Supplementary Online Materials

To complement:

"A voice region in the monkey brain"

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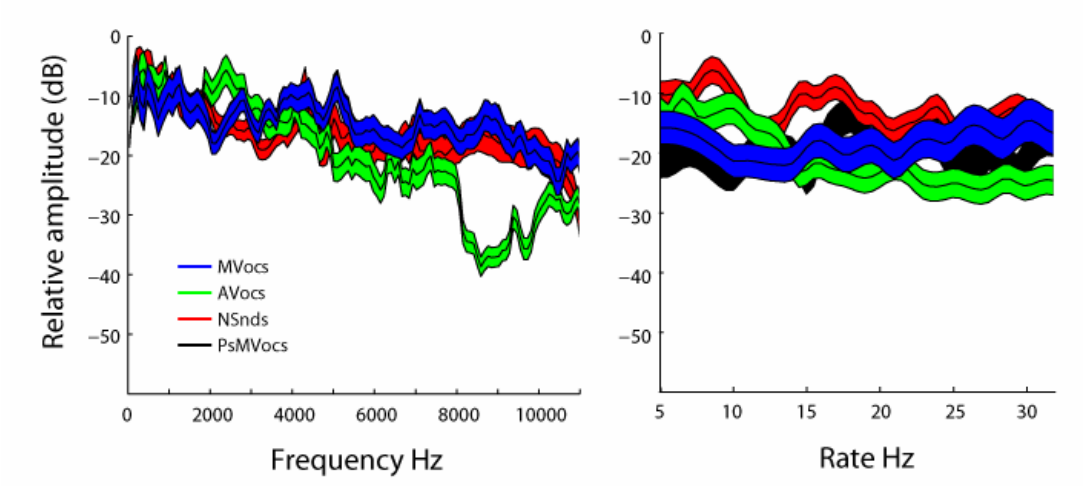

Figure S1. Acoustical properties of the four sound categories used in Experiment 1. (**Left**) shows the relative amplitude of the frequency components in the sounds (spectral amplitude). For each colored set of lines, the middle shows the mean spectral amplitude of that category of sounds and the lines above and below identify the standard-error of the mean (SEM) across the sounds in the category (n = 33 sounds). Note that the preserved spectrum MVocs (PsMVocs, black lines) have an identical spectrum to and are occluded by the MVocs (blue lines). (**Right**) shows the relative amplitude of the low frequencies (Rate) present in the sounds belonging to each category that would shape the amplitude envelope of the sounds.

