Implementing Time-Resolved Representational Similarity Analysis to Track Cortical Representation of Consciousness Report
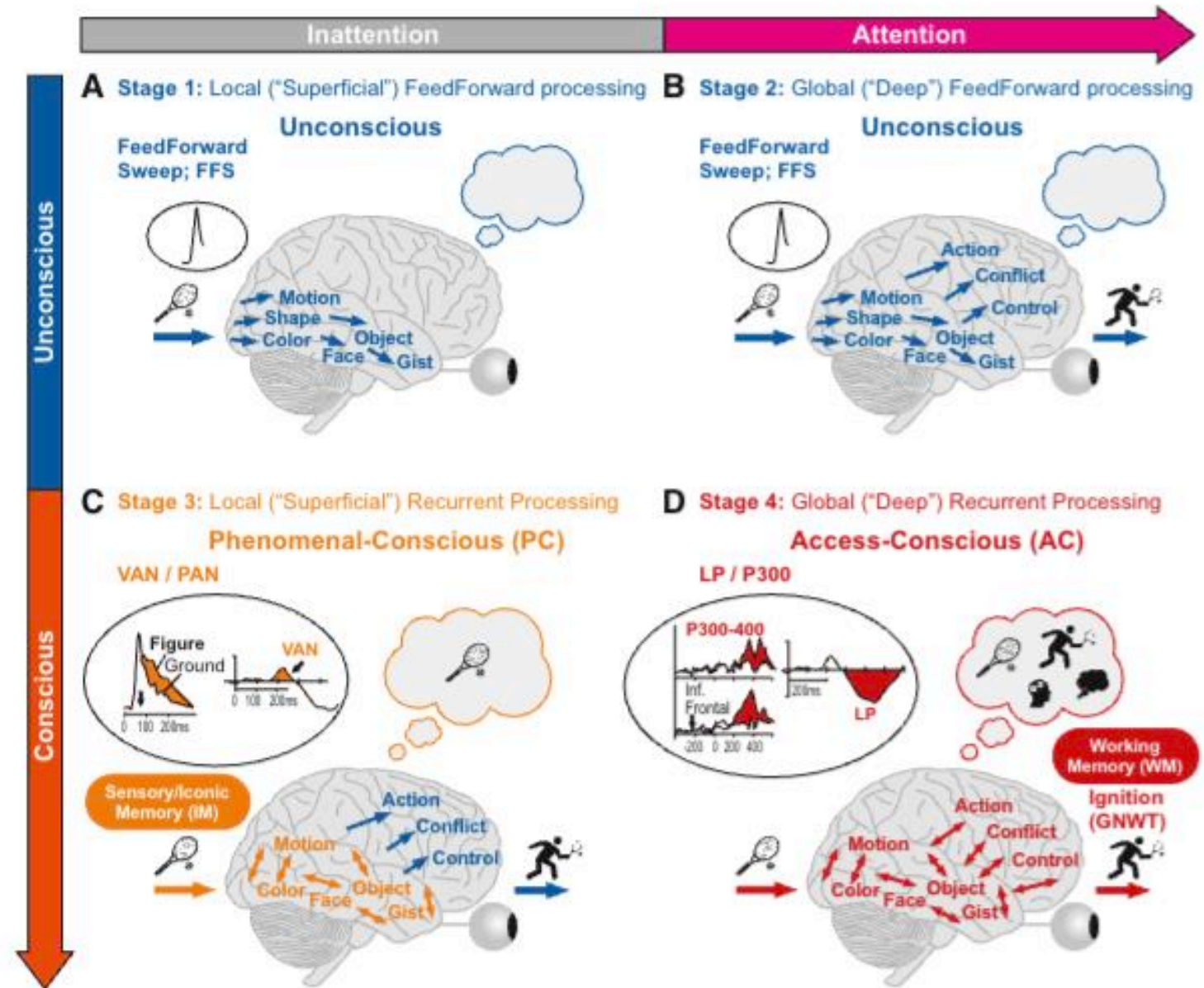
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Literature Review

- Neuronal Correlates of Consciousness (NCC)in ERP (Förster et al., 2020)
  - Visual Awareness Negativity, VAN(~200 ms)
  - Late Positivity, LP (300-500 ms)
  - Early v. Late controversy
- Recurrent Processing Theory v. Global Neuronal Workspace Theory
  - Lamme, 2010
  - Dehaene, 2014

Recurrent processing theory (RPT) of visual consciousness

Storm JF, Klink PC, Aru J, Senn W, Goebel R, Pigorini A, Avanzini P, Vanduffel W, Roelfsema PR, Massimini M, Larkum ME, Pennartz CMA. An integrative, multiscale view on neural theories of consciousness. Neuron 2024;112:1531–52. https://doi.org/10.1016/j.neuron.2024.02.004.

