

## Neural circuitries underlying distinct types of verb naming errors in aphasia

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Verb naming errors in aphasia can be of different types (Kemmerer & Tranel, 2000). Persons with aphasia (PWA) can produce semantic paraphasias (i.e., semantically closely related verbs) or grammatical class errors (i.e., nomination of objects involved in the target action). This first pattern is more characteristic of fluent aphasia, and the later of individuals with agrammatic aphasia. In the current study we investigated whether different neural activation patterns underlie these distinct behavioral responses.

Nineteen healthy individuals and six chronic patients with aphasia 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 required to name an action picture 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 outside the scanner. Neuroimaging data were processed using SPM 8. All activation clusters reported here for PWA were significant at  $q = .001$ , FDR-corrected.

In the control group action naming contrasted to the baseline condition elicited specific activation in the left inferior frontal cortex and precentral gyrus, providing support for their critical role in verb production. All PWA had lesions involving the left temporal lobe with partial involvement of the frontal lobe. Behaviorally PWA demonstrated either predominance of noun responses or verb semantic paraphasias. These two profiles of error patterns corresponded to distinct patterns of neural activation. Two patients who primarily produced nouns instead of verbs demonstrated activation in the inferior frontal lobe, supplementary motor cortex and precentral gyrus. In contrast, four patients with abundance of semantic paraphasic responses demonstrated similar extensive activation in the frontal areas (inferior frontal lobe, supplementary motor cortex, precentral gyrus) and in addition in the temporal cortex extending to inferior parietal areas.

Thus, cumulatively our data speak against verb naming being solely dependent on the frontal semantic network. The results are consistent with previous findings where verb-naming deficits stemmed from temporal lesions (Luzzatti, et al., 2006) and favor the interpretation that successful verb naming depends on intact and efficient interaction between the general temporal-parietal semantic system and frontal motor semantic system. Reported data add to the long-lasting debate of separate semantic systems for actions and objects and further emphasize the need to look into error patterns when neural correlates of anomia are under investigation.

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