

The neural correlates of actions: A meta-analytical perspective on motor domains and movement features

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Introduction

Distinct **motor domains** according to action modality:

- Action Execution [1]
- Action Imitation [2]
- Action Observation [3]
- Motor Imagery [4]
- Motor Learning [5]
- Motor Preparation [6]

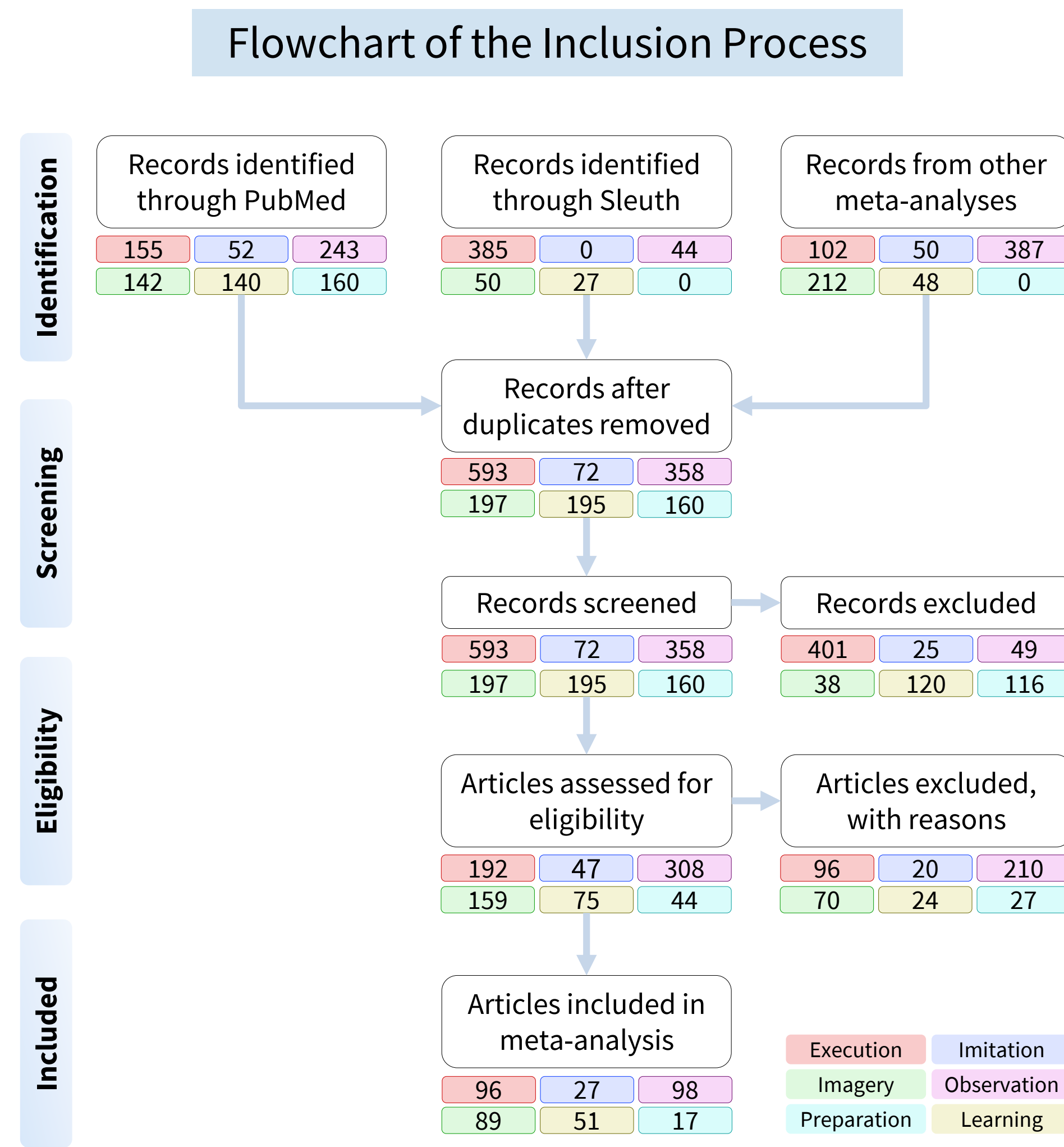
Distinct **features** characterizing action processing:

