Repetition suppression effects of sequential action across different visual cues: Preliminary results

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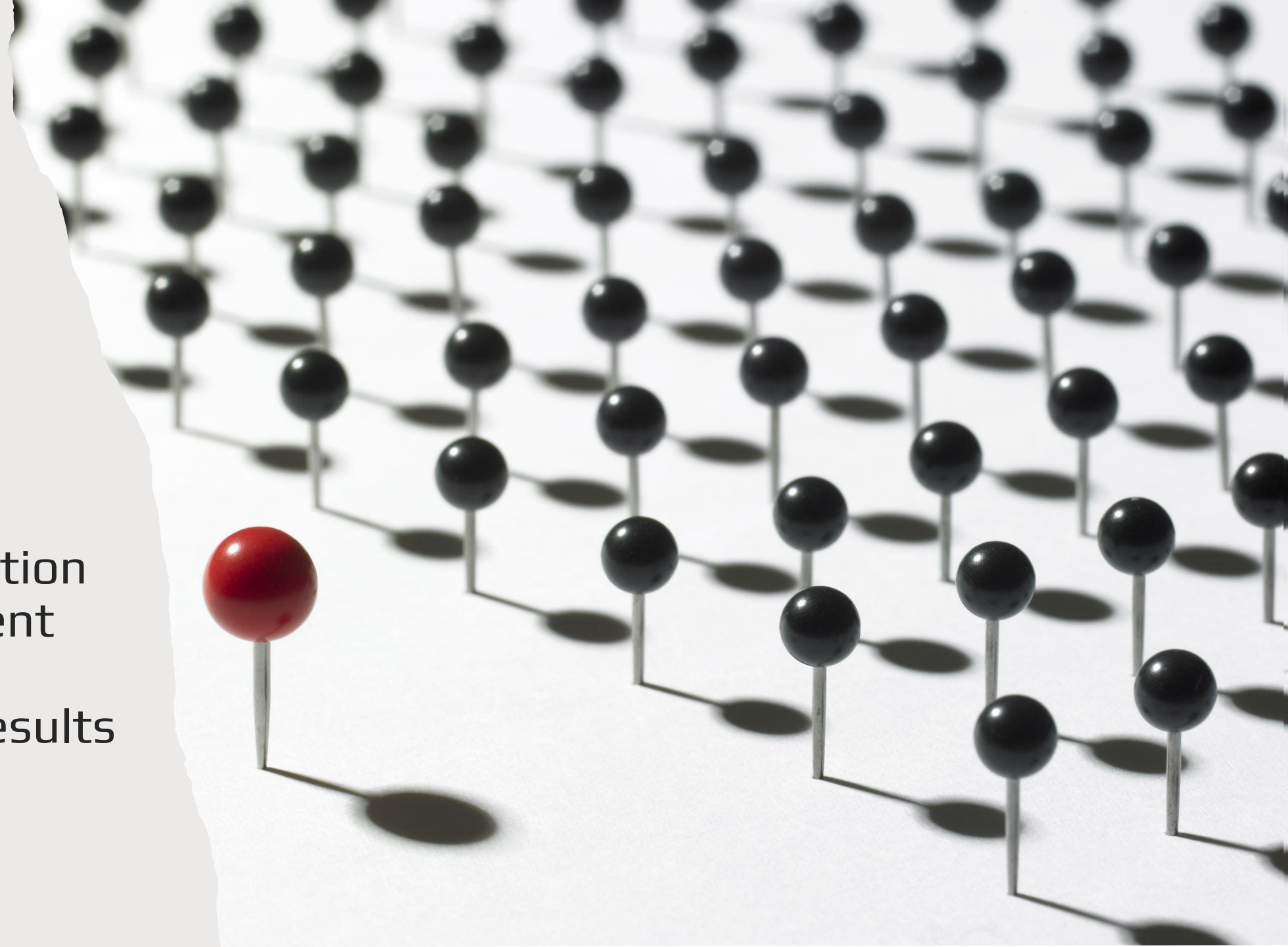
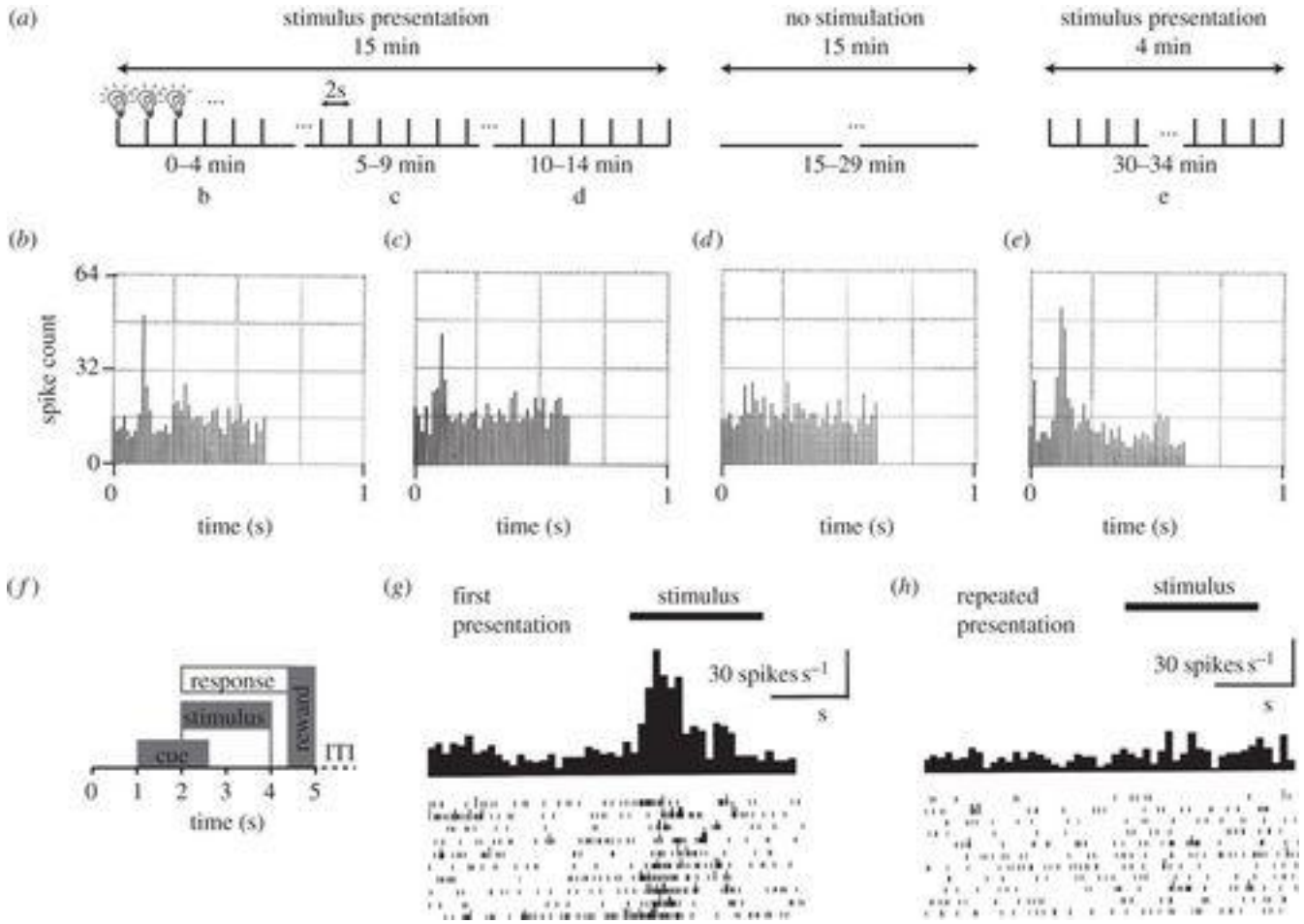


