RIO group

2017 Annual Research in Imagery and Observation Group Meeting

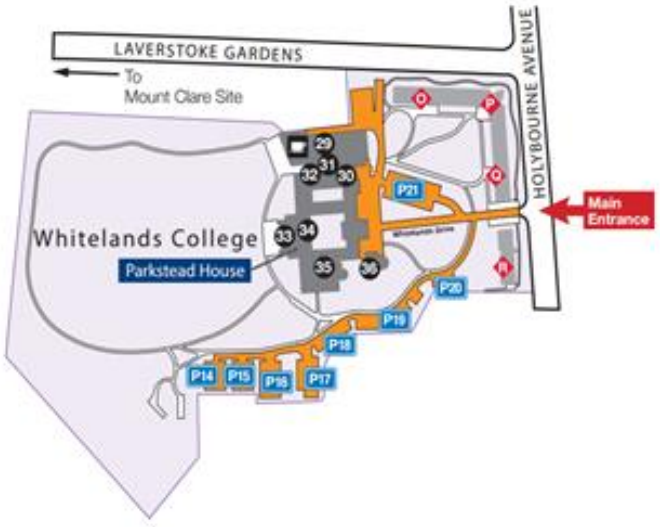
18-19 May 2017

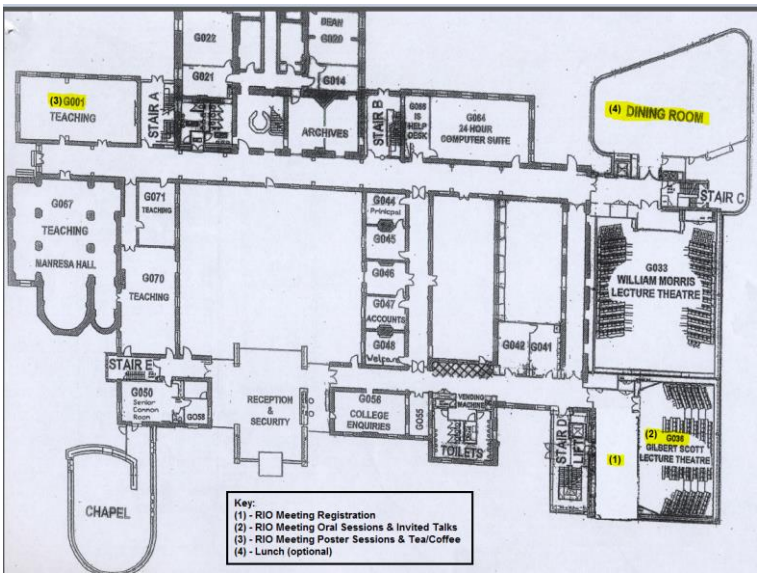
Welcome!

This year's meeting at Roehampton is being hosted by Adam Bruton, Daniel Eaves, David Wright, and Cornelia Frank (the RIO group organising committee). As you can see, we have an excellent programme in store and look forward to building on the great success of last year's 10th anniversary meeting. We would like to thank the Department of Life Sciences at the University of Roehampton for providing us with financial support and a venue to host the 2017 Annual Research in Imagery and Observation Group Meeting.

Venue and Travel Information

The meeting will be held at Whitelands College, University of Roehampton, Holybourne Avenue, SW15 4JD. A campus map and travel information can be found online: https://www.roehampton.ac.uk/globalassets/documents/campus/travel-options-guide.pdf





RIO Newsletter

The first RIO Group Newsletter was published in December 2016. Many thanks to all those who submitted updates on their research for inclusion in the newsletter. We hope that you all found the newsletter to be an interesting read. For those of you who have not yet seen it, the newsletter is available on the RIO website: http://riogroup.weebly.com/newsletter.html

We will issue another call for contributions for the second edition of the newsletter around September/October 2017, and we look forward to receiving your contributions once again.

RIO Crowdfunding

As you may be aware, we ran a crowdfunding initiative from October to December 2016 to attempt to raise funds to support the organisation of the annual conference for this year and in future years. The total amount raised was £334.00. We are continuing to accept donations to the group via the Eventbrite page for this year's meeting, and have received £60.00 of additional crowdfunding via this route. This option will be available until the first day of the annual group meeting. Your contributions have been used to fund tea and coffee during this year's event and cover certain costs for the invited speakers. Many thanks to all those who have contributed to the initiative so far!

2017 Annual Research in Imagery and Observation

Group Meeting Schedule

Thursday 18th May

9.00 – 9.15: Registration (PH.G036 Foyer)

9.15 – 9.30: Welcome and introduction (PH.G036)

9.30 – 11.30: Oral Session 1 (PH.G036) – ***Imagery, Observation and Learning***

9.30 **Chris Pocock**[1], Matt Dicks[2], Richard Thelwell[2], Michael Chapman[2], Jamie Barker[3]
[1]St Mary's University, [2]University of Portsmouth, [3]Staffordshire University
Using an imagery intervention to train visual exploratory activity in elite academy football players

10.00 **Stephanie Romano-Smith**[1], Caroline Wakefield[1], Greg Wood[2]
[1]Liverpool Hope University, [2]Manchester Metropolitan University
The effect of action observation and motor imagery on performance of an aiming task

10.30 **Ben Marshall**, David Wright, Paul Holmes, Greg Wood
Manchester Metropolitan University
Combining action observation and motor imagery improves eye-hand coordination during the learning of a novel visuomotor task

11.00 **Sonia Abad-Hernando**, A. Gálvez-Pol, B. Forster, Beatriz Calvo-Merino, B.
City, University of London
How do we represent observed actions? Investigating the specificity of the sensorimotor encoding of human bodies using EEG

11.30 – 12.30: Poster Session 1 (PH.G001) – ***Imagery and Observation across Domains***
Complementary Tea/Coffee Available

Majid Alenezi, Amy Hayes, Gavin Lawrence, David Markland, Nichola Callow
Bangor University
Effectiveness of imagery on musculoskeletal system function: A systematic review

Adam Bruton[1], Ceri Diss[1], Isabelle Moore[2], Stephen Mellalieu[2]
[1]University of Roehampton, [2]Cardiff Metropolitan University
Examining the effects of combined gait-retraining and video self-modeling on habitual runners experiencing knee pain

William Docherty[1], Adam Bruton[1], David Shearer[2], Stephen Mellalieu[3]
[1]University of Roehampton, [2]University of South Wales, [3]Cardiff Metropolitan University
Who said there is no I in team? Examining the effects of observation content level upon efficacy beliefs in team sports athletes

David Harris[1], Gavin Buckingham[1], Sam Vine[1], Mark Wilson[1], John McGrath[2]
[1]University of Exeter, [2]Exeter Surgical Health Services Research Unit
Observational learning of surgical skills on the daVinci system

Saadia Hasan
University of Nottingham
Visualising the ideal self: Testing three techniques of visualisation in a language learning setting

Taeho Kim, Thomas Schack, Cornelia Frank
Bielefeld University
The effect of combined training of action observation and motor imagery on the development of mental representation structure, cognitive performance, and skill performance

Magda Mustile[1], Alissa Fineschi[1], Laura Romano[1], Daniele Caligiore[1], Francesca Assogna[2], Francesco E. Pontieri[2], Fabrizio Piras[2], Gianfranco Spalletta[2], Gianluca Baldassarre[1]
[1]Istituto di Scienze e Tecnologie della Cognizione, [2]Santa Lucia Foundation
Action observation therapy and Parkinson's disease patients: a double blind controlled study

Judith Bek[1], Jordan Webb[1], Paul Holmes[2], Chesney Craig[2], Zoe Franklin[2], Emma Gowen[1], **Ellen Poliakoff**[1]
[1]University of Manchester, [2]Manchester Metropolitan University
Development of an app to improve everyday actions in Parkinson's disease through action observation and motor imagery: A focus group study

