

## Methods

**Experimental Stimuli:** We selected 24 animals, 24 tools, and 24 nonmanipulable object concepts following the criteria described in a previous study. For each item, a black and white grayscale photo was selected (400x400 pixels) and the stimulus was recorded as a spoken word (22.050 kHz, 16 Bit, native Italian speaker, female). Auditory stimuli were presented binaurally to participants in the scanner. The three stimulus types were matched on length in Italian (animals mean length = 7.0 letters; tools: 7.6; nonmanipulable: 7.8; one-way Anova:  $F_{2,69} < 1$ ). Stimuli (both auditory words and photographs) were presented with custom software (AS<sub>(imple)</sub>F<sub>(ramework)</sub>) written in Matlab utilizing the Psychophysics Toolbox extensions (Brainard, 1997; Pelli, 1997). The software for stimulus presentation is available on request from J. Schwarzbach.

**Localizer task:** A mini-block design was used, in which all 24 photographs from each semantic category were presented within 20 seconds (each stimulus presented for 50 refreshes of the monitor, refresh rate = 60Hz, ISI = 0). There were 20 seconds of fixation between mini-blocks of stimuli. All picture stimuli (i.e., mini-blocks of items) were repeated three times throughout the run. The order of items within a block was random, as was the order of blocks. The run lasted approximately 10 minutes. A fourth category of objects (fruit/vegetables) was also included in the picture-viewing experiment (data not shown). Participants viewed the stimuli through a mirror attached to the head coil adjusted to allow foveal viewing of a back-projecting monitor.

**Size-judgment task with auditorily presented words:** The details of the design for the auditory size judgment task are presented in the text of the article. Both blind and sighted participants were asked to keep their eyes closed throughout the experiment. The ISI for the six items within a mini-block consisted of randomly selected intervals in the range of  $[.5*X]$ ,  $[.75*X]$ ,  $[.9*X]$ ,  $[1.1*X]$ ,  $[1.25*X]$ , and  $[1.5*X]$  where 'X' corresponds to the duration of the entire block (20 seconds) minus the total duration of all auditory wave files in the block, divided by 6.

**Participants:** Twenty-seven participants (21 sighted, 12 female; 3 congenitally blind, 2 female; 3 late blind, 1 female) were recruited from the Center for Mind/Brain Sciences volunteer pool and paid for participation in the study. The data for one sighted participant for the auditory task were excluded due to a failure to properly respond; that participant's data from the localizer task were retained. The datasets for both the auditory size-judgment task as well as the picture-viewing experiment were excluded for another sighted participant due to excessive head motion. This left 20 datasets from sighted participants for the localizer experiment, and 7 for the auditory size judgment task. The 13 participants who completed the localizer task but not the auditory size judgment task participated in a different experiment using auditory presentation of the same materials.

Handedness was assessed with the Edinburgh inventory (Oldfield, 1971). All sighted participants who performed the auditory size-judgment task were right handed; 2 of the 13 (remaining) sighted participants who completed the picture-viewing experiment were left handed (all others right handed). Two of the three

congenitally blind participants (CB1 and CB3) were right handed; CB2 was ambidextrous. All late blind participants were right handed.

Sighted participants (mean age: 31.2yrs, standard deviation: 9.5yrs, range: 20yrs to 51yrs) had normal or corrected to normal vision (vision corrected using MR compatible lenses). Participant CB1 (female, age at testing 60yrs) was blind due to Retinitis Pigmentosa, CB2 (male, age at testing 20yrs) due to congenital glaucoma, and CB3 (female, age at testing 31 yrs) due to complete retinal damage at birth. Two of the three late blind individuals were blind due to adult-onset retinitis pigmentosa; the third was blind due to glaucoma in childhood (this participant used prosthetic eyes, which were removed during MR scanning). The age at testing for the late blind participants was (LB1, 46yrs; LB2, 42yrs; LB3, 48yrs). All participants were examined by a medical doctor (GB) prior to participation in the study.

