

Comparison of neural correlates between elderly and young people during planning and execution of tool use

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Motivation

- Aging process experience declines in general motor cognitive performance^[1]
- Planning and execution of using tools are important in our daily life
- neural mechanisms underlying tool use affected by aging process are not fully understood

Main Research Questions

Tool use performance in individuals may depend on three main factors:

- Age (young or old)
- Object (known tool or unknown tool)
- Manipulation (execute or not)

→Neural activation pattern was investigated using functional MRI data

Materials and methods

Subjects

- Elderly: N = 16 (F=6), means: 67.6 Years
- Young: N = 16 (F=5), means: 25.4 Years
- No neuropathy history

fMRI data

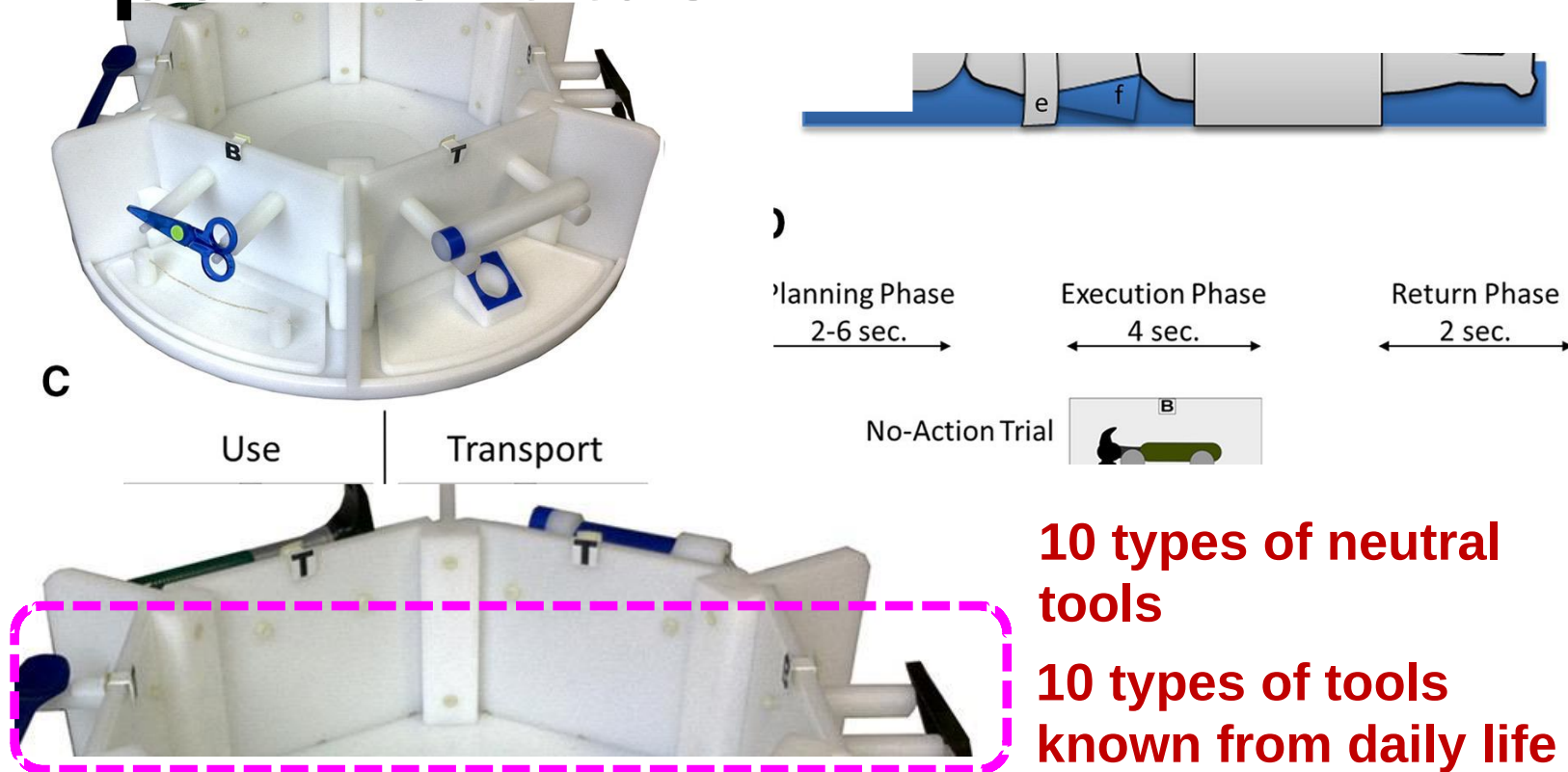
- Siemens 3T Verio MRI scanner
- T1-weighted image
MP-RAGE sequence, $1 \times 1 \times 1 \text{ mm}^3$
- T2*-weighted image
gradient echo sequence, TR = 2s,
slices = 35, voxel size = $3 \times 3 \times 3 \text{ mm}^3$
- Spatial normalization: MNI template space
- Smoothing kernels = 8 mm^3
- Analysis & visualization
SPM12 with MATLAB R2021b
MricroGL v1.2

