Thursday, 21 February 2013, 9.30am-3pm

The Old Library, Emmanuel College, St Andrew's Street

http://www.memlab.psychol.cam.ac.uk/CAMM

Directions

Emmanuel College is situated on St Andrew's Street, in the centre of Cambridge. Enter through the main gate, past the Porters' Lodge, then walk to the left and around Front Court. Go through two sets of doors and the Old Library is on your right.

Welcome!

Welcome to what will hopefully become the annual Cambridge Memory Meeting. The aim of this Cambridge-wide meeting is to encourage more interaction between the many local groups working on the psychology/neuroscience of short- and long-term memory, both human and non-human.

The idea is for a friendly, informal meeting in which students and postdocs can present their research in a supportive environment, helping us all find out about related work taking place on our doorsteps, and highlighting areas for future collaboration.

Schedule

9.30am   **Arrival, morning coffee**

9.55am   **Welcome, introductory comments**

10.00am   **Talk session 1**

10.00-10.20   Joni Holmes, MRC CBU
Working memory and its disorders: Causes, consequences and treatments

10.20-10.40   Cristina Savin, Department of Engineering
Two is better than one: A dual system for memory recall

10.40-11.00   Emiliano Merlo, Department of Psychology
Constraining fear: Calcineurin in the amygdala determines the transition from reconsolidation to extinction of fear memory

11.00-11.20   Andrea Greve, MRC CBU
Predicting learning via learned predictions that become violated

11.20-11.40   David Vogelsang, Department of Psychology
Self-referential source recollection

11.40-12.00   Christof Teufel, Department of Psychiatry
Memory-based changes in perception as a model for visual hallucinations

12.00pm   **Poster session during sandwich lunch**

Andrew Bateman, Heidi Bonnici, Elisa Cooper, Martha Hvoslef-Eide, Mark Renshaw, Taylor Schmitz, Olivia Shipton, Naresh Subramaniam, Sam Wass, Yasemin Yazar

1.00pm   **Talk session 2**

1.00-1.20   Charlotte Oomen, Department of Psychology
Learning and memory in the touchscreen operant chamber for rodents

1.20-1.40   Kristian Kalm, MRC CBU
Representation of order information in the temporal lobe

1.40-2.00   Johanna Finnemann, Department of Psychology
Self-projection in autism spectrum disorders

2.00-2.20   Vincent Magloire, Department of PDN
Hippocampal-entorhinal communication during sleep-like pattern in an acute in vitro model

2.20-2.40   Susanne Schweizer, MRC CBU
Affective working memory: Insights from training studies

2.40-3.00   Lucy Cheke, Department of Psychology
Are mental time travel researchers singing from the same hymn sheet?

3.00pm   **Departure**

Talk Abstracts

Joni Holmes, MRC CBU
Working memory and its disorders: Causes, consequences and treatments

We will provide an overview of our new programme investigating the cognitive and neural basis of disorders of working memory. The work involves the development of a new diagnostic assessment of working memory, training studies with children with memory and language deficits, and investigations of cognitive training schedules to establish optimal methods for enhancing flexible working memory function.

Cristina Savin, Department of Engineering
Two is better than one: A dual system for memory recall

Upon encountering a long-unseen schoolmate, one may experience different forms of recognition: it could be a vivid recollection of past times together, or just a nagging feeling that 'she looks familiar', without being able to trace the source of that memory. Findings from animal models and patients with brain lesions suggest that recollection and familiarity are distinct processes, subserved by different brain regions. The question of how exactly these brain regions support recognition remains however at the center of a heated debate. Here, we develop a novel account for the existing data, starting from the fundamental question 'why have two systems at all?'. The answer goes back to the underlying plasticity mechanisms used for storing the original memories: due to biological constraints, memory has a palimpsest character, with facts about the past being slowly overwritten by new experiences. In such a system, knowing the age of a memory is critical for recalling it faithfully. Hence, optimal recollection implies a tight coupling between estimates of memory age or strength, as a form of familiarity, and the neural dynamics of recollection. Importantly, our model — constructed exclusively for recollection — is successful in explaining crucial aspects of recognition memory behaviour, thus providing a new window onto the contentious debate about the neural mechanisms of recognition memory.

