SUPPLEMENTARY ONLINE MATERIAL

S1 – Univariate analysis.

S2 – Example of between-subject MVPA.

S3 – What is the locus of neuroplastic changes happening within the AC of congenitally deaf individuals?

Fig. S1 – Univariate whole-brain analysis of the representation of the azimuth and medial planes

S1. Univariate analysis.

We performed univariate analysis on our visual data within the deaf and hearing groups. We first did a region-of-interest univariate analysis over the data from our experiment, and showed that for deaf but not hearing participants, the contrast between the inner-most and the outer-most annuli yielded activation in AC (bilateral, \( t(3080) = 1.85, p = 0.064 \); right hemisphere AC, \( t(3080) = 1.97, p = 0.048 \)).

Moreover, the contrast between locations within the azimuth plane (i.e., left vs right) yielded marginally significant activations in right AC (\( t(3080) = 1.90, p = 0.058 \)), whereas the contrast between positions within the medial plane (i.e., up vs. down) did not (\( t(3080) = 0.66, p = 0.511 \)).

We then performed whole-brain analyses. For the deaf, but not for the hearing, contrasting left versus right presentations (i.e., the azimuth plane condition) led to activation within superior temporal and parietal regions. Contrasting superior versus inferior visual presentations (i.e., the medial plane) led to a much less widespread pattern of activation throughout temporal and parietal cortices, within both deaf and hearing participants. Finally, contrasting central to peripheral locations showed a widespread activation in superior parietal regions for both groups, and some temporal and temporo-parietal activation (more in the right hemisphere) for the deaf.

These data show, as demonstrated before (e.g., Finney et al., 2001), that there is a neural processing advantage for items presented in the periphery within the auditory cortex of deaf individuals, and that this is especially prevalent within the right auditory cortex. These data also hint at the fact that this advantage may be restricted to items presented within the azimuth plane.
S2. Example of between-subject MVPA.

To better explain the way in which we analyzed our between-subject MVPA data, we will present an example for within-group classification performed over data from the AC of congenitally deaf individuals regarding the classification “center versus periphery”. We conducted MVPA to investigate the possibility of dissociating activation patterns arising as a response to centrally presented visual stimuli (i.e., the 2 most central rings) from those arising as a response to peripherally presented visual stimuli (i.e., the two most peripheral rings). We trained the classifier to predict whether the activation patterns were related with “central” or “peripheral” visual stimuli on beta values from 8 deaf participants (10 beta values times 2 categories times 8 subjects for a total of 160 pattern vectors), and tested the model over beta values from the remaining 2 deaf participants (10 beta values times 2 categories times 2 subject for a total of 40 pattern vectors; Haxby et al., 2001, 2011).

S3. What is the locus of neuroplastic changes happening within the AC of congenitally deaf individuals?

Prior findings implicate several auditory areas, but leave the role of PAC, and in particular A1, underdetermined in congenitally deaf humans. Some reports showed that A1 responds to visual stimulation both in human and non-human subjects (e.g., Finney et al., 2001; Hunt et al., 2006; Roe et al., 1990). Many others, however, have failed to show any visual responses in A1 (e.g., Hickok et al., 1997; Kral et al., 2003; Nishimura et al., 1999; Stewart and Starr, 1970). Moreover, it seems that A1 in deaf animals still responds to electric stimulation of the auditory nerve (e.g., Hartmann et al., 1997), suggesting that A1 may not go through massive reorganization under deafness. Nevertheless, given the coordinates of our auditory region, it seems that our activation is within PAC, alongside activation in non-core auditory regions.
**Fig. S1** – Univariate whole-brain analysis of the representation of center and periphery, as well as the azimuth and medial planes. Contrast (t-values) maps for the contrasts of interest. (A) Contrast maps for center versus periphery locations across the whole-brain for deaf and hearing participants; (B) Contrast maps for left versus right locations across the whole-brain for deaf and hearing participants; and (C) Contrast maps for up versus down locations across the whole-brain for deaf and hearing participants. Contrast maps are cluster corrected 0.001.
REFERENCES


Neuroplasticity in the congenitally deaf


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FIGURE LEGENDS

Figure 1. Stimuli used in the experiments. (A) stimuli used for visual field location classification; and (B) stimuli used for eccentricity classification.

Figure 2. Auditory and visual cortex. (A) Regions within auditory cortex (AC), defined in hearing participants, and primary visual cortex used for the classification. (B) The auditory cortex ROI includes de Heschl's Gyrus (Brodmann Area 41), but does not include other auditory regions of interest such as Brodmann Areas 42 and 22. t map corresponds to the AC ROI contrast of white noise vs. silence. HG – Heschl’s Gyrus; SF – Sylvian Fissure; STG – Superior Temporal Gyrus; STS – Superior Temporal Sulcus.

Figure 3. Percent correct performance for real and surrogate data in auditory cortex (bilaterally) and visual cortex. (A) Percent correct performance for quadrant classification in AC; and (B) Percent correct performance for the classification of the contrasts left vs. right and up vs. down in AC; (C) Percent correct performance for quadrant classification in V1; and (D) Percent correct performance for the classification of the contrasts left vs. right and up vs. down in V1. Bars correspond to performance with real data, and black dashes (-) correspond to performance with the surrogate data. Dashed lines correspond to different confidence intervals for the estimate of the mean of the surrogate data. Red error bars correspond to the SEM of the classification data, whereas black error bars correspond to the SEM of the surrogate data. Within-group classification performance for deaf individuals is above chance for quadrant classification, demonstrating that visual location is represented in the AC of congenitally deaf individuals. Stimuli within the azimuth, when compared to stimuli within the meridian plane, seem to drive responses in AC of congenitally deaf individuals. Results in V1 show highly significant classification performance across classifiers.

Figure 4. Whole-brain searchlight classification accuracy for center/periphery locations, and locations within the azimuth and meridian planes. (A) Decoding performance effect maps (z-values) for decoding center versus periphery locations across the whole-brain for deaf and hearing participants; (B) Decoding performance effect maps (z-values) for decoding left versus right locations across the whole-brain for deaf and hearing participants; and (C) Decoding performance effect maps...
(z-values) for decoding up versus down across the whole-brain for deaf and hearing participants. z-values (calculated against surrogate data) above 3.9 correspond to p-values equal to or less than 0.0001; Decoding performance for the deaf group is represented in yellow, whereas for the hearing group it is represented in blue. Overlap in decoding ability for both groups is represented in silver gray.
Figure 1. Stimuli used in the experiments.

A

Left  Right  Up  Down

B

First  Second  Third  Fourth
Figure 2. Auditory and visual cortex.
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