Electronic Supplementary Materials

1. Task protocols

All tasks were scripted in MATLAB 2009b using PsychToolbox 3.0.9. Tasks were run on a MacBook Air. The scanner screen width was 43 cm (1024x768 pixels) and display had a refresh rate of 75 Hz. Participants viewed the screen at a distance of 88 cm. Pixels-per-degree of visual angle were calculated to be 37.29.

Tasks in the Passive task set required no overt response during the active task period. For the Sensory and Word tasks, participants practiced the relevant response mappings before the beginning of each task with sample trials as well as in response to verbal cues by the experimenter until it was judged that they could perform the response mappings with automaticity. Additional details of the tasks can be found in the following sections.

To mitigate potential fatigue as well as to maximize the number of distinct tasks that we could collect in a single session, we opted for short (3 min 57 sec) scans, of which only the middle 3 minutes were active task blocks. Nevertheless the session was long and we made sure to interact verbally with the participant in between each scan, using questions that allowed us to assess their vigilance and comfort levels throughout the session.

(a) Passive tasks. In the **Count** task, participants silently counted backwards from 1000 by threes. At the end of the run they were asked to verbally report the number they had reached. In the **Imagine** task, participants were told to imagine living out the next day, starting from the time they woke. They were to imagine events in as much detail as possible while always remaining in the first person perspective. At the end of the run they were asked to report what time of day they had reached. A third **Fixate** task consisted of passively fixating the central crosshair. At the end of the run they were asked to report if they had been able to successfully maintain fixation during the scan. Finally, the **Monitor** task required participants to continue to fixate the center crosshair while broadening their attention covertly to take in the whole screen. Participants were instructed to monitor for the possible appearance of a rare, briefly presented (200 msec) small dot. It was emphasized that there was no need to count, remember the location, or otherwise keep

track of any dots they perceived. Before the scan commenced, participants were shown a short (30 sec) training presentation in which dots appeared at several different locations at random intervals. At the end of the task run they were asked to report whether they had noticed any dots. In no instance were dots actually presented during the run, rendering this task perceptually identical to the other tasks.

(b) Sensory tasks. For all tasks, practice trials were conducted during short test functional run sequences to ensure that scanner noise was constant across practice and task runs. Conditions were counterbalanced within and across pairs. Stimuli were presented at a rate of 1 Hz.

For the **Auditory** tasks, participants were to indicate whether they perceived a complex tone on the left or right, corresponding to a button press with the index finger of their left or right hand. In actual fact, auditory stimuli were presented to both ears with an interaural phase difference to simulate localization about 7° from central fixation. Participants confirmed during practice trials before the task run as well as after the scan in post-session debriefing that they perceived tones to be lateralized.

Complex stereo tones were generated using MATLAB and delivered to participants through MRI-compatible Sensimetrics earphones. The tone consisted of a fundamental frequency of 650 Hz and its corresponding second (1300 Hz) and third (1950 Hz) harmonics. The sample rate was set at 44100 Hz. Sound localization was achieved through interaural phase differences in each ear to simulate an interaural time difference. An interaural time difference of 0.4 msec was used to simulate localization in space of approximately 7° degrees from center. Tones were 250 msec duration and participants had up to 1 sec to respond. The high-fidelity condition consisted of tones presented at a volume of 45% of the maximum volume output of the Apple MacBook Air laptop used for presentation of stimuli. Low-fidelity volumes were determined using a 2-Down-1-Up staircase protocol with a 0.25 discount rate. The auditory staircase procedure was conducted in the scanner at the start of the Sensory task set. Low-fidelity volumes were computed for each ear separately. Average volume for low-volume (hard) Auditory stimuli was .03% of maximum MacBook Pro volume output.

The task for the **Visual** and **Audio/Visual** conditions was to detect whether a
Gabor contrast grating was angled 45 degrees counterclockwise (to the left) or clockwise
(to the right) from vertical. Gabor contrast gratings were created using a sine function
masked by a Gaussian envelope using PsychToolBox functions in MATLAB. Gabor
filters were presented at ~7° eccentricity from center and subtended ~6° of visual angle.
Gabor gratings were equally likely to be delivered to the left or to the right of the central
fixation cross; the side determined which hand should be used to make the response.
Gratings were characterized by a frequency of 0.75 cycles/degree and aspect ratio of 1.0.
Sigma, the standard deviation of the Gaussian envelope in pixels per degree, was 46.
Contrast gratings were presented at a rate of 1 Hz with a stimulus duration of 250 msec.
A black central fixation cross was present for the duration of the block against a 50%
gray background.

