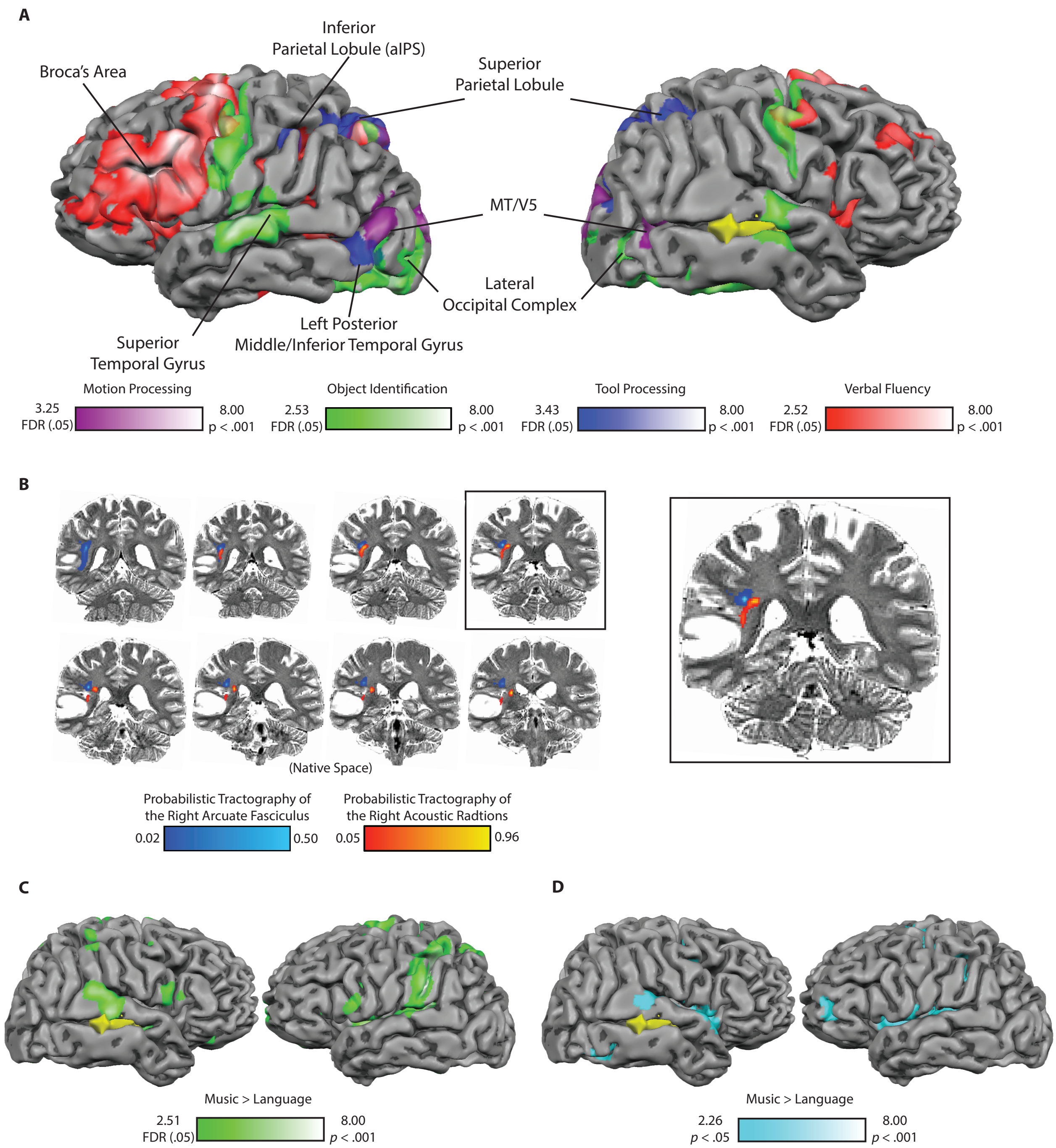
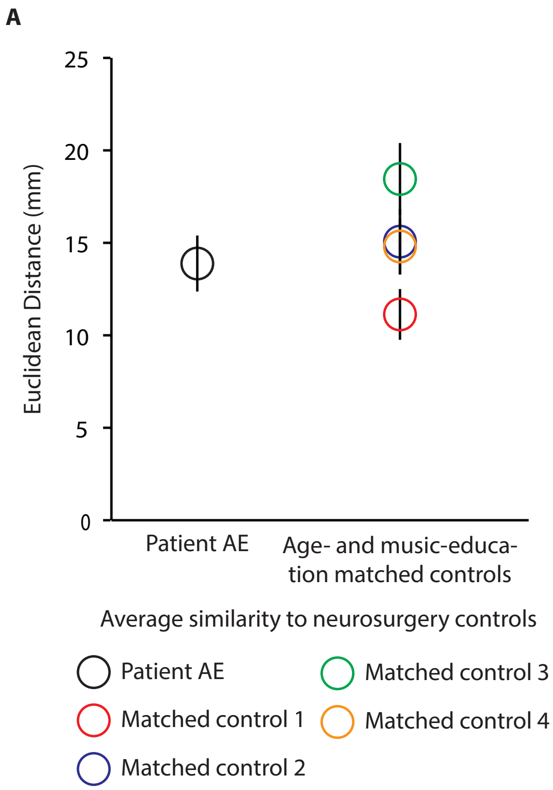

