Aligned motion-direction information for touch and vision in the human brain

Shahzad I.* [1], Battal C.[1,2], Cerpelloni F.[2,5], Van Audenhaege A.[2], Mouraux A.[1], Collignon O.[1,2,3]

(1) Institute of Neuroscience (IoNS), Université Catholique de Louvain (2) Institute of Research In Psychological Sciences (IPSY), Université Catholique de Louvain
(3) HES-SO Valais-Wallis, The Sense Innovation and Research Center (4) Brain and Cognition, Leuven Brain Institute, KU Leuven, belgium

Introduction

Motion can be perceived through multiple senses like vision and touch. **Where does this motion information coming from different senses aligns in the brain?**

Since vision and touch are initially coded in different spatial frames of reference, it can be hypothesised that the tactile motion-directions can be remapped to a common external frame of reference in a region that is both visual and tactile motion selective.

In addition to processing visual motion signals, the middle temporal area hMT+/V5 selectively responds to tactile as well as auditory motion information. Here, we aim to identify the visual and tactile motion selective areas and study the representation of the directions across different frames of references in each of these areas.

Materials and Method

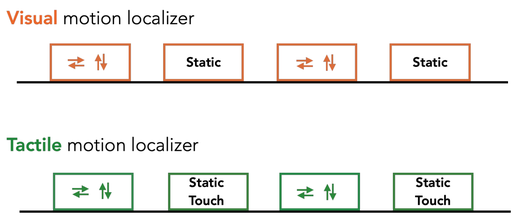


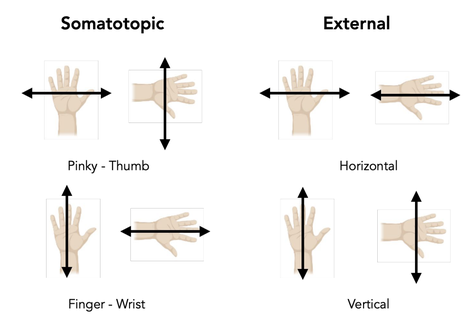
20 Healthy adults; right handed
2 sessions each
Tactile stimulation on right hand
Preprocessing and analyses: spm12 and bidspm toolbox
MVPA: coSMoMVPA

Stimuli

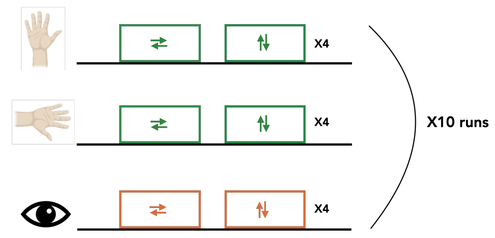


Experiment I: Motion localizers
(n= 18 subjects)



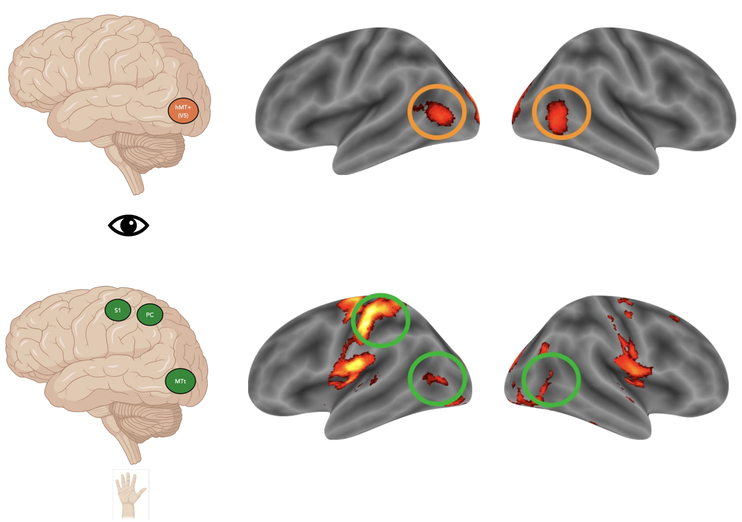


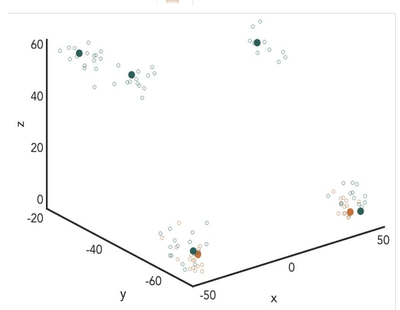
Experiment III: Directional motion decoding experiment
(n= 20 subjects)

