## 1999 - March 18/19 University of Oxford

# OXFORD MEETING 1999

A scientific meeting will be held at the Department of Experimental Psychology, University of Oxford on 18th and 19th March, 1999. Accommodation will be in University College. The Local Secretary for the meeting is Faith Ayre, Research Co- ordnator, Department of Experimental Psychology.

PROGRAMME

**Wednesday 17th March (evening)**

8.30 pm Reception (University College, Beer Cellar)

**Thursday 18th March**

*Department of Experimental Psychology: Lecture Theatre B*

9.00 John Towse, Joe Redbond*, Carmel Price* and Sue Cook* (Royal Holloway University of London and University of Oxford)
Playing by the rules: The 3-year olds' conundrum.

9.30 Clare Harries* and Nigel Harvey (University College London)
Causes of the pruning bias: tests of three models

10.00 E. P. Chronicle, T. C. Ormerod and J. N. MacGregor* (Lancaster University and University of Victoria, Canada)
When less is more: Gestalt versus strategic determinants of visual problem solving

10.30 Coffee

11.00 Amanda Parker and David Gaffan (University of Oxford)
Magnocellular mediodorsal thalamic ablation does not disrupt preoperatively learned visual object associations, but impairs both new acqusition of object associations and scene learning.

11.30 E. A. Gaffan and M. J. Eacott* (University of Reading and University of Durham)

Visual object identificaion and perirhinal cortex in the rat.

12.00 EPS prize lecture
R. C. Honey (Cardiff University)
Associative priming in Pavlovian conditioning.

1.00 Lunch

2.00 Anne H. Anderson, Art Blockland*, Gwyneth Doherty-Sneddon* and Sandra McAuley* (University of Glasgow and University of Stirling)
Discourse context effects on children's spoken word productions.

2.30 Ian A. Apperly* and Elizabeth J. Robinson (University of Birmingham)
Children's related difficulties with ambiguity and referential opacity.

3.00 Elaine Funnell and Nicola Pitchford* (Royal Holloway, University of London)
Introducing the lexical reading age.

3.30 Tea

4.00 Jukka Hyönä, Alexander Pollatsek* and Raijmond Bertram* (University of Turku, Finland and University of Massachusetts)
The processing of long Finnish compound words.

4.30 V. M. Holmes and M. Babauta* (University of Melbourne)
Reading spelling: Can people improve spellings after reading them?

5.00 Angus Gellatly and Geoff Cole* (University of Keele)
New visual objects recruit processing resources.

5.30 Pamela Heaton*, Linda Pring and Beate Hermelin (Goldsmiths College, University of London)
Musical cognition in autistic children.

6.10 Business Meeting (members only)

7.30 Pre -dinner drinks. Allington Room, University College

8.00 Conference Dinner. Hall, University College

**Friday 19th March**

*Department of Experimental Psychology: Lecture Theatre B*

9.00 R. J. R. Blair (Institute of Cognitive Neuroscience, London)

Responding to emotional facial expressions in children and adults with psychopathic tendencies.

9.30 Lisa Cipolotti (National Hospital for Neurology and Neurosurgery, London)
Sparing of country and nationality names in a case of modality specific oral output impairment: implicatons and theories of speech production.

10.00 Ardi Roelofs* (University of Exeter. Introduced by Dr. D. C. Mitchell)
Perceptual cohorts and the time course of lexical access in picture naming.

10.30 Coffee

11.00 D. V. M. Bishop and D. H. Skuse* (University of Oxford and Institute of Child Health, London)
Genetic fractionation of perception and memory: evidence from Turner syndrome of distinct loci on the X-chromosome affecting neurodevelopment.

11.30 Laura Davison*, Glyn V. Thomas and Jenny Sloneem* (University of Birmingham)
Effects of drawing on young children's recall.

12.00 Martin A. Conway, Kay Harries* and Jan Noyes* (University of Bristol)
The disruption and dissolution of directed forgetting: Inhibitory control of memory.

12.30 EPS undergraduate project prize lecture
Carmel Price* (University of Oxford, formerly Royal Holloway)
On the co-ordination of verbal and spatial immediate memory in reading and mathematical ability.

1.00 Lunch

2.00 Patrick Rabbitt, Neil Pendleton*, Peter Diggle* and Fiona Holland* (University of Manchester and University of Lancaster)
Aging in the fast and slow lanes.

2.30 Christine Lowe* and Patrick Rabbitt (University of Manchester)
Do "executive" tests predict rate of change over time in a longitudinal follow-up of an elderly population?

3.00 Edward de Haan, Yvonne Sterken*, Albert Postma* and Alexandra Dingermans* (Utrecht University)
Egocentric and exocentric spatial judgements of visual displacement.

