Parcellating the social, cognitive, and motor topography of the cerebellum

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Introduction

- Historically the cerebellum (CB) has been associated with motor function. Recent findings indicate that it plays a role in aspects of cognition (Leiner, Leiner, & Dow, 1986; Middleton & Strick, 1994; Schmahmann, 1991, 1997, 1998; Schmahmann & Pandya, 1989, 1997)
- Guell et al. (2018) recently analyzed the HCP dataset and reported distinct CB activations at the cluster level for various tasks.

Goal

To extend Guell et al. (2018) by asking whether, using different thresholds and quantification methods, there are distinct functional subregions in the cerebellum.

Methods

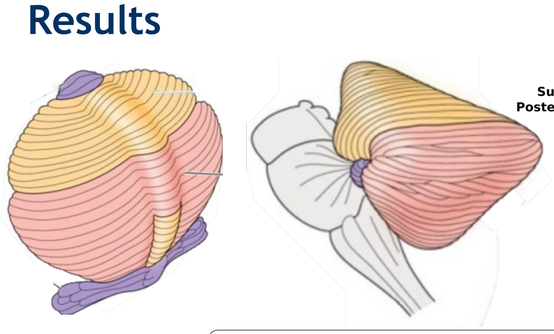
Participants:
900 subjects (final sample = 671; 21-35 years old) from the Human Connectome Project dataset

T1w
Task fMRI

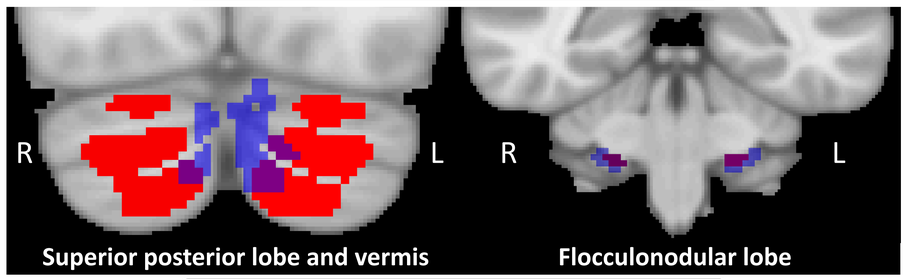
- Theory of Mind
- Emotion processing
- Language
- Motor
- Relational memory
- Working memory

(1) Cluster creation based on task activations
(2) Sørensen–Dice coefficient calculation for cluster overlap
(3) Local maxima extraction within each cluster activation
(4) Euclidean distance calculation between local maxima

