The long night effect on the brain functional organization

ID:861

The Research Council of Norway

Meng-Yun Wang[1,2], Max Korbmacher[2,3,4], Rune Eikeland[1,2], Karsten Specht[1,2]

1. Department of Biological and Medical Psychology, University of Bergen, Bergen, Norway
2. Mohn Medical Imaging and Visualization Centre, Haukeland University Hospital, Bergen, Norway
3. Department of Health and Functioning, Western Norway University of Applied Sciences, Bergen, Norway
4. NORMENT Centre for Psychosis Research, University of Oslo and Oslo University Hospital, Oslo, Norway

Western Norway University of Applied Sciences

NORMENT

Background

As we all know, our brain activity can be affected by external factors, such as the time of day [1,2] and coffee consumption [3]. However, little is known about how the long night phenomenon influences our brain organization architectures. Fortunately, we live in a region where the long night and long day phenomena naturally exist during winter and summer, respectively. For example, in the city of Bergen in Norway, we have almost 18h dark time and 20h daylight during December and June, respectively. Therefore, the main aim of this study is to explore how the long night affects our brain functional organization.

The left picture was taken at 20:35 February while the right picture was taken at 23:11 in June.

Method

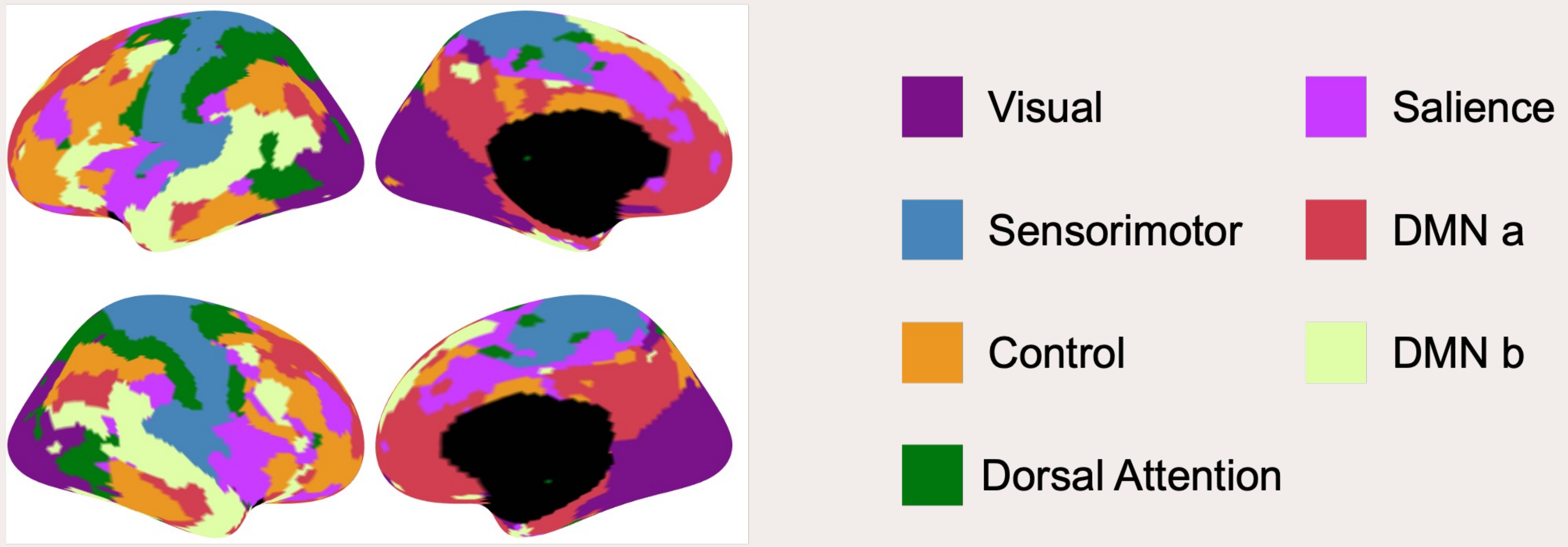
For this study, we collected a deep brain neuroimaging dataset named the Bergen Breakfast Scanning Club (BBSC) dataset [4]. A total of twelve sessions from subject 1 were selected: six in May and six in December with the daytime difference being around 10hs. Then, the individual brain parcellation method [5] was applied to parcellate the brain, and dice coefficients (DC) were computed where a larger number represents a higher similarity between two parcellations.

