

Supplementary Fig. 1

A

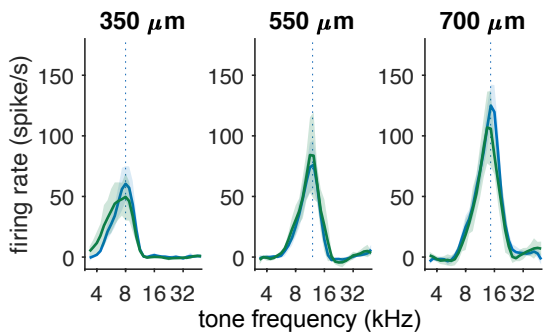


5-25 sec after entry
80% probability

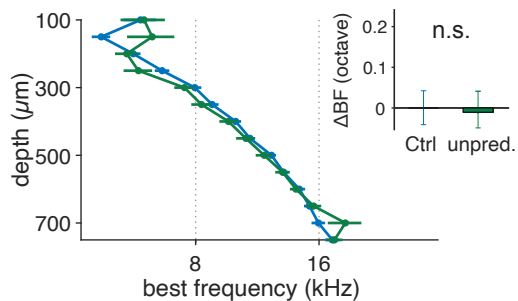
— control, n = 9
— unpredictable, n = 9

a visit in the corner

B



C



D

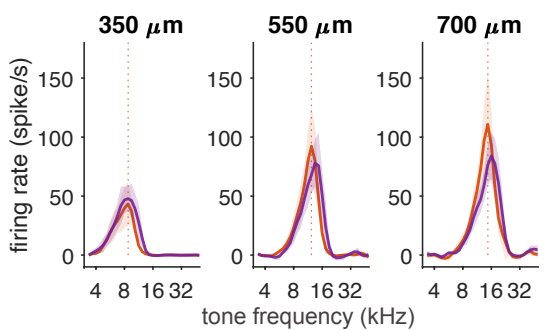


3 sec

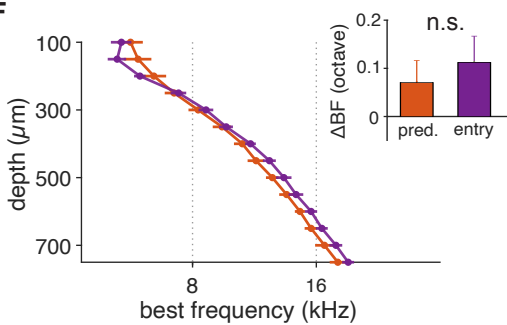
— predictable-W, n = 10
— predictable-entry, n = 10