Emiliano Merlo, Department of Psychology
Constraining fear: Calcineurin in the amygdala determines the transition from reconsolidation to extinction of fear memory

A persistent maladaptive memory is a major component of some neuropsychiatric disorders such as post-traumatic stress, specific phobias and drug addiction. Memory persistence is critically affected by retrieval. In rats, a single presentation of a conditioned fear stimulus induces memory reconsolidation and fear memory persistence, while repeated fear cue presentations result in loss of fear through extinction. These two opposite behavioural outcomes are operationally linked by the number of cue presentations at memory retrieval. We show here that calcineurin (CaN) is

required for the extinction, but not reconsolidation, of conditioned fear. We studied the molecular landscape associated with reconsolidation and extinction and characterised, both behaviourally and molecularly, the transition from maintenance to inhibition of conditioned fear. We show that an increase in CaN in the basolateral amygdala (BLA) is necessary for the persistence of a fear extinction memory, supporting the shift from fear-maintenance to fear-inhibition. NMDA-type glutamate receptors (NMDAR) recruit and modulate the molecular mechanisms that determine whether or not the fear memory will persist. An NMDAR-dependent CaN increase in the BLA induced by increasing cue presentations is a critical condition for persistent fear memory extinction.

Andrea Greve, MRC CBU
Predicting learning via learned predictions that become violated

Predicting future events on the basis of prior experience is a key component of adaptive behaviour and vital for guiding future decisions and actions. The recently proposed Predictive Interactive Multiple Memory Systems (PIMMS) framework suggests that unexpected events (violations of prior predictions) play a key role in memory encoding processes that drive better learning of novel information. Here we present a series of behavioural investigations that examine whether prediction errors (PE) do indeed enhance learning of novel associations. All experiments contained an initial training phase during which unrelated scenes and faces were repeatedly presented for a varying number of times in order to induce a range of predictions for particular face-scene pairings. A critical study phase violated such expectations by showing trained scenes with unexpected faces. A subsequent 3 AFC test assessed memory performance for the unexpected faces presented at critical study to investigate whether novel learning was indeed modulated by the history of trained expectations. The pattern of observed results favoured models of prediction-error learning over standard Hebbian learning or interference based learning. Although we will consider potential alternative explanations of the results, our data are generally in agreement with key assumptions proposed by the PIMMS framework.

David Vogelsang, Department of Psychology
Self-referential source recollection

Medial anterior prefrontal cortex (mAPFC) activity has been associated with aspects of both social cognition (e.g. thinking about oneself and other people) and episodic memory (e.g. recollecting contextual details of an event). However, it is unresolved how these two abilities might relate to each other. The current fMRI experiment used a novel factorial design that contrasted source recollection of agentic self/other information (whether oneself or someone else previously read a word out loud) and conceptual self/other information (whether a personality trait word had previously been related to oneself or someone else). The fMRI analysis revealed a role for the ventral mAPFC in retrieving conceptual but not agentic information about the self compared to another person, suggesting this region is involved in processing one's abstract concept of self rather than a sense of agency. The experiment also investigated differences in the incidental encoding of new items that were presented as foils during both the

agentic and conceptual source recollection tasks. The result of this '*foil recognition test'* showed that attempting to recollect conceptual rather than agentic self-referential recollection led to significantly better encoding of new items, resulting in higher subsequent discrimination of conceptual than agentic foils from completely novel items in a later recognition test. This foil recognition finding further supports the account that different processes were engaged during retrieval of conceptual versus agentic information, which, in turn, led to differences in encoding. The results of this experiment advance our understanding of the role played by mAPFC in self-referential processing and source recollection, indicating that ventral mAPFC is particularly important for maintaining an abstract concept of ourselves over time, a critical aspect of conscious awareness.

