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Are Posterior Auditory-Cortex Neurons Tuned to Sound Location in Humans

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BACKGROUND: Anterior and posterior areas of the human auditory cortex may be differentially tuned to processing of object/content ('what') and sound location ('where' information [1], respectively. Our recent studies [2] suggest that tuning properties of auditory-cortical neurons can be non-invasively studied by measuring adaptation of audi MEG/EEG responses as a function of preceding stimulation. Here, we determined wheth the posterior and anterior sources [3] of the neuromagnetic N1m response differentially to sound location and phonetic category. The effects of selective attention on response tu properties were also studied.
METHODS: During the MEG measurements, subjects were presented with pairs of the Finnish vowels /ä/ and /ö/ simulated from locations straight ahead or 45 degrees to the ri of the subject's head. Stimuli were simulated by convolving raw vowel recordings with acoustic impulse responses measured at the ears of a manikin head to generate stereo sti with appropriate phonetic ('what') and spatial ('where') attributes. Either the phonetic o spatial attributes changed between the two stimuli making up each stimulus pair, with th other attribute held fixed across the pair. (Occasionally, the pairs were fixed for both attributes.) During a one-back task, subject was instructed to press a button upon hearing consecutive pairs identical with respect to the attribute of interest. The attribute of intere (phonetic or spatial) alternated in successive 60-s-long selective-attention blocks, interle with 30-s blocks of unattended stimulation. The 306-channel MEG was averaged to 2-s epochs including responses to each tone in a pair (200-ms pre-stimulus baseline). Equiv current dipole (ECD) modeling was utilized to contrast response amplitudes in the condi of interest.
RESULTS: Consistent with previous observations [2, 3], ECDs modeled to the ascendin phase of N1m to the first stimulus in a pair originated posterior to those modeled at the descending phase of N1m. Time-varying multi-ECD models indicated that the posterior source activity was strongly adapted regardless of the phonetic similarity/dissimilarity w the pair (Fig.1). However, robust posterior N1m responses were observed when the secc stimulus came from a different direction than the first. This effect was generally larger v subjects actively attended spatial rather than phonetic stimulus attributes. The anterior N source activity was, analogously, stronger for sounds that were phonetically dissimilar r than similar, independent of their spatial similarity; however, this effect was weaker thar modulation of posterior N1 by spatial changes (Fig.1,2).
CONCLUSIONS: Neural ensembles occupying regions posterior to the human primary auditory cortex (e.g., planum temporale, posterior superior temporal gyrus) may be specifically tuned to sound-location cues. Selective attention might sharpen the feature tuning of these neurons.

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Figure 1. Grand-average ECD amplitude waveforms for the posterior (Top) an anterior (Bottom) N1m sources in the right hemisphere of 5 subjects. The subjects attending to the sound location. Note that the amplitude of the posterior N1m to second sound (Top) was clearly larger when the sound location changed in relatio the first sound.

Figure 2. Grand-average ECD amplitude waveforms for the posterior (Top) an anterior (Bottom) N1 sources in the right hemisphere of 5 subjects. The subjects v attending to the phonetic attributes of sound pairs.