a visit in the corner

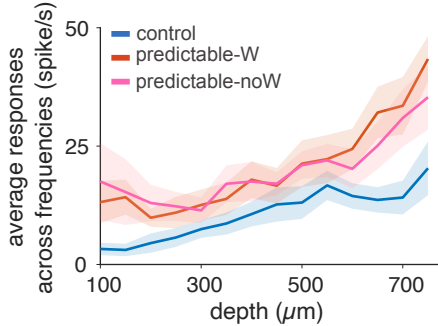
E



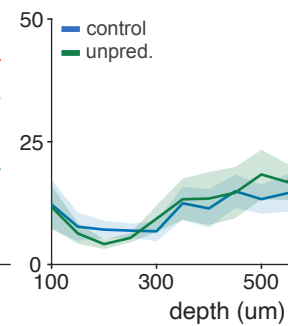
F



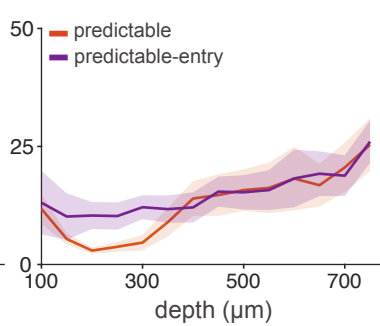
G



H

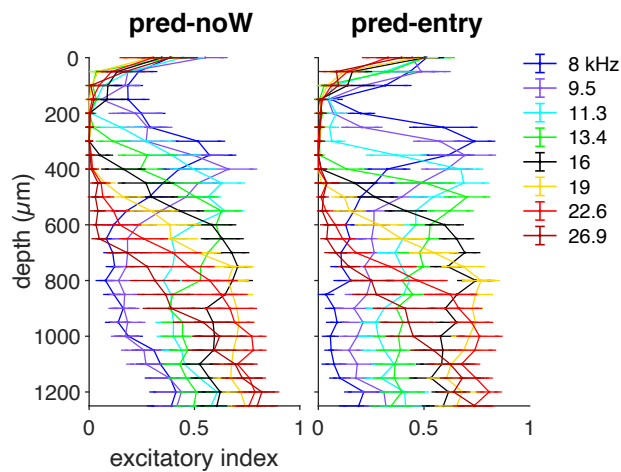


I

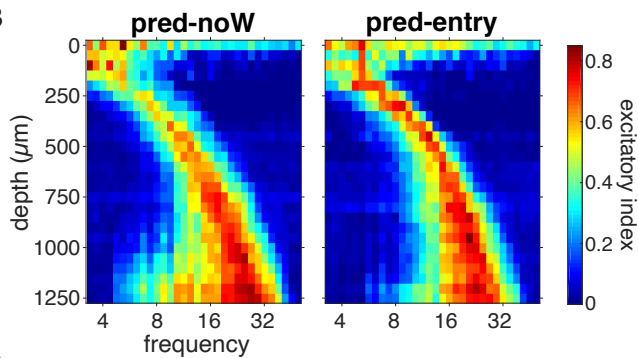


Supplementary Fig. 2

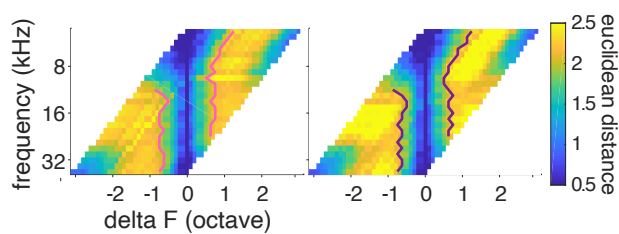
A



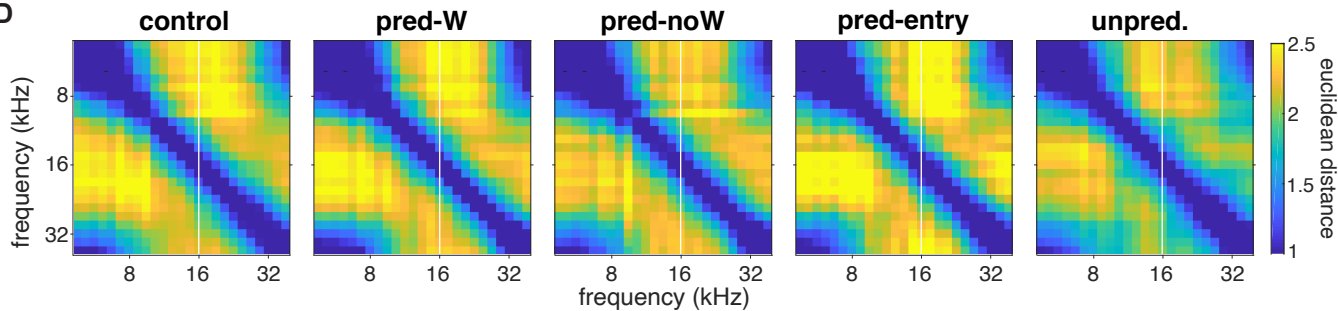
B



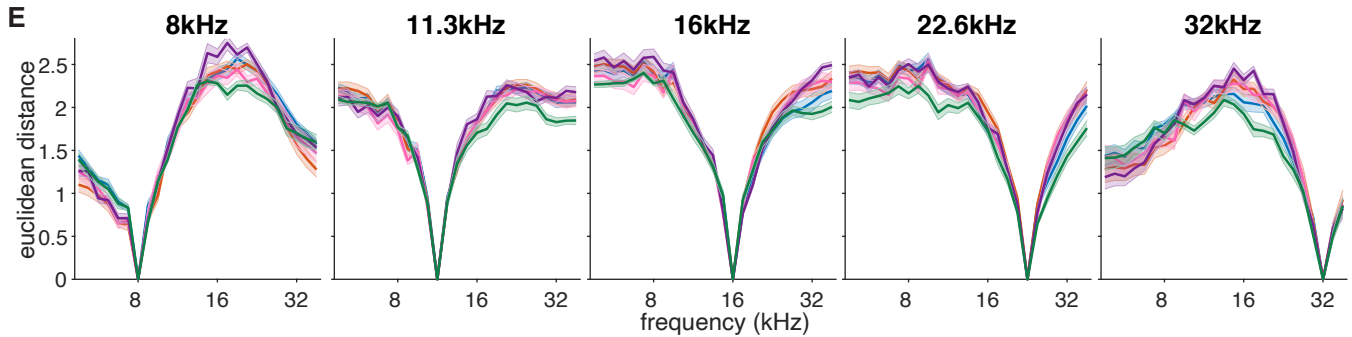
C



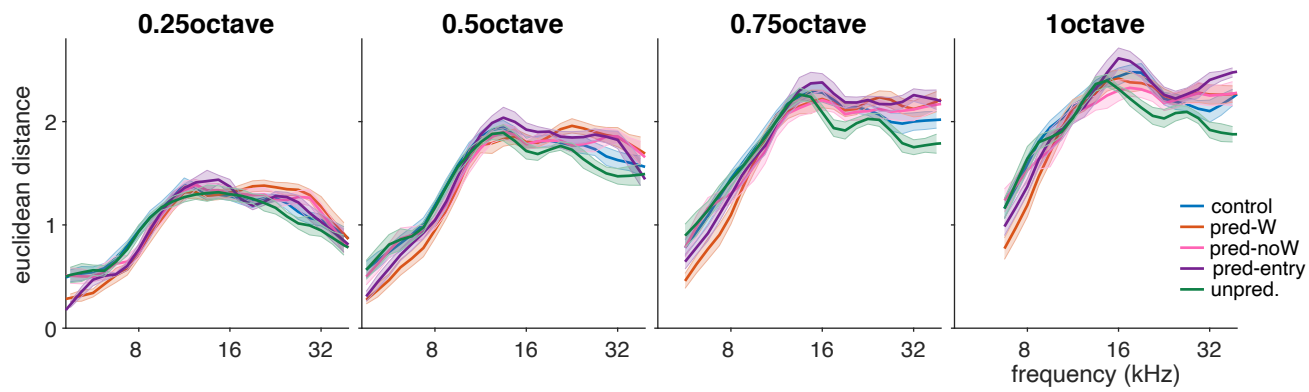
D



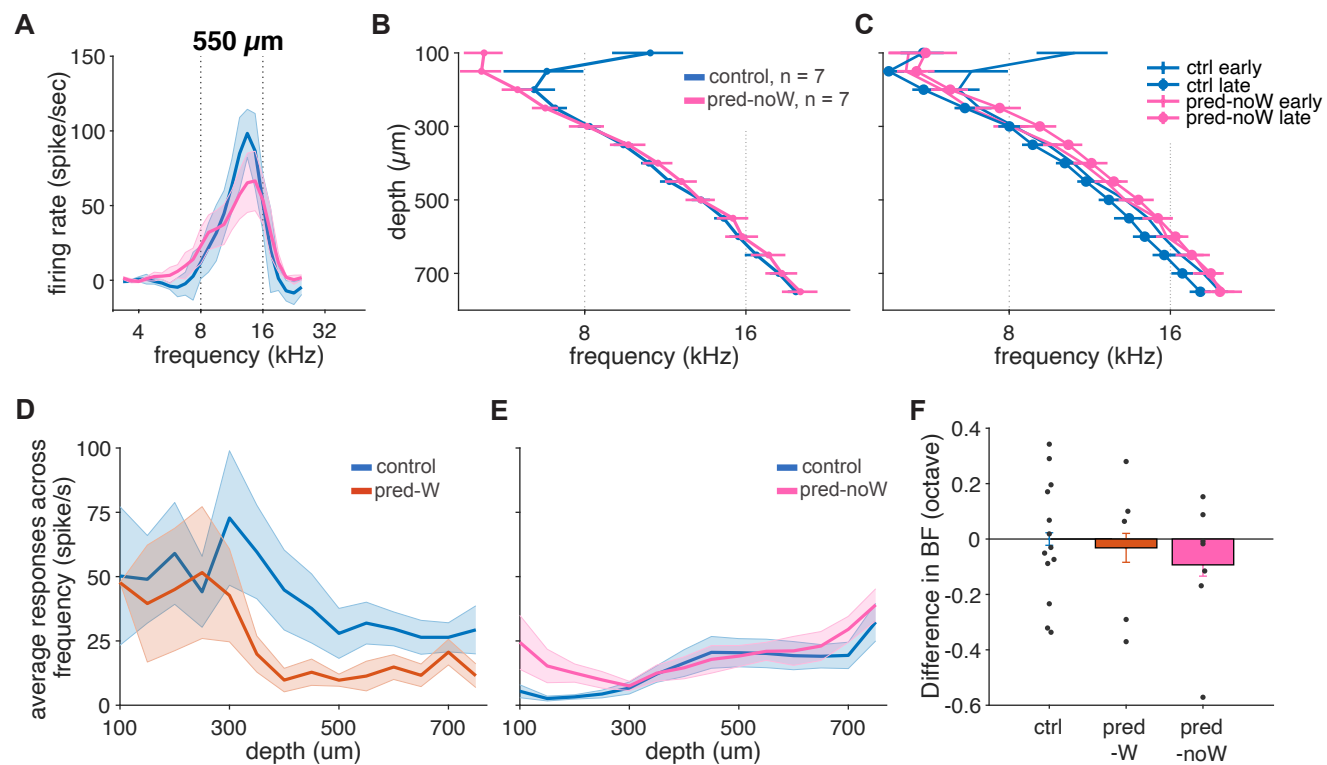
E



F



Supplementary Fig. 3



Supplementary Fig. 1: Predictable sound-context association induced a homogeneous increase in response gain.

A, Schematic representation of the sound exposure protocol for the control and unpredictable group. **B**, Average tuning curves of simultaneously recorded sound-evoked activity at 70 dB for the depth of 350, 550, and 700 μm in the IC of the control (blue) and unpredictable (dark green) group. **C**, Average best frequency (BF) as a function of recording depths (linear mixed effect model with the group and depth factor: $p_{\text{group}} = 0.63$, $p_{\text{depth}} < 0.0001$, $p_{\text{group, depth}} = 0.64$). Insert: Difference in BF relative to the average BF of the control group (two-sample t-test, $p = 0.75$). **D**, **E**, **F**, Similar to **A**, **B**, **C**, for the comparison between the predictable and entry-only group. There was no shift in BF (linear mixed effect model with the group and depth factor: $p_{\text{group}} = 