Christof Teufel, Department of Psychiatry
Memory-based changes in perception as a model for visual hallucinations

Hallucinations are among the most staggering symptoms in schizophrenia. The potential of our perceptual systems to create a full-blown percept in the absence of an appropriate stimulus is remarkable and a better understanding of this phenomenon is bound to shed light on some of the most fundamental aspects of biological vision. Given, however, that hallucinations are defined by the way in which they are phenomenologically experienced, it is exceedingly difficult to examine them in a rigorous laboratory setting. We have therefore developed psychophysical tasks allowing us to study certain processes within the visual system that share crucial similarities with hallucinations. In particular, we examine memory-based changes in perception as a model for visual hallucinations. In this talk, I will discuss the theoretical background and the psychophysical techniques we use, some preliminary evidence we have collected in hallucination-prone individuals, and future directions that will hopefully allow us to provide full mathematical formalizations of the underlying computational processes.

Charlotte Oomen, Department of Psychology
Learning and memory in the touchscreen operant chamber for rodents

Over the past few years, our lab has developed a new method of assessing cognitive behaviour in rodents; a touchscreen equipped operant chamber. This approach allows comparison with test batteries used in humans (such as CANTAB). Furthermore, the touchscreen apparatus can provide a 'flexible battery' in which multiple aspects of memory and higher cognitive function can be tested. During my talk, I will describe neural correlates of two touchscreen tasks. Firstly, I will present data on an object-place paired associates learning task, in which animals have to associate certain stimuli (pictures) with the location on the screen. Secondly, I will describe a novel working memory task that assesses memory for location and spatial pattern separation

Kristian Kalm, MRC CBU
Representation of order information in the temporal lobe

Here we investigate how item and order information is represented in auditory short term memory (STM). We used the immediate serial recall (ISR) task where both item and order information need to be processed in order to successfully recall the sequence. While several studies have investigated the representations of phonological items in the temporal lobe using multivariate fMRI and iEEG, it is an open question how the order of items is encoded. Here, we aim to dissociate fMRI activity patterns representing the phonological information of the items in STM from the patterns representing their order. We compared the similarity structure of the fMRI patterns elicited by different orderings of items within a set with similarity measures obtained from different representational models of order. Crucially, these models made different predictions about the way order is represented: a model based on Hamming distance encodes direct item-position associations, meaning that order is encoded independently of items. An alternative model based on Euclidean distance implies a relational representation, where items and their positions are encoded in *n*-dimensional space. A model based on Hamming distance between sequences was significantly successful in predicting similarities between activation patterns and revealed a set of brain areas in the anterior temporal lobe, pre-frontal cortex and ventral pre-motor cortex, partially overlapping with areas encoding item information. Two competing models of order representation leading to alternative pattern similarity predictions (Euclidean and inverse Hamming) were shown to be inconsistent with the fMRI data.

Johanna Finnemann, Department of Psychology
Self-projection in autism spectrum disorders

Recent research suggests that there is a core network of frontal, temporal, and parietal regions that supports various forms of mental self-projection. These include prospection (a simulation of the future), retrospection (a projection of the self into the past), navigation (a mental projection into an alternative place), and mentalising (adoption of a different perspective). The fact that people with ASD are reported to exhibit difficulties in all of those areas raises the question of whether one of the underlying causes could be found in the atypical functionality of the self-projection network. To test this hypothesis we invited a group of adults with ASD and a control group of typically- developed adults to perform a variety of tasks assessing 'self' and 'other' processing, prospection, and planning for the future. More specifically we were interested in comparing memory performance on tasks measuring processing of the current self, a similar other, a dissimilar other, and the self in the near and far future. Whereas the control group replicated previous research that suggested superior performance for self-processing compared to tasks requiring a mental representation of a similar or dissimilar other, the ASD group showed a distinct impairment in the processing of a similar other. Taken together this suggests that the extent to which thinking about others and the personal future is modelled on the self varies as a function of perceived self-similarity and furthermore that this mechanism is atypically recruited by individuals with ASD.