Aidan Shell, Adam Bruton, Zara Abbas, Luke Felton
University of Roehampton
Learning from the best: The effect of observational learning frequency on self-efficacy, motivation and skill acquisition in tennis

David Shearer[1], Shona Leeworthy[1], Emma Rickards[1], Sarah Jones[1], Adam Bruton[2]
[1]University of South Wales, [2]University of Roehampton
Is there an 'eye' in team? A team selection-based eye-tracking study

12.30 – 1.30: Invited Talk 1 (PH.G036)

Wolfgang Taube
University of Fribourg
Mental simulation in the context of balance control – functional relevance and underlying mechanisms

1.30 – 2.30: Lunch Break (Whitelands College Dining Room)
Hot food and sandwiches available for purchase

2.30 – 4.30: Oral Session 2 (PH.G036) – ***Imagery Ability and Stored Representations***

2.30 **Francesco Di Gruttola**[1], Oriana Incognito[1], Elisa Menardo[2], Danilo Menicucci[1], Laura Sebastiani[1]
[1]University of Pisa, [2]University of Verona
Objective and subjective assessment of kinesthetic imagery: different measures of the same ability

3.00 **Mary Quinton**, Sarah Williams, Jennifer Cumming
University of Birmingham
Investigating the mediating role of positive and negative mastery imagery ability

3.30 **Scott Glover**
Royal Holloway University of London
Executive functions in motor imagery

4.00 **Stéphane Grade**, Mauro Pesenti, Martin Edwards
Université catholique de Louvain
The role of body action on automatic imagery

4.30 – 5.00: Afternoon Break (Whitelands College Dining Room)
Tea/Coffee available for purchase

5.00 – 6.00: Invited Talk 2 (PH.G036)

Angelika Lingnau
Royal Holloway University of London
The organization of actions in the human brain

6.00 – 6.15: Annual Group Meeting Photo (Parkstead House Steps)

6.45: Meet for Drinks (Telegraph Pub, Putney)

7.30: Conference Dinner (Telegraph Pub Function Room)

Friday 19th May

9.00 – 9.30: Registration (PH.G036 Foyer)

9.30 – 11.30: Oral Session 3 (PH.G036) – ***The Role of Gaze in Action Observation***

9.30 **Zoe Franklin**[1], Neil Fowler[2], Paul Holmes[1]
[1]Manchester Metropolitan University, [2]University of Salford
Eye gaze markers indicate visual attention to threatening images in chronic pain patients

10.00 **Judith Bek**[1], Emma Gowen[1], Stefan Vogt[2], Trevor Crawford[2], Emma Stack[3], Matthew Sullivan[4], Jeremy Dick[5] and Ellen Poliakoff[1]
[1]University of Manchester, [2]Lancaster University, [3]University of Southampton, [4]Manchester Metropolitan University, [5]Salford Royal NHS Foundation Trust
Action observation and imitation in people with Parkinson's disease: The importance of biological form

10.30 **David Wright**, Greg Wood, Zoe Franklin, Ben Marshall, Martin Riach, Paul Holmes
Manchester Metropolitan University
Directing gaze to task-relevant features of an observed action facilitates corticospinal excitability: A combined TMS and eye-tracking experiment

11.00 **Giorgia D'Innocenzo**, Dan Bishop, Alex Nowicky
Brunel University
Motor imagery ability and gaze modulate corticospinal excitability during action observation

11.30 – 12.30: Poster Session 2 (PH.G001) – ***Imagery and Observation: A Neuroscience Perspective***
Complementary Tea/Coffee Available

Marie Alsamour, Gaëtan Stoquart, Anne Renders, Thierry Lejeune, Martin Edwards
Université catholique de Louvain
Does action observation of a disabled child influence action execution in healthy children?

Jack Binks, Kirsty Biolsi
St Francis College New York
'Feel' the power of the imagination: Exploring kinesthetic motor imagery as the primary modality for skill acquisition when physical practice is not possible

Cédric Gaudissart[1], Meryl Nadine[1], Chueng Chen Chuan[2], Nicola Callow[2], Martin Edwards[1]
[1]Université catholique de Louvain, [2]Bangor University
Using tDCS to better understand the imagery neural network

Emilie Lacroix, Martin Edwards, Naïma Deggouj
Université catholique de Louvain
Vestibular impairments and visuo-spatial dysfunction: Comparison of subjective and objective cognitive assessment in patients with bilateral vestibular loss

Pierre Mengal, Martin Edwards
Université catholique de Louvain
Embedded cognition in computer-generated worlds

Vincenza Montedoro, Marie Alsamour, Stéphanie Dehem, Maxime Gilliaux, Daniel Galinski, Luisa Schommers, Françoise Coyette, Adrian Ivanoiu, Gaëtan Stoquart, Thierry Lejeune, Martin Edwards
Université catholique de Louvain
The development of an integrative robot test for the diagnosis of hemineglect

Flavio Ragni[1], Raffaele Tucciarelli[2], Patrik Andersson[1], Angelika Lingnau[2]
[1]University of Trento, [2]Royal Holloway, University of London
An eccentricity effect for different stimulus categories during visual imagery

Stefan Vogt[1], Satomi Higuchi[2], Michael Ziessler[3], and Katrin Sakreida[4]
[1]Lancaster University, [2]Iwate Medical University, [3]Liverpool Hope University, [4]Aachen University
Motor imagery engages an insula-centered tactile network more than action observation: An fMRI study

12.30 – 1.30: Invited Talk 3 (PH.G036)

Mark Wilson
University of Exeter
Feed forward eye movement training: Observing expert eye movements can support task learning

1.30 – 2.30: Lunch Break (Whitelands College Cafeteria)
Hot food and sandwiches available for purchase

2.30 – 4.00: Oral Session 4 (PH.G036) – ***Perspective, Prediction and Priming in Imagery and Observation***

2.30 **Martin Riach**, Paul Holmes, Zoe Franklin, David Wright
Manchester Metropolitan University
Screen position and viewing preference effect corticospinal activity during action observation

3.00 **Clément Letesson[1]**, Stéphane Grade[2], Martin Edwards[2]
[1]Central European University, [2]Université catholique de Louvain
Towards an integrative approach to action prediction processes

3.30 **Ben Toovey[1]**, Annette Sterr[1], Ellen Seiss[2]
[1]University of Surrey, [2]Bournemouth University
A neurocognitive appraisal of motor imagery using EEG: Sustained foreperiod LRP but no enhancement of the CNV in an S1-S2 pre-cuing paradigm

4.00 – 4.30: Group Discussion on the Future of RIO and Closing Remarks (PH.G036)

Abstracts for Invited Speakers

Invited Talk 1

Wolfgang Taube, University of Fribourg

Mental simulation in the context of balance control – functional relevance and underlying mechanisms

