

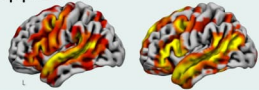
# Seeing the whole sentence or one word at a time: differential network engagement in functional language mapping

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## Introduction

Clinical fMRI language mapping often relies on word-by-word sentence presentation to minimize eye movements and associated activation in oculomotor regions such as the frontal eye field (FEF) [1]. In contrast, a recently developed commercial mapping software employs whole-sentence stimulus presentation [2]. However, displaying full sentences at once could increase the need for visual scanning across the text, potentially inducing additional eye movements and thereby increasing activity in motor and attention-related brain regions. Such effects might compromise the specificity of language-related activation patterns. We wanted to know, whether whole-sentence presentation lead to heightened motor involvement, making it less suitable for clinical language-mapping compared to the conventional word-by-word approach.



**Language activation maps** obtained with the Nordic Aktiva (left) and UMG (right) approaches.

## Methods

### Participants

- Two subjects (♂ 27 years; ♀ 31 years)

### MRI data acquisition

- GE-EPI; TR = 2 s; 493 volumes
- MPRAGE (T1w image)

### Stimuli

- 2 × 24 incomplete prompt sentences
- 24 lists of consonant strings
- 24 phototactically matched and controlled lists of pseudowords (UMG)

### Stimulus presentation

- Nordic Aktiva: whole sentence / list
- UMG: word-by-word sentence / list
- Block design with pseudorandomized presentation of conditions

### Data analysis

- Fixed-effects GLM analysis to fit the hemodynamic response function
- Psychophysiological interaction (PPI) analysis to determine the connectivity fingerprints of the frontal eye field (FEF) and the precentral ventral cortex (PrCv) [3].

## Methods

Whole-sentence stimulus presentation in the Nordic Aktiva paradigm

Language stimulation

Probe sentence + word retrieval

Ein lachendes Kind ist \_\_\_\_\_

Control stimulation

Probe sentence + no word retrieval

Bg h x g h n g h n x q v x x g r  
h n r w g l l c \_\_\_\_\_

Word-by-word stimulus presentation in the UMG paradigm

Probe sentence

Word retrieval

An

Ostern

suchen

wir

\_\_\_\_\_

Probe sentence

No word retrieval

Ustend

al

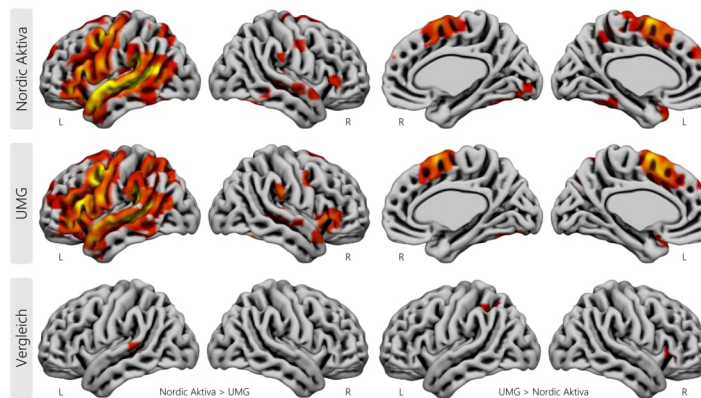
Tusten

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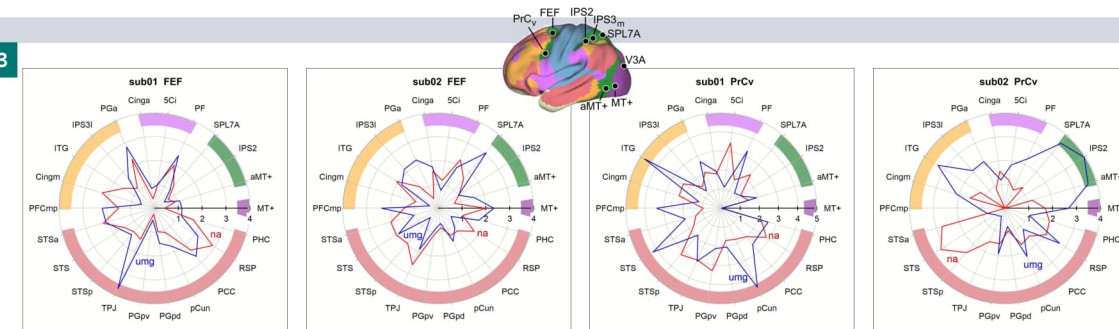
## Results

### 1 Comparison of activated areas between conditions



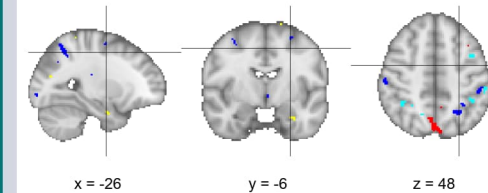
Both paradigms engaged key areas of the **left-hemispheric language system**. This included frontal regions supporting word retrieval and speech planning (IFG, MFG, anterior insula, PMC/M1, preSMA/SMA), as well as temporoparietal regions involved in phonological, lexical and semantic processing (SMG, AG, STG, STS, MTG). The Nordic Aktiva paradigm elicited stronger activation in the left superior temporal gyrus (STG), whereas the UMG paradigm was associated with greater engagement of the left intraparietal sulcus (IPS), and the right inferior frontal gyrus (IFG) and insular cortex.

### 3



**Functional connectivity fingerprints** of the frontal eye field (FEF) and precentral ventral cortex (PrCv) for the Nordic Aktiva (na) paradigm (red) and the UMG paradigm (blue). Cortical regions are grouped according to major functional networks: visual (purple), dorsal attention (green), ventral attention (violet), frontoparietal (orange), and default (red).

## 2 Comparison of activation in the FEF between test setups for the individual patients



Sub 1: UMG > Nordic Aktiva **blue**, NA > UMG **red**;  
Sub 2: UMG > Nordic Aktiva **light blue**, NA > UMG **yellow**;  
Crosshair at the FEF

## Discussion

- Increased left STG activation in the Nordic Aktiva paradigm likely reflects more contribution of phonological processing to the sentence > consonant strings contrast.
- In contrast, stronger left IPS and right insula/IFG engagement in the UMG paradigm indicates higher cognitive control demands (attention, verbal WM, inhibition).
- Comparable premotor/motor and FEF activity across paradigms argues against differential eye-movement requirements.
- PPI results suggest greater involvement of the dorsal attention network during UMG-style presentation, consistent with increased attentional allocation to visual stimuli.

## Conclusion

The Nordic Aktiva-style presentation may more effectively engage naturalistic reading processes and therefore may be better suited for clinical language-mapping purposes. The reason for the strong motor-system involvement observed in the Nordic Aktiva paradigm remains unclear.

## References

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