A
Inferior
Parietal Lobule (aIPS)
Broca's Area
Superior
Parietal Lobule
MT/V5
Lateral
Occipital Complex
Left Posterior
Middle/Inferior Temporal Gyrus
Superior
Temporal Gyrus
Motion Processing
3.25
FDR (.05)
8.00
p < .001
Object Identification
2.53
FDR (.05)
8.00
p < .001
Tool Processing
3.43
FDR (.05)
8.00
p < .001
Verbal Fluency
2.52
FDR (.05)
8.00
p < .001
B
(Native Space)
Probabilistic Tractography of
the Right Arcuate Fasciculus
0.02
0.50
Probabilistic Tractography of
the Right Acoustic Radtions
0.05
0.96
C
Music > Language
2.51
FDR (.05)
8.00
p < .001
D
Music > Language
2.26
p < .05
8.00
p < .001


A
25
20
15
10
5
0
Euclidean Distance (mm)
Patient AE
Age- and music-educa-
tion matched controls
Average similarity to neurosurgery controls
Patient AE
Matched control 1
Matched control 2
Matched control 3
Matched control 4
B
Y = -37
Y = -35
Y = -33
Y = -31
Y = -29
X = 59

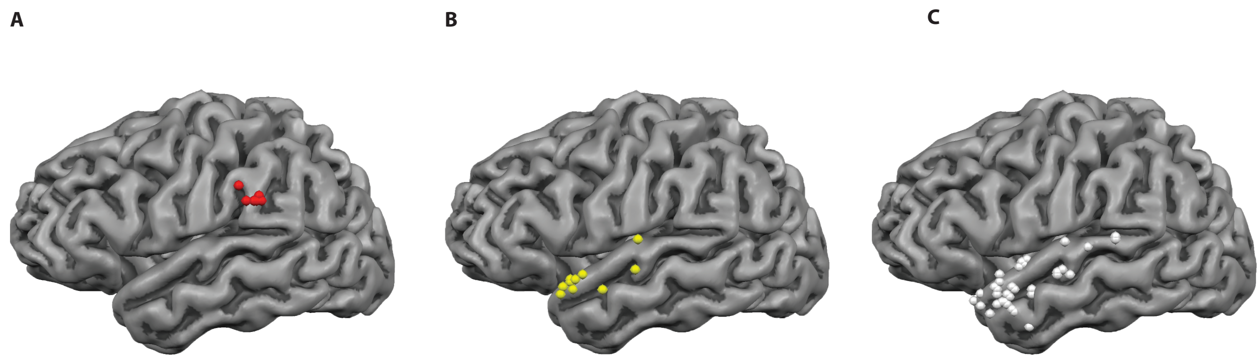

A
B
C

**Figure S1. Pre-operative fMRI mapping of high-level visual processing, language production, and manipulable object processing and praxis in Patient AE's brain. A.** Patient AE took part in three fMRI experiments in which we mapped high-level visual processing and language function. The tumor is represented in yellow in the right temporal lobe, visible through the expanded right superior temporal sulcus. We characterized motion-related visual activity Patient AE by asking him to attend to arrays of moving dots and contrasting BOLD contrast for moving dots against BOLD contrast for stationary dots (plotted on the purple-white color scale); this contrast identified MT/V5 bilaterally. In another experiment Patient AE fixated and named images of tools, animals, famous faces, and famous places; we contrasted those stimuli against a baseline condition in which AE fixated upon phase-shifted versions of those images (green-white color scale); that contrast identified bilateral lateral occipital complex, bilateral middle/superior temporal gyrus, and motor cortex (associated with speech motor activity). We contrasted tool stimuli against the average of animal, famous face, and famous place stimuli (equally-weighted) and identified increased BOLD contrast in the left inferior parietal lobule, bilateral superior parietal/dorsal occipital cortex, and the left posterior middle/inferior temporal gyrus (blue-white color scale; for precedent, see [*S1*-*S3*]). Language-related areas were identified with a verbal fluency task: BOLD contrast elicited when Patient AE produced words to letter, semantic category, and action cues compared to a resting baseline condition is shown (red-white color scale). That contrast identified the left inferior frontal gyrus (Broca's area), superior temporal/inferior parietal cortex, and the speech motor system. **B.