- Object-directedness [7]
- Sequentiality [8]

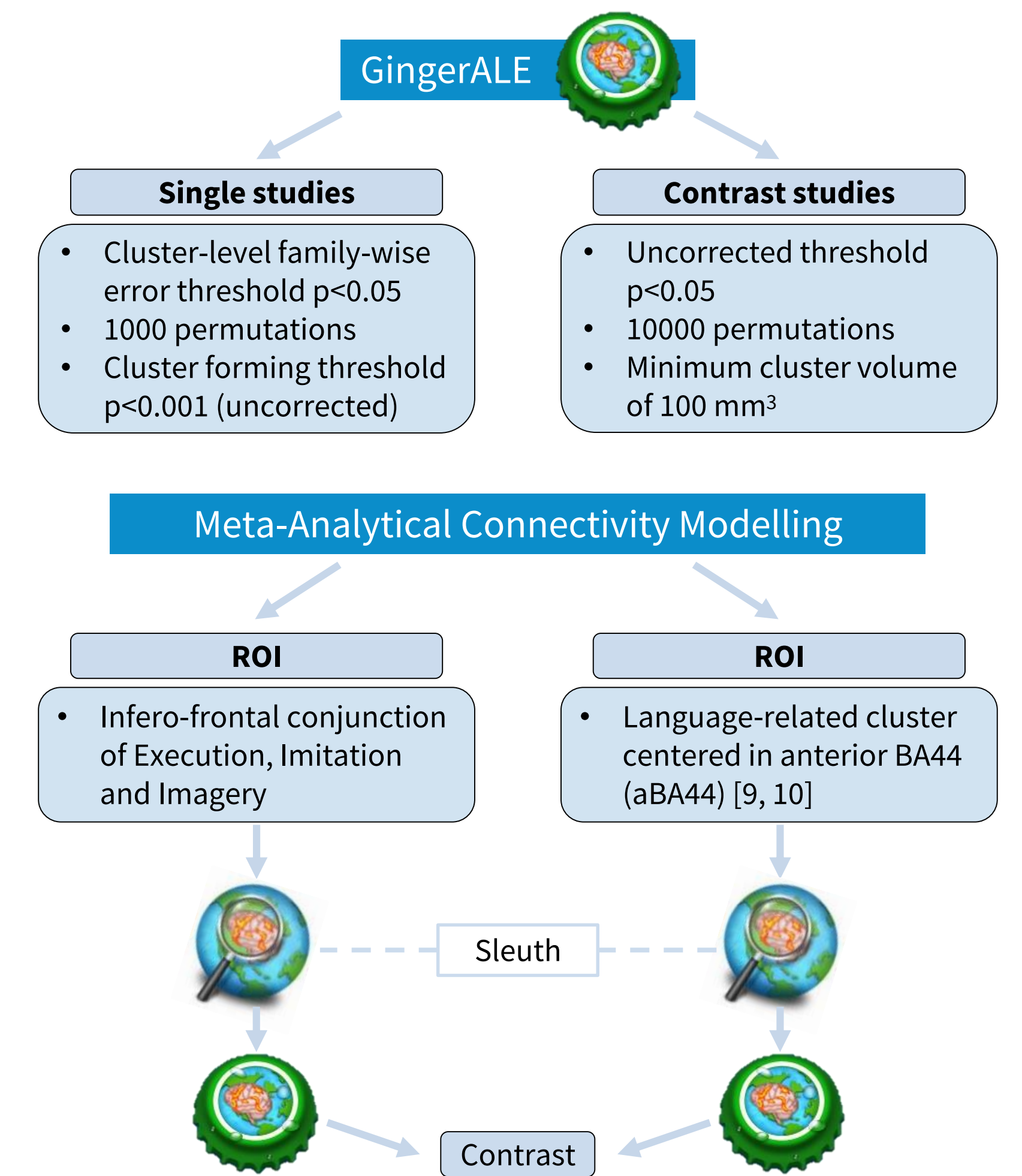
Research questions:

- How are the motor domains implemented in the motor regions and in the higher cognitive areas of the cerebral cortex?
- Do different action features involve different cortical networks?
- What is the role played by Brodmann Area (BA) 44 in the different domains of interest?