Repetition suppression effects

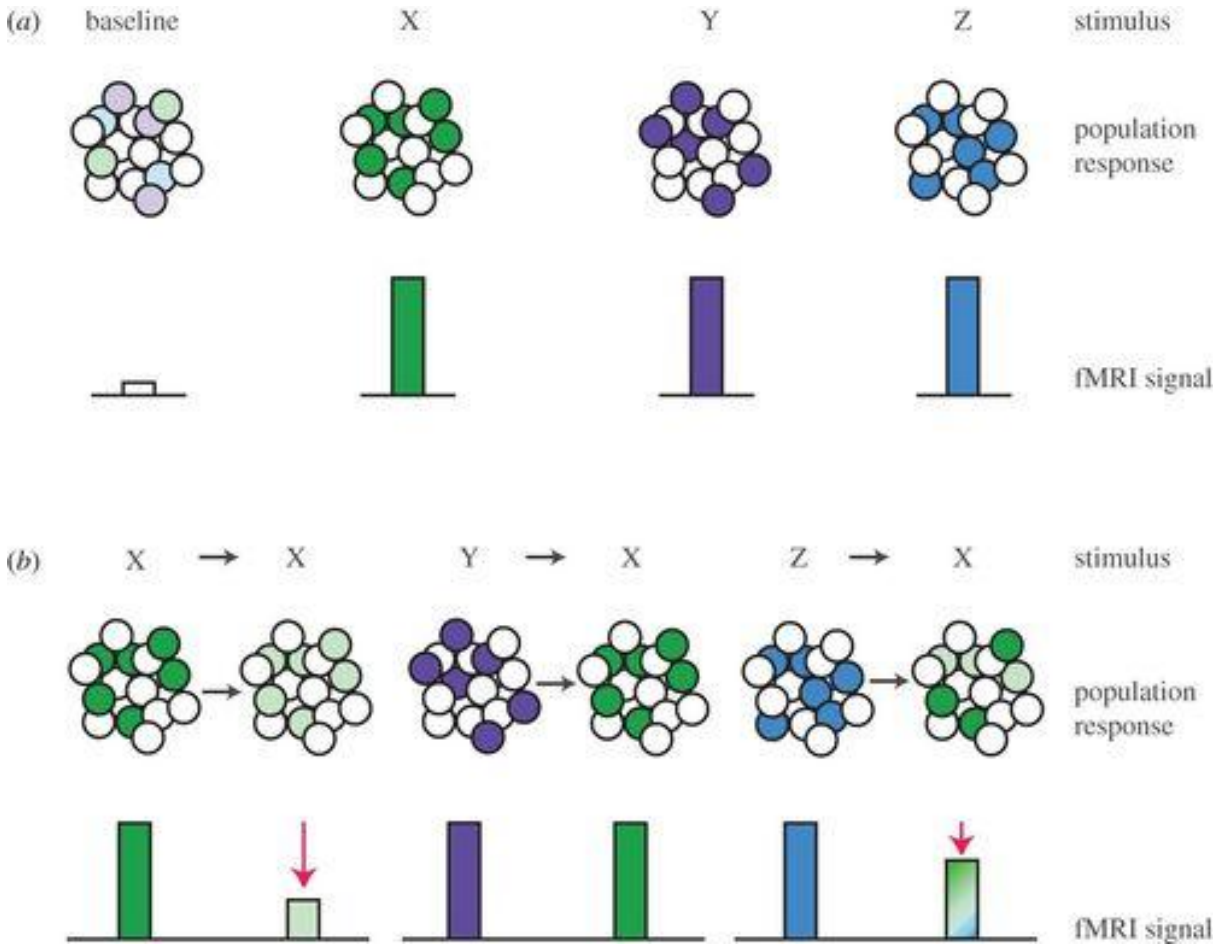


Repeated exposure to the same stimulus may reduce
Evoke neural activity with faster behavioral response