** Pre-operative tractography showing the right acoustic radiations and arcuate fasciculus in relation to AE's tumor (5% threshold, overlaid on native T2-weighted image). **C**. Four Eastman School of Music Graduate Students took part in the music and language fMRI experiment (see Figure 1A, Experiment 1). Overlaid on Patient AE's brain in the green-white color scale (top panel) is the whole-brain contrast map of music preferences [music (perception and production) > language (perception and production)] using a fixed-effects general linear model. We observed increased BOLD contrast for music stimuli in the right superior temporal gyrus and bilaterally in temporal and parietal areas. **D**. Ten neurosurgery patients in the pre-operative phase of their treatment took part in the same experiment. Overlaid on Patient AE's brain in the cyan-white color scale (bottom panel) is the whole-brain contrast map of music preferences [music (perception and production) > language (perception and production)] using a random effects general linear model. Once again, we observe increased BOLD contrast for music stimuli in the right superior temporal gyrus. ('Figure S1. Pre-operative fMRI mapping of high-level visual processing, language production, and manipulable object processing and praxis in Patient AE's brain' related to Figure 1.)

**Figure S2. Quantitative and qualitative analysis of the location of music-preferring cortex from Experiment 1. A.** We defined the peak music-preferring voxel with the contrast [music perception & production] > [language perception & production] in Patient AE and in each of the control participants. One neurosurgery patient (out of 10) did not show robust music preferences in the right superior temporal gyrus with this contrast; thus, in that patient the peak voxel was defined with the contrast [music perception & production] > fixation baseline. The Talairach coordinate for the peak in Patient AE and in each control was extracted. We then computed the Euclidean distance between Patient AE and each of the 10 neurosurgery patient controls. The average distance (+/- the standard error of the mean (SEM)) is plotted in as the black circle. The same procedure was carried out for each of the age and music-education matched control participants (comparing each of those matched control participants to the 10 neurosurgery patient controls). The resulting means (+/- SEM) are plotted in the red, blue, green and orange circles. The key finding is that Patient AE is within the range established by the age- and education-matched control participants. **B.** We also qualitatively inspected the gyral anatomy in Patient AE, overlaying the peak for music preferences from Experiment 1. As can be appreciated, the peak in Patient AE is in the posterior Sylvian fissure, and likely in the posterior superior temporal gyrus just posterior to the posterior-most aspect of the Sylvian fissure (see also sagittal image). ('Figure S2. Quantitative and qualitative analysis of the location of music-preferring cortex from Experiment 1' related to Figure 1.)

