Liverpool Neuroscience Day 2016
Presentation Programme

Session I (Chair: Francis McGlone)

12.50	Opening remarks	
13.00	Plenary Speaker: **Giuseppe di Pellegrino** *University of Bologna / Bangor University*	The Contributions of the Orbitofrontal Cortex to Decision-Making: Evidence from Lesion Studies in Humans
13.30	Plenary Q&A	
13.40	**Susannah Walker** *Liverpool John Moores University*	Skin Senses: From First Order Neuron to Brain and Behaviour
13.55	**Nicholas Fallon** *University of Liverpool*	Structural and Functional Alterations in Fibromyalgia Syndrome Patients
14.10	**Will Swaney** *Liverpool John Moores University*	Neural Mechanisms of Population Variation in Animal Social Behaviour
14.25	**Stergios Makris** *Edge Hill University*	The Neural Correlates of Superior Perception and Action Skills in Athletes
14.40	**Andrej Stancak** *University of Liverpool*	Functional Aspects of Noxious Laser Evoked Potentials and Neuromagnetic Fields
14.55	**Andreas Goebel** *University of Liverpool*	The Liverpool Pain Research Institute
15.10	PGR Presentations I: **Andrew Marshall** *Liverpool John Moores University*	Alterations in Affective Touch Following Spinothalamic Tract Lesioning
	Kimberley Billingsley University of Liverpool	The Role of Retrotransposons in Neurodegeneration
	Amy Spray University of Liverpool	Microstructural Adaptation in the Corpus Callosum Following Only One Hour of Music Training
15.30	**Poster Session / Tea & Coffee Break**	

Session II (Chair: John Quinn)

16.00	PGR Presentations II: **Damien Wright** *University of Liverpool*	Electrophysiological Responses to Visual Symmetry in Each Cerebral Hemisphere
	Reyadh Al-Mosawi *University of Liverpool*	Effects of Commonly Used Antiepileptic Drugs on Markers of Oxidative Stress in a Human Neuroblastoma Cell Line
16.15	**Valentina Cazzato** *Liverpool John Moores University*	Neurobehavioral Account of Visual Body Representation: Basic and Clinical Research Advances
16.30	**Stephen Fairclough** *Liverpool John Moores University*	Neuroadaptive Technology and Physiological Computing
16.45	**Mark Hollands** *Liverpool John Moores University*	Combining Visuomotor Neuroscience and Cognitive Psychology to Understand Motor Control Processes in Groups Spanning the Entire Spectrum of Movement Capability: from Elderly Fallers to Olympic Athletes
17.00	**Rebecca Lawson** *University of Liverpool*	Objects in Vision and Touch
17.15	**Sally Williamson** *Liverpool John Moores University*	Invertebrate Neurobiology: from Pest Control to Slugs on Drugs
17.30	**Neil Harrison** *Liverpool Hope University*	Research activity in cognitive neuroscience at Liverpool Hope University
17:45	**Discussion & Concluding Remarks**	
18.00	**Wine reception and posters**	

13:00

Plenary Speaker

Professor Giuseppe di Pellegrino

Professor of Cognitive Neuroscience
Department of Psychology, University of Bologna

Leverhulme Visiting Professor
School of Psychology, Bangor University

Professor di Pellegrino has investigated the neural and cognitive mechanisms of selective attention and space representation, using a variety of methodological approaches, ranging from single-cell recordings in animals, to behavioural, eye-movement, electroencephalographic and psycho-physiological measurements in humans. His empirical work revealed the existence of a visual peripersonal space centred on the hand, and has shown its modulatory effects on tactile perception. His current research focuses on the functional mechanisms of cognitive control and decision-making.

… … …

The contributions of the orbitofrontal cortex to decision-making: evidence from lesion studies in humans.

Giuseppe di Pellegrino[12]

[1] Department of Psychology, University of Bologna;
[2] School of Psychology, Bangor University;

Every day we face many decisions, from what to have for lunch to whether is better to invest in bonds over stocks. Several studies have consistently implicated a region in the anterior part of brain, the orbitofrontal cortex (OFC), in this type of decisions, yet the exact role of this brain area remains elusive. Patients with bilateral lesions in OFC show profound impairments in judgment and decision-making in real-life settings, in spite of maintaining a normal intellect. One influential hypothesis suggests that patients' disadvantageous choices may be related to an inability generating emotions and unconsciously use visceral sensations (somatic markers) to guide behavior. An alternative and more recent approach focuses on the role that the OFC has in the cognitive ability to transcend the present and encode a more abstract representation of the task. By using a wide array of task in OFC patients, ranging from moral judgment to economic games, I will provide some initial evidence supporting this second view.