**MR data acquisition and analysis:** MR data were collected at the Center for Mind/Brain Sciences, University of Trento, on a Bruker BioSpin MedSpec 4T. Before collecting functional data, a high ( $1 \times 1 \times 1 \text{ mm}^3$ ) resolution T1-weighted 3D MPRAGE anatomical sequence was performed (sagittal slice orientation, centric Phase Encoding, image matrix =  $256 \times 224$  (Read x Phase), FoV =  $256 \text{ mm} \times 224 \text{ mm}$  (Read x Phase), 176 partitions with 1mm thickness, GRAPPA acquisition with acceleration factor = 2, duration = 5.36 minutes, TR = 2700, TE = 4.18, TI = 1020 ms,  $7^\circ$  flip angle). Functional data were collected using an echo planar 2D imaging sequence with phase over-sampling (Image matrix:  $70 \times 64$ , TR: 2250ms TE: 33 ms, Flip angle:  $76^\circ$ , Slice thickness = 3 mm, gap = .45mm, with  $3 \times 3$  in plane resolution). Volumes

were acquired in the axial plane in 37 slices. Slice acquisition order was ascending interleaved odd-even.

All MR data were analyzed using Brain Voyager (v. 1.9). The first two volumes of functional data from each run were discarded prior to analysis. Preprocessing of the functional data included, in the following order, slice time correction (sinc interpolation), motion correction with respect to the first (remaining) volume in the run, and linear trend removal in the temporal domain (cutoff: 3 cycles within the run). Functional data were then registered (after contrast inversion of the first remaining volume) to high-resolution de-skulled anatomy on a participant-by-participant basis in native space. For each individual participant, echo-planar and anatomical volumes were transformed into standardized (Talairach and Tournoux, 1988) space. A Gaussian spatial filter with a 4.5 mm full-width at half-maximum was applied to each volume.

All functional data were analyzed using the general linear model in Brain Voyager. Experimental events (duration = 20 seconds) in the picture-viewing experiment were convolved with a standard dual gamma hemodynamic response function. There were 4 regressors of interest (corresponding to the four stimulus types) and 6 regressors of no interest, corresponding to the motion parameters obtained during preprocessing. For the analyses of the auditory size-judgment task, a finite impulse response model (modeling 6 TRs) was used with regressors for all stimulus events, the auditory response cue, and the outputs of motion correction. A random effects analysis was used to analyze the group data in the picture-viewing experiment (n = 20). Fixed effects analyses with separate study (i.e., run) predictors

were used to analyze the data from the sighted participants performing auditory size-judgments ( $n = 7$ ), and the late ( $n = 3$ ) and congenitally blind participants ( $n = 3$ ). Beta estimates were standardized (z scores) with respect to the entire time course.

