

RIGHT BRAIN, WRONG VERB: FUNCTIONAL NEUROANATOMY OF ACTION NAMING IN APHASIA

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Rationale

FMRI in aphasia: confrontation naming

- correct object naming responses ~ perilesional activation in the LH
- sometimes accompanied by activation in right inferior frontal regions
- semantic paraphasias ~ additional activation of right temporal-occipital areas (Fridriksson et al., 2009; Postman-Caucheteaux et al., 2010)

Aims of the study:

- to further extend these findings by examining action naming
- to quantitatively link verb production efficiency to specific cortical regions

Method

Participants

- 18 individuals with no history of neurologic impairments (mean age 44)
- 6 patients with aphasia assessed with Luria's neuropsychological battery:

Patient	Age	Sex	Months post-onset	Aphasia	Severity	Etiology	Lesion
P1	70	m	2	non-fluent (efferent and afferent motor)	moderate	stroke	left frontal
P2	56	m	8	non-fluent (efferent motor)	mild-to-moderate	stroke	left parietal
P3	49	m	3	non-fluent (efferent and afferent motor)	severe	stroke	left frontal, temporal-parietal
P4	24	m	39	fluent (acoustic-mnemonic)	mild	encephalitis	left frontal, temporal-parietal, subcortical
P5	55	m	25	fluent (acoustic-mnemonic, sensory)	moderate	encephalitis	left frontal, temporal; right temporal
P6	72	m	10	fluent (sensory)	moderate	stroke	left temporal-parietal

- all participants were native speakers of Russian and (premorbidly) right-handed

Naming scores

Patient	Correct	Semantic paraphasias
P1	91%	5%
P2	91%	8%
P3	81%	18%
P4	79%	12%
P5	53%	43%
P6	47%	52%

Tested out of the scanner, using the same pictures in a different order (no effect of priming confirmed in a preliminary study)

- P1 and P2: relatively high naming scores, few verbal paraphasias
- P3 and P4: lower naming scores, higher rate of semantic paraphasias
- P5 and P6: poor naming scores, very high rate of semantic paraphasias

Materials and Procedure

- 72 black-and-white line drawings of actions
verbs balanced on frequency, imageability, length, argument structure
- 36 abstract pictures
digitally distorted real pictures, the same level of objective visual complexity
- overt picture naming task
"Say aloud what the actor is doing in the picture in one word" → 3SG verb form
"Say *kávaet*" – a pseudo verb for abstract pictures
- two fMRI sessions consisted of 18 blocks each
12 with real actions, 6 with abstract pictures, three pictures per block (presentation time 5.5 sec, ISI 0.5 sec)
- 1.5T Siemens Avanto scanner
BOLD: TE = 50 ms, TR = 3000 ms, FOV = 25 x 25 cm, 64 x 64 matrix, voxel dimension 3 x 3 x 3 mm
high-resolution anatomical image: T1-weighted, MPRAGE; 0.98 x 0.98 x 1 mm; TE/TR 3/1900 ms
- fMRI data analysis was performed in SPM8, results with FDR-corrected $p < 0.05$ are reported



