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SUPPLEMENTARY INFORMATION

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Functional boundaries in the human cerebellum revealed by a multi-domain task battery

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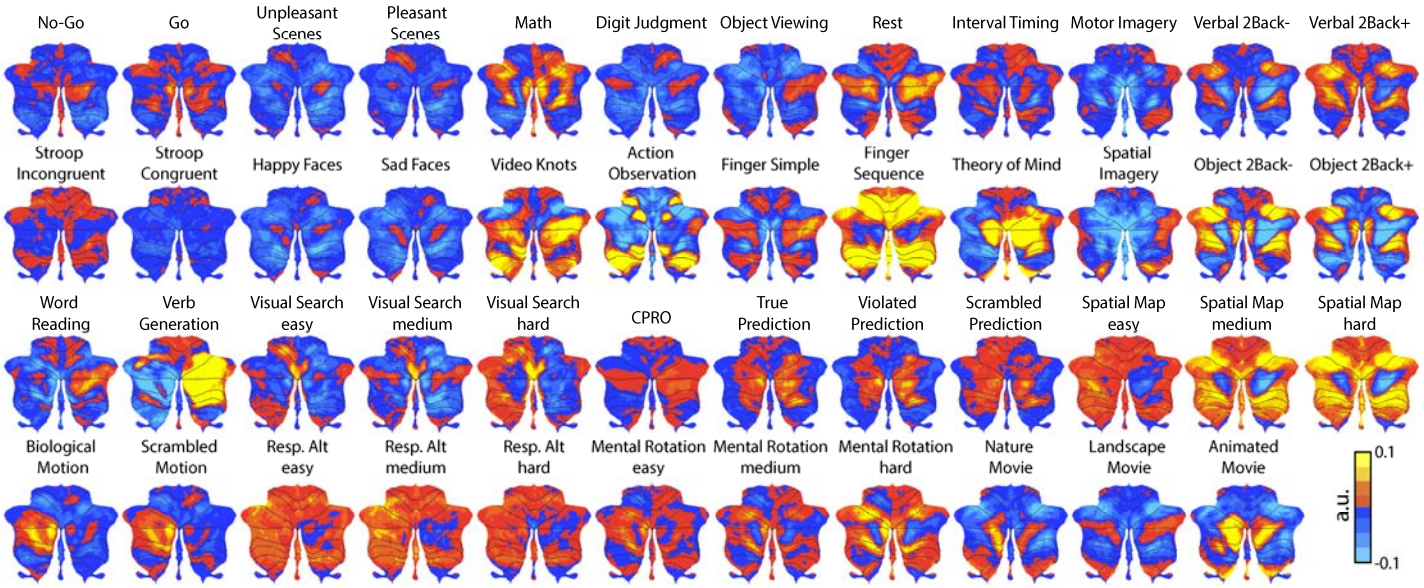
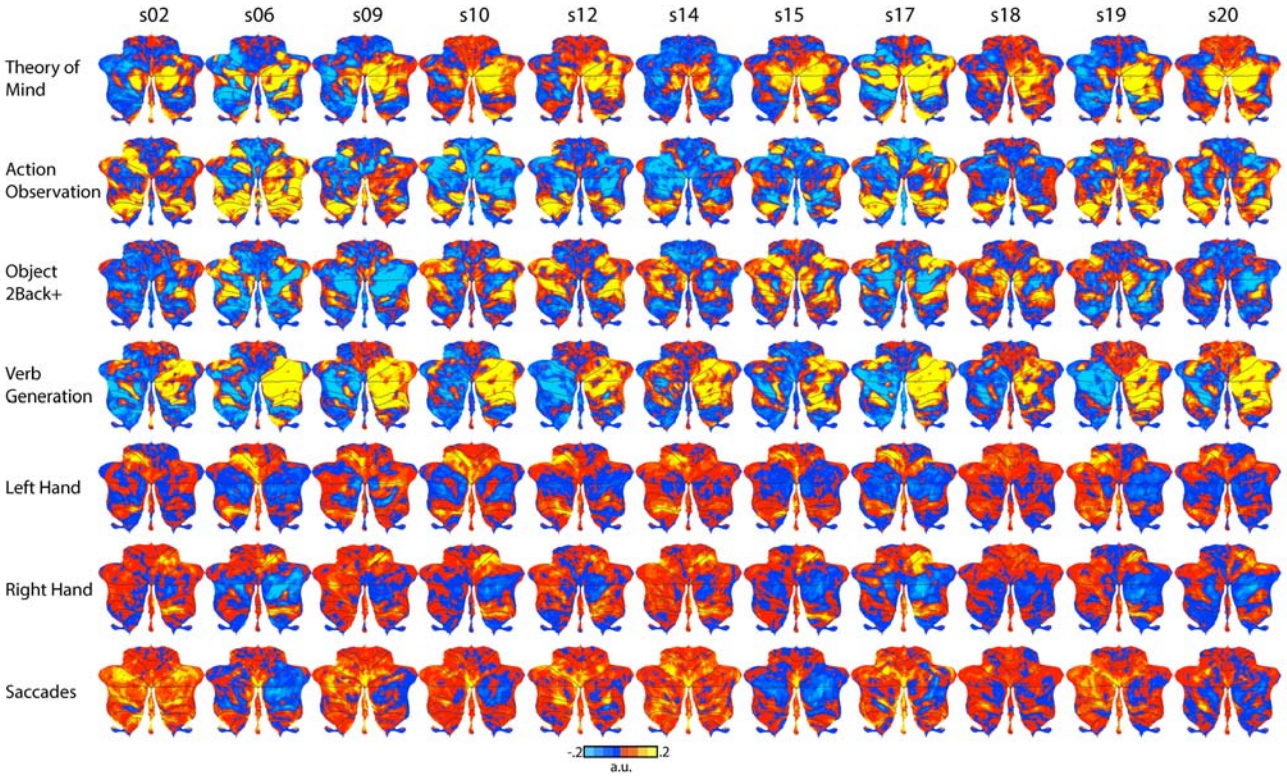