3.30 Tea

4.00 Veena Kumari* (Institute of Psychiatry, London. Introduced by Professor J. A. Gray)
Neural correlates of prepulse inhibition of the human tactile startle response: A functional MRI investigation.

4.30 J. M. Brunstrom* and B. Roberts (University of Birmingham)
Evidence of separate mechanisms of perceptual fusion of spectral components and for the calculation of global pitch.

5.00 Vicki Culpin* (University of Central Lancashire. Introduced by Professor Graham Hitch)
The many faces of grouping - a multifaceted explanation of the temporal grouping effect with visual and auditory presentation.

5.30 Meeting ends.

**Playing by the rules: The 3-year-olds' conundrum.**

John Towse1, Jo Redbond1, Carmel Price2, and Sue Cook1

1. Royal Holloway University of London
2. University of Oxford

The ways that pre-school children represent the world, and act on their representations, have become an intense focus of interest for developmental psychologists. Currently, this takes its most celebrated form in theory of mind tasks. However, a recent entry into the debate has been made by Zelazo and colleagues using a rule use paradigm (e.g., Zelazo, Frye & Rapus, 1996). Zelazo has reported a striking 'abulic' phenomenon among 3-year-olds. Children successfully use a rule to sort a series of cards, but when given a new, conflicting rule, they fail to sort correctly, despite accurately reporting what the new rule is. Data have been taken to suggest that 3-year-olds lack the representational flexibility to embed rules hierarchically, a finding that in turn may be relevant to understanding false-belief tasks, and, more generally, dissociations within consciousness.

While it is possible to obtain prototypical 'abulic' behaviour using the card- sorting paradigm, we describe multiple demonstrations of 3-year-olds' competence implementing separate and conflicting card sorting rules. A consideration of the conditions that lead to correct and incorrect sorting provides the basis for an alternative and more generous description of pre-schoolers' representational sophistication.

Zelazo, P. D., Frye, D., & Rapus, T. (1996). An age-related dissociation between knowing rules and using them. *Cognitive Development, 11, 37-63.*

**Causes of the pruning bias: tests of three models.**

Clare Harries and Nigel Harvey

University College London

Support theory, a focal hypothesis perspective and the ecological approach make different predictions about how pruning bias in familiar and unfamiliar scenarios should be affected by presentation order of different causal categories and by response format. We asked students to make likelihood judgements for various causes within scenarios that were familiar or unfamiliar to them. They made these judgements in terms of probability, relative frequency or absolute frequency on either a full or a pruned set of causes. The position of the "all other causes" category within the list of causes was varied. Our data from an unfamiliar scenario were most consistent with the focal hypothesis perspective: there was

an effect of presentation order and frequency responses reduced the likelihood given to the (unpacked) explicit description. For our familiar scenario, results were more consistent with Support Theory: there was no effect of presentation order and frequency responses increased the likelihood given to the (packed) implicit disjunction. However, neither of these models is completely satisfactory. We argue that an explanation in terms of cognitive processes requires development of models based on use of anchor-and-adjust heuristics. These provide a parsimonious explanation for the pattern of judgements of likelihood.

**When less is more: Gestalt versus strategic determinants of visual problem solving.**

E. P. Chronicle1, T. C. Ormerod1 and J. N. MacGregor2

1. University of Lancaster
2. University of Victoria, Victoria, B.C

Two experiments are reported, in which we investigated alternative approaches to facilitating performance in the 9-dot problem, a well-known visual problem-solving task. There are competing accounts in the literature as to the source of the 9-dot problem's difficulty, and these accounts may be broadly classified as perceptually or cognitively based.

In Experiment 1, we provided a visual cue as to the solution of the problem, consisting of a shaded background shape whose outline conformed to the lines required for a successful solution. Only minimal facilitation was found, compared to a no-hint condition. This finding is difficult to reconcile with a perceptual account in which problem difficulty is mediated by Gestalts available in the problem display. In Experiment 2, two versions of the problem were presented, in which the first line was given. The first version included an horizontal line that extended beyond the dot array, the second a diagonal line within the array. Contrary to the predictions both of a perceptual account and some cognitively-based accounts, facilitation was greater with the diagonal line. The results are interpreted in terms of a novel information- processing model of visual problem-solving.

**Magnocellular mediodorsal thalamic ablation does not disrupt preoperatively learned visual object associations, but impairs both new acquisition of object associations and scene learning.**

Amanda Parker and David Gaffan

University of Oxford

Monkeys were trained preoperatively in both visual object association learning and in scene learning. The visual object association learning task used lists of unique 2-d visual objects made from randomly generated coloured shapes. The scene learning task used lists of object pairs which occupied positions in unique backgrounds, each of which had been generated using randomly chosen colours and shapes. We then examined the effect of bilateral ablations intended to remove the entire magnocellular portion of the mediodorsal thalamic nucleus (MDmc). We found that MDmc ablation had a substantial effect on new learning, both of visual object associations and in scene learning, but did not affect established

memories of preoperatively learned object associations. We conclude that the MDmc thalamus has an integrative role in memory.

