Caught Between Rumours and the Road

Internal and External Information Processing Modes of Emotional Speech Processing and Visuo-spatial Workload

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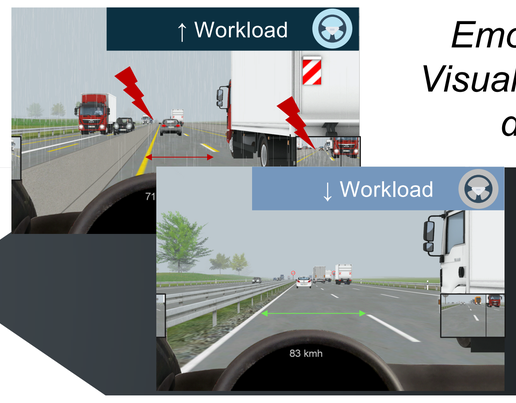
Research Question

How does **emotional speech** and **visuo-spatial workload** modulate **information processing**, indicated by gaze behaviour and neural oscillations?

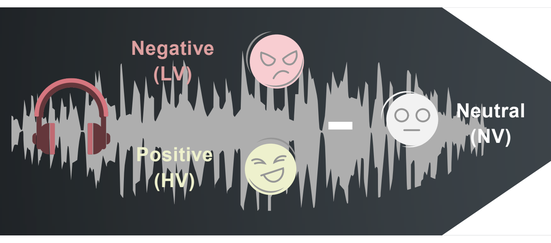
Magnetoencephalography Eyetracking Study

with 48 subjects (M_{age}= 25.25) and a within-subject block design with the factors:



Emotional Speech x Visual-Spatial Workload during Driving

Emotional Speech Processing

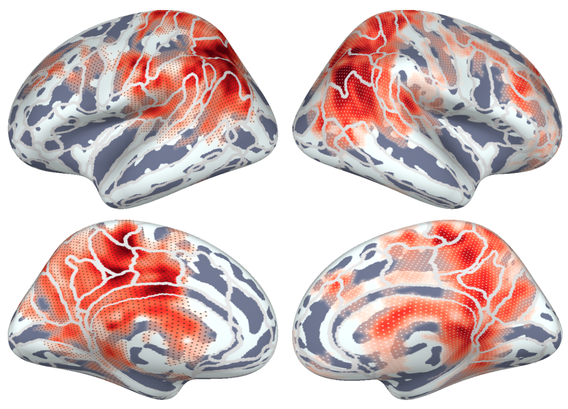


Two Processing Modes during Dual-Tasking

Visuo-Spatial Workload

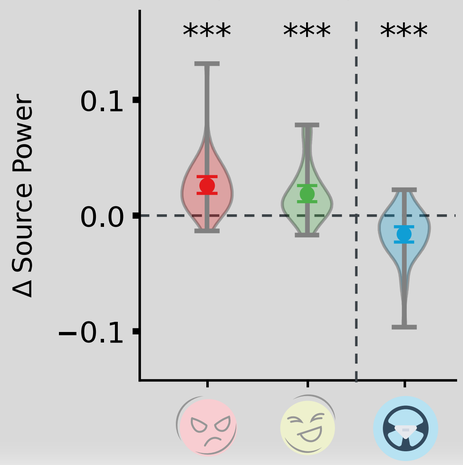
β Social Cognition – Internal Mode

↑ ***β**** in parietal regions indicates increased predictive listening*

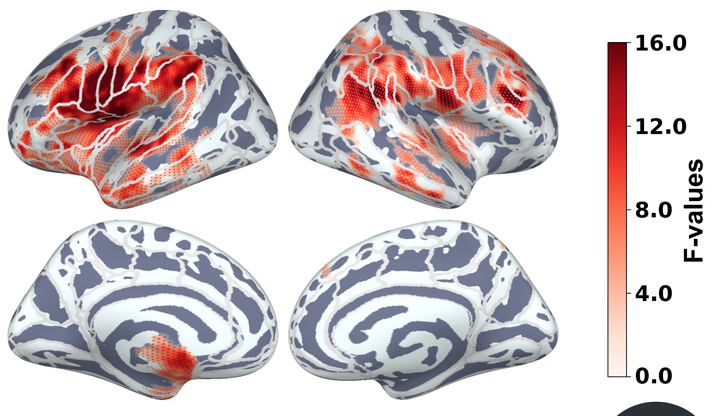


Beta Band Power

(13 – 20 Hz)

