

Grant Title: Visual Body Illusions for Treatment of Osteoarthritis Pain

Award Holders: Dr Catherine Preston (University of York), Dr Daniel Baker (University of York), Dr Kirsten McKenzie (University of Lincoln).

PhD Student: Kirralise Hansford

Grant Duration: 01/10/21 – 30/09/2024 (36 months)

Report: This report describes progress over a 9 month period (01/10/21 – 30/06/22)

Abstract: Osteoarthritis is a leading cause of pain and disability in the UK, particularly in those over 50, and an ageing population means that the social and financial cost of osteoarthritis is increasing. Recent studies report that patients find current treatments unsatisfactory and that they often have severe side-effects, or even make clinical outcomes worse. Therefore, the need for an effective, drug-free treatment is imperative. Although osteoarthritis is characterised by damage to joint cartilage, there is growing evidence that arthritic pain is exacerbated by abnormalities in the brain's representation of the affected joint. Our previous studies have already shown dramatic pain relief and increased feelings of joint flexibility from body illusions that change the perceived size of arthritic joints. However, currently the methodology for delivering these analgesic illusions is expensive and cumbersome. A possible solution to this is through the development of body illusions relying on vision only, removing the need for expensive technology. Recent research suggests that immersive multisensory experiences, such as virtual or augmented reality, are not essential for delivering body illusions; changes to the perception of our bodies can be induced using non-immersive visual-only manipulations. However, it is currently unclear whether visual-only illusions have the same analgesic potential as fully immersive multisensory illusions. This question is important as visual-only illusions could allow for these methods to be widely accessible to patients via mobile phone applications. Therefore, this project will examine the therapeutic potential of visual body illusions for pain management in osteoarthritis. To achieve this, we will compare brain responses along with subjective changes in bodily perception and pain intensity between visual-only and multisensory illusions. Additionally, we will investigate the potential cumulative effect of experiencing visual illusions on arthritic pain, delivered using a mobile phone application.

Project aims: This project aims to further investigate the analgesic effects of multisensory body illusions in relation to neural mechanisms and feasibility for developing accessible illusion-based treatments via a mobile phone application. Specifically, we wish to establish a neural signature of illusion-based analgesia using EEG comparing highly immersive illusion induction to an alternative unimodal (visual) method as would be most suitable for a mobile phone app. We will aim to examine potential cumulative effects of experiencing visual illusions on levels of osteoarthritis pain to determine feasibility of such methods for long term management.

Progress so far:

The project initially met with some delays primarily as a result of COVID. This prevented the equipment from being relocated to York as planned and also the commencement of testing. We also had unexpected delays due to creating new custom programmes to deliver the illusions. However, despite these delays the project has gone well so far and is only slightly behind the scheduled timetable.

1. The equipment was successfully transferred to the University of York from Lincoln. It was discovered that the original programmes were unsuitable due to outdated software. Therefore Dr Baker produced new programmes using Psychtoolbox in Matlab.
2. Ms Hansford received training in using the equipment and delivering the illusion.

3. Ms Hansford conducted a small pilot study (N = 17) to test the new programmes. This was conducted on healthy control participants (N = 9) and some chronic pain participants (N = 8). Piloting helped optimise the programmes and the paradigm as well as producing support for the effects of the illusion in terms of embodiment and potential for pain reduction.
4. Ms Hansford received training in setting-up and running EEG experiments.
5. The first study was formally pre-registered on the Open Science Framework and Ms Hansford subsequently received an University of York Open Science Award based on the quality of the pre-registration (<https://archive.org/details/osf-registrations-trp39-v1>)
6. Dr McKenzie visited the University of York to meet Ms Hansford in person and assess progress.
7. Data collection for the first experiment was completed. Based on the pilot study the experiment design was changed from a between subjects design to a within subjects design. New power calculations were also conducted based on the most recent pilot data thus the total sample for experiment one was adjusted to N=48.
8. Behavioural data from the first experiment was analysed.
9. Ms Hansford is currently receiving ongoing training for EEG analysis and has conducted EEG pre-processing and preliminary analysis for experiment one EEG data.
10. Ms Hansford completed a literature review as part of her ongoing PhD assessments and formally passed her 9 month PhD progression as assessed by the Department of Psychology and the University of York (24/06/2022).

Dissemination and Public Engagement

1. The first study was pre-registered on the Open Science Framework (<https://archive.org/details/osf-registrations-trp39-v1>).
2. A lab Twitter account was set up for dissemination of activity and findings from this and other projects from the lab (@york_tap_lab).
3. Ms Hansford and Dr Preston demonstrated body illusions at the York Festival of ideas (12/06/2022)
4. Dr Preston was invited to present preliminary findings as part of a symposium at the International Multisensory Research Forum this July (04/07/2022).

Professional Development

Outside the core project Ms Hansford has engaged with many other activities and training to help develop her career.

1. Presented preliminary findings (poster) at the Department of Psychology Postgraduate Research Day at the University of York (28/06/2022).
2. Accepted to attend European Doctoral Summer School for (Promoting Research using Social Media, Transferable Skills)
3. Attended departmental Early Career Research (ECR) workshops on Rstudio, fellowships and Open Science.
4. Undertaken outreach events at Bishopthorpe Primary school, York Festival of Ideas, and York Family Day
5. York Open Science Advocate and part of the Open Science Interest Group in Psychology
6. Appointed as a Maths Skills Centre Tutor in Statistics
7. Departmental Graduate Teaching Assistant (GTA) experience (seminar Leader, marking, providing one-to-one support to a visually impaired MSc student, Supervisor for second year undergraduate Mini Projects, assisted in supervision final year MSci student project, taught Academic Skills in writing support sessions, assisted in practical sessions for SPSS).
8. Member of the ECR Committee