Reorganization of language networks in people with aphasia: resting state fMRI data

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While resting state networks, which reflect the large-scale functional architecture of the human brain (Biswal et al., 2010), have been extensively investigated in healthy population, similar studies remain less common in brain-damaged people and especially in people with aphasia (van Hees et al., 2014).
Specifically, the patterns and the role of language networks reorganization in aphasia have not been clarified yet.
The aim: to investigate differences in resting state language networks in people with aphasia and non-brain-damaged individuals.

Method

Participants

- Thirty two people with aphasia due to a stroke in the left hemisphere (9 females, mean age 56 ± 10 years) and 32 healthy age-matched individuals (22 females, mean age 51 ± 10 years); all were right-handed, native speakers of Russian

Data acquisition

- 1.5 T Siemens Magnetom Avanto scanner
- T1-weighted images (TR/TE/FA=1.9s/2.93ms/15°; 1x1x1 mm voxel; matrix 256x256; 176 slices)
- T2*-weighted BOLD images (TR/TE/FA = 3s/50ms/90°; 3.9x3.9x3.75 mm voxel; matrix 64x64; 35 slices; 180 volumes)
- Participants were instructed to stay relaxed in the scanner, with their eyes closed; no active task was given

Data analysis

- Data preprocessing was performed in SPM8
- Resting state networks were identified using group ICA in GIFT
- Univariate tests in GIFT were used to test the difference between people with and without aphasia in the intensity of resting-state spatial maps (connectivity and degree of co-activation within a network)
- The intensity of activation in people with aphasia and healthy individuals within different parts of the revealed language network was compared using a binary mask in SPM8
- The strength of activation in each of the resulted ROIs (extracted using the REX toolbox) was analyzed in relation to the post onset time, aphasia type and severity, and language scores of people with aphasia

Results

2 The left part of the language network displayed stronger intensity of spontaneous activity in healthy individuals, while the right part was more strongly activated in people with aphasia
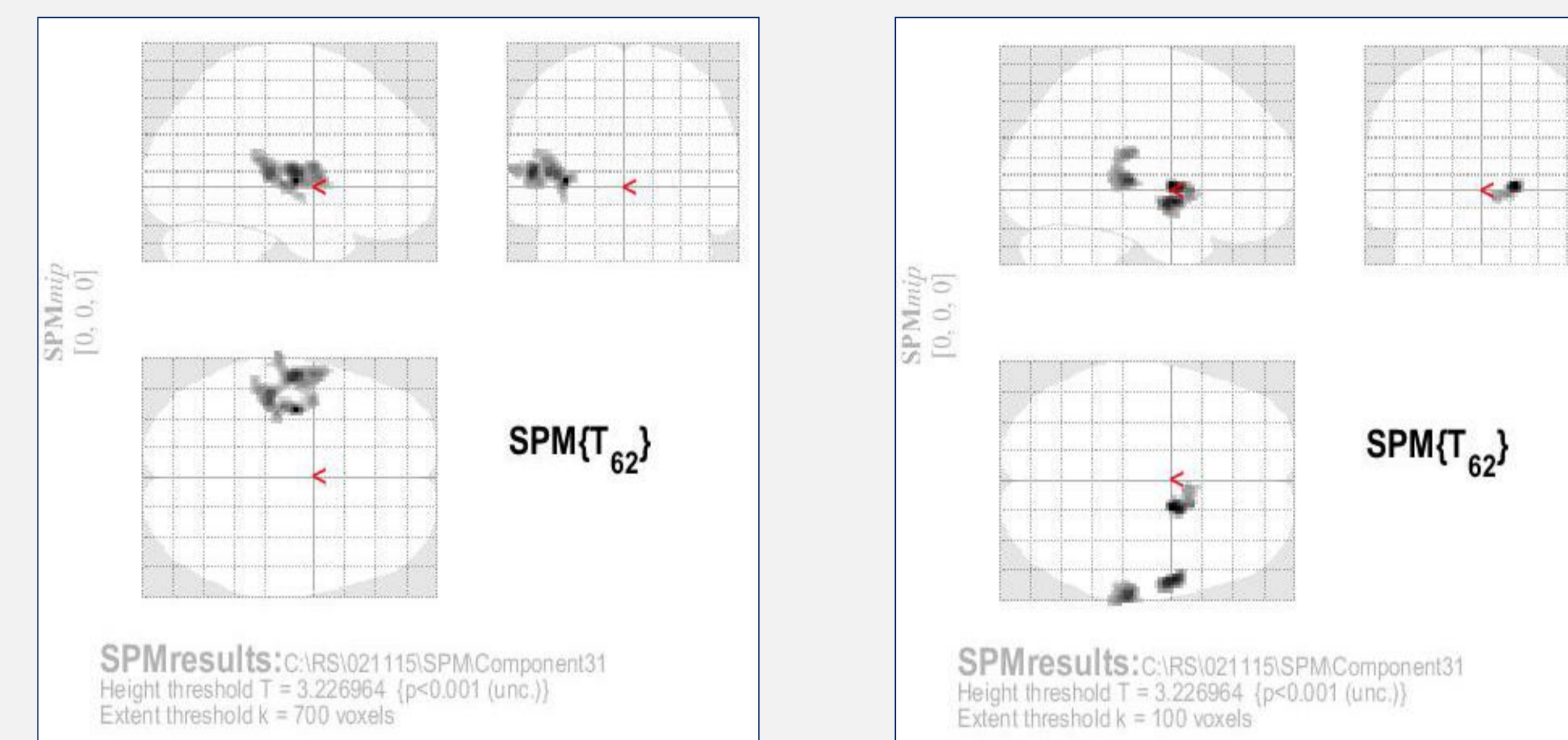
3