The current presentation will focus on mental simulation of postural tasks. First, the relevance of mental, non-physical training to improve motor performance, i.e. balance skills and rehabilitation of gait after hip surgery, will be pointed out. Second, underlying neural brain activation patterns when mentally exercising balance are presented and different forms of mental simulation techniques are compared. In this context, we previously highlighted by means of fMRI- and TMS-protocols that the combination of motor imagery (MI) and action observation (AO), called AO+MI in the following, is more effective to activate brain centres responsible for postural control than MI or AO alone. Furthermore, it will be shown that the brain activation is modulated in a task-specific manner during mental simulation. In a third step, these task-specific adaptations in brain activity are compared between real physical balance task execution and mentally simulated balance tasks while subjects are asked to switch from a stable stance to an unstable stance condition. By means of a paired-pulse TMS-protocol, intracortical inhibition is decreased as soon as the balance demands are increased; in both, the physically executed and the mentally simulated condition. The fourth aim of the talk is to highlight that age-related differences that are known from actual postural task execution are similarly obvious when young and elderly subjects are asked to mentally simulate balance tasks. The so-called 'cortical overactivation' in elderly subjects during the execution of demanding tasks – probably a compensation strategy – can also be observed during mental simulation of balance tasks. Furthermore, by means of fMRI we could show that elderly subjects depend on visual guidance to activate subcortical centres that are thought to be important for a more automatized task execution that is less prone to interference. The fifth and last step of the presentation elaborates the question whether we can 'predict' balance performance based on brain activation patterns obtained during mental simulation of balance tasks. For this purpose, a machine learning approach was used to establish the link between balance behavior (sway path during one leg stance) and functional (fMRI) and structural MRI (sMRI) data. We could show that in elderly subjects the activity in a certain area of the prefrontal cortex during AO+MI of balance tasks is a good predictor of their balance level (area under curve, AUC = 0.86) but the prediction can even be improved when additionally considering the structural volume of the white matter of the primary motor cortex (AUC = 0.90). In summary, the findings that will be presented in the current talk strongly support the 'simulation theory' put forward by Marc Jeannerod and underline the similarity between real task execution and mental simulation in the context of postural control. Furthermore, the current observations may encourage using mental simulation techniques, especially the combination of AO +MI, for the training and rehabilitation of balance and gait disorders.

Invited Talk 2

Angelika Lingnau, Royal Holloway University of London

The organization of actions in the human brain

Being able to understand other people's actions is fundamental for social interactions. According to the dominant view in the literature, this ability critically relies on the recruitment of parietal and frontal regions that are also involved when we plan and perform our own actions. In this talk I will present a number of recent studies using multivariate pattern analysis (MVPA) and representational similarity analysis (RSA) of functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG) data to identify action representations that generalize across features (e.g. effector, kinematics) that are irrelevant for action understanding. I will discuss the results, which highlight the importance of the lateral occipito-temporal cortex for such abstract representations, in light of the ongoing debate on the neural basis of action understanding.

Invited Talk 3

Mark Wilson, University of Exeter

Feed forward eye movement training: Observing expert eye movements can support task learning

It is well recognized that the performance of visually guided skills is supported by task-specific eye movement patterns that assist in the planning and control of the ensuing limb movements. However, it has only recently been shown that novices can benefit from observing these accurate and timely eye movement patterns and that in turn this can have important benefits when learning skills. I will discuss some recent research in sport, surgery, and in children, where we have examined the efficacy of teaching task-specific expert eye movements via video modelling to novices, in order to expedite the learning process and make skills more robust.

Abstracts for Oral Presentations

Chris Pocock[1], Matt Dicks[2], Richard Thelwell[2], Michael Chapman[2], Jamie Barker[3]
[1]St Mary's University, [2]University of Portsmouth, [3]Staffordshire University

Using an imagery intervention to train visual exploratory activity in elite academy football players

Football players have to constantly adapt their movements to pick-up information from the surrounding environment. Theoretically, such a proposal is underpinned by Gibson's ecological approach which emphasises the reciprocal link between perceptions and actions. To guide their movement and perceive opportunities for action, football players engage in visual exploratory activity. The importance of such behaviour(s) is suggested to support skilled performance as analysis of elite football players has indicated that a higher frequency of visual exploratory activity before receiving the ball is reflective of a higher forward passing accuracy. The purpose of the present study was to use a PETTLEP imagery intervention to train visual exploratory activity and improve performance with the ball. A single-case, multiple baseline across participants design was employed with five elite academy football players during a regular season with a professional football club. Data should be cautiously interpreted but there are indications that a PETTLEP imagery intervention can improve visual exploratory activity, with the largest improvements seen in centre midfielders. Participants significantly improved imagery ability (p=.017) when comparing post-intervention to baseline measures for kinesthetic scenarios of the MIQ-R. However, absence of a strong indication for improvements in performance with the ball has been attributed to the non-representative design of the imagery intervention. It is therefore suggested that the pick-up of information was not calibrated with the action capabilities of the participants and future interventions could implement imagery with physical practice to analyse the effects on performance with the ball.

Stephanie Romano-Smith[1], Caroline Wakefield[1], Greg Wood[2]
[1]Liverpool Hope University, [2]Manchester Metropolitan University

The effect of action observation and motor imagery on performance of an aiming task

Motor imagery (MI) and action observation (AO) are techniques, which have been shown to be effective in the enhancement of motor skill learning. Both of these techniques have been used independently, and often in combination with physical practice. More recently, research has begun to employ combined AO and MI to investigate the potential effects on motor skill learning. However, varying combinations of these two skill learning techniques is a relatively under-researched area. This study examined a combined AO and MI approach on a target-based sport task. Participants (n=50) were randomly allocated to one of five training groups: video action observation (AO), PETTLEP-based motor imagery (MI), simultaneous imagery and observation, (SIO), alternative imagery and observation (AIO) and a control group. Pre- and post-test performance was measured using a dart throwing target task. Imagery instructions and supplementary videos were supplied where necessary and interventions were conducted three times per week for six weeks. A repeated measures ANOVA revealed a significant difference in post-test scores [$F(4,45)=6.04$, $p<.05$]. Post hoc analyses showed that, although the groups did not differ at baseline the MI, SIO, and AIO groups showed a significant improvement from pre-test to post-test. AO and control groups did not improve significantly from pre-test to post test. Furthermore, SIO group improved to a significantly greater degree than the MI and AIO groups. These findings have important implications for the design of motor learning strategies, as encouraging performers to simultaneously conduct imagery and observation may be the optimal method for motor stimulation.

Ben Marshall, David Wright, Paul Holmes, Greg Wood
Manchester Metropolitan University

Combining action observation and motor imagery improves eye-hand coordination during the learning of a novel visuomotor task

Concurrent action observation and motor imagery (AOMI) has been proposed as an effective technique for motor (re)learning. This study compared the effectiveness of AOMI, observing to imitate and passive observation training interventions for improving eye-hand coordination and motor learning, in the absence of physical practice. Forty right-handed participants were randomly assigned to one of four groups (AOMI; observe to imitate (OI); passive observation (PO); physical practice (PP)) and performed a novel 90^{o} visuomotor rotation task whilst eye movements were recorded. Each participant then performed 20 task trials using the training intervention to which they had been assigned before repeating the initial task in a post-test. Results showed that the PP group experienced a statistically significant increase in the percentage of improvement in eye-hand coordination compared to the OI and PO groups. However, no significant difference was found between the PP and the AOMI group. This indicates that AOMI improved eye-hand coordination to a similar extent as PP. The importance of these improvements in eye-hand coordination was underlined by a linear regression analysis that revealed a positive relationship between percentage of improvement for predictive gaze control and task performance. In conclusion, although the neurophysiological effects of AOMI are well known, this research suggests that this technique may offer supplementary benefits to the development of effective eye-hand coordination. These benefits could be crucial to the rehabilitation of patients who cannot perform physical practice such as those suffering a stroke or patients facing hand amputation.

Sonia Abad-Hernando, A. Gálvez-Pol, B. Forster, Beatriz Calvo-Merino, B.
City, University of London

How do we represent observed actions? Investigating the specificity of the sensorimotor encoding of human bodies using EEG

How do we represent observed actions in working memory? Could we differentiate between perceptual or functional roles of embodiment? Recent studies already suggest we hold information in memory differently when it contains body information. It has been shown that visual encoding of body stimuli engages electrophysiological activity not only in visual cortices, but also in body-related areas. The aim of this study is to clarify whether this activity is triggered by body stimuli per se, or modulated by the degree in which we embody that stimuli. For this purpose, we test if somatosensory cortex (SCx) involved on holding body information in memory is sensitive to the degree of embodiment elicited by different tasks while using the same body stimuli. Participants performed a visual working memory task in which items to-be-remembered were colored hand images (depicting 6 different hand positions and in 6 different colors). Each memory array consisted of 1 or 2 hands per hemifield. In 50% of the trials, we elicited simultaneously visual evoked potentials (VEP) and somatosensory evoked potentials (SEP) by applying task irrelevant single tactile taps simultaneously delivered to both hands. This allowed us to do a later subtraction, so we can isolate and examine the state of the SCx free of visual evoked activity, exposing its underlying processing during memory encoding and maintenance of the visual stimuli. We expect to find differences in SCx activity modulated by the level of embodiment. This study will help us to dissociate the perceptual-functional roles on how working memory encodes body-related information.