Methods



Methods



Results

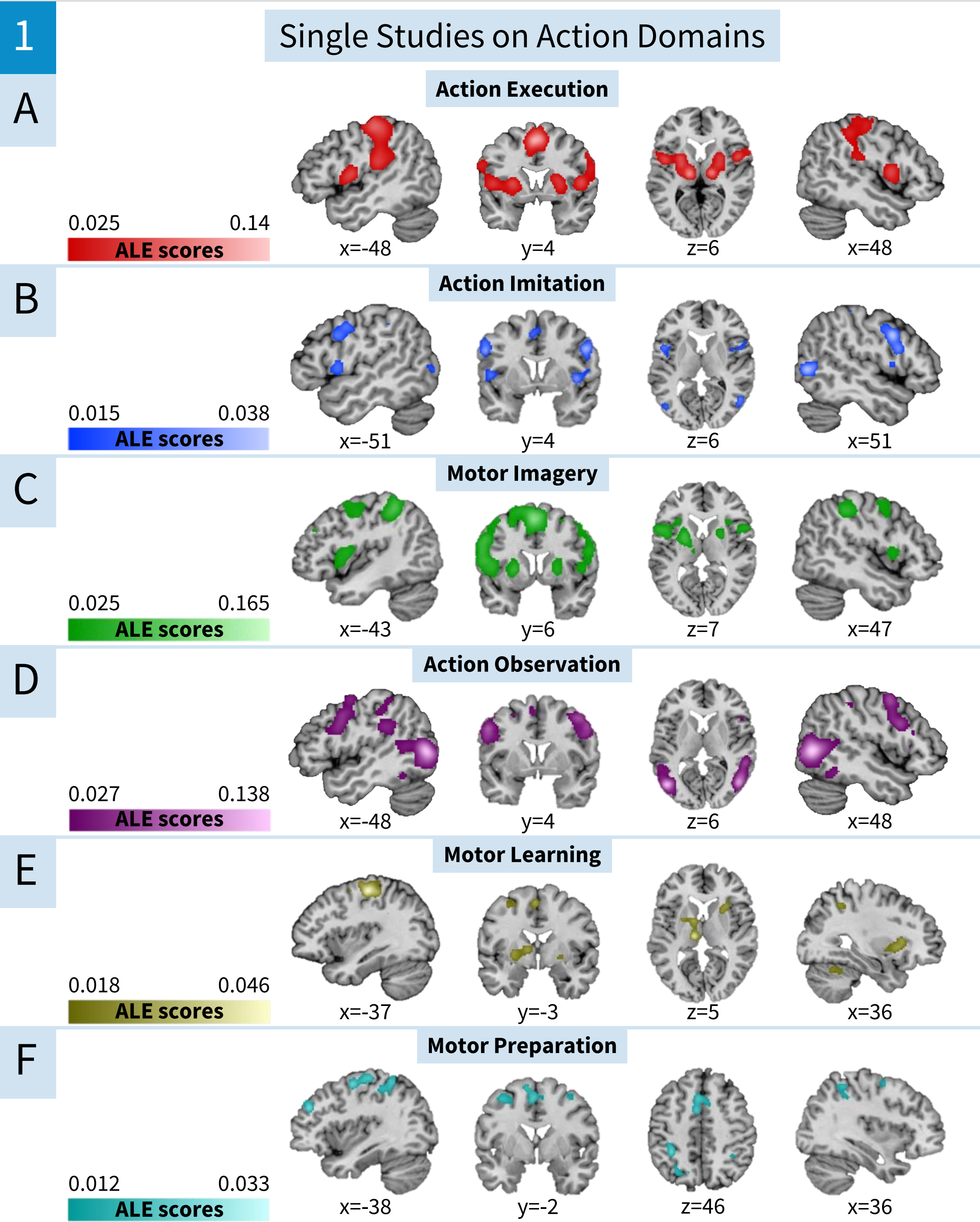


Figure 1. Overview of the significant clusters resulting from the six single studies: (A) Action Execution; (B) Action Imitation; (C) Motor Imagery; (D) Action Observation; (E) Motor Learning; (F) Motor Preparation.