**Visual object identification and perirhinal cortex in the rat.**

E. A. Gaffan1 and M. J. Eacott2

1. University of Reading
2. University of Durham

Bilateral resection of the medial temporal lobes of the rhesus monkey, designed to mimic the surgery that caused amnesia in the patient H.M., produces very severe impairment in a recognition memory test, delayed non-matching to sample with trial- unique objects. It was originally assumed that this effect stemmed from the intended ablation of amygdala and hippocampus. However, we now know that the real cause was damage to the overlying inferior temporal cortex in the region of the rhinal sulcus, including perirhinal and entorhinal cortex, the perirhinal cortex being most strongly implicated (Meunier et al., 1993). Recent work with monkeys suggests that the object- recognition deficit is not an effect on memory per se, but rather a failure of object identification, the ability to form a representation of an individual object that allows it to be distinguished from a large population of other, potentially confusible objects (Buckley & Gaffan, 1998; Eacott et al., 1994).

We asked whether lesions of rats' perirhinal cortex, which is anatomically and physiologically homologous to that of primates, would impair visual object identification. The stimuli were "scenes" each comprising three different "objects" (multi-featured abstract shapes) distributed across a wide display area (two adjacent monitor screens in one arm of a large Y-maze). The task was constant-negative discrimination. On each trial, two scenes are presented, one constant (the same on every trial) one variable (different on every trial) and rats are rewarded for choosing the variable scene. In this experiment, there were 4 types of variable scene that differed from the constant scene as follows; Type O, novel objects in the same positions as those of the constant scene; Type P, the same objects but in different positions; Type O+P, novel objects in different positions, and Type OP, the same objects and positions but recombined. Type O+P is easiest to discriminate and was used as a baseline. Relative to this baseline, Dark Agouti rats with perirhinal lesions performed worse than controls on Type O trials, but were similar to controls on other types. The results are consistent with the idea that rats' perirhinal cortex, like that of monkeys, subserves object identification in the visual modality.

Buckley, M. J., & Gaffan, D., (1998). Perirhinal cortex ablation impairs visual object identification. Journal of *Neuroscience, 18*, 2268-2275.

Eacott, M. J., Gaffan, D., & Murray, E. A., (1994). Preserved recognition memory for small sets, and impaired stimulus identification for large sets, following rhinal cortex ablations in monkeys. *European Journal of Neuroscience, 6,* 1466-1478.

Meunier, M., Bachevalier, J., Mishkin, M., & Murray, E. A., (1993). Effects on visual recognition of combined and separate ablations of the entorhinal and perirhinal cortex in monkeys. *Journal of Neuroscience.*

**Associative priming in Pavlovian conditioning.**

R. C. Honey

Cardiff University

Any occasion on which an animal is placed in an experimental setting or context and receives pairings of one event with another, provides the opportunity for a variety of associative structures to be acquired. These structures range from simple associations, that could allow the presentation of one event to activate or prime a representation of the other, to hierarchical associations, that might allow a simple association to be primed by some other, superordinate event (e.g., the context in which the simple association was acquired). Experiments with rats are reviewed that reveal priming effects consistent with both of these putative associative structures.

**Discourse context effects on children's spoken word productions.**

Anne H. Anderson1, Art Blockland1, Gwyneth Doherty-Sneddon2 and Sandra McAuley2

1. University of Glasgow
2. University of Stirling

In spoken word production discourse context has been shown to exert a powerful influence on the clarity of adult speakers' articulations. The first time a word is spoken in a discourse it is articulated more clearly than on subsequent mentions, Fowler & Housum, (1987), Bard & Anderson (1994). This effect depends upon coreference in discourse not mere reappearance of words in an unrelated word list. The effect seems to rely then on the adult speaker's awareness of the ongoing discourse. Far less is known about the extent to which children of various ages show this ability to modify their spoken word production according to the surrounding discourse context. Children have been shown to adapt some elements of their speech to aspects of the communicative context. For example, speakers as young as four change the grammatical forms they use according to the age and status of their listeners (Shatz & Gleman, 1973, Corsaro, 1979). There is little published work however, about the effects of such factors on the acoustic qualities of their speech. The study we will describe attempts do just that. We investigated words extracted from the speech of children aged 5 and 9, who were engaged in problem-solving dialogues. Twenty pairs of coreferential first and second mentions were found in the dialogues of 9 year old speakers and twenty-five pairs of coreferential words were found in the speech of 5 year olds. These words were then randomized and played to adult listeners to identify. The design ensured that each word was heard by twenty listeners and no listeners heard the first and second mention of the same lexical item. The results showed that there was no difference in the intelligibility of the first and second mentions in the speech of five year olds with listeners identifying 57.3% and 58.1%, respectively. The nine year olds' data however did show evidence of a discourse context effect although this was not reliable across the whole sample of word pairs. The mean number of first mentions correctly recognised was 74.6%, and the mean number of second mentions recognised was 65.9% (By listener ANOVA ($F_{1,79}=4.95$, $p<0.05$; by materials ($F_{1,38}=2.79$, $p=0.1$). The paper will explore possible explanations for this developmental pattern and will reflect on how these data add to our understanding of the extended time course of the development of discourse skills.

