Evidence of Right Hemisphere Engagement during the Production of Overt Emotional Prosody: An Event-Related fMRI Study


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Purpose
The purpose of this study was to compare the activation related to overt production of a sentence spoken with emotional prosody, to the same sentence spoken with only neutral prosody. The aim was to reveal the change in the MR signal specifically related to the production of emotional prosody, after the common motor and language related activation had been removed.

Introduction
The physiological mechanisms underlying the production of emotional prosody are not well understood. There is evidence from lesion studies that this capability is principally supported by the right hemisphere [1,2]. Using fMRI, we examined the pattern of activation during overt speech production of a single sentence (“They went to the store”) spoken with and without emotional prosody. The utilization of an event related methodology permitted overt speech production because the artifactual activation related to movements of the head during speaking were minimized during post hoc data processing [3].

Methods
Twelve right handed subjects (6 male, 6 female) without a past neurological injury were examined. Task: The subjects were presented with a single target sentence (e.g. “They went to the store”) and a target emotional prosody (happy, neutral or angry) and they overtly produced the sentence with the target prosody during the initial 2.94s of an 11 epoch trial (1.47s = 1 epoch; 11 epochs = 16.17s total) with 25 repetitions. Image Acquisition: Images were obtained using a 1.5 Tesla GE Signa with a 2-spiral gradient echo scan with: 9 contiguous axial 6.9 mm thick slices; 180 mm FOV; TR/TE/FA = 735ms/30ms/40deg. Image Analysis: Functional images were overlaid onto high-resolution anatomic images obtained with a 3D-SPGR sequence (TR/TE/FA = 27ms/7ms/45deg); FOV = 240 mm; 256 x 192 x 124 matrix; voxel size = 0.94 x 0.94 x 1.3 mm. Significantly active voxels were visualized using the AFNI package [4]. Regions of interest (ROI) were defined in the inferior frontal gyrus, frontal pole dorsolateral frontal cortices, M1/Premotor areas for both hemispheres and clusters > 50 ml in volume were tabulated.

Results
The mean volume of activation for the ROI's in the right hemisphere were larger than for the ROI's of the left hemisphere. Prominent activation was noted in the right inferior frontal gyrus, right frontal poles, as well as in the dorsolateral frontal lobes (Figure 1). Figure 2 shows the signal-to-noise benefits accrued from averaging signal responses across cycles and runs.

Discussion
These results support the hypothesis that the right hemisphere has a prominent role in the control of emotional prosody, corroborating evidence from studies of right hemisphere patients.

References