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# PROJECTS FROM ABC RESEARCH GROUP

## JUDE BEK PROJECT 1

**Transcranial direct current stimulation to augment motor imagery training: A systematic review and meta-analysis.**

Dr Judith Bek (UCD and University of Toronto), Assoc Prof Nuala Brady (UCD)

**Will this project require Garda vetting?** No

**Project details:** Motor imagery training, sometimes referred to as mental rehearsal or mental practice, is known to have beneficial effects on movement and motor learning, through activation of sensorimotor brain areas overlapping with those recruited during motor execution. An established technique in sport, motor imagery is also used in musical training and more recently in neurorehabilitation. Another approach that has shown promise in neurorehabilitation (e.g., for stroke and Parkinson's disease) is transcranial direct current stimulation (tDCS). TDCS is a relatively safe and low-cost, non-invasive brain stimulation technique that applies a low-level electric current via electrodes on the scalp, which modulates neural excitability and may promote neuroplastic effects. There is some evidence that

combining tDCS with other interventions such as physiotherapy can enhance effects in neurological populations. However, few studies have investigated the effects of combining tDCS with motor imagery. If effective, combined tDCS and motor imagery training could provide a novel treatment that is suitable for home-based administration for individuals with neurological conditions or other conditions that impact on movement. This study will systematically review the available evidence across all populations to identify the potential benefits of combining tDCS and motor imagery training. If sufficient data are found, evidence will be synthesised via meta-analysis to provide a clearer understanding of the therapeutic potential of this approach.

This project would suit a student interested in neurorehabilitation and offers training in conducting a systematic review and meta-analysis using R.

**Recommended Reading**


- Beretta, V. S., Conceição, N. R., Nóbrega-Sousa, P., Orcioli-Silva, D., Dantas, L. K. B. F., Gobbi, L. T. B., & Vitório, R. (2020). Transcranial direct current stimulation combined with physical or cognitive training in people with Parkinson's disease: A systematic review. *Journal of NeuroEngineering and Rehabilitation*, 17(1), 74. https://doi.org/10.1186/s12984-020-00701-6
- Lagueux, É., Bernier, M., Bourgault, P., Whittingstall, K., Mercier, C., Léonard, G., Laroche, S., & Tousignant-Laflamme, Y. (2018). The Effectiveness of Transcranial Direct Current Stimulation as an Add-on Modality to Graded Motor Imagery for Treatment of Complex Regional Pain Syndrome. *The Clinical Journal of Pain*, 34(2), 145–154. https://doi.org/10.1097/AJP.0000000000000522
- Metais, A., Muller, C. O., Boublay, N., Breuil, C., Guillot, A., Daligault, S., Di Rienzo, F., Collet, C., Krolak-Salmon, P., & Saimpont, A. (2022). Anodal tDCS does not enhance the learning of the sequential finger-tapping task by motor imagery practice in healthy older adults. *Frontiers in Aging Neuroscience*, 14, 1060791. https://doi.org/10.3389/fnagi.2022.1060791
- Saimpont, A., Mercier, C., Malouin, F., Guillot, A., Collet, C., Doyon, J., & Jackson, P. L. (2016). Anodal transcranial direct current stimulation enhances the effects of motor imagery training in a finger tapping task. *European Journal of Neuroscience*, 43(1), 113–119. https://doi.org/10.1111/ejn.13122
- Saruco, E., Di Rienzo, F., Nunez-Nagy, S., Rubio-Gonzalez, M. A., Debarnot, U., Collet, C., Guillot, A., & Saimpont, A. (2018). Optimal Combination of Anodal Transcranial Direct Current Stimulations and Motor Imagery Interventions. *Neural Plasticity*, 2018, e5351627. https://doi.org/10.1155/2018/5351627


## NUALA BRADY PROJECT 1

**Brain lateralization in reading words and faces in dyslexia**


Assoc Prof Nuala Brady (UCD)


**Will this project require Garda vetting?** No

**Project details:** Developmental dyslexia is very common with prevalence estimated between 5% and 17%, and dyslexia is often associated with neurodevelopmental disorders such as ADHD and autism. Traditionally, anomalous phonological processing – the way in which words are sounded out - has been considered the primary deficit underlying dyslexia. Recent findings argue for a reconceptualization of

dyslexia as a multifaceted disorder, one in which anomalous visual processing may occur independently of or in conjunction with poor phonological processing (e.g., Sigurdardottir et al., 2015; Gabay et al., 2017; Brady et al, 2021). This project will investigate brain lateralisation in young adults with dyslexia, using eye tracking methodology to investigate visual field bias in viewing faces (Åsberg Johnels et al., 2022) and in viewing both isolated words and sequential words during a natural reading task, and will examine the relation of visual field bias to reading scores,

The School of Psychology has invested in state of art eye tracking technology (both stationary and portable Eye Link systems) and this project will allow for analysis of pupil diameter and binocular coordination as well as visual field bias during all tasks. This project would suit students with an interest in dyslexia and its relationship to neurodevelopmental conditions.