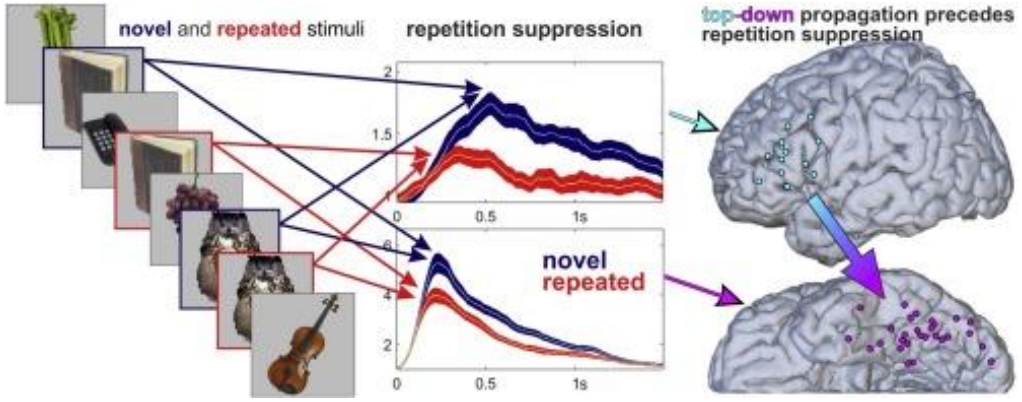
First reported from single-unit recordings in the primate
IT (inferotemporal) cortex