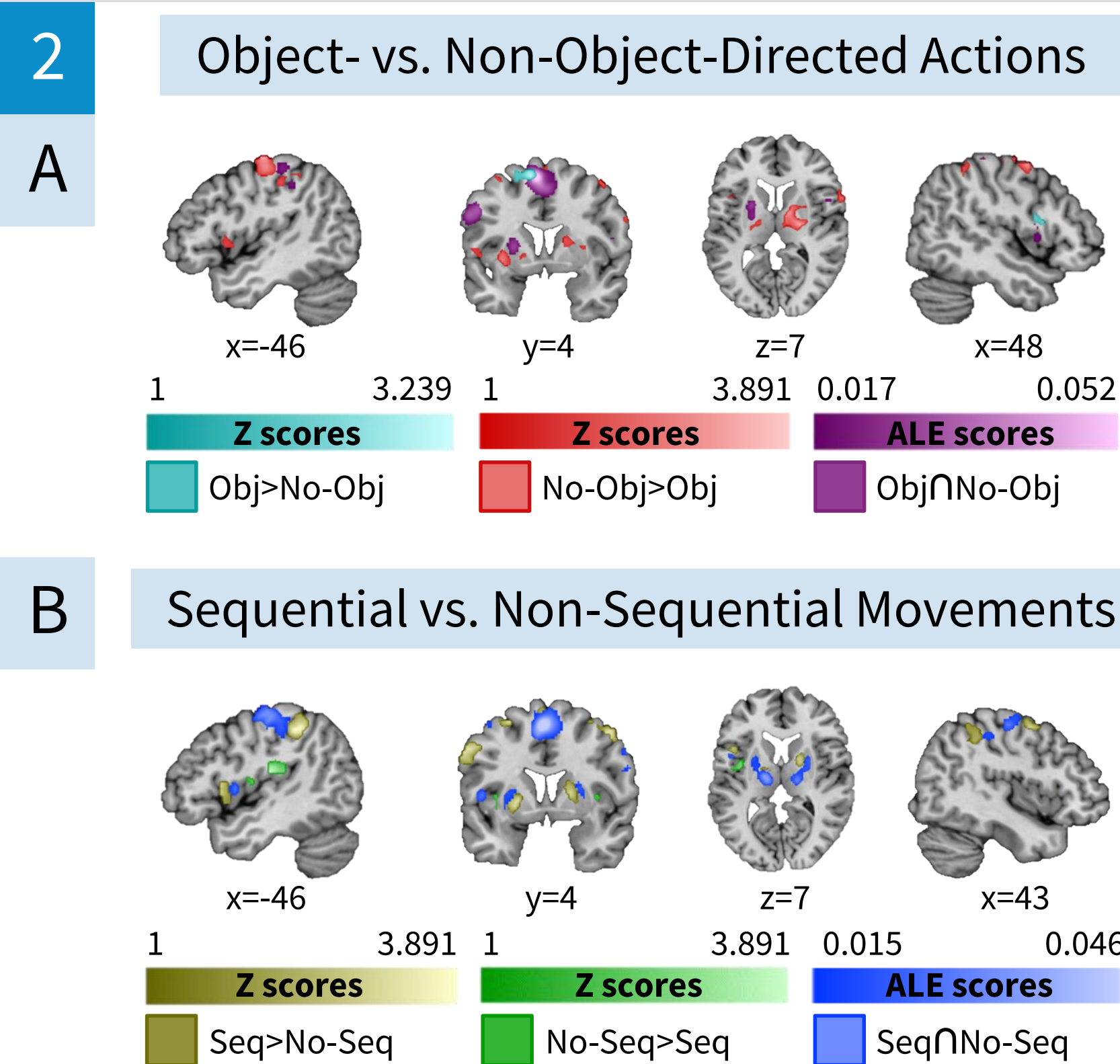


Figure 2. Overview of the significant clusters resulting from two different contrast analyses: (A) object-directed vs. non-object-directed actions; (B) sequential vs. non-sequential movements.