Bard, E.G., & Anderson, A.H., (1994) The unintelligibility of speech to children: the effect of referent availability. *Journal of Child*

*Language, 21*, 623-648.

Corsaro, W., (1979) Young children's conception of status and role. *Sociology of Education, 52*, 46-59.

Fowler, C., & Housum, J., (1987) Talkers signalling 'new' and 'old' words in speech and listeners' perception and use of the distinction. *Journal of Memory and Language, 26*, 489-504.

Shatz, M., & Gleman, R., (1973) The development of communication skills: modifications on the speech of young children as a function of listener. *Monographs of the Society in Child Development, 38*, (5, Serial no. 152).

**Children's related difficulties with ambiguity and referential opacity.**

Ian A. Apperly* and Elizabeth J. Robinson

University of Birmingham

In previous work (Apperly & Robinson, 1998) we examined children's tendency wrongly to accept substitution of co-referential terms when commenting on a protagonist's knowledge: they judged that "Heinz knows there's a present in the box" when protagonist Heinz had seen a ball in the box but did not know it was a present. Children who made this error nevertheless correctly denied "Heinz knows the ball is a present". We explained this dissociation in terms of children's ability to handle partial representations. This same account can accommodate the existing research concerning children's difficulty with ambiguous utterances, and leads to new predictions about the ability to handle the distinction between the literal meaning and the intended meaning of utterances. We tested these in a study involving 97 4-5 year olds. Heinz gave an ambiguous message, referring to a round red balloon only as red. As predicted, children correctly denied that Heinz said "that the red balloon was round", but wrongly accepted that he said "it was the round balloon he chose". Correlations between performance on ambiguity and referential opacity task were also as predicted. Children's difficulty with referential opacity and with ambiguity are both symptoms of a broader problem handling partial representations.

Apperly, I. A., & Robinson, E. J., (1998). Children's mental representation of referential relations. *Cognition, 63*, 287-309.

**Introducing the lexical reading age.**

Elaine Funnell and Nicola Pitchford

Royal Holloway, University of London

Oral reading age is a standard measure for assessing the level of children's reading performance and has been used recently to compare the incidence of developmental patterns of surface and phonological dyslexia (Bryant and Impey, 1986; Manis, Seidenberg, et al, 1996; Stanofich, Seigel and Gottardo, 1997). In this paper, we show that reading age varies with the level of contribution from sub-lexical skills, which itself varies with the pattern of dyslexia. Children with surface dyslexia, who have superior sub-lexical reading skills, achieve higher reading ages for their chronological age than do children with phonological dyslexia, who have deficient sub- lexical skills. By using a novel measure of lexical

reading age, based on the reading of irregular words, we show that groups of children with surface and phonological patterns achieve similar levels of lexical reading for their chronological age, and differ only in their sub-lexical processing ability. We propose that a diagnostic reading test that takes both lexical and sub-lexical processing levels into account is required for the proper assessment of the incidence of surface and phonological forms of developmental dyslexia.

Bryant, P., and Impey, L., (1986). The similarities between normal readers and developmental and acquired dyslexics. *Cognition, 24,* 121-137

Manis, F. R., Seidenberg, M. S., Doi, L. M., McBridge-Chang, C., and Peteresen, A., (1996). On the bases of two subtypes of development dyslexia. *Cognition, 58,* 157-195.

Stanovich, K. E., Siegel, L. S., and Gottardo, A., (1997). Converging evidence for phonological and surface subtypes of reading disability. *Journal of Educational Psychology, 8*9, 114-127.

**The processing of long Finnish compound words.**

Jukka Hyönä1, Alexander Pollatsek2 and Raijmond Bertram1

1. University of Turku, Finland
2. University of Massachusetts, U.S.A.

The processing of long two-noun Finnish compound words was studied in three experiments. The compound words were embedded in sentences, and subjects' eye fixations were registered when they read these sentences for comprehension. In Experiment 1, the frequency of initial compound word constituent was manipulated, in Experiment 2, the frequency of second constituent was varied, and in Experiment 3, the constituent frequencies were controlled for while varying the whole word frequency. The results showed the frequency of initial constituent affected an early stage of processing, as reflected in the initial fixation made on the compound word, whereas the frequency of second constituent and the whole word frequency affected a later stage of processing, as reflected in the duration of second fixation and the probability of making a third fixation on the word. It is concluded that the pattern of results suggests a compositional model for the recognition of long Finnish compound words, although a fully compositional model does not seem viable.

