2023-06-22

# Coaching Imagery to Athletes with Aphantasia
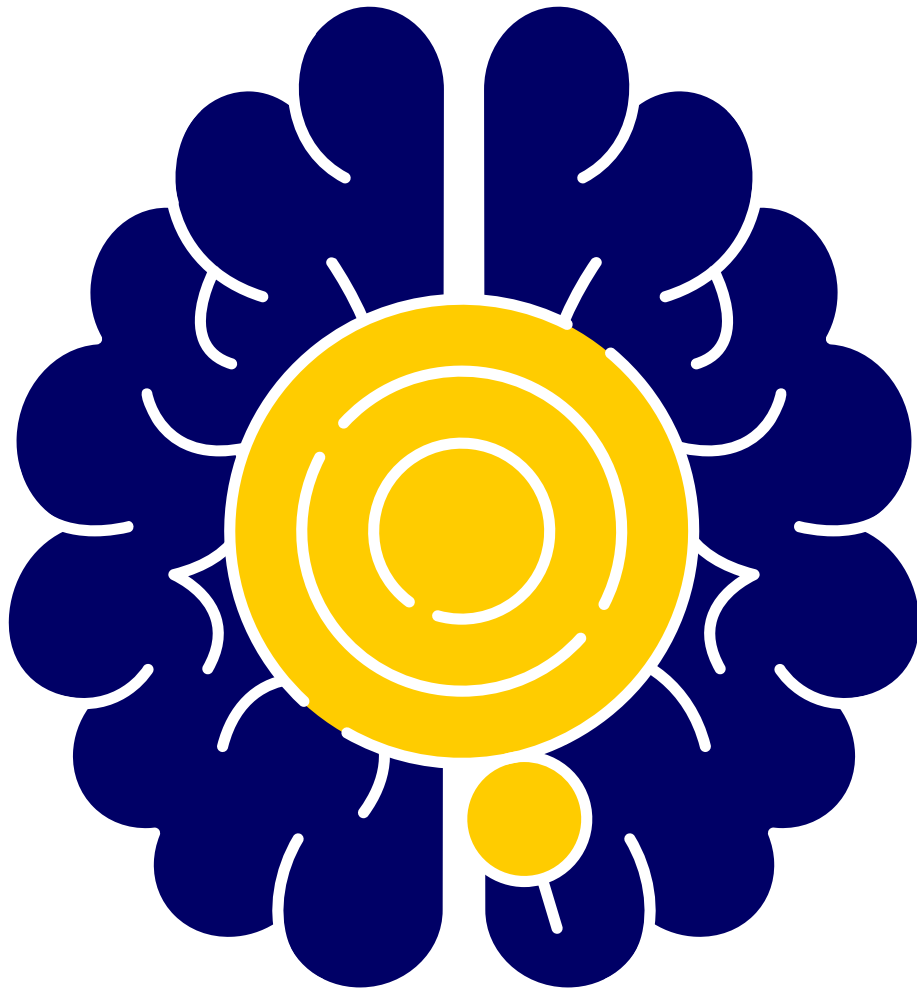
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# 17th European Workshop on Imagery and Cognition

20th - 22nd June 2023

Anglia Ruskin University, Cambridge, UK

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# WELCOME

Welcome to the historic city of Cambridge and to Anglia Ruskin University, where we are honoured to be hosting the 17th European Workshop on Imagery and Cognition (EWIC). These meetings have been running biennially since the first EWIC organised by Michel Denis in Paris in 1986. For over thirty-five years they have offered researchers and postgraduate students from across the world the opportunity to present and discuss the latest developments in the study of imagery and visuo-spatial cognition, in a friendly and informal atmosphere.

This meeting had to be postponed from 2020 due to the Covid pandemic, and it is with great pleasure (and relief!) we can finally welcome you all in-person to our campus to participate in the 17th EWIC. Our programme includes an exceptional line-up of oral and poster presentations delivered over the three days of the meeting, as well as keynote talks from leading international researchers in cognition, clinical psychology, and cognitive neuroscience. In keeping with the original spirit of EWIC as a *workshop*, we encourage you all to engage in spirited and inquisitive debate, during both the scheduled sessions and the conference social events afterwards!



**Professor David Pearson**

Lead Conference Organiser

It is my great pleasure to formally welcome you to the 17th European Workshop on Imagery and Cognition (EWIC).

 It is an honour for Anglia Ruskin University (ARU) to be hosting this workshop dedicated to the study of mental imagery and spatial cognition. Since its first meeting in France in 1986, EWIC has been a leading forum for researchers to present their work, exchange views and develop new research collaborations. It is a privilege to be welcoming EWIC to the beautiful City of Cambridge for the first time.

 ARU is an innovative global university with a strong civic mission. Our students come from 185 countries worldwide. ARU is consistently named as one of the top 350 institutions in the world in The Times Higher Education World University Rankings. Our mission is to transform lives through innovative, inclusive and entrepreneurial education and research.

The [School of Psychology & Sport Science](#) provides a vibrant, supportive and inclusive environment for students and staff. Our Sport & Exercise Sciences courses have been recognised for their excellence in undergraduate teaching provision, being ranked in the top 5 courses in the Guardian League tables for the past 4 years.

 In the recent Research Excellence Framework (REF) Psychology returned 90% of eligible research staff with 98% of its submission being internationally recognised or better with 15% classified as world leading.

 As one of three [research groups](#) in the school, the Centre for Mind and Behaviour at ARU (ARU-CMB) offers world-class EEG, virtual reality, and eye-tracking laboratory facilities, including the only Salimetrics-accredited Centre of Excellence biomarker testing laboratory operating in the UK. There is a thriving postgraduate program, including our MSc in Cognitive and Clinical Neuroscience as well as a vibrant Ph.D. community.

We are extremely proud of our staff and students at ARU and the values that they represent, and I hope you get the opportunity to learn more about their work and our community.

I wish you a successful workshop as you share ideas and look for new opportunities to drive forward research and scholarship and to create a better future.

I do hope that we find new ways to collaborate together on areas of mutual interest.

**Professor Laurie T Butler**

Pro Vice Chancellor & Dean

# We would like to thank the following exhibitors and sponsors for their support of the Cambridge EWIC

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A fascinating measure of restoration? Using eye-tracking to assess effortless attention during controlled and field exposure to outdoor environments (Emily McKendrick)

Drivers avoid attentional elaboration under safety-critical situations and complex environments (Vasiliki Kondyli)

11:20 – 11:40   **Break**

11:40 – 13:00   **Session 1** (Chair: Francesca Pazzaglia)

Mental maps are made of this: how transit maps and city borders distort our geographical representations (Florien Leprevost)

Mental representations and emotions in urban environments: affective state, restorativeness and distance and time estimations (Veronica Muffato)

How Walking EMDR Therapy (WET) Impacts Post-Traumatic Stress Disorder (PTSD) Symptoms: An evaluation of participants experiences (Lorraine Tindale)

Embodied cognition and road-crossing decision-making : The impact of real and simulated ageing (Marie Trouve)

13:00 – 14:00  **Lunch**

14:00 – 15:00    **Session 2** (Chair: Ineke van der Ham)

Emotional landmarks and spatial learning in a virtual environment: An online study (Teophile Rasse)

Considering the role of visual feedback on mental representations of the body following tool use in virtual environments (Kristen Macuga)

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# DAY 2: 21st June 2023

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15:30          **Punting Tour and Riverside BBQ (Granta Moorings and The Granta pub, Newnham Rd)**.

              Please gather in LAB Broad Street Foyer at 15:30 if you would like to be guided to the venue (25 minute walk).

# DAY 3: 22<sup>nd</sup> June 2023

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Coaching Imagery to Athletes with Aphantasia (Jonathan Rhodes)

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15:10 – 16:10   **Keynote Lecture: Neil Burgess, *Neural Mechanisms of Spatial Memory and Imagery***
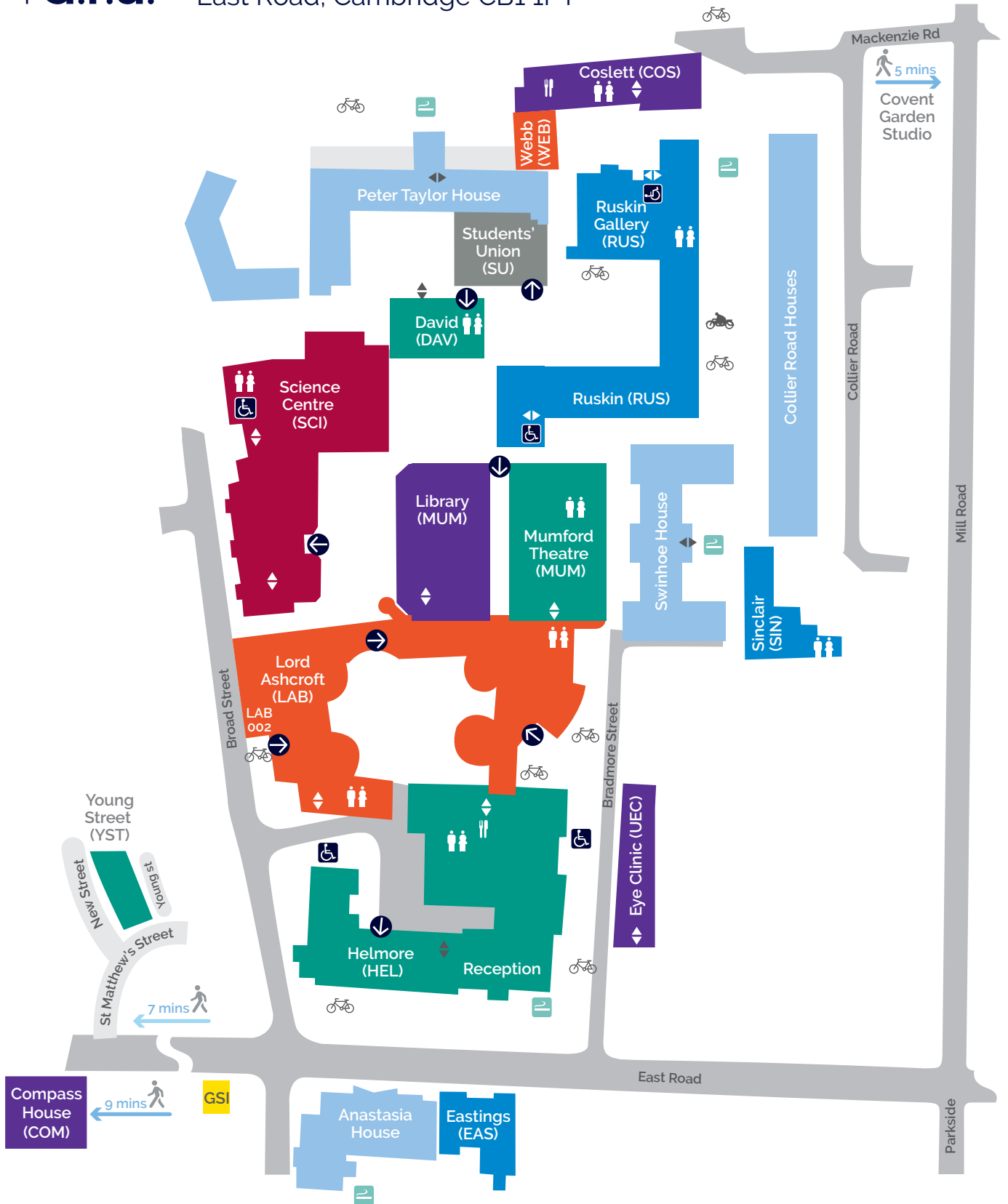
16:10 – 16:30   **Closing comments and announcements**

# LIST OF POSTER PRESENTATIONS (DAY 1)

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2. Restoration effects after gameplay in virtual environments (Suzanne Brinkman)
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4. Navigation ability in men and women: Examining the type of task and beliefs about spatial abilities (Laura Miola)
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6. The involvement of the temporo-parietal junction in switching between egocentric and allocentric spatial representations: an fNIRS Study (Renato Orti)
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9. Affective response of young and elderly people to multisensory environments: the role of interoceptive awareness and cognitive abilities (Tina Iachini)
10. How object ownership influences object's processing: the role of spatial location (Lucie Lenglart)
11. Spatial Language in Map tasks: A classroom observation (Estfania Gamarra Burga)
12. A personal sensory navigation profile: Creating a novel tool to determine navigational strategies in blind and visually impaired individuals (Dominique Blokland)
13. Judging action opportunities in virtual versus physical environments (Milena Golz)
14. Exploring the effect of ASMR on biomarkers and interpersonal space. (Lovell Jones)
15. From the outside in: ASMR is characterised by reduced interoceptive accuracy but higher sensation seeking (Flavia Cardini)
16. Heightened Interoception in Adults with Fibromyalgia (Jennifer Todd)
17. Preliminary Evidence of Enlarged Peripersonal Space Representation in Adults with Fibromyalgia (Jennifer Todd)
18. Exploring bodily perception and personal space (Deanna Finn)

# Cambridge campus

East Road, Cambridge CB1 1PT

a.r.u.