**Recommended reading:**


- Brady, N., Darmody, K., Newell, F. N., & Cooney, S. M. (2021). Holistic processing of faces and words predicts reading accuracy and speed in dyslexic readers. *PloS one*, *16*(12), e0259986.

- Sigurdardottir HM, Ivarsson E, Kristinsdottir K, Kristjansson A. Impaired Recognition of Faces and Objects in Dyslexia: Evidence for Ventral Stream Dysfunction? Neuropsychology. 2015;29: 739–750. pmid:25643213

- Gabay Y, Dundas E, Plaut D, Behrmann M. Atypical perceptual processing of faces in developmental dyslexia. Brain and Language. 2017;173: 41–51. pmid:28624595

- Åsberg Johnels, J., Galazka, M. A., Sundqvist, M., & Hadjikhani, N. (2022). Left visual field bias during face perception aligns with individual differences in reading skills and is absent in dyslexia. *British Journal of Educational Psychology*.


## NUALA BRADY PROJECT 2

**What is the relationship between proprioceptive accuracy and the maintenance of the body schema?**

Assoc Prof Nuala Brady (UCD), Dr Sarah Cooney (UCD)

**Will this project require Garda vetting?** No

**Project details:** In both psychology and neuroscience the representation of one's body is variously referred to as the *body image* and the *body schema*, the latter usually referring to a sensorimotor representation of the body that we use to guide our actions (De Vignemont, 2010). Our experience of our bodies is mediated by different sources of information — including somatosensory and visual information, signals originating from inside the body that tell us about our physiological state (interoceptive information), and the position of our limbs in space (proprioceptive information). Of these, proprioception - our perception or implicit knowledge of the position and movements of our joints in space - is particularly relevant to the *body schema* and is crucial to the control of action.

Based on sensory information from receptors in the muscles, the skin and the joints (Tuthill & Azim, 2018), proprioceptive accuracy shows considerable variability across individuals and can vary with handedness (Goble, 2010) and with motor skills (Jola et al, 2011). In this project, participants will complete a variant of the hand laterality task (Viswanathan, Fritz & Grafton, 2012), a motor imagery task that indexes the *body schema* and their performance on this task will be evaluated with respect to their proprioceptive accuracy as measured separately (Jola et al, 2011). In addition to informing us about the role of proprioception in the maintenance of the body schema, the results will shed light on its role in motor imagery. This project would suit a student with a strong interest in cognitive neuroscience, experimental psychology, perception and cognition.

**Recommended reading:**


- De Vignemont, F. (2010). Body schema and body image — Pros and cons. *Neuropsychologia*, *48*(3), 669-680
- Tuthill, J. C., & Azim, E. (2018). Proprioception. *Current Biology*, *28*(5), R194-R203.
- Jola, C., Davis, A., & Haggard, P. (2011). Proprioceptive integration and body representation: insights into dancers' expertise. *Experimental brain research*, *213*, 257-265


## NUALA BRADY PROJECT 3

**Exploring the role of 'movement tagging' in biological motion perception**

Assoc. Prof. Nuala Brady (UCD), Prof Klaus Kessler (UCD)

**Will this project require Garda vetting?** No

**Project details:** We are remarkably good at perceiving bodies in motion as demonstrated by the pioneering work of Johansson (1973), who showed that we can readily identify actions from sparse 'point-light displays' (PLDs) in which an actor's movement are conveyed solely by the kinematics of lights placed on the major joints of the body (shoulders, hips, knees, elbows etc). Such sensitivity reflects the importance of body motion perception to social cognition. While brain imaging techniques (EEG, fMRI, TMS) have identified a number of brain regions involved in biological motion processing, distinguishing the mechanisms involved in the processing of movement versus other aspects of biological motion stimuli (e.g., gender, identity, emotion) is difficult. Here we adopt a 'frequency tagging' approach developed by (Cracco et al, 2022) and a naturalistic task developed in the UCD Perception Lab (Murphy, Brady et al, 2009) whereby the PLD walkers will walk to the right or left across a screen and participants will be asked to decide the direction of motion. Students interested in biological motion perception are recommended to read the review paper by Blake & Shiffrar (2007) for an excellent introduction. This project would suit a student interested in gaining experience with EEG; they will be supported via group training of all students on the MSc programme who are using EEG for their projects.

**Recommended reading**


- Blake, R., & Shiffrar, M. (2007). Perception of human motion. *Annual review of psychology*, *58*, 47.

- Cracco, E., Oomen, D., Papeo, L., & Wiersema, J. R. (2022). Using EEG movement tagging to isolate brain responses coupled to biological movements. *Neuropsychologia*, *177*, 108395.

- Johansson, G. (1973). Visual perception of biological motion and a model for its analysis. *Perception & psychophysics*, *14*(2), 201-211.

- Murphy, P., Brady, N., Fitzgerald, M., & Troje, N. F. (2009). No evidence for impaired perception of biological motion in adults with autistic spectrum disorders. *Neuropsychologia*, *47*(14), 3225-3235.