13:40

The Skin Senses: From First Order Neuron to Brain & Behaviour.

Susannah Walker[1], David Moore[1] & Francis McGlone[1]

[1]Research Centre for Brain & Behaviour, School of Natural Sciences & Psychology, Liverpool John Moores University;

The skin senses are a truly multisensory modality, with specific populations of cutaneous receptors & afferent nerve fibres coding for touch, temperature, pain, itch and 'pleasure'.

Our group's research interests span across the whole somatosensory range, and also includes cross-modal interactions with the chemical senses of taste and smell. Our interdisciplinary studies focus on the neural mechanisms as well as the affective and cognitive consequences of painful and pleasant cutaneous sensations, in both healthy and clinical populations.

My talk will give you a flavour of our ongoing research and the range of techniques we use to assess sensory function, including electrophysiological recording from single afferent nerves using microneurography to the study of their central projections and function using behavioural tasks & fMRI.

We have a particular interest in a population of low threshold mechanosensitive c-fibres named C-tactile (CT) afferents. Only recently discovered in humans, they respond most strongly to 'gentle stroking touch' and are hypothesised to underpin the rewarding properties of tactile social interactions and to play a critical role in the developing social brain.

13:55

Structural and Functional Alterations in Fibromyalgia Syndrome Patients

Nicholas Fallon[1], Yee Chiu[2], Turo Nurmikko[34] & Andrej Stancak[1]

[1]Department of Psychological Sciences, University of Liverpool;
[2]Wirral University Teaching Hospital NHS Foundation Trust;
[3]Pain Research Institute, University of Liverpool;
[4]The Walton Centre NHS Foundation Trust;

Fibromyalgia syndrome (FMS) is a chronic pain disorder primarily associated with pain and tenderness in deep tissues which particularly affects women of middle age. The syndrome is frequently comorbid with a variety of clinical, functional and psychological disorders and is both challenging and costly to diagnose and treat. Central mechanisms, including structural and functional brain alterations, have been proposed as a causal or maintaining factor of the disorder and studies have demonstrated augmented brain activity and reduced pain thresholds which have led many to hypothesise that FMS is a central sensitisation syndrome. However, the precise nature of how any such sensitisation in the brain occurs is still not fully understood. Our research has shown that non-painful tactile sensations are amplified in the brain of FMS patients, causing patterns of brain activation similar to those seen when healthy people are in pain. Shape and volume structural alterations were also identified in the brainstem of patients, and these may relate to how the central amplification process occurs. However, we have also revealed a powerful effect of FMS during emotional processing of observed pain, and the importance of top-down psychological factors cannot be discounted in this disorder. Our most recent work points to alterations in resting brain activity of patients. Such differences could represent a predisposing factor for developing FMS, or a consequence of prolonged chronic pain.

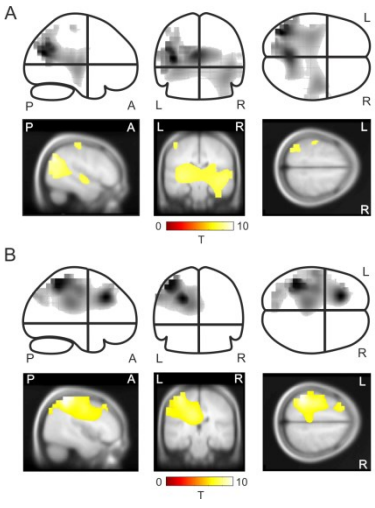


Figure 1: Source localisation (beamformer analysis) of brain oscillatory changes evoked during repetitive tactile stimulation in FMS patients (A), and age-matched, healthy control participants (B).

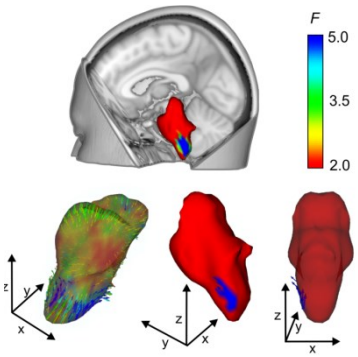


Figure 2: Vertex analysis of shape alterations in the brainstem of FMS patients. Blue colour indicates significant inward shape distortion in the FMS group relative to healthy, age-matched control participants

.

