Somatosensory Response Changes During Illusory Finger Stretching: A Registered Report

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Background

- Resizing illusions delivered through augmented reality (Figure 1) change the perceived size of a body part.
- The neural underpinnings of resizing illusions are currently undefined.
- Resizing illusions can provide analgesia for individuals with chronic pain (Boesch et al., 2016).
- There are two main theories explaining illusory analgesia:
  - **Somatosensory blurring Hypothesis (Haggard et al., 2013)**: Cortical representation of painful body part is blurred, viewing sharpens this representation, reducing pain.
  - **Magnification Hypothesis (Gilpin et al., 2015)**: There is reduced cortical representation, increasing through magnifying the body part, reducing pain.

This study aimed to understand the neural underpinnings of resizing illusions in participants without chronic pain, to provide an empirical basis for later investigations in chronic pain samples.

Methods

- Participants (n = 46; Mean age = 20.3 years) underwent 4 different resizing illusions (Figure 2):
  - MS (Multisensory)
  - UV (Unimodal Visual)
  - NI (Non-Illusion)
  - NIT (Non-Illusion Tactile)
  - Participants were fitted with an EEG cap and a vibrotactile stimulator taped to either their right index or middle finger (Figure 3), which vibrated during each trial eliciting a steady state evoked potential (SSEP) response.
  - After each condition, participants completed a questionnaire measuring illusory experience and disownership.

Positive Control Results

**Hypothesis 1** – There will be a greater illusory experience in (1a) the MS condition compared to the NI condition and in (1b) the MS condition compared to the NIT condition.

Participants experienced a significantly stronger illusion in the MS condition compared to the NI, NIT and UV conditions.

**Hypothesis 1a = supported**

**Hypothesis 1b = supported**

Experimental Results

**Hypothesis 2** - There will be a significant difference in SSEP response across electrodes of interest (F1 & FC1) across all conditions. There will be significant differences in SSEP response when comparing (2a) the MS condition to the NI condition, when comparing (2b) the UV condition to the NI condition, but (2c) not when comparing the NIT condition to the NI condition.

A Friedman test found a significant overall effect of condition.

**Hypothesis 2 = supported**

No differences were found using post hoc comparisons of each condition.

**Hypothesis 2a = unsupported**

**Hypothesis 2b = unsupported**

**Hypothesis 2c = supported**

Conclusions

- Significant differences in subjective experience were found between NI and MS illusion conditions, and EEG data measuring SSEP responses showed reduced amplitudes in illusory conditions compared to NI conditions, but without reaching statistical significance.
- Findings demonstrate a potential sharpening of neural representations as a result of illusory stretching in participants without chronic pain, providing a basis for investigations with a chronic pain population, who are thought to have more diffuse neural representations of their affected body parts.