Gross et al., J Neuropysiol., 1967

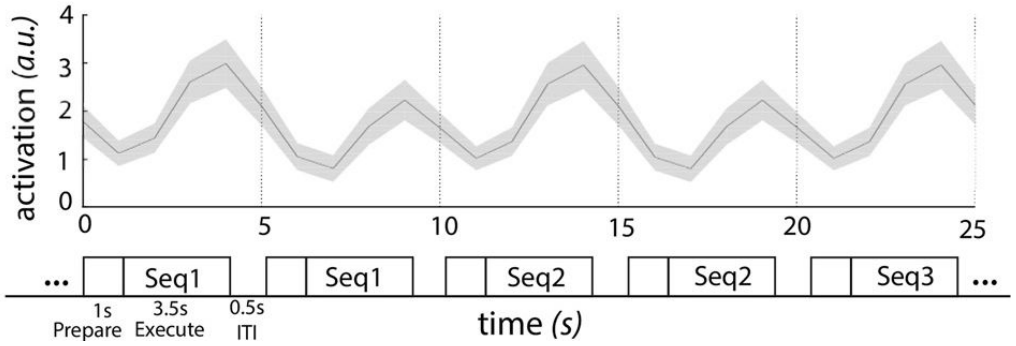
Principle underlying fMRI adaptation



Barron et al., Phil Trans Royal Soc, 2016



Korzeniewksa et al., Prog Neurobiol, 2020



Berlot et al., J Neurosci, 2021

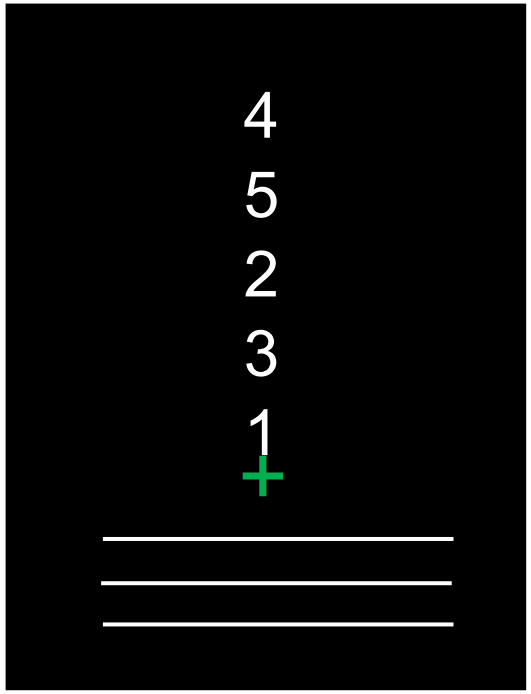
Experiment design

Four motor sequences with two different visual cues

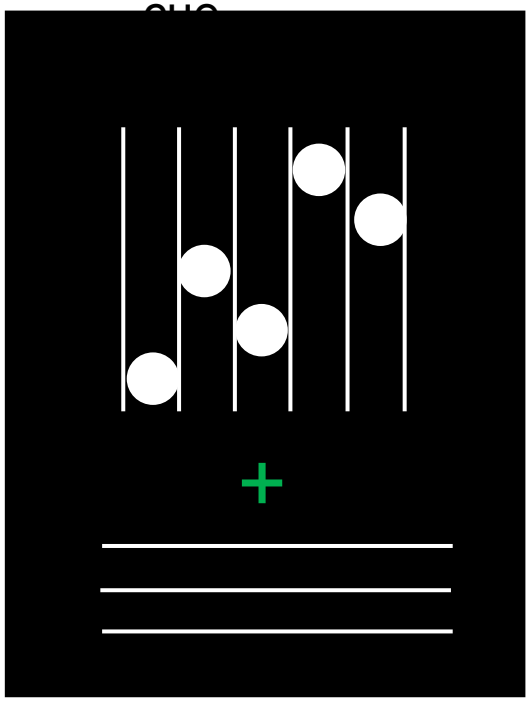
Motor sequences

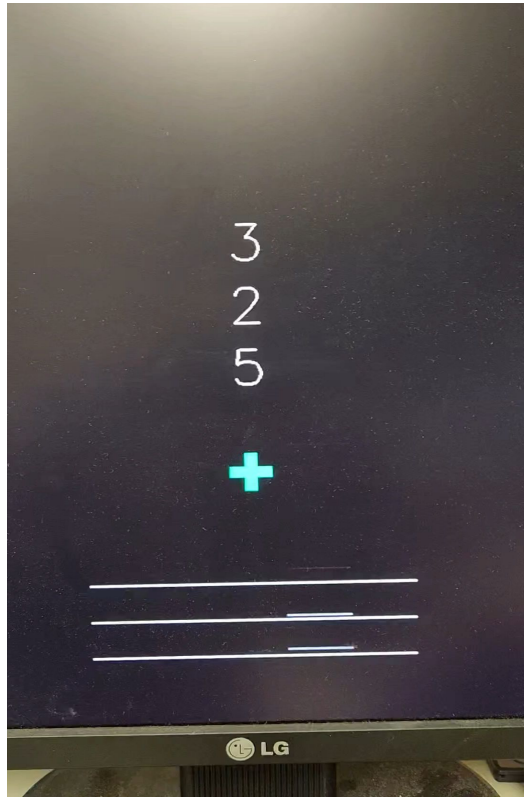
13254
14523
32451
35124

Letter cue



Spatial cue





N-1 th trial		N th trial: Letter Cue 1	Letter Cue 2	Letter Cue 3	Letter Cue 4	Spatial Cue 1	Spatial Cue 2	Spatial Cue 3	Spatial Cue 4
Letter Cue	1	B	C	C	C	S	N	N	N
	2	C	B	C	C	N	S	N	N
	3	C	C	B	C	N	N	S	N
	4	C	C	C	B	N	N	N	S
Spatial Cue	1	S	N	N	N	B	C	C	C
	2	N	S	N	N	C	B	C	C
	3	N	N	S	N	C	C	B	C
	4	N	N	N	S	C	C	C	B

First finger repetition

B : both of cue and sequence repetition
(8 trials)

S: only sequence repetition
(8 trials)

C: only cue repetition
(24 trials)

N: no repeition
(24 trials)