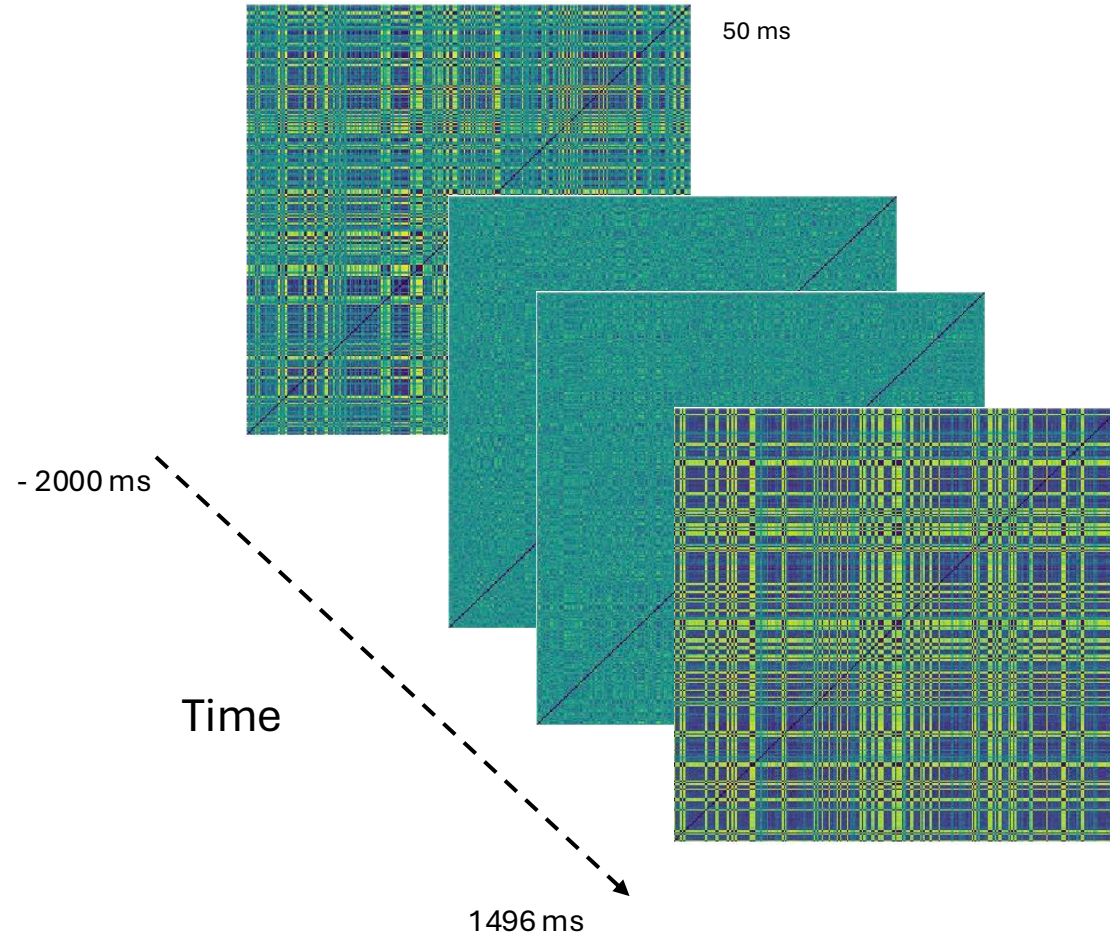# Literature Review (cont.)

- Dichotomous vs. Graded perspective
  - Cumulative fashion of visual consciousness.
  - Colombari et al. (2024) used independent component analysis to separate different independent procedures of visual consciousness.
  - Cohen et al. (2023) proposed a new behavioral model by adding a parameter to stand for the strength of neural presentation after stimulus onset.