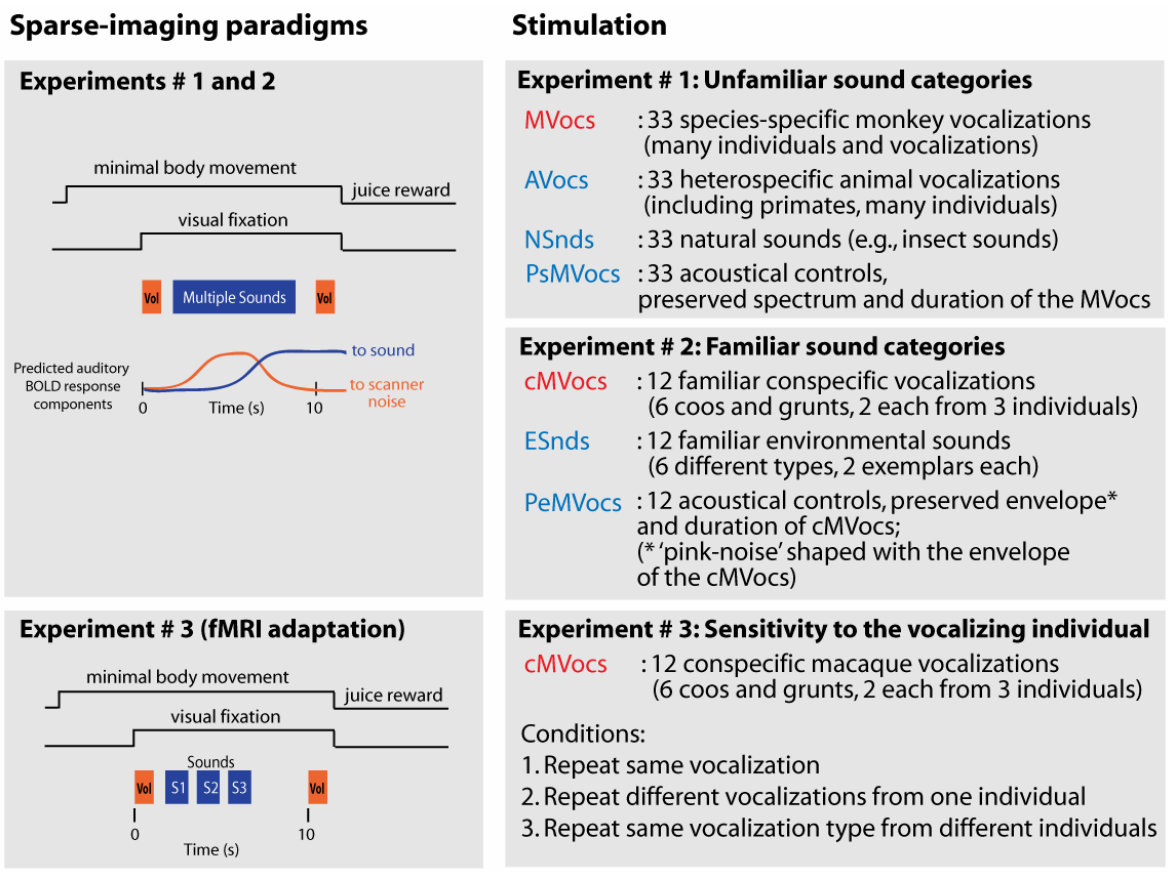

Figure S2. Summary of the imaging paradigms and stimulation used in the experiments. (**Left column**) Sparse-imaging paradigms with the behaving animals. (**Right column**) Summary of stimulation used for the three experiments. For details see the Supplementary Methods.

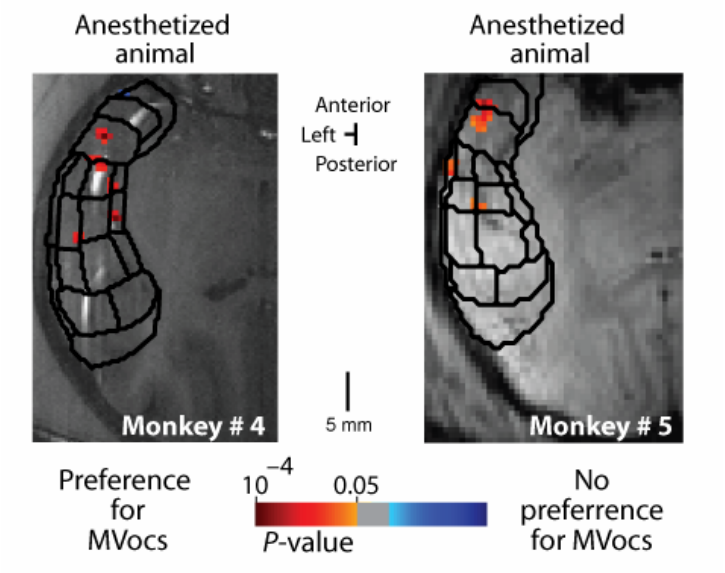

Figure S3. Additional examples of experiments with anesthetized animals. Format as in **Fig. 3**. The example to the right (Monkey #5) overlays the results on the acquired functional data (the mean of the GE-EPI images is shown in grayscale) because an anatomical scan was not available for this experiment.

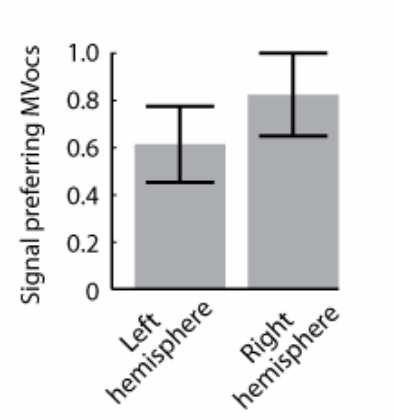

Figure S4. Lack of hemispheric differences in the preference for species-specific vocalizations. Shown is the hemispheric preference for MVocs in Experiment 1 for the anterior region (the measure is the signal preferring MVocs, evaluated here as: MVocs minus the mean activity for the other conditions, error bars show the standard error of the mean across the voxels, n = 24). The right hemisphere data used in these analyses were from the anterior regions in both monkeys that showed a significant preference for MVocs (see manuscript text and **Figs. 1a-b**). We mirrored these regions to the left hemisphere and evaluated the strength of the signal preferring MVocs in both hemispheres. As the bar graph shows we observed that the left hemisphere showed a strong preference for MVocs that did not differ from the right when tested directly (paired samples t-test, P = 0.32). For Experiment 2, mirroring the anterior region defined by the dashed outline (see **Fig. 5**) to the left hemisphere again showed no hemispheric differences (P = 0.76).

