The Neural Basis of Successful Oral Word Reading in Chronic Aphasia

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OBJECTIVE: To understand the neural systems supporting successful oral word reading after damage to the left perisylvian phonological system. BACKGROUND: Damage to perisylvian structures in the left middle cerebral artery territory typically causes phonological processing deficits, typified by phonological paraphasia and inability to sound out pseudowords. The mechanisms supporting successful oral word reading in the setting of chronic left perisylvian phonological system damage are unclear. We hypothesized that patients recruit undamaged parts of the semantic system to mediate successful word reading. DESIGN/METHODS: Event-related fMRI was used to study 24 chronic aphasia patients and 16 matched controls as they read aloud 72 concrete nouns. Individual trials were classified according to response success. Activation maps were compared between the groups, including in the analysis only items that were read successfully. In separate behavioral testing, patients performed an oral reading task and a pseudoword rhyme judgment task to characterize reading ability and phonological deficits. RESULTS: In behavioral tests outside the scanner, patients showed a pattern of severe phonological impairment, as demonstrated by a high incidence of phonological paraphasia (56% of errors on average) in the reading task and severe impairment on the pseudoword rhyme judgment task (average z-score = -5.26). Compared to controls, patients showed impaired activation in both left and right perisylvian phonological networks during successful word reading. Patients showed stronger activation than controls in bilateral orbital frontal cortex and the pars orbitaI of the right inferior frontal gyrus. CONCLUSIONS: Orbital frontal cortex and IFG pars orbitaI have been linked with semantic retrieval and other conceptual processes. Successful word reading after damage to the left perisylvian phonological network is in part mediated by additional activation in these undamaged regions of the conceptual system. Supported by: NIH grants R01 NS033576, R01 DC003681, and R03 NS054958.

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