Supporting Information

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SI Text

Conventional Analyses of Evoked Responses in Sensor Space

Vowel Deviants. The MMF amplitude generated by D1 was significantly lower than that generated by D2 [D1: $M = 81.34$ fT, SE = 10.56; D2: $M = 116.10$ fT, SE = 16.74; $t(8) = -3.39$, $P < 0.01$, $r = 0.75$] and significantly lower than that generated by D3 [D3: $M = 120.31$ fT, SE = 18.36; $t(8) = -2.74$, $P < 0.05$, $r = 0.67$]. There was no significant difference between MMF amplitude for D2 and D3 [$t(8) = -0.38$, $P = 0.71$, $r = 0.13$] (Fig. 2 *Upper*). The latency of peak amplitude was not significantly different between D1 and D2 [D1: $M = 200.00$ ms, SE = 8.82; D2: $M = 196.67$ ms, SE = 6.24; $t(8) = 0.26$, $P = 0.80$, $r = 0.09$]. The peak amplitude was reached earlier for D3 ($M = 164.44$ ms, SE = 7.84) than for both D1 [$t(8) = -3.65$, $P < 0.01$, $r = 0.77$] and D2 [$t(9) = -3.67$, $P < 0.01$, $r = 0.77$] (Fig. 2 *Lower*).

Tone Deviants. There was no significant difference between MMF amplitude generated by D1 and D2 [D1: $M = 76.74$ fT, SE = 10.70; D2: $M = 73.00$ fT, SE = 12.03; $t(8) = 0.28$, $P = 0.78$, $r = 0.09$]. The MMF amplitude generated by D3 ($M = 109.30$ fT, SE = 15.76) was significantly greater than the amplitude generated by both D1 [$t(8) = 2.78$, $P < 0.05$, $r = 0.68$] and D2 [$t(8) = 2.90$, $P < 0.05$, $r = 0.70$] (Fig. 2 *Upper*). The latency of peak amplitude was not significantly different between D1 and D2 [D1: $M = 204.44$ ms, SE = 7.83; D2: $M = 187.78$ ms, SE = 10.77; $t(8) = 1.54$, $P = 0.16$, $r = 0.46$], however, peak latency was significantly earlier for D3 ($M = 172.22$ ms, SE = 6.62) than for D1 [$t(8) = -3.54$, $P < 0.01$, $r = 0.76$]. There was no significant difference in latency between D2 and D3 [$t(8) = 1.70$, $P = 0.13$, $r = 0.49$) (Fig. 2 *Lower*).

Comparison of Matched Vowel and Tone Deviants. There was no significant difference between the MMF generated by vowel D1 and tone D1 in terms of either amplitude [$t(8) = 0.52$, $P = 0.62$, $r = 0.18$] or peak latency [$t(8) = -0.43$, $P = 0.68$, $r = 0.14$]. The MMF amplitude generated by vowel D2 was greater than that generated by tone D2 [$t(8) = 2.64$, $P < 0.05$, $r = 0.66$), but there was no difference in the peak latency of MMF generated by these stimuli [$t(8) = 1.08$, $P = 0.31$, $r = 0.34$]. There was no significant difference between the MMF generated by vowel D3 and tone D3 in terms of either amplitude [$t(8) = 0.82$, $P = 0.43$, $r = 0.26$] or peak latency [$t(8) = -1.49$, $P = 0.17$, $r = 0.44$].

DCM

Vowel Deviants. The model comparison demonstrated strong evidence in favor of model 4 for all vowel deviants (Fig. 1). The sum of the log model evidences for model 4 relative to the second-best model was 100.65 (D1), 220.09 (D2), and 10.12 (D3). The deviant-induced coupling changes from model 4 (the winning model) were extracted for each subject and taken forward to the next stage of the analysis (second-level t tests).

As reported in the previous section, in sensor space, the MMF amplitude for D1 (the within-category deviant) was significantly lower than the amplitudes for D2 and D3 (the across-category deviants, which were not significantly different from each other). When tested in a paired sample t test across the group (with posterior connectivity means collapsed across D2 and D3), the connection strength in area left STG was found to be significantly higher when the deviant crossed a native vowel category [$t(8) = 2.56$, $P < 0.05$], whereas the connection strength between right STG and left STG decreased significantly [$t(8) = -2.36$, $P < 0.05$). No other significant changes in connection strength were observed.