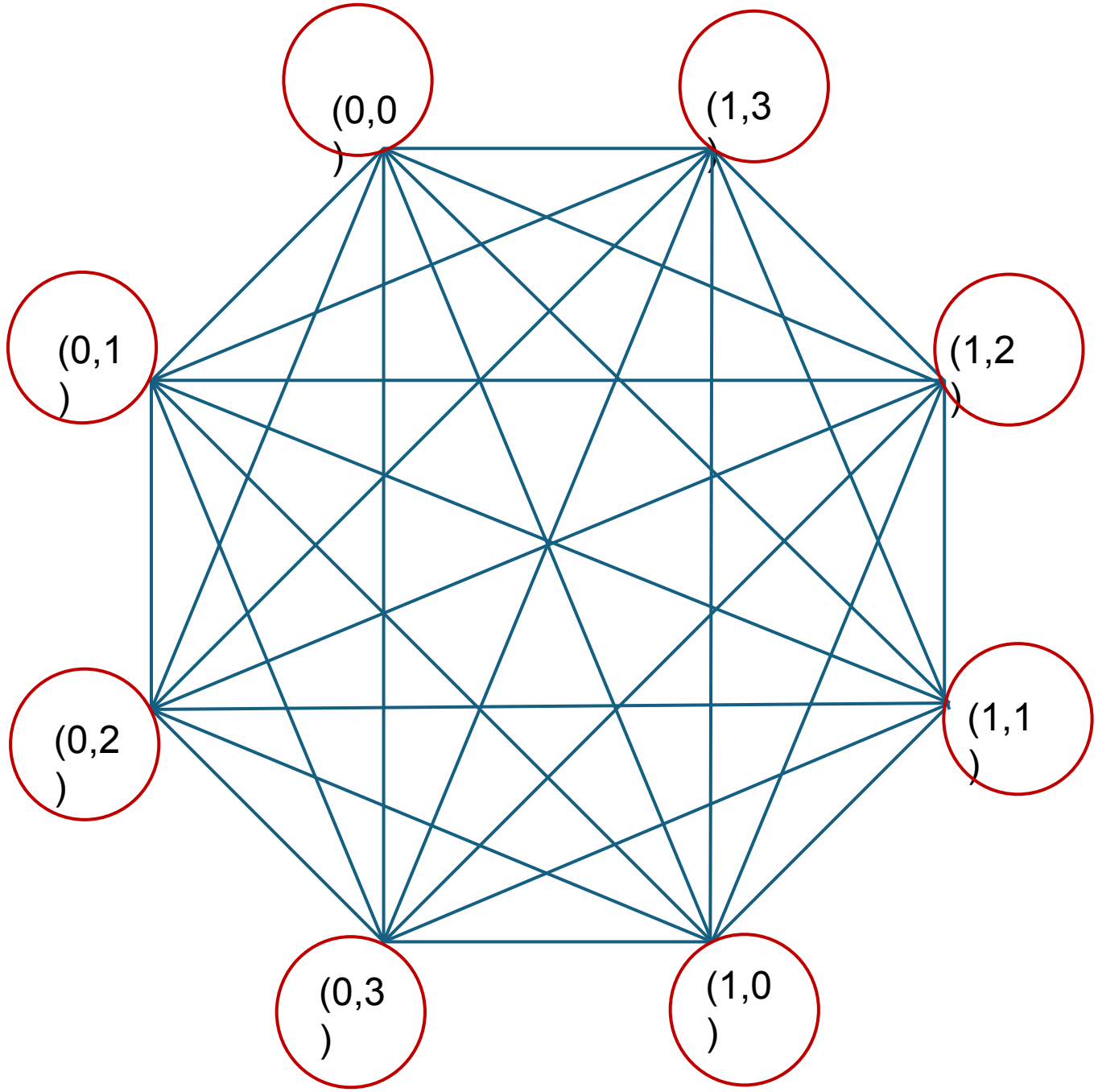
Experiment design

- 8 trial states : 2 types of cue (letter, spatial) , 4 sequences
  - TS = (c, s) (c: cue type; s: sequence type; c= 0, 1; s = 0, 1, 2, 3)

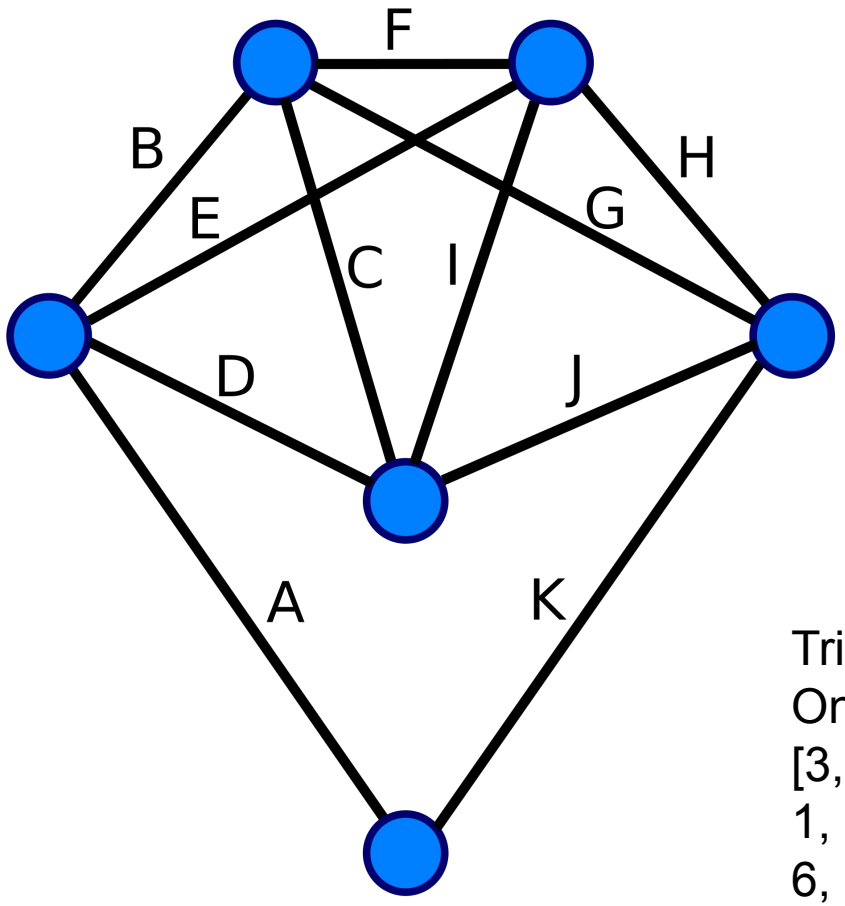
- 64 transitions between the previous and the current trials
  - Do all the 64 transitions between trials can be implemented by 65 trials?

Can you draw this with one stroke?

Blue line: You should draw twice bidirectionally
Red circle: You should draw once



Euler found the solution about 300 years ago...



Euler's Theorem
A connected graph has an Euler cycle if and only if every vertex has even degree.