Mackenzie Rd

5 mins
Covent Garden Studio

Coslett (COS)

Webb (WEB)

Peter Taylor House

Ruskin Gallery (RUS)

Students' Union (SU)

David (DAV)

Collier Road Houses

Collier Road

Ruskin (RUS)

Science Centre (SCI)

Library (MUM)

Mumford Theatre (MUM)

Swinhoe House

Sinclair (SIN)

Mill Road

Lord Ashcroft (LAB)

LAB 002

Broad Street

Bradmore Street

Eye Clinic (UEC)

Young Street (YST)

New Street

Young st

St Matthew's Street

Helmore (HEL)

Reception

7 mins

9 mins

Compass House (COM)

GSI

Anastasia House

Eastings (EAS)

East Road

Parkside

## Legend

- Student Accommodation
- Global Sustainability Institute (GSI)
- Disabled parking
- Cycle parking
- Motorcycle parking
- Toilets
- Restaurant / cafe
- Smoking area
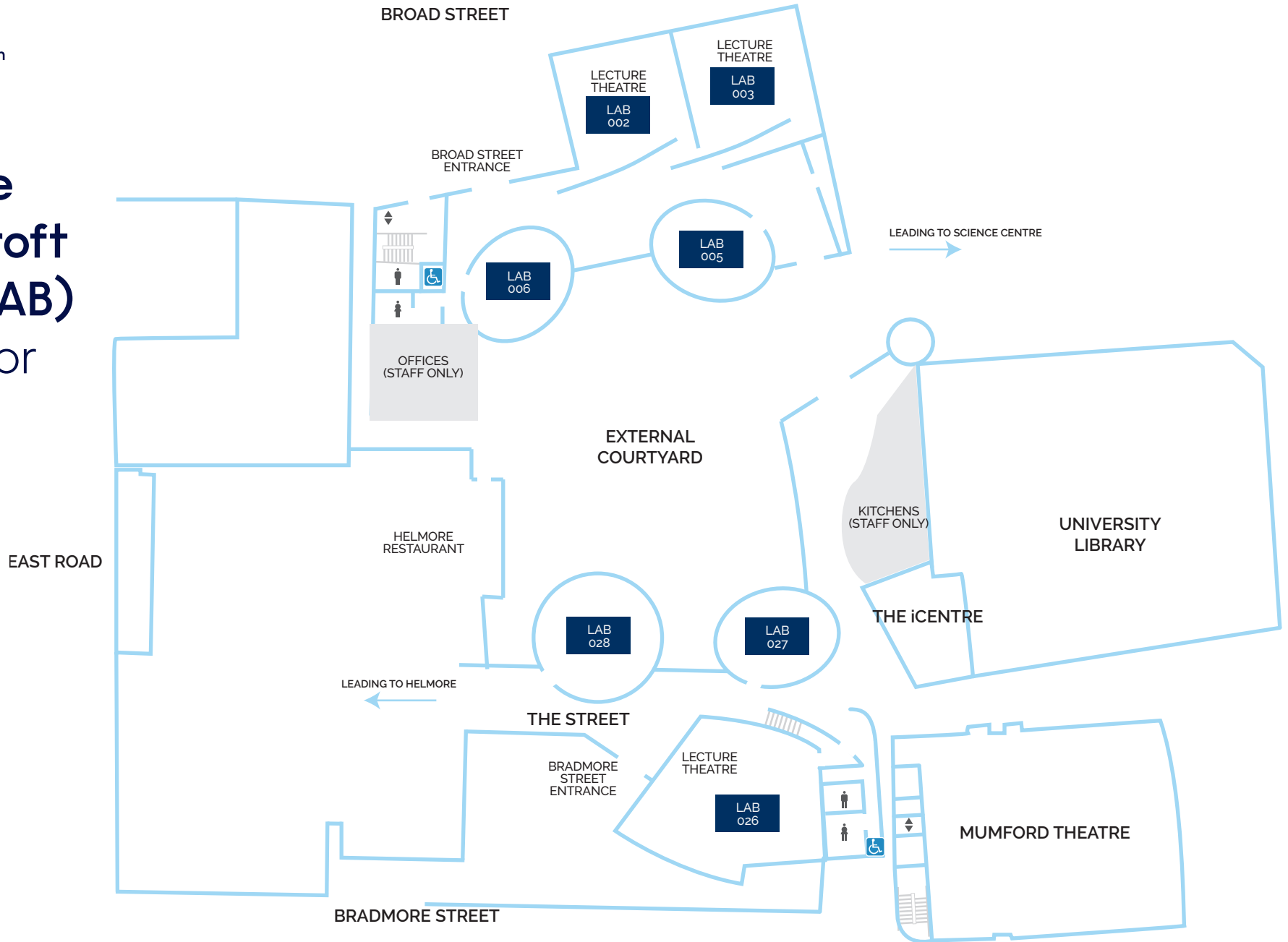- Lifts
- Disabled lift
- Main entrances

11

September 2019

# Cambridge city centre

Cambridge campus, East Road, Cambridge CB1 1PT

a.r.u.



**Map labels:**

- NEWMARKET RD
- JESUS LN
- MAIDS CAUSEWAY
- Compass House
- park&ride drop off / pick up
- St MATTHEW'S ST
- NEW ST
- YOUNG ST
- Young Street
- PETWORTH ST
- GEO
- OART ST
- The Grafton Shopping Centre
- Christ's Pieces
- SIDNEY ST
- HOBSON ST
- EMMANUEL RD
- Abbeygate House
- NORFOLK ST
- EDWARD ST
- STURTON ST
- Market Square
- Lion Yard
- Bus Station
- EMMANUEL ST
- park&ride drop off/pick up
- Anastasia House
- Eastings
- EAST RD
- BROAD STREET
- Peter Taylor House
- Grand Arcade Shopping Centre
- Corn Exchange
- St ANDREW'S ST
- BRADMORE ST
- ARU Cambridge
- a.r.u.
- DOWNING ST
- Arts Picturehouse
- PARK TERRACE
- Fire Station
- Swinhoe
- MILL RD
- WILLIS
- GUEST RD
- MACKENSIE
- PEROWNE ST
- GWYDIR ST
- KINGSTON ST
- Parker's Piece
- Parkside Swimming Pool
- Kelsey Kerridge Sports Centre
- TENNIS COURT RD
- REGENT ST
- GRESHAM RD
- GLISSON RD
- TENISON RD
- St BARNABAS RD
- DEVONSHIRE RD
- LENSFIELD RD
- HILLS RD
- BROOKSIDE
- RUSSELL ST
- NORWICH ST
- BATEMAN ST
- TENISON RD
- STATION RD
- Train Station
- TRUMPINGTON RD
- Botanic Garden
- CB1 & The Railyard (Student residences)
- BROOKLANDS AVE

**Legend:**

- Main campus
- University student residences
- Compass House (COM)
- Young Street (YST)

![Anglia Ruskin University logo] **a.r.u.** | Anglia Ruskin University

# Cambridge Lord Ashcroft Building (LAB)
## Ground floor

**Toilets**
**Disabled toilet**
**Lift**

BROAD STREET

LECTURE THEATRE
LAB 003

LECTURE THEATRE
LAB 002

BROAD STREET ENTRANCE

LEADING TO SCIENCE CENTRE

LAB 005

LAB 006

OFFICES (STAFF ONLY)

EXTERNAL COURTYARD

KITCHENS (STAFF ONLY)

UNIVERSITY LIBRARY

EAST ROAD

HELMORE RESTAURANT

THE iCENTRE

LAB 028

LAB 027

LEADING TO HELMORE

THE STREET

BRADMORE STREET ENTRANCE

LECTURE THEATRE
LAB 026

MUMFORD THEATRE

BRADMORE STREET

# Cambridge Science Centre
## Ground floor

**Toilets**

**Disabled toilet**

**Lift**

BROAD STREET

ATRIUM

ANT COLONY

SCI 105

LECTURE THEATRE

MAIN ENTRANCE

LORD ASHCROFT BUILDING

LAB COURTYARD
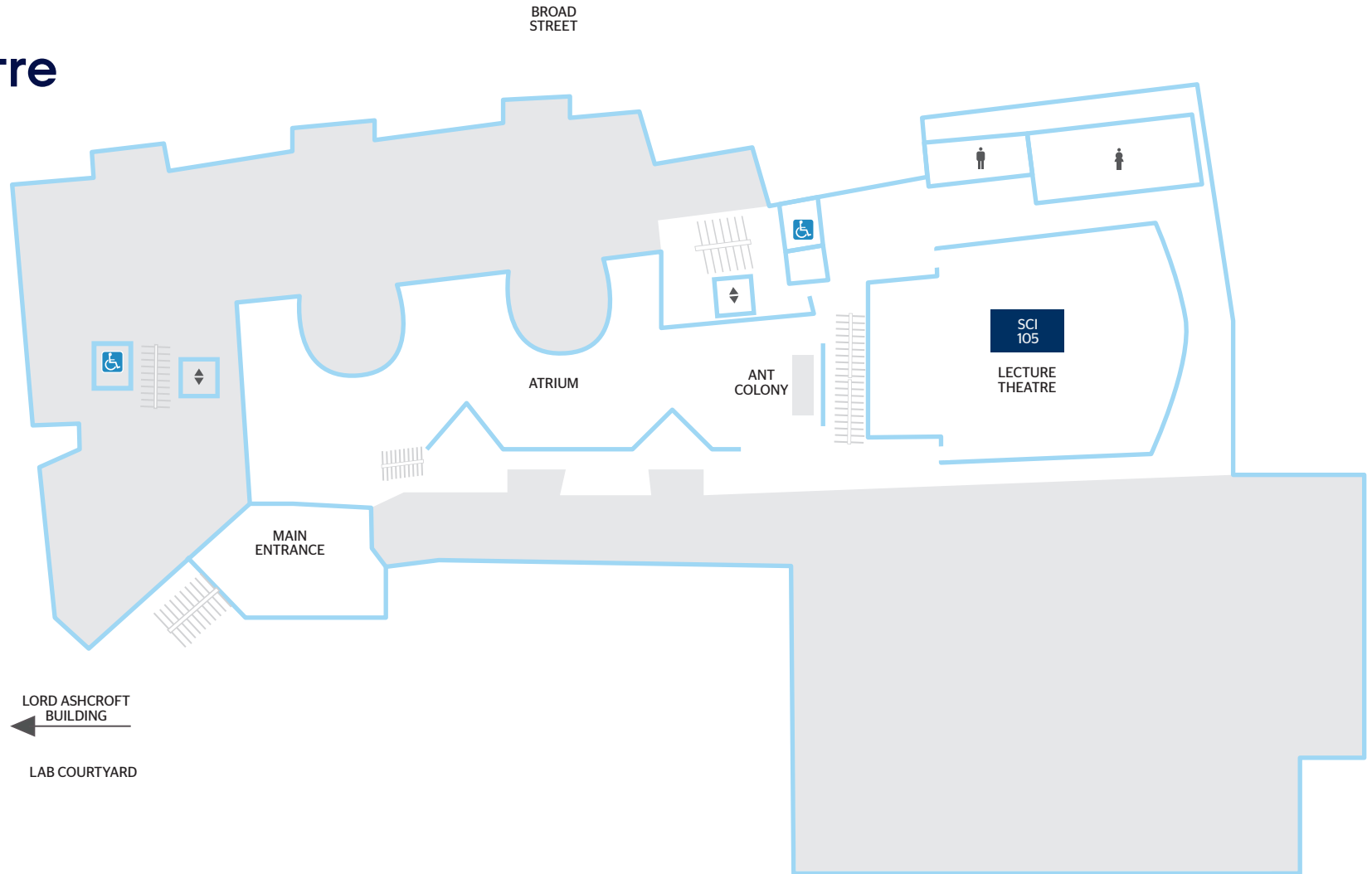
# ABSTRACTS: DAY 1
# Tuesday 20th June

# OPENING ADDRESS

## 10:00 – 10:40, LAB003

# Stretching the Imagination

## Robert H. Logie

*University of Edinburgh*

Stretching the Imagination captures the idea that mental imagery is a flexible mental tool that can be used in a variety of everyday cognitive tasks, and in laboratory studies of capacity and longevity of the imaged representations. Its flexibility was clear from a presentation at the first (1986) EWIC by Tore Helstrup on 'Imagery as a major strategy'. Debates about capacity and longevity featured in that first meeting and in most subsequent meetings including EWIC 2023, so have yet to be resolved. Other topics were central for some EWIC meetings but then disappeared from schedules. This was in part because researchers moved on to other topics or retired, but rarely were debates resolved by mutual agreement among the main protagonists, and such never ending debate might be seen to inhibit the accumulation of science. Helstrup's 'Imagery as strategy' suggested that different participants might use imagery along with other strategies for any given task. This possibility that the same task might be performed in different ways contrasts sharply with the more general reliance in cognitive psychology on results from averaging data across participants, treating individual variability in performance patterns as statistical noise. It also challenges the tendency for different laboratories to work in isolation or follow a particular theoretical perspective and set of paradigms, with debates perpetuated through a scientific competition that no side ever wins outright. A major motivation for EWIC 1986, led by founder Michel Denis, was to encourage co-operative research across European imagery researchers, the success of which is clear in EWIC 2023. Yet collaborations tend to occur between researchers who share theoretical perspectives, and debates are unresolved between researchers who adopt opposing theoretical assumptions. Focusing on debates in visual working memory, I will present examples of how different participants may and do perform the same tasks in different ways, and will advocate adversarial collaboration between researchers who disagree as an approach to debate resolution and scientific advance.

# SESSION 1 (Chair: Francesca Pazzaglia)

## 10:40 – 13:00, LAB003

## A fascinating measure of restoration? Using eye-tracking to assess effortless attention during controlled and field exposure to outdoor environments.