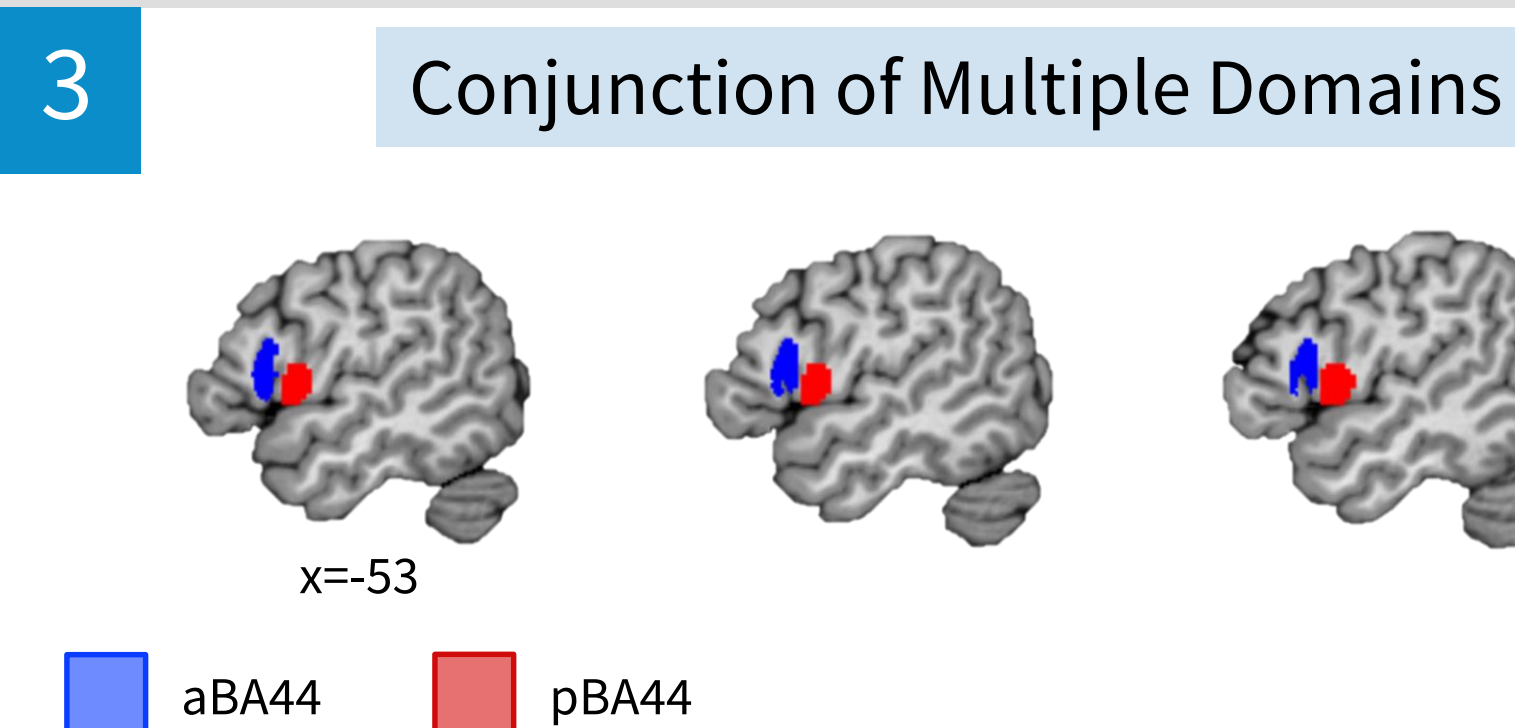


Figure 3. The conjunction of Action Execution, Motor Imagery and Action Imitation resulted in a cluster located in a poster sub-region of BA44 (pBA44; red), distinct from the language-related sub-region of the area (aBA44, blue).