Pipelines for individual RSA

Construct a trial-by-trial neural RDM → Construct Behavioural RDM → Doing RSA

Construct a trial-by-trial neural RDM

- 50 ms time bin for neural RDM constructions
  - Trail-by-trail RMD(268 x 268)
  - 64 channel x ⌊250 Hz *0.05 time bin⌋=64*12=768 (dimension)
- PCA dimension reductions(99 % variance retention)
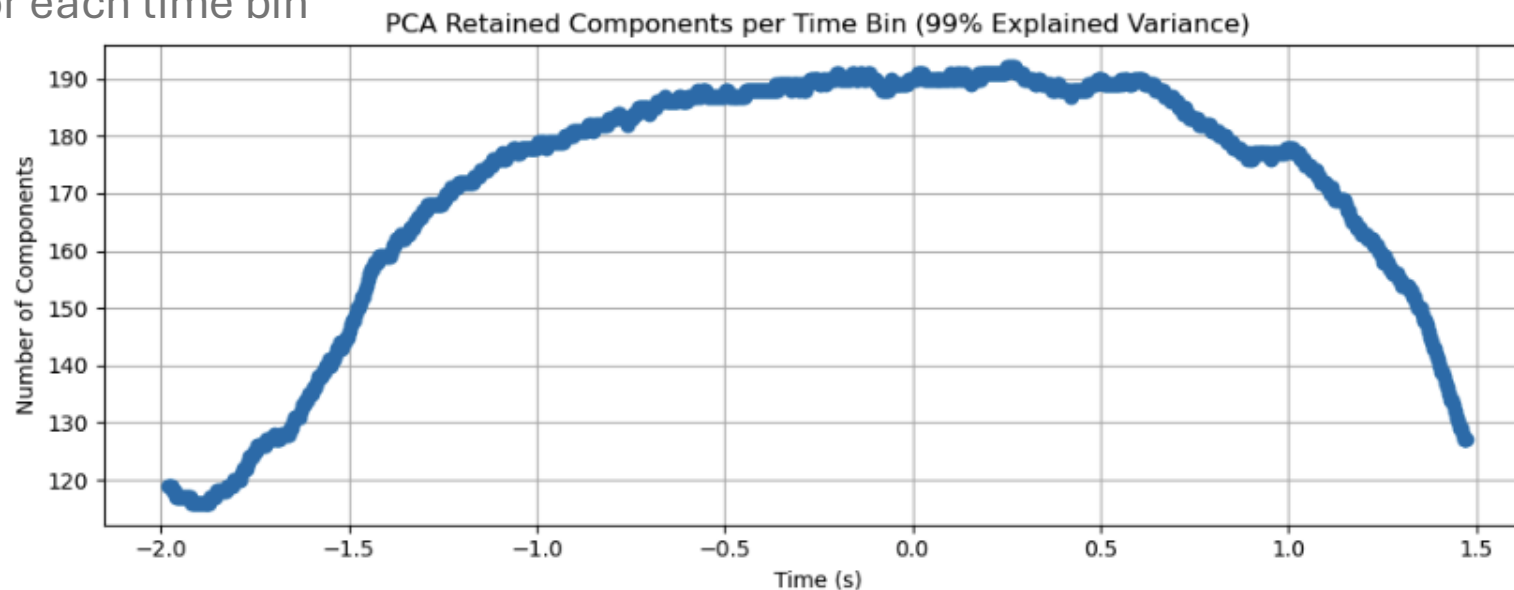 - Visualization
- Split-half reliability test for each time bin

50 ms

- 2000 ms

Time

1496 ms

- 50 ms time bin for neural RDM constructions
  - Trail-by-trail RMD(268 x 268)
  - 64 channel x ⌊250 Hz *0.05 time bin⌋=64*12=768 (dimension)
- PCA dimension reductions(99 % variance retention)
  - Visualization
- Split-half reliability test for each time bin

```
✅ 有效條件的 trial 數：
Right_correct_2: 13 trials
Right_correct_1: 47 trials
Right_incorrect_0: 42 trials
Right_correct_0: 22 trials
Left_correct_1: 60 trials
Left_correct_0: 29 trials
Right_incorrect_1: 4 trials
Left_incorrect_0: 16 trials
Right_correct_3: 5 trials
Left_correct_2: 15 trials
Left_incorrect_1: 10 trials
Left_correct_3: 5 trials
```


PCA Retained Components per Time Bin (99% Explained Variance)

Construct a trial-by-trial neural RDM (cont.)