Emily McKendrick*, Mike Pake, Helen Keyes, David G. Pearson

*Anglia Ruskin University, Cambridge, UK.*

*emily.mckendrick@aru.ac.uk

According to Attention Restoration Theory (ART; R. Kaplan & S. Kaplan, 1989), environments that capture attention effortlessly, whilst allowing for reflection, provide opportunity to restore fatigued attentional capacities. This visual-attentional process of "soft-fascination" has been recorded via eye-movement behaviour towards nature. However, research employing eye-tracking methods typically compares fascinating nature to unappealing urban environments, is not accompanied by reliable restoration measures, and/or focuses on laboratory-based exposure ignoring real-world interactions. To overcome these shortcomings, the present research aimed to investigate the usefulness of eye-tracking as a measure of effortless attention. Specifically, whether differences in visual and attentional responses between nature versus built scenes exist when environments vary in soft-fascination and persist across direct and indirect exposure. Study 1 measured fixations and saccades of 64 participants while viewing one of four photograph sets of natural or built environments rated either high or low in soft-fascination in a preliminary study. Attentional capacity and mood were measured before and after 10-minutes of photograph exposure. Study 2 measured fixations of an independent sample of 64 participants while spending time in high- and low-fascination natural environments or in high- and low-fascination built environments. The natural and built locations were selected in a preliminary field study and soft-fascination manipulation checks were confirmed. Attentional capacity and mood were measured before and after 10-minutes of viewing the environment from a seated position while wearing the Tobii Glasses 2 eye-tracker. Fixation frequencies and durations were distinguishable between attention towards natural and built environments. Fixations were also found to significantly relate to attentional capacity during direct exposure to natural and built environments. Findings further demonstrate that natural and built environments can be equally attentionally restorative, particularly when considering highly fascinating built environments. Findings confirm the effectiveness of using eye-tracking to measure effortless attention during both indirect and direct exposure to outdoor environments.

# Drivers avoid attentional elaboration under safety-critical situations and complex environments.

Vasiliki Kondyli[1*], Daniel Levin[2], Mehul Bhatt[1]

*1Örebro University, Örebro, Sweden*

*2Vanderbilt University, Nashville, USA*

*vasiliki.kondyli@oru.se

In everyday activities where continuous visual awareness is critical such as driving, several cognitive processes pertaining to visual attention are of the essence, for instance, change detection, anticipation, monitoring, etc. Research suggests that environmental load and task difficulty contribute to failures in visual perception that can be essential for detecting and reacting to safety-critical incidents. However, it is unclear how gaze patterns and attentional strategies are compromised because of environmental complexity in naturalistic driving.  In a change detection task during everyday simulated driving, we investigate inattention blindness in relation to environmental complexity and the kind of interaction incidents drivers address. We systematically analyse and evaluate safety-critical situations from real-world driving videos and replicate a number of them in a virtual driving experience. Participants (N= 80) aged 23-45 years old, drove along three levels of environmental complexity (low-medium-high) and various incidents of interaction with roadside users (e.g., pedestrians, cyclists, pedestrians in a wheelchair), categorized as safety critical or not. Participants detected changes in the behaviour of road users and in object properties. We collect multimodal data including eye-tracking, egocentric view videos, movement trace, head movements, driving behaviour, and detection button presses.  Results suggest that gaze behaviour (number and duration of fixations, 1st fixation on AOI) is affected negatively by an increase in environmental complexity, but the effect is moderate for safety-critical incidents. Moreover, anticipatory and monitoring attention was crucial for detecting critical changes in behaviour and reacting on time. However, in highly complex environments participants effectively limit attentional monitoring and lingering for non-critical changes and they also controlled "look-but-fail-to-see errors", especially while addressing a safety-related event.  We conclude that drivers change attentional strategies, avoiding non-productive forms of attentional elaboration (anticipatory and monitoring) and efficiently disengaging from targets when the task difficulty is high. We discuss the implications for driving education and research driven development of autonomous driving.

# Mental maps are made of this: how transit maps and city borders distort our geographical representations.

Florien Leprévost[1*], Prabhakar Archana[2], Simon Lhuillier[2], Grison Elise[1], Simone Morgagni[1]

[1]*SNCF, Direction de la Recherche, Experience & Cognition, La Plaine Saint-Denis, France*

[2]*Université Paris Cité & Université Gustave Eiffel, LaPEA, Versailles, France*

[*] f.leprevost@sncf.fr

Mental maps geometric properties are systematically distorted because of cognitive organizing principles that facilitate storing in memory (Tversky, 1992). In their study, Prabhakar et al. (2022) showed that inhabitants' mental maps of London or Paris were closer to the Public Transport (PT) schema than to the geographical map. By nature, PT schema shows geographical distortions, with one common characteristic being the compression of the periphery relative to the centre – to account for the lower density of the network in peripheral regions. Thus, the goal of this study was to refine those results by focusing on the centre-periphery distortion observed in PT schema.

In an online experimental set-up, we asked inhabitants of Paris and London to place 20 of their city's landmarks one-by-one, central or peripheric, on a blank map. It had a single reference point that was either a central or a peripheral landmark was provided, to control for a potential reference point effect (Holyoak & Mah, 1982).

We expect to find PT schema distortions in participants' answers: centre-centre distances should be overestimated, relative to centre-periphery and periphery-periphery distances. This distortion should thus increase with a central reference point, and be higher in Paris: we show that the centre-periphery border is stronger in Parisians' minds, and cities' boundaries repel landmarks away (Carbon & Leder, 2005).

This study should show that mental maps are built through experience, so that some widespread functional representations of space such as PT schemas might influence their properties.

# Mental representations and emotions in urban environments: affective state, restorativeness and distance and time estimations.

Veronica Muffato[*], Laura Miola, Marilina Pellegrini, Francesca Pazzaglia, Chiara Meneghetti

*Department of General Psychology, University of Padova, Italy*

[*] veronica.muffato@unipd.it

Research has shown that factors at both the environmental and individual levels could support the ability to mentally represent an environment. Among the former, the presence of green regenerates from stress, renewing cognitive resources. Among the latter, individuals' cognition and dispositions, but also their affective state may be related to the ability to represent an environment.

However, few studies have investigated how environment and individual factors jointly relate to environment representation. Therefore, the present study aims to investigate the relationship between the individual's affective state, the perceived restoration, and the ability to mentally represent - in terms of distance and time estimation – paths covered by walking in urban environments, with different levels of green. About 150 participants (99 females) performed trait affective state (PANAS trait), mental rotation test, wayfinding inclinations questionnaire, and connectedness to nature scale. Then, they walked paths in urban environments (70 to 130 meters each) and completed the PANAS state, the distance and time estimation tasks (random order), and the restorativeness scale. The results showed that the characteristics of the environment (level of green) were correlated with perceived restorativeness. Furthermore, concerning individual factors, mental rotation abilities correlated with distance estimation; connectedness to nature with state positive affect; trait and state positive affects correlated with perceived restorativeness. A mediation model is tested finding that state positive affect is related to restorativeness, which in turn is related to distance estimation performance (considering also the role of mental rotation, connectedness to nature, and trait affective state). To conclude, although environmental characteristics appear not related to environment representation accuracy (assessed with distance and time estimations), emotional aspects and restorativeness seems work together to impact distance estimation ability.

# How Walking EMDR Therapy (WET) Impacts Post-Traumatic Stress Disorder (PTSD) Symptoms: An evaluation of participants experiences, a pilot study.

Lorraine Tindale*, Nick Caddick, Débora Vasconcelos-e-Sa, David G. Pearson

*Anglia Ruskin University, Cambridge, UK*

* lnt104@pgr.aru.ac.uk

The use of walking (in nature) as bilateral stimulation to reduce stress, restore attention and improve mental health is supported by a growing body of contemporary evidence based literature. This study explores the views of clients undertaking Walking EMDR Treatment (WET) as an innovative potential trauma treatment, of Post-Traumatic Stress Disorder (PTSD) symptoms. The objective of this study is to explore participants' experiences of WET, using qualitative interviews before, during and after the WET intervention to evaluate its feasibility of integrating trauma treatments with walking in nature. 11 participants with PTSD diagnosis, were privately recruited (WET clinic), assigned 12 weekly 90 min sessions using the EMDR Adaptive Information Processing (AIP) driven protocol for walking (WET). Participants were interviewed pre-, mid-, and post-treatment to obtain their lived experiences of WET, and their qualitative responses analysed using Contextual Content Analysis (CCA). Initial CCA qualitative analysis indicate significant positive trends (100%) in WET being a natural, instantaneous, meticulous, and a harmoniously effective way to impact PTSD symptoms. 9% found it intermittently exposing, (27%) physically exhausting and (36%) emotionally challenging. The preliminary findings suggest WET may positively impact PTSD and enhance trauma treatments. This opens new exciting innovative possibilities for the application of EMDR in a nature-based context.

# Embodied cognition and road-crossing decision-making: The impact of real and simulated ageing.

Marie Trouvé*, Aurélie Dommes, Valérie Gyselinck

*The University Gustave Eiffel and the Laboratory of Applied Psychology and Ergonomics (LaPEA), Versailles, France*

* [marie.trouve@univ-eiffel.fr](mailto:marie.trouve@univ-eiffel.fr)

To date, few studies have examined ageing through an embodied approach of cognition (Vallet, 2020). We adopted this approach on a complex task to better understand the street-crossing difficulties older people are known to experience (Dommes, 2019), and examine the different functions it involves (sensorial, motor, and cognitive). A suit was used to simulate aged-related sensorimotor constraints (Moll, 2019) in order to disentangle the cognition from its sensorimotor context. Three groups of participants were compared. The first group consisted of 30 young adults (age 19-37), the second of 30 young adults wearing the suit (age 18-36) and the third of 26 older adults (age 65-83). The participants were asked to cross a two-way street in a full-scale virtual reality platform that allowed actual walking. There were three blocks of 34 trials, and various measures were collected. Additional functional tests were proposed to assess participants' cognitive, visual and auditory functions. Results suggest that the suit simulates sensorimotor ageing well, but with a less pronounced slowing of walking speed, but a stronger decline in visual and auditory functions in the young group wearing the suit than in the older group. Results also indicated that older and younger participants wearing the suit had more collisions in the first block of trials than young participants, while all groups took as many crossing decisions. This difference disappeared faster in the older group than in the group with the suit. Additionally, contrary to younger participants, the crossing speed adopted by older and younger participants wearing the suit was higher than their usual walking speed in the first block of the task. In the last block, only older participants still went faster than their usual speed. Relevance of using the ageing simulation suit is discussed together with the impact of these results on an embodied ageing view.

# SESSION 2 (Chair: Ineke van der Ham)

## 14:00 – 15:00, LAB003

## Emotional landmarks and spatial learning in a virtual environment: An online study.

Téophile Rasse[12*], Valérie Gyselinck[12], Jérôme Guegan[1]

*1Université de Paris. France*
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The influence of emotion in spatial memory has until now received only little attention in spatial cognition research. Some studies have nevertheless shown that landmark's emotional valence can impact route (Balaban et al., 2017; Palmiero & Piccardi, 2017) and survey spatial learning (Ruotolo et al., 2019). Recently, the interaction between valence and arousal of landmarks has been investigated in Vista space (Piccardi et al., 2020) and simple virtual environments (Ruotolo et al., 2021). These studies suggest that valence, regardless of arousal, supports learning of route knowledge, and that the interplay between these two emotional dimensions could influence survey knowledge. The aim of the present study was to clarify the impact of emotionally laden landmark's valence and arousal dimensions on spatial memory, and to extend previous results to more complex and wide environmental space configurations. To this end, 284 adults were recruited in an online experiment administered using Labvanced platform. They were asked to watch a movie of a walk in an urban virtual environment containing landmarks that differed in terms of arousal and valence across conditions (high-arousal-positive; low-arousal-positive; high-arousal-negative; low-arousal-negative). Participant's route knowledge was assessed using a direction recall task and survey knowledge by asking them to plot the position of each landmark encountered during the route on a map. Survey knowledge accuracy and biases were quantified using bi-dimensional regression (Carbon, 2013). Results suggests that the presence of positive landmark could benefit route knowledge acquisition as opposed to high arousing ones that could impair it. Additionally, despite no effect of the interplay between landmark's valence and arousal was found on survey knowledge global accuracy, results suggest an influence of landmark's valence on participant's maps rotational bias. Relevance of the stimuli used in this experiment and the previous work on emotional landmarks, and that of the emotional dimensions considered are discussed.

# Considering the role of visual feedback on mental representations of the body following tool use in virtual environments.

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Tool embodiment is a theory of human tool-use that has gained considerable attention in recent years. The tool embodiment literature suggests that tools are perceived and experienced as extensions of our own bodies, with such claims supported by changes in body landmark localization tasks and movement characteristics after hand-held tool-use, implying an extension of the arm. In a previous experiment, we attempted to reproduce these arm lengthening tool-use effects in virtual reality by recreating a seminal tool-use paradigm (Cardinali et al., 2009). Our participants localized the perceived positions of their unseen wrist, elbow, and mid-forearm and repeatedly reached to lift and replace an object with their hands both before and after completing the same reaching tasks with a grabber tool. We observed no effect of tool-use on landmark localization errors or reaching kinematics, but surmised that a lack of visual feedback of the body may have prevented such effects from appearing in the virtual environment. In the current study, we addressed this possibility by including a virtual avatar that was controlled by inverse kinematics. We again found no evidence that tool-use extends the body representation. Further, a real-world replication found effects that ran counter to tool embodiment predictions. These results suggest that, insofar as it is captured by proprioceptive-based localization judgments and reaching kinematics, tool-use does not extend the body representation in either virtual or real environments. We contextualize these results in light of our recent critical review of tool embodiment, and suggest that landmark localization and reaching kinematics are not valid measures of the phenomenon (Bell & Macuga, 2022).