Supplementary Figure 1

Unthresholded, group-averaged activation maps for the 47 unique task conditions displayed on a surface-based representation of the cerebellar cortex[14].

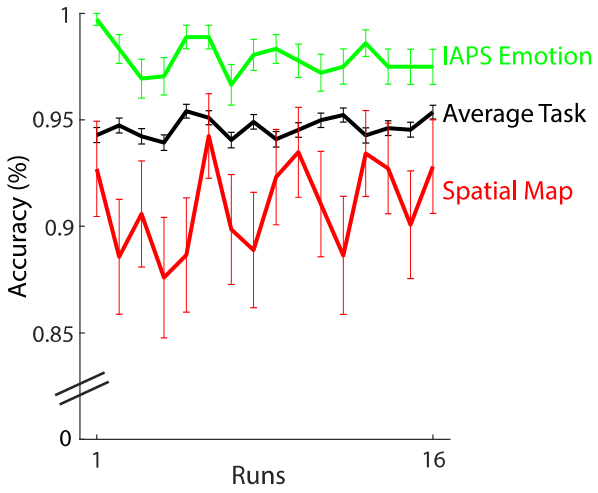
All activations are calculated relative to the mean activation across all conditions. Red-to-yellow colors indicate increases in activation and blue colors indicate decreases in activation. Activity is normalized by the root-mean-square-error of the time-series fit for each voxel.



Supplementary Figure 2

Unthresholded, individual activation maps for 4 representative tasks and motor feature maps for 11 representative participants.