- 50 ms time bin for neural RDM constructions
  - 64 channel x ⌊250 Hz *0.05 time bin⌋=64*12=768 (dimension)
- PCA dimension reductions(99 % variance retention)
  - Visualization
- Trail-by-trail RMD(268 x 268)
- Split-half reliability test for each time bin
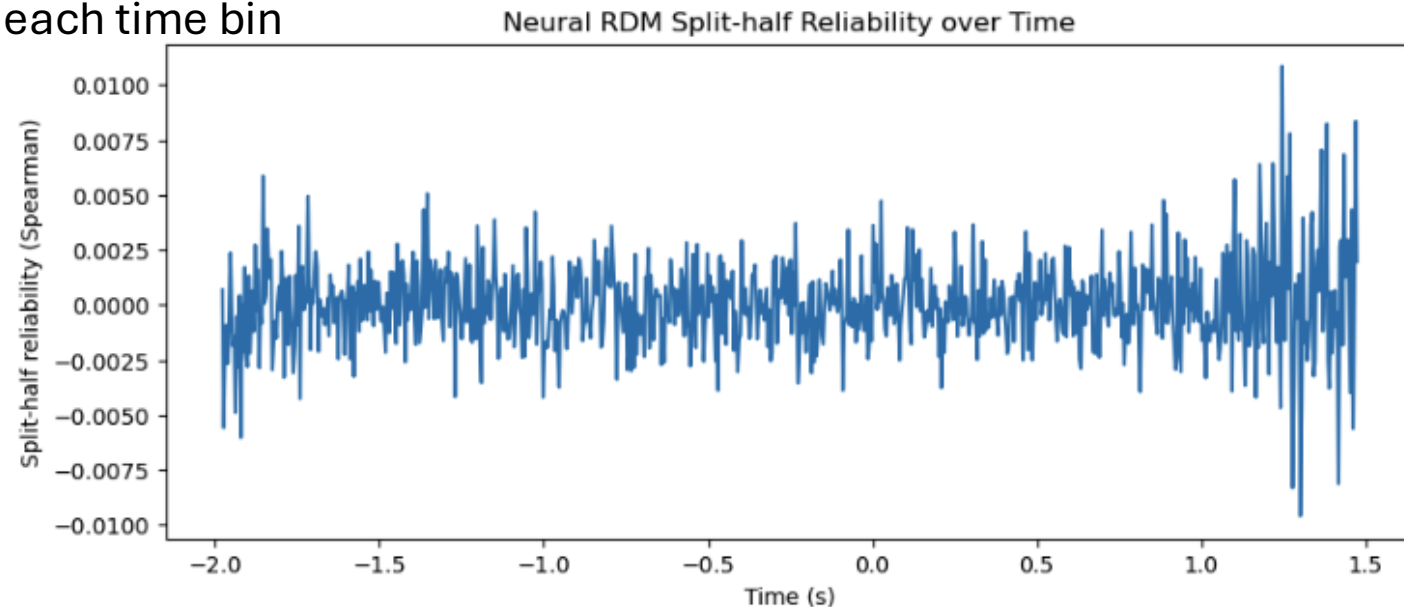
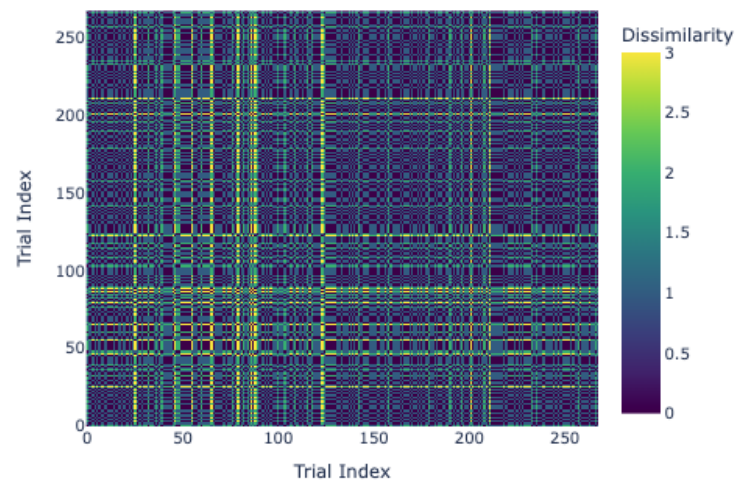Neural RDM Split-half Reliability over Time