# Evolutions of a spatial description of a virtual route: From childhood to adulthood.

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Even if some studies have helped characterizing the spatial descriptions of itineraries in adults, little is still known about how they develop in children. This study investigated how children and adults construct a spatial representation of a route in a virtual town. Thirty-six second graders (8 y/o), thirty-six fourth-graders (mean ages 10 y/o) and forty-eight adults were shown an itinerary in a virtual town, presented twice on a computer screen. They then performed several spatial tasks among which they were asked to make a description of the route. In this report, we focused on the analysis of spatial descriptions, with a special interest on landmarks, spatial information and actions, and their associations. We considered the number of mentions of landmarks (entities easily perceived and remembered) alone, actions alone, landmarks associated with spatial information (e.g. "the park is on the right"), actions associated with spatial information (e.g. "turn right"), actions associated with a landmark (e.g. "turn at the bakery") and action with landmarks and spatial or temporal information (e.g. "turn right at the bakery").
An ANOVA was run with age and type of information mentioned as between-factors. A significant increase with age was observed in the number of information mentioned to describe the route, and an effect of type of information was also obtained. Interestingly, the number of landmarks and actions mentioned alone decreased with age. By contrast, the number of landmarks mentioned with an action increased, followed by an increasing number of landmarks with both actions and spatial and/or temporal details. Moreover, even at eight years old, children mention more decisional landmarks that are the most important information to be able to redo the travel. To conclude, we observed an important evolution from 8 to 10 y/o and to adulthood of spatial description not only on number of information but more importantly in the types and relevance of information reported.

## KEYNOTE ADDRESS 1

16:20 – 17:20, LAB003

# *The Mechanisms and Impact of Mental Imagery*

Joel Pearson

*University of New South Wales, Sydney, Australia*

Mental imagery can be advantageous, and unnecessary (aphantasia), to clinically disruptive and traumatic. It allows us to disconnect our senses from reality and test out virtual combinations of sensory experience. With methodological constraints now overcome, empirical research has shown that visual imagery can function much like a weak version of afferent perception. This talk will cover methods of objectively and reliably measuring visual imagery and some new research into the mechanisms of imagery generation. Further, I will cover some of the cognitive implications of having aphantasia through to hyperphantasia (strong imagery), from memory, thought control, and cravings, to empathy and PTSD.

# POSTER PRESENTATON ABSTRACTS

15:20 -16:20 Tuesday 20th June

Science Centre Atrium

# 1. The creative self of dancers

Tommaso Feraco[1*], Nicole Casali[2], Benedetta Agostinis[1], Chiara Meneghetti[1]

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Dancing requires many complex skills, including physical and cognitive abilities, but differently from other sports or disciplines, it should require high imagery and creative abilities. No studies, however, tested whether dance practice does relate to people's creative potential including different aspects of creativity.

In this study, 117 participants divided in a control group of people not practicing sport (N = 36), amateur dancers (N = 46), and professional dancers (N = 35) completed a test of creativity (alternative uses tasks) and a reasoning task and filled three questionnaires measuring creative self-efficacy, creative metacognitive strategies, and creative identity. Dancers also performed an improvisation performance whose creativity was evaluated by two expert judges.

Results of four linear regressions (one for each creativity score) show that – controlling for gender and reasoning– professional dancers outperform controls in all tasks and questionnaires, while amateurs only score higher than controls in the alternative uses tasks.

Professionals' improvisation was evaluated as more creative than amateurs' one. Interestingly, a stepwise regression analysis showed that the evaluation of the improvisation was positively associated with (both professional and amateur) dancers' creative identity , but not with other creativity scores.

Results of this study suggest that the practice of dancing is related to creative ability and beliefs. Such beliefs, can favour dancers' performance, highlighting a virtuous cycle of associations between our creative self and dance.

## 2. Restoration effects after gameplay in virtual environments

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Exposure to natural environments has been demonstrated to result in restoration effects. After a visit to nature, people can experience less mental fatigue, higher levels of relaxation and cognitive improvement. The Attention Restoration Theory (ART) suggests that restoration occurs because of four factors: being away, fascination, extent and compatibility (e.g. Kaplan, 2001). If these four factors underly the restoration found, then restoration could also be achieved using other environments, which may be easier to access. In this experiment, we exposed participants to virtual environments in a game setting to study the extent to which this leads to restoration. We compared a natural and an urban environment, to study the impact of environment design. 45 young adult participants were assigned to the urban game environment and 41 to the natural game environment. The natural environment was predominantly green set in a forest area surrounded by mountains, whereas the urban environment consisted mainly of grey concrete buildings and asphalt. The game consisted of five mini games spread out across the environment, which were identical in cognitive content for both environments and concerned simple tasks. Before and after gameplay, the perceived restoration scale, digit span, and Corsi block tapping tasks were administered. Results indicate that perceived restoration occurred after both types of gameplay and was significantly higher after gameplay in the natural environment, compared to the urban environment. The working memory measures were not affected by type of environment. We can conclude that subjectively, restoration as found after exposure to nature can be achieved through gameplay. This effect is stronger if a natural virtual environment is used in the game design.

### 3. The relationship between GPS use and navigation ability: A systematic review

Laura Miola*, Veronica Muffato, Enrico Sella, Chiara Meneghetti, Francesca Pazzaglia

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Global Positioning System (GPS) tools are globally accepted as promising aids to effectively reach destinations. GPS use has in fact been recognized as an important aspect of navigation experience, but it is still unclear what is the relationship between GPS use of people and their navigation abilities in everyday life and the personal perception of navigation ability (e.g., sense of direction). This systematic review aims to provide an integrative summary on (i) the available evidence on the associations between GPS use and navigation abilities (i.e. performance and sense of direction), (ii) how the effects of GPS use are measured, and which methods and the instruments are commonly used, and (iii) the methodological quality (i.e. risk of bias) of evidence of each reviewed study on this research topic. This review is carried out according to the Preferred Reporting Items for Systematic Reviews and Meta-analysis Guidelines (PRISMA), and the review protocol was preregistered in the PROSPERO database (CRD42022378106). Studies are identified in the three electronic databases (PsycInfo, Web of Science, and Scopus), with no restriction on publication year. The risk of bias of each included study is assessed using tools based on the Joanna Briggs criteria. From an applied perspective, this review allows a better understanding of the contribution of experience with GPS on navigation abilities, and to give some recommendations, suggestions, and future directions on this research topic.

## 4. Navigation ability in men and women: Examining the type of task and beliefs about spatial abilities.

Laura Miola[1*], Chiara Meneghetti[1], Francesca Pazzaglia[1], Ineke van der Ham[2]

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Literature in various fields has shown how beliefs, in terms of mindset, self-efficacy, and gender stereotype, can influence our behavior and performance.

In the area of spatial cognition initial evidence suggests that beliefs about spatial abilities can be related to navigation performance and may underlie gender-related differences in navigation ability. To date, it is unclear how such beliefs about spatial abilities are related to each other and interact in relation to different components of navigation. Moreover, it is understudied whether men and women differ in evaluating their mindset, stereotype, and self-efficacy. The aim of the study was to investigate gender-related differences in navigation ability and beliefs about spatial abilities. We also examined whether self-efficacy before performing a task interacts with other spatial beliefs (mastery experience, mindset, and gender stereotype) in predicting different components of navigation. A sample of 150 participants learned a virtual environment, then performed five tasks: landmark, path route, location egocentric, location allocentric, and path survey task. Before and after each spatial navigation task, participants assessed their spatial self-efficacy and gender stereotype. They responded to questionnaires on growth mindset, gender stereotype, and mastery experiences. The results showed that women performed less well than men on the landmark task and scored lower on mastery experiences and the growth mindset. No gender-related differences emerged for task-specific self-efficacy and navigation performance, apart from the landmark task. Finally, we found that spatial self-efficacy interacts with mastery experience and gender stereotype for landmark, location-egocentric, and location-allocentric tasks. Performance increases with increasing spatial self-efficacy in those who have higher levels of mastery experience and lower levels of stereotype than the opposite sex. These results shed light on the interplay of beliefs about spatial ability and navigation performance and gender-related differences.

## 5. Exploring the relation between anxiety and a visual cognitive style: are involuntary thoughts the key?

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In anxiety disorders, involuntary distressing mental images and thoughts are common and play an important role in the maintenance of the disorder. Moreover, a superior use of non emotional imagery has been described in socially anxious individuals. In the framework of the verbalizing/visualizing dichotomy (and with the distinction of object and spatial imagery) a visual cognitive style has actually been described in this population. The aim of the present study is to investigate the link between a visual cognitive style and involuntary thoughts in the context of general anxiety disorder.

A total of 480 participants (232 females, 247 males) fulfilled the Generalized anxiety disorder (GAD-7), the Object Spatial Imagery Verbal Questionnaire (OSIVQ), the Frequency of Involuntary thoughts scale (FITS) and the White Bear Suppression Inventory (WBSI). Preliminary results indicate positive correlations between anxiety, visual-object imagery and frequency of involuntary thoughts. The more anxious are participants, the more they report a visual-object cognitive style and frequent involuntary thoughts. Furthermore, the WBSI's intrusiveness and suppression indices are positively correlated with the frequency of involuntary thoughts. This indicates that the more involuntary thoughts participants report, the more they report a tendency to suppress thoughts and experience intrusive thoughts. Negative correlations are observed between anxiety and the OSIVQ verbal and visual-spatial scores.

Preliminary results indicate a link between a visual cognitive style and involuntary thoughts in anxiety disorder. Further work will aim to determine the contribution of each factor in the symptomatology of anxiety. The results of this study will contribute to the understanding of the role of mental imagery in the emergence and maintenance of psychopathological disorders.

## 6. The involvement of the temporo-parietal junction in switching between egocentric and allocentric spatial representations: an fNIRS Study.

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In our daily-life activities we frequently switch between egocentric (subject-object) and allocentric (object-object) reference frames. For example, when we have to grasp an object, we constantly switch from the representation of the object's position in relation to our body (egocentric) to that between the object and the external environment (allocentric) and vice versa. Despite the prominence of this visual-spatial ability, it is still unclear which cortical regions underly the switching between egocentric and allocentric spatial representations. In the present study, participants were asked to perform a visuo-spatial working memory switching task (Ego-Allo Switching Task). Specifically, participants were shown with triads of 3D geometrical objects and had to memorize the objects and their positions. Afterwards, they were asked to provide two spatial judgments sequentially on the same triad. This was made in two different conditions: non-switching and switching. In the non-switching condition both spatial judgments regarded the same reference frame: egocentric (i.e. object X closest to you?) or allocentric (i.e. object X closest to object Y?). In the switching condition if the first judgment was egocentric the second was allocentric (or vice versa). The functional near-infrared spectroscopy (fNIRS) was used to measure the brain cortical activity underling switching vs. non-switching visuo-spatial processes in terms of changes of concentrations of oxygenated and deoxygenated haemoglobin. The results revealed a generalized activation of frontal regions during switching compared to non-switching conditions. Furthermore, an increased brain cortical activity during egocentric-to-allocentric switching process was found in the Temporo-Parietal Junction (including the Supramarginal and Superior Temporal gyri). Overall, these results suggest an involvement of frontal regions in the transition from both ego-to-allo and allo-to-ego spatial representations. Furthermore, in line with the third-stream hypothesis (Rizzolatti & Matelli, 2003), a selective involvement of the

"ventro-dorsal stream" was observed during the switching from an egocentric to an allocentric reference frame.

# 7. Encoding positions of objects used toward and away from the body: the role of frames of reference and the space sector.

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In everyday life we interact with objects that can be used by performing actions toward our body (combing our hair) or away from our body (drawing). Besides, to act on an object, it is necessary to encode its position in space with respect to both our own body (egocentrically) and elements in the environment (allocentrically). In addition, objects can be located within our action space (near space) in which by extending our arms it is possible to act, or beyond this space (far space). The aim of the study was to investigate how the objects direction use could affect how we represent their location in near and far space. Therefore, objects typically used towards the body or away from the body positioned in either near space or far space were presented on a table. Individuals had to judge whether an object was closest to them (egocentric judgment) or closest to another object (allocentric judgment). Results showed that egocentric judgments about objects used towards the body had an accuracy advantage in near space rather than far space. Whilst allocentric judgments on objects used away from the body showed a disadvantage compared to egocentric judgments in near space, but not in far space. The findings were interpreted on the basis of the different role of visuospatial and visuomotor mechanisms in far and near space, respectively.

## 8. The influence of temporal constraints on the use of egocentric and allocentric spatial reference systems.

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This study aimed to explore the effect of temporal information on the ability to represent spatial positions of objects according to an egocentric (i.e., body-based) or allocentric (i.e., environment-based) reference system. Participants saw pairs of three-dimensional geometric figures presented on a panel and placed at different distances from them and from a black bar. They had to memorize the position of the objects and then indicate which object was closest to them (egocentric judgement) and which object was closest to the black bar (allocentric judgement). The crucial manipulation consisted in making the two objects appear one after the other, i.e., at two different times. The results showed that egocentric judgements were more accurate when the closest object was also presented first rather than second, whereas allocentric judgements improved when the target object was presented second rather than first. These results suggest the possibility that the way we encode the positions of elements in the environment is influenced by the temporal constraints of our exploratory activity. Usually, the objects we encounter first are also those closest to our body, just as the objects we encounter later are also those furthest from the body but closest to other elements in the environment. This interpretation is in line with an embodied perspective to spatial cognition.

## 9. Affective response of young and elderly people to multisensory environments: the role of interoceptive awareness and cognitive abilities.

Francesco Ruotolo[1*], Mariachiara Rapuano[1], Massimiliano Masullo[2], Luigi Maffei[2], Gennaro Ruggiero[1], Tina Iachini[1]

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Several studies have shown that the characteristics of the living environment influence our emotions. For example, environments characterized by natural elements elicit more positive emotions than cemented environments (e.g., Koivisto & Grassini, 2022; Rapuano et al., 2022). However, the role of individual differences and/or different environmental characteristics in inducing such affective responses is still poorly understood (Bower et al., 2019). In this study, participants were shown images of different environments (i.e., green, coloured, or cemented parks) combined with different sounds (i.e., water, birdsong, chattering, or traffic) and rated how calm, happy, and excited each environment made them feel, and how pleasant, stimulating, and attractive it was. In addition, participants performed a cross-modal correspondence task, which measured their ability to pay attention to both acoustic and visual features and filled out a questionnaire about their ability to recognize and react appropriately to their internal body signals (i.e., interoceptive awareness, MAIA). As these abilities change during ageing, reactions of young (N=50, yav=24.88) and elderly people (N=50, yav=66.38) were measured. The results showed that, in addition to green parks, colourful parks combined with natural sounds had a more positive impact on the elderly than on the young. Furthermore, the presence of birdsong and the water sound enhanced the elderly's positive reaction to cemented parks. More interestingly, the affective responses of the young were mainly predicted by visual features, whereas the affective responses of the elderly were also predicted by acoustic features. Finally, especially in the elderly, as interoceptive awareness and the ability to pay attention to different sensory stimuli improved, positive reactions to scenarios increased. These results support the idea that the type of affective response to the environment depends on specific combinations of auditory and visual

characteristics and is influenced by people's age and cognitive and emotional abilities.