Behavior Protocol	Functional Protocol	Structural Protocol
✓ Before scanning questionnaire	✓ T1-weighted	✓ FLAIR
✓ After scanning questionnaire	✓ MRS	✓ T2-weighted
	✓ Rs-fMRI	✓ DWI

- Behavior_data
  - Demographic
  - External_factor
  - Internal_factor
  - PANAS
  - ARSQ
- MRS
  - Raw_data
    - sub-01
    - sub-02
    - sub-03
  - Output
    - LCM*
    - SegMaps
    - Quantify Results
- Functional
  - Data
    - Raw_data
    - BIDS
  - QC
  - Prep
    - fMRIprep
    - FSL_Prep
  - T1_analysis
- Structural
  - FLAIR
  - T2
  - DWI

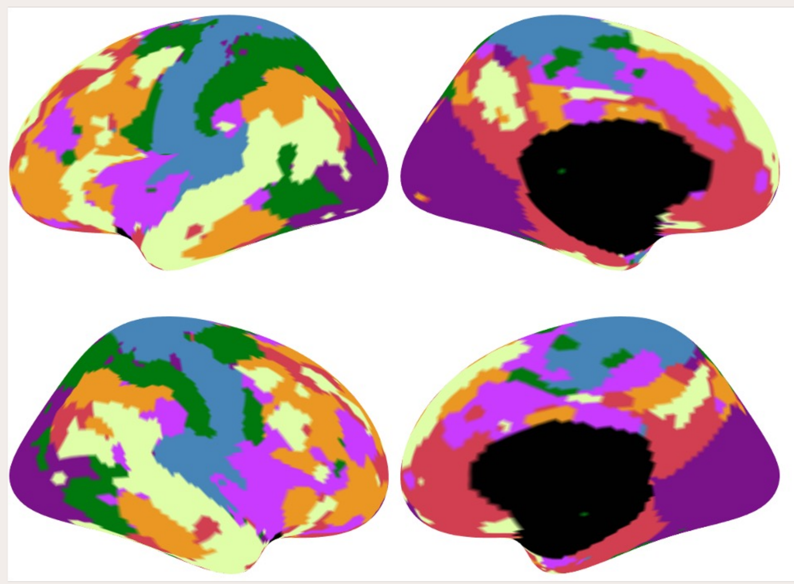
Results

(A)



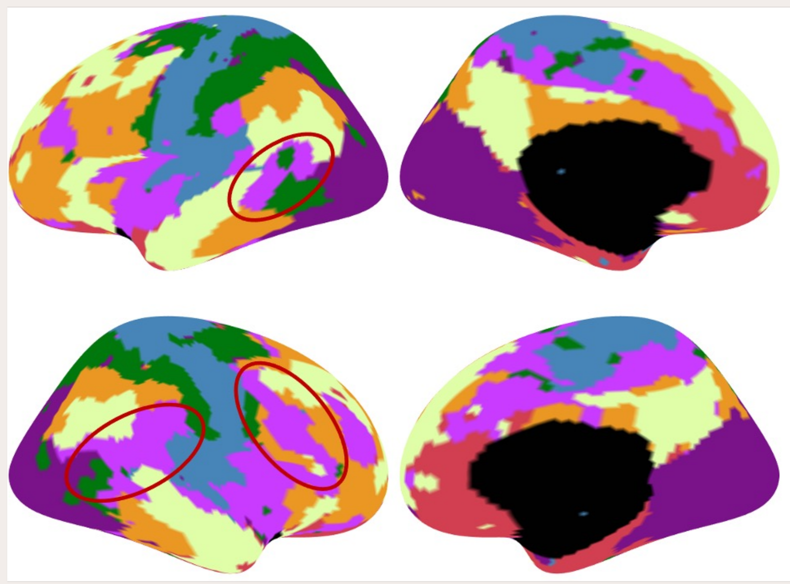
All sessions

(B)



May

(C)



December

Seven networks can be constructed from each dataset and two DMN networks were identified (A). Furthermore, the salience network constructed from the December dataset, encroaching some brain areas from DMN networks, is larger than that of the May dataset which is manifested (highlighted in red circles) especially in the right hemisphere (B, C) with a DC value of 0.68.

REFERENCES

[1] Vaisvilaite, L., Hushagen, V., Grønli, J., & Specht, K. (2022). Brain connectivity.

[2] Orban, C., Kong, R., Li, J., Chee, M. W., & Yeo, B. T. (2020). PLoS biology.

[3] Poldrack, R. A., Laumann, T. O., Koyejo, O., Gregory, B., Hover, A., Chen, M. Y., & Hunicke-Smith, S. (2015). Nat. Commun.

[4] Wang, M. Y., Korbmacher, M., Eikeland, R., & Specht, K. (2023).. bioRxiv, 2023-05.

[5] Kong, R., Li, J., Orban, C., Sabuncu, M. R., Liu, H., Schaefer, A., ... & Yeo, B. T. (2019). Cerebral cortex.

ACKNOWLEDGEMENTS

This project is under the project titled “When default is not default” which is funded by the Research Council of Norway. We would like to thank Liucija and Alexandra for their suggestions on post rest-fMRI data collection questionnaire. We also thank Alex for his expertise in MRS data analysis. Besides, we thank Ulvhild for providing useful resources about language learning and circadian rhythm. More importantly, we appreciate the tech support and data collection from our radiologists at the Haukeland University Hospital.

UNIVERSITY OF BERGEN