**Reading spelling: Can people improve spellings after reading them?**

V. M. Holmes and M. Babauta

University of Melbourne, Australia

Students typed spellings of words and were permitted to see only the last one to four letters. Given an immediate whole-word review of their spelling, students almost never changed correct spellings, but they did change about one in four misspellings. However, they were no more likely to improve a misspelling than they were to change it to something equally incorrect or worse. The number of letters visible had no impact

on initial spelling accuracy, nor on improvement ability. The results suggest that the orthographic representation people consult for spelling is the same as the one they access to identify words during reading.

**New visual objects recruit processing resources.**

Angus Gellatly and Geoff Cole

University of Keele

We will describe a series of experiments in which observers are required to decide on the presence or absence of a target object in a display of non-targets. In the first two experiments the target is an illusory square containing stationary horizontal lines on a background of downward moving lines; non-targets are illusory squares containing upward moving lines. The comparison of interest is between new and old objects. New objects are those which appear immediately following an auditory signal to search for a target. Old objects have been present on the screen for (usually) 500 ms before an auditory signal to indicate that one of them may become a target. In general, new object targets are detected far more efficiently than old object targets. Experiments 3 to 5 replicate and extend this finding for the case in which target, non- targets and background are all different shades of grey, showing the effect is not confined to a particular class of stimulus. The results will be discussed in terms of the recruitment of pre-attentive processing resources. Possible connections to the phenomena of 'attentional blink' and 'change blindness' will be suggested.

**Musical cognition in autistic children.**

Pamela Heaton, Linda Pring and Beate Hermelin

Goldsmiths College, University of London

Of all the psychological theories concerning autism, central coherence theory (Frith, 1989) is the only one that is able to offer any insights into why children with autism might show what Kanner (1943) described as "Islands of ability". It might further help to explain why there is a preponderance of those with autism amongst the savant population. It appears that weak central coherence, manifested in a tendency towards segmented information processing amongst those diagnosed as autistic, might contribute to the subsequent development of savant abilities (Heaton, Hermelin and Pring, 1998). In the studies to be described central coherence will be investigated by looking at musical processing in children with autism and their matched controls.

**Responding to emotional facial expressions in children and adults with psychopathic tendencies.**

R. J. R. Blair

Institute of Cognitive Neuroscience, London

The present studies investigate the ability of children and adults with psychopathic tendencies to respond to facial expressions. Study 1: 80 children in mainstream education were shown expression stimuli. These were photographic quality images interpolated ("morphed") between prototypes of the 6 emotions in the Ekman and Friesen series to create a hexagonal continuum (running from happiness to surprise to fear to sadness to disgust to anger to happiness) Calder et al (1996). The ability of the children to recognise sad, and particularly fearful, but no other expressions was significantly related to their psychopathic tendencies as indexed by the Psychopathy Screening Device (PSD: Frick & Hare, in press). In study 2, 18 psychopathic individuals and 18 incarcerated controls, identified using the Revised Psychopathy Checklist (Hare, 1991), were shown the same expression stimuli and, in addition, their skin conductance responses (SCRs) were recorded. The adults, unlike the children, showed no impairment in recognising any of the emotion expressions. However, the psychopathic adults did show, in contrast to controls, reduced SCRs to sad and fearful expressions.

**Sparing of country and nationality names in a case of modality specific oral output impairment: implications for theories of speech production.**

Lisa Cipolotti

National Hospital for Neurology and Neurosurgery, London

A patient (BF) with Pick's disease who presented with a modality specific category preservation is reported. In the oral output modality (oral naming and reading aloud) she presented with a selective sparing of country and nationality names in the context of a severe impairment affecting a wide variety of common nouns, proper nouns and verbs. In the written output modality (written naming and writing to dictation) her deficits were restricted only to proper nouns (except country names) and verbs. Her written production of common nouns is virtually intact. Semantic errors were present only in the oral output modality. It is argued that this evidence is seriously problematic for the dual stage models of lexical production and for the hypothesis of obligatory phonological mediation. It is concluded that: 1. access to words' modality specific lexical information need not to be mediated by the selection of a modality neutral level of lexical representation (lemma) ; 2. orthographical lexical forms can indeed be independently accessed for production without the mediating role of phonology. The possible distinct neuronal structures underpinning country and nationality names categories are discussed.