## **JESSICA BRAMHAM** PROJECT 1

**Treatment Approaches for Alexithymia After Brain Injury: A Systematic Review.**

Prof Jessica Bramham (UCD), Dr Suvi Dockree, Principal Specialist Clinical Neuropsychologist

**Will this project require Garda vetting?** No

**Project details:** Alexithymia refers to a deficit in identifying and describing feelings and is common after a brain injury. In everyday function, alexithymia may present as confusion as to what emotion one is feeling (e.g., referring to mood in general terms, such as feeling "bad"), difficulty distinguishing emotions from bodily sensations (e.g., inability to connect increased heart rate or abdominal pain to stress or anxiety), difficulty discriminating between cognition and emotions (e.g., "I feel I want to go to bed" instead of identifying the *feeling* of depression and loss of motivation and the *thought* of wanting to go to bed), and as difficulty describing and communicating emotions to others. In essence, alexithymia makes it difficult to identify when one is feeling something and to assign a name to this feeling. Alexithymia is known to predict a range of psychological difficulties, including depression, anxiety, somatisation, and aggression. Treatment of alexithymia can include psychoeducation to improve emotional and interoceptive awareness, teaching emotional vocabulary, labelling and identifying feelings, and discerning feelings from thoughts and bodily symptoms. Despite its high prevalence, sparse evidence exists for effective interventions tailored to treat alexithymia. This study will systematically search and narratively describe all the available evidence from the past 30 years (1993-2023).

**Recommended Reading**


- Fynn, D. M., Gignac, G. E., Becerra, R., Pestell, C. F., & Weinborn, M. (2021). The prevalence and characteristics of alexithymia in adults following brain injury: a meta-analysis. *Neuropsychology Review*, *31*(4), 722-738. https://doi.org/10.1007/s11065-021-09484-6
- Messina, A., Beadle, J., & Paradiso, S. (2014). Towards a classification of alexithymia: primary, secondary and organic. *Journal of Psychopathology*, *20*, 38-49.
- Neumann, D., Malec, J. F., & Hammond, F. M. (2017a). The relations of self-reported aggression to alexithymia, depression, and anxiety after traumatic brain injury. *The Journal of Head Trauma Rehabilitation, 32*(3), 205-213.

- Neumann, D., Malec, J. F., & Hammond, F. M. (2017b). Reductions in alexithymia and emotion dysregulation after training emotional self-awareness following traumatic brain injury: A phase I trial. *The Journal of Head Trauma Rehabilitation*, *32*(5), 286.


**Useful weblinks:**

- For informative, brief explanations of what alexithymia is and how it presents among persons with brain injury, check YouTube videos with keywords 'Dawn Neumann Alexithymia'
- If the evidence proves extremely scarce, the inclusion and search criteria could be extended to any alexithymia interventions regardless of diagnosis/ presentation.

## **SARAH COONEY** PROJECT 1

**Imagining the Body: Do our beliefs about our appearance affect how we imagine movement?**


Dr Sarah Cooney (UCD), Dr Brendan Rooney (UCD), Prof Klaus Kessler (UCD)


**Will this project require Garda vetting?** No

**Project details:** Body image disturbance (BID) is a multidimensional concept that encompasses perceptual, behavioural, and cognitive distortions associated with weight or shape (Cash & Deagle, 1997). The disturbance typically occurs in relation to explicit negative attitudes and evaluations of one's body, known as body image (Cash & Deagle, 1997; Skrzypek et al., 2001). Recent research has shown disturbances in another body representation, the body schema: an implicit sensorimotor representation of the body in space and action (de Vignemont, 2010) in individuals with high levels of BIDs. Whereby individuals with eating disorders (EDs), both perceive their body to be larger than it is and concurrently imagine and interact with their body as if their body occupies a larger space (Beckmann et al., 2021; Guardia et al., 2010, 2012).

To date links between body image disturbance and body schema have primarily been researched in the context of young women diagnosed with EDs (Guardia et al., 2010; Keizer & Engel, 2021; Meregalli et al., 2022). Individuals with negative body image (e.g. high body dissatisfaction) tend to experience a larger discrepancy between their actual body size, and the size they perceive themselves to be (Moelbert et al, 2014). This can lead them to believe that they cannot fit through spaces in the environment (Guardia, 2010; Guardia, 2012) and even cause them to move as if their body is larger than it really is (indicating an oversized body schema) (Metral et al, 2014). This specific use of the body schema is called body-scaled action, which involves estimating your bodily dimensions in relation to an object in the environment. Much of the research has focused solely on individuals with eating disorders (EDs). However, BIDs are not limited to individuals with EDs. Recent research by the UCD Body Cognition Lab has shown that many features of BIDs are present in females without eating disorders and extend throughout female adulthood (Naraindas & Cooney, 2023). We demonstrated that BIDs can impact how healthy adult females imagine rotating their bodies to make judgments about their position.

**This masters project examines how an individual's feelings about their body can affect the way they imagine their bodie**s and how high and low levels of Body Image Disturbance (BID) can affect

an individual's ability to make size-related judgments about their body in relation to body and non-body objects in immersive Virtual Reality (Experiment A, student 1),.

**Experiment B** extends the above VR set up to include a manipulation of avatar embodiment via realtime Motion Capture. Here the body that the participants inhabits in VR will be modified in term of appearance ( e.g., size, shape, weight). We ask: are these size related body schema judgements modulated by avatar appearance?

