The tool-use network supports actions independent of the acting body part

SENSORY AND MOTOR PLASTICITY LAB

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PREPRINT

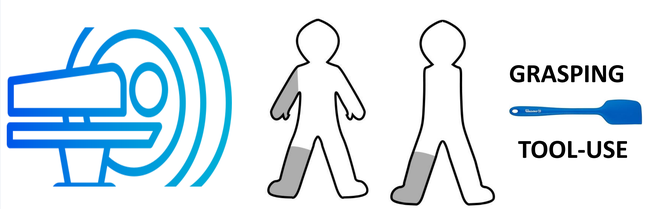
Organization of actions in the brain

- The sensorimotor system is broadly organized **somatotopically**.
- Yet, we can execute the same action with **different body parts**, suggesting there is a **motor plan that generalizes across certain action parameters**.
- Indeed, higher-level action regions (e.g. the **parietal lobe** and the **premotor dorsal areas**) represent more **abstract action information across motor parameters**.
- These association action areas support reaching and grasping actions when performed by other body parts. Does this generalization extend to **non-evolutionarily based actions**, like **tool use**?
- We tested if the tool-use network supports the generalization of action-type across body parts (hand and foot).

MOTIVATING QUESTION:
Does the brain support generalization across acting body parts for tool-use actions?

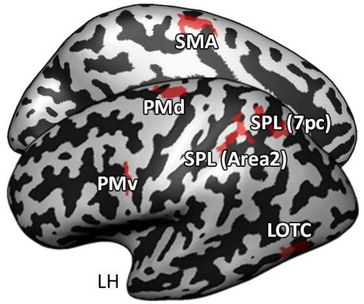
Methods and Approach

fMRI experiment of action execution:
n = 22 right-handed controls (5 excluded)
n = 8 individuals born without hands (IDs; 2 excluded)

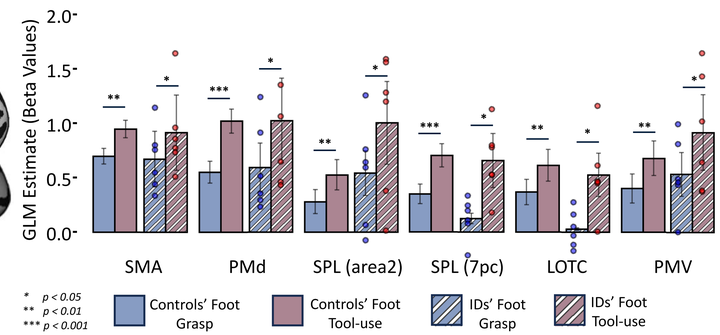


The tool-use network generalizes across body parts

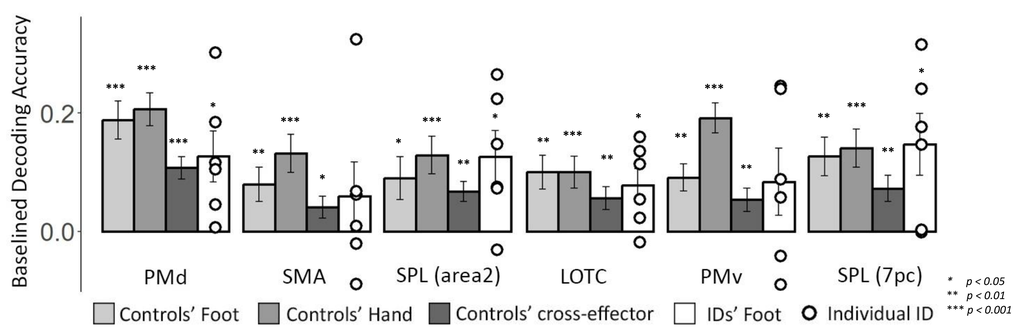
Hand tool-use selective regions



Hand tool-use regions show consistent tool-use preference in foot actions



Hand tool-use areas have a shared neural code between the hand and the foot

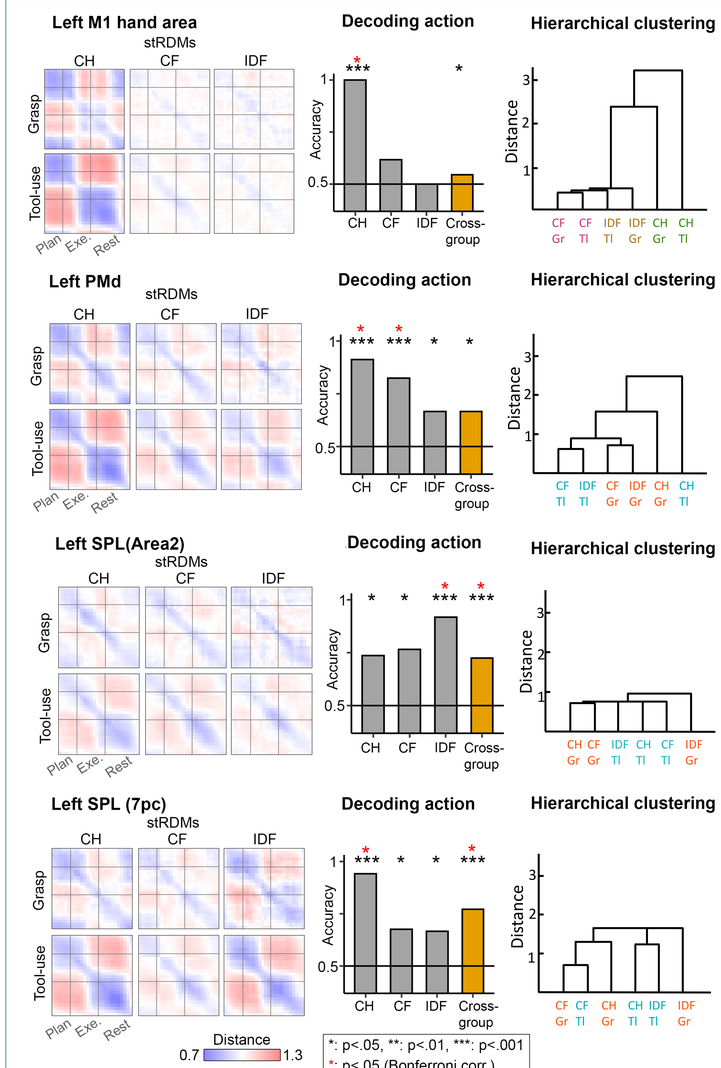


Hand tool-use areas generalize across body parts in motor association areas

Conclusions

- **Tool-use areas** defined from the hand execution data show a **preference for tool-use in foot actions, regardless of sensorimotor experience**
- The PMd, SPL (area2 and 7pc), and LOTC have a **shared neural code across the hand and the foot** in typically-developed participants
- Temporal analyses reveal a **hierarchical dissociation** between **lower-level M1** which groups by body part and **higher-level association areas** which instead tend to cluster by action-type

Temporal dynamics patterns cluster by action in association areas



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