Construct Behavioural RDM
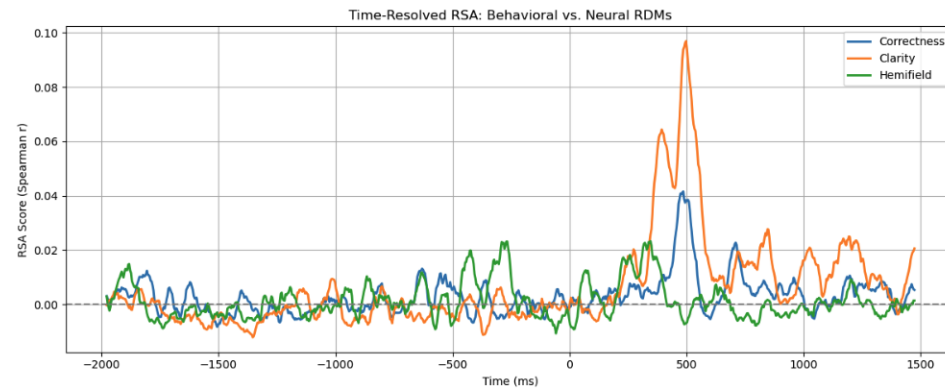
Spearman r

50 ms

- 2000 ms
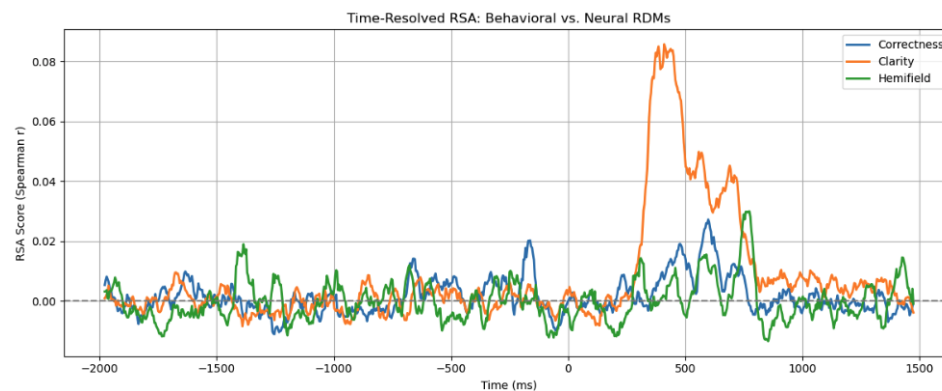
Time

1496 ms
