

CONTEXT

- High efficiency of name production in healthy humans
 - Few speech errors committed in normal conditions
- Most of our knowledge about the neuroanatomy of speech errors comes from lesion-symptom mapping (LSM) and laboratory paradigms designed to elicit speech errors
- Little evidence from naturally occurring errors in healthy participants¹

MATERIALS AND METHODS

➤ Novel analysis of perfusion fMRI data from de Zubicaray et al. (2015)²

- 24 healthy right-handed native English volunteers
- Continuous picture naming task on 165 items³

➤ Difference from original study:

	Original study	The present study
Naming errors	Excluded	Included
Filler items	Excluded	Included

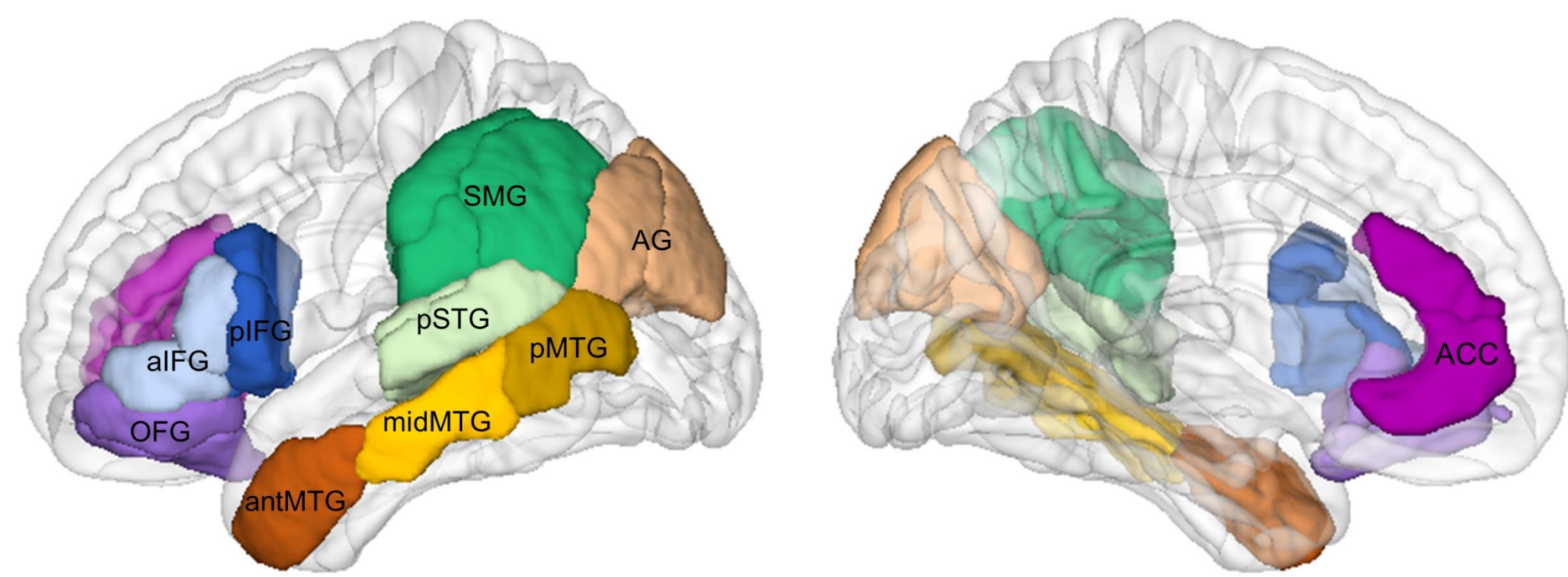
➤ Behaviour: naming responses

- Classification⁴: correct, semantic, phonological, mixed, unrelated, nonword, omission + dysfluency
- Creation of sets of matched correct trials for each subject for total errors (n=24), semantic errors (n=23) and omission errors (n=9)

➤ Neuroimaging: perfusion MRI at 4T

- Two contrasts: errors vs. baseline & errors vs. matched correct trials
- Height threshold of $p < .001$ and cluster FWE corrected threshold of $p < .05$