Vincent Magloire, Department of PDN
Hippocampal-entorhinal communication during sleep-like pattern in an acute in vitro model

Consolidation of episodic memory requires the communication between neocortex and hippocampus during sleep. The information flows between the hippocampus and the neocortex via the medial entorhinal cortex (mEC). This latter structure has recently been shown to exhibit persistent network activity during sleep that filters neocortical-hippocampal communication. Entorhinal-hippocampal microcircuit has thus been suggested to act as a single unit during sleep that would facilitate or block the transfer of spatial and non-spatial information to the neocortex during memory consolidation. In order to study the mechanisms responsible for this privileged communication between hippocampus and mEC during sleep, we have developed an entorhinal-hippocampal acute slice model that exhibits in vivo like persistent network activity. Simultaneous intra and extracellular recordings in mEC revealed that neurons from layer 3 are the most depolarized during network activity. Moreover, temporal analysis of spiking activity in the different layers indicated that persistent activity is initiated in layer 3 and then propagates to layer 2. Persistent activity could therefore influence CA1 hippocampal activity via the "tempero-ammonic" as well as the trisynaptic pathway. We hypothesized that persistent activity would directly influence CA1 hippocampal neurons. Dual recordings of spiking activity in CA1 and synaptic currents in mEC layer 3 indicated us that CA1 neurons respond to persistent activity in our in vitro model. We are therefore now investigating whether CA1 pyramidal neurons can be directly influenced by persistent activity and whether they can reciprocally excite neurons in mEC layer 3.

Susanne Schweizer, MRC CBU
Affective working memory: Insights from training studies

Working memory (WM) has long been understood to be associated with higher cognitive functions such as fluid intelligence. However, most laboratory work on WM has examined the processing of emotionally neutral information. Despite the ubiquity of socio-affective information to process in everyday life, research on WM in these affective contexts - affective WM - is only starting to emerge. Affective control capacity (e.g., the ability to regulate emotions or manipulate emotional material in the service of task goals) is associated with professional and interpersonal success. Impoverished affective control, by contrast, characterizes many neuropsychiatric disorders. Insights from neuroscience indicate that affective cognitive control relies on the same fronto–parietal neural circuitry as that recruited by standard laboratory WM tasks. This suggests that systematic affective WM training, i.e training carried out in an emotional context, has the potential to augment affective cognitive control. In a series of studies presented here we explored the possibility of improving affective control capacity using a novel affective WM training protocol. We will discuss both behavioural and neural transfer effects and their implications for future research.

Lucy Cheke, Department of Psychology
Are mental time travel researchers singing from the same hymn sheet?

As with any young field of research, research into Mental Time Travel is beset with debate. Much of this debate is limited by the lack of consensus as to how Mental Time Travel is assessed. A number of different philosophical, theoretical and empirical perspectives on Mental Time Travel have led to a proliferation of methods of assessing it. Although these tests putatively assess the same psychological capacity, they are, at least superficially, very different. Crucially, they have rarely if ever been tested in the same subjects. Here we present two studies that aimed to investigate the extent to which these different tests could be said to be assessing the same cognitive processes. The first investigates whether performance on these tests is related in developing children, and the second in adults.

Poster Abstracts

Andrew Bateman, Oliver Zangwill Centre
Neuropsychological rehabilitation in the community: An invitation to bridge the translation gap

Memory dysfunction is present in a diverse patient groups. Locally their rehabilitation is provided in Cambridgeshire community by Occupational Therapists and colleagues. There have been a few advances in the neuropsychology literature that have seen their way to full implementation: Assistive technology such as paging and text messaging was built on the research by Barbara Wilson. The Neuropage service continues to operate out of the Oliver Zangwill Centre, currently providing support for 33 profoundly amnesic patients around the UK. New research is to be starting soon to investigate rehab needs among people with Multiple Sclerosis. More recent research using Sensecam (ViconReview) has seen some clinical usage but is not widely clinically available or remembered by clinicians (yet). Internal strategies continue to be investigated, procedures such as 'errorless learning' finding a place in the therapist's vocabulary. However the "translational gap" of making links between research findings and clinical implementation continues. This talk will briefly illustrate current memory rehabilitation activity and invites the collective creativity of Cambridge memory researchers to think about which current Cambridge projects might be the next big thing for our patients. The need for links between the research and clinical communities is emphasised.