**Recommended Reading:**


- Keizer, A., Smeets, M. A., Dijkerman, H. C., Uzunbajakau, S. A., van Elburg, A., & Postma, A. (2013). Too fat to fit through the door: first evidence for disturbed body-scaled action in anorexia nervosa during locomotion. *PLOS one*, *8*(5), e64602.

- Moelbert, S. C., Klein, L., Thaler, A., Mohler, B. J., Brozzo, C., Martus, P., ... & Giel, K. E. (2017). Depictive and metric body size estimation in anorexia nervosa and bulimia nervosa: A systematic review and meta-analysis. *Clinical psychology review*, *57*, 21-31.

- Metral, M., Guardia, D., Bauwens, I., Guerraz, M., Lafargue, G., Cottencin, O., & Luyat, M. (2014). Painfully thin but locked inside a fatter body: abnormalities in both anticipation and execution of action in anorexia nervosa. *BMC research notes*, *7*(1), 1-11.

- Naraindas, A., & Cooney, S. M. (2023, July 7). PsyArXiv - Preprint. Body image disturbance, interoceptive sensibility and the body schema across female adulthood: A pre-registeredstudy. https://doi.org/10.31234/osf.io/jmn9g


**Notes**
Masters students who join this project team will become members of UCD Body Cognition & Media and Entertainment Psychology Labs and are welcome to attend lab meetings

## SARAH COONEY PROJECT 2

**The relationship between interoception and body representation in immersive Virtual Reality**

Dr Sarah Cooney (UCD), Dr Brendan Rooney (UCD), Prof Klaus Kessler (UCD)

**Will this project require Garda vetting?** No

**Project details:** As the body is a core feature of the phenomenology of self, it can seem as if the experience of the body were immune to perceptual distortions and illusions as observation of one's body is ubiquitous in experience. However, a large body of research has demonstrated that participants exhibit systematic tactile body size and body proportion distortions (e.g., Linkenauger et al., 2014; Longo & Haggard, 2011; Sadibolova et al, 2019) as well as multisensory embodiment (ownership) illusions such as the Rubber Hand illusion and Full -body illusion (see Ehrsson, 2020 for review). These body distortions have been shown in health and disorder - raising the possibility that these perceptual biases may exist on a continuum. **Interoception** refers to processing stimuli that originate from within

the body (Craig, 2003). Visceral organs like the heart, stomach, and lungs generate signals that indicate the current state of the organ, such as heart rate, hunger, and breathing. The nervous system detects, interprets, and integrates this information to provide an ongoing understanding of the body's internal condition at both conscious and unconscious levels (Cameron, 2002; Craig, 2003). The processing of interoceptive information contributes to our sense of body ownership (Berlucchi & Aglioti, 2010; Tsakiris et al., 2011). Changes in body ownership have been shown to modulate interoceptive processing (Filippetti and Tsakiris, 2017). Though less well-studied interoception is considered fundamental to building up higher-level body representations such as body image (for review see Badoud & Tsakiris, 2017: Raimo et al., 2022).

**Research Aims:**

A. This research aims to understand the relationship between interoception and body representations.
B. To examine whether explicit body distortions in VR produce corresponding changes in interoceptive precision and subjective beliefs regarding that precision.
C. To understand the functional role of body distortions in health and its relationship to interoception.

We will employ immersive Virtual Reality to recreate the Heartbeat discrimination task (Legrand et al.,2022 ) and in real-time using MoCap VR modify the appearance of the avatar that the participants embody.

**Recommended Reading:**


- Filippetti, M. L., & Tsakiris, M. (2017). Heartfelt embodiment: Changes in body-ownership and self-identification produce distinct changes in interoceptive accuracy. *Cognition*, *159*, 1-10.
- Ehrsson, H. H. (2020). Multisensory processes in body ownership. *Multisensory perception*, 179-200.
- Legrand, N., Nikolova, N., Correa, C., Brændholt, M., Stuckert, A., Kildahl, N., ... & Allen, M. (2022). The heart rate discrimination task: a psychophysical method to estimate the accuracy and precision of interoceptive beliefs. *Biological Psychology*, *168*, 108239.
- Linkenauger, S. A., Wong, H. Y., Geuss, M., Stefanucci, J. K., McCulloch, K. C., Bulthoff, H. H., Mohler, B. J., & Proffitt, D. R. (2014, December 15). The Perceptual Homunculus: The Perception of the Relative Proportions of the Human Body. Journal of Experimental Psychology: General.
- Longo, M. R. (2022). Distortion of mental body representations. *Trends in Cognitive Sciences*, *26*(3), 241-254.
- Murphy, J. (2023). Interoception: Where do we go from here?. *Quarterly Journal of Experimental Psychology*, 17470218231172725.


## **PATRICIA GOUGH** PROJECT 1

**Controlling for age of acquisition in measures of embodiment of language – A TMS study**

Dr Patricia Gough (UCD)

Embodiment of language refers to the idea that ourrepresentation of language relies on cortical areas involved in the representation of a word's referent i.e. the experience of what a word refers to is relevant for how the brain processes a word itself. For example,
words referring to actions, or objects on which a person can act, would be expected to activate motor areas, words that refer to items with visual experience would be expected to activate visual areas etc. An individual word may activate several sensory and motor regions of the brain.