➤ Selection of ROIs from Brainnetome parcellations⁵:



Behavior

- 14.4% of errors on the whole stimulus set on average (~24 / 165 items)
- Most frequent error types:
 - 1) Semantic error (mostly taxonomic)
 - 2) Omission error
 - 3) Unrelated error

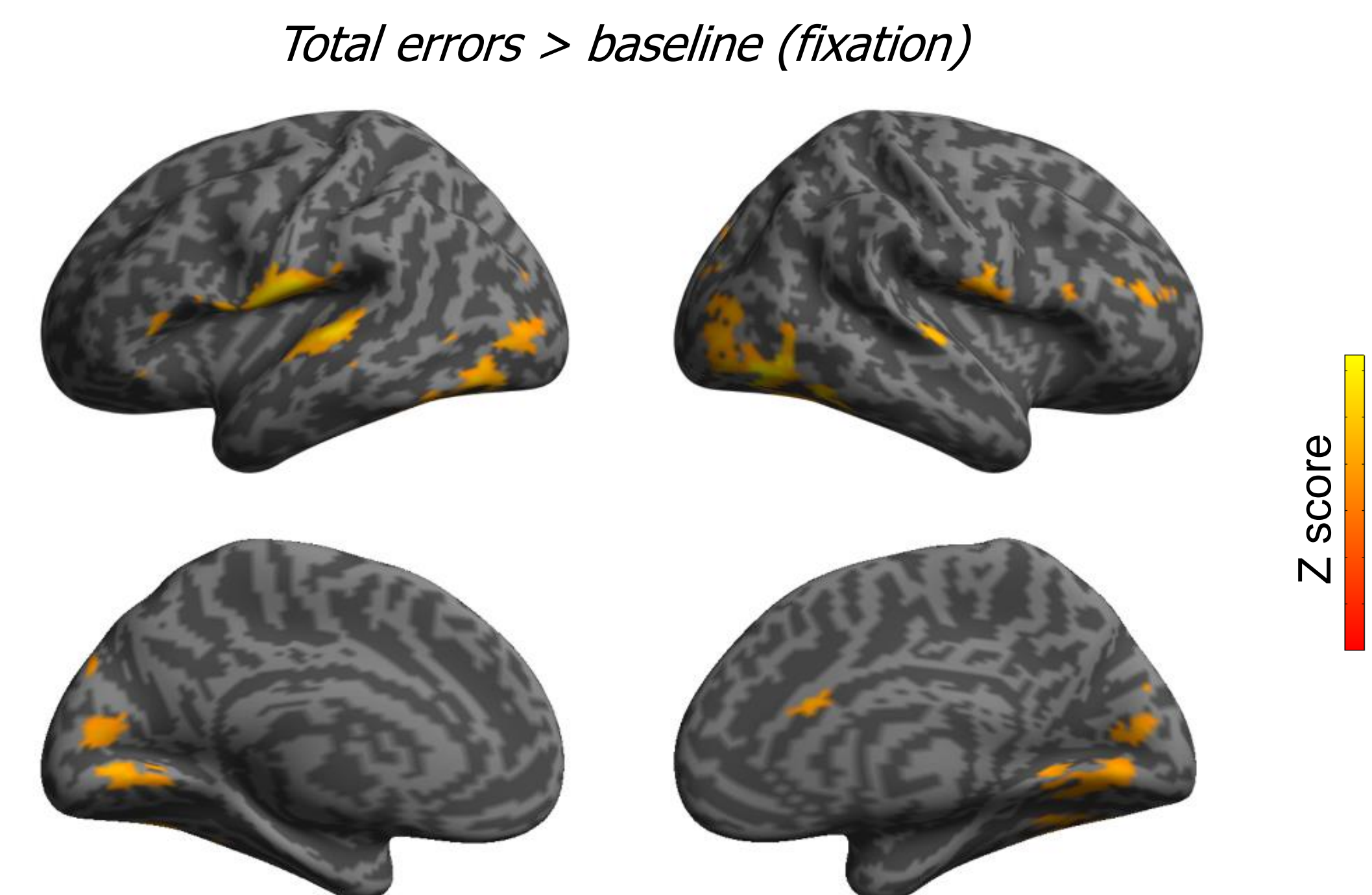
Response type	Nb responses (%)
Correct	3391 (85.63)
Error	569 (14.37)
Semantic	337 (8.51)
Phonological	0 (0)
Mixed	6 (0.15)
Unrelated	45 (1.14)
Non word	1 (0.02)
Omission	171 (4.32)
Dysfluency	9 (0.23)
Total	3960 (100)