Tone Deviants. Model 4 was also the best model tested for all tone deviants. The sum of the log model evidences for model 4 relative to the second-best model (model 1) was 7.94 larger for (D1), 224.09 (D2), and 44.00 (D3). The deviant-related coupling changes from model 4 (the winning model) were extracted for each subject and taken forward to the next stage of the analysis.

In sensor space, the MMF amplitudes for D1 and D2 did not differ significantly, whereas MMF amplitude for D3 was significantly higher than for both D1 and D2. When tested in a paired sample t test across the group, the connection strength between right A1 and right STG was found to be significantly higher for D3 than for D1/D2 collapsed [$t(8) = 4.06$, $P < 0.05$]. For the same contrast, the intrinsic connection strength in area right HG was also greater [$t(8) = 2.25$, $P = 0.05$].

5-Region Models. To test our assumption that 4 sources were sufficient to model the MEG data, we estimated two 5-region models and compared them with our 4-region models. One 5-region model comprised our winning model (model 4), with the addition of the right IFG as a source (coordinates taken from ref. 1) and reciprocal (i.e., forward and backward) connections between this region and the right STG. Model comparison showed that this new 5-region model performed poorly for every deviant compared with all 4-region models already tested. The sum of the log model evidences for model 4 relative to this 5-region model was: vowels, 5,538 (D1), 5,615 (D2), and 5,333 (D3); tones, 5,873 (D1), 6,186 (D2), and 5,907 (D3).

The second 5-region model included the left IFG as the fifth source, with reciprocal connections between left STG and left IFG. This model also performed poorly, the sum of the long model evidences relative to the winning model being: vowels, 6,885 (D1), 7,374 (D2), and 6,876 (D3); tones, 7,145 (D1), 7,385 (D2), and 7,291 (D3).

1. Garrido MI, Kilner JM, Kiebel SJ, Friston KJ (2007) Evoked brain responses are generated by feedback loops. *Proc Natl Acad Sci USA* 104:20961–20966.

