulty and rate of information loss. Transforming the task into a computer-based game, children either rapidly dispatch commander signals to an appropriate secret agent, or hide information in a 'top secret' folder. They subsequently attempt to recall the top secret folder contents. Three experiments, involving 183 children, explore how memory varies with the difficulty, complexity and duration of the decision process for sending signals to secret agents. The effect of different memoranda is also considered. We conclude that the original Posner & Rossman conclusions may be misleading. Nonetheless, subtle task strategies appear to give the illusion of trade-off phenomena.

Posner, M. I., & Rossman, E. (1965). Effect of size and location of informational transforms upon short-term retention. *Journal of Experimental Psychology*, 70, 496-505.

Towse, J. N., Hitch, G. J., & Hutton, U. (2000). On the interpretation of working memory span in adults. *Memory & Cognition*, 28(3), 341-348.

Refractory-access dyslexia: evidence of multiple task-specific phonological output stores

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We investigated the case of a patient with a dementing illness whose reading was characterised by multiple phonemic paraphasic errors. An error analysis of a large corpus of reading responses (760 words, 86 nonwords) highlighted the preponderance of phonological errors which did not occur in his naming, repetition or spontaneous speech. His comprehension of the written word was relatively preserved, even for words he was unable to read aloud. We suggest his impairment lies at the level of the phonological output store. Increasing the response-stimulus delay was also shown to

have a facilitatory effect upon reading but not naming or repetition performance ($z=4.17$, $p<0.0001$, 2-tailed).

Two main points are drawn from our results. First, we argue that our patient can be characterised as having a refractory-access type of deficit. To our knowledge no previous case of a refractory deficit affecting word reading has been reported. Secondly, the task-specificity of both the phonological error pattern and the sensitivity to temporal factors is difficult to reconcile with the idea of a unitary phonological output store. Contrary to orthodox neuropsychological models, we propose there are independent stores specific for reading and spoken output.

Two irrelevant speech effects: Implications for short-term memory and speech production

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The purpose of this study is to examine the influence of phonological similarity on the irrelevant speech effects in speaking and immediate serial recall. In Experiment 1, speech errors are induced by a technique in which participants are exposed to a speech sound immediately before the utterance of a target word. Speech sounds that are phonologically similar to the target word lead to a greater number of errors in speaking the target than do the dissimilar sounds. Furthermore, the speech error scores are significantly correlated with memory span scores. In Experiment 2, the memory span scores are again correlated with the rate of the speech errors that are induced from the task-irrelevant speech sounds. Experiment 3 and 4 show a strong irrelevant speech effect in the serial recall performance for nonwords. The magnitude of the irrelevant speech effects and the patterns of recalled errors are not, however, affected by the phonological similarity between the TBR nonwords and the irrelevant speech materials. We discuss the existence of two irrelevant speech effects with different underlying mechanisms, one operating via phonological short-term memory and the others via the processes underpinning speech production.

Phonological working memory: two buffers or one?

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In the standard model of working memory of Baddeley and colleagues (e.g. Baddeley, 1986), there is a single phonological buffer to which heard speech gains automatic access, and into which speech codes generated from meaning or from text can be coded. However, it has been argued (e.g. Monsell, 1987, Nickels, Howard & Best, 1997) that the data are better captured by a model with separate but linked input and output buffers for phonology, the former specialised for comprehension, the latter for production. The two-buffer model allows the possibility that different phonological content could be loaded into the two buffers at the same time. We tested this by requiring subjects simultaneously to encode a visual stream of words for ordered recall, and an auditory sequence of nonwords for an order-recognition probe. The dual-task

cost to estimates of capacity for each kind of sequence was much smaller than would be expected if input and output phonology must share the capacity of a single buffer.

Baddeley AD (1986) *Working memory*. Oxford University Press

Monsell S (1987) On the relation between lexical input and output pathways for speech.

In Allport A et al (Eds) *Language perception and production: Relationships between listening speaking reading and writing*. (pp 273-311) Academic Press.

Nickels L, Howard D & Best W (1997) Fractionating the articulatory loop: Dissociations and associations in phonological recoding in aphasia. *Brain & Language*, 56, 161-182.