Much work in the area of language embodiment, including the current project, focuses on motor-related language and the roll of the motor system. Two of the possible methods to test for embodiment effects are reaction times (RTs), and Transcranial Magnetic Stimulation (TMS) to primary motor cortex (M1) with measurement of Motor Evoked Potentials (MEPs) at a given muscle (e.g. a hand muscle). While researchers interested in the embodiment of
language are careful to balance word stimuli in terms of frequency, far fewer researchers take into consideration the possible effect of age of acquisition (AoA). Recent (unpublished) work, using RTs as a measure of embodiment, suggests that the AoA of words can have large effects on embodiment measures, with early acquired words appearing to drive the overall effect.

**Recommended Reading:**


- Gough, P.M., Campione G.C., Buccino, G. (2013). Fine tuned modulation of the motor system by adjectives expressing positive and negative properties. *Brain and Language* 125(1), 54-59.

- Marino, B.F.M., Gough, P.M. Gallese, V., Riggio, L, and Buccino, G (2013). How the motor system handles nouns: A behavioural study. *Psychological Research*, 77(1), 64-73

- Gough, P.M., Riggio,L., Chersi, F., Sato, M., Fogassi, L., and Buccino, G. (2012). Nouns referring to tools and natural objects differentially modulate the motor system. *Neuropsychologia* 50, 19-25.

- Walsh, V., & Cowey, A. (2000). Transcranial magnetic stimulation and cognitive neuroscience. *Nature Reviews Neuroscience*, *1*(1), 73-80.

- Pitcher, D., Parkin, B., & Walsh, V. (2021). Transcranial magnetic stimulation and the understanding of behavior. *Annual Review of Psychology*, *72*, 97-121.


**Notes:** This project would suit someone keen to learn to use TMS. The use of TMS in the measurement of MEPs is one of the simpler types of TMS protocols and is a good introduction to the technique.

## CIARA GREEN PROJECT 1

**Can misinformation affect behaviour?**

**Will this project require Garda vetting?** No

**Project details:** This project will investigate whether exposure to misinformation in the form of online fake news can substantially affect behaviour. The project will involve an online survey, followed by an in-person lab assessment. During the online survey, participants in the misinformation condition will be exposed a fake news story describing widespread contamination of nut products. Participants will then be invited to complete a behavioural task in the lab, as part of which they will be invited to taste various foods (including the target nuts). We will assess whether exposure to the misinformation affects their attitudes towards the target food and their subsequent behavioural choices (i.e. how much they eat).

**Recommended reading:**


- Greene, C.M. & Murphy, G. (2021). Quantifying the effects of fake news on behaviour: Evidence from a study of COVID-19 misinformation. *Journal of Experimental Psychology: Applied,* 27(4), 773-784. https://doi.org/10.1037/xap0000371.

- Murphy, G. Loftus, E.F., Grady, R.H.., Levine, L.J. & Greene, C.M. (2020). Fool Me Twice: How effective is debriefing in false memory studies? *Memory*, 28(7), 938-949. https://doi.org/10.1080/09658211.2020.1803917

- Bernstein, D. M., & Loftus, E. F. (2009). The consequences of false memories for food preferences and choices. *Perspectives on Psychological Science*, *4*(2), 135-139.https://doi.org/10.1111%2Fj.1745-6924.2009.01113.x


**Useful weblinks:**

- http://ucdattentionmemory.com/

**Notes** This is a group project run in collaboration with Dr Gillian Murphy at University College Cork. All team members will collect data towards the larger project, however each student will focus on a distinct research question, which they will write up in an independent thesis. We will decide on these individual research questions at the start of the academic year.

## KLAUS KESSLER PROJECT 1

**Rhythm makes the world go round: Brain oscillations underpinning theory of mind**

Prof Klaus Kessler (UCD)

**Project details:** This project focuses on social cognition, specifically, on the representation of others' beliefs and perspectives, which underpins how people communicate and understand each other and how interaction might break down in certain clinical conditions (e.g. autism, schizophrenia, etc.)

Focusing on healthy participants in the first instance, this project aims to compare the neural signatures of perspective taking (how another's experience of the world differs from ours) and belief reasoning (how their beliefs differ from ours), and how these processes contribute towards Theory of Mind (ToM), i.e., representing others' mental states. Recently, we were the first research group to distinguish these two cognitive functions using a novel integrated behavioural task (Green, et al., 2023). Neurological differences between perspective taking and belief reasoning will be the focus of the project and will be

determined using the School's new electroencephalography (EEG) system (see lab link). Based on our previous research (e.g. Bögels et al., 2015; Seymour et al, 2018; Wang et al., 2016) the investigation will focus on brain oscillations at theta frequency (3-7Hz) which have generally been associated with high-level social functioning and cognition.

