Stimulating the language network at the subject level: What has more effect - the brevity of Mark Twain or sweeping sentences by Charles Dickens?

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Introduction

fMRI is used as part of **preoperative diagnostics** to identify **language-eloquent brain regions**.

Such examinations are resource intensive, i.e. load **cognitive resources** of patients and **economic resources** of the diagnostic institution.

Here, we tested newly generated stimuli **to optimize measurement times** and **effect sizes** for clinical application.

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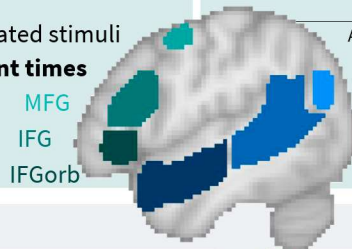
Methods

Participants

	Exp. 1	Exp. 2
N (female)	10 (7)	11 (7)
Age (years)	$M = 42$ (24 – 61)	$M = 37$ (20 – 61)
Patients	72 years (m) AVM I° left opercular	43 years (m) AVM II° left temporal

AVM = Arteriovenous malformation

Language paradigm

- Block design
- Contrast: sentences/texts vs. nonwords
- Probe at the end of each trial

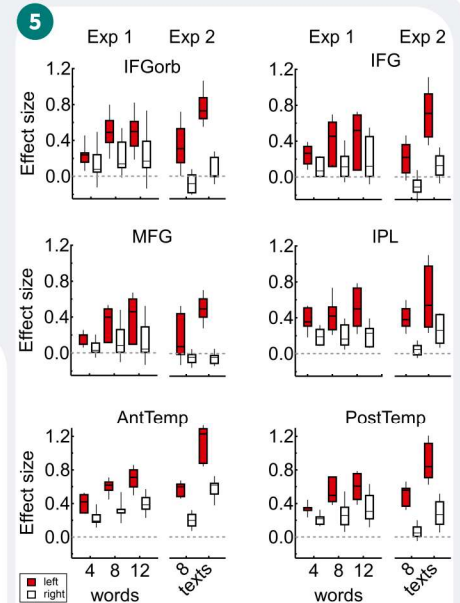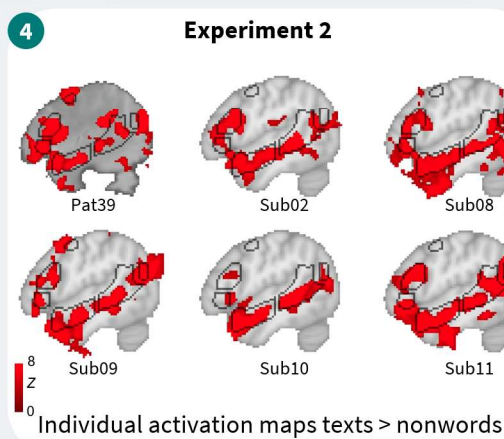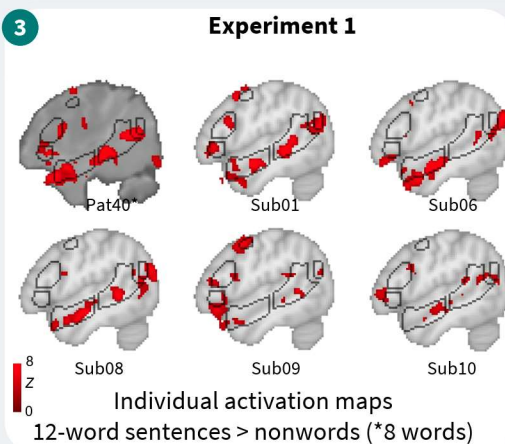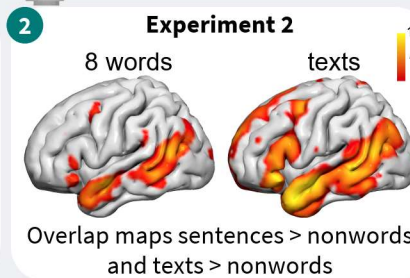Examples: IM – RADIO – LÄUFT – MUSIK
SA – KRIDO – MAUFT – LASUK

Conditions

- Sentence length: 90×4; 42×8; 30×12 words [1]
- Text length: 42 to 50 words; $\Sigma = 368$ [2]

Analyses

- Group-constrained subject-specific fROI-analysis [3, 4]
- Test the influence of semantic density

Results

1
Experiment 1
4 words   8 words   12 words

Overlap maps sentence > nonwords

2
Experiment 2
8 words   texts

Overlap maps sentences > nonwords and texts > nonwords

3
Experiment 1

Pat40*   Sub01   Sub06
Sub08   Sub09   Sub10

Individual activation maps
12-word sentences > nonwords (*8 words)

4
Experiment 2

Pat39   Sub02   Sub08
Sub09   Sub10   Sub11

Individual activation maps texts > nonwords

5

left   right

12-word sentences in Experiment 1 and texts in Experiment 2 robustly showed the highest effect sizes in left hemisphere language regions across all participants

Conclusion

The paradigm robustly activated temporal and parietal language regions in all individuals [3, 4].

- 12-word sentences showed significantly stronger activations than 4-word sentences
- Texts showed the comparatively strongest activations
- Texts also activated frontal areas
- Longer sentences and texts **shortened** MRI measurement **time by 4 to 10 minutes**
- Increased semantic density boosted language network activity

6

1 Run   2 Runs   3 Runs   4 Runs
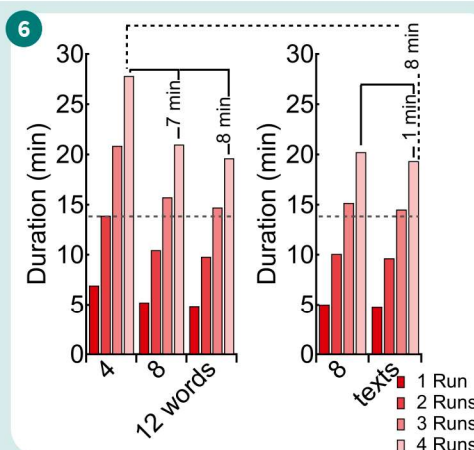
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[4] **Mahowald K.** Reliable individual-level neural markers of high-level language processing: A necessary precursor for relating neural variability to behavioral and genetic variability. *NeuroImage* 2016, 139, 74-93.