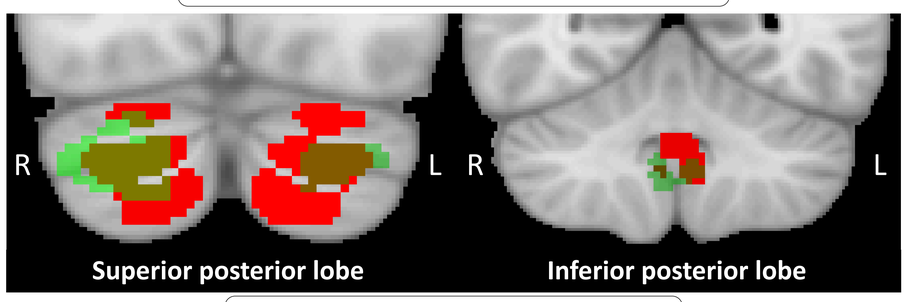
Results



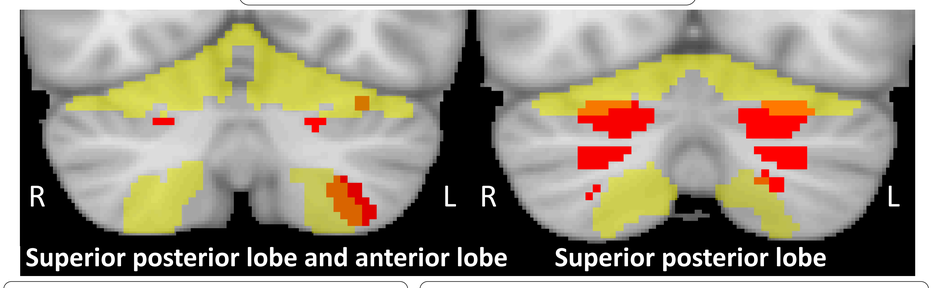
Social Emotion overlap 18.66%



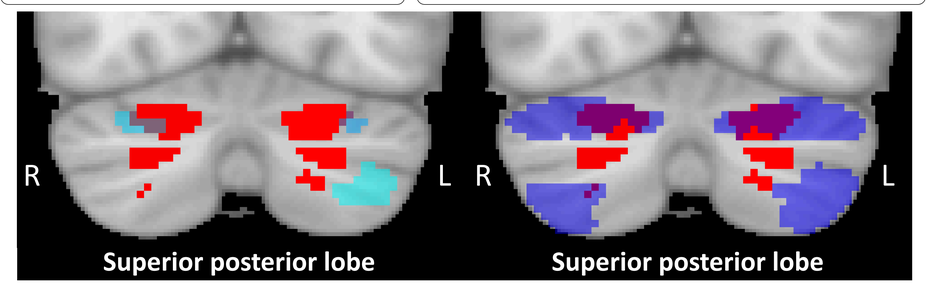
Social Language overlap 45.17%



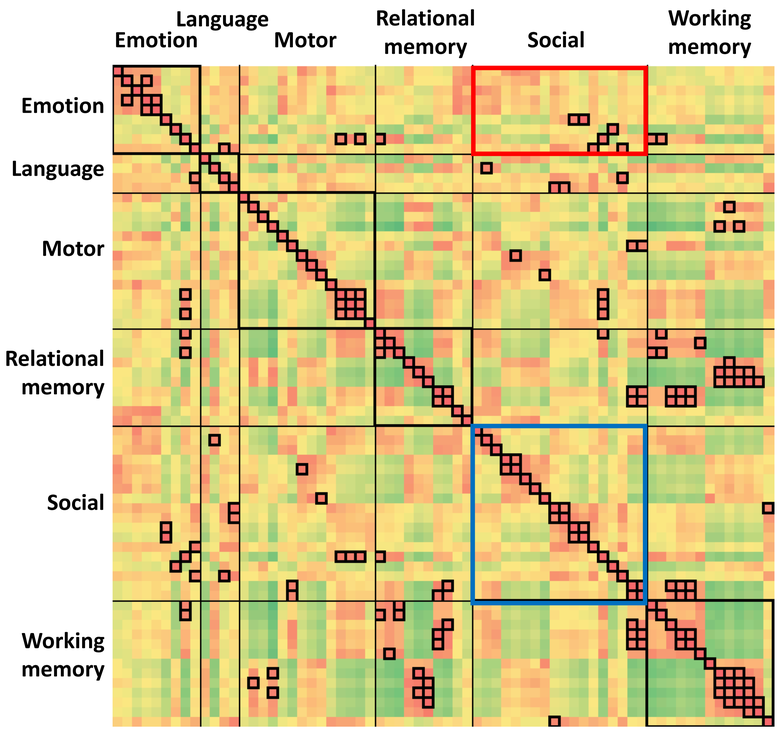
Social Motor overlap 5.5%



Social Relational overlap 2.89% | **Social Working Memory overlap 11.76%**



Cluster local maxima Euclidean distance



Each box contains the Euclidean distance between local maxima of clusters of one task (eg. blue box: distances between local maxima found in the social clusters) or between tasks (eg. red box: distances between local maxima found in the social and emotion clusters).
The small boxes with a thick, black outline are Euclidean distances <8.5mm, which is the standard deviation of the mean of all distances.

Findings

1) Cluster triple representation of social processing in posterior lobe, flocculonodular lobe, and vermis (consistent with Guell et al. (2018))
2) **Euclidean distances of local maxima offer additional certainty that the cerebellum's topography corresponds to a domain specific way of functioning**

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