The project offers a unique opportunity to conduct research at the very forefront of cognitive neuroscience, i.e., by employing state-of-the-art EEG, by using MATLAB toolboxes for data analysis, and by employing a novel task that was specifically developed for comparing perspective taking and belief reasoning at brain and behaviour level (Green, et al., 2023). The successful candidate will further benefit from working closely together with a PhD student. We are seeking a dedicated and skilled candidate who would conceive of this challenge as an opportunity.

**Recommended Reading:**


- Green, R., Shaw, D. J., & Kessler, K. (2023). Dissociating visual perspective taking and belief reasoning using a novel integrated paradigm: A preregistered online study. *Cognition*, *235*, 105397.

- Wang, H., Callaghan, E., Gooding-Williams, G., McAllister, C., & Kessler, K. (2016). Rhythm makes the world go round: An MEG-TMS study on the role of right TPJ theta oscillations in embodied perspective taking. *Cortex*, *75*, 68-81.

- Seymour, R. A., Wang, H., Rippon, G., & Kessler, K. (2018). Oscillatory networks of high-level mental alignment: A perspective-taking MEG study. *NeuroImage*, *177*, 98-107.

- Butterfill, S. A., & Apperly, I. A. (2013). How to construct a minimal theory of mind. *Mind & Language*, *28*(5), 606-637.


**Useful weblinks:**

https://people.ucd.ie/klaus.kessler1

https://www.ucd.ie/psychology/t4media/MNClabequipment.pdf

**Notes:** All enquiries welcome. Just email Prof Klaus Kessler: klaus.kessler1@ucd.ie

## KLAUS KESSLER PROJECT 2

**EEG Neuromarkers of Psychosis**

Prof Klaus Kessler (UCD), Dr Keith Gaynor (UCD)

Recent reviews (e.g., Perrottelli et al., 2021) have highlighted that abnormal Electroencephalography (EEG) indices in patients with chronic schizophrenia can also be observed in high-risk (but subclinical) subjects and in the prodromal phase of psychosis (Atagun et al., 2020; Haigh et al., 2017; Reilly et al., 2018; Tada et al., 2019;). This supports the hypothesis that cerebral network dysfunctions appear early

in the course of the disorder (Fusar-Poli et al., 2012; Kahn & Sommer, 2015) and may aid the prediction of high-risk individuals who will transition to psychosis. Crucially, most previous studies rely on only one EEG index (but see Zimmermann et al., 2010) for comparisons of high-risk (HR), first-episode psychosis (FEP) subjects, and healthy controls (HC).

Within the larger project in collaboration with the Dublin & East Treatment & Early Care Team (DETECT) – Early Intervention in Psychosis (EIP) Service, we aim to expand on previous research by (i) studying multiple EEG indices previously associated with aberrations in psychosis, (ii) examining several established tasks that tap into different neurocognitive subsystems associated with psychosis (e.g. perceptual, affective, social, executive), and (iii) including a clinical FEP group, a HR group, with two HC control groups (one with low and one with high non-clinical psychosis-proneness).

The aim for the MSc students will be to collect data (in person) for contrasting the two HC groups in the first instance. Each student will focus on one particular task. Psychosis-proneness will be assessed through self-report questionnaires. EEG will be recorded with the School's new mobile 128 electrodes system that is certified as medical equipment and will also be used for testing FEP and HR patients at a later stage of the overall project. You will have the opportunity to learn about brain oscillations and how these make our mind "tick". EEG data analysis will be conducted using Matlab toolboxes, adding to the students' transferrable skills. MSc students will also be given the opportunity to engage with the DETECT team and its service provision and clinical testing may commence towards the end of the MSc course, expanding the students' experience. We are seeking dedicated and skilled candidates who would conceive of this challenge as an opportunity

**Recommended Reading:**


- Perrottelli, A., Giordano, G. M., Brando, F., Giuliani, L., & Mucci, A. (2021). EEG-based measures in at-risk mental state and early stages of schizophrenia: a systematic review. Frontiers in psychiatry, 12, 653642.

- Zimmermann, R., Gschwandtner, U., Wilhelm, F. H., Pflueger, M. O., Riecher-Rössler, A., & Fuhr, P. (2010). EEG spectral power and negative symptoms in at-risk individuals predict transition to psychosis. Schizophrenia research, 123(2-3), 208-216.


**Useful weblinks:**

https://people.ucd.ie/klaus.kessler1

https://www.ucd.ie/psychology/t4media/MNClabequipment.pdf

https://people.ucd.ie/keith.gaynor

http://www.detect.ie/index.html

**Notes:** All enquiries welcome. Just email Prof Klaus Kessler: klaus.kessler1@ucd.ie or Dr Keith Gaynor (keith.gaynor@ucd.ie).

## **BRENDAN ROONEY** PROJECT 1

**Physiological Responses to "Unreal" Virtual Environments: Testing a Dual Awareness Model of Subjective Realism**.

Dr Brendan Rooney (UCD), Lauren Christophers (UCD)

**Will this project require Garda vetting?** No

**Project details:** The research project aims to investigate the cognitive and affective mechanisms underlying illusions of realism, particularly in the context of Virtual Reality (VR) and entertainment experiences. We will explore both objective and subjective factors that contribute to the immersive feeling of "being there" in virtual environments, while "knowing" they are fabricated.