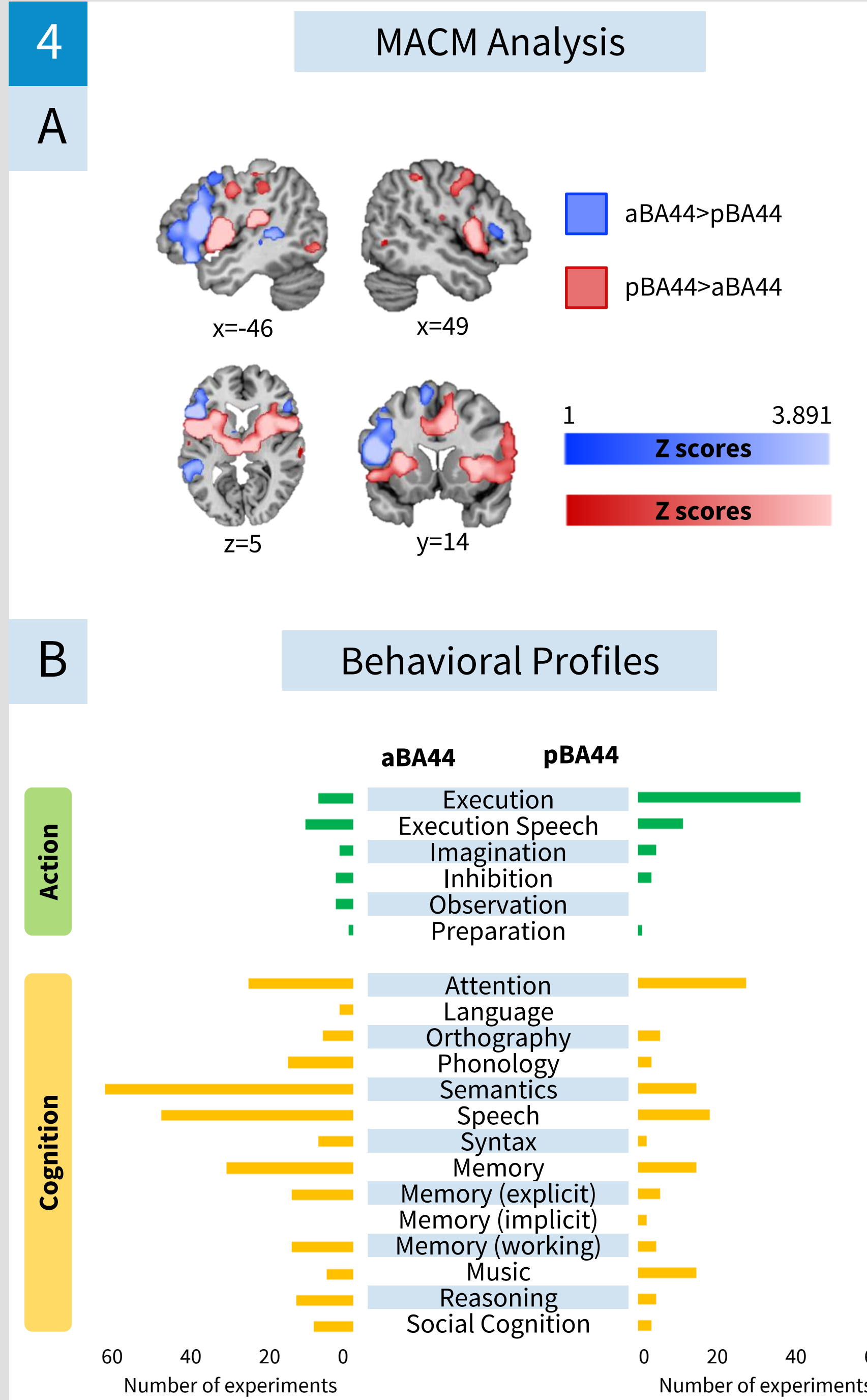


Figure 4. (A) Overview of significant clusters resulting from the MACM analysis: aBA44 vs. pBA44 (blue), pBA44 vs. aBA44 (red). (B) Histograms of the behavioral profiles associated with each of the seed regions: aBA44 (left), pBA44 (right).

Discussion

- Distinct functional patterns for different motor domains, with cross-modal convergence for Action Execution, Motor Imagery and Action Imitation in different brain areas, including pBA44 of the left Inferior Frontal Gyrus (IFG).
- Fine-grained analyses in pBA44 suggest that neural activity in the region is most strongly associated with non-object-directed actions, regardless of a sequential structure.
- The involvement of BA44 is not to be linked to the presence of an object over which to operate. Rather, it could be related to the active processing of time-locked action features [11].
- The functional connectivity network identified from seeding in the motor-based localized cluster of pBA44 is significantly different from the connectivity network seeding in the (language-related) anterior BA44.
- Our results question the role of the left IFG as a domain-general hub for processing syntactic complexity and simultaneously fail to support a mirror neuron hypothesis of action processing.

References

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