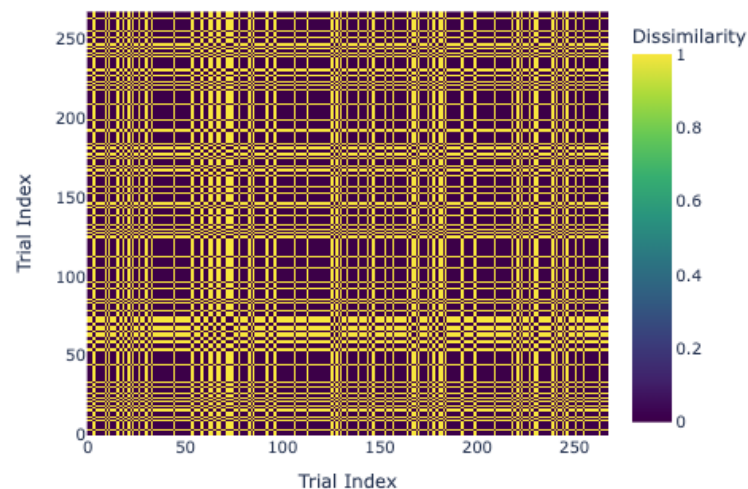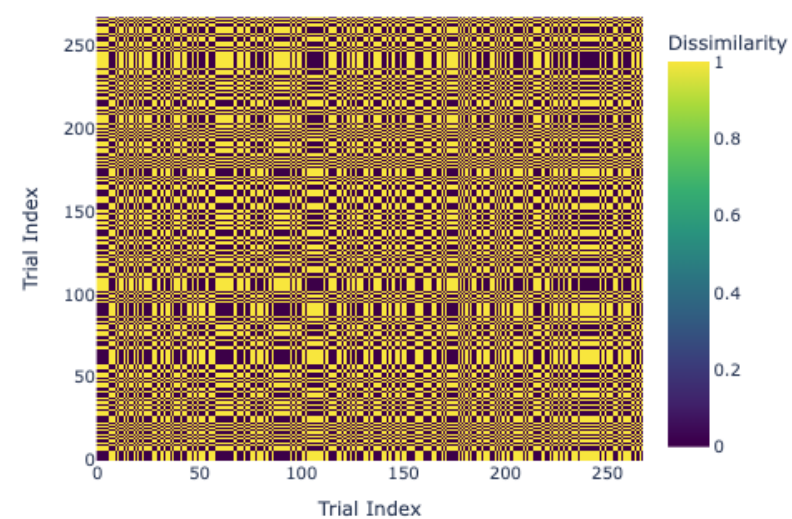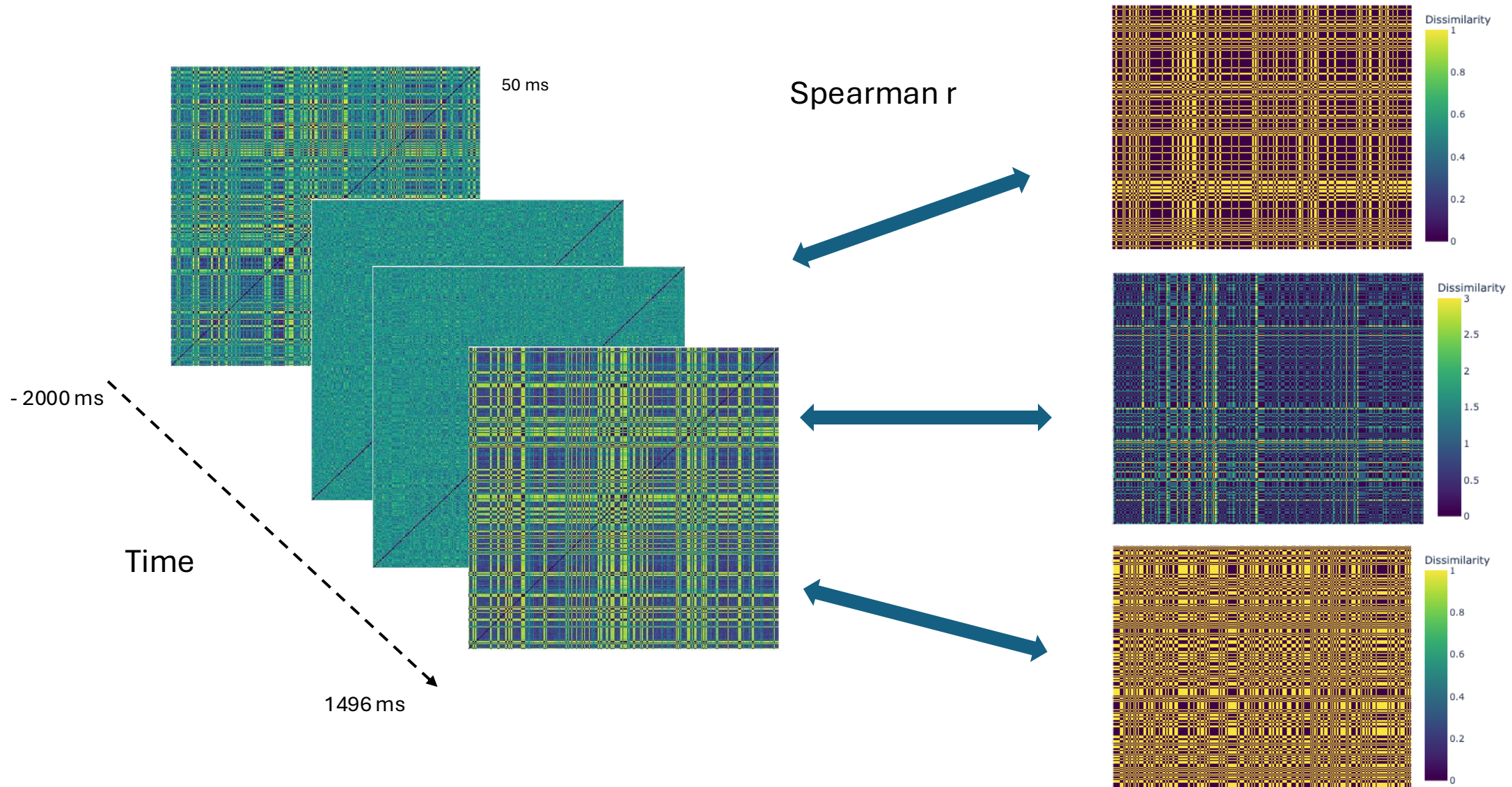
Individual RSA results
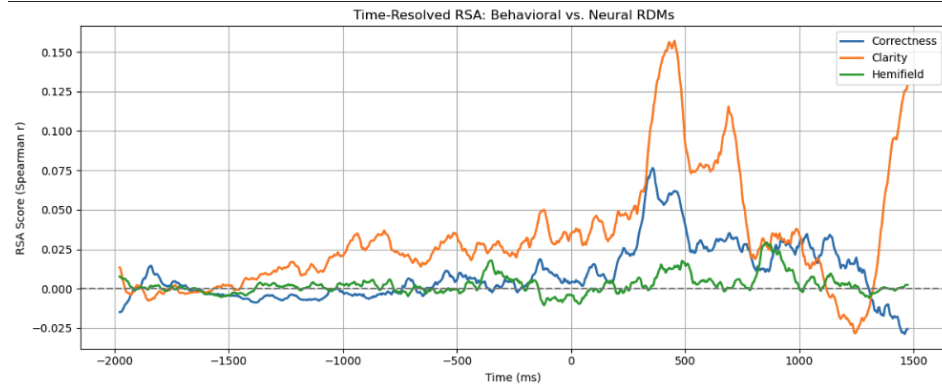
S2