-1873 by Carl Hierholzer

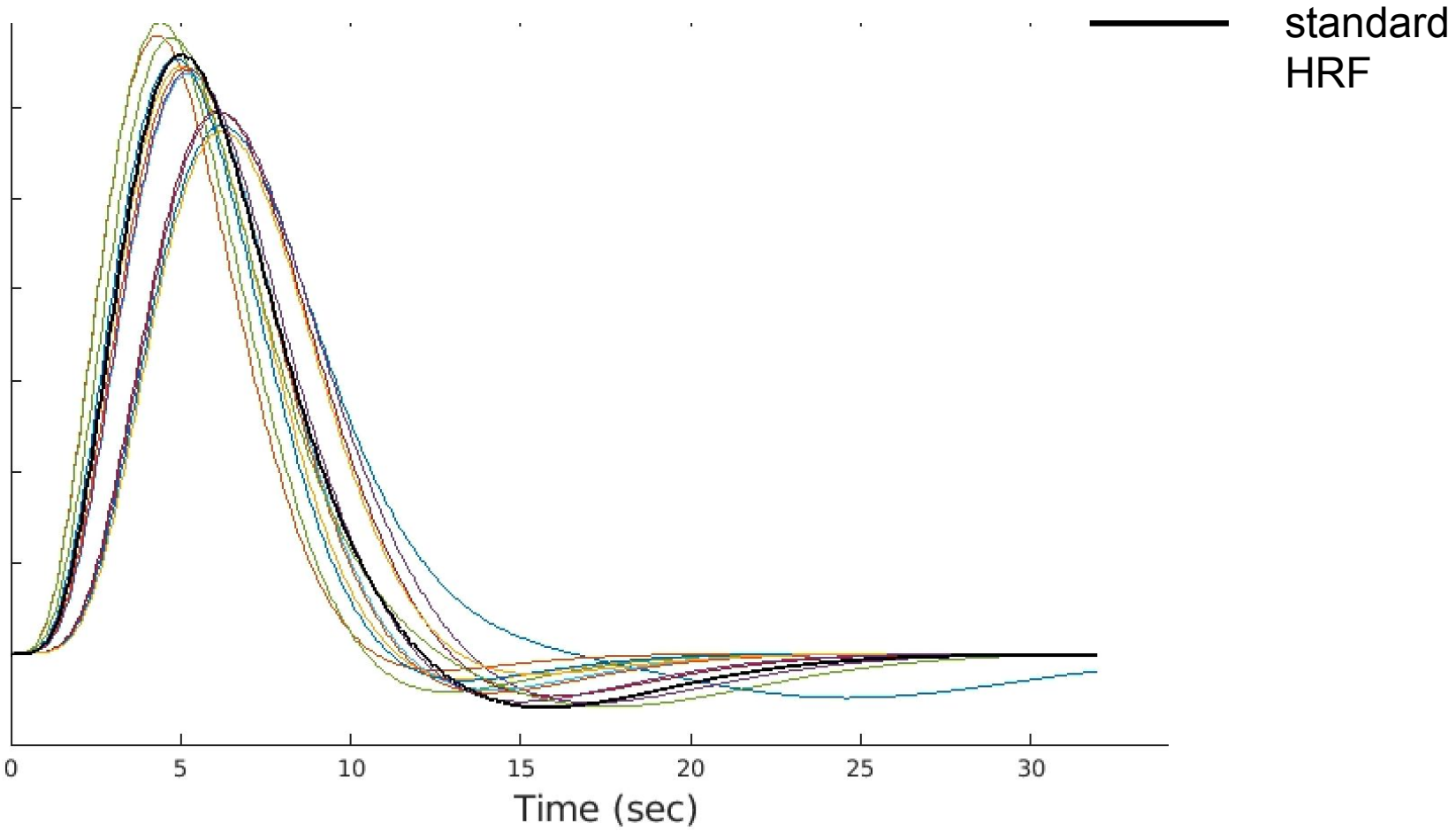
Trial state = 0, 1, 2,…, 7
One of solutions:
[3, 6, 5, 0, 6, 0, 0, 3, 2, 1, 6, 1, 3, 4, 5, 4, 0, 2, 2, 4, 7, 0, 4, 3, 1, 1, 4, 6, 4, 1, 2, 7, 1, 7, 2, 3, 5, 3, 3, 0, 1, 0, 5, 5, 6, 6, 7, 5, 1, 5, 7, 7, 4, 4, 2, 6, 3, 7, 6, 2, 5, 2, 0, 7, 3]

fMRI experiment

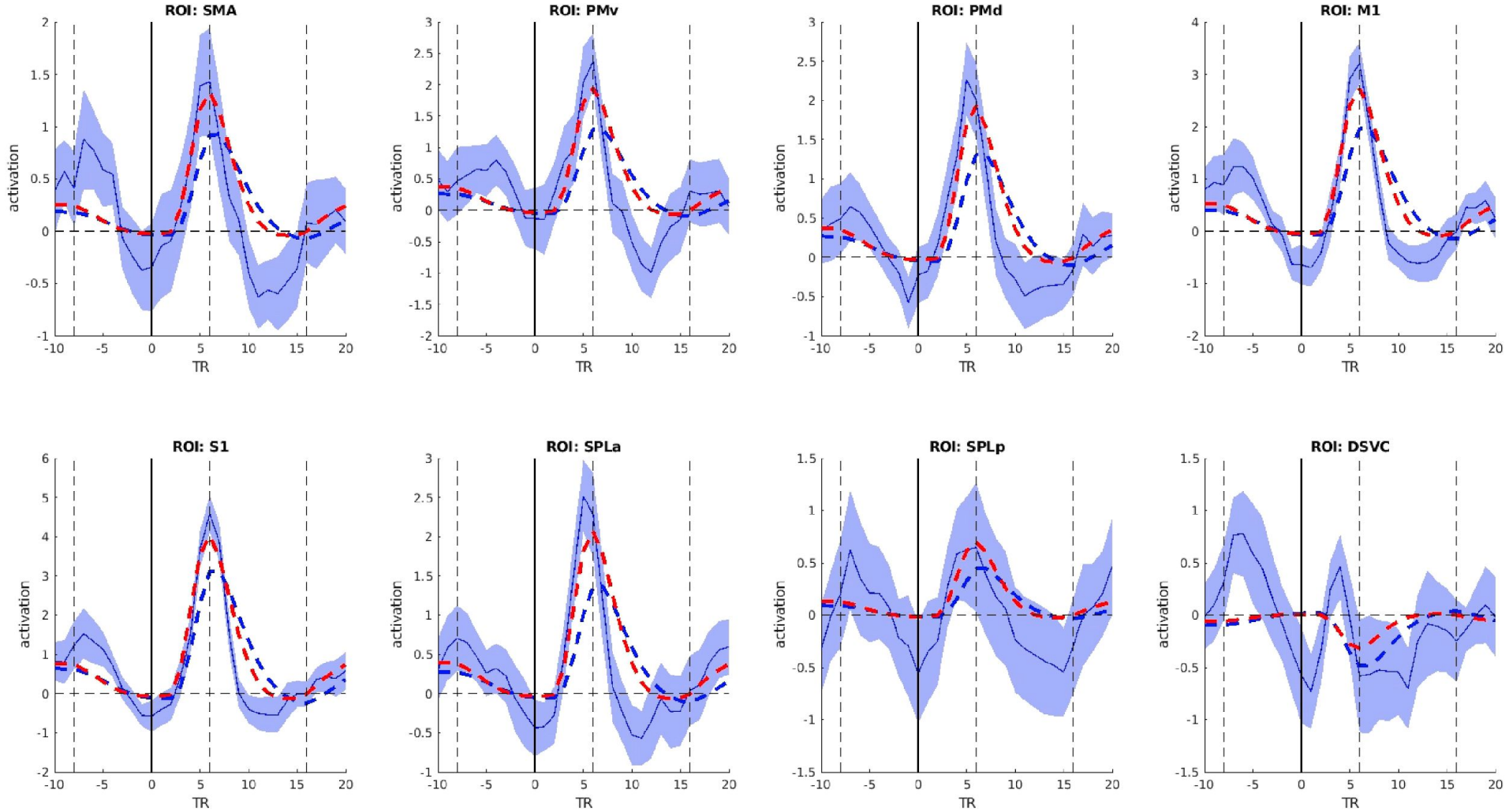
- 12 participants
- 2 sessions
- Each session: 8 runs with 68 trials