Heidi Bonnici, Department of Psychology
Detecting representations of recent and remote autobiographical memories in hippocampal subfields

In a previous study using high-resolution structural and functional MRI in combination with multi-voxel pattern analysis (MVPA), we found that representations of both recent (2 weeks old) and remote (10 years old)

autobiographical memories could be decoded significantly above chance from patterns of activity across voxels in the hippocampus. Studies in rodents and computational models suggest that key computations necessary for memory occur in specific subfields of the hippocampus such as CA3 and dentate gyrus (DG). Although fMRI studies examining hippocampal subfields in humans are on the increase, none has yet explored the involvement of the subfields in autobiographical memory. To that end, we set out to examine the neural representations of recent and remote autobiographical memories in CA1, CA3, DG and subiculum. Each of these areas was manually delineated (including separation of CA3 and DG) on structural MRI scans with $0.5x0.5x0.5mm^3$ isotropic voxels using a novel segmentation protocol. As in the previous study, during high-resolution fMRI scanning participants recalled, numerous times and in a random order, 6 memories (3 recent that were 2 weeks old; 3 remote that were 10 years old) that were matched for ease of recall, vividness, level of detail, and valence. Considering first the MVPA analysis of the recent memories, it was possible to predict which recent memory was being recalled significantly above chance from patterns of activity across voxels in CA1 and the subiculum, but not CA3 or DG. By contrast, accurate decoding of remote memories was possible in all subfields. A formal comparison between recent and remote memories revealed a significant difference between decoding accuracies in just one subfield, CA3, with better decoding of remote compared to recent memories. We suggest that examining the instantiation of autobiographical memories at the subfield level may help to elucidate key underlying mechanisms.

Elisa Cooper, MRC CBU
Hippocampal Learning vs. Fast Mapping; does one preclude the other?

There is compelling evidence that the hippocampus promotes learning of novel associations. Many current theories posit that initially episodic information is acquired exclusively by the hippocampus and is only gradually integrated into neocortical memories. This view is supported by the consistent failure of amnesic patients with hippocampal damage to learn new declarative information. A recent study by Sharon et al. (2011), however, reported four amnesic patients who acquired novel name-picture associations, when trained with a procedure that encourages 'fast mapping' (FM). This success was attributed to the following features of the FM learning task: i) discovery of associative links via disjunctive inference, ii) placing the novel associations in a context of pre-existing semantic information and iii) incidental learning. As yet it remains unclear whether and to what extent such task demands underpin hippocampal-independent FM. This is systematically addressed here. 48 participants studied novel associations using four distinct encoding tasks with differing subsets of FM features specified by Sharon et al.: Task1: all three features; Task2: inference and incidental learning; Task3: semantic context and incidental learning; Task4: incidental learning only. Participants exhibited superior performance in tasks with fewer demands: Task 4 > Task3 & Task2 > Task1, suggesting that a combination of all three demands, as reported in Sharon's et al. (2011) FM procedure (here tested in Task1), does not improve but rather impedes associative learning in healthy young adults. Whether some

degree of hippocampal *abnormality* might be crucial to the reported FM advantage was assessed with 24 elderly participants, showing age related hippocampal volume loss, and one developmental amnesic, showing abnormally small bilateral hippocampi following severe hypoxia during birth. Unsurprisingly, compared to healthy young adults, both studies revealed decreased recognition accuracy in the episodic task. Importantly, performance was even more impaired, or at chance in the FM task. Overall, our results indicate that healthy young adults show no FM benefit. Associative learning improved with decreasing FM task demands and was overall best for episodic learning. It is possible that an intact hippocampus inhibits FM advantages in young adults. Such a view could also explain the lack of FM benefits in our ageing individuals who, despite some memory decline, can still make use of an intact hippocampus. More challenging, however, is the finding that our developmental amnesic also failed to display any FM benefits, and performed at chance following the FM procedure.