Statistical analysis

- Excluded scan-to-scan movement > 3mm
- Threshold: $p_{\text{FWE}} < 0.05$ in 2nd-level analysis
- Threshold : $p_{\text{FWE}} < 0.05$ in VBM analysis
- Threshold : $p_{\text{unc}} < 0.001$ in BPM analysis (no significant result)

Task & Data analysis

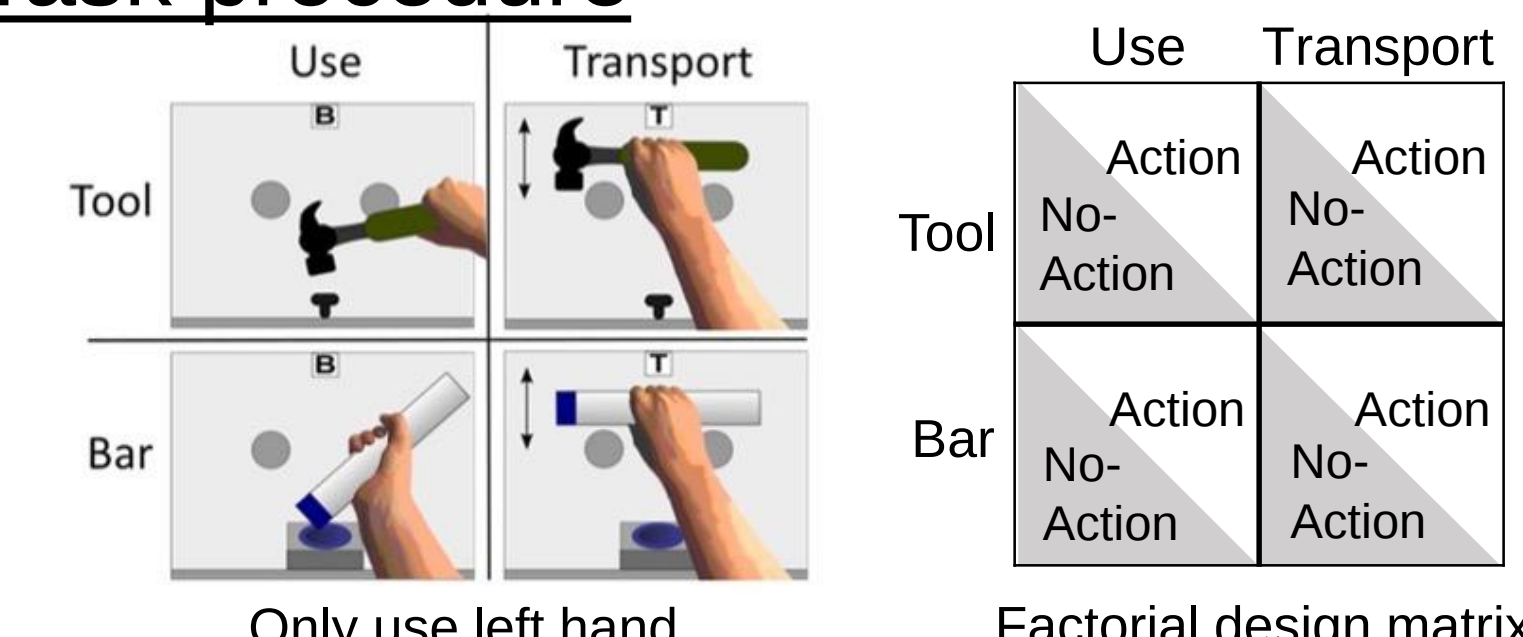
Experiment task



Same usage

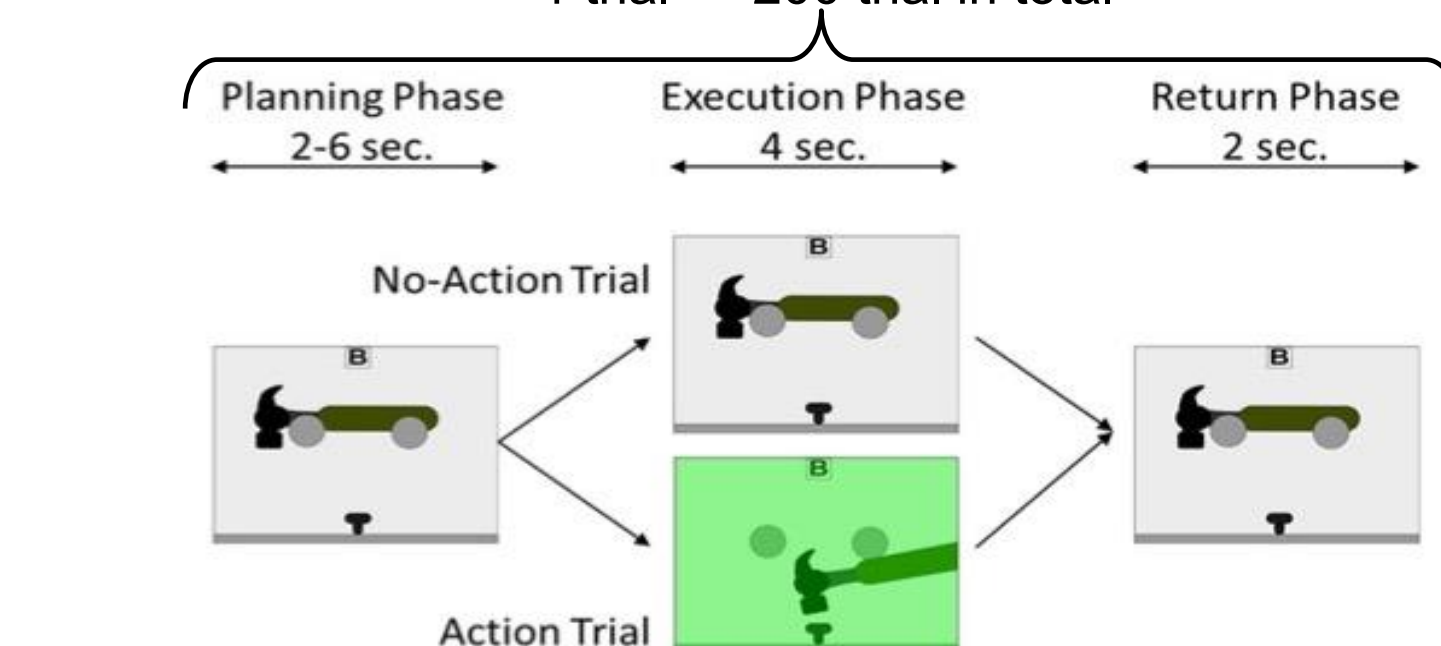
- Tool-Carousel apparatus
- Real reachable & usable stimuli