**Perceptual cohorts and the time course of lexical access in picture naming.**

Ardi Roelofs (Introduced by Dr. D. C. Mitchell)

University of Exeter

I address a recent challenge to the view that lexical access in speech production proceeds in two discrete stages. Over the past few years, researchers have obtained the SOA curves of the effects of visual and spoken distracters in picture naming. Discrete two-stage access is supported by early semantic and late phonological effects from spoken distracters. However, semantic and orthographic effects from written

distracters overlap in time and the effects interact. The interaction is also observed for spoken distracters. I discuss a perceptual cohort account of the interaction within WEAVER++, which is a discrete two-stage model of lexical access in speech production (Roelofs, Cognition 1992, 1997; Levelt, Roelofs, and Meyer, Behavioural and Brain Sciences, in press). Three experiments are reported that tested the account. Experiment 1 showed that semantic and phonological effects overlap in time. Experiment 2 showed that word-initial cohort syllables suffice to produce the semantic and form effects, irrespective of modality. Experiment 3 showed that form neighbours of the distracters yield semantic effects on target production in both the spoken and written modality. These findings suggest that perceptual cohorts are effective in picture-word interference exactly as predicted by WEAVER++, thereby meeting the challenge.

**Genetic fractionation of perception and memory: evidence from Turner syndrome of distinct loci on the X-chromosome affecting neurodevelopment.**

D. V. M. Bishop1 and D. H. Skuse 2

1. University of Oxford
2. Behavioural Sciences Unit, Institute of Child Health

Turner syndrome (TS) is associated with a distinctive neuropsychological phenotype. It is usually assumed that this results from haploinsufficiency, i.e., insufficient dosage of gene products that are normally produced by a pair of alleles on the sex chromosomes. An alternative hypothesis maintains that some aspects of neurodevelopment are influenced by genes that are imprinted, i.e., their expression depends on whether the gene is inherited from the mother or father. If haploinsufficiency is implicated, all females with a single X chromosome should be impaired. However, if imprinted genes are involved, then we would expect to see differences between those with a single maternal X chromosome (45Xm) and those with a single paternal X chromosome (45Xp) . For a test of visuospatial perception, the haplosufficiency account was supported. However, on visuospatial memory, those with 45Xp karyotype forgot significantly more than the 45Xm females. For long-term verbal memory, disproportionate forgetting of stories was seen only in those with 45Xm karyotype. The contrasting patterns of forgetting for verbal and nonverbal material in relation to parental origin suggests there is a complementary set of imprinted genes on the X chrosomsome that affect the development of lateralized brain regions important for memory function.

**Effects of drawing on young children's recall.**

Laura E. Davison, Glyn V. Thomas and Jenny Sloneem

University of Birmingham.

Asking young children to make a drawing of a personally experienced event can dramatically increase the amount of information reported (see, for example, Gross & Hayne, 1998). In 3 experiments we examined possible mechanisms and determining conditions for these effects. In

Experiments 1 and 2 children aged 5- to 8- years viewed an array of 25 thematically linked objects and were asked to recall as many items as possible 4 hours later. In Experiment 1, drawing the objects did not facilitate recall, whereas reinstating the actual objects as they were recalled did. In Experiment 2, drawing interfered with recall; significantly fewer objects were recalled by 5- to 6- year olds when drawing and when drawing and telling than when telling alone. In Experiment 3, children verbally recalled a house described in a story, having previously verbally described or drawn the house. Children who had made schematic drawings of the house recalled significantly more stereotypical features, often erroneously. These results help to explain the mechanisms by which drawing interacts with recall. Effects extend beyond simple facilitation, and caution is advised with the practical application of drawing at recall.

Gross, J., & Hayne, H., (1998). Drawing facilitates children's verbal reports of emotionally laden events. *Journal of Experimental Psychology: Applied, 4*, 163-179.

**The disruption and dissolution of directed forgetting: inhibitory control of memory.**

Martin A. Conway, Kay Harries and Jan Noyes

University of Bristol

In a series of directed forgetting (DF) experiments it was found that inhibition of a to-be-forgotten (TBF) list could be disrupted by a secondary task and completely abolished by a concurrent memory load during second to-be-remembered (TBR) list learning. Similarly, inhibition was found to be wholly abolished when the TBF and TBR list were strongly associated but not when weakly associated. These findings suggest that inhibition in the DF procedure depends on how powerfully the second TBR list competes in memory with the representation of the TBF list. When the representation of the TBR list is impoverished or when it is too similar to the TBF list then competition is weak and inhibition is as a consequence weak or does not occur.