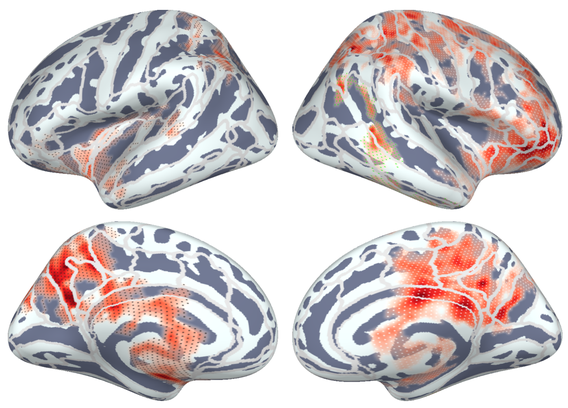


↓ ***β**** in temporo-parietal regions indicates reduced social cognition*



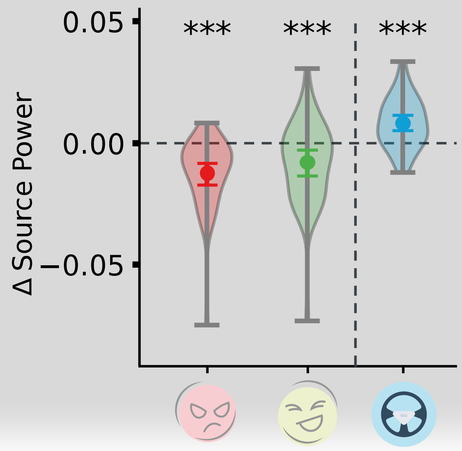
γ External Mode – Spatial Cognition

↓ ***γ**** in parietal regions indicates reduced spatial cognition*



Gamma Band Power

(30 – 42 Hz)

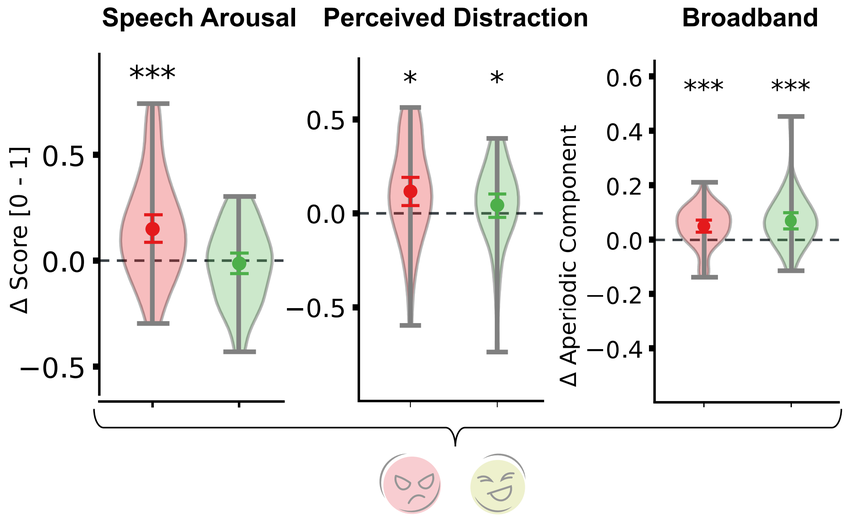


↑ ***γ**** in motor & prefrontal regions indicates increased driving and decision making*