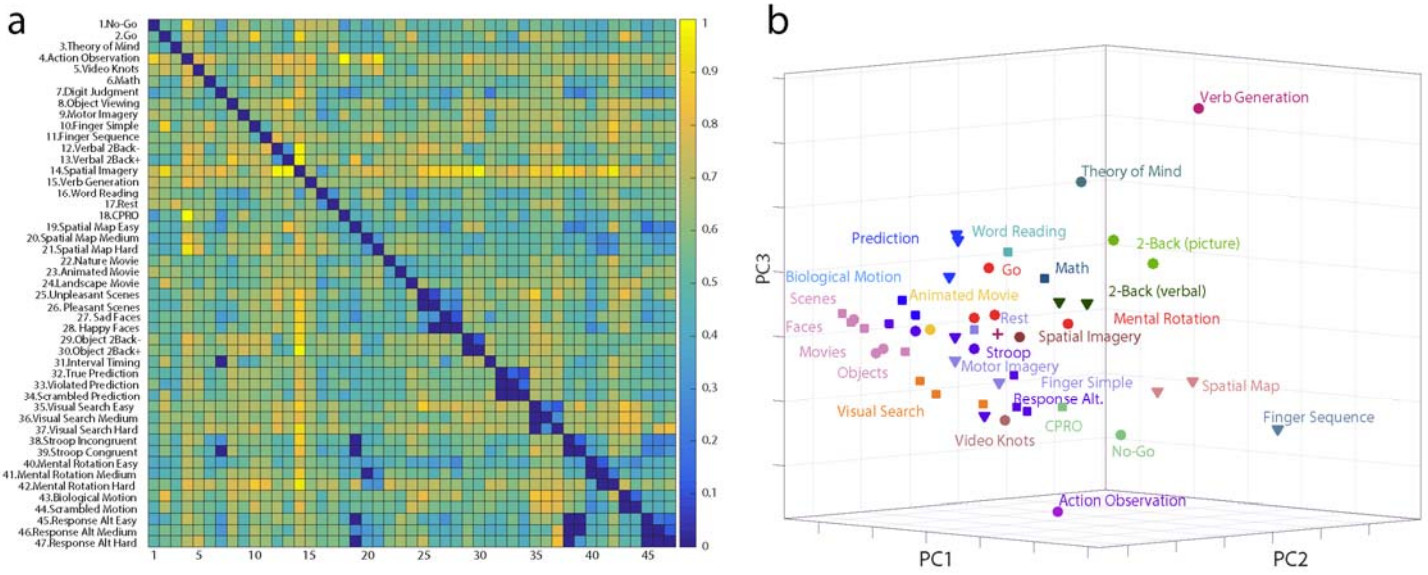
All activations are calculated relative to the mean activation across all conditions. Red-to-yellow colors indicate increases in activation and blue colors indicate decreases in activation. Activity is normalized by the root-mean-square-error of the time-series fit for each voxel.



Supplementary Figure 3

Stability of task performance.

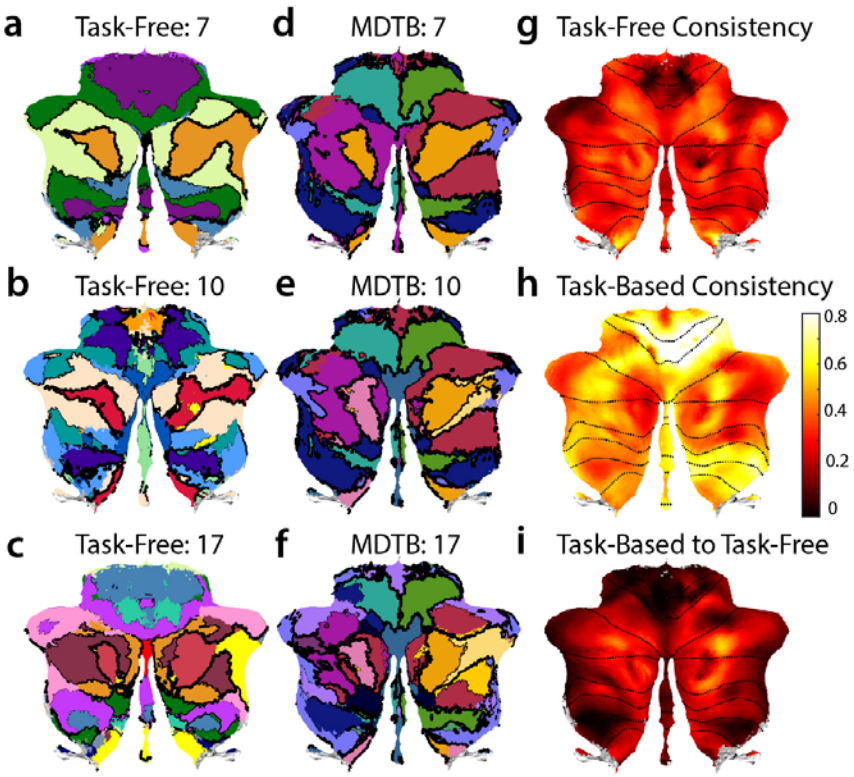
Percent accuracy, averaged across two scanning sessions, each composed of eight runs. Average across all tasks is shown in black. Poorest performance was on the spatial map task (red line) and best performance was on the IAPS emotion task (green line). Error-bars indicate between-subject (N=24) standard error.