  (4 blocks, 17 trials for each block), additional run with long-ISI (~
- The starting trial states are randomly permuted
- 5 s for each trial (preparation: 1 s, movement: 3 s, ISI: 1s)
- Long resting period between blocks (~16 seconds)
- Each run takes about 7 minutes

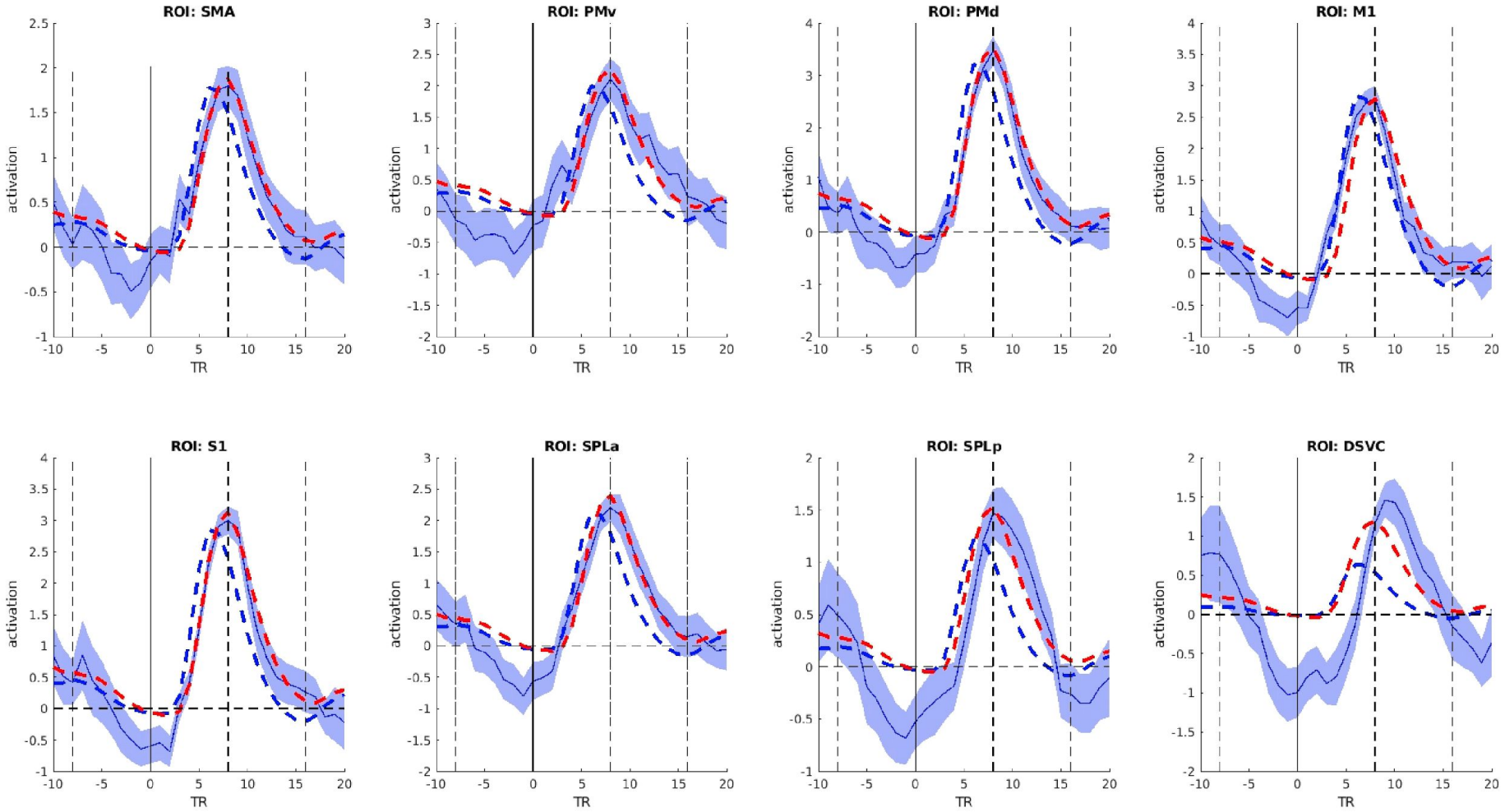
Fitted HRF for individual participants



HRF parameter fitting (example 1)



HRF parameter fitting (example 2)