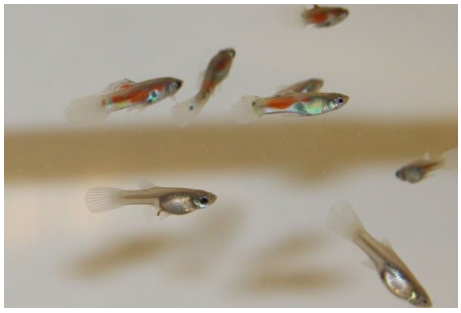
14:10

Neural Mechanisms of Population Variation in Animal Social Behaviour

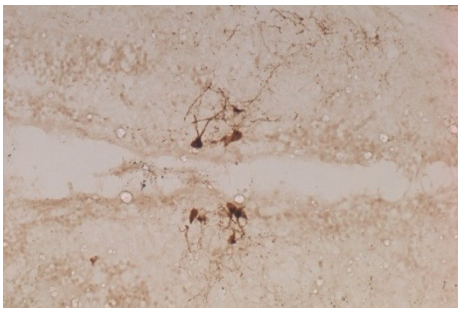
William T. Swaney[1], Maria Cabrera[2], Susie Hewlett[3] & Simon M. Reader[2]

[1]School of Natural Sciences & Psychology, Liverpool John Moores University;
[2] Department of Biology, McGill University;
[3]Department of Biological Sciences, Macquarie University

Social behaviour is ubiquitous across the animal kingdom, with enormous variation in sociality seen between species, however stable intraspecific variation in social behaviour between populations is also common. Such variation is thought to be driven, at least in part, by differences in the costs and benefits of social behaviours according to local environment. We have investigated how differences in local ecology, primarily predation level, influences social behaviour in shoaling fish and explored the proximate neural mechanisms regulating this behavioural variation. Studies of



predator-exposed guppies found that social grouping and social learning in particular are responsive to predator exposure. We then investigated how this variation was regulated by the nonapeptides vasotocin and isotocin, teleost homologues of vasopressin and oxytocin, neuropeptides that have been extensively implicated in the control of social behaviour across vertebrate taxa. Predator-exposed guppies exhibited changes in abundance of vasotocinergic neurons and in pharmacological sensitivity to vasotocin; however we found little evidence that the oxytocin-like nonapeptide isotocin is involved in the changes in social grouping behaviour seen in these fish. These findings were despite further work which indicates that both nonapeptides are capable of influencing grouping behaviour in guppies, suggesting that it is vasotocinergic signalling specifically which has changed in response to predation and which may underpin the phenotypic changes seen in these fish. Our results also indicate that the effects of each nonapeptide vary across taxa and depending on behaviour and context, and so caution against a simplistic narrative that nonapeptides are broadly prosocial hormones.



14:25

The Neural Correlates of Superior Perception and Action Skills in Athletes

Stergios Makris[1]

[1]Department of Psychology, Edge Hill University;

The ability to form anticipatory representations of ongoing actions is crucial for effective interactions in dynamic environments. In sports, elite athletes exhibit greater ability than novices in predicting other players' actions, mainly based on reading their body kinematics. This superior perceptual ability is modulated by motor expertise and has been associated with a selective activation of both visual and motor brain areas (namely the action observation network).

In a series of behavioural and neurophysiological projects, we are investigating by means of non-invasive brain stimulation techniques (spTMS, rTMS, tDCS) the causative roles of visual and motor action representations in expert athletes' ability to predict the outcome of observed familiar sport actions. Furthermore, we are trying to shed more light on how expert and/or elite athletes in various sports are able to detect bluffing actions and whether that ability is also grounded on their superior motor and perceptual skills.

Overall, we are expecting to find causative evidence on the neural underpinnings of athletes' superior perceptual and action skills and apply these findings on the development of novel approaches for the physical preparation and training in sports.

14:40

Functional Aspects of Noxious Laser Evoked Potentials and Neuromagnetic Fields.

Andrej Stancak[1], Nicholas Fallon[1], Stephanie Cook[1] & Hazel Wright

[1]Department of Psychological Sciences, University of Liverpool

Laser evoked potentials (LEPs) or laser neuromagnetic fields are produced by brief radiant heat stimuli (2-20 ms) applied to a small region (4-10 mm in diameter) of hairy skin. This type of stimuli typically evokes an initial pin prick sensation as well as subsequent burning or warming sensations suggesting involvement of A□ and C fibres. LEPs typically evolve in the latency period ranging from 140 to 500 ms, however, we have recently disclosed novel ultra-long latency components ranging up to 1300 ms [1].