Task procedure



Each combination contains 40 trial randomly assigned + 40 extra control trials

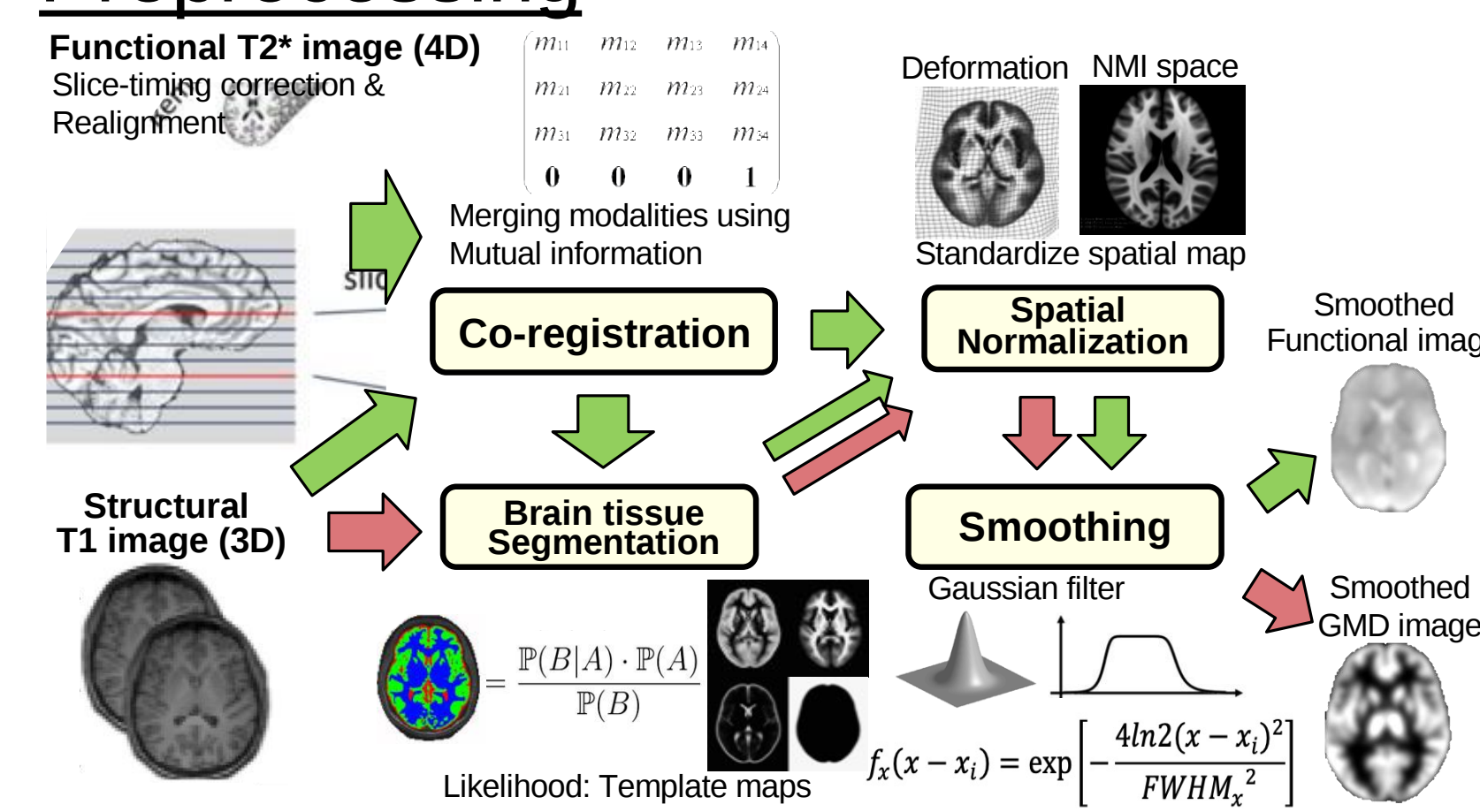
1 trial $\rightarrow$ 200 trial in total