**Figure S3. Patient AG's intraoperative picture naming performance by error type and stimulation location**. As a positive control on the sensitivity of the language mapping task to elicit errors, we report the intraoperative mapping data form Patient AG who underwent language mapping in her left temporal lobe using the same task as was used for Patient AE (see Movie S3 for examples of Patient AG's errors). **A.** Patient AG presented with speech arrest when regions in the left inferior parietal lobule were stimulated. **B.** In contrast, Patient AG presented with phonemic paraphasias when regions in the left anterior temporal lobe were stimulated. **C.** Stimulation sites associated with correct picture naming are labeled in white. Importantly, as was the case with Patient AE, stimulation of a given region did not invariably elicit an error, while there was a clear topographic distribution in the locations that when stimulated, led to an error. ('Figure S3. Patient AG's intraoperative picture naming performance by error type and stimulation location' related to Movie S3.)

**Table S1. Patient AE and control participants' neuropsychological results.**

| | Patient AE | Patient Controls | |
|---|---|---|---|
| | | Mean | SD |
| Object Decision | 0.98 | 0.89 | 0.10 |
| Number Identification | 0.97 | 0.77 | 0.17 |
| Picture-Word Matching | 1 | 0.97 | 0.03 |
| Function Judgments | 0.92 | 0.96 | 0.07 |
| Manipulation Judgments | 0.96 | 0.83 | 0.25 |
| Biological Motion Processing | 1 | 0.94 | 0.14 |
| Word Reading | 1 | 0.96 | 0.05 |
| Snodgrass Picture Naming | 0.93 | 0.94 | 0.05 |
| Nonword Reading | 1 | 0.90 | 0.16 |
| Cambridge Face Memory Test | 0.99 | 0.71 | 0.16 |
| Pantomime Discrimination | 1 | 0.96 | 0.06 |
| Action Decision | 0.95 | 0.93 | 0.07 |
| Sentence Repetition | 1 | 0.93 | 0.14 |

| | | | Control Group A (Peretz et al. [*S4*]; N = 120) | | Control Group B (Seven Matched Controls) | |
|---|---|---|---|---|---|---|
| MBEA Subtest | Patient AE Pre-Op | Patient AE Post-Op | Mean | SD | Mean | SD |
| Scale | 94 | 97 | 89 | 8.18 | 93 | 6.67 |
| Contour | 100 | 90 | 88 | 8.32 | 95 | 5.04 |
| Interval | 100 | 97 | 87 | 7.98 | 95 | 6.04 |
| Rhythm | 97 | 100 | 88 | 8.59 | 98 | 2.62 |
| Metric | 100 | 100 | 84 | 14.47 | 99 | 2.62 |
| Memory | 100 | 100 | 91 | 7.26 | 98 | 3.70 |

**Table S1. Patient AE and control participants' neuropsychological results.** We assessed Patient AE's broader cognitive abilities using a battery of neuropsychological tests developed and adapted in our lab, and compared his performance against a group (n = 13) of neurosurgery patient control participants in the pre-operative phase of their clinical treatment. We assessed Patient AE's musical knowledge using the Montreal Battery of Evaluation of Amusia pre- and post-operatively, and compared Patient AE's performance against two control groups. The data from Control Group A are publically available along with Peretz and colleagues' study [*S4*] (see Methods). We asked a separate cohort of age- and education-matched graduate students at the Eastman School of Music to complete the MBEA (Control Group B). Patient AE performed similarly to control participants in groups A and B when tested pre- and post-operatively. Importantly, across all neuropsychological tests, Patient AE exhibited performance that was within the normal range, typically at the upper end of the distribution or control performance. ('Table S1. Patient AE and control participants' neuropsychological results' related to STAR Methods.)

**Supplemental References**


S1. Chen, Q., Garcea, F. E., & Mahon, B. Z. (2016). The representation of object-directed action and function knowledge in the human brain. *Cerebral Cortex*, 26, 1609-1618.

S2. Garcea, F. E., & Mahon, B. Z. (2014). Parcellation of left parietal tool representations by functional connectivity. *Neuropsychologia*, *60*, 131-143.

S3. Garcea, F. E., Kristensen, S., Almeida, J., & Mahon, B. Z. (2016). Resilience to the contralateral visual field bias as a window into object representations. *Cortex*, *81*, 14-23.

S4. Peretz, I., Champod, A. S., & Hyde, K. (2003). Varieties of musical disorders. *Ann. New York Aca. Sci.*, *999*, 58-75.