S3

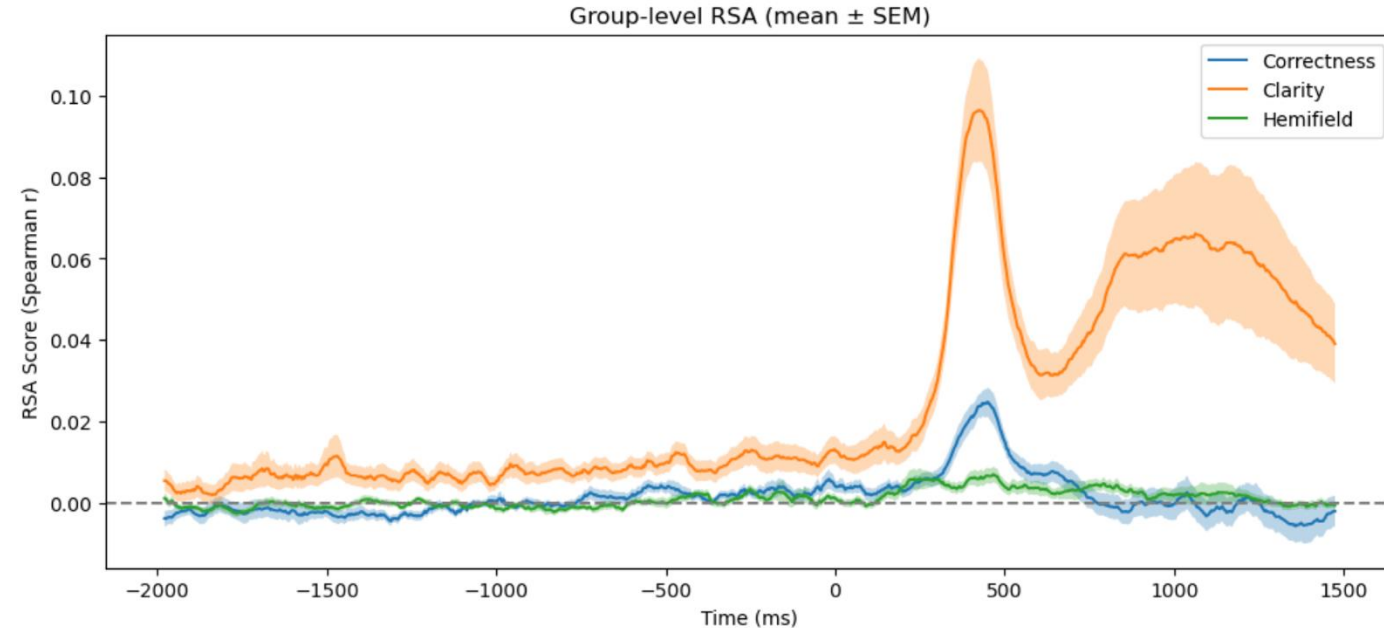S3

Group-level RSA

- 34 participants
- Average the results from each individual
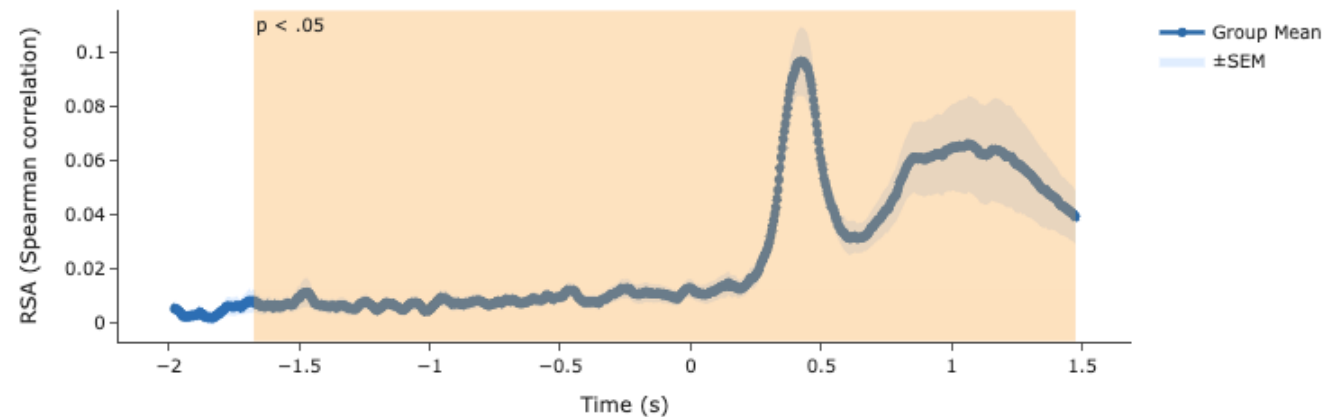- Cluster permutation test for neural RDM and behavioural RDM similarity analysis

Group-level RSA (mean ± SEM)

Group-level RSA Results

- 34 participants

- Average the results from each individual