High-contrast (easy) Gabor gratings were presented at a fixed contrast level of
35%. Low-contrast (hard) levels were determined by a 2-Down-1-Up staircase protocol
with a discount rate of 0.25 for each participant. The visual staircase procedure was
conducted in the scanner at the start of the Sensory task set. Average contrast level for the
low-contrast gratings was 3.07%. Participants were instructed to respond to the
orientation of the contrast gratings while keeping their gaze fixated on the central cross
during the entirety of the run.

(c) Word tasks. A total of 125 abstract and 125 concrete words were taken from a
previously used set of abstract and concrete words [1]. The words were divided into 25
groups, with 10 words per group. Each group consisted of five concrete words and five
abstract words. Average word frequencies per group were calculated using the SUBTL
frequency norms from the SUBTLEX$_{US}$ corpus as described in [2]. Mean word
frequency across all groups was 25.84 per million words on this scale. In addition, word
length was limited to three to seven letters. Word frequency and word length did not
differ significantly between groups. The 25 word groups were cycled through each of the
four word tasks such that each list was assigned to each task an equal number of times
across participants. Trials consisted of 1 sec word presentation followed by 1 sec fixation
for a total of 90 trials. For each task first-order counterbalancing was done to generate

presentation sequences whereby each trial type followed every trial type an equal number of times.

In the **Semantic-New** task, each of the 90 words was presented only once. For the **Semantic-Repeat** task, one list of 10 words was used. Each word repeated 9 times throughout the task block.

For the **0-Back** and **2-Back** tasks, 33% of trials were designated "hits." For the 0-back task, one word was drawn from the lists assigned and designated the TARGET word for each participant. This word was displayed before the beginning of the run and the participant verbally confirmed that they read the word and understood the task. Participants were to press one key when the target word appeared, and another key if the current word did not match the target. In both tasks there was an equal proportion of "foils" – words that repeated throughout the run but were not matches.

Words were presented as black text (Arial) on white background.