Supplementary Figure 4

Representational task space for 47 unique task conditions.

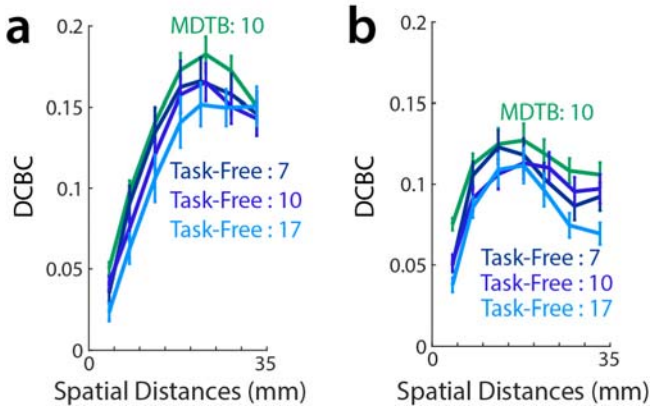
(a) *Group-averaged representational dissimilarity matrix (RDM) data for the unique 47 task conditions. Shared tasks are averaged across the four scanning sessions. Dark blue represents low dissimilarity between pairwise task-evoked activity patterns while high distances (bright yellow) represent high dissimilarity between pairwise task-evoked activity patterns. Thresholded values are shown below the diagonal (dark blue cells indicating pairwise comparisons between task conditions were not significant (p<.001, e.g., pleasant and unpleasant scenes).* ***(b)*** *A multi-dimensional scaling plot (MDS, using first three PCs for display purposes), showing the relative similarity of the task-evoked activity patterns after correction for activity related to basic motor output. Hierarchical clustering was applied to the tasks, with colors in both the RDM and MDS indicating cluster membership.*



Supplementary Figure 5

Comparison of task-based and task-free parcellations.

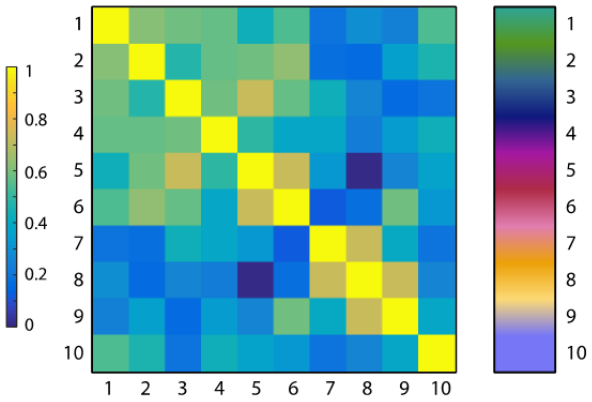
*7, 10, and 17 region parcellations derived from task-free HCP **(a-c)** and MDTB **(d-f)** data. **(g)** Average Rand coefficient between task-free parcellations, computed locally (1cm sphere) around each cerebellar voxel. **(h)** Average Rand coefficient between MDTB parcellations. **(i)** Average difference of Rand coefficients for the MDTB and task-free parcellations.*



Supplementary Figure 6

Cross-validated evaluation of MDTB parcellation on a subset of 7 tasks, selected to be most dissimilar to task conditions included in the data set.

For comparison purposes, task-free parcellations are evaluated on the same tasks. ***(a)*** *MDTB parcellation trained on Set A and evaluated on 7 tasks from Set B (Mental Rotation Easy, Mental Rotation Medium, Mental Rotation Hard, Spatial Map Medium, Spatial Map Hard, Animated Movie, and Nature Movie).* ***(b)*** *MDTB parcellation trained on Set B and evaluated on 7 tasks from Set A (Sad Faces, Interval Timing, Go, Theory of Mind, Word Reading, Motor Imagery, Math). Error-bars indicate between-subject standard error (N=24).*



Supplementary Figure 7

Pearson correlation between the task-profiles of the 10 regions of the MDTB parcellation.

The values in the correlation matrix are scaled between 0 (blue) and 1 (yellow). The bar on the right denotes the colors of each of the 10 regions (see Fig 5).

