Supplemental Data

Chronically Deafferented Sensory Cortex Recovers a Grossly Typical Organization after Allogenic Hand Transplantation

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Supplemental Experimental Procedures

Subjects

Patient D.S. lost his dominant right hand above the wrist in an industrial accident at age 19 years and 7 months of age. He underwent a successful unilateral hand allotransplant on November 29th, 2006, and the data reported here as collected on April 5th, 2007. Details of the transplant procedure can be found elsewhere [1, 2].

fMRI Sensory Mapping Tasks

Prior to each block, the body part to be stimulated next was cued on a monitor visible only to the experimenter. An aural cue then signaled the beginning of the stimulation block, and stimulus delivery to was paced by an auditory 1Hz tone. The final tone in each stimulation block was at a higher frequency, enabling the experimenter to prepare to stop. Stimulation of the cheeks was accomplished by briefly tugging on 1m long cotton strings attached to the perioral regions of each cheek with medical tape to induce an approximately 1cm displacement. To control force, a section of each string was replaced with a calibrated (130.41g/25.4mm) MRI-compatible spring. Preliminary testing verified that this technique did not create image artifacts.

fMRI Data Acquisition

The initial 4 scans in each BOLD fMRI run were discarded to allow steady-state magnetization to be approached. Whole brain EPI images were collected using a standard birdcage radio-frequency coil and the following parameters: : TR = 2000ms, TE = 30ms, flip angle = 80^0, 64 x 64 voxel matrix, FoV = 200mm, 33 contiguous axial slices, thickness = 3.0mm. A double gradient echo sequence was used to acquire a field map that was used to correct for EPI distortions. Two high resolution T1-weighted structural images were acquired using the 3-D MP-RAGE pulse sequence: TR = 2500ms, TE = 4.38ms, TI = 1100ms, flip angle = 8.0^0, 256 x 176 voxel matrix, FoV = 256mm, 176 contiguous axial slices, thickness = 1.0mm. Siemen's Auto Align Scout and True FISP sequences were executed prior to the start of each functional run to ensure that slices were prescribed in exactly the same positions across runs. DICOM image files were converted to NIfTI format using MRIConvert software (http://lcni.uoregon.edu/~jolinda/MRIConvert/).

fMRI Data Analyses

Each fMRI run for a given subject was modeled separately at the first level. Prior to statistical estimation, the following pre-processing steps were undertaken: EPI dewarping using Fugue, motion correction using MCFLIRT [3]; non-brain removal using BET [4]; spatial smoothing using a Gaussian kernel of 5mm (FWHM); mean-based intensity normalization of all volumes by the same factor; high pass temporal filtering (sigma=50.0s). Estimates of the degrees of freedom in the statistical model were corrected for autocorrelation in the data by using the FSL pre-whitening technique [5]. Time-series statistical analysis was carried out using FILM with local autocorrelation correction [5]. Delays and undershoots in the hemodynamic response were accounted for by convolving the model with a double-gamma basis function. Registration to high

resolution and standard images (MNI-template) was implemented using FLIRT [3, 6]. Inter-session (Level 2), and inter-subject (Level 3, for control participants only) levels of analysis were carried out using a fixed effects model, by forcing the random effects variance to zero in FLAME (FMRIB's Local Analysis of Mixed Effects) [7] [8]. Z (Gaussianised T/F) statistic images were thresholded using clusters determined by $Z > 2.3$ unless otherwise indicated and a (corrected) cluster significance threshold of $p < 0.05$ [9].

D.S.'s statistical parametric maps were overlaid on a 3-D rendering of the cortical surface of his brain created with version 5.5 of the CARET software *http://brainmap.wustl.edu/caret/* [10]. To account for individual variation in cortical topography, control group average data were mapped onto the population, landmark and surface-based atlas (PALs B12) of Van Essen using the multi-fiducial procedure [11]. To account for individual variation in cortical topography, control group average data were mapped onto the population, landmark and surface-based atlas (PALs B12) of Van Essen using the multi-fiducial procedure [11].

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Sensory Mapping

	Primary Sensory	X	Y	Z
Controls	Left Hand	40	-24	58
	Right Hand	-38	-28	58
	Left Cheek	56	-4	44
	Right Cheek	-62	-16	40
	Secondary Sensory			
	Left Hand	46	-24	16
		-	-	-
	Right Hand	-50	-22	16
		50	-32	22
	Primary Sensory			
Patient D.S.	Left Hand	38	-22	46
		-62	-18	44
	Right Hand	-40	-20	54
	Left Cheek	62	0	42
	Right Cheek	-50	-32	18
	Secondary Sensory			
	Left Hand	-60	-20	6
		52	-14	10
	Right Hand	-54	-30	16
		52	-30	22

Table 2. Locations of mean peak activations in primary and secondary sensory cortices during the conditions of the sensory mapping tasks for the control group and patient D.S. Coordinates are defined in the space of the Montreal Neurological Institute's standard template brain (MNI-152; see Experimental Procedures).