Francesco Di Gruttola[1], Oriana Incognito[1], Elisa Menardo[2], Danilo Menicucci[1], Laura Sebastiani[1]
[1]University of Pisa, [2]University of Verona

Objective and subjective assessment of kinesthetic imagery: different measures of the same ability

The goal of the investigation was to verify whether the assessment of kinesthetic imagery (KI) ability objectively and subjectively showed different brain activation profiles, as we expect. The sample (*N*=11) was composed of young adults (4 females). Firstly, we measured participants' KI ability: a) objectively, with chronometry, comparing KI and actual movement execution times; and b) subjectively, using the KI scale of the Movement Imagery Questionnaire -3. To compute these two indices we used the formulas of the Motor Imagery Index proposed by Collet and colleagues (2011). Afterwards, we performed an EEG recording (128 channels) on the same participants, at rest and during some KI tasks. We analyzed the correlation between the objective and subjective index and the change in power between the rest condition and the KI conditions. We found specific correlations located in the sensory-motor area at 10, 12, 22 and 30 Hz considering the objective index. This region of the brain is typically associated with the motor imagery process. The correlations involved one or both the hemispheres according to the KI task taken into account. The same topographical profile did not appear with the subjective index. These preliminary results show how the two indices measure different aspects of the KI ability and should be jointly used for a comprehensive assessment. In further studies, we will increase the sample size and use other indices (i.e. psycho-physiological) to differentiate motor imagery ability, also in the visual internal modality.

Mary Quinton, Sarah Williams, Jennifer Cumming
University of Birmingham

Investigating the mediating role of positive and negative mastery imagery ability

Imagery is effective in regulating confidence, stress appraisals, and stress responses but is more effective with greater imagery ability. Mastery imagery ability (e.g., persisting through difficult situations) is particularly relevant when considering how individuals cope with stress. Mastery imagery ability is reported to be the strongest predictor of confidence, challenge and threat appraisals, and cognitive anxiety intensity. In accordance with the revised applied model of deliberate imagery use, mastery imagery ability likely mediates the relationship between confidence and these outcomes. However, only positive imagery ability has been investigated. This study investigated the mediating role of positive and negative mastery imagery ability between confidence and both stress appraisals and responses (i.e., anxiety) via path analysis. 335 athletes completed the Sport Imagery Ability Questionnaire (original and revised negatively worded versions), Cognitive Appraisal Scale, and Competitive Trait Anxiety Inventory-2. Positive mastery imagery ability mediated the relationship between confidence and both challenge appraisals (B = .10, p = .001, 90% CI = 0.05 to 0.17) and cognitive anxiety intensity (B = -.05, p = .007, 90% CI = -.094 to -.020). Negative mastery imagery ability mediated between confidence and both threat appraisals (B = -.13, p = .001, 90% CI = -0.22 to -0.07) and cognitive intensity (B = -.07, p = .001, 90% CI = -.106 to -.036). Results support the mediating role of mastery imagery ability and suggest that when promoting more adaptive appraisal and responses to stress, positive and negative mastery imagery ability are likely important determinants.

Scott Glover
Royal Holloway University of London
Executive functions in motor imagery

A conventional account of motor imagery holds that it reflects the mental experience of the internal unfolding of stored motor representations. This 'functional equivalence' view predicts that motor imagery should closely match the timing of overt actions, yet discrepancies in the respective timings of overt action and motor imagery are common. As an alternative to the functional equivalence view, I propose the Motor-Cognitive Model of motor imagery. In the Motor- Cognitive Model, motor images are generated through stored representations, but their unfolding depends heavily on executive resources. In several experiments, I will show how interfering with executive functions leads to very large increases in the time required to imagine even simple grasping and placing movements. These interference effects are replicable across a broad range of tasks that rely on executive functions, and can be shown to occur independently of other mental functions such as working memory or response preparation. Taken in sum, the experiments provide strong support for the Motor-Cognitive Model, and its central tenet that executive functions play a fundamental role in motor imagery.

Stéphane Grade, Mauro Pesenti, Martin Edwards
Université catholique de Louvain
The role of body action on automatic imagery

The judgement of whether an object is within or outside or reach is thought to involve automatic imagery cognition where the individual covertly imagines reaching to the object in order to make the decision. In my research, I have demonstrated that action simulation is necessary for reachability perception, whereby disruptions to action cognition disrupts reachability judgements. Furthermore, using virtual reality, I have demonstrated that manipulating reach capability of the body can moderate subsequent reachability perception. Both experiments provide further knowledge on how the simulation of the body in action is taking place and how this mechanism would contribute to space perception. In this presentation, I will discuss how the segmentation of space perception is derived from action imagery, and whether action imagery is based on fixed or dynamic body representations.

Zoe Franklin[1], Neil Fowler[2], Paul Holmes[1]
[1]Manchester Metropolitan University, [2]University of Salford
Eye gaze markers indicate visual attention to threatening images in chronic pain patients

Research into attentional biases and threatening, pain-related, information has produced mixed results with the majority of studies using reaction time as the dependent variable. This study aimed to extend previous research that has used reaction time in a dot probe paradigm to provide a more in depth investigation of chronic back pain patient's attention to emotional stimuli by recording eye movement behaviour. Chronic back pain participants (*n*=18) were recruited from a back rehabilitation program and age and sex matched against 17 controls. All participants completed a dot probe task comprising 150 experimental trials, which included back pain specific threatening images and neutral images. Eye movement metrics included number of fixations, average pupil diameter, and average and total fixation duration. There were no significant differences between chronic pain and control participants in attentional biases recorded using reaction time from the dot probe task. Participants in the pain condition, however, demonstrated a significantly higher fixation count, larger pupil diameter and a longer average and total fixation duration to threatening compared to neutral images. They also had a significantly longer average fixation duration and larger pupil diameter to threatening images compared to control participants. The findings of this study suggest that eye gaze metrics may provide a more sensitive measure of attentional biases in chronic pain populations. These findings may have important therapeutic implications for the patient and therapist.

Judith Bek[1], Emma Gowen[1], Stefan Vogt[2], Trevor Crawford[2], Emma Stack[3], Matthew Sullivan[4], Jeremy Dick[5], Ellen Poliakoff[1]
[1]University of Manchester, [2]Lancaster University, [3]University of Southampton, [4]Manchester Metropolitan University, [5]Salford Royal NHS Foundation Trust

Action observation and imitation in people with Parkinson's disease: The importance of biological form

In healthy people, both kinematics and form of a stimulus may influence imitation, with eye gaze data showing that action prediction is reduced for non-biological stimuli, such as an object moving independently. In our previous work, people with Parkinson's disease (PD) have shown intact imitation of the speed and amplitude of hand movements. However, simple visual cues can also facilitate movement in PD and are often used in physiotherapy. Additionally, neuroimaging data indicate an increased reliance on visual processing during motor imagery in PD. People with PD may thus show reduced sensitivity to biological vs. non-biological stimuli, as well as a reduction in anticipatory eye movements during action observation compared with controls. People with PD (N = 20) and healthy age-matched controls (N = 22) observed and immediately imitated simple sequential movements varying in speed and amplitude. The observed movements had a biological kinematic profile and were depicted by either a human hand or a shape. Hand kinematics and eye gaze were recorded. Imitation was indexed by degree of modulation of speed and amplitude in response to the observed movements, and eye movement measures included tracking and pursuit of the hand vs. object. Correlations with motor imagery measures were also analyzed. Analysis is currently under way and preliminary results will be presented. Findings will inform the understanding of mechanisms of action representation in both PD and healthy ageing.

