**Somatosensory response and changes during illusory finger stretching in healthy and chronic pain participants**

Hansford, Baker, McKenzie and Preston

*Stage 1 Registered Report review – Dr Alexandra Mitchell*

The authors present a planned study to investigate the link between illusions of body state and ownership on chronic pain relief using EEG. To do this, experimenters plan to induce an illusion (the finger stretching illusion) in two groups: healthy controls and individuals with chronic pain (n = 47 per group) with four different manipulations multisensory stretching, visual stretching, non-illusion without tactile input and non-illusion with tactile input. All required elements are present for a stage 1 registered report, and this has the promise to be an interesting study and I am looking forward to the results. This study is complex and addresses many critical points, but it is worth considering whether this registration would be better off as two studies. Study one on multisensory illusions and EEG in healthy participants. Study two focusing on the pain reducing element of the illusion. This may simplify things somewhat. I have, however, reviewed this under the impression that it is one standalone study.

**Major Comments**

1. The most pressing issue is that the study premise appears to depend upon the participants experiencing the finger stretching illusion, in at least one of the conditions. This is especially important for the NRS after the illusion. I believe that, as well as pilot data showing the relevant EEG frequency, the authors should also pilot the illusion and present these data, in at least 4 participants, to show whether individuals can be susceptible to your illusory manipulations. This is a critical step before continuing with this stage 1 RR. Confirming that participants are likely to experience the illusion, allows you to address the question of interest with more confidence.
2. The study aims are somewhat unclear. The abstract and the introduction are clearly directed at the relationship between body ownership illusions and pain (a link which is quite tenuous at best) but the focus of most of your hypotheses is, instead on whether multisensory illusion will show the strongest effect. The aims and purpose of the study need to be clear, especially with respect to the use of EEG and multisensory illusion conditions.
3. Although the authors have argued their reasoning for a 21-point pain scale I would argue that a 10-point scale is still preferable. One of their reasons is that using a more unusual scale will make the participants think about their pain levels more and be ‘less automatic’. I disagree with this take as I believe presenting the 21-point scale will make it less comparable and therefore make it more challenging for participants to rate their pain. The 10-point scale is also more translatable and comparable with different studies, and therefore makes the work more reproducible and replicable. I am happy to hear a rebuttal to this point.
4. It would add weight if you were able to predict a direction of the change in SSSEPs between the illusory and non-illusory conditions
5. My final major comment is somewhat related to the second. Although you are recruiting from two groups, none of the pre-registered hypotheses address comparisons between the two groups. Why is this? Between group hypotheses appear, to me at least, to be a natural continuation of the argument shaped in the introduction. Comparisons in illusory strength and susceptibility, as well as SSSEPs, between the two groups may be interesting, as we do not know whether chronic pain may alter the experience of this illusion or interact specifically with the tactile elements of the experiment and how this presents at the neuronal level.

**Minor/in text comments**

As there are no line or page numbers (please add these for resub), I made my own. Page 1 is the page after the title page with the abstract and start of the introduction on it.

1. The introduction very long and can be cut down substantially. It is not clear why there is so much detail about specific concepts (e.g. predictive coding accounts of pain, the RHI)
2. On a similar note, the relevant illusion (finger stretching illusion) needs to be much more clearly described either in the introduction or methods
3. The hypotheses paragraph in the introduction is very difficult to follow and I suggest saving most of the detail for Section 2.4 and summarising clearly in the intro.
4. Matching groups is hard to achieve, I assume the authors will recruit chronic pain patients first and then healthy controls. But details on how this will be achieved should be present in the manuscript.
5. Recruitment – is there a recruitment age limit?
6. Recruitment – healthy participants who are currently experiencing pain or have experienced more than 4 hours of consistent pain the last week should also be excluded
7. Recruitment – why are operations that could damage peripheral nerve pathways an exclusion criterion in the chronic pain group? Some of these procedures may result in chronic pain
8. How will pain levels to recruit participants in chronic pain group be assessed before and on the day?
9. Analysis pipeline page 7 – questionnaire data should be averaged to give median scores as questionnaires are ranked
10. Planned analysis pages 7 and 8 – provide specific predictors for ANOVAs and t-tests so reader knows exactly what is being compared. For all hypotheses – hypothesis 3 is particularly lacking in detail
11. Tables or appendices should be indexed correctly in text
12. Analyses hypotheses 2: why are two t-tests chosen? Would be more appropriate to use an ANOVA or a linear regression to compare results from these conditions on SSSEPs.
13. Power analyses – Hypothesis 1: It is not clear where the first two effect sizes used to calculate the power came from
14. Power analyses – hypotheses 2: the minimum effect size of interest quoted by Lakens is lower than this. From memory, d = .23, I believe. Also, is there a way of showing whether the chosen effect size is also relevant for EEG studies?
15. Does the power analysis for hypothesis 3 only relate to the chronic pain group?
16. Sample size (2.5) should be at the start of methods
17. When referencing a section, also include the number e.g. (see Power analysis in section 2.4)
18. Finally, there is room for much more concise writing throughout