Uncovering the process of reprioritizing weaker meanings in human brain

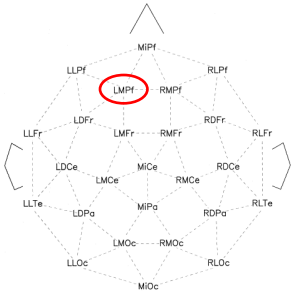
Po-Heng Chen
D04142002
National Taiwan University

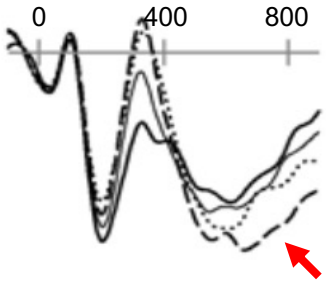
BrainHack School

Research background & aim

- Prior EEG studies have demonstrated an enhanced anterior positivity for weaker but plausible meanings.
- The downside of EEG is bad spatial resolution.

Unexpectedness (Context)





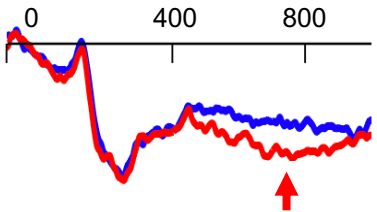
Expected

Unexpected

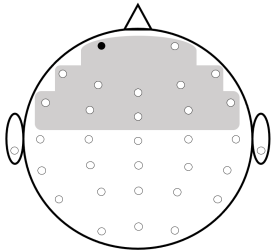
frontal positivity

meaning reprioritization

Ambiguous words (Form)



frontal positivity



Dominant

Subordinate

Federmeier, Wlotko, De Ochoa-Dewald, & Kutas (2007)

Chen, Federmeier, & Lee, in prep.

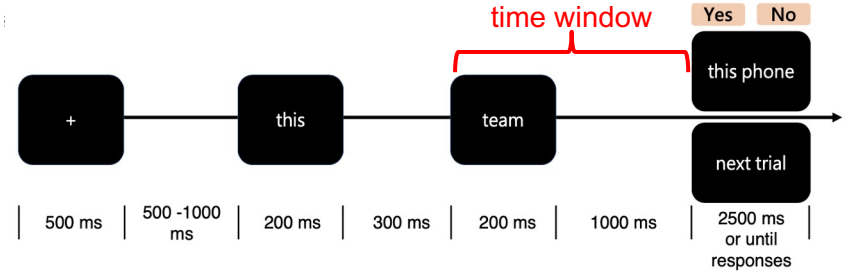
Objectives

- In the present project, we take advantage of Magnetoencephalography (MEG) to investigate the neural substrates of meaning reprioritization (indexed by the frontal positivity in past EEG studies).

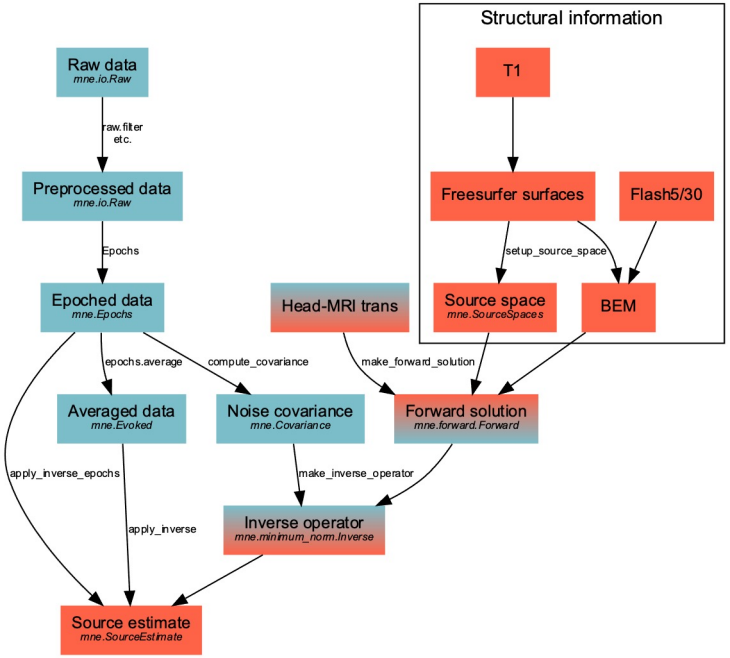
Methods

- MEG data were collected from 26 young participants while they read short phrases in Taiwan Mandarin.