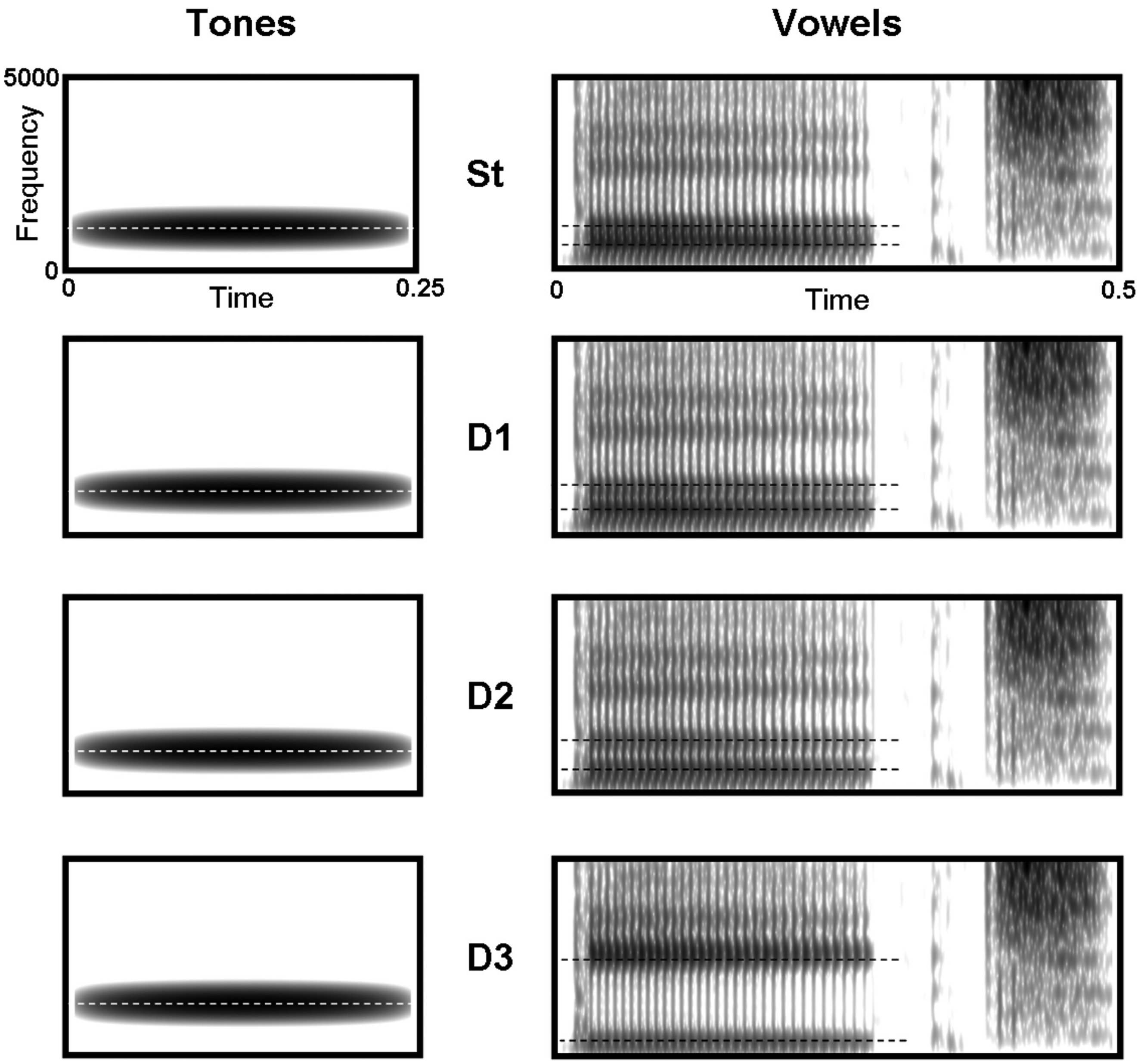

Fig. S1. Spectrograms (time/frequency plots) of the 8 auditory stimuli used in the study; the standard (St) and 3 deviants (D1-D3) are shown with the tones on the left. The center frequencies of the tones and of the first and second energy band (formant) of each vowel stimulus are marked with dotted lines. Note the rise (increasing frequency value) in the second formant of the vowel stimuli from St to D3. The frequency changes in the tone stimuli (i.e., difference between standard and deviants) are smaller than for the vowels, because the 2 series are matched perceptually (i.e., a smaller change in the tone frequency is required to match the discriminability of a formant frequency difference)

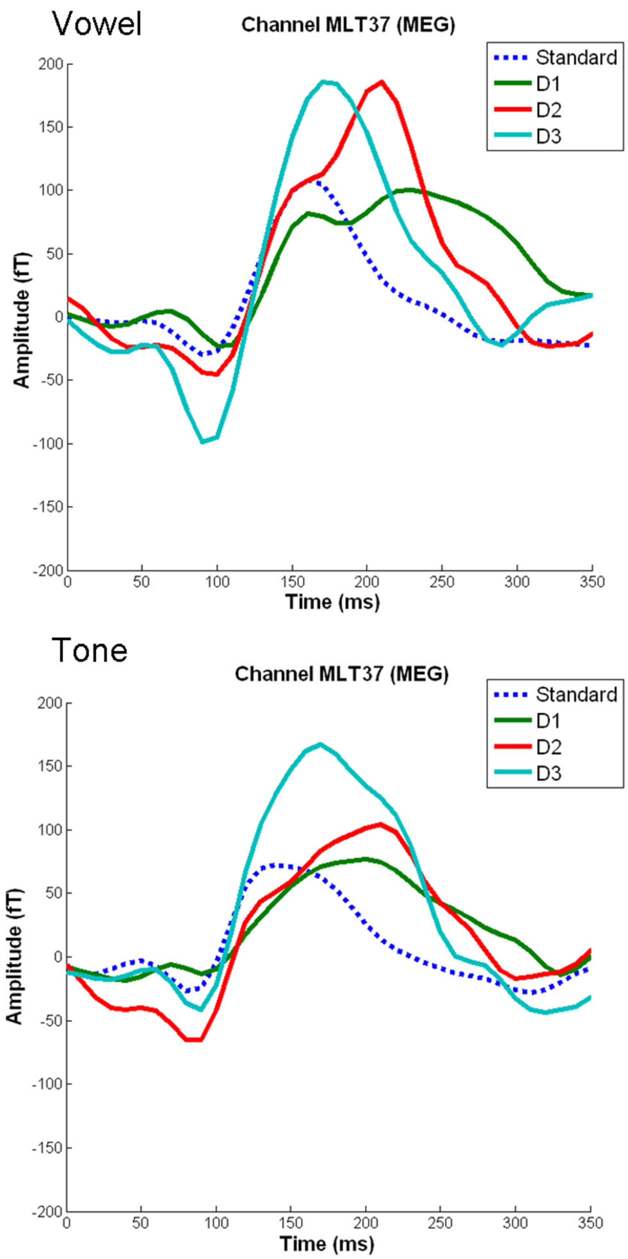

Fig. S2. Average event-related fields for each stimulus type taken from a temporal sensor for a typical subject. (*Upper*) Responses for vowel stimuli. (*Lower*) Responses for tone stimuli.

