Optic flow parsing in Persistent Postural Perceptual Dizziness (PPPD) – a pilot study

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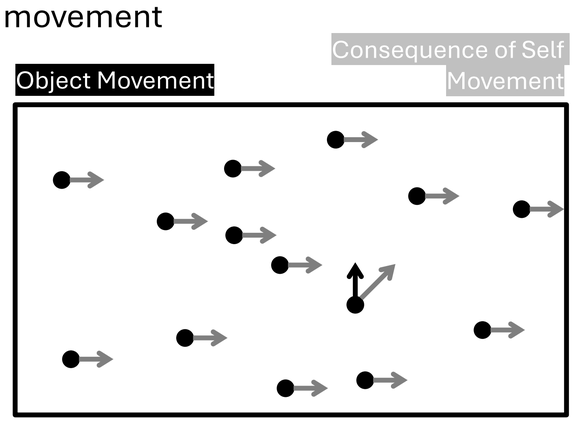
Background

Optic Flow Parsing

Purely visual mechanism

Acts to compensate for visual consequences of self-movement

Comparing motion across the image to parse out motion that is due to self-movement



Detecting Scene Relative Movement

Use self-movement estimates to predict motion in the image

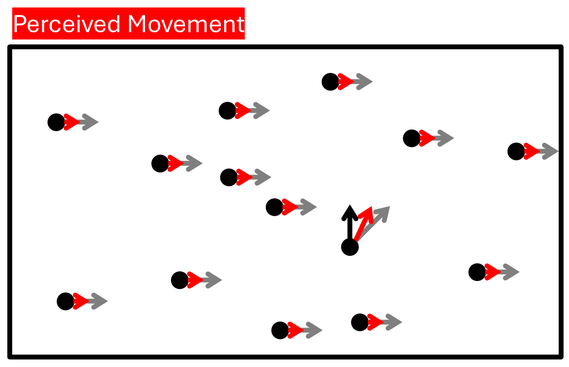
Look for **mismatches** between the estimate and our visual signal

PPPD

Functional Neurological Disorder

Symptoms include:

- Chronic dizziness
- Severe dizziness which is caused by:
  - Upright posture
  - Self-movement
  - Stimulating visual environments
- Perceive the world as unstable



Mismatch Hypothesis:
*PPPD patients may have **inaccurate** self-movement estimates which lead to **perceived instability***

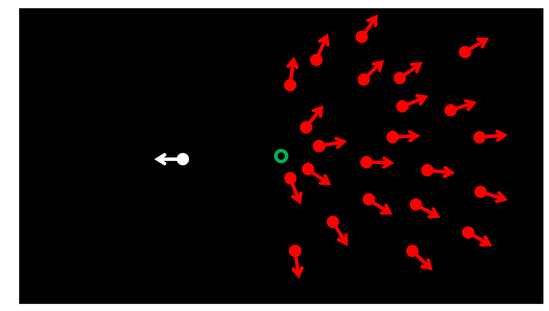
Design

Participants

5 PPPD patients (average age:) and 30 undergraduates (average age:)

Stimuli

Hemifield of expanding or contracting flow
Probe object moves left or right in other hemifield



Method

2 Alternative Forced Choice (2AFC)

Did the white dot move left or right?

Speed adaptively increased or decreased with Kesten staircases

4 staircases, two ascending and two descending

Previous finding

Evans, L., Champion, R. A., Rushton, S. K., Montaldi, D., & Warren, P. A. (2020). Detection of scene-relative object movement and optic flow parsing across the adult lifespan. *Journal of vision*, *20*(9), 12-12.

In a relative tilt task, we found a positive correlation between age and bias

Older participants have a stronger Optic Flow Parsing effect

Here, the PPPD group was older than the undergraduate group (see Participants)

Age and Mismatch Hypothesis predict opposite results

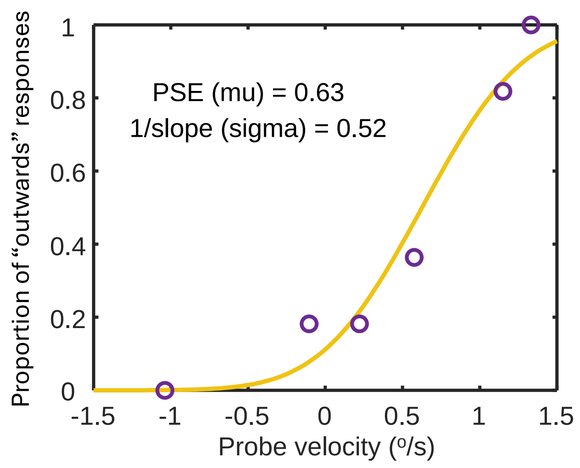
Results

Psychometric Functions

4 psychometric functions *(expanding/contrasting flow x probe in the left/right hemifield)*