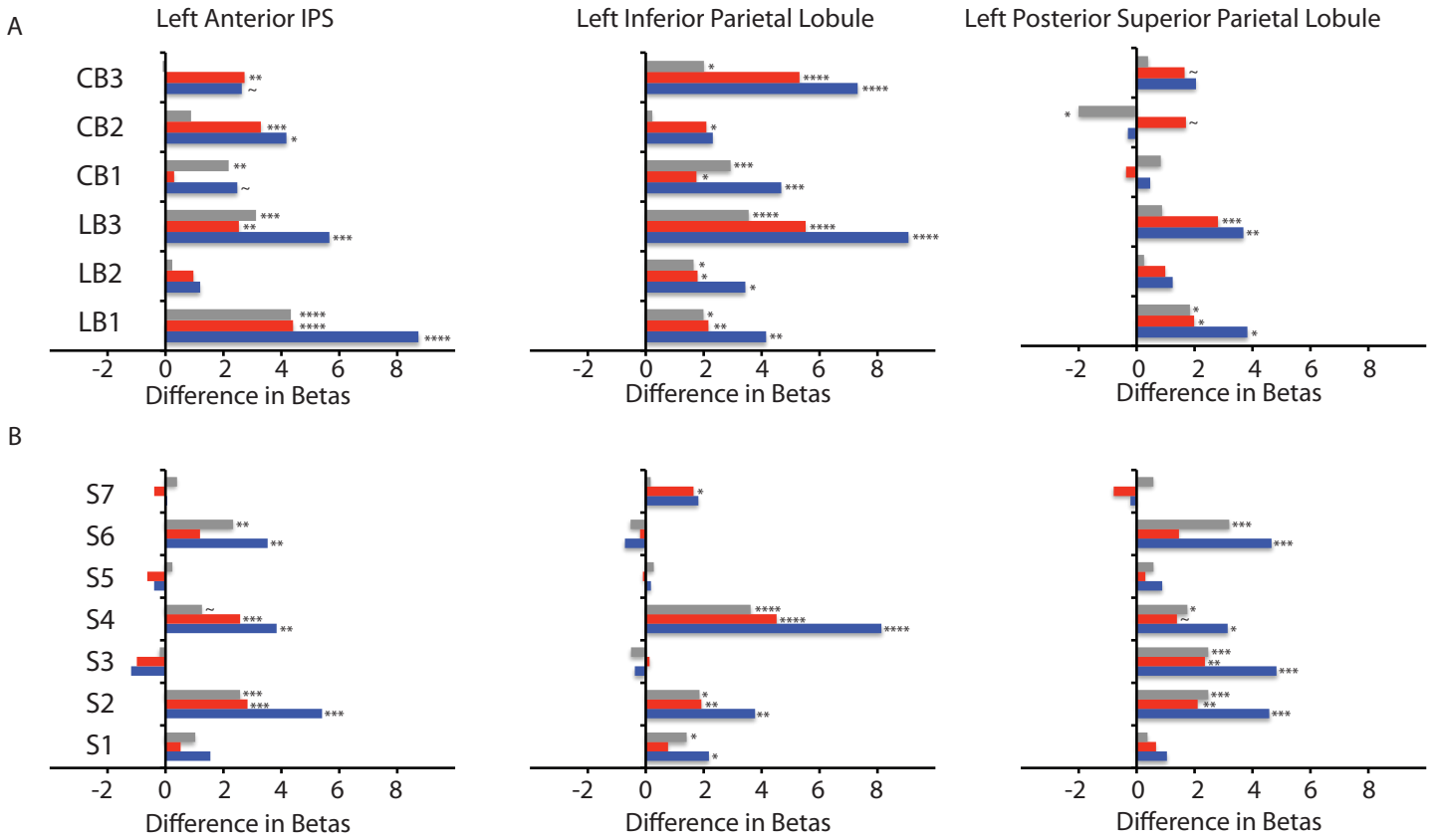
## Figure Captions for Supplementary Figures

**Supplementary Figure S1.** The ROI analyses reported in Figure 2 of the manuscript were also run for each individual participant who performed the auditory size judgment task. Plotted in the graphs are the difference in betas for the contrasts of (gray) tools > nonmanipulable; (red) tools > animals; and (blue) tools > non-tools (animal + nonmanipulable). The ROIs for these analyses are those described in Figure 1. The data for individual blind participants are shown in panel A, while those for individual sighted participants in panel B. These results demonstrate that the pattern of results for late and congenitally blind participants summarized by the fixed effects ROI analyses reported in Figure 2, are not carried by individual participants.

**Supplementary Figure S2.** Contrast maps were defined for each participant individually for the contrast of 'tool > non-tool (animal + nonmanipulable)', thresholded for all participants at  $p < .05$ , FDR corrected for the entire brain volume. The single subject maps were then overlaid and the probability of observing a significant effect (at the above threshold) is plotted for each group of participants (panel A: sighted performing auditory size judgments, panel B: late blind, and panel C: congenitally blind). This analysis demonstrates that the effects reported in Figures 2 and 3 of the manuscript for the auditory size judgment task, and which were run with fixed effects analyses, were not carried by a single blind participant (for either the late or congenitally blind groups).

# Supplementary Figure S1

## ROI Analysis By Subject for all Subjects who completed the Auditory Size Judgment Task



~ = .1 > p > .05      \* = p < .05      \*\* = p < .01      \*\*\* = p < .001      \*\*\*\* = p < .00001

CB = Congenitally Blind  
 LB = Late Blind  
 S = Sighted

■ Tool > NonManipulable  
 ■ Tool > Animal  
 ■ Tool > (Animal + NonManipulable)

Supplementary Figure S2