To shed light on the functional roles of different latency components of LEPs, we carried out a series of experimental studies in which changes in LEPs were evaluated in the context of motor readiness, emotion-inducing stimuli, temporal summation, motivational states, attentional distraction, and introspective multivariate scaling of pain. Our data suggest that the early N1 component of LEPs (140-180 ms), largely generated in bilateral operculo-insular cortex, is affected by the state of motor readiness in absence of any overt motor activity [2]. We also showed that the operculo-insular cortex was the only brain region showing a match between the variations in pain level and amplitudes of neuromagnetic fields during repeated warm laser stimulation [3]. Our studies show that unpleasant emotional stimuli strengthen the operculo-insular LEP component suggesting a top-down regulation occurring during the early phase of nociceptive processing [4, 5]. The N2 component (200-280 ms), although differentiating between painful and non-painful laser stimuli [6], shows absence of somatotopic organization [7] suggesting its role in higher order pain processing. The N2 and especially the P2 component (300-420 ms) involves a number of cortical generators and therefore, both components respond to a variety of factors such as pain intensity, emotional context of noxious stimulus, attentional distraction (in preparation), or presence of incompatible motivational drive [8]. Our recent research data [6] indicate that the N2-P2 complex re-occurs with a diminishing amplitude up to the latency of 1300 ms , suggesting an oscillatory structure of the processes that shape individual aspects of ongoing pain experience and provide a top-down modulation of pain.

[1] Stancak, A., et al., Data In Brief, 2015. **5**: p. 1031-1034. [2] Stancak, A., J. Johnstone, and N. Fallon, Behav. Brain Res., 2012. **227**: p. 215-223. [3] Stancak, A., J. Alghamdi, and T.J. Nurmikko, PLOS1, 2011. **6**: p. e19744. [4.] Stancak, A. and N. Fallon, Front. Hum. Neurosci., 2013. **7**: p. 552. [5] Stancak, A., H. Ward, and N. Fallon, Eur. J. Pain, 2013. **17**: p. 324-35. [6] Stancak, A., et al., NeuroImage, 2015. **125**: p. 244-255. [7] Stancak, A., H. Polacek, and S. Bukovsky, Brain Res., 2010. **1317**: p. 69-79. [8] Wright, H., et al., J Neurophysiol, 2015. **113**(5): p. 1323-33.

14:55

The Liverpool Pain Research Institute

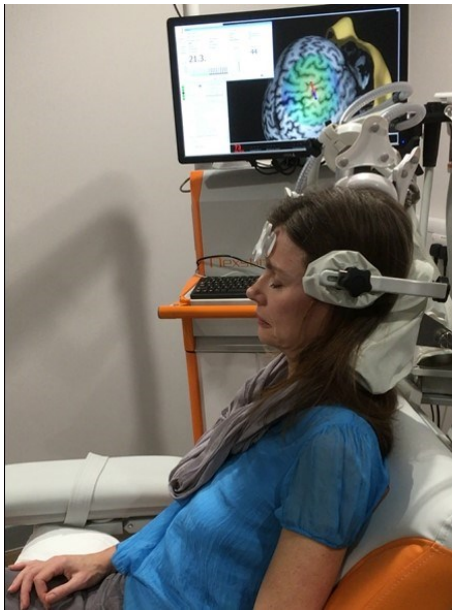
Andreas Goebel[12]

[1]Pain Research Institute, University of Liverpool;
[2]The Walton Centre NHS Foundation Trust;

Moderate or severe chronic pain affects one in 7 people in the UK. Pain is the number one concern for many patients, including those who have other chronic health conditions. 'Pain colours everything' was the top finding in a recent, large patient survey conducted by the Research Charity Arthritis Research UK.

Pain-research has been recognized an under-funded area in relation to the burden that pain causes. Increasing funding efforts can be expected in the UK over the next few years.

The Liverpool Pain Research Institute (PRI) aims to support people who conduct research into the causes and best treatments of human chronic pain. Our mission is to encourage researchers in developing their own research ideas, by helping them to transform their excellent ideas into projects. We help researchers to find funding, and deliver their project to a high standard in order to benefit patients suffering with chronic pain.



The researchers working under the umbrella of the Liverpool Pain Research Institute are a multi-disciplinary group. They receive substantial funding from major UK research councils, and collaborate closely with the Walton Centre NHS Foundation Trust, and with research groups in Liverpool, the UK and worldwide. The Liverpool Pain Relief Foundation, a Pain Research Charity provides funding for our offices and administration.