**On the co-ordination of verbal and spatial immediate memory in reading and mathematical ability.**

Carmel Price University of Oxford (formerly Royal Holloway)

Children's performance at complex cognitive tasks such as reading and arithmetic has often been interpreted within the model of working memory (Baddeley and Hitch, 1974). Past research has examined whether such tasks are differentiated by their relationships with the verbal and spatial components of the working memory system. However, much recent research has focused on the role of the central executive, arguing that children's difficulties with reading and numerical tasks are caused by limitations in the control processes used to co-ordinate and integrate information across subsystems (e.g. Swanson, 1993). To evaluate these claims further, 75 children, aged between five and ten years, were administered standardised word reading and number skill assessments, along with a variety of memory tests. The memory tasks examined (1) the role played by the verbal and spatial stores, measured using digit span and Corsi-type tasks, and (2) the central executive, measured using a new task combining the demands of the basic digit and Corsi tasks. Regression analysis showed that the central executive task added nothing to

the prediction of children's cognitive skills over and above the contribution of basic measures of verbal and spatial short-term memory. The finding that the integration of verbal and spatial information is not an important determinant of reading or numerical ability has implications for both the normal and atypical development of these.

**Ageing in the fast and slow lanes.**

Patrick Rabbitt1, Neil Pendleton1, Peter Diggle2 and Fiona Holland2

1. University of Manchester
2. University of Lancaster

A central problem in Cognitive Gerontology has been whether all individuals cognitively change at the same rates and, if not, what factors determine differences in rates of ageing. A related problem has been whether all individuals show the same patterns of relative change across mental abilities or whether there are different, characteristic, patterns of change.

A pratical problem in asking the first question has been that it is difficult to disassociate improvement with practice from age related declines during prolonged longitudinal studies. A problem in asking the second question has been to find ways of identifying individuals with different patterns of age-related change in large populations.

We describe statistical solutions to both these problems, and present data from a 15 year longitudinal study in which the effects of practice, selective drop out, and initial differences in general mental ability are taken into consideration in order to reveal the amount, and variability, in age related change. Evidence is presented that sub-groups of individuals do experience different patterns of change across mental abilities as they age, and analyses of one such syndrome, the "memory poor" syndrome, are given.

**Do "executive" tests predict rate of change over time in a longitudinal follow-up of an elderly population?**

Christine Lowe and Patrick Rabbitt

University of Manchester

One hundred volunteers now aged between 65 and 85 years were tested, and again re-tested after a 5 year interval, on a battery of cognitive tests with the aim of establishing cognitive neuropsychological profiles for healthy older individuals. The battery includes tests from the Shallice and Burgess frontal lobe battery, Baddeley's 'Names' and 'Doors' recognition tests, visual processing and switching tasks. The comparison of the test - re-test scores identifies individuals who have shown disproportionate decline on either all or a sub-set of the tests along with the interaction between age, fluid IQ and the rate and pattern of change. This data set offers a novel opportunity to test and retrospectively compare those individuals who have shown disproportionate decline over time with those showing no decline, on a new, different, battery of 'everyday' tests of executive/frontal function. Results allow analysis of the value of the new battery in predicting rate of cognitive decline in 'still healthy'

individuals, and go some way to suggesting the anatomical correlates of this decline.

**Egocentric and exocentric spatial judgements of visual displacement.**

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The role of changes in ego- and exocentric spatial relationships on perceptual judgements about visual displacement was investigated in this study. Subjects were asked to indicate whether a dot in a test stimulus was displaced compared to a dot in a reference stimulus. Subjects were given explicit instruction to report displacement relative to themselves (egocentric) or relative to a circle surrounding the dot (exocentric). Four types of test stimuli were used in which object-circle (exocentric) and object-observer (egocentric) relations were systematically varied. It was found that for test stimuli which reveal conflicting ego- and exocentric spatial information, subjects performed poorly in both instruction conditions. This suggests that ego- and exocentric representations can not be used independently and probably are interconnected.