## 10. How object ownership influences object's processing: the role of spatial location.

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Previous studies have shown that objects located in the peripersonal space (PPS) receive enhanced attention, as compared to extrapersonal space (EPS), However, most objects in the environment belong to someone in particular and how object ownership influences object coding in relation to PPS representation is still unclear. In the present study, after having chosen their own cup, participants performed a reachability judgment task of self-owned and other-owned cups presented at different distances while facing a virtual character. This task was followed, on each trial, by a localisation task in which participants had to indicate where the cup, removed from view, was previously located. The two tasks were separated by a 900 ms visual mask during which the virtual character was unnoticeably shifted by 3˚ to evaluate the spatial frame of-reference used. The results showed that self-owned cups were processed faster than other-owned cups, but only when located in the PPS. Furthermore, reachability   judgments were biased for self-owned cups, leading to an extension of the PPS representation, especially for participants with a high score on the fantasy scale of IRI. Finally, the virtual character shift altered the localisation performance but only for the distant cups, suggesting a progressive shift from egocentric to allocentric frame-ofreference when moving from the PPS to EPS, irrespective of object ownership. Overall, our data reveal that the representations of PPS and ownership interact to facilitate the processing of owned manipulable objects, to an extent that depends on individual sensitivity to the social presence of others.  Additional studies need to be conducted to better understand the impact of the social context on these results and how different neurocognitive mechanisms may contribute to them

## 11. Spatial Language in Map tasks: A classroom observation.

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Studies show that spatial ability relates to success in STEM careers (Wai et al., 2009) and that this ability is malleable (Uttal et al., 2012). Language has been identified as an influential factor on the development of spatial ability (Pruden et al., 2011), but relevant studies that address this influence have focused on settings other than the classroom, where decisive learning takes place. Our study presents a qualitative analysis on how teachers present map navigation tasks and how their spatial language use affects class performance. Class observation and discourse analysis was used on six middle school classes. Teachers completed the Santa Barbara Navigational Ability test (Hegarty et al. 2002) as a measurement of their confidence in their navigational ability. Results show various relations between teacher's spatial language use and class task performance. For instance, teachers tended to encourage the use of landmarks when they realised that student groups were struggling with the task. Also, when teachers did not establish clear beginning points for the route, completing the task in the assigned time became more difficult for the children. There are also indications of a relation between navigational confidence and teacher's use of spatial language.

## 12. A personal sensory navigation profile: Creating a novel tool to determine navigational strategies in blind and visually impaired individuals.

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The ability to navigate the world around us is fundamental to everyday life as it allows us to independently obtain our personal goals. Individuals with visual impairments often receive orientation and mobility training with the goal to improve navigating the world using their other senses, such as hearing and touch. Standardized and evidence-based guidelines on which type of sensory information and strategies lead to the best navigation performance in distinct types of visual impairments and for different individuals are lacking. The aim of the current project is to develop and validate a personalized sensory navigation profile questionnaire to identify idiosyncratic navigation strengths, weaknesses, and preferences for use in mobility training for a wide range of visually impaired individuals. This will be done by conducting qualitative, semi-structured interviews with visually impaired individuals and clinical professionals to collect input for the most important topics and constructs. The interview data will be analysed using thematic analysis, and used to develop the sensory navigation profile questionnaire. In later studies, data from the navigation profile questionnaire will be combined with behavioural data concerning individuals' actual navigational behaviour when using different senses. This presentation will provide an overview of the research protocol that is currently running as well as preliminary interview data from the first study in the protocol. The findings from these studies will ultimately be of interest to people with visual impairments, clinical workers, and scientists that study navigation and sensory functions and can be implemented directly in orientation and mobility training.

# 13. Judging action opportunities in virtual versus physical environments.

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The correct judgment of action opportunities by estimating environmental properties and our own capabilities, is an essential ability in daily life. While young and healthy adults are able to make quick and adequate so-called affordance-based decisions, lower performance was observed in older age or after stroke. The aim of the current study was to evaluate whether a Virtual Reality (VR) setting may be feasible for diagnostics and training of affordance judgments. Therefore, two questions arose:

1. Do people judge action opportunities similarly in physical environments (PEs) versus virtual environments (VEs)?

2. Does visual feedback in VR improve judgment behavior in both the PE and the VE?

In a sample of 24 healthy participants, we assessed how well the subjects were able to judge whether their hand fits into a given opening that varied in width in a VE (Oculus Rift goggles) and a PE. In Study 1, we evaluated the equivalence of accuracy and detection theory measures between VE and PE. In Study 2 we applied and evaluated a VE feedback training in the same 24 healthy young adults. Results revealed an equivalent level of both conditions for accuracy. Concerning perceptual sensitivity, no clear statement could be made and for judgment tendency, no equivalence could be shown. A training effect was shown within the virtual condition, however, the improvement appeared transferable to the physical condition only on a descriptive level. Promisingly, equivalence testing post-training revealed that perceptual sensitivity performance in VE approached the PE level. The used approach seems applicable and with the current work, steps are made towards effective affordance judgment training in VEs. Implications for future studies are to specify potential conditions that might establish enhanced

equivalence for signal detection variables and significant transfer effects from the VE to the PE.

## 14. Exploring the effect of ASMR on biomarkers and interpersonal space.

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Autonomous Sensory Meridian Response (ASMR) describes a warm and pleasant experience of tingling sensations starting at the crown of the head and sometimes spreading down the body. This sensation is often evoked in response to various audio-visual triggers such as whispering, tapping and hand movements. This subjective experience has been often associated with feelings of calm and relaxation (Barratt and Davis, 2015).

The benefits of experiencing ASMR are widely accepted, with some people successfully relying on ASMR videos to help relieve stress, anxiety and insomnia. Yet, so far mostly anecdotal evidence supports these beneficial effects.

Recent research findings have unveiled physiological (Poerio et al., 2018) and neuroimaging (Lochte et al., 2018) correlates of ASMR, showing activation of areas involved in empathy, social cognition and emotional arousal.

The aim of the current study is twofold: 1) to unveil any hormonal correlates of the calming effect induced by ASMR and 2) to investigate if this calming effect promotes people's affiliative behaviours, in particular interpersonal space (IPS).

Participants' saliva was collected, and their interpersonal space (IPS) measured, before and after watching a video inducing ASMR - or a control video. IPS was measured using an online audio simulation of footsteps getting louder, mimicking footsteps getting closer. ASMR induced a significant reduction in IPS, suggesting an increased proneness to allow the others to come closer, after experiencing ASMR. However, no changes in levels of Alpha Amylase – key hormonal indicator of a stress response – were found. Results suggest that ASMR can reliably promote and improve interpersonal connection, but this is not mediated by the calming experience induced by ASMR.

## 15. From the outside in: ASMR is characterised by reduced interoceptive accuracy but higher sensation seeking.

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Autonomous Sensory Meridian Response (ASMR) is a complex sensory-perceptual phenomenon characterised by relaxing and pleasurable scalp-tingling sensations. The ASMR trait is non-universal, thought to have developmental origins, and a prevalence rate of 20%. Previous theory and research suggest that trait-ASMR may be underlined by atypical multisensory perception from both interoceptive and exteroceptive modalities. In this study, we examine whether ASMR-responder differ from non-responders in interoceptive accuracy and multisensory processing style. Results showed that ASMR-responders had lower interoceptive accuracy but a greater tendency towards sensation seeking, especially for tactile, olfactory, and gustatory modalities. Exploratory mediation analyses suggest that sensation seeking behaviours in trait-ASMR could reflect a compensatory mechanism for deficits in interoceptive accuracy, a tendency to weight exteroceptive signals more strongly, or both. This study provides the foundations for understanding how interoceptive and exteroceptive mechanisms might explain not only the ASMR trait but also individual differences in the ability to experience complex positive emotions more generally.

## 16. Heightened Interoception in Adults with Fibromyalgia.

Jennifer Todd[1*], David Plans[2-4], Michael C Lee[5], Jonathan Bird[6], Sonia Ponzo[3], Geoffrey Bird[4,7] & Jane E. Aspell[1] 2

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Previous research suggests that how we sense what is going on inside our bodies (interoception) affects how we experience pain. There is some evidence that people with fibromyalgia syndrome (FMS), which is a condition characterised by chronic pain and fatigue, may have altered interoceptive processing. However, previous studies have had mixed results, and some tests for measuring interoception have been questioned. We used a new task called the Phase Adjustment Task (PAT), which measures heartbeat perception using a smartphone app, to examine interoception in adults with FMS and address these issues. We examined: the tolerability and validity of the PAT in an FMS sample ($N = 154$); if there are differences in facets of interoception (PAT performance, PAT-related confidence, and scores on a questionnaire called the Private Body Consciousness Scale) between an FMS sample and an age- and gender-matched pain-free control group ($N = 94$); and, if subgroups of participants with FMS could be identified according to interoceptive accuracy levels. After including additional task breaks and a recommended hand posture, the PAT was both tolerable and valid in the FMS sample. The FMS sample were more likely to be classified as 'interoceptive' on the PAT, and had significantly higher interoceptive sensibility compared to the pain-free sample. Within the FMS sample, participants who were classified as interoceptive on the PAT had significantly lower symptom impact than the unclassified participants. Conversely, interoceptive sensibility was positively correlated with FMS symptom severity and impact. Present findings suggest that interoception may be an important factor to consider in understanding and

managing FMS symptoms, and that the PAT is a useful tool for assessing interoception in this population. We recommend future longitudinal work to better understand associations between fluctuating FMS symptoms and interoceptive processing.

# 17. Preliminary Evidence of Enlarged Peripersonal Space Representation in Adults with Fibromyalgia

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**Background:** Fibromyalgia is a long-term disorder characterised by chronic widespread pain, in addition to fatigue and sleep disturbances. Peripersonal space (PPS) is the space in the immediate vicinity of the body or the space within reach. It is a crucial area for the execution of actions towards reachable objects and reacting to potential threats approaching the body. **Methods:** We measured PPS in women with fibromyalgia ($n$ = 31) and matched pain-free controls ($n$ = 31) using an online visual looming task. Participants viewed images which increased in size as though they were moving toward the participant, and then disappeared. Participants indicated (by button press) when they thought that that the object would make contact with their body (time to contact; TTC). There were two object types (hard vs soft), two first frame picture widths, and three actual TTC expansion rates. **Results:** A 2 (group) x 2 (object) x 2 (width) x 3 (TTC) mixed ANOVA indicated significant main effects of group, object type, first-frame picture width and TTC (no interactions). PPS appears to be larger in participants with fibromyalgia compared to pain-free participants. This was evidenced by faster estimated TTC judgements (i.e., stimuli were judged to contact the body at a greater distance from the body). **Conclusions:** A larger PPS may reflect the fear of threats from the physical or social environment, and regular guarding against bodily pain. We are currently running a follow-up study, where we expect to replicate these findings using an audio-tactile PPS task.

## 18. Exploring bodily perception and personal space.

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Body image refers to appearance-related thoughts, feelings, and behaviours. This study investigated the relationship between body image and one's perception and interaction with the space surrounding the body. Interpersonal space (IPS) refers to the distance naturally maintained during social interactions. Peri-personal space (PPS) is used for the planning and co-ordination of actions within the external environment. Here, we hypothesised that people with a negative body image would prefer to maintain larger interpersonal distances, and display larger peri-personal space boundaries due to the role both boundaries play in the organisation of protective and defensive behaviour. A non-clinical sample of right-handed women ($N$ = 65) aged 18-40 ($M$ = 24.08) completed online measures of body appreciation, body image flexibility, body acceptance by others, body shame body surveillance, body dissatisfaction, and social anxiety. IPS was measured using a comfort-distance task: participants approached/were approached by a researcher, indicating when they began to feel uncomfortable with the others' proximity. To estimate peri-personal space boundaries, participants were blindfolded and responded to a vibrotactile stimulus which occurred at five timestamps alongside an audio clip of pink noise, which seemed to approach the participant. Timestamps correlated with the distance of the sound from the body, where sharp reductions in reaction time were taken as evidence of the stimulus entering the participants' PPS. Preliminary results evidence relationships between body acceptance by others, social anxiety, and interpersonal distances. No significant associations were found between body image and peri-personal space. These findings strengthen previous literature by demonstrating that body image has a significant effect on social cognition, particularly how a person perceives and conducts themselves in the social space.

# ABSTRACTS: DAY 2
# Wednesday 21st June

# SESSION 3 (Chair: Tina Iachini)

## 09:30 – 11:00, LAB003

## The role of imagery in motivation.

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We argue that mental imagery plays a central role in motivation and drives choices at moments of goal conflict. Specifically, we propose that imagining a goal strengthens desire for that goal and competes for limited-capacity working memory resources with conflicting goals and desires. Goal imagery is the representation against which perceived current states are contrasted, strengthening desire for change, and against which imagined behavioural solutions are compared, motivating behavioural plans to achieve the goal. When goals conflict, we hypothesise that behaviour selection involves a competition between the relative affective strength of competing motivations at that moment. This competition is driven by the vividness and affective charge of goal-related imagery, therefore more familiar short-term rewards have an advantage because they are easier to imagine vividly. We summarise three lines of evidence consistent with this model: 1. Experimental data showing that imagery competition reduces desire to smoke or eat; 2. Psychometric studies showing that multisensory imagery is associated with motivational strength and behaviours including alcohol reduction, sport and exercise; 3. Intervention studies showing that training people in motivational imagery leads to larger changes in motivation and behaviour than dialogue-based motivational support alone.