The Pain Research Institute is a Trans-Departmental Institute within the University of Liverpool.

I will highlight, as PRI Director, pain research projects conducted by Liverpool researchers. Projects cluster around the areas 'Pain Immunology', 'Neuro-recording', 'Pain Neuro-modulation', 'Pain-Imaging', 'Analgesia Trials', and 'Pain Psychology'.

15:10

PGR 1

Alterations in Affective Touch Following Spinothalamic Tract Lesioning

Andrew Marshall[12], Manohar Sharma[3], Kate Marley[4] & Francis McGlone[1]

[1]Research Centre for Brain & Behaviour, School of Natural Sciences & Psychology, Liverpool John Moores University;
[2]Salford Royal NHS Foundation Trust;
[3]Walton Centre for Neurology and Neurosurgery;
[4]University Hospital Aintree;

Introduction: Microneurographic and psychophysical studies have established the existence of a system of low threshold mechanosensitive C-fibres, C-Tactile (CT) afferents, in human hairy skin. CT afferents show velocity dependent spiking in response to gentle stroking touch and are hypothesised to encode the pleasant nature of touch. Currently the CT ascending spinal projection pathways in humans are unknown. To address this we assessed for alterations in pleasant touch following therapeutic spinothalamic tract ablation.

Methods: Nine patients with intractable unilateral cancer related pain underwent assessment of discriminative and affective touch before and after anterolateral C1/C2 cordotomy. Stroking at velocities optimal (3cm/s) and sub-optimal (0.3 and 30cm/s) for CT afferent activation were performed on the right and left forearm. Patients were asked to rate the pleasantness of touch. Absolute pleasantness ratings and the CT preference index ([rating for 3cm/s x 2 - ratings for 0.3cm/s + 30cm/s] / 2) were calculated. Discriminative touch was assessed using two-point discrimination, tactile detection thresholds and graphesthesia.

Results: Spinothalamic tract ablation, confirmed by total or sub-total loss of thermal sensation contralateral to the cordotomy and reduction or abolishment of ongoing pain, resulted in a small but significant ($p<0.05$) reduction in CT preferred touch and a significant reduction in CT preference index ($p<0.005$) on the side contralateral to cordotomy. No change was seen on the side ipsilateral to lesioning. Discriminative touch was unaltered by cordotomy.

Conclusion: The alterations in the perception of CT optimal touch contralateral to cordotomy lend support to hypothesis that information salient to affective touch is transmitted in the spinothalamic tract. Unlike the dramatic changes in temperature and nociception the effects are relatively subtle. This may reflect spinal integration, incomplete spinothalamic tract ablation or top-down processing of dorsal column cortical input.

PGR 2

The Role of Retrotransposons in Neurodegeneration

Kimberley Billingsley[1], Abigail Savage, Olympia Gianfrancesco, Veridiana Pessoa, Vivien J Bubb & John Quinn

[1]*Department of Molecular and Clinical Pharmacology, Institute of Translational Medicine, University of Liverpool;*

Retrotransposons often referred to as "jumping genes" are endogenous genomic DNA elements that have the potential to wreak mutational havoc by making copies of themselves that can then insert elsewhere into the genome causing somatic mutation resulting in damage to cell function. These elements are most strikingly active in our brain cells and have been demonstrated to increase in activity with ageing. It has been estimated that each neuron in a healthy adult brain has an average of 13 unique insertions.

They are now being considered as a major driver of age associated neuronal dysfunction and disease. Most noticeably increased mobilisation has recently been documented in schizophrenia and motor neuron disease.

I am currently addressing their role in neurodegenerative diseases including Parkinson's and Alzheimer's disease. If these elements play a role in such conditions there is hope in the future to intervene in their progression using drugs that inhibit the jumping/mobilisation of such retrotransposons.

PGR 3

Microstructural adaptation in the corpus callosum following only one hour of music training

Amy Spray[1], Georg Meyer[1], Anton Beer[2] & Vanessa Sluming[1,]

[1]University of Liverpool;

[2]University of Regensburg;

Background: The structure of the corpus callosum (CC) of experienced musicians is different from non-musicians. Little is known about how these structural differences emerge and in particular the time scale of these structural adaptations. Diffusion-weighted magnetic resonance imaging (MRI) not only is sensitive in detecting alterations of the brain microstructure but also allows inferences about its nature. Therefore, microstructural changes of the CC contingent on short-term music training were quantified by diffusion-weighted MRI.