- Items named correctly across participants were acquired earlier in life than items incorrectly named by at least one participant
- Observed for all error types
- No difference on lexical frequency, number of phonemes or syllables, visual complexity or luminosity

RESULTS

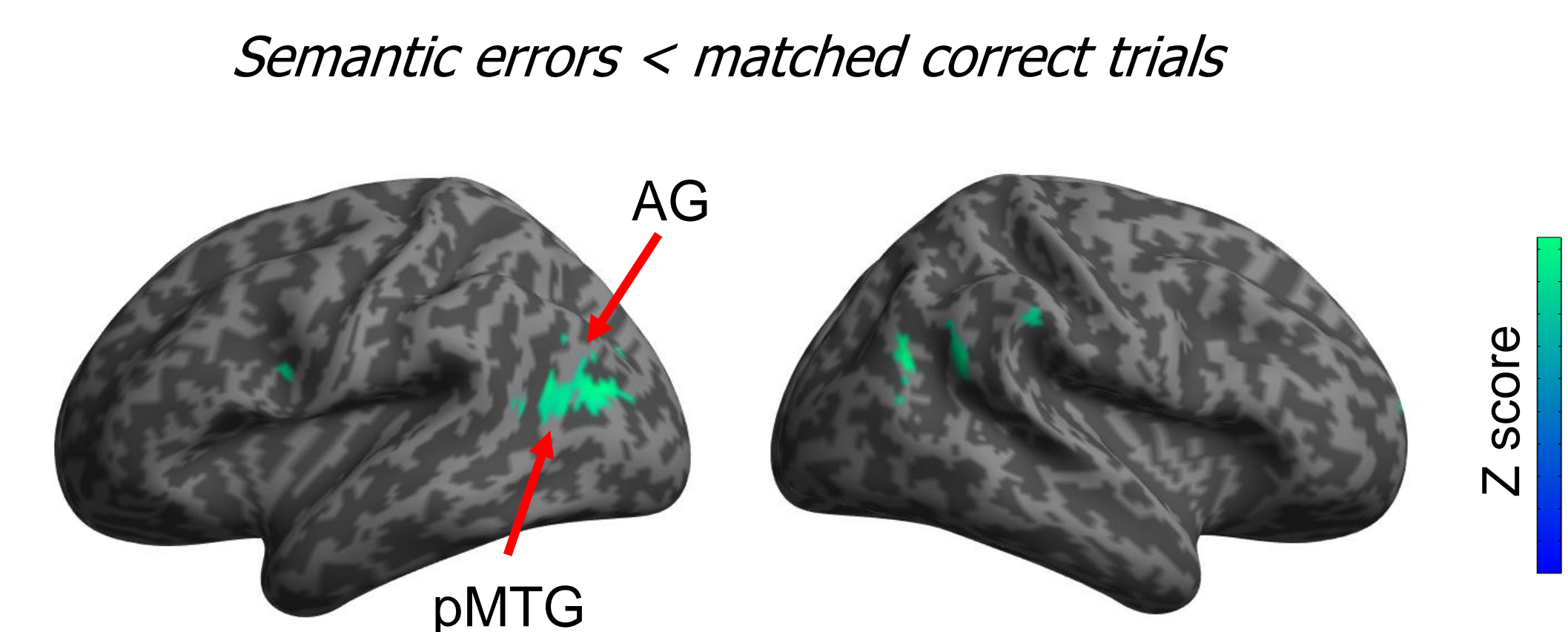
Neuroimaging

Total errors (n=24)