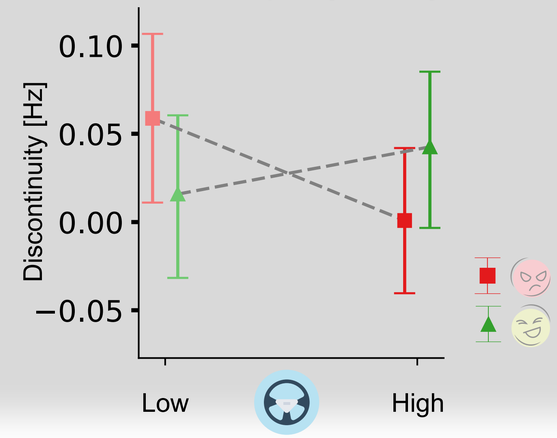
Multimodal Integration

Top-down processing for emotional speech

Speech Arousal **Perceived Distraction** **Broadband**

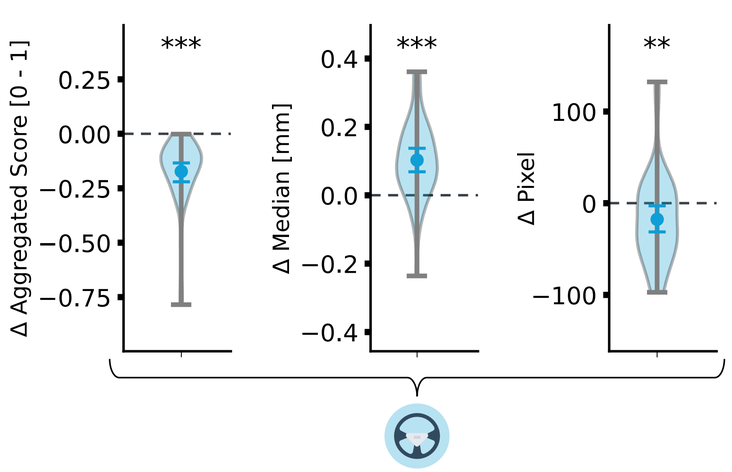


Pupillary Oscillations
Index of Pupillary Activity



Bottom-up processing for visuo-spatial cognition

Driving Quality **Pupil Dilation** **Gaze Dispersion**



Conclusion

Internalised processing during emotional speech is reflected in increased parietal beta band power, aperiodic broadband activity, and, to some extent, pupillary oscillations. This mode likely indicates anticipatory listening [1–3], socio-emotional cognition [3], and cognitive meta-control involved in dual-tasking [4]. Auditory engagement, as reflected in pupillary oscillations, was co-modulated by visuo-spatial workload.

Externalised processing during high visuo-spatial workload is reflected in increased driving-related gamma band power [5], pupil dilation, and visual tunnelling [6]. It indicates cognitive strain and the allocation of cognitive resources to accommodate driving-task demands [5–6].

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Caught Between Rumours and the Road II

Decoding the Interaction of Emotional Speech Processing and Attentional Control during Simulated Driving

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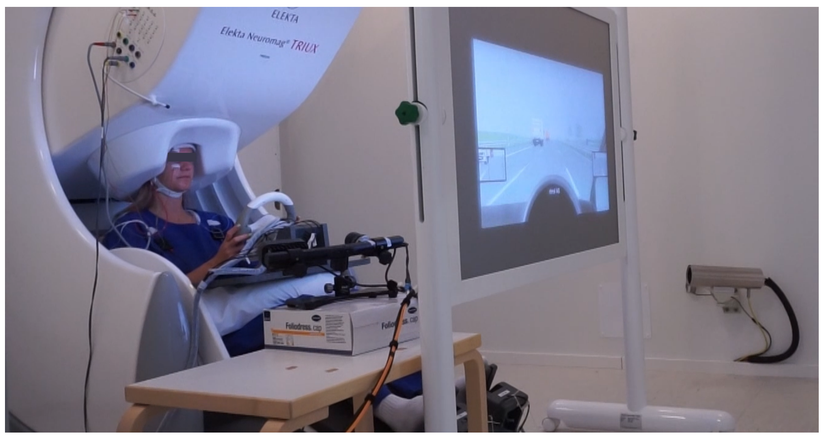
1 RESEARCH QUESTION

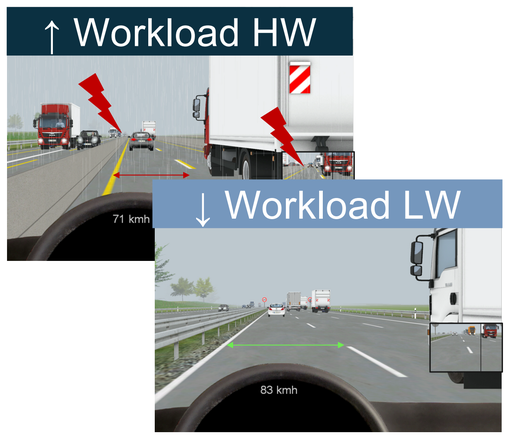
Do **valence of emotional speech** and **workload** during **visuo-spatial cognition** co-modulate neural information processing in multisensory realistic environments? Which neural signatures regulate emotional interference?

2 METHODS

Magnetoencephalography & eyetracking
N = 48 subjects (M_{age}= 25.25 ± 4.01)



Simulated driving in a within-subject design with two factors:



X

Negative (LV) Emotional speech

Positive (HV) Emotional speech

Hypothesised role of **frontal γ** in **cognitive control [1-3]**

4 **Multivariate pattern analysis** with common spatial patterns and linear discriminant analysis [4-5]