Method: Thirteen non-musicians were examined directly before and one day after a one hour polyrhythm tapping task. Both behavioural performance in the polyrhythm task and MRI diffusion properties of the corpus callosum were investigated. Diffusion properties were derived from the tensor model and included mean diffusivity (MD), axial diffusivity (AD), radial diffusivity (RD), and fractional anisotropy (FA).

Results: Following short-term music training significant reductions in MD, AD and RD were observed in the anterior and body parts of the corpus callosum. No equivalent changes in diffusivity were observed in the posterior CC. Importantly, MD strength of the CC predicted performance in the music task after training. Furthermore, the degree of MD reduction correlated with performance gains in the music task.

Conclusion: This is the first demonstration that the special brain structure related to music expertise may be induced by training even in inexperienced adults and that changes in brain microstructure are specific to musical training. The rapid structural alterations are likely mediated by oligodendrocytes.

16:00

PGR 4

Electrophysiological responses to visual symmetry in each cerebral hemisphere

Damien Wright[1], Alexis Makin, & Marco Bertamini

[1]University of Liverpool;

Symmetry is an important and prevalent feature that is present in both natural and man-made objects. The human visual system is particularly efficient at processing reflection symmetry. ERP work has identified a symmetry specific response known as the Sustained Posterior Negativity (SPN): Amplitude in posterior electrodes is more negative for symmetrical than random patterns from 200ms after stimulus onset (Bertamini & Makin, 2014). Previous behavioural and electrophysiological evidence has suggested that this response originates from a symmetry-sensitive network that spans both hemispheres. However, previously the SPN has only been examined to stimuli presented in central vision therefore activating the extrastriate visual areas in both hemispheres. For the first time we report responses to reflection and random patterns in one hemifield. We examined whether the SPN is produced just to symmetry at fixation, or if each hemisphere can produce an independent response to symmetry in the contralateral visual field. Participants were presented with reflection and random dot patterns to the left and right of fixation (3.2°). They were required to judge whether the patterns were light or dark red in colour. In Experiment 1, a reflection and random pattern were present either side of fixation. In Experiment 2, a single pattern, either reflection or random, was presented in one visual field. In Experiment 3, both visual fields contained matching patterns. The SPN was produced independently in each hemisphere and it was unaffected by stimuli in the opposite hemifield. We conclude that a symmetry sensitive network of extrastriate visual areas in each hemisphere can be activated independently.

PGR 5

Effects of commonly used antiepileptic drugs on markers of oxidative stress in a human neuroblastoma cell line

Reyadh Al-Mosawi[1], Graeme J Sills[1]

[1]Department of Molecular & Clinical Pharmacology, Institute of Translational Medicine, University of Liverpool, UK

Background: Emerging evidence suggests that oxidative stress plays an important role in the development of seizures and that anti-oxidant compounds might be useful in the treatment of epilepsy. Existing antiepileptic drugs (AEDs) have complex mechanisms of action but there is no reliable evidence to suggest whether they have pro- or anti-oxidant effects.

Aim: To determine the effects of commonly-used AEDs on routine markers of oxidative stress in a human neuroblastoma cell-line.

Methods: SH-SY5Y cells were grown under standard cell culture conditions until 80-90% confluent. Cells were exposed to carbamazepine (CBZ; 0-100□M), levetiracetam (LEV; 0-300□M), lamotrigine (LTG; 0-100□M) and valproic acid (VPA; 0-1000□M) for 1, 4 and 24 hours. Cell viability at each concentration and time-point was determined by MTT assay. AED effects were assessed against basal oxidative stress, determined by malondialdehyde (MDA) concentration, superoxide dismutase (SOD) activity, and reduced / oxidised glutathione (GSH/GSSG) ratio, and again following exposure to 100□M H_2O_2 for a further 4 hours.

Results: All AEDs caused concentration-related oxidative damage to SH-SY5Y cells. MDA concentrations were increased up to 9.5 folds, 13 folds, 25.1folds and 26.7 folds of control values for CBZ, LEV, LTG and VPA, respectively. The activity of SOD was reduced to 72.5%, 25.5%, 57.5% and 39.5% of control for CBZ, LEV, LTG and VPA, respectively. Likewise, the GSH/GSSG ratio was reduced to 7.75%, 14.4%, 10.7% and 17% of control for CBZ, LEV, LTG and VPA, respectively. The majority of AED effects were exacerbated by exposure to H_2O_2, with MDA concentrations increased by a further 2.4 folds on average, SOD activities reduced by a further 19.3% and the GSH/GSSG ratio reduced by a further 13.4%.