0.39$, $p_{\text{depth}} < 0.0001$, $p_{\text{group, depth}} = 0.04$) and no significant difference in BF change (two-sample t-test, $p = 0.81$). **G**, Average evoked responses to frequencies at 70 dB as a function of recording depth (linear mixed effect model with the group and depth factor: $p_{\text{ctrl-noW}} = 0.02$, $p_{\text{depth}} < 0.0001$, $p_{\text{pred, depth}} = 0.02$). **H**, **I**, Similar to **G**, show the response gain for the control vs. unpredictable (linear mixed effect model with the group and depth factor: $p_{\text{group}} = 0.53$, $p_{\text{depth}} < 0.0001$, $p_{\text{group, depth}} = 0.72$) and predictable vs. entry-only (linear mixed effect model with the group and depth factor: $p_{\text{group}} = 0.69$, $p_{\text{depth}} < 0.0001$, $p_{\text{group, depth}} = 0.006$), respectively.

Supplementary Fig. 2: BF Shifts were accompanied by changes in sound representations.

A, Structural tuning curves, as relative response magnitude to a given frequency across the IC. Sound-evoked responses were rescaled with a 0-max normalization based on the tuning curve of each depth. **B**, Population vector calculated as the relative response magnitude to a given frequency across the IC. **C**, The dissimilarity of activity patterns measured by Euclidean distance between the excitatory profile of frequency pairs. The boundaries where the mean Euclidean distance was larger than 2 were marked for each group respectively. **D**, Frequency discrimination