1.   Poldrack RA, Wagner AD, Prull MW, Desmond JE, Glover GH, Gabrieli JD. 1999 Functional specialization for semantic and phonological processing in the left inferior prefrontal cortex. *NeuroImage* **10**, 15–35. (doi:10.1006/nimg.1999.0441)
2.   Brysbaert M, New B. 2009 Moving beyond Kucera and Francis: a critical evaluation of current word frequency norms and the introduction of a new and improved word frequency measure for American English. *Behav Res Methods* **41**, 977–990. (doi:10.3758/BRM.41.4.977)
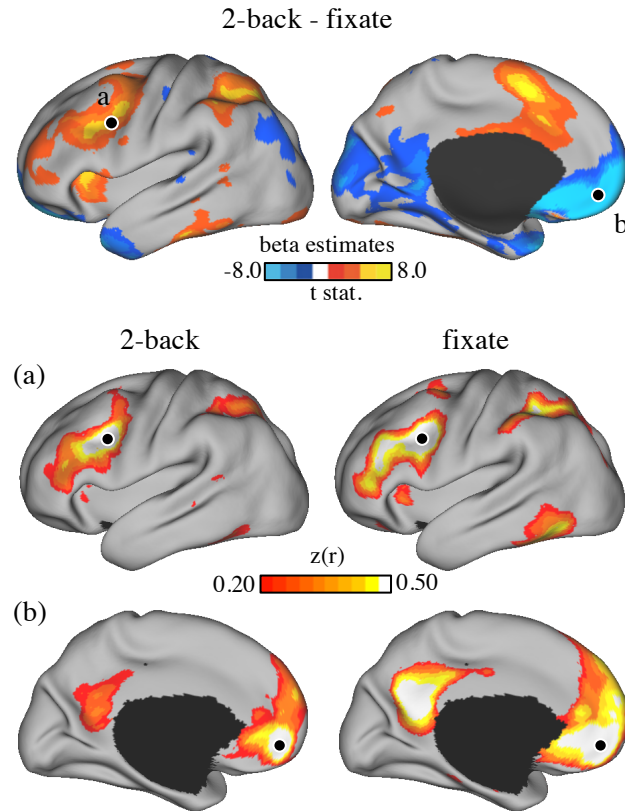
2. Supplementary Figures S1-S4
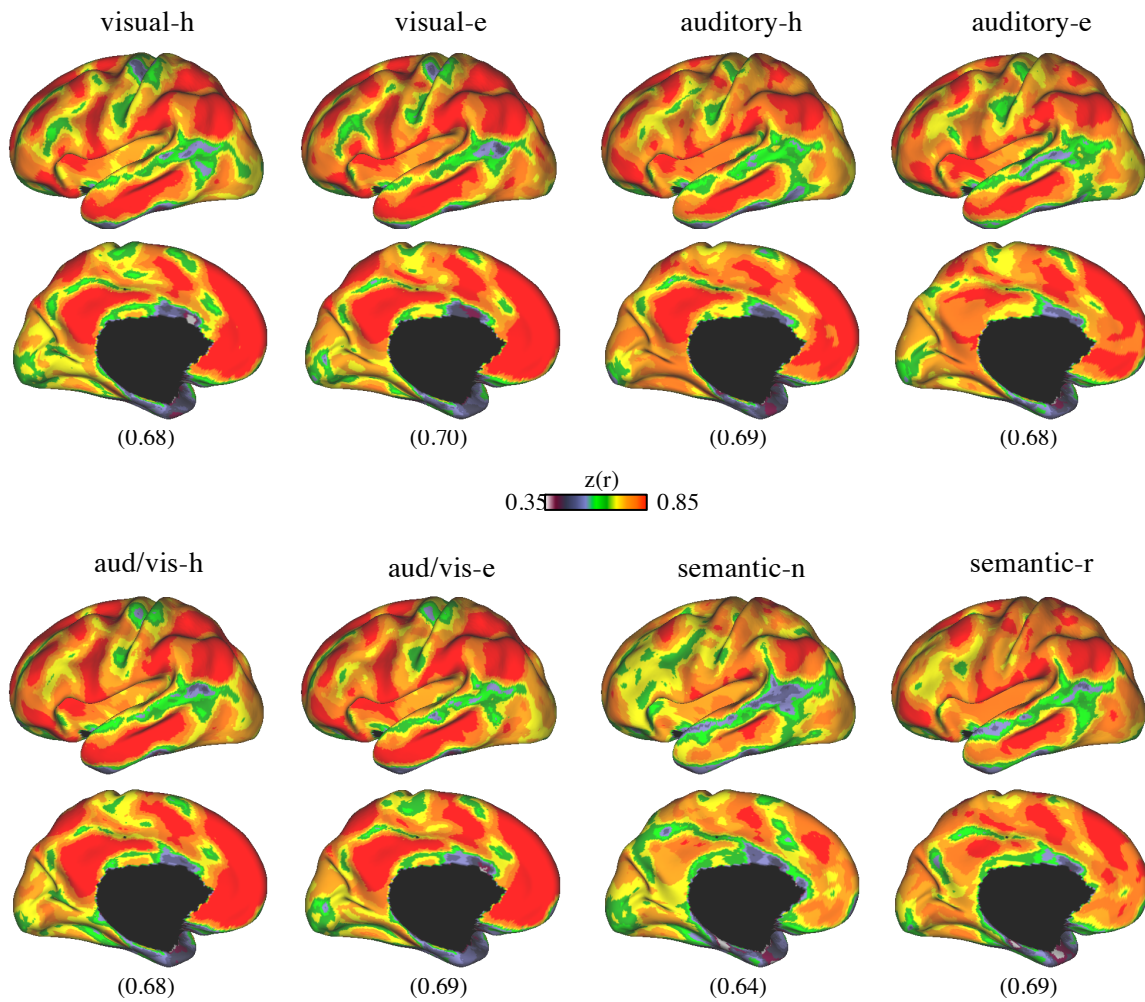
Supplementary Figure S1. Shared global fcMRI structure across task variants. Global correspondence between a task and the average connectivity matrix from the remaining tasks are shown for 8 tasks. Remaining tasks are shown in figure 4 in the main text.
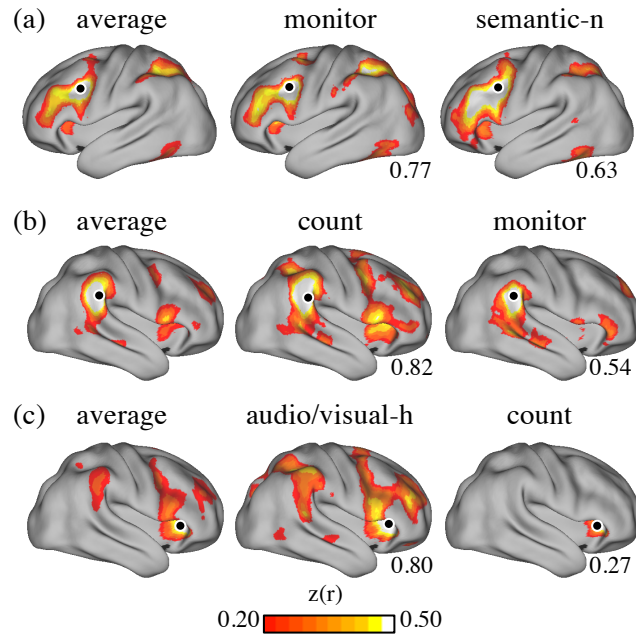
Supplementary Figure S2. Dynamic reconfiguration of functional connectivity across task states. *(left column)* Connectivity for three seed regions (black circles) computed in a correlation matrix obtained from averaging the matrices of all 14 tasks. *(right columns)* The same seed regions are plotted for two individual tasks to illustrate variation in connectivity patterns. Seeds were selected by identifying regions that showed variable agreement between tasks (see figure 5-7 in main text).