Conclusions: These results suggest that commonly used AEDs have pro-oxidant effects that are unlikely to contribute to their anticonvulsant activity and might actually worsen seizure activity under some circumstances.

16:15

Neurobehavioral Account of Visual Body Representation: Basic and Clinical Research Advances.

Valentina Cazzato[1]

[1]Research Centre for Brain & Behaviour, School of Natural Sciences & Psychology, Liverpool John Moores University;

Visual representation of the body is a key aspect of self-image. Its importance in our social life is proved by the unreasonable time and effort we put on taking care of our physical appearance and body shape, including use of plastic surgery, as well as by the severe mental disorders associated to its alteration, including Eating Disorders (EDs). Crucially, body shape is also an important cue to form impressions of other people on the basis of basic perceptual processing and explicit negative attitudes and beliefs towards obese individuals seem to modulate the activity of perceptual areas. From the neuroanatomical point of view, evidence suggests the extrastriate body area (EBA) plays a critical role in body (mis)perception and weight-bias towards obese individuals. Furthermore, functional or structural alterations of this area may contribute to development of disturbances in perceptual and affective components of body image in women with EDs.

In series of non-invasive brain stimulation projects (using TMS and tDCS), we aim at demonstrating that recognition of one's own and others' body crucially depends on the functional integrity of the lateral-occipital cortex. Furthermore, temporary inhibition of visual area selectively impairs the aesthetic preference of specific bodily cues (i.e., shape and implied motion), thus suggesting a crucial role of EBA in aesthetic appreciation of human bodies. Finally, we aim at providing causative evidence that activity in the EBA actively contributes to the formation and expression of implicit stigma based on body size, thus supporting the notion that interactions between neural systems important for 'person perception' may upregulate or downregulate the response in body-selective cortex[8,9]. Clinical implications and future directions are also discussed.

16:30

Neuroadaptive Technology and Physiological Computing

Stephen Fairclough[1]

[1]Research Centre for Brain & Behaviour, School of Natural Sciences & Psychology, Liverpool John Moores University;

There is an emerging category of computing where signals from the brain and the body provide direct inputs to a technology as part of a closed-loop system.

Access to neurophysiological and autonomic signals can deliver a quantified representation of the user state, which can enable implicit and intelligent software adaptation for working systems. Hence, help information is delivered when frustration is detected, the challenge of the game increases when the player is bored, automated driving switches to manual control if the driver is falling asleep.

This nascent form of neuroadaptive technology will be described with reference to basic research on motivation and performance using electrocortical and neurovascular measures of brain activity.

The development of this research into a working closed-loop system will be described with reference to a neuroadaptive gaming prototype.

The wider implications of this emerging form of technology for human-computer interaction will be also be discussed.

16:45

Combining Visuomotor Neuroscience and Cognitive Psychology to Understand Motor Control Processes in Groups Spanning the Entire Spectrum of Movement Capability: from Elderly Fallers to Olympic Athletes

Mark Hollands[1], Simon Bennett[1], Spencer Hayes[1], Joe Causer[1]

[1]Research Institute for Sport and Exercise Sciences, Liverpool John Moores University;

There is deterioration in oculomotor control during normal ageing, which is partly related to voluntary control processes involved in predicting future events. To understand these effects we are studying upper limb and eye movement responses to visual perturbations that emphasise internal representation of object motion. We are exploring the use of tDCS to determine contribution of cortical areas associated with visual-spatial memory on pursuit movements.

Looking at features you want to walk towards or step onto is crucial for effective goal-directed locomotion. Therefore, problems moving the eyes due to compromised oculomotor or cognitive function have a negative influence on stepping accuracy and in extreme cases can lead to falls, injury and even death. We have shown that measuring where frail individuals look can provide us with information that can be used to predict individuals at risk of falling and improve our understanding of the neural mechanisms that contribute towards motor problems.

To test whether elite athletes have enhanced visual-cognitive abilities, and if these can be trained, we have examined visual function of elite football players at Man Utd, and whether acquisition of interceptive actions is facilitated by stroboscopic vision. We are also examining visual processing in elite cricketers at the ECB, and whether use of quiet eye strategies by Olympic shooters and expert golfers facilitates performance. These projects are revealing subtle differences between visual-cognition as a function of the demands placed upon the athlete as well as their skill level.

