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Neuroimaging of prosodic comprehension

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Background

Prosody comprises the non-verbal part of oral communication, and its underlying neural basis is less well understood than the lexical, grammatical and articulatory processes of speech. With prosody, initial work involved behavioural studies on patients with cerebral damage, and these studies suggested that the right hemisphere was involved in prosodic comprehension, though subsequent neuroimaging data has not always clearly delineated hemispheric involvement. Such inconsistencies may arise for two reasons: firstly due to inherent inaccuracies of lesion studies, with their potential for wide areas of changed cerebral activity, and secondly, due to the differing experimental paradigms utilized. In particular, tests evaluating emotional prosody have had to contend with the possible confounding of lexical and higher cognitive evaluation of material presented. We postulated that evaluating processing of changes in a single subcomponent of prosody, namely pitch, and by utilizing a second experimental paradigm of matched musical analogies, we could control for these confounders.

Materials and methods

Twelve subjects were recruited with inclusion criteria being: males aged between 18 and 65, right-handedness, English as a first language. A modified English version of the music and prosody discrimination task designed by Patel *et al*. (1998) was used in this study. The stimuli consisted of lexically matched sentence pairs and their non-verbal, musical analogues. The only prosodic changes in stimuli utilized in this experiment were in internal pitch pattern (emphasis shift). Six counterbalanced blocks were presented, with each block composed of twelve trials: four pairs of sentences, four pairs of musical tones, and four null trials, a silent period equal in length to four paired stimuli. Subjects undertook the prosodic discrimination task whilst being scanned in a 1.5 Tesla MRI scanner at the Institute of Psychiatry. Analysis of the fMRI data was with XBAM software in UNIX.

Results

The results demonstrated greater right frontotemporal activation during musical prosodic assessment, and greater left hemispheric activation during sentence assessment. Areas common to prosodic assessment lie within right frontal, bilateral temporal and left parietal cortices.

Discussion

This data support the task dependent hypothesis of prosodic processing, with a greater engagement of the left rather than the right temporal cortex during generic assessment of pitch. We have also added weight to the shared neural resources hypothesis, being the first neuroimaging study to follow the previous behavioural data on the topic. These earlier studies looked at the further semantic prosodic subcomponents of terminal-shift and internal timing changes. Our current work would support further research to neuroimage these subcomponents, study which could also continue to investigate the two main competing prosodic hypotheses.

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