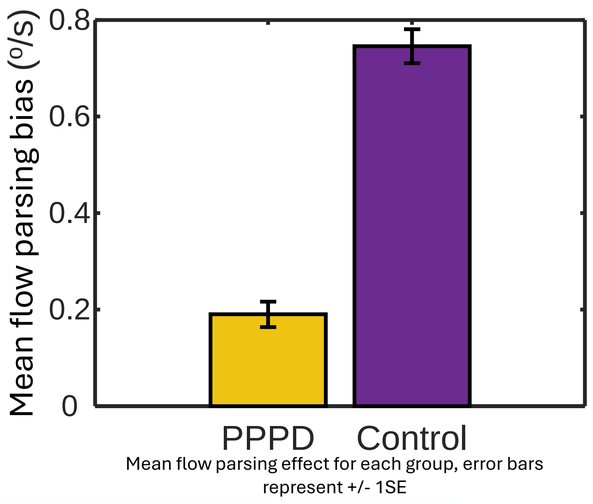
Probability of a rightwards response against probe velocity

Negative probe velocity denotes leftwards movement



Example psychometric function from a control participant

Flow Parsing Effect



Mean flow parsing effect for each group, error bars represent +/- 1SE

Pattern of biases obtained across the 4 conditions similar in PPPD and undergraduate groups

Averaged bias across direction and hemifield of flow

Optic Flow Parsing appears to be weaker in participants with PPPD

This will be verified in the STARDUST project which is ongoing

STARDUST

We are investigating the perception of people with PPPD to better understand the mechanisms of PPPD and reduce symptoms through tailored VR therapy

The mechanisms of PPPD are not well understood. They may even vary across patients, with different symptom presentations hinting at subtypes of PPPD

The Mismatch Hypothesis is just one potential explanation of PPPD, we will be investigating another hypothesis in an experiment described briefly below

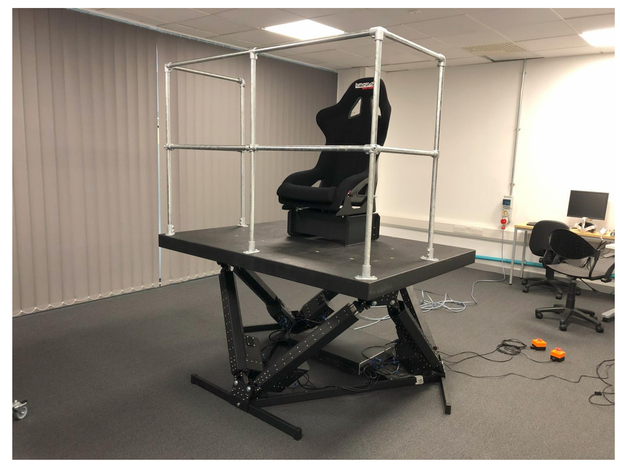
If you know of anyone with PPPD who may be interested in participating in this research, please contact Dr Joshua Haynes or scan the QR code below to view our participant advert.
Email: joshua.haynes@manchester.ac.uk

We **integrate** self-movement estimates from different sources

Integration Hypothesis:
*PPPD patients may **overweight** visual information during this integration*

Adapting the methodology from Yakubovich et al. (2020)

Using a motion platform to move participants while presenting visual motion information in Virtual Reality



Yakubovich, S., Israeli-Korn, S., Halperin, O., Yahalom, G., Hassin-Baer, S., & Zaidel, A. (2020). Visual self-motion cues are impaired yet overweighted during visual–vestibular integration in Parkinson's disease. *Brain communications*, *2*(1), fcaa035.

Summary and Conclusions

- **Optic Flow Parsing is a purely visual mechanism that acts to identify scene relative movement by subtracting out retinal motion due to self-movement.**
- **By presenting flow patterns in one hemifield and a probe object in the other, we can measure the amount of optic flow that is subtracted under Flow Parsing**
- **Preliminary evidence suggests that PPPD patients have weaker Optic Flow Parsing (less flow subtracted) than controls.**
- **Weaker Optic Flow Parsing could explain why these patients perceive an unstable world (consistent with the Mismatch Hypothesis)**
- **This finding is despite the difference in age between the two groups**
- **This preliminary finding is currently being verified within the STARDUST project. We will also investigate other hypotheses for the mechanisms behind PPPD and aim to reduce dizziness symptoms using tailored VR therapy.**

For a virtual copy of this poster and our participant advert **SCAN HERE:**

STARDUST
Study to Assess and Reduce Dizziness Using Sensory Theory

MANCHESTER 1824
The University of Manchester

PERSISTENT POSTURAL PERCEPTUAL DIZZINESS (3PD)?

STARDUST is a UK-wide study to investigate the causes of 3PD symptoms, so that we can ultimately design new therapies

Participants will visit our Manchester laboratories to take part in simple experiments (some in VR) assessing their perception of movement. You will also need to undergo a screening interview and complete some baseline tests (IQ, visual acuity) and questionnaires to characterise symptoms

Participants will be compensated for their time & reasonable travel expenses

If you are interested in taking part in our study and would like to know more/discuss eligibility then please contact:

Dr. Joshua Haynes (josh.haynes@manchester.ac.uk)

Participants must:

- Be aged 18+ and have a formal diagnosis of 3PD
- Have an MRI scan performed within last 10 years of the Brain/Auditory Meatus
- Have normal or corrected to normal eye sight
- Be willing and able to travel to Manchester for two half day testing sessions
- Be able to easily understand verbal/written explanations in English
- Have no other diagnosed neurological, cardiac, visual or psychological conditions

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