David Wright, Greg Wood, Zoe Franklin, Ben Marshall, Martin Riach, Paul Holmes
Manchester Metropolitan University

Directing gaze to task-relevant features of an observed action facilitates corticospinal excitability: A combined TMS and eye-tracking experiment

Transcranial magnetic stimulation (TMS) research has shown that corticospinal excitability is facilitated during the observation of human movement. However, the relationship between corticospinal excitability and participants' gaze behavior during action observation is rarely considered. Nineteen participants took part in four experimental conditions: (i) a static hand condition, involving observation of a right hand holding a soft ball between the thumb and index finger; (ii) a passive observation condition, involving observation of the ball being pinched between the thumb and index finger; and (iii and iv) finger-focused and ball-focused conditions, involving observation of the same ball pinch action with the instruction to focus visual attention on either the index finger or the ball. Single-pulse TMS was delivered to the left motor cortex and motor evoked potentials (MEPs) were recorded from the first dorsal interosseous (FDI) and abductor digiti minimi muscles of the right hand. Eye movements were recorded simultaneously throughout each condition. Results showed that the ball-focused condition produced MEPs of significantly larger amplitude in the FDI muscle, compared to the passive observation or static hand conditions. Furthermore, regression analysis indicated that the number of fixations on the ball was a significant predictor of MEP amplitude in the ball-focused condition. These results have important implications for the design and delivery of action observation interventions in motor (re)learning settings. Specifically, providing viewing instructions that direct participants to fixate on task-relevant objects affected by the observed movement may access the motor system in a more optimal manner than passive observation instructions.

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Motor imagery ability and gaze modulate corticospinal excitability during action observation

Action observation (AO) and motor imagery (MI; mental simulation of a movement) have been found to increase activity in motor regions of the human mirror neuron system – an effect known as motor resonance – and are useful tools for enhancing motor learning. We previously found that, by using exogenous cues to direct observers' point-of-gaze as they viewed thumb movements, we could elevate their corticospinal excitability. Hence, such techniques may allow us to maximise the effects of AO. Since MI activates motor areas of the brain in a similar manner to AO, then engagement in MI, and MI ability, may enhance motor resonance during AO. Accordingly, we aimed to determine i) whether motor resonance during AO and MI of a motor sequence can be modulated by different types of visual guidance; and ii) whether the observer's ability and tendency to engage in MI during AO can modulate motor resonance. Single-pulse TMS was used to assess motor resonance during AO and MI. Participants observed sequences of transitive upper-limb movements while maintaining their gaze on a target- or effector-based visual guide, or while free viewing, before imagining performance of the observed actions. AO and MI both resulted in facilitation of MEP amplitudes. Gaze affected motor resonance during AO, but this was modulated by the participants' pre-existing MI abilities. These findings suggest that, by directing the learner's gaze during AO, we might enhance motor resonance – but researchers should seek to control for MI engagement and ability in future studies.

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Screen position and viewing preference effect corticospinal activity during action observation

Structured action observation has been suggested to be an effective adjunct to motor (re)learning in performative and therapeutic environments. Optimal viewing conditions for action observation interventions are, however, yet to be established. This experiment used single-pulse transcranial magnetic stimulation (TMS) to investigate the effect of two screen positions and individuals' screen position preference on motor evoked potential (MEP) amplitude during observation of a ball pinch. Twenty-four participants observed either an index finger-thumb ball pinch or a static hand holding a ball, displayed on horizontally and vertically positioned screens. TMS was delivered to the hand representation of the left primary motor cortex and MEPs were recorded from the first dorsal interosseous muscle of the right hand. The normalized MEP data analysis showed no significant difference between screen positions. In a follow up procedure, participants engaged in individual semi-structured interviews and completed a questionnaire to assess screen position viewing preference. Deductive thematic analysis of the qualitative data was performed and each participant's screen position preference determined from the questionnaire. Original MEP data were split according to screen position preference and analysed using a 2x2 repeated measures ANOVA. Post-hoc t-tests showed that participants who preferred the horizontal screen position (n=16) demonstrated significantly greater MEP amplitudes during observation of the ball pinch action on the horizontal screen compared to the vertical screen position. These results suggest that ensuring anatomical and perceptual congruency with the physical task and consideration of participants' viewing preferences may be important as part of the optimization of action observation interventions.

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Towards an integrative approach to action prediction processes

During goal-directed interactive behaviors with another individual, observers typically display predictive eye movements - orientating gaze direction and attention towards the goal of the observed action ahead of time (i.e., before the actor's hand meets the goal object). Humans are experts at observing, predicting and understanding actions. To do so, they learn to extract meaningful and predictable information from the observed behaviors of others. A classical view of action observation postulates a major role for motor information through motor simulation, but successful predictions of the to-be-grasped object can also be derived from the observation of others' gaze, of objects or from contextual information. Each individual source of information is uncertain in nature, and only provides an approximation of the observed action goal. Here, we aimed to test the general hypothesis that action prediction processes would benefit from the integration of multiple cross-checked sources of information when they were available. In the present work, we investigated the potential contribution/integration of these different sources of predictive information indicative of others' action goals. This approach helped us to reposition the involvement of motor resources in action prediction processes, broadening our view of action prediction towards a more integrative account.

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A neurocognitive appraisal of motor imagery using EEG: Sustained foreperiod LRP but no enhancement of the CNV in an S1-S2 pre-cuing paradigm

Motor imagery (MI) is used in applied settings for rehabilitative or sports performance, yet there is limited evidence supporting any possible mechanisms underlying MI. This issue has been highlighted in recent review papers. Response priming paradigms are one tool used to explore cognitive mechanisms involved in action planning, but these are not without caveats; the results of studies using MI to prime responses demonstrate a mixture of positive and negative behavioural performance in contrast to mostly positive findings in applied research. Secondly fundamental motor preparation (MP) processes are not considered in their designs. The present study adapted a congruency-manipulating S1-S2 precuing paradigm, previously used to find enhanced behavioural costs *and* benefits of MI on performance compared to MP in the lower limb. 12 participants took part in a repeated-measures EEG experiment over two sessions. Analysis of the LRP component provided evidence for sustained motor cortex pre-activation in MI compared to MP, as shown by larger area amplitude differences between congruency conditions for MI, while similarity of the late CNV between tasks may indicate that MI has limited or no influence on the generation or implementation of the central motor plan. These data clarify the role of MI in altering performance through *sustained* enhancement of the motor cortex, even when controlling for EMG activity, and encourage use of similar priming paradigms to probe the covert nature of motor imagery mechanisms. Particularly significant here is the support for a model which considers the role of fundamental preparatory processes within the scope of motor imagery.

Abstracts for Poster Presentations

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Effectiveness of imagery on musculoskeletal system function: A systematic review

The efficacy of imagery practice for enhancing performance and learning/relearning skills is well established in sport and in neurological rehabilitation (e.g. stroke). Imagery interventions can also improve musculoskeletal function, however research is more limited and would benefit from systematic review. Does imagery practice influence the function of the musculoskeletal system in participants free from nervous system damage/disease? Our predefined protocol (registered in the international prospective register of systematic reviews in health and social care (PROSPERO), registration number CRD42017055453) followed two guidance sources, the Effective Public Health Practice Project (EPHPP) and Cochrane. Electronic bibliographic databases in the fields of health (CENTRAL, PubMed, CINAHL, PEDro, AMED, EMBASE), psychology (PsycINFO), and sport (Sport Discus) were searched (1960 to September 2015). Search terms were related to musculoskeletal system, imagery, and rehabilitation outcomes. Included papers tested participants who were healthy or had musculoskeletal injury/disease (without nervous system disorder) using specific outcome measures of muscle and physical function. All imagery interventions were included (e.g. Guided Imagery, cognitive/functional, motivational, pain management), and all study designs were included. Papers were assessed using the EPHPP tool for assessment of bias and quality. Narrative (descriptive) synthesis of data is planned, and a quantitative synthesis will be used if the included studies are sufficiently homogenous. Subgroup analyses will be done for participant type (healthy/ patient); imagery interventions (Guided Imagery/movement-based imagery); and outcome measures (e.g. strength, physical activity). One preliminary result is that movement-based imagery proves effective in healthy participants; this technique should be tested in rehabilitation settings.

