Pain is fundamentally dependent on the brain’s capacity to localise the threat. To do this, the brain integrates somatosensory, visual, vestibular and proprioceptive input. Previous work\(^1\) reported that, during an illusion called the Disappearing Hand Trick (DHT), the participants did not perceive their disappeared right hand as threatened because it was disowned. However, without knowing the precise location of one’s own body part is it still possible to protect that part from threat? Where do the participants think their hand is during this trick?

**OBJECTIVE**

We aimed to investigate the role of vision and proprioception in the localisation of one’s own body part over time. In particular, we wanted to test whether in case of inaccurate vision, participants tend to rely sooner on proprioception, even though vision is initially prioritized.

### Experiment 1

16 healthy volunteers (9 males, mean age: 31±11 years) performed three main conditions with their eyes open or closed. The conditions were: (1) Incongruent: the participants saw their right hand moving inward (i.e. leftward), while it was actually moving outward (i.e. rightward). (2) Congruent Inward: the participants’ right hand was moving inwards and the position seen was congruent to the real position. (3) Congruent Outward: the participants’ right hand was moving outwards and the position seen was congruent to the real position. After each condition, the participants were asked to localise their hidden right hand over a 3-minute period. A questionnaire about the right hand sensations (e.g. about its position in space) was administered to the participants at the end of each condition.

### Results

![Graph showing error in localisation of the hand](Image)

The mean (SD) error in localisation of the hand during each condition.

**Random Effects ANOVA with Congruency** (Congruent Outward, Congruent Inward, Incongruent), **Arrow Direction** (Right, vs. Right to Centre) and **Time** (13 points over three minutes), yielded main effects of Congruency \((p<0.001)\) and Time \((p<0.005)\), and interactions: Congruency x Time \((p<0.001)\) and Congruency x Time \((p<0.001)\).

**Accuracy:** Error scores were converted into positive values, and a 2 (EO, EC) x 3 (Congruent Outward, Congruent Inward, Incongruent) repeated measures ANOVA yielded a main effect of Congruency \((p<0.001)\). Bonferroni-corrected pairwise comparisons \((p=0.0167)\) revealed that accuracy was significantly lower in the Incongruent condition than in both the Congruent Inward \((p=0.001)\) and Congruent Outward \((p=0.007)\) conditions.

**Questionnaire:** One-way repeated measure ANOVA was not significant \((n.s.)\).

### Experiment 2

18 healthy volunteers (10 males, mean age: 33±9 years) underwent the original Disappearing Hand Trick\(^1\) twice. During the localisation task, in one condition the arrow was starting from the centre of the screen and moving rightward (just as in Experiment 1), while in the other condition the arrow was moving at the same velocity but from the right hand side of the screen towards left. The task was exactly the same as described above.

![Graph showing drift](Image)

Repeated measures ANOVA with factors: **Arrow Direction** (Centre to Right, vs. Right to Centre) and **Time** (10 vs. 112) yielded a main effect of Time \((p<0.001)\) but no main effect of Arrow Direction \((p=0.093)\), nor a significant Arrow Direction x Time interaction \((p=0.107)\). That is, direction of arrow movement did not explain the results of Experiment 1.

### Conclusion

By introducing incongruence between the seen and actual positions of the right hand, our data showed a switch from vision-suggested to proprioceptively-suggested information. Also, we showed that when visual information becomes less reliable, and, possibly, when proprioception starts to become more stable, the participants switch from a visual-based localisation strategy to a proprioceptive-based one. These findings are of fundamental importance to our understanding of the movement and proprioceptive disorders that characterise chronic pain\(^4\), and for the recent discovery that experimentally disrupting the processes by which the brain localises a body part and therefore a noxious stimulus, can disrupt the pain itself\(^4,5\).

### Refs.


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**Where does it hurt? Untangling multisensory inputs for awareness of body location**

Valeria Bellan, Helen R. Gilpin, Tasha R. Stanton, Roger Newport, Alberto Gallace, G. Lorimer Moseley

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**Experiments**

**Methods**

**Results**

**Conclusions**

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**Visualisation**

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**CREDITS**

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