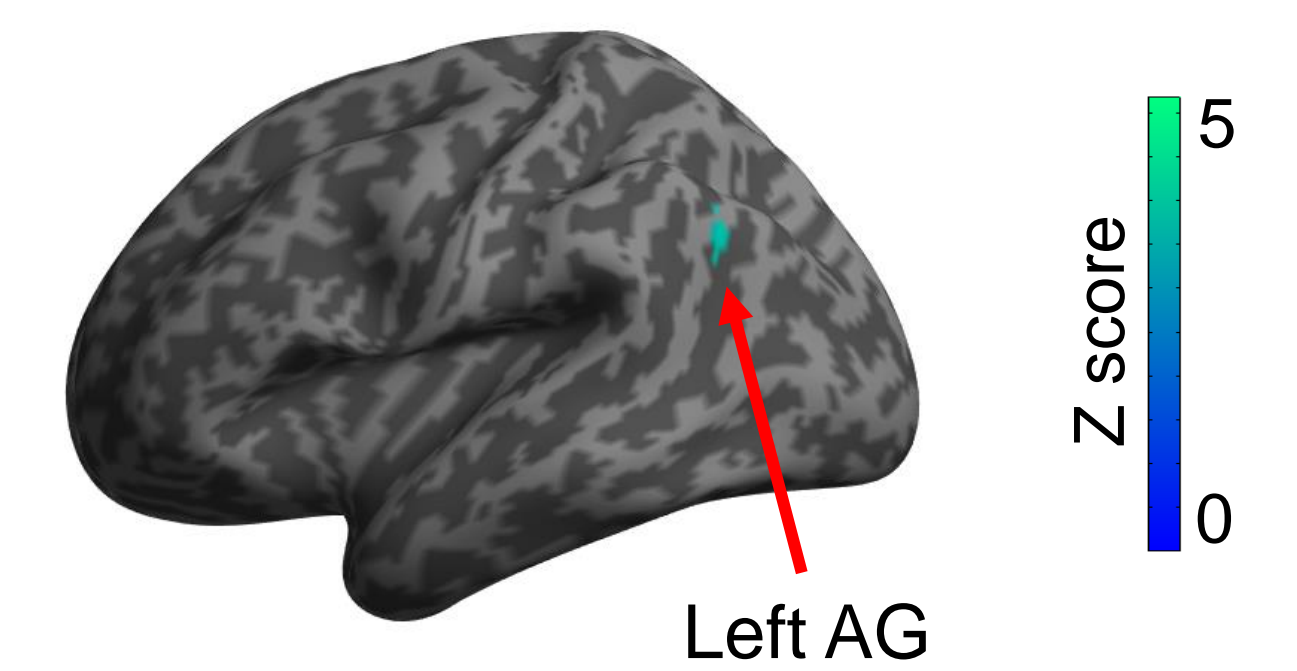
- Total speech error production involves a broad set of left-lateralized, frontal, parietal and temporal regions
- Similar network as engaged during production of correct responses in the same paradigm²

Semantic errors (n=23)