# Flashforward mental imagery in non-suicidal self-injury, an ecological momentary assessment investigation.

Juli Ji[1*], Penelope Hasking[2], Michael Kyron[3], Lisa Saulsman[3], Ashleigh Lin[4], Rodrigo Beccera[3], Emily Holmes[5]

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Non-suicidal self-injury (NSSI) is a prevalent and repetitive behaviour in young people. Flashforward mental imagery relating to NSSI (NSSI imagery) are ubiquitous during NSSI episodes, and it has been proposed as a cognitive driver of NSSI. This talk will present results from the first ecological momentary assessment (EMA) study investigating the real-time temporal relationship between NSSI imagery frequency and content as predictors of NSSI urge and behaviour. $N$ = 44 young people aged 17-24 reporting 5+ episodes of NSSI behaviour over the past 12 months as well as current NSSI ideation or behaviour received survey prompts seven times a day over 14 days via the mobile phone app SEMA[3]. Participants were prompted at each time point to report on NSSI urge, behaviour, as well as NSSI imagery occurrence, content, temporal focus, and subjective and motivational impact. Cross-sectional and cross-panel lagged analyses of the relationship between NSSI imagery, urge, and behaviour will be presented. Findings suggest "flashforward" mental imagery is not simply epiphenomenal to, and may constitute a cognitive driver of, NSSI behaviour. Monitoring "flashforward" imagery frequency and content may be a useful clinical target that can predict the transition from NSSI intent to NSSI behaviour during daily life.

# The role of emotions and the self in long-lasting episodic memories: New insights from an immersive virtual walk.

Diane Lenormand*, Eric Orriols, Alexandre Gaston-Bellegarde, Pascale Piolino

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Episodic memory (EM) is a long-term memory system that allows the encoding, storing and retrieval of personally experienced events with their internal and external context and grounds our sense of self. However, most laboratory studies of EM generally lack ecological validity when creating new memories, and validity control when assessing newly formed real-life memories. In the present study, 60 participants were invited to experience an immersive walk in a virtual city where they either witnessed or interacted with 30 events with various emotional valences (positive, neutral, or negative). Physiological measures, including the electrodermal activity, respiration rate and heart rate, were recorded during the incidental encoding in the virtual city. The participants took a surprise memory test after a one-month delay. For a sub-group of 30 participants, two memory tests were added, one immediately after encoding and one a week after encoding, to assess the role of memory re-activation during the retention delay. All participants had to characterize each memory using different scales (subjective assessment: emotion, self-relevance, memorability, etc.). The main results at the one-month delay reveal the effects of the different factors (valence, self, group) and their interactions on the number of memories and their richness. Depending on the number of memory rehearsals during the retention delay and using the implicit (physiological responses) and explicit (self-assessments) measures, predictive models of long-lasting EM were built. This study explores an innovative approach examining the formation of EM in a naturalistic and controlled setting, which lays the groundwork for new rehabilitation methods for memory.

# Eye movements and mental scene construction during autobiographical recall.

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There is growing evidence supporting a significant role for spontaneous eye movements during autobiographical recall, but the functionality of such eye movements remains unclear. In this study we hypothesise that eye movements may facilitate the process of mental scene construction, in which complex and coherent scenes associated with an autobiographical event are mentally generated and maintained during recall. To explore this, we examined participants' spontaneous eye movements during the retrieval of cued autobiographical memories. Participants' verbal descriptions of each memory were recorded in synchronisation with their accompanying eye movements and pupil size during recall. For each memory participants were asked to describe both the place (the details of the physical environment where the recalled event took place) and the event (the details of what happened in this environment). Memory narratives were analysed using the Autobiographical Memory procedure, which separated internal spatial (place) and non-spatial (event, thoughts and emotion) details. Eye movements during the recall of place details had significantly higher fixation duration and smaller saccade amplitude, and a significantly higher number of consecutive unidirectional saccades, in comparison to the recall of event and thought/emotion details associated with the same cued memory. Recall of place details was also associated with significantly greater pupil area in comparison to event and thought/emotion details. The findings are consistent with the spontaneous production of less random and more structured scan path patterns and greater cognitive load during the recall of internal spatial episodic details in comparison to episodic non-spatial details. These results are consistent with eye movements facilitating the activation and correct positioning of elements of a complex scene relative to other imagined elements during autobiographical recall.

# SESSION 4 (Chair: Chiara Meneghetti)

## 11:20 – 12:50, LAB003

## Travelling through space OR time: dimension-specific biases during a magnitude estimation task using virtual self-motion.

Simon Lhuillier[1*], Anna Martin[2], Valérie Gyselinck[1]

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Spatial and temporal processing share systematic biases (Winter et al., 2015) which can be interpreted as the result of common predictive Bayesian mechanisms (Petzschner et al., 2015) such as the existence of cross-domains statistical prior expectancies (Petzschner & Glasauer, 2011). However, arguments have been found both in favour of shared global mechanisms (Thurley & Shilde, 2018) as well as local magnitude-specific processing (Martin et al., 2017).

The present study aims at investigating if Bayesian priors are shared between spatial and temporal magnitudes. Participants were seated in an immersive virtual train simulator in which self-motion was simulated using optic flow velocity through a head-mounted-display. For each trial, they were asked to memorize either the distance or the duration separating two external signals (green and red lights through the train window), and then they had to reproduce this magnitude by pressing then releasing a button. Participants completed four blocks of 75 trials. We manipulated statistical uncertainty of the prior by using a low or high deviance stimulus distribution depending on the block. Within each block, we also manipulated optic flow speed by having participants memorizing the reference magnitude at 15 m/s, then either reproducing it while at 20 (acceleration) or 10 (deceleration) m/s.

Results show that increasing statistical uncertainty make participants' answers less biased towards the statistical mean of the stimulus distribution. While this effect is observed for both dimensions, it is much stronger for durations than for distances. Furthermore, we replicated the time dilation effect related to optic flow speed (van Rijn, 2014). Interestingly, spatial reproductions were not affected by speed. These results are line with the hypothesis of local domain-specific priors and raise further questions regarding the contributions of temporal and spatial events from optic flow (Kaneko & Murakami, 2009; Sherman et al., 2020).

# The effect of ownership on boundary extension.

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Boundary Extension is the tendency to remember scenes as larger than their original boundaries, resulting in the inclusion of more information in memory than originally present. One could understand this effect as a mental 'zooming out' from an original 'view'. Boundary extension is affected by characteristics of the observer (e.g., how much attention was allocated, did they know the scene), as well as other variables such as characteristics of the view itself, the display, and the observer (cf. Hubbard et al., 2010). This study investigates the relationship between Boundary Extension and object knowledge effects, such as ownership and familiarity. Ownership is linked to memory benefits, with owned objects being remembered more accurately (Cunningham et al., 2008), which may counteract the effects of Boundary Extension. Furthermore, it was found that owned objects tend to be remembered to be closer by in 3D-space, compared to non-owned objects (Coventry et al., 2014). Even when there is no actual ownership, but when ownership is merely indicated on a trial-by-trial basis by a verbal description of an object ("*your/my* [object]"), presented prior to the object at its location (Gudde et al., 2016). We hypothesized that object ownership may induce a mental 'zooming in', or Boundary Contraction, that counteracts Boundary Extension.

In a scene memory task, participants were presented with scenes and asked to remember the location of objects, verbally primed with '*my/your/the* [object]', to examine whether ownership mitigates the effects of boundary extension. They performed two (counterbalanced) tasks for each scene: indicating the exact remembered location by placing a crosshair and scaling the scene and object individually. Results shed light on the interplay between boundary extension and object knowledge effects.

# Mental imagery and emotions in relation to declared choices under risk.

Joanna Smieja[*], Tomasz Zaleskiewicz, Jakub Traczyk, Agata Sobkow

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The results of four preregistered studies (two experiments) show that mental imagery, in tandem with emotions, can predict people's willingness to take risky actions. We investigated the idea that by generating visual mental images, decision makers can "pre-experience" how rewarding or threatening future outcomes of their choice would be, which can support the decision-making process. Another prediction was that emotions mediate the link between the valence of mental imagery and declared risk taking.

In studies 1 and 3, participants were faced with risky activities and generated mental images illustrating their involvement. They rated the valence of mental images and their willingness to engage in risky actions. In Study 3, they also reported their emotions (positive and negative). We found in both studies that the valance of mental images was positively correlated with the willingness to take risks. Importantly, in Study 3, we observed that emotions mediated the relationship between the valence of mental imagery and risk-taking willingness. The more positive (negative) mental images participants produced, the more positive (negative) emotions they reported, and the more willing (unwilling) they were to take risks. In two experiments (2 and 4), we manipulated the valence of mental images so that participants were requested to generate only positive or negative images. In Study 4, they again reported their emotions. In both studies, we found that the valance of mental imagery had a causal effect on risk-taking declarations: Generating positive (negative) mental images increased (decreased) the readiness to take risky actions. Study 4 confirmed that emotions mediate the relationship between mental imagery valence and the willingness to engage in risky actions.

To conclude, we showed that (1) generating mental imagery could impact people's decisions concerning their potential involvement in risky actions, and (2) mental images are the source of emotions that regulate risky choices.

# Going for a walk: Route learning in amnestic patients.

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Navigation skills allow us to visit both new and familiar places in our surroundings. As such they are critical for goal directed behavior and also support social interactions. Amnestic patients have difficulty in forming adequate cognitive maps of their environment. This hampers them in learning to reach novel destinations. In the present study we assessed in how far a repeated route training enabled a group of Korsakoff patients with global amnesia to learn a new itinerary. We compared three training methods: errorless learning, trial and error learning, and passive guidance. Errorless learning has proven a useful neuropsychological rehabilitation method in which counterproductive mistakes during learning are prevented from entering both implicit and explicit memory. Passive guidance refers to the common situation in which you follow a guide or a friend to visit a novel place without paying deliberate attention to the way-in. Preliminary results indicate that patients can effectively learn a new route with all three training methods. Important secondary results revealed that also self-reported quality of life and objective physical fitness improved in participants. We will discuss in how far the training routine can be transferred to other patients groups and clinical settings. This also involves a consideration of what makes a 'good route': e.g. number of turns and types of landmarks.

# KEYNOTE ADDRESS 2

## 13:50 – 14:50, LAB003

# *In The Mind's Eye: from Ghosts to Ghost Pieces*

## Emily A. Holmes

*Uppsala University, Sweden*

Hamlet saw (the **ghost** of) his father in his 'mind's eye', thus putting words on this fleeting phenomenon that captures all of us at this conference. Mental imagery allows us to time travel. So doing can have a powerful impact on our emotions, motivation and behaviour. Intrusive image-based memories can "flash backwards" to past trauma. Mental imagery can "flash forwards" to the future, such as in suicidal thinking, craving or goals in hypomania. Better understanding mental imagery offers insights to improve interventions for mental health.

Mental imagery has a more powerful impact on emotion than thinking in words. There is great potential for adaptions and innovations in psychological treatments. Mental imagery remains underexplored and insights from many at this conference can fuel a wide range of intervention developments.

Here we focus on reducing the number of intrusive memories after traumatic events. This single symptom approach, compared to studying a full heterogeneous mental health diagnosis, can arguably aid translation between lab and clinic. Intrusive memories comprise involuntary, emotional mental imagery. Taking a mental imagery perspective to this symptom generated a novel intervention - the idea of working with intrusive mental images of trauma using imagery-competing concurrent tasks. The ensuing imagery-competing task intervention (ICTI) approach aims to (a) to help prevent the build-up of unwanted intrusive memories soon after a traumatic event[1]; and (b) reduce the reoccurrence of intrusive memories at longer times interval, days, week and months after a trauma[2]. We will discuss a recent clinical trial of a remotely delivered version of the intervention for healthcare staff who faced repeated and ongoing trauma working with COVID-19 patients [2]. The ICTI approach involves at least 3 steps from (i) imagery recall, (ii) mental rotation and (iii) sustained Tetris computer game play. The devil is in the methodological detail – and we will discuss the importance of switching off the "**ghost** piece" while playing Tetris.

# ABSTRACTS: DAY 3
# Thursday 22$^{nd}$ June

# SESSION 5 (Chair: Boris Suchan)

## 09:30 – 10:50, LAB003

## A Renaissance of Dual Coding Theory in Public Education.

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The propositions of Dual Coding Theory (DCT) are well known in the world of imagery and cognition. Fundamentally, DCT proposes that cognition is driven by the coding systems of mental representations and language when referentially integrated memory, language expression, thought, and perhaps even intelligence are enhanced. Most recently, the applications of DCT are being researched in applied educational settings in the United States.

Based on the instructional application of DCT in various educational environments, a challenge has emerged that opposes long-held theoretical views on how best to teach reading. Specifically, the instruction methodology involves the conscious process of stimulating mental representations from language and integrating them with language expression.

The current well-accepted view of teaching reading, referred to as the Simple View of Reading, will be reviewed alongside the comprehensive components of DCT as related to the language and cognitive processing needs of students.

The theoretical instruction role of DCT is also being researched within the applied neuroscience communities, involving language-based processing/disabilities, developmental oral and written language comprehension, dyslexia, and the cognitive processing needs of individuals on the autism spectrum. Specifically, neuroscientific behavioural research will be offered using an intervention based on DCT. Two of these studies will be highlighted as specifically addressing the needs of dyslexics and the cognitive/comprehension needs of children on the autism spectrum.