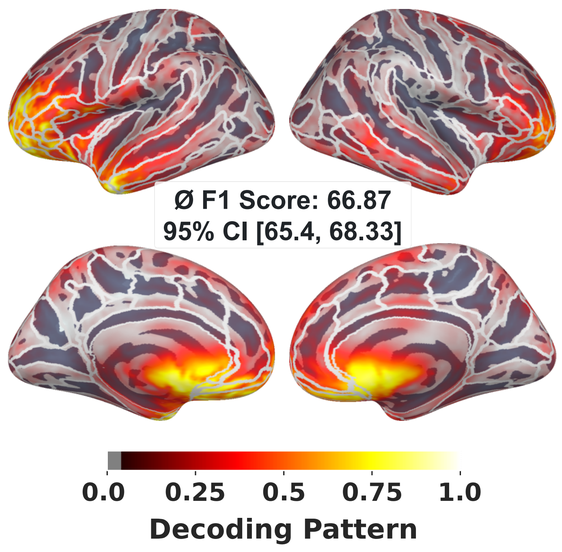
5 **Mass-univariate permutation-based spatial clustering** in source space (MNE)

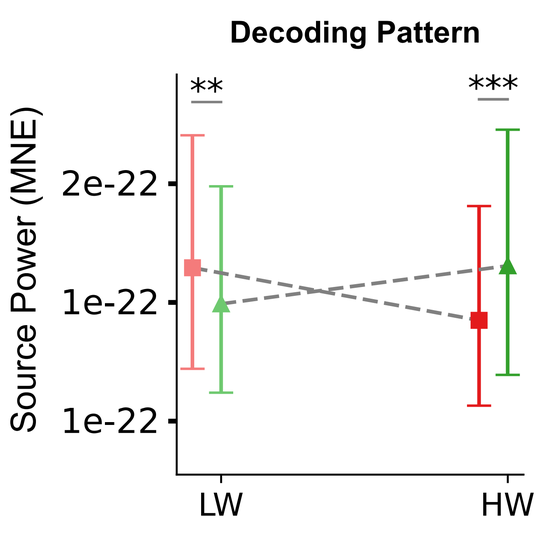
3 RESULTS — SUBJECTIVE RATINGS

Valence and **workload co-modulate** the subjective experience of emotional speech and the simulated driving scenario.

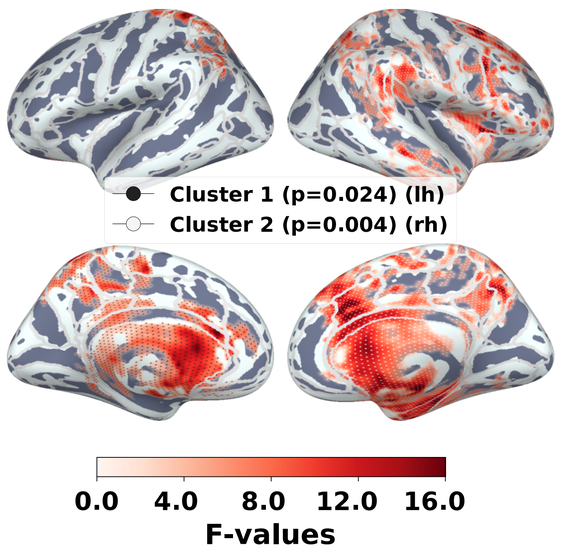
Appraisal of positive valence seems to occur only during drives of **low visuo-spatial workload** [6].

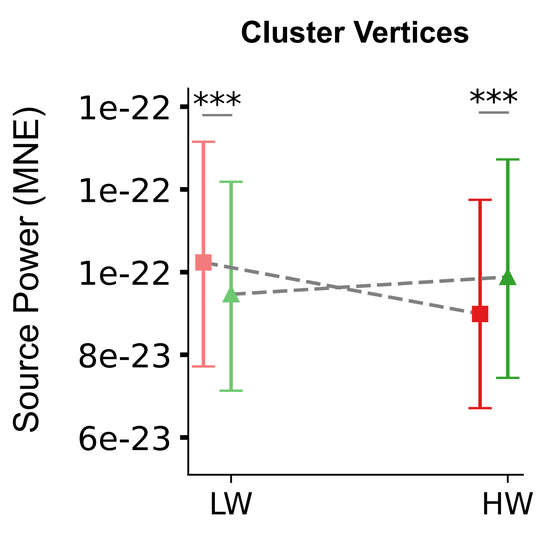
4 MULTIVARIATE PATTERN ANALYSIS





5 PERMUTATION-BASED CLUSTERING





6 CONCLUSION

Our findings indicate that **fronto-temporal gamma-band** modulations contribute to **top-down control** of emotional interference.
Cross-over interactions suggest that **positive speech is down-regulated only under high cognitive demand**, whereas down-regulation of negative speech becomes less effective as cognitive workload increases.
We advocate the use of converging methods and multivariate statistics to study brain function in complex, naturalistic environments.

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