Phase-encoding analysis for ILD preferences in the human auditory cortex

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VANDERBILT

INTRODUCTION

Phase-encoding paradigms

- Have been used to **emphasize topographic representations** ([1-8])
- **but few looked at** preferences Interaural Level Difference (**ILD**)

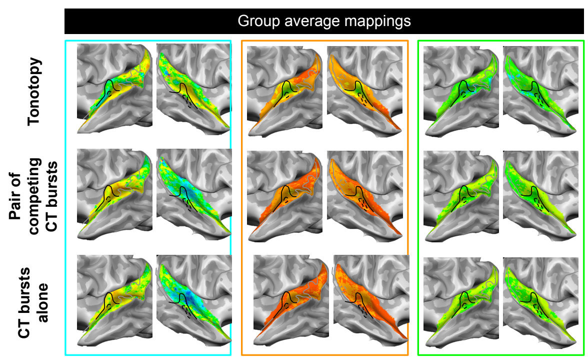
Cortical tuning to space is

- **broad** in mammals, mainly **contralateral** dominance
- **large variability** depending on the cue, paradigm, stimuli, neuroimaging technique
- **sharper representations** when presented **with a competitor** ([12-13])

PURPOSE

Investigate

- **ILD preferences** in normal hearing subjects using phase-encoding mappings
- whether **competing sounds enhance ILD selectivity** relative to the non-competing condition



Group average topographic mappings (turquoise box), tuning amplitudes (orange box) and tuning bandwidths (green box) projected onto subject 1609. Black lines: HG borders (full) and partial duplication (dashed). Grey lines: Planum Temporale (PT) and Planum Polare (PP).

RESULTS

Frequency preferences

- **mirror-symmetric gradients** of frequency preferences within PAC, reproducing previous findings [4-7,9-11]
- **clusters of large amplitude and bandwidth co-localized with PAC**, as seen in both mappings and ROIs plots
- **strong correlation between amplitudes and bandwidth in PAC**, but not in STG

ILD preferences

- ILD representations, BOLD responses, amplitudes and bandwidthsshowed **strong contralateral dominance** of cortical preferences for **ILD within PAC and pSTG**
- **tuning amplitudes** revealed **higher specificity for frequency than ILD within PAC, and higher specificity for contralateral ILD and competing CT burst during competition in A1 and pSTG**
- **tuning bandwidths** showed **broader selectivity within PAC and pSTG for midline and contralateral ILD**, with broader selectivity during non-competing stimuli
- **tuning amplitudes and bandwidths** within preferred ILD **were highly correlated in PAC when CT bursts were presented alone**

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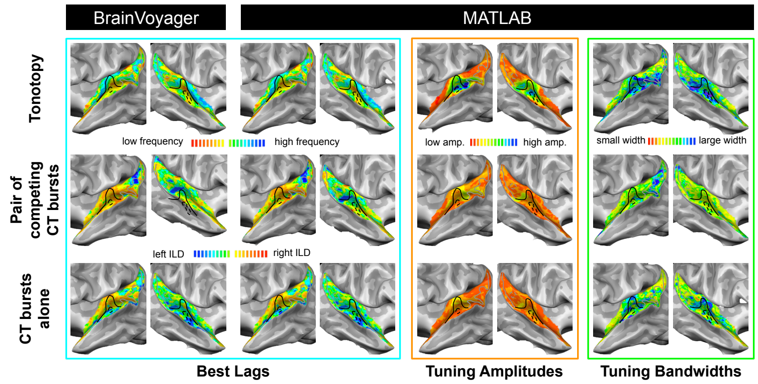


Results of an exemplar subject (1609). Topographic mappings for frequency (upper row) and ILD (middle and lower row) from BrainVoyager (left panel, turquoise box) and Matlab (right panel, turquoise box). Tuning amplitudes (orange box) and bandwidths (green box) for all phase-encoding experiments. Black lines: HG borders (full) and partial duplication (dashed). Grey lines: Planum Temporale (PT) and Planum Polare (PP).

METHODS

Tonotopy paradigm

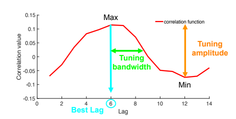
- **progressions of pure tone bursts** (88 - 8 kHz) presented in blocks of 32s, used to **localize primary auditory cortex** (PAC) based on frequency gradients across Heschl's gyrus (HG; [5-7])

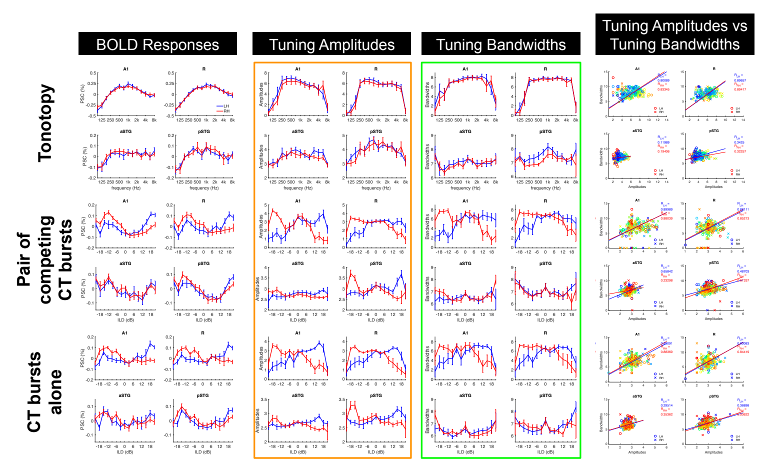
Phase-encoding ILD experiment

- **progressions of ILD** (-21 dB to +21 dB, in 3 dB steps) of amplitude-modulated complex-tone (CT) bursts
- **CT bursts** presented **alone, or** in alternation **with competing CT bursts** of 0 dB ILD in 34s-cycles

Analysis

- **phase-encoding analysis** to extract cross-correlation maps for **preferred frequency and ILD** using Brain Voyager and MATLAB
- **MATLAB scripts** to calculate **tuning amplitudes and bandwidths** (amplitude and width of the correlation function)





Group average BOLD responses, amplitudes, bandwidths, and relationship between both within best-frequency (upper row) or best-ILD (middle and lower row) bins in PAC (A1 and R) and STG (aSTG and pSTG) ROIs. Blue line: left hemisphere; Red line: right hemisphere; x: left hemisphere data point; o: right hemisphere data point; Same colors as in the topographic mappings.

CONCLUSION

- **contralateral ILD preferences within bilateral PAC (A1) and STG (pSTG)**, consistent with previous human imaging studies ([15]),
- **interleaving** target sounds with different-ILD **distractors enhanced voxels' selectivity and specificity to target ILD in PAC and pSTG ([12])**

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