The combined findings from the application and research associated with Dual Coding Theory offer a more comprehensive model for the practical necessities of increasing student achievement. Specific data on the outcomes of the application of DCT in all referenced areas.

# Visual mental imagery abilities in autism.

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Individuals with autism have an atypical perceptual functioning and significant visuospatial abilities. Important mental imagery capacities have also been described in this condition but, until now, only the ability to manipulate mental images has been investigated. Other stages of mental imagery (generation, maintenance, inspection) remain to be explored in autism.  34 adults with autism and 33 control participants performed 4 tasks to assess the 4 different stages of mental imagery: Image generation task (mentally generating a letter on a grid and indicating whether it passes over a probe located in that grid), the Visual pattern test (maintaining visual patterns in memory), the Image scanning test (inspecting mental images) and the Mental rotation test (mentally manipulating representations of geometric figures).  Concerning generation and manipulation of mental images, we replicated previous results showing that the mental image of the letter is generated segment by segment. Individuals with autism were equivalent to controls both in accuracy and response time. For the maintenance of mental images, visual span on the Visual pattern test was significantly higher in the ASD group. As for the inspection of mental images, response times were higher when the distance to inspect was greater for the control group but not for the ASD group. Participants with autism were equally fast regardless of distance.  The results of this study indicate preserved or greater visual mental imagery abilities in autism. Particularities in the inspection of mental images can be related to the atypical perceptual functioning of people with autism, in particular with the bias towards a more local processing of information and a lesser top-down effect (weaker influence of knowledge).

# Coaching Imagery to Athletes with Aphantasia.

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We administered the Plymouth Sensory Imagery Questionnaire (Psi-Q) which tests multi-sensory imagery, to athletes (n=329) from 9 different sports to locate poor/aphantasic (baseline scores <4.2/10) imagers with the aim to subsequently enhance imagery ability. The low imagery sample (n=27) were randomly split into two groups who received the intervention: Functional Imagery Training (FIT), either immediately, or delayed by one month at which point the delayed group were tested again on the Psi-Q. All participants were tested after FIT delivery and six months post intervention. The delayed group showed no significant change between baseline and the start of FIT delivery but both groups imagery score improved significantly (p=0.001) after the intervention which was maintained six months post intervention. This indicates that imagery can be trained, with those who identify as having aphantasia (although one participant did not improve on visual scores), and improvements maintained in poor imagers. Follow up interviews (n=22) on sporting application revealed that the majority now use imagery daily on process goals. Recommendations are given for ways to assess and train imagery in an applied sport setting.

# Attention and reaction speed in sports.

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In one study we investigated the involvement of different aspects of attention in a task that is popular for sports training and which requires fast physical responses to targets. Fifty participants carried out the SpeedPad task, a virtual adaptation of the Batak Pro and Fitlights tasks that are commonly used by athletes of various sports. They also carried out three established cognitive tasks on a desktop screen: the Posner cueing task, a visual search task with conjunction searches only, and a Motion Object Tracking (MOT) task. Results showed significant correlations among performance in the 4 tasks in the expected direction. Regression analyses carried out for each of 4 array sizes of SpeePad (9, 15, 19, and 29 possible target locations) revealed that scores achieved at SpeedPad were predicted significantly by reaction time in the cueing task. The MOT and visual search tasks did not explain any additional variance in the SpeedPad performance beyond that explained by the cueing task. Overall, our results indicate that tasks such as SpeedPad that are commonly used to improve reaction speed in athletes, rely partly on the ability to orient attention efficiently to locations in the environment.

# SESSION 6 (Chair: Valérie Gyselinck)

## 11:10 – 12:30, LAB003

## Recognizing types of skin-to-skin touch and their emotional content through auditory signals: A study on distant social touch.

Malika Auvray[1*], Alexandra Tavakelian[1], Catherine Pelachaud[1], Louise Kirsch[2]

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Social touch allows communicating specific emotions and has been shown to be crucial for development and well-being. Furthermore, a decrease in socio-tactile interactions is linked to higher anxiety and feeling of loneliness. Hence, with the increase of social isolation, social distancing, and distant communication, it appears timely to allow socio-affective interactions even at a distance. One way to do so would consist in providing social touch signals through another sensory modality. One good candidate is the auditory channel, as skin-to-skin touch is creating vibrations that can be easily transposed into an audio signal. Two experiments investigated the extent to which it would be feasible to perceive social touch through audition. The vibratory signals from prototypical skin-to-skin touches were recorded with a violin microphone and amplified by means of basic sensory signal processing. In a first experiment, participants were presented with the sounds corresponding to different social touches (i.e., stroking, rubbing, tapping, hitting). They had to recognize and then categorize these audio recordings. In the second experiment, participants had to recognize and categorize the emotional intention (i.e., love, empathy, joy, impatience, fear, anger) underlying auditorily displayed social touches. The results of the two experiments revealed high accuracies in the recognition and categorisation tasks, suggesting the auditory conversion of skin-to-skin touch to be an effective means to convey information about both the type of social touch and its emotional content. Future research will investigate to what extent these audio-touches can elicit emotional responses in comparison to their tactile counterpart.

# Relationship between action peripersonal space and multisensory integration.

Laurie Geers*, Yann Coello

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The space that allows physical interactions with the environment, conceptualised as peripersonal space, is assumed to be multisensory in nature compared to far extrapersonal space that offers no action possibilities. This is supported by electrophysiological studies in monkeys showing the existence of bimodal neurons that respond to visual stimulation presented in reachable space and tactile stimulation delivered to the body. However, human evidence that peripersonal space differs from extrapersonal space by its multisensory properties is tenuous. The present study directly investigated the relationship between peripersonal space and multisensory integration by requiring participants to indicate when an approaching stimulus was reachable by hand (indexing peripersonal space) or to respond to tactile stimulation delivered on the trunk during the approach of the visual stimulus (indexing multisensory integration). Results showed that the extent of multisensory integration was larger than peripersonal space and did not correlate with the latter. These data suggest that multisensory integration is not specifically constrained by the space underlying motor action. The possible reasons for this mismatch will be further discussed.

# How motor imagery impacts peripersonal space and body representation during robotic telepresence.

Anne-Lise Jouen*, Ahmad Khaddour, Jeremie Gaveau, Florent Lebon, Peter Dominey, Jocelyne Ventre-Dominey

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Robotic telepresence has been shown to impact body-self processing (Farizon et al, 2021). As we know, the representations of body-self and peripersonal space (PPS) are closely linked in their internal brain processes. In robotic telepresence, the subject is embodied into a robot as he/she sees stereo vision through the robot eyes, and controls the robot movements through motion capture. In this study, we asked whether being incorporated in another body -like a robot- can change the body and PPS representations in different situations of robotic telepresence.

Healthy right-handed subjects participated in a robotic telepresence experiment where they performed a motor imagery task while the robot was executing a hand pointing task. In this condition, the subject saw the short robotic arm pointing towards cubes that were reachable or not (100 trials) while he/she imagined performing the same movements in time and position. Perceptual changes in body and space representations were evaluated before and after the embodied pointing task, using respectively a proprioceptive bisection task (blindfold evaluation of the middle of one's own forearm) and a reachable distance estimation task (visual interception of a moving ball). Results were compared to two other experimental conditions where participants -in the same telepresence situation- had either to observe or to execute the same pointing movements as the robot. Statistical analysis revealed that after the embodied pointing task with the robot, the subjects perceived their arms significantly shorter and their PPS significantly reduced. These changes in body and space perception were more pronounced in the motor imagery task. These effects indicate that in the subject, body and space representation are impacted by the shortened robotic arm. These findings will be discussed within the theoretical framework of embodiment processes and motor control models involving body and space representation.

# Haptic boundary extension in blind and visually impaired individuals.

Krista Overvliet*, Jeannelle Sneep, Océane Peschar, Albert Postma

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A scene is often remembered as containing information that may have been present just beyond the actual boundaries of that view, which is referred to as boundary extension. Boundary extension is repeatedly reported in visual scene memory studies, but there is also evidence that boundary extension takes place in haptic scene memory. It is suggested that scene representations are functionally unitary, or multimodal (Intraub et al 2015). However, in a related field of research, it has been shown that haptic object representations are mediated by vision: haptic input is likely to be first translated to or mediated by vision to form a representation (Overvliet et al, 2013). In the current study we investigate whether vision is also needed to translate or mediate scene representation from haptic inputs. To this end, we tested blind, visually impaired and sighted individuals on a haptic boundary extension task. We asked our participants to haptically explore a scene with wooden boundaries that contained three objects with a common theme (office, bathroom and sports) and to label the scenes with the appropriate themes. After a short break we asked participants to replace the boundaries. We measured the amount of boundary extension. We hypothesized that vision influences scene representation just like object representation, and therefore influences the amount of boundary extension: if participants have no vision (i.e. are blind), they will not be able to translate a haptic scene into a visual scene representation, and therefore no boundary extension will take place. Results indeed show that blind participants show less boundary extension as compared to visually impaired and sighted participants. Moreover, blind participants were less accurate in labelling scenes. However, congenitally blind participants did not show any difference to late blind participants, indicating that current availability of vision is more important for scene memory than visual experience.

# SESSION 7 (Chair: David Pearson)

## 13:30 – 14:50, LAB003

**Individual differences in mental arithmetic are associated with grey matter volume in the perisylvian regions: A brain-wide association study with 536 children and adolescents.**

Nurit Viesel-Nordmeyer[12*], Jérôme Prado[1]

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Although mental arithmetic is a foundation for mathematical development (cf. Ashcraft, 1982), it is also the source of large individual differences between children or adolescents. To date, a number of brain-wide association studies have attempted to identify the neural correlates of these individual differences (cf. Peters & de Smedt, 2018). However, these studies have yielded inconsistent results, most likely because they were underpowered to detect such relatively small brainbehaviour associations (cf. Marek et al., 2022). We address this problem by studying a sample of n = 536 children or adolescents (from 7.5 to 15 years) from six structural brain imaging datasets (set #1: Girard et al., 2021; set #2: Schwartz et al., 2018; set #3: SuárezPellicioni et al., 2019; set #4: Lytle et al., 2019; set #5: Lytle, Prado et al., 2020; set #6: Lytle, Hammer et al., 2020) whose arithmetic skills levels were systematically assessed. Using voxel-based morphometry, we identified whole brain associations between grey matter volume (GMV) and arithmetic skills, while controlling for age and several language and cognitive skills that are known to play a role in arithmetic learning. Across the whole sample (n = 536; 7.5-15 yo), we found a unique  Instructions for the Submission of Papers for Review Abstract submissions for oral and poster presentations should not exceed 300 words. All submissions will be reviewed by members of the Conference Scientific Committee. Some submissions for oral presentations may be accepted as posters due capacity restrictions in the conference timetable.  Once the Abstract form is completed please submit to cambridgeEWIC2021@anglia.ac.uk. positive relation between arithmetic skills and GMV in the left inferior frontal gyrus. Moreover, we identified positive relations between GMV and arithmetic skills in the bilateral temporal cortex (superior and medial temporal gyrus), but only in the oldest participants (n = 268; 10.4515 yo). Therefore, our results highlight brain-wide associations between

arithmetic skills and GMV of perisylvian regions. The specific role of these brain regions for individual arithmetical differences in children and adolescents will be discussed, including their role in language processing.

# Neural correlates of semantic and episodic mental time travelling in the young and the elderly.

Itsaso Colás-Blanco[1*], Valentina La Corte[12], Pascale Piolino[12]

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Our declarative memory can be classified into episodic (presenting contextual details that enable to re-experience an event) and semantic memory (facts and knowledge lacking its context of acquisition). Classical memory taxonomies have postulated that episodic and semantic memory are dissociable (Tulving, 1972); however, other conceptualizations conceive these memory processes as the extremes of a continuum (Cabeza & St Jacques, 2007), in which personal semantics (facts and knowledge about the self) could be placed midway (Tanguay et al., 2018). In the present study, we assess the neurocognitive correlates of general semantic (GS), personal semantic (PS), and episodic (EPI) memory in mental time travelling to the distant past and the future (more than 10 years away from the present moment). We carried out an EEG experiment on 20 young (25-40 years) and 20 old adults (60-80 years), in which they were presented with positive personality traits. Along the different experimental conditions, participants were asked to give a yes or no response based on whether the trait: a) was (or will be) valued by society (SG), b) characterized (or will characterize) themselves (SP), and c) could evoke a specific event from their past (or future) (EPI). The N400 and LPC potentials were taken as proxies for semantic and episodic processing, respectively, and we analyzed how they were modulated by the group factor (young vs old), the type of representation (SG, SP, and EPI), and the temporality (past vs future). Results revealed group differences in episodic memory both in past and future dimensions, and differences in ERP components as a function of the type of representation. This evidence aligns with previous studies highlighting the episodic decay in healthy ageing (Abram et al., 2014), and seems to favor the episodic-semantic continuum proposal instead of the dissociation proposal.

# Age – related dynamic of illusory memory neural correlates: Evidence from a DRM virtual reality task.

Kouloud Abichou[1*], Valentina Lacorte[12], Pascale Piolino[12]

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Episodic memory serves critical functions in everyday life but is also prone to distortions, producing false memories (FM). Several lines of evidence suggest that the production of FM can be accompanied by the recall of encoding context and trigger a high recollective experience. Furthermore, the susceptibility to produce compelling FM increases with advancing age. Most of the research investigating FM in the laboratory has applied the Deese-Roediger-McDermott (DRM) paradigm using classic material such as word or image lists, which is, far from the conditions encountered in daily life. In this novel work, we implemented a variant of the DRM paradigm thanks to virtual reality where, young (N=25) and Older (N=25) adults had to navigate in a virtual city using a joystick. Participants had to memorize a series of items and their associated context displayed in realistic situations (e.g., fruits on a market stand).