I. Supplementary Methods

For each of the three experiments, **Fig. S2** schematizes the imaging paradigms and summarizes the stimulation used. Related to this figure, the next sections provide additional details.

Imaging paradigms. The awake and behaving animals completed behavioral trials composed of the schematized sparse-imaging sequence (**Fig. S2**). Sparse-imaging temporally interleaves data acquisition and sound stimulation: 1) to sidestep the auditory BOLD response elicited by the scanner noise during imaging of a brain volume (Vol, orange rectangle, **Fig. S2**), and 2) to allow the presentation of sounds during the quieter periods devoid of scanning (blue rectangles). In all experiments, the animal began an 'imaging trial' by minimizing movement on two sensors for 5 seconds. The two sensors were a jaw sensor and another sensor in the seat of the chair for monitoring body movements, both of which have been shown to be important for imaging behaving animals at high magnetic fields[1]. After the animal visually fixated a dot on the visual display the scanner was triggered to acquire a "baseline" volume, prior to which no acoustical stimulation was present. Sound stimuli were then presented during the time period that is schematized by the blue rectangles (**Fig. S2**), see the next section for details in relation to each specific experiment. The behavioral imaging trial would complete after the acquisition of the second "stimulus-related" volume. If the animal did not abort the trial by moving or breaking fixation he received a juice reward following trial completion. The imaged volumes associated with the correctly completed trials were identified and further analyzed. If the animal aborted a trial, we repeated that trial until it was correctly completed to balance the data acquisition evenly across the different categories or conditions of each experiment.

The imaging of the anesthetized animals was not behaviorally gated. For these experiments we acquired multiple baseline and stimulus related volumes all separated by 10 second intervals: blocks of 4 baseline volumes were followed by 4 stimulus-related volumes and then the sequence was repeated. Further details on both awake and anesthetized animal imaging and preparation can be found elsewhere[2-4].

Experimental stimulation protocols. For Experiments 1 and 2 each imaging trial was randomly assigned to a sound category and sound stimuli within that category were randomly presented from 3.5 – 8 secs during the imaging trial, with a 300 ms inter-stimulus-interval (**Fig. S2**). For Experiment 3, we used an fMRI adaptation paradigm, where we repeated three sounds from one of the three experimental conditions. The conditions were: 1) repeat the same vocalization, 2) repeat the different vocalizations from the same individual, or 3) repeat a similar vocalization type from different individuals. Three sounds from each condition were presented in succession starting at 2.5 seconds into the trial, repeated with a 1.5 second stimulus-onset-asynchrony until 7 seconds into the trial. Our positioning of the sounds within a trial guaranteed that the last of the three sounds would elicit a maximal auditory response, as measured by the stimulus-related volume. To determine the lag in the peak of the auditory hemodynamic response and the point at which to present the last sound to elicit a maximal response, we conducted pilot experiments prior to Experiment 3. For the pilot experiments, we shifted the position of a 1-second long white noise burst in relation to the stimulus-related volume and found a peak in the auditory response at 4 ± 0.5 seconds before the stimulus-related volume.

References:

1. Keliris, G.A., *et al*. Robust controlled functional MRI in alert monkeys at high magnetic field: effects of jaw and body movements. *Neuroimage* **36**, 550-570 (2007).

2. Kayser, C., Petkov, C.I., Augath, M. & Logothetis, N. Integration of touch and sound in auditory cortex. *Neuron* **48**, 373-384 (2005).

3. Petkov, C.I., Kayser, C., Augath, M. & Logothetis, N.K. Functional imaging reveals numerous fields in the monkey auditory cortex. *PLoS Biol* **4**, e215 (2006).

4. Kayser, C., Petkov, C.I., Augath, M. & Logothetis, N.K. Functional imaging reveals visual modulation of specific fields in auditory cortex. *J Neurosci* **27**, 1824-1835 (2007).