ability measured by Euclidean distance between the excitatory profile of frequency pairs. **E**, Frequency discrimination ability for a given frequency to other frequencies. **F**, frequency discrimination ability for a given ΔF as a function of sound frequency.

Supplementary Fig. 3: The BFs remained unchanged during the initial days of sound exposure.

A, Average tuning curves, before (solid lines) and after cortical inactivation (dashed lines), at 550 μm for control (blue) and noW exposure (pink) groups during the early days of sound exposure. **B**, Average best frequency (BF) as a function of recording depths for mice during the early days of sound exposure. **C**, Average best frequency (BF) as a function of recording depths for mice during the early and late days of sound exposure. **D**, Average evoked responses to frequencies at 70 dB as a function of recording depth for the predictable (red) and the control (blue) group (linear mixed effect model, for the ventral area, with the group and depth factor: $p_{\text{group}} = 0.005$, $p_{\text{depth}} = 0.007$, $p_{\text{group, depth}} = 0.036$). **E**, Similar to **D**, for the noW exposure (pink) and the control

(blue) group. Modeling with a linear mixed model reveals a significant effect of the depth $p < 0.0001$, but no effect of the group $p = 0.08$. **F**, Difference in BF relative to the average BF of the control group. There is no significant difference between groups (unpaired t-test, $p > 0.05$).