- Cluster permutation test (100 times)for neural RDM and behavioural RDM similarity analysis
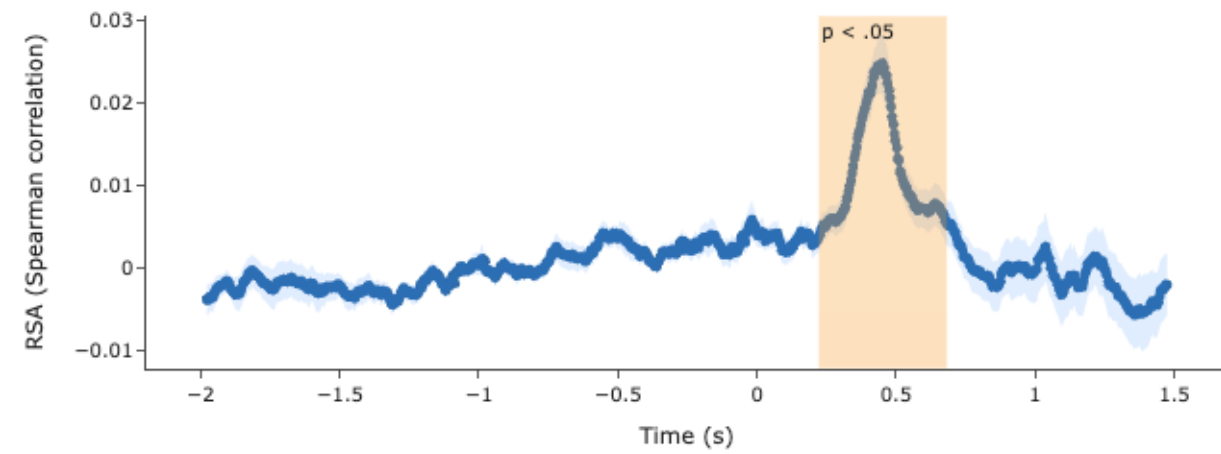
Behavior R... [Correctness ▾]

Behavior R... [Hemifield ▾]

Cluster Permutation Result: Correctness

Cluster Permutation Result: Hemifield

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