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Task Name	Task Description	Dataset	Conditions	Hand Assignment
Object Viewing	Passive viewing, pictures of objects and a checkerboard pattern.	A		None
Motor Imagery[39]	Imagine playing a game of tennis.	A		None
Stroop[40]	3AFC, indicating color of stimulus word (3 colors), comparing conditions in which color-word mapping is congruent or incongruent (Stroop task).	A	Congruent Incongruent	Both
Verbal Working Memory[41]	2AFC, indicating if current stimulus in stream of letters matches letter displayed two items previously (2-back).	A	2-Back 0-Back	Left
Interval Timing[42]	2AFC, indicating if a tone is short (100ms) or long (175ms)	A		Right
Arithmetic[43]	2AFC, indicating if simple multiplication equations (e.g. 2x7=14) are correct or incorrect. For control task, participants view a series of four numbers and indicate presence/absence of target number (e.g., 1).	A	Math Digit Judgment	Right
IAPS affective[44]	2AFC, indicating if picture (scenes, animals, foods) is pleasant or unpleasant.	A	Pleasant Scenes Unpleasant Scenes	Left
IAPS emotion[44]	2AFC, indicating if picture depicts sad or happy face.	A	Happy Faces Sad Faces	Right
Go/No-Go[45]	Go-NoGo task with positive (Go) or negative (No Go) words.	A	Go No Go	Left
Theory of Mind[46]	2AFC to indicate if short story contains true or false belief (Theory of Mind task)	A & B		Left
Rest	Passive viewing of fixation cross.	A & B		None
Object N-Back[43]	As above, with objects instead of letters (2-back).	A & B	2-Back 0-Back	Right
Verb Generation[47]	Verb generation task requiring covert responses to visually-presented nouns, either repeating the stimulus (Read) or generating a verb associated with the noun (Generate).	A & B	Verb Generation Word Reading	None
Spatial Imagery[39]	Imagine walking from room to room in childhood home, with a cue specifying the path to be taken (e.g., "Imagine walking from the kitchen to the bedroom, stopping to look around at different rooms").	A & B		None
Motor Sequence[48]	6-element sequence, either requiring one key press with each of six fingers (bimanual) or repetition of a single key press with one finger (unimanual left or right).	A & B	Finger Sequence Finger Simple	Both
Action Observation[49]	Passive viewing of videos of knots being tied, learning the name of the knot (presented at top of screen) for a latter recall test.	A & B	Video Actions Video Knots	None

Visual Search[50]	2AFC, indicating if target stimulus ("L") is present among distractors ("T"), with varying set size (4, 8, 12).	A & B	Small (4) Medium (8) Large (12)	Left
Spatial Map	Memorize a spatial mapping of numbers (either, 1, 4, or 7) for subsequent recall	B	Easy (1) Medium (4) Hard (7)	Both
Mental Rotation[51]	Mentally rotate target object to determine whether it can be brought into alignment with baseline object. Difficulty is measured by angular disparity between target and baseline image. Stimuli were obtained from Ganis and Kievit (2015)[52]	B	Easy (0) Medium (50) Hard (150)	Right
Biological Motion[53]	2AFC to identify intact point-light walkers (either happy or sad) or scrambled walkers (fast or slow). Stimuli obtained from Troje et al. (2017)[53]	B	Biological Motion Scrambled Motion	Right
Concrete Permuted Rules Operations (CPRO)[54]	Apply task-rule set (logic, sensory, & motor rules) to two consecutively presented stimuli (rectangles: either red or blue, vertical or horizontal)	B		Both
Word Prediction[55]	2AFC task to indicate if five sequentially-presented words comprise a semantically meaningful sentence. Stimuli obtained from D'Mello et al. (2017)[56]	B	Prediction Prediction Violated Prediction Scrambled	Left
Response Alternatives[57]	Execute a fast motor response to an imperative signal (white cross) that appears in one of 1, 2, or 4 primed positions	B	Easy (1) Medium (2) Hard (4)	Both
Nature Movie[58]	Passive viewing of a nature clip of kickboxing kangaroos, taken from "Planet Earth II: Islands"	B		None
Animated Movie[59]	Passive viewing of an emotional love story between two characters from the Pixar movie "Up"	B		None
Landscape Movie[58]	Passive viewing of an aesthetically-pleasing clip that depicts a diverse scenery, taken from Vimeo	B		None

Table S1. *Task set description for all 26 unique tasks and 47 unique conditions. Tasks that require overt motor responses are executed either with the left, right, or both hands.*

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