The role of tactile information on metacognitive representations of agency

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Introduction

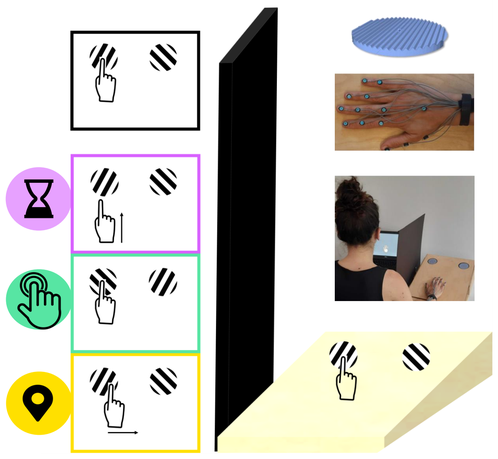
When we intentionally move our body, our brain compares the sensory predictions to the sensory consequences accompanying our actions. Only if these two match do we feel we are the agents of our actions.

Empirical studies often investigate this sense of agency by manipulating primarily visual representations of actions and then measuring participants' experience of control with subjective ratings.

There are two limitations to this approach. First, while most experimental manipulations focus on the visual consequences of movement, tactile information can and does also guide our movements by encoding properties of the external world. Second, subjective ratings are prone to response biases.

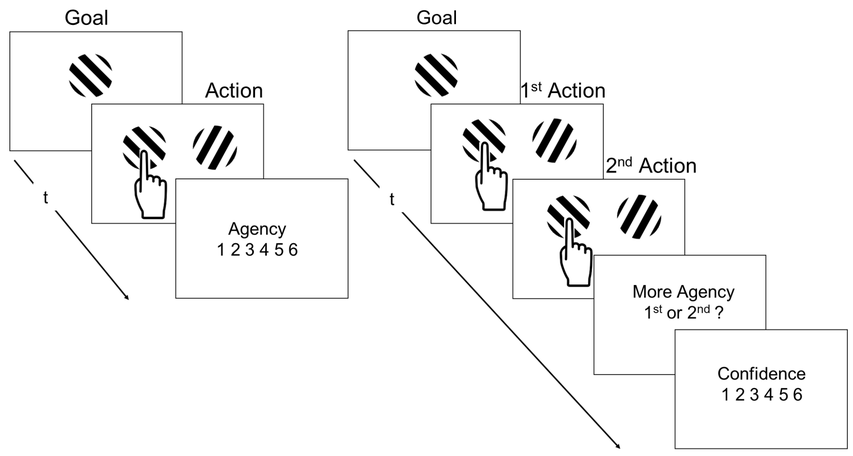
We address these limitations and tested whether agency judgments and metacognitive representations rely on tactile information, just like temporal and spatial information.

Methods



The basic motor task was the same: Participants reached with their right hand toward a textured surface

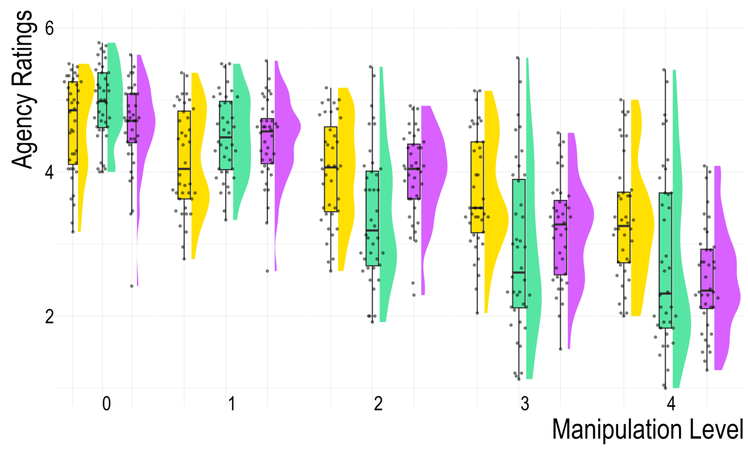
The online visual feedback matched or differed in one of three possible aspects::tactile, spatial and temporal .



On the agency task, participants acted once and then rated how much agency they felt they had.