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Examining the effects of combined gait-retraining and video self-modeling on habitual runners experiencing knee pain

This study aimed to reduce stride length by 2-4% for two habitual runners experiencing chronic knee pain using a combined gait-retraining and video self-modeling intervention. The study adopted a single-case A-B-B-A design, monitoring changes in psychological (PSY) and biomechanical (BIO) factors associated with injury and performance across an 8-week period. Phase A^1 involved pre-intervention baseline monitoring (4x PSY, 1x BIO), Phase B^1 involved four sessions of gait-retraining (4x PSY), Phase B^2 involved four sessions of gait-consolidation (4x PSY), and Phase A^2 involved post-intervention baseline monitoring (4x PSY, 1x BIO). Self-modeling videos comprising 3 repetitions of 9 x 5*sec* video clips of in-session footage were administered after each gait-retraining or gait-consolidation session. P1 met the required reduction in stride length (2.6%, *ES* = 0.23), resulting in decreased vertical ground reaction forces (9%, *ES* = 0.49). Task self-efficacy (M_{diff} = 17.50), maintenance self-efficacy (M_{diff} = 4.25), and intrinsic motivation (M_{diff} = 3.25) significantly increased post-intervention. P2 did not meet the required reduction in stride length (1.3%, *ES* = 0.28), resulting in increased vertical ground reaction forces (1.9%, *ES* = 0.18). Task self-efficacy (M_{diff} = 15.00), general self-efficacy (M_{diff} = 7.00), positive affect (M_{diff} = 3.50), and intrinsic motivation (M_{diff} = 3.25) significantly increased post-intervention. Recovery self-efficacy (M_{diff} = -4.00) and worry (M_{diff} = -2.00) significantly decreased post-intervention. The findings suggest the need to consider individualized responses to interventions targeting a change in gait, as applying a 'one-size-fits-all' approach may be detrimental to reducing injury risk.

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Who said there is no I in team? Examining the effects of observation content level upon efficacy beliefs in team sports athletes

Observation-based methods have received support as interventions to improve efficacy beliefs in sport. This study examined the effects of observation intervention content level (individual vs team) upon the self-efficacy (SE) and collective efficacy (CE) beliefs of soccer players. Participants were recruited from 2 soccer teams at a UK university (N = 17; ♂ = 9, ♀ = 8). Competitive video footage of each sports team was collected over a 4-week period. 10 x 7*sec* video clips of positive individual actions were produced for all individual-level interventions and 7 x 10*sec* video clips of positive team actions were produced for all team-level interventions. All participants completed both the individual and team-level Interventions, with intervention order counterbalanced across the study sample. Individual SE and CE perceptions were recorded pre- and post-intervention for both conditions. SE increased for both individual (M_{diff} = 0.58) and team conditions (M_{diff} = 0.13). CE increased for both individual (M_{diff} = 0.52) and team conditions (M_{diff} = 0.53). Follow-up social validation interviews revealed that participants perceived the video footage to increase efficacy beliefs through evidencing previous performance accomplishments at both the individual and team level. The findings provide further support for the use of observation to enhance efficacy beliefs in team sports athletes, acknowledging the importance of level of content when developing interventions. It is recommended that a combination of both individual- and team-based interventions should be used to improve SE/CE in sports teams.

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Observational learning of surgical skills on the daVinci system

Robotically-assisted surgery provides important benefits for both patient outcomes and surgeon satisfaction. The use of observational learning has established benefits for skill acquisition across a variety of domains, but a growing body of evidence has highlighted the efficacy of learning from errors, as opposed to traditional expert models. In addition, there has been limited investigation of the comparative effects of learning from 3D as opposed to 2D videos. Therefore, the objective of this investigation was to examine differences in the acquisition of early stage surgical skills across a variety of observational learning conditions, comparing expert with error-strewn models. 150 medical students with no previous surgical experience were recruited to perform a ring transfer task on the daVinci surgery system. Following baseline tests participants were randomly assigned to one of five learning conditions: expert model, novice model, mixed novice/expert, 3D expert or control. Learning of the primary task, retention after a one-week interval and transfer to a novel knot-tying task were assessed through time to completion and incidence of errors. Improvements in motor control were assessed through Geneactiv accelerometer measurement of instrument movements. Participants also wore head mounted SMI ETG 3.0 eye tracking glasses whilst viewing training videos in order to assess the role of attention to errors in learning. Findings will compare performance (time to completion, errors) and movement proficiency (mean acceleration and jerk) across the five learning conditions for acquisition, retention and transfer tasks. These outcomes are potentially informative for the use of observational learning in surgical training curricula.

Saadia Hasan
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Visualising the ideal self: Testing three techniques of visualisation in a language learning setting

Learning a second language is a long journey; one that requires substantial motivation if it is to be completed. Recent theorizing in the field of Second Language (L2) Learning has identified the 'Ideal Self' as a key force in long-term motivation. The Ideal Self is the person that we would like to be in the future, and if activated effectively, will act as a self-guide, pulling us towards our desired goals. Although the role of mental imagery in generating and activating students' Ideal L2 Self is now beginning to be recognized in L2 literature, the practical application of imagery in the classroom is yet to be empirically explored. This study takes one of the first steps in this direction, by exploring the use of three visualisation techniques: Layered Stimulus and Response Training (LSRT), Personalised Imagery Scripts and Personalised Audio-scripts. These three techniques will be tested for their ability to impact upon the ease and vividness of learners' imagery, as well as on learners' overall imagery ability. In addition, another measure for investigation will be the effect of imagery use over time on learners' motivation to work towards their Ideal Self. Using a mixed-methods approach, and conducted in three settings (UK, Hong Kong and Spain), it is hoped that this study will yield some useful insights for those who wish to use imagery in an educational context.

Taeho Kim, Thomas Schack, Cornelia Frank
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The effect of combined training of action observation and motor imagery on the development of mental representation structure, cognitive performance, and skill performance

Action observation (AO) and motor imagery (MI) have received support as independent training methods for motor performance and learning. However, it is expected that the combined use of AO + MI training is more effective than the use of AO or MI alone. The purpose of this study was to investigate the effect of AO, MI and combined AO + MI training on the development of mental representation structure, and improvement of cognitive performance and skill performance for a complex action. Forty-eight beginners with no experience in Taekwondo were randomly assigned to one of four groups: AO training group, MI training group, AO + MI training group, and non-practice group (control). Participants allocated to the three training groups took part in three days of training, with three training sessions per day and thirty trials per session. Mental representation structure and cognitive performance were measured immediately before and after the training programs, and one day after completion (retention). After retention testing, all participants performed 90 repetitions of Taekwondo roundhouse kick (i.e., three blocks, 30 times per block). Their performance was video-recorded so that Taekwondo experts can evaluate the accuracy of the performance according to set criteria. The reviewer scores will be used to examine the development in skill performance following the respective training. Currently, the data coding work for the statistical analysis is in progress.