Word type	Condition	Context	Target
Unambiguous words	Unambiguous	這支 ‘this’	球隊 ‘team’
Homographs	Dominate usage	一套 ‘a set of’	制服 ‘uniform’
	Subordinate usage	一同 ‘together’	制服 ‘subdue’



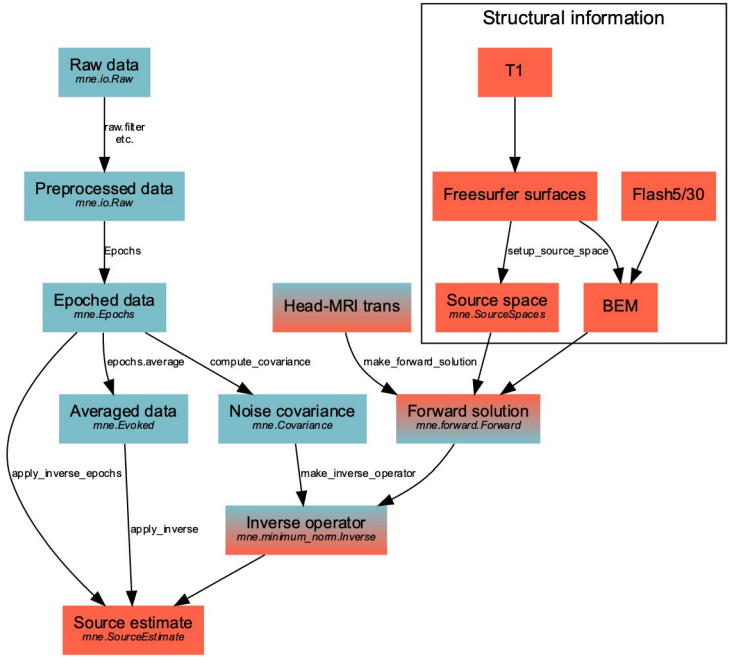
- Data will be analyzed at sensor level and source level following the Workflow of the MNE-Python software.