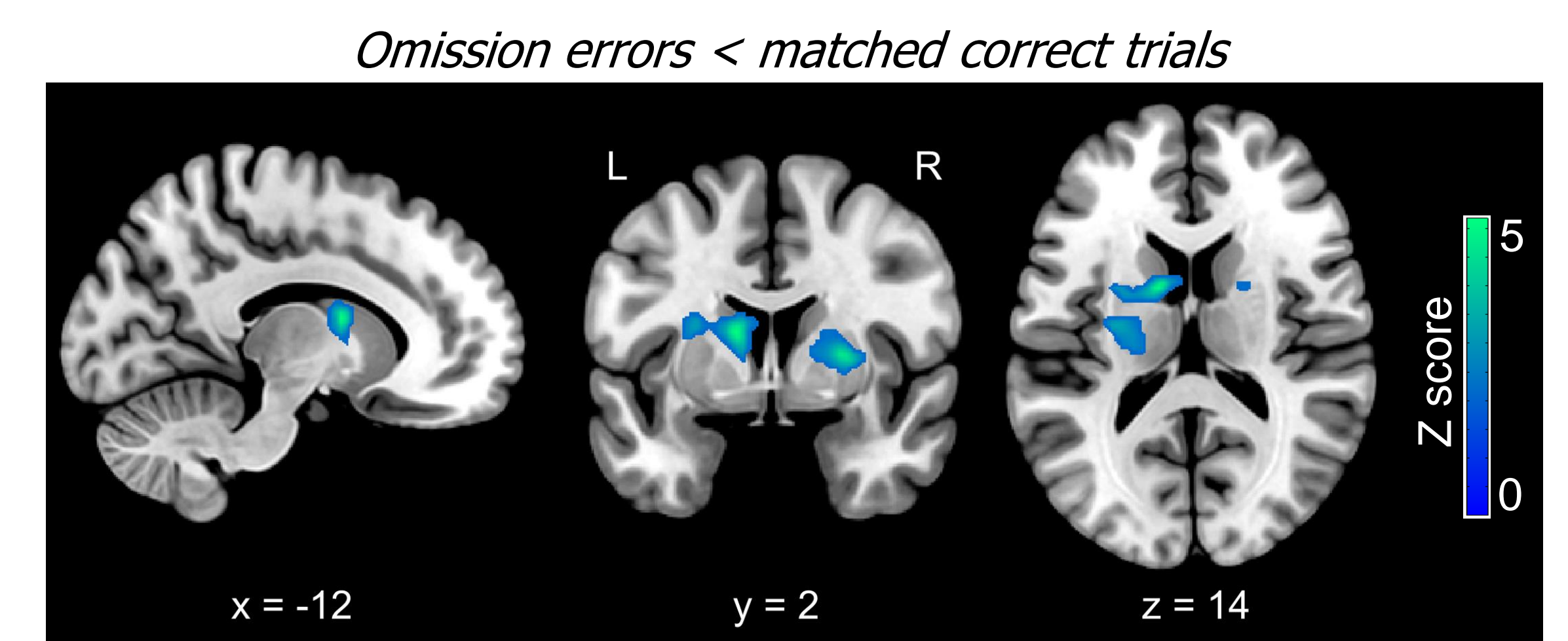
- Difference with matched correct trials = decreased perfusion in the left AG and pMTG
- Failure selecting the correct lemma among semantic competitors?

Total errors < matched correct trials



- Only difference with matched correct trials = decreased perfusion for total errors in the left AG
- No signal differences in regions previously associated with error monitoring processes⁶ (e.g., superior temporal gyrus or anterior cingulate cortex)
- Differs from previous results¹ that highlighted the right supplementary motor area, middle frontal gyrus and left insula for the same contrast
- Coverage? Handedness? Picture presentation time?

Omission errors (n=9)



- Difference with matched correct trials in the left dorsal caudate nucleus
- Failure initiating the correct articulatory-motor response?

CONCLUSION

- Brain regions activated during speech error production and errorless production are highly similar but some regions are less activated for errors than correct responses, with a different locus for semantic (i.e., in the left AG and pMTG) and omission errors (i.e., in the left caudate nucleus).
- Monitoring mechanisms may only be strongly engaged when errors are produced as a function of *external* manipulations.
- Our observations differ from LSM studies, suggesting that the production stages/mechanisms responsible for generating speech errors in healthy participants are less variable than those involved in patients with aphasia.

REFERENCES

- ¹ Abel S. *et al.* (2009). *Neurosci Letters*, 463:3, 167-171.
- ² de Zubicaray G.I. *et al.* (2015). *Lang, Cogn & Neurosci*, 30:3, 261-272.
- ³ Howard D. *et al.* (2006). *Cognition*, 100:3, 464-482.
- ⁴ Dell G.S. *et al.* (1997). *Psychol Rev*, 104:4, 801-838.
- ⁵ Fan L. *et al.* (2016). *Cereb Cortex*, 26:8, 3508-3526.
- ⁶ Meekings & Scott (2021). *J Cogn Neurosci*, 33:3, 422-444.