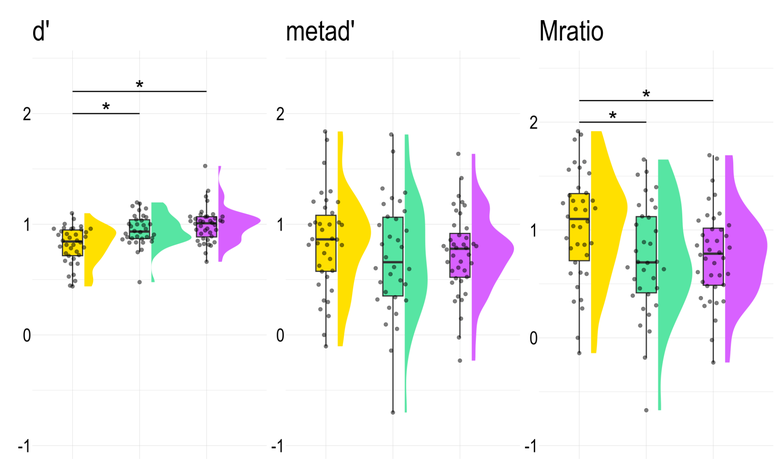
On the metacognitive task, participants acted twice, discriminated in which of the two intervals they felt more control over, and then rated their confidence in their own decision

Results



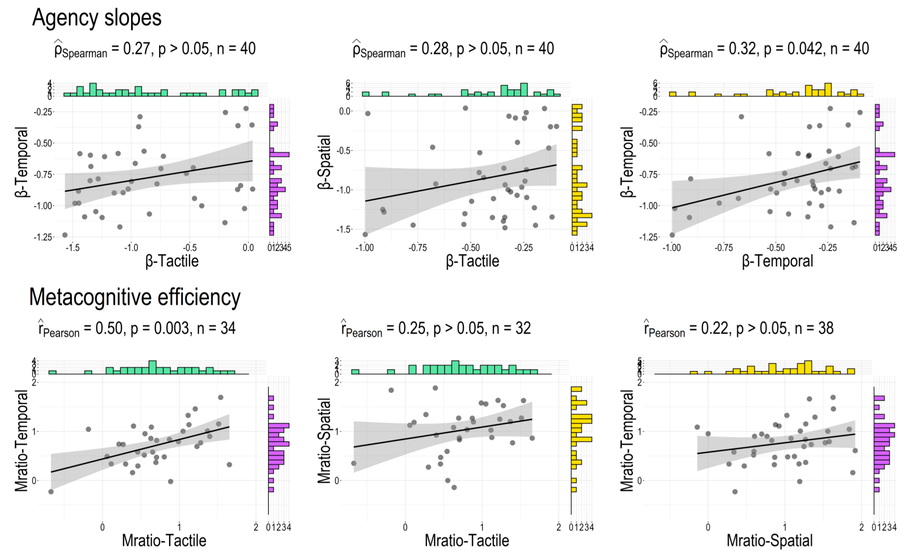
Agency Task

The agency ratings decreased as the level of magnitude of manipulation increased in all conditions. This result validates our experimental task and shows that violations of tactile predictions are processed similarly to others.



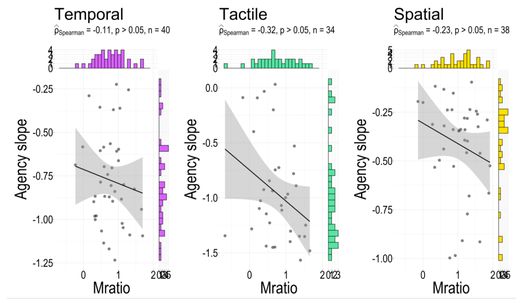
Meta-Agency Task

We found significant differences in d' and M-Ratio only between the spatial and tactile, spatial and temporal conditions. These results show that tactile information, similar to temporal but to a lesser degree than spatial, informed participants' metacognitive representations of agency.



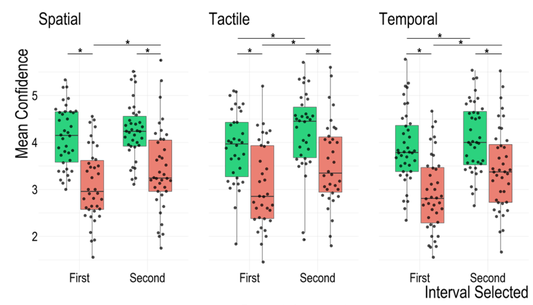
Correlating measures of agency sensitivity across conditions

Significant correlations only between temporal and spatial agency slopes and between tactile and temporal Mratios. This suggests that tactile and temporal information contributes through similar mechanisms to participants' metacognitive representations of agency.



Correlating measures of agency

Agency slope and Mratio. There is a negative, but not significant, trend between the metacognitive and subjective measures of agency.



Confidence bias

We found a three-way interaction effect on confidence between the condition, manipulated interval, and interval selected, indicating that response biases exist in the two-interval forced-choice tasks.

Discussion

- Given the ubiquitous tactile sensation that results from our movements, this study sheds light on a crucial but neglected aspect of our interaction with the world while maintaining tight experimental control.
- It also complements the recent approach that we and other groups have developed, aiming to investigate agency in relation to, and using tools borrowed from metacognition research.
- It shows that tactile predictions, like temporal and spatial predictions, contribute to participants' subjective and metacognitive representations of agency.
- Our experimental design can be further developed to address, for example, how different types of predictions computationally combine to create a unified experience of agency.

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