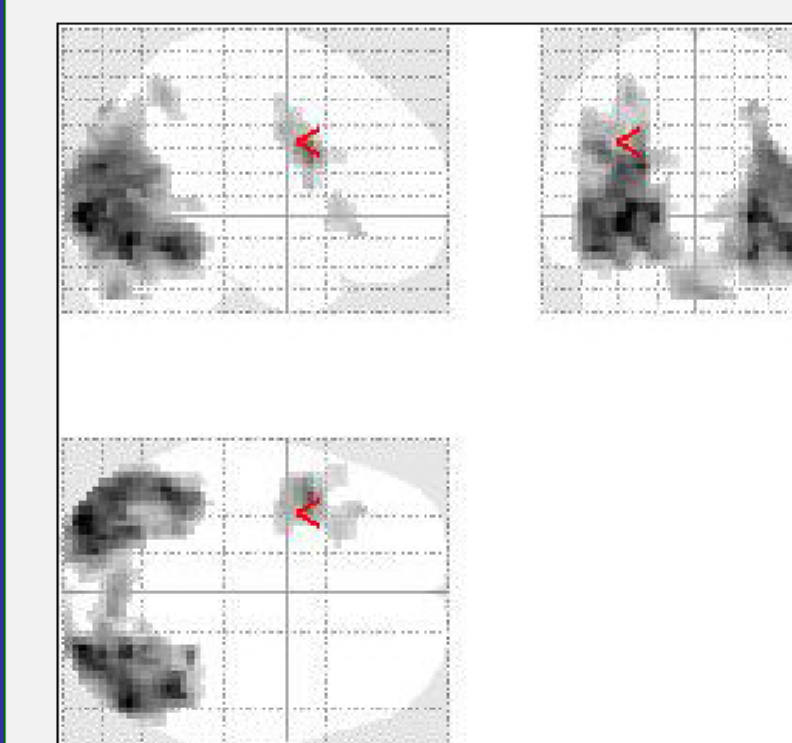
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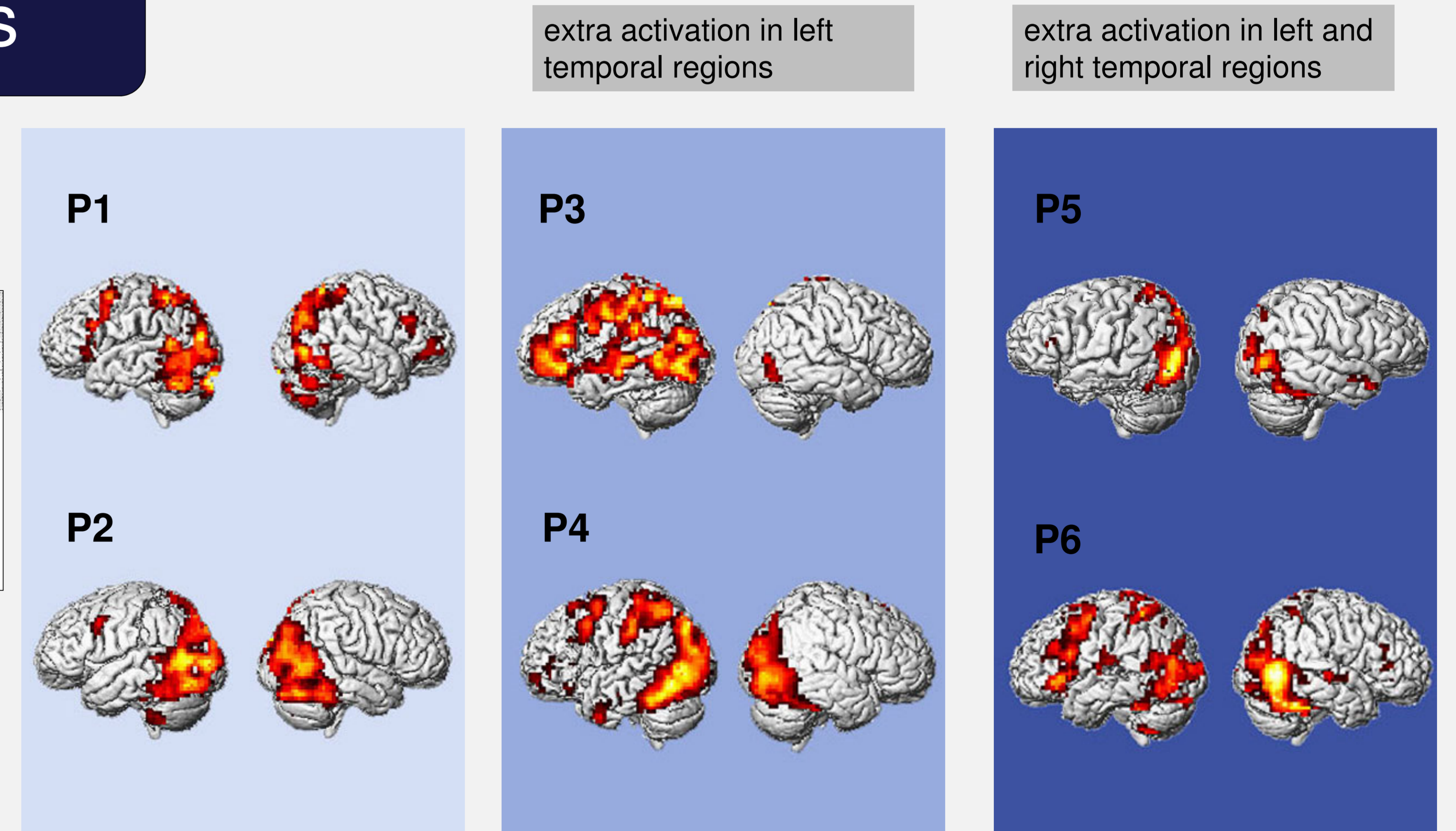
kávaet

Results

Control group



- occipital regions bilaterally
- left ITG
- left frontal incl. tri IFG



Discussion

- critical involvement of left frontal regions in normative verb production
- extra activation in bilateral occipital regions and left inferior temporal gyrus (parts of the ventral visual stream) can be related to greater objective visual complexity (e.g., recognition of human actors and tools)

- 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 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
- the findings are in line with research demonstrating that effective language processing relies primarily on the language network of the LH (Fridriksson et al., 2010; Price & Crinion, 2005; Saur et al., 2006) and that recruitment of RH regions (particularly posterior ones) is associated with more pronounced naming errors (Fridriksson et al., 2009; Postman-Caucheteaux et al., 2010)