

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 the period 01/06/22 – 11/05/23.

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:

Despite initial COVID related delays in year one, the second year of the project has gone well. We have deviated from slightly the initial project time table due to taking the decision to submit Experiment Two as a registered report. Although this means that data acquisition cannot start until the registered report is accepted, as part of the process, Ms Hansford has already written up most of this study, which was scheduled to take place later during the PhD. The delay in starting Experiment Two has also allowed for time to conduct two additional studies (see details below). The delay has also not changed plans to commence Experiment Three that is scheduled to start this summer. Ms Hansford continues to impress at her Thesis Advisory Panel meetings (held every six months with additional faculty from the department) due to her work ethic, productivity and engagement in open science practices.

Experiment one:

1. Data analysis completed.
2. Study has been written up and submitted for publication at in *Neuropsychologia* (IF = 3.05). This manuscript has gone through one round of peer review. We also disseminated a pre-print of this article: <https://doi.org/10.1101/2023.01.18.524558>

Experiment two:

1. Experiment two plans (detailed methods and analysis) have been written up and submitted as a registered report to Peer Community in Registered Reports (PCI).
2. The registered report passed initial check from the recommender and has undergone one round of peer review from four reviewers.

Dissemination:

In order to have greatest impact for our project as well as facilitating networking and presenting experience for Ms Hansford, the work has been presented at several national and international conferences.

1. Ms Hansford presented a poster at the Psychology Postgraduate Research conference (University of York and York st. John University), June 2022.
2. After being awarded a University of York Open Science Award in her first year, Ms Hansford was invited to present a poster presentation at the Open Research at York conference, July 2022.
3. Dr. Preston presented an oral presentation in a symposium at the International Multisensory Research Forum in (Ulm, Germany), July 2022.
4. Ms Hansford presented an oral presentation at the Body Psychology Research Meeting (Durham), September 2022
5. Ms Hansford presented a poster presentation at the Experimental Psychology Society conference (London), January 2023.
6. Ms Hansford presented a poster presentation at the British Pain Society conference (Glasgow), May 2023.
7. Dr Preston presented an oral presentation the Biomedical Science and Neuroscience applied to Mental Health event, May 2023.

Public Engagement:

To ensure greatest impact for the project and further develop communications skills for Ms Hansford we engage in activities to communicate research to a general audience.

1. Ms Hansford will present (oral) a summary of her PhD project as part of the Pint of Science initiative, 21st May 2023.

Additional experiments:

Due to the student's initiative, we have included two additional studies as part of this body of research.

1. Audio illusion study: Ms Hansford has completed an additional study as part of her PhD thesis that examined the role of audio stimuli on illusion experience. This study was specifically added in order to explore methods to improve illusion experience for a potential mobile application for a pain treatment. This study was designed by Ms Hansford in collaboration with the PhD supervisors. The study received ethical approval and was pre-registered on the open science framework (<https://osf.io/6x4ce>). Data acquisition (N = 52) has been complete along with initial analysis and drafting of the paper. The article is being written up using *R markdown* so that all data analysis will be computationally replicable (creating pdf of manuscript with integrated analysis scripts). The key findings demonstrate a facilitatory effect of congruent audio stimuli on the stretching illusion, but only for the visual only condition. This suggests that in the absence of congruent tactile stimulation the experience of the illusion can be enhanced with other relevant sensory information. We intend to present this project in the 2023 York Postgraduate Research Conference and will submit the abstract for the Body Representation Network meeting (BRNet)
2. Pain Research Barriers Focus groups: In order to facilitate recruitment for patients with chronic pain, Ms Hansford has begun a research project that specifically assess the potential barriers that patients face when considering taking part in pain research. This study received ethical approval and was pre-registered on the open science framework (<https://osf.io/37snz>). Ms Hansford aims to run approximately six online focus groups in order to identify potential issues and facilitators for encouraging participation in pain research. Data acquisition is currently underway anticipating to complete data collection by the end of June 2023.

Professional Development:

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

1. Joined focus groups for local pain network (Footsteps Festival).
2. Assisting with analysis for an EEG project with the languages and linguistics department
3. Involvement in the *ReproduceMe* project, for which PhD students are trained to make research papers computationally replicable (using *R markdown*)
4. Attending a *Making Accessible Documents* workshop.
5. Graduate teaching duties (e.g., marking, leading tutorials) in the Psychology Department.

Awards:

1. Ms Hansford has been awarded a Grindly Grant from the Experimental Psychology Society to fund expenses for the British Pain Society conference (£500)