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Action observation therapy and Parkinson's disease patients: a double blind controlled study

This is a study to evaluate the effects of Action observation therapy (AOT) on Parkinson's disease (PD). PD is a neurodegenerative disorder characterized by motor and cognitive impairment. AOT is a method in which participants are required to observe others' actions and execute them. Many studies demonstrate that AOT has positive effects in rehabilitation. A total of 10 patients with idiopathic PD received an AOT treatment 3 times a week for 1 month. During treatment subjects had to watch 24 videos in which an actor performed a daily life activities and to reproduce it. All patients were evaluated in four times: baseline, pre-test, post-test, and follow up. Evaluation included: Rey Auditory Verbal Learning test; Rey-Osterrieth Figure test; Taylor Complex Figure test; Verbal and Semantic Fluency test; Stroop Color Word test; Trail Making test; Wisconsin Card Sorting test; and Corsi test. Movement impairment and autonomy were evaluated by Unified Parkinson's Disease Rating Scale; Tinetti Scale; IADL/ADL; and Euroqool Rating Scale. We used also the Movement Imagery Questionnaire for motor imagery ability and Jebsen Hand Function Test for movement velocity. After the intervention significant improvements were found in verbal memory (p=.009; p=.014); in Stroop Color Word test performance (p=. 000; p=.020); in long-term visuospatial memory (p=.002). Results suggest that the application of AOT may be effective in the treatment of PD, in particular for working memory and attention cognitive functions.

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Development of an app to improve everyday actions in Parkinson's disease through action observation and motor imagery: A focus group study

Action observation (AO) and motor imagery (MI) have been separately shown to facilitate movement in Parkinson's disease (PD). Behavioural and neurophysiological studies in non-clinical populations have shown that combining AO and MI increases effects and recently we have found that combined AO+MI increases imitation of simple hand movements in PD. We are developing a PD-specific tablet-based app that utilises combined AO+MI to train functional actions in the home. The app would be used for self-administered therapy, allowing patients to train personally-relevant actions in a flexible manner, thus increasing independence and choice in rehabilitation. A previous focus group with people with PD indicated the feasibility and acceptability of the approach, and identified potential PD-relevant actions to include. We have developed a prototype based on an app designed for use in stroke rehabilitation, which has been modified for users with PD. A focus group was conducted with six people with mild to moderate PD to obtain feedback on the prototype app and further input on the proposed therapy. An interactive demonstration of the prototype app was provided. Discussion topics included current use of technology (devices/apps), usability of the app, training format, feedback and motivation. Discussions were transcribed and deductive thematic analysis will be used to identify themes in the data. Results will inform the next stage of therapy development. The findings will also be of relevance to other rehabilitation approaches based on AO+MI.

Aidan Shell, Adam Bruton, Zara Abbas, Luke Felton
University of Roehampton

Learning from the best: The effect of observational learning frequency on self-efficacy, motivation and skill acquisition in tennis

There is consistent support for the use of observational learning (OL) to improve self-efficacy, motivation, and motor learning in sport. This study examined the effects of OL (expert modeling) frequency on novice tennis players' self-efficacy, motivation, and performance on an adapted service task. Twenty-four participants were split equally into three conditions: control (practice), OL_{LOW} (practice and low frequency OL) and OL_{HIGH} (practice and high frequency OL). A tennis court was simulated indoors with participants serving from half distance (544.5cm) towards a regular service box (640cm x 411.5cm). Target boxes were arranged inside the service box for performance assessment. The researcher kept track of the number of times participants missed the service box (0 points), and landed in the outer (1 point), middle (2 points), inner (3 points), and target boxes (4 points). During pre-test, each participant performed 16 scored serves and completed a self-efficacy and a motivation questionnaire. After this, each participant completed 60 practice serves. The control group proceeded uninterrupted and the OL_{LOW} and OL_{HIGH} groups were shown video footage of a skilled performer serving successfully after every 10 and 6 practice serves, respectively. Post-test procedures were identical to those adopted for pre-testing. Learning was inferred from a one-week retention test (identical procedure to pre- and post-test). It is expected that performance, self-efficacy and motivation will significantly increase pre- to post-test for all groups, with the largest increase evident for the OL_{HIGH} group. It is predicted that there will be no differences between groups pre-test, with differences expected between groups post-test.

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Is there an 'eye' in team? A team selection-based eye-tracking study

It is suggested that individuals form collective efficacy perceptions about their team through observing the actions and emotions of other team members. In this study, we examined the role of facial expressions in team selection for a team-based obstacle course task. To begin, participants viewed a video of the obstacle course task before recording self-efficacy and big-five personality scores. Each participant was then presented with a total of thirty slides, each with six pre-rated head-shot photos (i.e., positive or negative emotions), and asked to select the two least or most confident team members (IV). For each team selection, an eye gaze fixation ratio was calculated (positive:negative emotions) and participants were asked to rate their collective efficacy perceptions for that team. Preliminary analysis indicates that when participants were instructed to select the 'most confident team' they tended to choose people displaying more positive emotional expressions (M = 3.64, SD = 1.72) and rate collective efficacy higher (M = 66.87, SD = 9.4) compared to when instructed to select their 'least confident team' (M = -4.43, SD = 3.55; M = 33.25, SD = 12.3). Similarly, eye gaze fixation ratio was more positive for the 'most confident' condition (M = 6.52, SD = 23.65) compared with the least confident condition (M = -20.10, SD = 13.99). No differences were evident in the data in terms of either self-efficacy or big-five personality characteristics. Results provide evidence that when looking to select confident team members, humans tend to focus on positive emotional expressions.

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Université catholique de Louvain
Does action observation of a disabled child influence action execution in healthy children?

Research has shown that action observation can prime action execution and mainly focused on congruent versus incongruent types of action, actions outside observer's own expertise or biomechanically impossible actions. The aim of the present study was to investigate this effect further by testing whether healthy participants would show primed action execution after observation of action performed by a mild unilateral motor disabled actor and/or by a neurologically healthy actor, relative to a baseline condition. Sixteen neurologically healthy right-handed children aged 6-13 years were tested on several motor measures linked to fine and gross motor function, and action kinematics using a precise robotic device. The cross-over design consisted of two experimental conditions; (i) watching actions performed by a child with hemiparesis, and (ii) watching actions performed by a healthy child; and a double baseline. Statistical analyses were performed using repeated measures ANOVA, with Bonferroni corrected post-hoc analyses. Results showed that both types of action observation improved peak speed variance coefficient in the robotic target-pointing task, as well as in fine manual dexterity measures. Additionally, specifically observing the hemiparetic child enhanced gross dexterity, speed and speed variance coefficient in the robotic amplitude task. Therefore, contradictory to previous literature, observing actions from a motor disabled child enhanced action execution, even more than observing a healthy model. These results are discussed in terms of a novelty effect for observing the hemiparetic action, and gives weight to the use of non-healthy models to improve action through Action Observation Therapy.

Jack Binks, Kirsty Biolsi
St Francis College New York
'Feel' the power of the imagination: Exploring kinesthetic motor imagery as the primary modality for skill acquisition when physical practice is not possible

Motor Imagery (MI) has been frequently shown to be an effective modality for skill acquisition when physical practice (PP) is not possible. However, procedural discrepancies pollute the literature and have caused researchers to challenge the credibility of prior MI studies. As per Stinear et al.'s recommendations, MI must be conducted by using kinesthetic motor imagery (KMI) from an internal perspective, as this is the only modality of imagery which modulates cM1, in the same way as PP. However, most MI research up to this date has been based around vague task instruction. The present study questioned previous research by exposing a multitude of imagery styles which are not accounted for when a comprehensive manipulation check is not applied. The researcher created an experimental group, which maintained a focus on KMI, and challenged said condition against basic instruction, which is frequently applied across the literature; a control group was also used. Results found the KMI condition to improve significantly more than the control, whereas the basic instruction condition did not. Female participants performed significantly better than males in imagery capacity and motor skill ability. Finally, the researcher proposed a direction for future research in an applied setting while sharing the important findings of *confidence* in motor learning and implores for a universally applied operational definition for MI - a definition to be used as a base for all future research.