People with autism spectrum disorders have difficulty copying how a movement is performed, which inhibits the performance of everyday activities. Using a novel motor imitation protocol, we have shown that adults with autism can overcome these problems when the task promotes sensorimotor integration. Further work is exploring the effects of motor practice in the context of social imitation, which is also known to be compromised in autism.

17:00

Objects in Vision and Touch

Rebecca Lawson & Stefano Cecchetto

[1]Department of Psychological Sciences, University of Liverpool

Although objects are important concepts in perception and cognition it has been difficult to formally define them, even for visual stimuli (Feldman, 2003), and this issue has barely been considered in haptics (our sense of active touch).

It might be that objectness does not matter for haptics, given its limited ability to perceive scenes, to explore multiple objects simultaneously, and to rely on vision to specify objects. However, the results of our studies suggest that defining what is an object plays an important role in haptic as well as visual processing. We compared haptic and visual regularity detection by investigating whether symmetry signals the presence of one object and repetition signals the presence of multiple, similarly-shaped objects. Our results suggest that diverse cues combine to define haptic objects. Some cues, such as proximity and contour polarity (concavities and convexities along a contour) are also used by vision. However, others, such as whether stimulus exploration involves one rather than two hands, are modality-specific. Thus the nature of what it means to be an object appears to differ for haptics and vision.

This conclusion supports Feldman's (2003) claim that objects cannot be defined purely objectively, by considering only properties of the external world. Instead, objects appear to be specified relative to the system processing them, and so require a modality-specific definition.

Feldman, J. (2003). What is a visual object?, *Trends in Cognitive Sciences*, 7(6), 252-256.

17:15

Research activity in cognitive neuroscience at Liverpool Hope University

Neil Harrison[1], Philippe Chassy[1], Letizia Palumbo[1] & Nicola Jones[1]

[1]Department of Psychology, Liverpool Hope University

The Cognitive Neuroscience Research Group was formed at the start of this year to bring together and share expertise among researchers at Liverpool Hope who use the methods of cognitive neuroscience. The formation of the group coincided with the opening of the new Health Sciences building at Hope Park in which there are new EEG, fNIRS, and TMS labs.

In this talk we will give an outline of the research interests, recent findings, and plans of the group members (Dr Neil Harrison, Dr Philippe Chassy, Dr Letizia Palumbo & Dr Nicola Jones, and two PhD students).

Dr Harrison's research uses ERPs to study crossmodal perceptual processes, and in particular the neural correlates of audio-visual motion perception. He also investigates action effect anticipation and has recently shown that effect anticipation affects perceptual, cognitive, and motor phases of response preparation. Following on from his previous research using fMRI, Dr Chassy is using fNIRS to investigate mathematical cognition, with a particular interest in how the fronto-parietal network underpins the learning of abstract concepts. Dr Palumbo uses EEG and EMG to study neural correlates of sensorimotor processes with dynamic emotional facial expressions. She also investigates ERPs in relation to visual processing of symmetry (SPN in the LOC) and preference for curvature (LPP). Dr Jones's research interests include memory, attention, glucoregulation and ageing. Following initial results in older adults indicating the differential impact of glucoregulatory efficiency on ERPs in verbal memory and face recognition, she is now extending her research to examine this across the lifespan.

Together, the group has a wide range of research interests in the area of cognitive neuroscience and welcomes collaboration with researchers at other local institutions.

17:30

Invertebrate neurobiology: from pest control to slugs on drugs

S. M. Williamson[1]

[1]School of Natural Sciences & Psychology, Liverpool John Moores University;

As an invertebrate neurobiologist, people are often a little sceptical about the utility of studying animals completely lacking any prefrontal cortex, whose neurological complexity extends at best to a few anterior ganglia fused together. Imagine a Skinner box filled with drug-crazed snails: is that sort of thing really credible research?

Yet neurotransmitters, receptors and ion channels are largely conserved within different animal groups, and by studying animals with a simple behavioural repertoire, insights can be gained into the action of drugs on an animal's behaviour without the psychosociological complications which arise in studies using rodents or human subjects.

A new avenue of research I have recently been exploring is studying the actions of drugs which target serotonin and dopamine signalling on the behaviour of flatworms, and slugs and snails. I have also been performing similar experiments with nicotine and caffeine.

From simple motility assays, to classical and aversive conditioning, to exploring drug effects on social interactions: slugs on drugs may provide new insights into psychopharmacology, allowing us to separate the psychological from the pharmacological effects of drugs on behaviour.