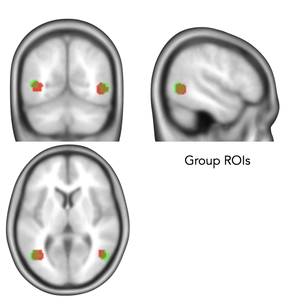


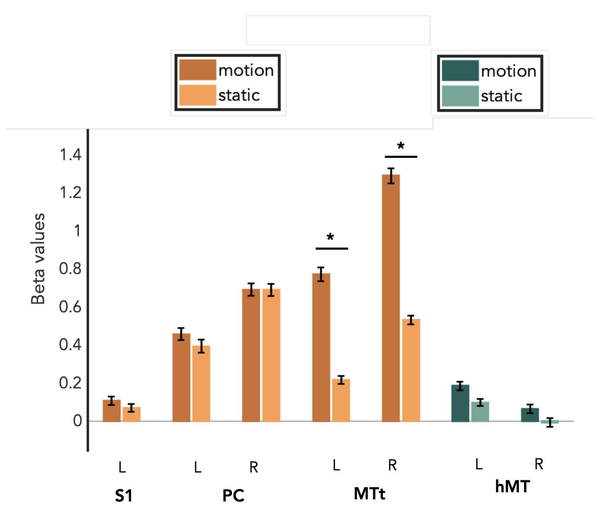
Results

Univariate Analyses

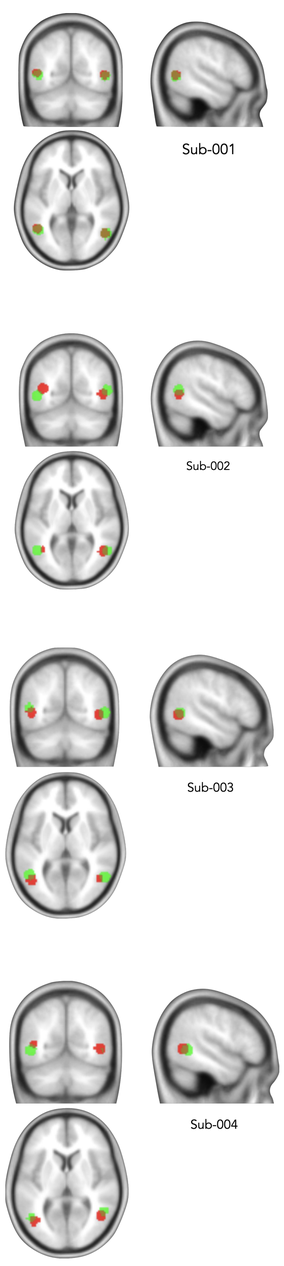




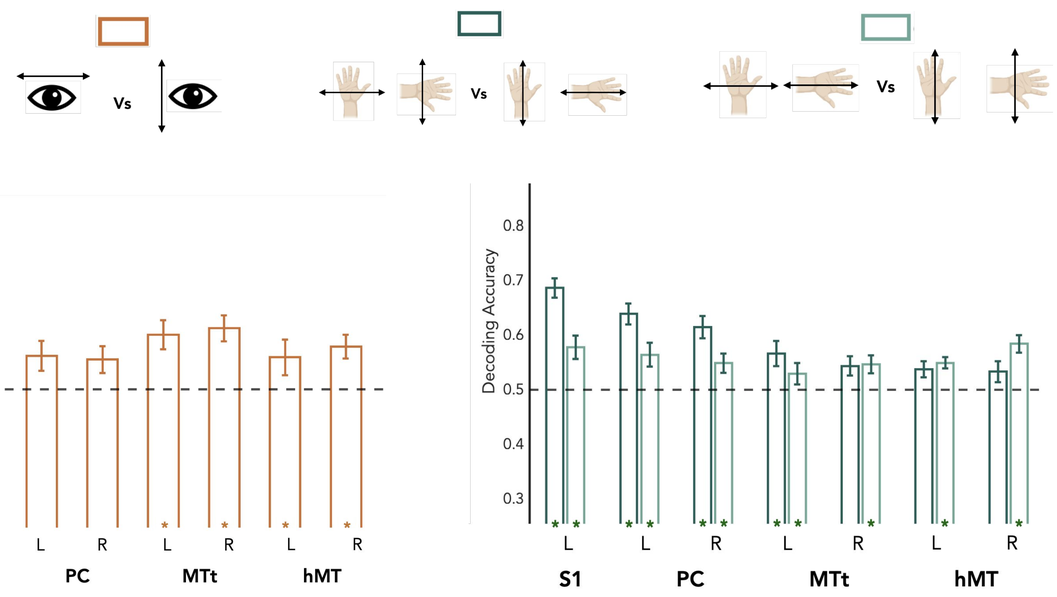


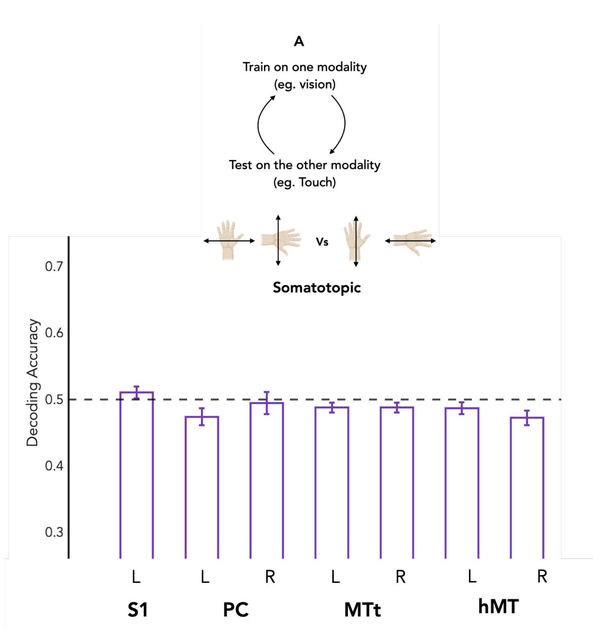


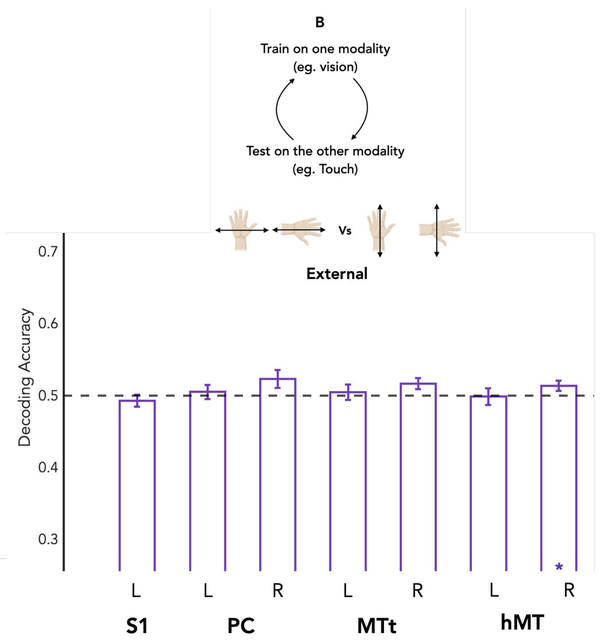
Regions of Interest (ROIs)



Multivariate Pattern Analyses (MVPA)







Conclusions

hMT/V5 is tactile motion selective.

Tactile motion-direction selectivity is observed in sensory specific as well as in the MT region.

Right hMT/V5 seems to code the tactile motion-directions in a representation that is similar to the visual motion-directions. This suggests that it uses a common external frame of reference.

References

- Hagen, M. C., Franzén, O., McGlone, F., Essick, G., Dancer, C., & Pardo, J. V. (2002). Tactile motion activates the human middle temporal/V5 (MT/V5) complex. *European Journal of Neuroscience*, *16*(5), 957-964.
- Huk, A. C., Dougherty, R. F., & Heeger, D. J. (2002). Retinotopy and functional subdivision of human areas MT and MST. *Journal of Neuroscience*, *22*(16), 7195-7205.
- Rezk, M., Cattoir, S., Battal, C., Occelli, V., Mattioni, S., & Collignon, O. (2020). Shared representation of visual and auditory motion directions in the human middle-temporal cortex. *Current Biology*, *30*(12), 2289-2299.

Acknowledgement

This project has received funding from the European Union's Horizon 2020 Research and Innovation Program under Marie Skłodowska-Curie Actions ITN Grant Agreement *No. 860114 (Project multiTOUCH)* and the Belgian Excellence of Science (EOS) program (*Project No. 30991544*).

iqra.shahzad@uclouvain.be