We investigated on one hand, state of consciousness and assessed the richness of context associated with both recognition production types. On the other hand, we assessed Event-Related Potentials (ERP) neural correlates of **familiarity** versus **recollection process.**

Our preliminary results revealed an expected age effect that concerned correct recognition with younger producing significantly more correct recognition highly recollective and associated with the rich encoding context. Our finding did not reveal an age effect for false memory recognition rate, **phenomenology and associated context**. For both age groups, false recognitions were recollective and rich in context. Interestingly, in line with behavioral result, younger' true memories displayed neural correlates of familiarity and recollection. Besides, only elderly' false recognition exhibited neural correlates of recollection. Thus, this study stressed on the fact that for the elderly, both true and false recognition can be indistinguishable and thus, false memory can be in elderly a byproduct of memory mechanisms rather than just a familiarity-based mechanisms.

# Grid-like encoding of long lists within a Memory Palace.

Alexandra Constantinescu*, Ellie Patel, James Bisby, Andrea Castegnaro, Neil Burgess

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The memory palace technique (or "method of loci") allows long lists of items to be remembered quickly and in order, by using mental visualisations to place each item along a sequence of locations on a route through the palace. Grid cells are neurons that form cognitive maps of the environment by using a two-dimensional code with 6-fold periodicity. This code can be measured non-invasively with fMRI during navigation in physical and conceptual spaces. Here, we tested in healthy humans for grid-like encoding of long lists of words along two routes through a memory palace inspired by the Hogwarts School of Witchcraft and Wizardry. Given that the routes were orthogonal, we hypothesized that the fMRI activity during list learning could be predicted according to the alignment of the routes relative to the orientation of their grid-like patterns during navigation. We created in virtual reality (VR) a square room housing 36 magical objects arranged in a 6x6 square layout. We trained our participants with a battery of tasks and we encouraged them to imagine multi-sensory associations with strong affective valence. Then we scanned their brains with fMRI while they navigated in VR, as well as in their imagination during encoding of 72 new words in order, split between the two routes. Participants successfully encoded each word in ~10 seconds. During VR navigation, we found 6-fold grid-like signals in the entorhinal cortex, medial prefrontal cortex and amygdala. The 6-fold grid signal predicted the relative activity when encoding words along the two routes. Our results suggest that relational codes with hexagonal patterns mediate the use of a memory palace to enable memory for long lists of words.

# KEYNOTE ADDRESS 3

15:10 – 16:10, LAB003

## *Neural mechanisms of spatial memory and imagery*

Neil Burgess

*University College London, UK*

I will consider the frames of reference used in spatial memory and their neural representations in medial temporal, retrosplenial and parietal brain areas, including place and boundary- and object-vector cells. I will describe how these neural representations could work together to support spatial memory and imagery, and how these relate to the dual representation theory of intrusive imagery within post-traumatic stress disorder. I will discuss the relationship between imagery and memory construction and consolidation from the point of view that generative models are trained by hippocampal replay to predict their own inputs. Finally, I will consider whether sequential structure is captured by generative models trained to predict the next input and mediated by grid cells.

# LOGO DESIGN COMPETITION WINNER

## Gabriel Arreaza-Mendes

*BA(Hons) Graphic Design Student, Anglia Ruskin University*

**We ran a competition for students at ARU to design the logo for the 17th EWIC. The winning entry was submitted by Gabriel Arreaza-Mendes, an undergraduate student on our BA (Hons) Graphic Design degree.**

As a designer, I have always been fascinated by the power of visual storytelling. Being able to communicate through art and design effectively has been a driving force for me throughout my career. My passion for the field is reflected in my specialization in Illustrative, digital imaging, and hand drawings.

My ultimate goal is to become a design curator, a role that allows me to showcase the work of other talented designers and artists. But before I get there, I want to gain experience working in a renowned design studio or developing my own freelance career. Both paths offer unique opportunities to learn and grow as a designer, and I am excited to explore them further.

To represent mental imagery and spatial cognition in the logo for EWIC I was between illustrating a person's profile silhouette and a brain incorporating a landmark of Cambridge. Still, as the silhouette has already been used in a past logo I went with the brain. For the landmark, I simplified the Corpus Clock as it was more appropriate to complement the brain as a fascinating example of the intersection of art, engineering, and history, and it has become an iconic symbol of Cambridge and its rich academic and cultural heritage.

# INVITED SPEAKERS

## Opening Address

### Professor Robert Logie

*University of Edinburgh, UK*

Robert H Logie is Professor of Human Cognitive Neuroscience, University of Edinburgh, UK. His research addresses theoretical and applied questions on human memory, especially working memory in healthy adults, in age-related cognitive change, and in cognitively impaired individuals. He has over 300 academic publications, including the first book on visual working memory (Logie, 1995) and multiple other papers on the topic, and he organised the third EWIC (1990) at the University of Aberdeen. More recently he was lead editor for *Working Memory: State of the Science (2021),* and *Memory in Science for Society (2023)*, both Oxford University Press. In 2015 he was Chair of the Psychonomic Society, and in 2022 was awarded the Bartlett prize by the Experimental Psychology Society for lifetime contributions to Experimental Psychology.

## Keynote Speaker 1

### Professor Joel Pearson

*University of New South Wales, Australia*

Joel Pearson is Professor of Cognitive Neuroscience at the University of New South Wales (UNSW), an Australian Research Council Future Fellow at Future Minds Lab, MindX and Agile Science. An internationally recognised leader in human consciousness research and applied Cognitive neuroscience, Pearson is the leading authority on mental imagery research (the human imagination). He began studying art and film making in Sydney at College of Fine Arts COFA (now UNSW Art and Design) before deciding to apply learned creative discovery techniques to the scientific mysteries of human consciousness and the complexities of the brain. He completed his science PhD in two years while travelling and speaking at conferences and University lectures. Celebrating a decade in 2019, UNSW Future Minds Lab is a global first, hands on, human-centred research lab/agency exploring the Psychology and Neuroscience of design, innovation and entrepreneurship, cognitive optimisation and the future of work and education. UNSW Future Minds Lab is creating products and services from its discoveries to deepen our collective understanding and build a better world.

# Keynote Speaker 2

## Professor Emily Holmes

*Uppsala University, Sweden*

Emily Holmes, PhD, DClinPsych is a Professor in Psychology at the Department of Psychology, Uppsala University, Sweden. She is also affiliated to the Karolinska Institute's Department of Clinical Neuroscience, and is a Visiting Professor of Clinical Psychology at the Department of Psychiatry, University of Oxford, UK. Holmes received her degree in Experimental Psychology at the University of Oxford, UK. She is also a clinician and completed a clinical psychology training doctorate at Royal Holloway University of London, and a PhD in Cognitive Neuroscience in Cambridge, UK. She is an Associate Editor for Behaviour Research and Therapy. She serves on the Board of Trustees of the research charity "MQ; transforming mental health". She was elected to the Swedish Academy of Sciences in 2019. Holmes' research group is particularly curious about mental imagery and emotion. Holmes' research has demonstrated that mental imagery has a more powerful impact on emotion than its verbal counterpart. Holmes' work as a clinical psychologist has also fuelled her research questions. She is interested in psychological treatment innovation in mental health - both in creating new techniques and reaching more people. Under the wider umbrella of "mental health science", her approach brings together psychology, neuroscience, psychiatry, maths and more. Her group is particularly interested in understanding and reducing intrusive imagery-based memories after trauma. This is relevant for people after a traumatic event, whether a severe motor vehicle accident, traumatic childbirth or war. As well as studying intrusive memories and flashbacks, she coined the term 'flash-forwards' to describe intrusive mental imagery of future events. Fundamental research on mental imagery is fascinating in its own right, and may also help as drive treatment innovation. She is looking forward to conversations at EWIC in this light.

# Keynote Speaker 3

## Professor Neil Burgess

*University College London, UK*

Neil Burgess is Professor of Cognitive and Computational Neuroscience at the Institute of Cognitive Neuroscience, University College London (UCL). Neil studied Maths and Physics at UCL and Theoretical Physics at Manchester, where he began modelling working memory with Graham Hitch. He returned to UCL to work with John O'Keefe, working on models and experiments concerning how neurons represent space and support memory. His behavioural, neuroimaging and electrophysiology experiments with both humans and rodents bridge the gap between brain science and observed behaviour, shining a light on the neural representations and computations supporting spatial cognition. With colleagues Tom Hartley and Colin Lever, he predicted and discovered neurons representing environmental boundaries. With Sue Becker in 2001, he proposed the first model explaining how neurons in the hippocampal system support coherent spatial imagery. This model has developed to explain aspects of episodic memory, imagery, post-traumatic stress disorder and planning in terms of the activity of populations of neurons. Neil is a Wellcome Trust Principal Research Fellow, and a Fellow of the UK Academy of Medical Sciences and Royal Society.

# REGISTRATION AND ARRIVAL

The conference registration desk will be open from 8:45am on Tuesday 20 June in the Lord Ashcroft Building Broad Street Foyer at the ARU Campus on East Road. Find out more about travelling to our Cambridge campus.

Upon arrival, please ensure that you sign-in, collect your delegate pack and Conference name badge. Your delegate pack will contain a printed copy of the conference programme and a map of the city centre. A PDF of the conference handbook will be available to download at registration, including all oral and poster presentation abstracts.

# ORAL PRESENTATIONS

Oral presentations have been scheduled for 20-minute slots (15-minute presentation + five minutes for follow-up questions). All oral presentations will take place in lecture theatre LAB003 in the Lord Ashcroft Building.

To avoid delay, our preference is for all speakers to load their presentation on the PC in the lecture theatre during the break preceding their session (or from 9am for the first session of the day). If you would prefer to use your own laptop, please check it will connect correctly to the projector **before** your session commences.

IT support will be available throughout the meeting to assist with any technical issues.

# POSTER PRESENTATIONS

Poster presentations should be formatted to fit within a portrait working area of 90 cm (wide) x 120 cm (high). We recommend printing A1 size in portrait orientation (594 x 841 mm), and definitely no larger than A0 size (841 x 1189 mm).

The poster session will take place in the Science Centre Atrium from 3.20-4.20pm on 20 June. Your poster board number is the same as the number listed next to your abstract title.

The boards will be available to attach posters from 1pm on 20 June (materials to attach posters will be provided). All posters must be removed after the poster session, no later than 6:30pm on 20 June.

**We will be awarding a £75 Amazon voucher (or equivalent in euros) for the best poster presentation at the conference.** The judging panel consists of members of the scientific and local organising committees who will view all posters in the session on the 20th June.

# OPENING DRINKS RECEPTION – 20<sup>TH</sup> JUNE



The first day of EWIC will close with a drinks reception held in the atrium of the Science Centre (the same area used for the poster session). Wine, non-alcoholic drinks, and canapes will be provided. The reception will commence at 17:30pm and will run until 18:30pm.

# PUNTING AND RIVERSIDE BARBEQUE – 21<sup>ST</sup> JUNE



Sit back and relax as your University crew member guides you down the River Cam in a traditional punt boat. The tour lasts for approximately sixty minutes and takes in sights such as the iconic Bridge of Sighs, King's College Chapel, and many riverside colleges.

The punting tour will depart from Mill Pond on Newnham Road. Staff and Conference Ambassadors will be available at 15:30pm at the conference registration desk to guide delegates to Mill Pond (25 minute walk). If you wish to make your own way there, please arrive no later than 16:00pm.

The punting tour will be followed by a riverside barbeque at the iconic Granta pub on Mill Pond. For those taking the tour your punt will stop at the Granta. If you are attending the barbeque only, please aim to arrive from 17:00pm.

# PLACES OF INTEREST IN CAMBRIDGE

## Fitzwilliam Museum

The Museum houses vast collections of antiquities from ancient Egypt, Greece, and Rome, including exhibits of English and European pottery and glass, furniture, clocks, Chinese jades, and ceramics from Japan and Korea.

## Kings College Chapel

This imposing English Gothic structure was built between 1446 and 1515 and is the site where many great scholars were educated.

## The Eagle

The Eagle is a historic pub in Cambridge's city centre, which is famously linked to Watson and Crick's discovery of DNA. Located opposite the University of Cambridge, the pub is particularly popular with staff at the Cavendish Laboratory for Experimental Physics.

## Kings College

Dating from the mid-15th century and one of the finest examples of medieval architecture, this college's main draw is its chapel that houses Rubens' Adoration of the Magi.

## The Backs

Landscaped open areas and gardens weaving behind many colleges on the river Cam, which are known for their daffodils and crocuses in the spring, and stunning views of the colleges across the river at any time of year.

## St Johns College

Founded in 1511 from the estate of Lady Margaret Beaufort, mother of King Henry VII, this Cambridge college features a gatehouse whose exterior is beautifully carved and painted.

## Trinity College

Founded in 1546 by Henry VIII, this college boasts the famous apple tree that prompted Isaac Newton to develop his theory of gravity.

## University Museum of Zoology

The University Museum of Zoology is one of Cambridge's major attractions. It reopened in 2018 after a five-year redevelopment programme. It offers the visitor an opportunity to explore new galleries displaying the diversity of animal life. Find out about evolution of life on earth, discover stories of extinction, survival and pioneering exploration.

# Places to eat in Cambridge

There is a large array of eateries around the city all of which are within easy walking distance of the ARU campus. We would advise using OpenTable to scour the options and find something that fits your budget and taste. The closest restaurants to the campus are on Mill Road and Burleigh Street.

# Getting around the city

There is much to see and do while you stay in Cambridge for the conference. Two popular means of transport in the city of cycles are hireable e-bikes and scooters. The city's main bus station is a ten-minute walk from the campus on Emmanuel Street.