Right brain, wrong verb: functional neuroanatomy of action naming in aphasia

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In previous research on object naming in aphasia perilesional activation in the left hemisphere, sometimes along with recruitment of right inferior frontal regions, has been associated with correct naming responses (Fridriksson et al., 2009; Postman-Caucheteaux et al., 2010). At the same time semantic paraphasias produced in a naming ask were related to additional activation of right temporal-occipital areas (Fridriksson et al., 2009). The current fMRI study aimed to further extend these findings by examining action naming and attempting to link verb production efficiency to specific cortical regions. Nineteen healthy individuals and 6 chronic patients with aphasia (half with non-fluent and half with fluent) due to left hemisphere damage were tested using an overt picture naming task in a block-design fMRI paradigm. In the experimental condition, participants were presented with drawings of actions and had to name an action with a single verb. In the baseline condition, they uttered a constant pseudo-verb in response to abstract pictures constructed by digital distortion of real drawings. Behavioral profiles of patients were assessed in a separate action naming test out of the scanner using the same stimuli. Action naming contrasted to the baseline condition elicited specific activation in the left inferior frontal cortex in healthy participants, providing support for the critical role of the latter in verb production. Two patients with relatively spared action naming (91% and 90% correct, 5% and 1% semantic paraphasias) showed a similar activation pattern, although extended to the right homologue in one of them. Additional activation in two patients with decreased naming performance (81% and 79% correct, 18% and 12% semantic paraphasias) was found in the left temporal lobe. Yet another two patients with the poorest behavioral profiles (53% and 47% correct, 43% and 52% semantic paraphasias) showed increased temporal activation bilaterally. The data suggest that left temporal activation is associated with a relatively productive attempt to overcome increased action naming difficulty and moderate lexical-semantic search deficit, which results in an increased but not excessive number of semantic paraphasias. In contrast, in poor performers, the left hemisphere resources are insufficient and broader semantic maps of the right temporal regions are recruited providing inadequate semantic specification, thus leading to high percentage of semantic errors. These findings are in line with research demonstrating that effective language processing relies primarily on the language network of the left hemisphere (Fridriksson et al., 2010; Price & Crinion, 2005; Saur et al., 2006) and that recruitment of right hemisphere regions (particularly posterior ones) is associated with more pronounced naming errors (Fridriksson et al., 2009; Postman-Caucheteaux et al., 2010).