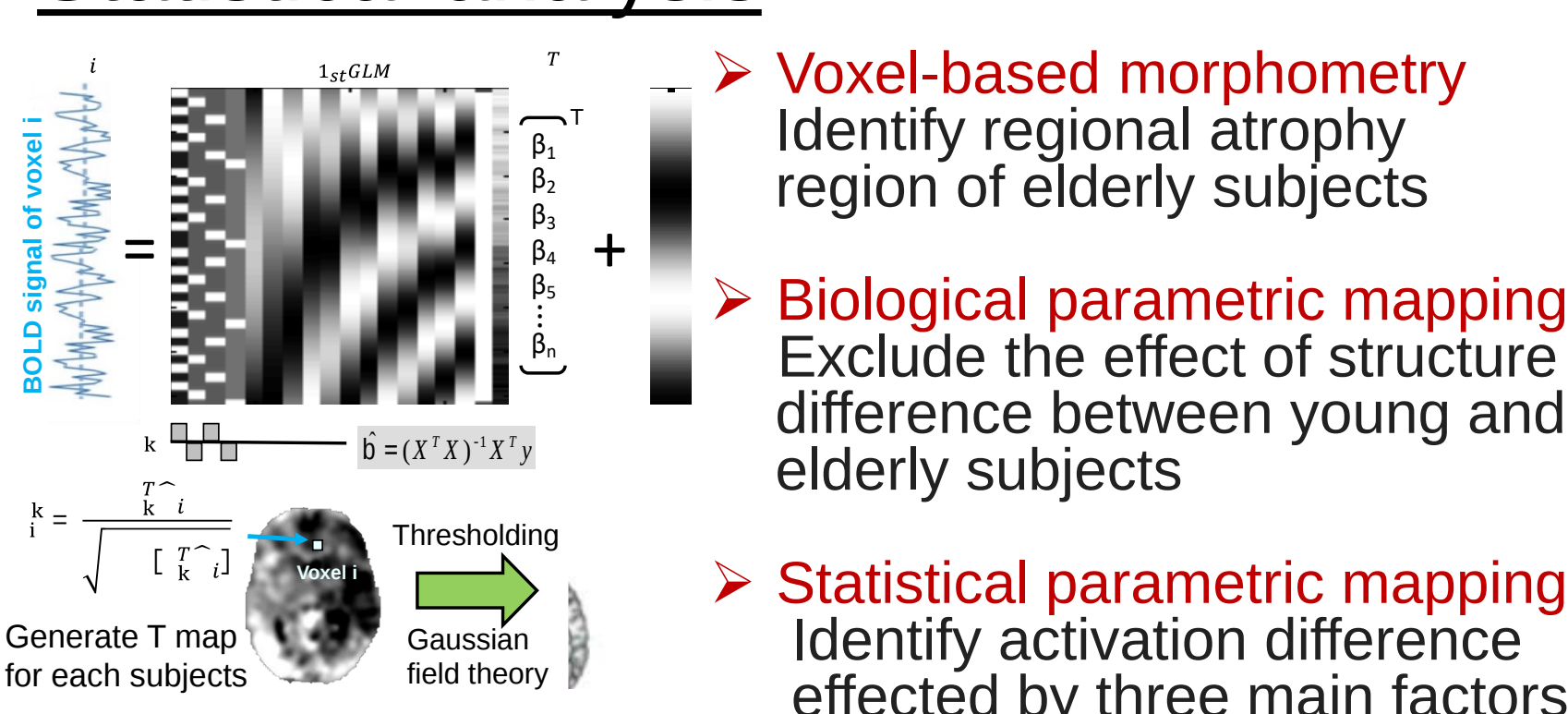
- Answered a questionnaire before the experiment for checking familiarity
- Instructions & trained in the fMRI scanner
- Recorded whole experiment for evaluation