The study builds off Kahneman's Dual Process Theory of information processing (Evans & Stanovich, 2013) , using Tan's (2008) Dual Process Model of Entertainment Engagement, which proposes two types of realism responses: Type 1 (felt) realism, characterized by experiential authenticity and a strong illusion of reality, and Type 2 (evaluative) realism, arising from conscious evaluations based on knowledge.

To achieve a comprehensive understanding, we will examine both explicit judgments of realism and more implicit, physiological responses, including emotion measures. By manipulating objective realism features and analysing subjective and physiological responses, we seek to uncover how these neurological processes interact to create the illusion of reality in VR and other media.

**Recommended Reading:**

Christophers, L., Lee, C. T., & Rooney, B. (2023). Exploring Subjective Realism: Do evaluative realism and felt realism respond differently to different cues? *International Journal of Human-Computer Studies*, *175*, 103027. https://doi.org/10.1016/j.ijhcs.2023.103027

Evans, J. S. B. T., & Stanovich, K. E. (2013). Dual-Process Theories of Higher Cognition: Advancing the Debate. *Perspectives on Psychological Science*, *8*(3), 223–241. https://doi.org/10.1177/1745691612460685

Rooney, B., Benson, C. and Hennessy, E. 2012. The apparent reality of movies and emotional arousal: A study using physiological and self-report measures. Poetics, 40: 405–422. http://dx.doi.org/10.1016/j.poetic.2012.07.004

Rooney, B., & Hennessy, E. (2013). Actually in the Cinema: A Field Study Comparing Real 3D and 2D Movie Patrons' Attention, Emotion, and Film Satisfaction. Media Psychology, 16(4). https://doi.org/10.1080/15213269.2013.838905

Tan, E. S. H. (2008). Entertainment is emotion: The functional architecture of the entertainment experience. *Media Psychology*, *11*(1), 28–51. https://doi.org/10.1080/15213260701853161

**Useful weblinks:**

https://www.ucd.ie/psychology/research/researchcentresandlaboratories/mediaentertainmentlaboratory/

https://www.mediaentertainmentlab.com/

**Notes:** Students will join the Media and Entertainment Psychology Lab, and attend lab meetings (jointly with the Attention and Memory Lab).

## FLAVIA SANTOS PROJECT 1

**How does Maths Anxiety relate to Number-Space Associations?**
Dr Flavia Santos (UCD)

**Will this project require Garda vetting?** Yes, if collecting data face-to-face and with children or adolescents. No, if the sample has undergraduate students.

**Project details:** Some children have difficulties learning mathematics associated with negative feelings, thoughts, and physiological responses toward mathematics, which is known as Maths Anxiety (Cipora et al 2022). We are interested in how children perceive the number order because this measure is a marker of mathematical reasoning and school outcomes. The proposed study will involve running a newly designed multi-directional number line task (Leonard, Santos 2021) developed in our Lab, The UCD Music and Math Cognition Lab and behavioural scales. The relationship between spatial and numerical cognition has been well established (Sokolowski, Hawes and Lyons, 2019). There is flexibility regarding the sample, the study could be carried out with children, adolescents, or young adults (undergraduates) and will compare task performance with levels of mathematical and spatial anxiety. Children with Dyscalculia (i.e., maths learning disorder) would be of particular interest to be examined in this paradigm. Ultimately, this study will aim to understand how the developing brain processes both spatial and emotional components of mathematics. Outcomes can be considered in designing interventions for both mathematics education in typical development and developmental conditions such as Dyscalculia, Dyslexia and ADHD.

**Recommended Reading:**


- Cipora, K., Santos, F.H., Kucian, K. and Dowker, A. (2022), Mathematics anxiety—where are we and where shall we go? Ann. N.Y. Acad. Sci. https://doi.org/10.1111/nyas.14770
- Sokolowski HM, Hawes Z, Lyons IM. What explains sex differences in math anxiety? A closer look at the role of spatial processing. Cognition. 2019 Jan;182:193-212. doi: 10.1016/j.cognition.2018.10.005. Epub 2018 Oct 18. PMID: 30343180.
- Siegler RS, Opfer JE. The development of numerical estimation: evidence for multiple representations of numerical quantity. Psychol Sci. 2003 May;14(3):237-43. doi: 10.1111/1467-9280.02438. PMID: 12741747.


**Useful weblinks:** Supervisor: https://people.ucd.ie/flavia.santos
Lab: https://tinyurl.com/2pfe4te5 Follow us on Twitter @DrFlaviaHSantos and Instagram: @ucd_mmclab

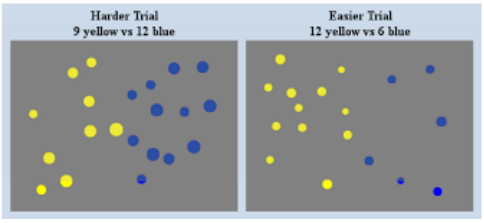
**Notes:** Students will join the **UCD Music and Math Cognition Lab**, and attend lab meetings including the monthly meetings of the UCD Neuropsychology Lab.