Data analyses

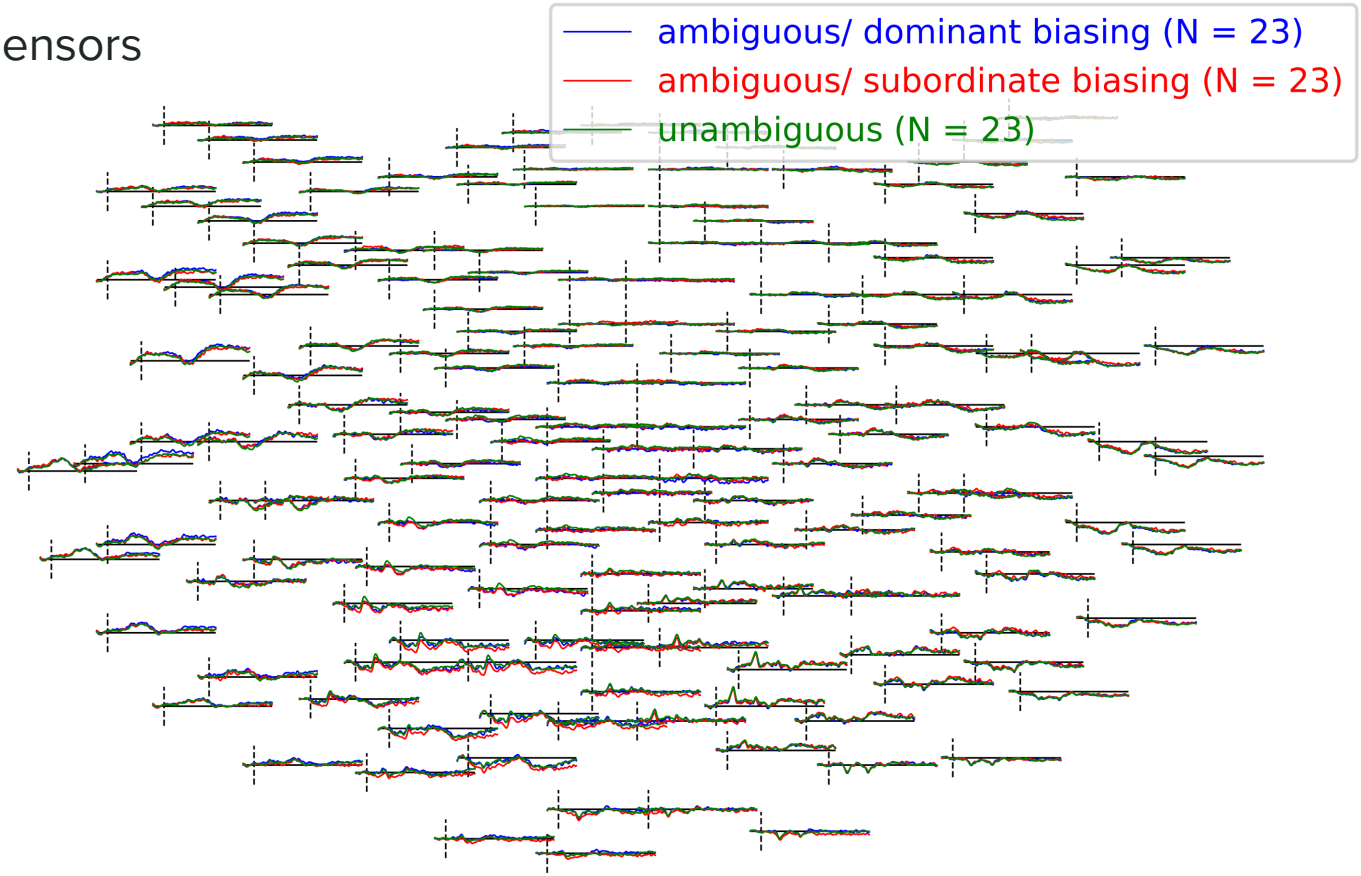
- Four scripts:
  - Preprocessing scripts for individual data at the sensor level
    - Low-pass filtering
    - Reject noisy epochs based on absolute amplitude
    - ICA
  - Preprocessing scripts for individual data at the source level
    - Data morphed to the fsaverage template
  - Grand averaging and plotting scripts for sensor-level data
  - Grand averaging and plotting scripts for source-level data

- Data will be analyzed at sensor level and source level following the Workflow of the MNE-Python software.