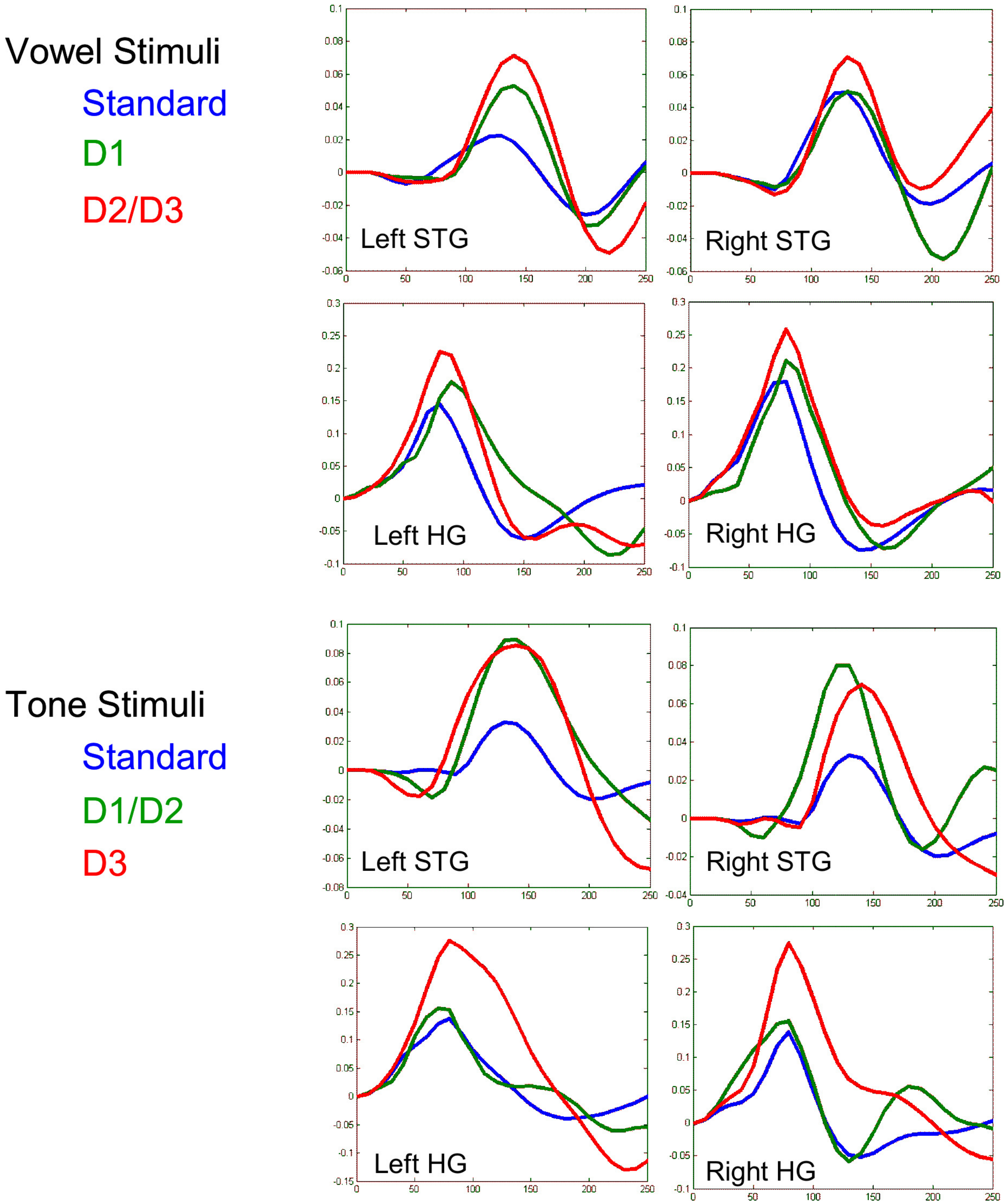

Fig. S3. Grand mean average waveforms for each stimulus type taken from the 4 sources in the network. (*Upper*) Responses for vowel stimuli. (*Lower*) Responses for tone stimuli.