Supplementary Figure S3. Coupling patterns are consistent despite divergent task-evoked responses. Beta estimates of task-evoked responses were obtained from a contrast between the 2-Back and Fixate tasks *(top panel)*. A seed placed in prefrontal cortex had a significantly higher evoked response in the 2-Back task relative to Fixate *(a)*. However the connectivity maps for this seed were substantially similar across the two tasks. Similarly, a seed region in medial prefrontal cortex, which had a higher response in the fixation task, has a similar correlation profile across tasks *(b)*. These comparisons are informative as they indicate that coupling does not always increase across task-evoked regions. Specifically, the region in *(a)* did not have stronger correlations in the 2-back task despite having a higher beta value for that task.
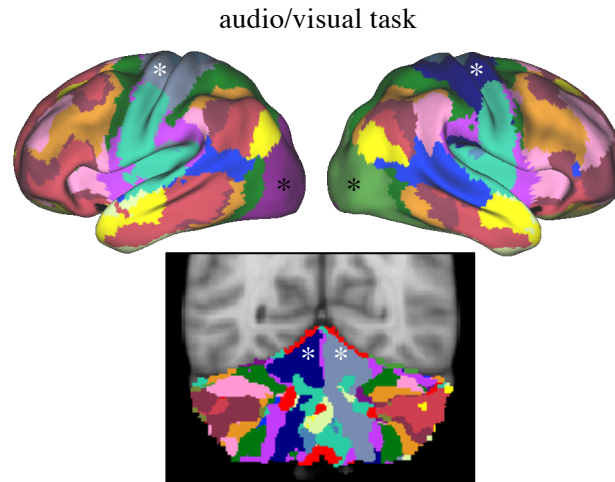
audio/visual task

Supplementary Figure S4. Asymmetry of cortico-cerebellar networks. The 17-network clustering solution was computed for the Audio / Visual discrimination task. The clustering split left and right hemisphere visual cortex into separate networks (black asterisks), but these visual regions were not grouped with the lateralized somatomotor networks (white asterisks on cortical surface). Lateralized somatomotor networks were assigned to contralateral portions of the cerebellum.