**Neural correlates of prepulse inhibition of the human tactile startle response: A functional MRI investigation.**

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Prepulse inhibition (PPI) refers to the ability of a weak non-startling stimulus, the prepulse, which by itself evokes little or no overt behavioural response, to inhibit the response to a closely following (by 30-150 ms) strong startling stimulus, the pulse. This effect is thought to represent a sensorimotor gating mechanism and to serve the function of avoiding behavioural interference that might otherwise result from the simultaneous processing of discrete stimuli. Deficits in the ability to avoid such stimulus interference are thought to lead to sensory over-stimulation and behavioural confusion, as seen e.g. in schizophrenia. Limbic and mesolimbic cortico- striato-pallido-pontine circuitry is thought to control PPI in the rat and deficient PPI has been noted in a number of psychiatric disorders that are characterised by abnormalities in cortico-striato-pallido-pontine circuitry, including schizophrenia, Huntington's disease, obsessive compulsive disorder and attention deficit disorder. The pattern of PPI disruption (i.e., deficits at varying prepulse-to-pulse intervals), however, is not uniform across disorders. This paper reports the results of a functional magnetic resonance imaging (MRI) investigation to elucidate the neural correlates of PPI in healthy human subjects, using tactile stimuli as both the prepulse and the pulse (prepulse presented at stimulus onset asynchronies, SOA, of 30, 60, and 120 ms). Significant activation was observed during PPI elicitation with 120-ms SOA, mainly in the caudate nucleus and insula, and during PPI at a 60-ms SOA in the dorsolateral prefrontal cortex, insula and middle prefrontal cortex. The 30-ms SOA condition showed the minimal amount of activation, this being in the dorsolateral prefrontal cortex. This study held the total amount of stimulation constant for all three SOAs (30-ms, 60-ms and 120-ms): only the temporal distribution of the stimuli (i.e. the interval between prepulse and pulse onset) differed between conditions. It was therefore remarkable that: (i) the 30-ms SOA, which produces minimal PPI, showed the minimal amount of brain activation; and (ii) the regions

most activated during the 120-ms SOA condition were not identical to those found to be most active during the 60-ms SOA condition. Although the two latter conditions both produce robust PPI, they differ in latencies to startle onset and in the subjects' ability consciously to discriminate the prepulse as being separate from the pulse. Further investigations are needed to elucidate whether differential patterns of PPI deficits in relevant clinical populations reflect disturbances at different levels of PPI circuitry and thus are accompanied by changes in activation in the brain regions found here to play a role in the production of PPI with various prepulse-to-pulse intervals in normal volunteers.

**Evidence of separate mechanisms for the perceptual fusion of spectral components and for the calculation of global pitch.**

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Spectral models of pitch perception commonly assume the operation of a mechanism that selects the harmonic 'template' which best fits the spectral distribution of partials in a complex tone. The same mechanism is often regarded as responsible for the perceptual fusion of harmonically related partials. Specifically, the selected harmonic template is assumed to fuse together those partials that fall through its slots (suppressing their individual pitches) and to ascribe them a global pitch corresponding to its fundamental (F0) frequency. The current study has tested this dual-role hypothesis using frequency-shifted complexes. These sounds are inharmonic but their partials preserve a pattern of equal spacing across the spectrum. Brunstrom and Roberts (1998) have previously developed a technique to profile the perceptual suppression of partials in periodic complex tones. Their technique was used here to identify regions of suppression in complexes that were frequency-shifted by either 25.0% or 37.5%. The nominal FO frequency of these complexes was 200 Hz, roved in the range +/- 20%. Three consecutive components (6-8) were removed and replaced with a sinusoidal "probe", located at one of a set of regularly spaced positions spanning the gap. On any trial, subjects heard a complex tone followed by an adjustable pure tone played in a continuous loop. Subjects were well able to match the pitch of the probe unless it corresponded with a position predicted by the regular spectral pattern of the complex. In contrast, hit rates were higher, often markedly, for probes positioned at integer multiples of the FO(s) corresponding to the global pitch(es) of the complex. These pitches were predicted from the data of Patterson (1973) for an FO of 200 Hz (a frequency shift of 25.0% gave values of about 211 Hz and 94 Hz, and a frequency shift of 37.5% gave values of about 216 Hz and 97 Hz). Our findings suggest that separate mechanisms are responsible for the calculation of global pitch and for the perceptual grouping of partials. Furthermore, they are consistent with speculations that the effects of harmonic relations on auditory grouping might instead be attributed to a more general principle of spectral regularity (Roberts and Bailey, 1996, Roberts and Brunstrom, 1998).

Brunstrom J. M., Roberts B., J *Acoust Soc Am*, 1998; (submitted).
Patterson R. D., *J Acoust Soc Am*, 1973; 53: 1565-72.
Roberts B, Bailey P. J., *J Exp Psychol: Human Percept Perform*, 1996, *22*, 604-14.
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**The many faces of grouping - a multifaceted explanation of the temporal grouping effect with visual and auditory presentation.**

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Hitch, Burgess, Towse and Culpin (1996) examined the role of Working Memory in temporal grouping effects and showed that although rehearsal plays some part in temporal grouping, a rehearsal based account of the effect is not sustainable. A number of experiments are reported examining further the role of rehearsal in temporal grouping. Manipulations include both the size and nature of the temporal pause ('filled' or 'unfilled') along with the effect of presentation modality. Results suggest that grouping is a multifaceted phenomenon, with rehearsal, only one facet, playing a greater role with visual presentation.

Hitch, G., Burgess, N., Towse, J., and Culpin, V., (1996) Temporal Grouping Effects in Immediate Recall : A Working Memory Analysis. *Quarterly Journal of Experimental Psychology, 49*, 116-139.