Right middle STG ROI: more activated in the lack of frontal lesions (t (30) = 3.3, p = .002)

Right globus pallidus ROI: more activated as the post onset time increases (F (2,29) = 33.17, p = .03) and in the presence of temporal (t (30) = -2.2, p = .04), parietal (t (30) = -2.4, p = .03) or occipital (t (30) = -2.1, p = .05) lesions
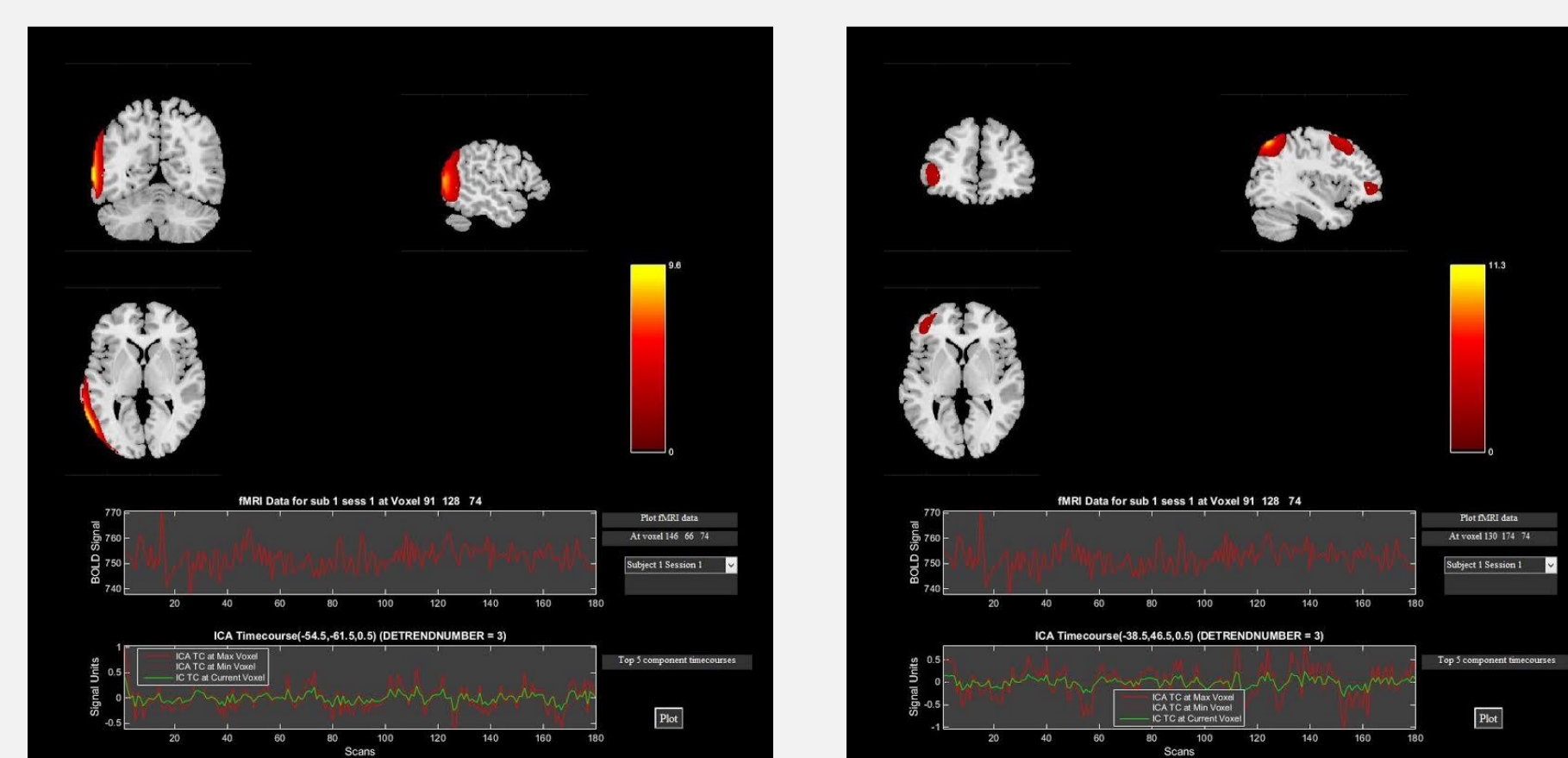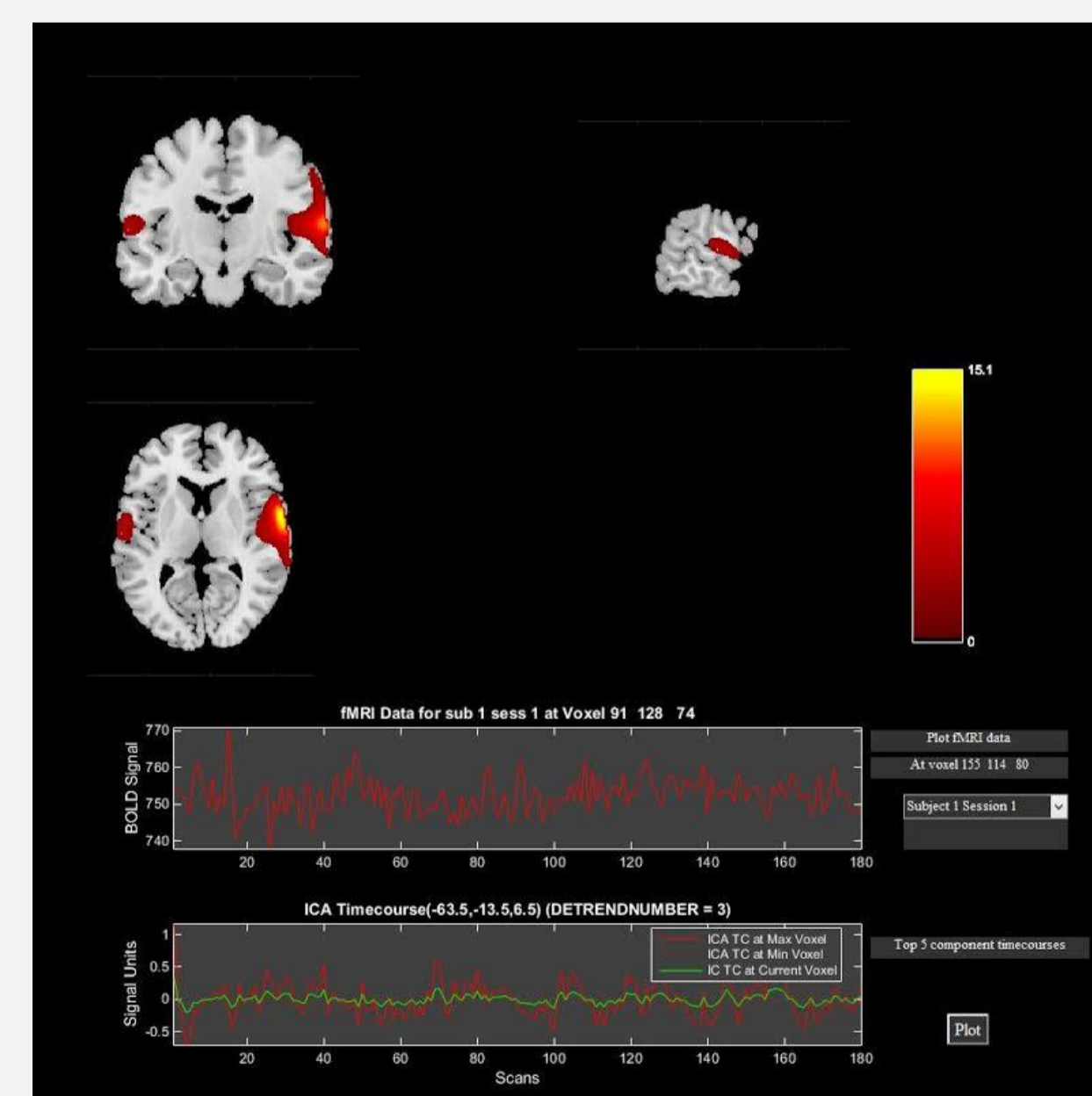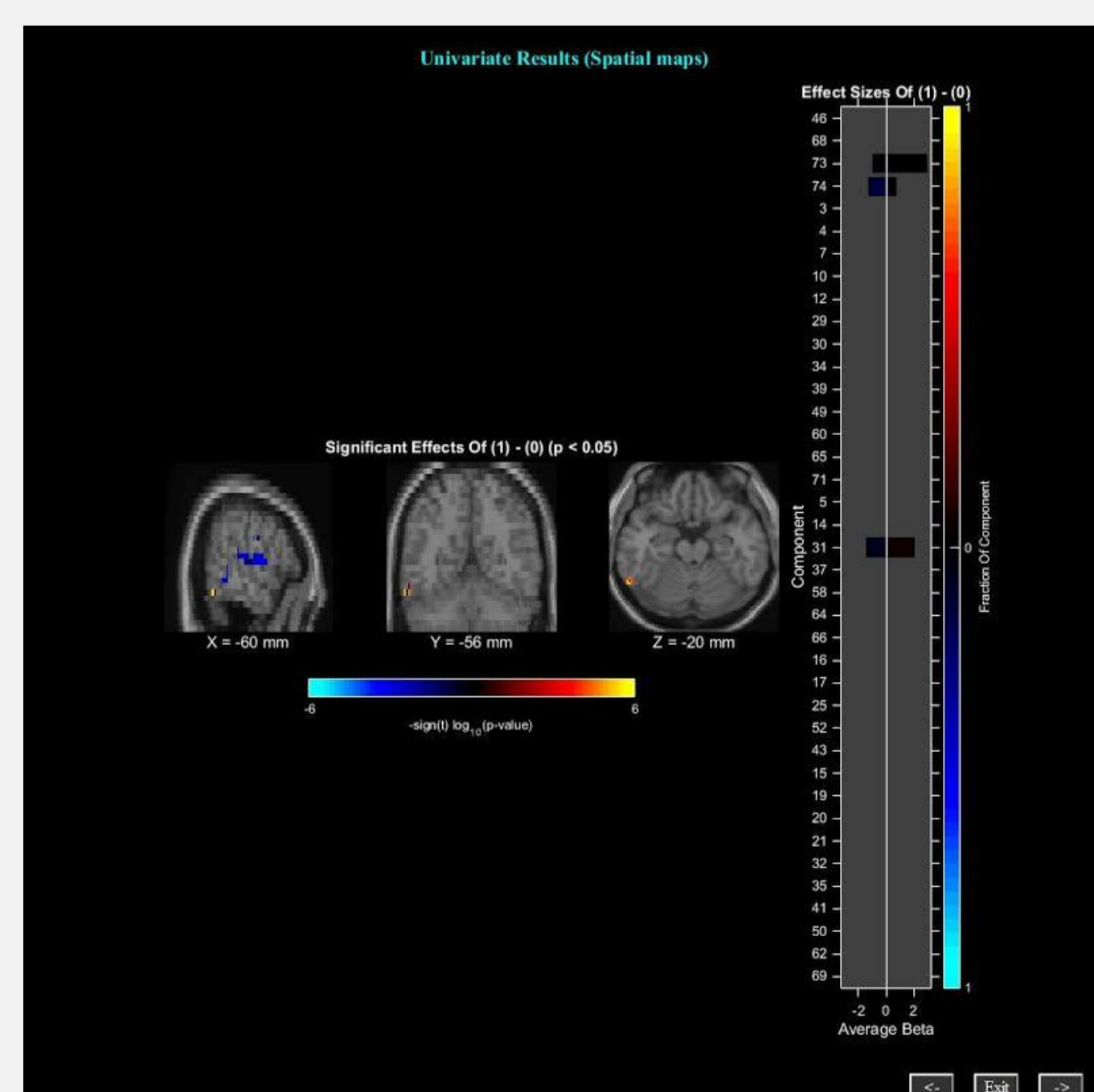
No correlations with aphasia type and severity, nor with language scores

Results

1 The effect of group (healthy vs. patients) was found significant in one language and two attentional networks

A language network: bilateral frontotemporal

Attentional networks

Conclusions

- A clear asymmetry has been found between healthy individuals and brain-damaged people with aphasia, regarding the language network: the left-lateralized frontal component of this networks was more strongly activated in healthy people; the right temporal components were more strongly recruited in people with aphasia

- Stroke-related reorganization of the language network resulted in more intense engagement of the right hemisphere temporal and basal ganglia structures might underlie this asymmetry, independently of linguistic profiles of patients

- The impact of the lesion site and the post onset time factors on specific right hemisphere structures to be clarified

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