Applying a Novel Visual-to-Touch Sensory Substitution for Studying Tactile Remapping

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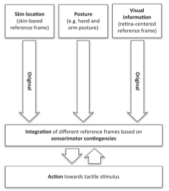
Introduction

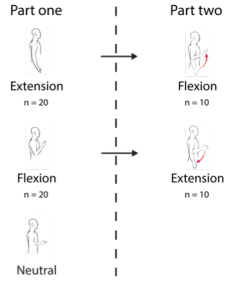
- Perceiving the spatial location and physical dimensions of objects that we touch is crucial for goal-directed actions. To achieve this, our brain transforms skin-based coordinates into a reference frame by integrating visual and proprioceptive cues, a process known as tactile remapping.
- One influential view considers tactile remapping as part of a wider process of acquiring sensorimotor contingencies. According to this theory, perception emerges through experiencing multiple co-patterns of incoming sensory signals coupled with outgoing motor actions towards stimuli.
- In the current study, we used Sensory Substitution Device to test the effects of switching body postures on tactile remapping in blindfolded participants.



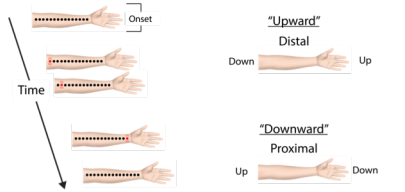
Heed et. al., 2015

Methods

Experimental paradigm

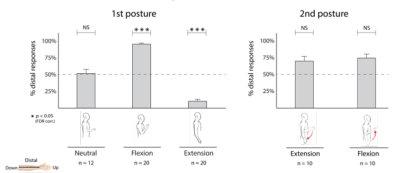


Stimuli

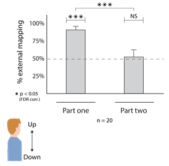


Results

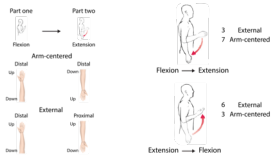
Group coordinate selection



Group reference frame selection



Single subject preferences



Discussion

- We found that participants' initial selection of reference frames was highly dependent on their posture, and not anchored to a specific anatomical location on the inner arm, such as the wrist or the elbow, but an external gravitational axis.
- After switching postures about half of the group maintained their previous reference frame, overriding the expected effect of the new proprioceptive information.
- This results is in contrast to a sensorimotor contingencies prediction, as participants are able to select new reference frames with little cognitive costs following the switch. Instead, we suggest that participants' explicit choices of reference frame can supersede incoming proprioceptive information.
- Top-down modulation can thus nullify bottom-up proprioceptive cues when choosing between reference frames and previously-stored representations can be abstracted from current sensory inputs.