## FLAVIA SANTOS PROJECT 2

**The effect of tRNS (transcranial random noise stimulation) in Non-symbolic Magnitude Comparison**

Dr Flavia Santos (UCD), Professor Klaus Kessler (UCD)

**Project details:** The ability to nonverbally approximate numbers plays a role in quantitative reasoning throughout the human life span and supports mathematical intuitions. In the nonsymbolic magnitude comparison task, participants are shown two dot arrays and asked to choose the larger, without counting. Magnitude comparison depends on the integrity of IPS (intraparietal sulcus), however, attentional resources and decision is guided by the DLPC (dorsolateral prefrontal cortex). In this study, we will test whether a single session of tNRS on DLPC (F3 and F4) or IPS (P3 and P4) can improve performance in a nonsymbolic magnitude comparison task. We also will investigate the potential mechanism. We expect a dissociation: A single session of tNRS in DLPC would improve reaction time but not accuracy on the dots discrimination task, while a single session of tNRS on IPS would improve accuracy but not reaction time in the discrimination task. The study design is 2 x 2 x 2 (two groups, two-time points and two conditions). Time-points: behavioural assessment will be carried out during pre- and post- tNRS sessions. Participants will be undergraduate students divided into two groups of tNRS sessions: N=12 (DLPC) and N=12 (IPS). Conditions: experimental vs placebo (sham). In the experimental condition, participants will have an active tNRS session in and in the sham condition, the same participants will take part in a mock tNRS session on the same day.




**Recommended Reading:**


- Halberda J, Feigenson L. Developmental change in the acuity of the "number sense": The approximate number system in 3-, 4-, 5-, and 6-year-olds and adults. *Developmental Psychology*. 2008;44:1457–1465. doi: 10.1037/a0012682.
- Lazzaro, G., Fucà, E., Caciolo, C., Battisti, A., Costanzo, F., Varuzza, C., Vicari, S., & Menghini, D. (2022). Understanding the Effects of Transcranial Electrical Stimulation in Numerical Cognition: A Systematic Review for Clinical Translation. *Journal of clinical medicine*, *11*(8), 2082. https://doi.org/10.3390/jcm11082082


## PROJECTS FROM OTHER SCHOOL RESEARCH GROUPS

## CHRISTINE LINEHAN PROJECT 1

**My epilepsy and me: hearing from adults with intellectual disability**

Associate Professor Christine Linehan (UCD)

**Project details:** Epilepsy is one of the leading health conditions experienced by individuals with intellectual disability. Epilepsy in this population is more severe and less amenable to treatment. The literature in this field is largely undertaken with healthcare professionals or family members. Few studies have spoken directly to people with intellectual disability. This qualitative study comprises a series of interviews with adults with intellectual disability who have epilepsy. The study will be supported by colleagues in the International League against Epilepsy, Intellectual Disability Task Force so provides an opportunity to work internationally with a team of neurologists and psychiatrists.

**Recommended Reading:**

- Newman H, Rudra S, Burrows L, Tromans S, Watkins L, Triantafyllopoulou P, Hassiotis A, Gabrielsson A, Shankar R. Who cares? A scoping review on intellectual disability, epilepsy and social care. Seizure. 2023 Mar 9.

## LOUISE MCHUGH PROJECT 1

### Speaker Coherence and Rule-Governed Behaviour: Why we Fall for Speakers who are Overly Confident

Professor Louise McHugh (UCD)

**Project details:** Humans like certainty even though the world is an uncertain place. At times we see those in leadership that talk in certain terms even when they cannot be certain gain traction. However, long term this strategy is conceptually believed to be one that will lose credibility.

"*In the long run, we believe or trust those …and [are] more likely to respond to a speaker who says, "The door is unlocked" than one who says "I think the door is unlocked," or "The door may be unlocked," but in the long run we shall believe or trust those who have added [qualifications] to tell us something about the strength of their behavior and have therefore less often misled us."* Skinner (1989)

Essentially it pays to be overconfident if you want to influence behaviour in the short term, but it's better to be honest if you want to influence listeners in the long term.

In the UCD Contextual Behavioural Lab we have a series of studies that are quantitative basic experiments that look at why we follow the rules provided by people who provide certain instructions even when they cannot be certain, and how our perceptions of speakers influence how we respond to them.

**Recommended Reading:**

Barnes-Holmes, D., et al. (2010). A sketch of the implicit relational assessment procedure and the relational elaboration and coherence model. *The Psychological Record, 60*(3).

Bianchi, P. H., et al. (2021). Effects of coherence on speaker preference and rule-following. *Revista Perspectivas*, *12*(1). https://doi.org/10.18761/PAC.2021.v12.RFT.07

Lupia, A. (2023). Political endorsements can affect credibility. *Nature.* https://doi.org/10.1038/d41586-023-00716-8

Skinner, B. F. (1989). *The Behavior of the Listener.* In Hayes, S. C. (1989) *Rule-Governed Behaviour.* Plenum Press

**Useful weblinks:**
https://www.ucd.ie/psychology/research/researchcentresandlaboratories/contextualbehaviouralsciencelaboratory/