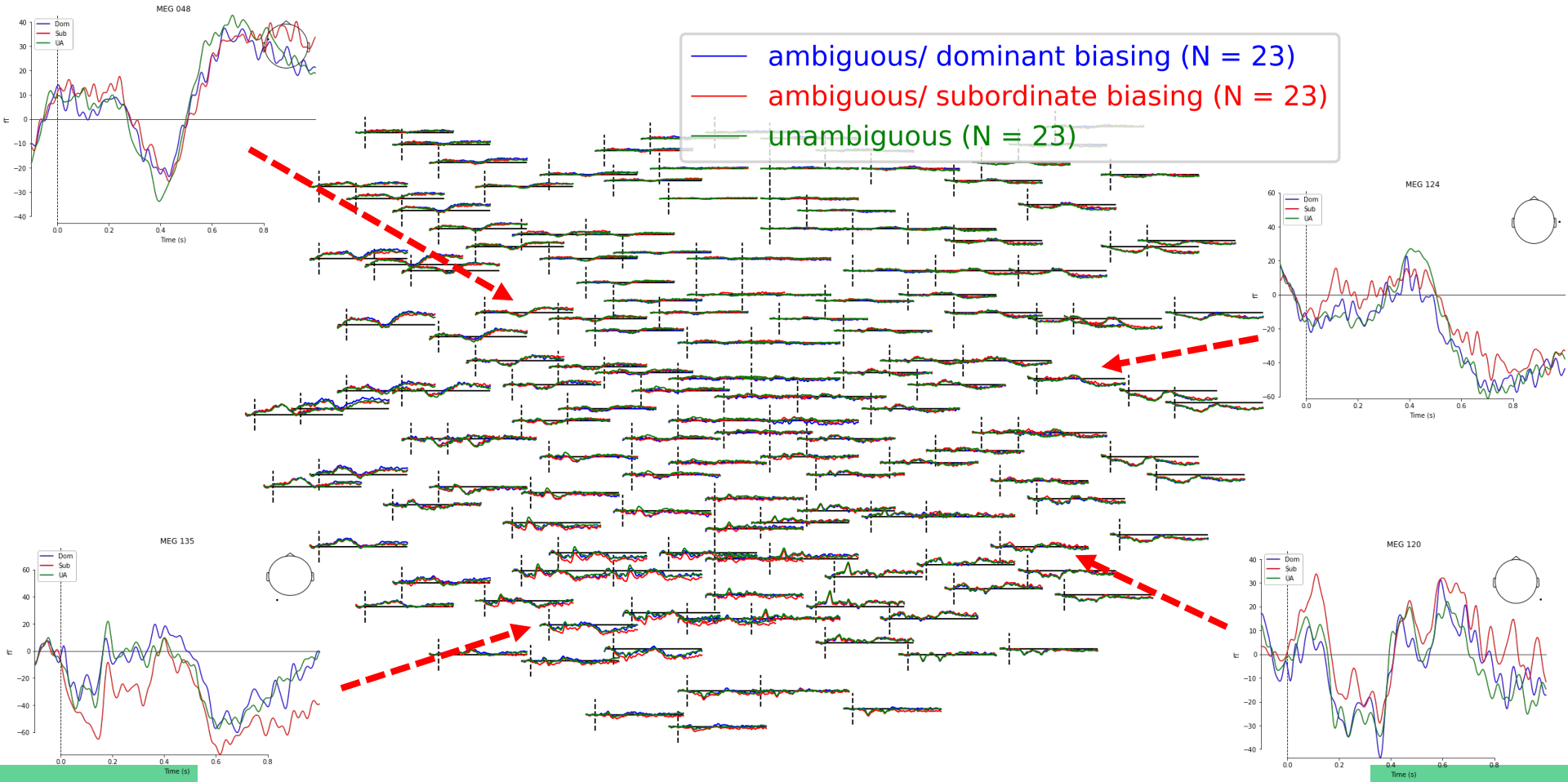


Preliminary results – sensor level

- 157 sensors



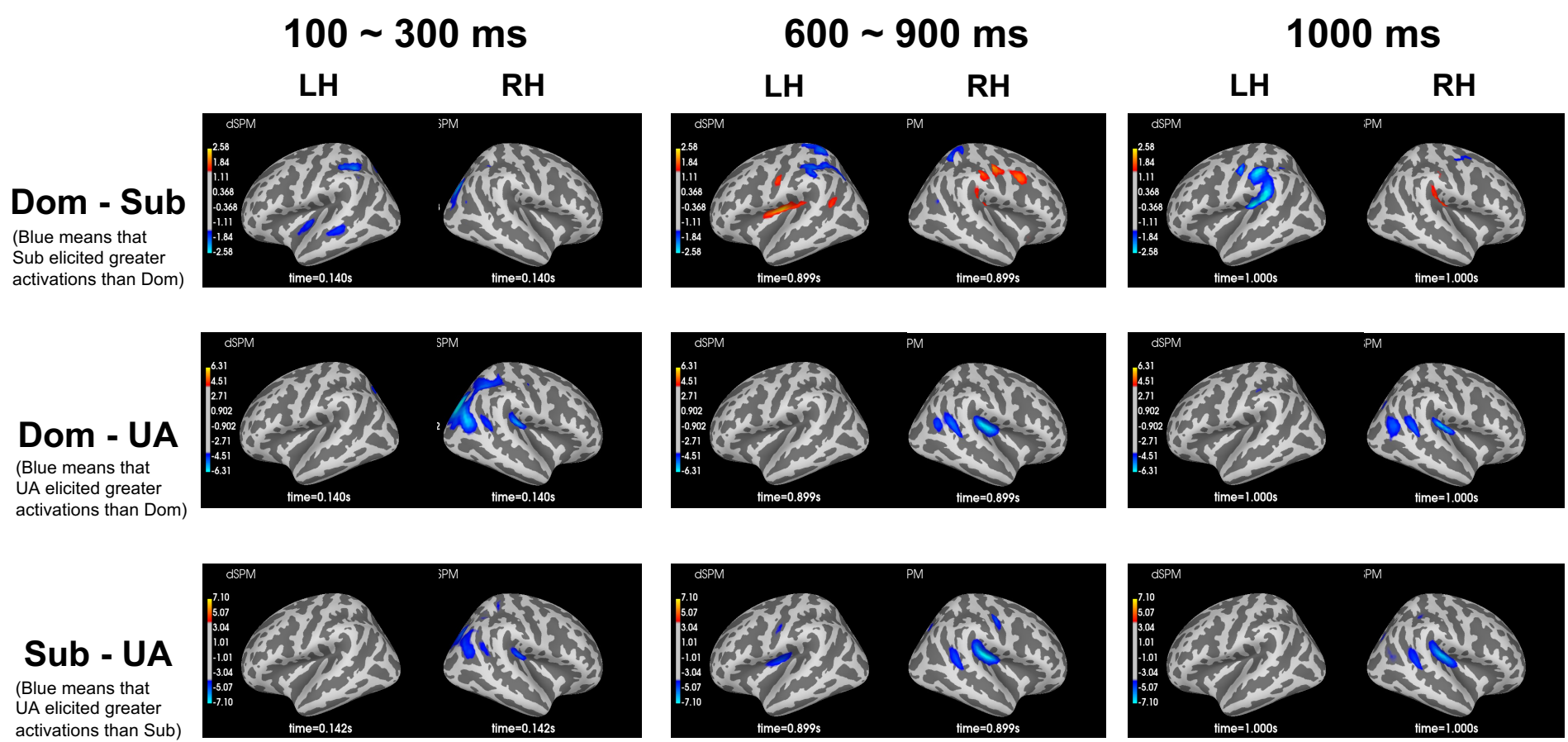
Preliminary results – sensor level



Progress at source level

- Source estimation was conducted for individual subject.
- Individual data were averaged and paired-wise conditional differences (Dom-Sub, Dom-UA, Sub-UA) were computed.
  - grandavg_stc_sub-unamb-lh.stc
  - grandavg_stc_sub-unamb-rh.stc
- When trying to visualize the conditional differences, I encountered some errors but solved them by changing the MNE environment (3.10.10).
  - At first, I was asked to install pyvistaqt.
  - AttributeError: type object 'WindowType' has no attribute 'Widget'

Preliminary results – source level



Conclusion

- At the sensor level, I observed some differences between subordinate meanings and the other two conditions (i.e., dominant meanings and unambiguous words) in two time windows.
  - 100~300 ms – might be related to early detection of mismatched word class information (Dikker et al., 2010)
  - 600~900 ms – might be related to higher-level meaning integration/reprioritization

- Once the visualization problem at the source level is solved, we would better understand the neural substrates of the process of meaning reprioritization.

Keywords: lexical ambiguity, frontal/anterior positivity, EEG/ERP, MEG

References

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