Data analysis

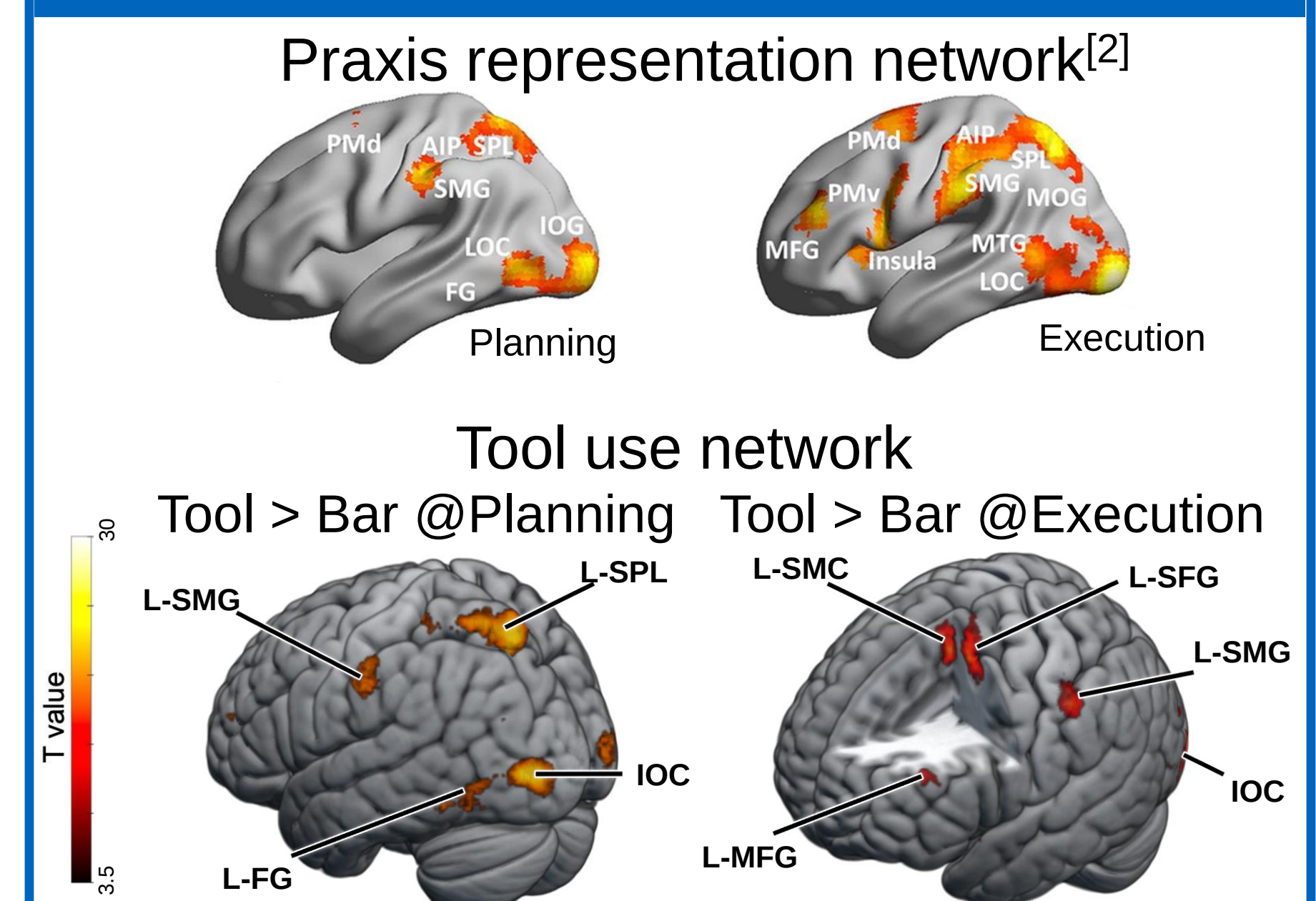
Preprocessing



Statistical analysis

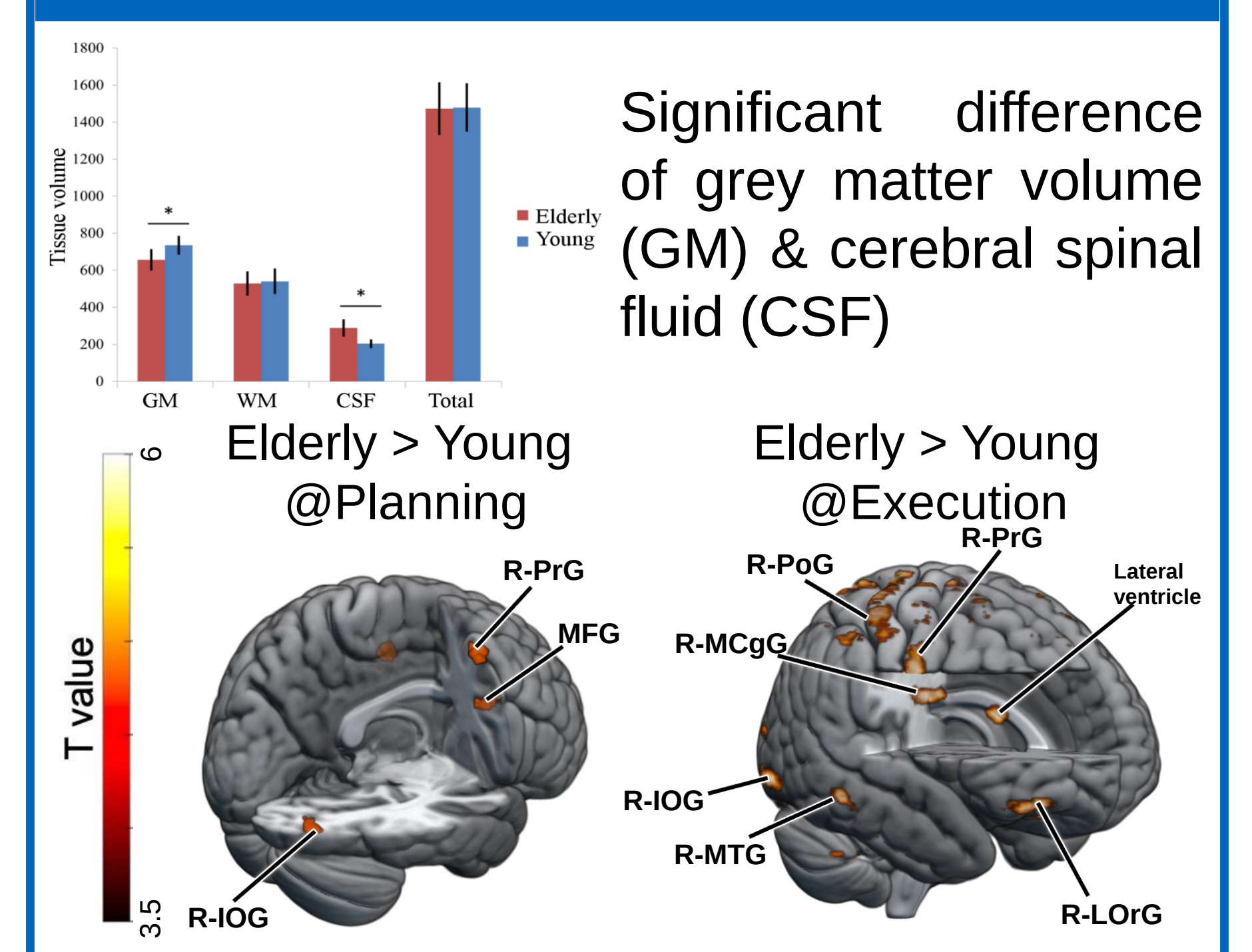


Neural correlates of tool use



- Tool use network showed similar as praxis representation network^[2]
- The activities of using real tool statistically stronger across the subjects

Age-related difference



Conclusions

- Main characteristics of tool use network remain stable across groups including activations in temporal, parietal and frontal association cortices
- Age-related increase the certain regions of neural activities during planning and execution
- Putative compensatory effects in the middle and inferior frontal gyrus, as well as in the superior parietal occipital complex in elderly subjects