Cédric Gaudissart[1], Meryl Nadine[1], Chueng Chen Chuan[2], Nicola Callow[2], Martin Edwards[1]
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Using tDCS to better understand the imagery neural network

Research has shown that motor imagery (a combination of first-person or internal visual imagery and kinesthetic imagery) activates neural regions associated with the mirror neuron system. Typically, these areas include the premotor cortex, supplementary motor area, primary somatosensory cortex, and inferior parietal cortex. Although there is much evidence supporting this 'motor imagery neural network', it remains unclear what role each of these brain regions has on motor imagery. In the present research, we selectively manipulated the activity of left premotor cortex / inferior frontal gyrus (IFG) using anodal tDCS. We hypothesized that increasing the activity of cortex would lead to behavioural changes specifically in right hand compared to left hand motor imagery, relative to baseline and control sham (no stimulation) conditions. Thirty right-handed university students participated in the experiment. The experiment asked participants to imagine performing an ambidextrous action, either with their left or right hand, and after each action, rate imagery ability using a visual analogue scale. We used a double-blind counterbalanced procedure for tDCS anode versus sham stimulation, separated by one week. In each session, the participant performed the experiment without stimulation, and then with (anodal or sham) stimulation. Results compared behavior for left versus right hand imagined actions for anodal versus baseline and sham stimulations. We discuss the value of this method for better understanding the imagery neural network, whereby the tDCS can me moved to different brain regions, and whether different imagery components can be tested.

Emilie Lacroix, Martin Edwards, Naïma Deggouj
Université catholique de Louvain

Vestibular impairments and visuo-spatial dysfunction: Comparison of subjective and objective cognitive assessment in patients with bilateral vestibular loss

Studies that have investigated cognitive and emotional problems in patients with bilateral vestibular loss have typically used questionnaires, with these showing significant increased complaints compared to control participants. However, currently, no research has explored the specific link between these subjective complaints and objective cognitive assessments. In the present study, we compared patient's subjective responses to the Dizziness Handicap Inventory, Hospital Anxiety Depression Scale, and Neuropsychological Vertigo Inventory to an objective neuropsychological assessment battery. We tested 13 patients with bilateral vestibular loss and 13 age and sex matched controls on the same assessments. Data analyses were performed using between groups ANOVA, with various independent variables associated with the different measures. The results showed a clear difference between groups for the subjective measures, replicating previous research, and showing that vestibular patients present with more subjective cognitive complaints than matched controls. However, interestingly, results on the objective neuropsychological measures failed to show statistically significant effects. These preliminary results suggest that even if patients believe that they have reduced cognition caused by their vestibular deficits, it remains challenging to demonstrate the effects using simple (standard) objective cognitive measures. We discuss the mismatch in results in terms of cognitive specificity, complexity and compensation. We propose that the objective measure may more likely show effects if combined with a dual task, or by performing complex imagery tasks, adding strain to cognitive resources.

Pierre Mengal, Martin Edwards
Université catholique de Louvain
Embedded cognition in computer-generated worlds

Real-world perception and action, and social interaction involves complicated cognitive processes. Using computer generated simulations of the world, we can manipulate factors influencing different cognitive processes, such as object affordances, environmental cues, and action observation for prediction of social interaction. In this poster, I will present a PhD research proposal that will use different manipulations of computer-generated worlds to test human perception and action cognition. This knowledge will then be tested using an Artificial Intelligence who learns through action observation, how to perceive and act in computer-generated worlds, and further, how to socially interact with humans. The knowledge gained from the studies will provide new theoretical understanding of perception and action interaction, but furthermore, will build towards a future of socially interactive robotics.

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The development of an integrative robot test for the diagnosis of hemineglect

Hemineglect is a frequent and persistent consequence of brain-damage that affects different modalities, including mental imagery. While clinical diagnosis tests exist for egocentric hemineglect, few measures exist for allocentric, and no tests exist for motor hemineglect diagnosis. Here, we report the first phase of a new integrative robot diagnosis test for hemineglect, with the creation and validation of an egocentric hemineglect measure. We tested 15 patients on two occasions (three-day interval for test-retest reliability). Participants had to detect a target randomly presented among distractors, responding by using the robot end-effector. Targets were presented across lateral space (egocentric left-to-right), and participant's mean response reaction time and percentage omissions to the targets were recorded. We also administered standardized hemineglect assessments to test validity. A repeated and between measure ANOVA showed that the robot test detected significant differences between patients with and without hemineglect, with hemineglect patients showing an ipsilesional bias of attention. Significant correlations between the new and existing tests demonstrated good validity for egocentric hemineglect diagnosis. Furthermore, intra-class correlation between the results of the two test occasions showed good reliability. The results are discussed in terms of the added value provided by the test, along with a description of phase 2 of the project, where we integrate allocentric objects and motor response components (where patients point to targets using the robot). We discuss how hemineglect in imagery may vary across the different components.

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An eccentricity effect for different stimulus categories during visual imagery

Participants respond faster to stimuli presented at smaller in comparison to larger eccentricities. This eccentricity effect has been suggested to be due to cortical magnification present in early visual cortex. Similar eccentricity effects have been obtained for visual imagery of simple shapes, and interpreted as a sign of early visual cortex involvement. Here we aimed to compare the eccentricity effect for different imagined stimulus categories to determine which categories are likely to recruit early visual cortex during visual imagery. Twelve participants imagined six stimulus categories (checkerboards, gratings, invented shapes, lowercase letters, objects, simple shapes) at four different locations (2° and 8° of visual angle, to the left or right side), indicated by four placeholders. Each block of 20 trials started with the presentation of a stimulus exemplar to be imagined, followed by a mask. In each trial, an auditory cue indicated at which location to imagine the stimulus. Participants pressed a button as soon as they reached a vivid imagery. We recorded reaction times, monitored eye movements and collected subjective ratings of vividness and difficulty for each category. We obtained a robust eccentricity effect for all six stimulus categories, suggesting that all categories are likely to recruit early visual cortex during visual imagery. The analysis of subjective reports highlighted a strong inverse correlation between vividness and difficulty ratings, suggesting how lowercase letters, objects and simple shapes could be imagined more easily and vividly with respect to remaining categories, and thus might be best suited as stimuli for future fMRI studies.

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Motor imagery engages an insula-centered tactile network more than action observation: An fMRI study

It is often stated that Action observation (AO) and motor imagery (MI) share the same neural substrate, but studies directly contrasting these two simulation states are rare. Here we demonstrate clear differences between the neural networks of AO and MI. One day before scanning, participants learned to imitate three spatial sequences (SEQ) and three rhythmical sequences (RHY) with their left index finger. During scanning, each trial began with the observation of a practiced or novel pattern (AO), followed by either rest, or by a cue to engage in motor imagery (MI) or in motor execution (EXE). All conditions of the 2x2x3 event-related design (SEQ/RHY; practiced/novel; AO/MI/EXE) were presented in pseudo-randomized order. Here we only consider the practiced patterns. SEQ and RHY tasks recruited distinct task networks. At the same time, both tasks provide convergent evidence for a partial dissociation between regions activated during AO and MI: During AO, the respective task network tended to be more strongly activated than during MI. In contrast, during MI of both SEQ and RHY tasks, a network comprising a more posterior sector of IPC, posterior insula, and SII was found activated, most likely reflecting complex tactile-kinesthetic processing. This network showed only moderate overlap with AO, and strong overlap with action execution. Based on these findings we reject the common view of 'largely overlapping neural substrates of AO and MI'. Rather, motor imagery appears to engage tactile-kinesthetic simulation to a larger extent than AO, which gives MI a privileged role in bridging perception and action.