Martha Hvoslef-Eide, Department of Psychology
The retrosplenial cortex and paired-associate learning

The paired-associates learning (PAL) task as part of the CANTAB test battery has been been validated as sensitive to detecting deficits in a range of conditions such as schizophrenia and Alzheimer's disease. Using touchscreen operant chambers, a rodent task assessing paired-associate learning has been developed in our lab in which the subject is required to learn three object-location associations. Using immediate early gene expression as a measure of neuronal activation, the retrosplenial cortex was identified as a region which might contribute in this form of associate learning. To test whether the retrosplenial (RSC) cortex contributes to paired-associates learning in rodents, 24 rats were trained on the rodent object-location paired associates task. After acquiring the task, rats underwent either a RSC lesion or sham treatment. Performance was assessed following one week recovery. RSC-lesioned rats were significantly impaired after surgery, but they re-acquired the task to the same level as controls within three sessions. When required to learn three new object-location associations, RSC-lesioned animals were impaired. In conclusion, both maging and lesion data indicate an involvement of the RSC in retention and acquisition of the rodent touchscreen-PAL. In light of the high sensitivity of CANTAB-PAL as a predictor for disease development in Alzheimer's disease and schizophrenia, and interestingly, the RSC is hypoactive early on in this disease. Thus, the rodent touchscreen object-location task may be useful tool for preclinical research into Alzheimer's disease.

Mark Renshaw, Department of Psychology
A role for GluR2 endocytosis in the amygdala during the reconsolidation of cued fear memories

Following their recall, conditioned fear memories enter a time-limited 'labile state' in which they become sensitive to disruption by protein synthesis inhibitors, such as anisomycin. The glutamatergic mechanisms of this mnemonic destabilisation and restabilisation – reconsolidation – were recently explored, showing that

activity at AMPA receptors was critical for behavioural expression of the memory but had no effect on its destabilisation or restabilisation. Yet levels of the AMPAR subunit GluR2 at synapses are temporarily decreased following reactivation and 'enhanced extinction' – in which multiple CS exposures following reactivation results in extinction resistant to spontaneous recovery – is dependent on this endocytosis of GluR2 receptors from synapses. Using a procedure that allows both memory destabilisation and restabilisation to be assessed, we inhibited GluR2 endocytosis using the peptide TAT-GluR2$_{3Y}$ during CS-fear memory reconsolidation. Preliminary data indicate that endocytosis inhibition neither affected cued recall nor prevented restabilisation of the memory, but prevented anisomycin from producing amnesia. One explanation for this pattern of results is that GluR2 endocytosis is critical for destabilising the memory, and that inhibition of destabilisation renders protein synthesis inhibition ineffective. But TAT-GluR23Y also prevents the amnestic effect of zeta inhibitory peptide (ZIP) on fear memories, raising the possibility that a critical post-reactivation effect of protein synthesis inhibition with anisomycin is, as with ZIP, the net endocytosis of GluR2 subunits from synapses, resulting in weakened synapses and amnesia. GluR2$_{3Y}$ may be preventing this outcome of protein synthesis inhibition, rather than interfering with memory destabilisation per se. Procedures to distinguish these explanations will be discussed.

Taylor Schmitz, MRC CBU
Attentional filtering in young and older adulthood

An emerging body of research suggests that age impacts attention at multiple stages of selection. In the context of working memory, age-related impairments have routinely been demonstrated for late selection in the prefrontal cortices, i.e. competition among previously encoded representations. More recent work has started to delineate a potentially distinct age-related impairment at early stages of selection, i.e. competition among inputs from the sensory environment, prior to encoding. Together, these findings are consistent with the emerging view that attention is a distributed resource, embedded in distinct cortical subsystems, and operates in a manner that reflects the properties of those subsystems. In this presentation, I will (1) discuss the distributed resource model of attention, (2) describe some of my research examining how healthy advanced aging influences early selection mechanisms embedded in posterior subsystems, perceptual encoding, and memory, (3) argue several reasons why theories of cognitive aging would benefit from incorporating the distributed resource model of attention.

Olivia Shipton, Department of Psychology
Left-right hippocampal asymmetry at the synaptic level: implications for memory

NMDA receptors (NRs) are required for the induction of hippocampal long-term potentiation (LTP). Recently, it was found that the subunit composition of postsynaptic NRs at the hippocampal CA3-CA1 synapse is different according to whether the afferent fibres originate in the CA3 of the left or right hemisphere.

CA1 cells receiving left CA3 projections have a high GluN2B content, in contrast to those receiving right CA3 projections. We have previously used optogenetics to access this asymmetry and demonstrate that only those synapses with left CA3 origin, and hence a high GluN2B content, express LTP. In this poster, I will present data showing how acutely manipulating the activity of these different types of CA3-CA1 synapses, with their different potential for plasticity, has implications for mice performing short- and long-term hippocampus-dependent memory tasks. In addition, I have found that the well-established effect of amyloid beta impairment of hippocampal LTP, a cellular model for early Alzheimer's disease, may be mediated by changes in GluN2B subunit-containing NRs selectively targeted by the left CA3. In conclusion, optogenetics provides a powerful tool to study plasticity at the synaptic, behavioural and pathophysiological level.

Naresh Subramaniam, Department of Psychiatry
A computational investigation of at-risk mental state patient's learning behaviour

We compare the performance of At-Risk Mental State (ARMS) patients with controls on a reward-learning task using computational modelling. The task entails participants making two selections in two successive stages and at each stage out of two possible options, which enable them to gain a monetary reward contingent on their two selections; the reward probabilities vary over time to enable continuous learning and the participants are made aware of the changing nature of the task at the beginning and are instructed to keep learning the changing contingencies in order to maximise their rewards. Participant's selection data is fit to a reinforcement learning computational model to estimate the model parameters. The estimated parameters then enable a quantitative comparison of the two group's learning rate, and exploration and exploitation behaviours.

Sam Wass, MRC CBU
Training attentional control and working memory during infancy.

Convergent evidence suggests that plasticity of brain and behaviour is greatest at very early stages of development. Evidence also points to increasing localisation and specialisation of neural networks supporting different cognitive functions over developmental time. We describe a battery of gaze-contingent computerised training programs aimed at training working memory and the endogenous control of attention during infancy. These training tasks targeted a mixture of subcomponents of working memory and attentional control including task switching, focused attention, interference resolution, inhibition and working memory for objects embedded in scenes. They were administered via an eyetracker, using a new gaze-contingent interface - i.e. different events took place contingent on where on the screen the infant was looking. We also present a medium-scale evaluation trial in which 42 typically developing 11-month-old infants attended a program of 5 lab visits. Relative to an active control group we found that 77 minutes of training led to short-term improvements at sustained attention and cognitive control and to reduced saccadic reaction time latencies.

This study was the first demonstration that these core executive skills can be trained in participants younger than four years. We present evidence from currently ongoing projects that will use these training paradigms to investigate how attentional control/working memory causally mediates learning in at-risk groups (infants born prematurely and infants at risk of attention deficit hyperactivity disorder). We also present plans to use this targeted training to investigate the relationship between performance on working memory/attentional control tasks and the embodied aspects of cognition (ECG/GSR/high-resolution movement patterns).

Yasemin Yazar, Department of Psychology
Does the parietal lobe have a role in long-term memory?

The parietal lobes have become an interesting riddle for memory researchers: neuroimaging studies show consistent activation of lateral parietal lobes (LPL) during studies of episodic memory retrieval, yet patients with LPL lesions are not amnesic. Objective memory performance exhibits no obvious decline in such patients, but there is evidence that memory is not completely normal, with patients reporting, for example, reduced confidence in their recollections. Neuroimaging studies indicate functionally distinct sub-regions within LPL with Intraparietal Sulcus (IPS) associated with familiarity-based, and Angular Gyrus (ANG) with recollection-based judgments, but patient lesions rarely allow such anatomical specificity. Here, we used continuous theta-burst stimulation (cTBS) in healthy volunteers to systematically evaluate whether a causal role exists for sub-regions of LPL and memory tasks that vary in their demands on objective and subjective recollection and familiarity. Consistent with predictions from the patient literature, cTBS to LPL regions did not affect objective recognition or recollection accuracy, but significant and selective reductions in source recollection confidence were observed in the ANG group. This study provides evidence for a specific causal relationship between ANG and recollection confidence, supporting a theory that LPL modulates the subjective experience of confidence in richness or vividness of retrieved memories.