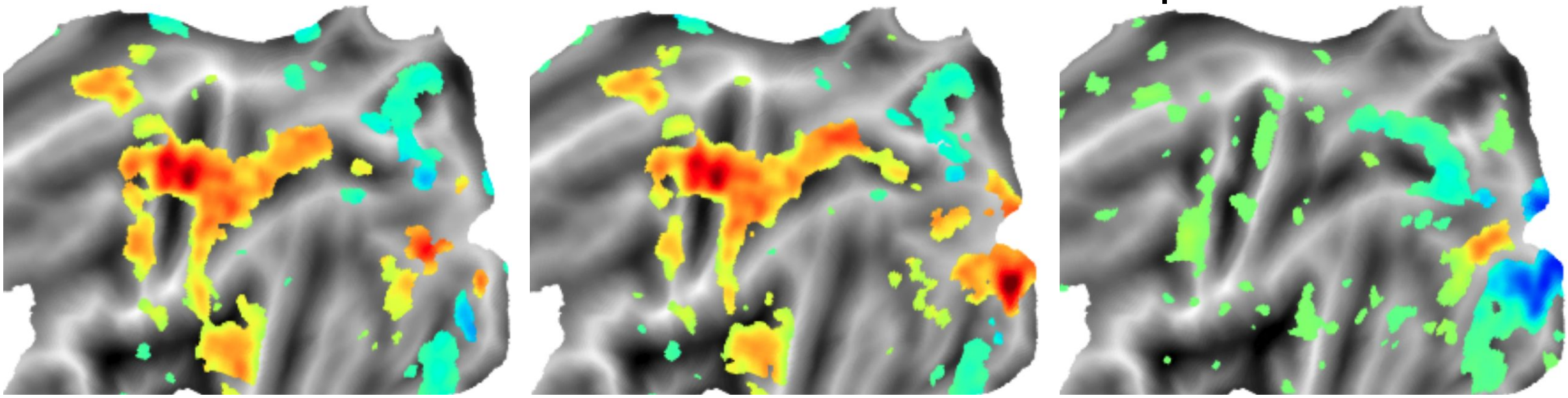


Task-related regions

Letter

Spatial

Letter-Spatia
l



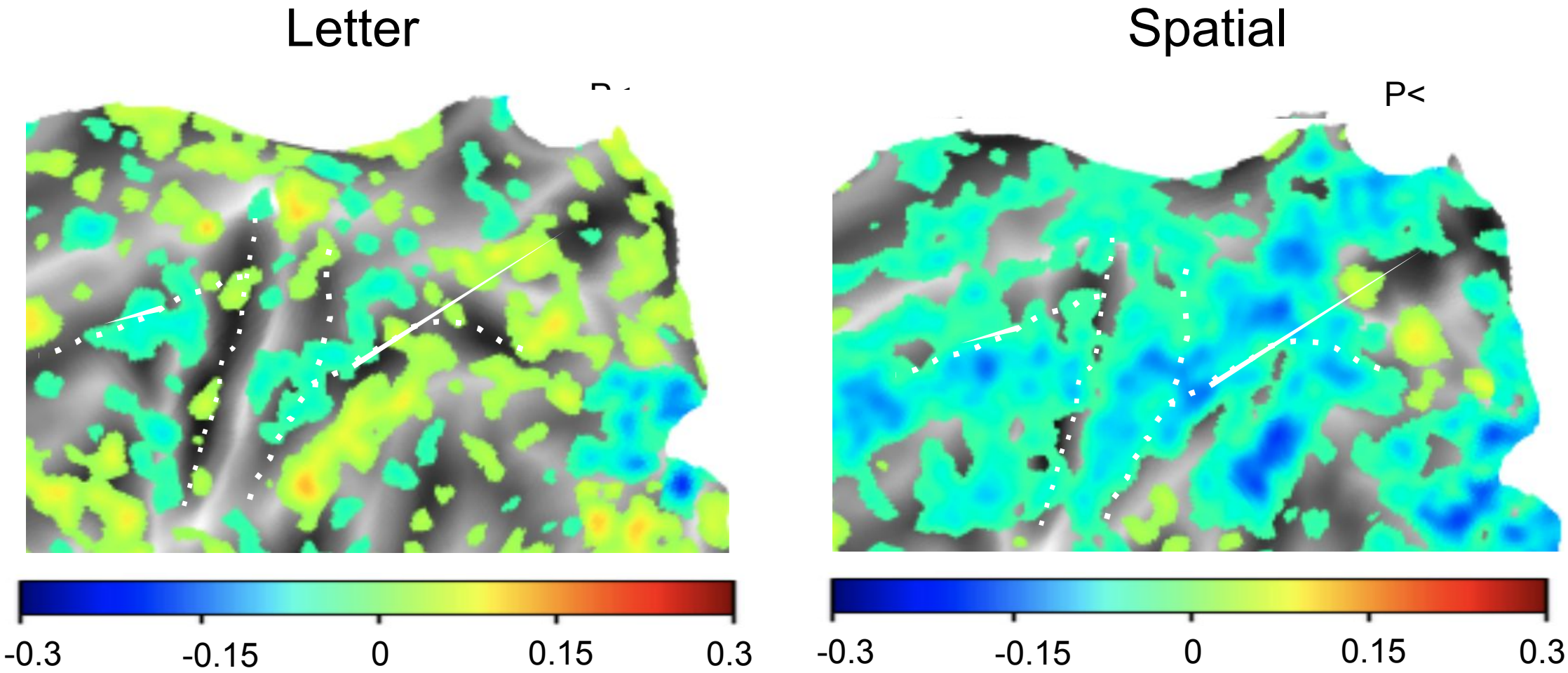
Percent signal change

-2

0

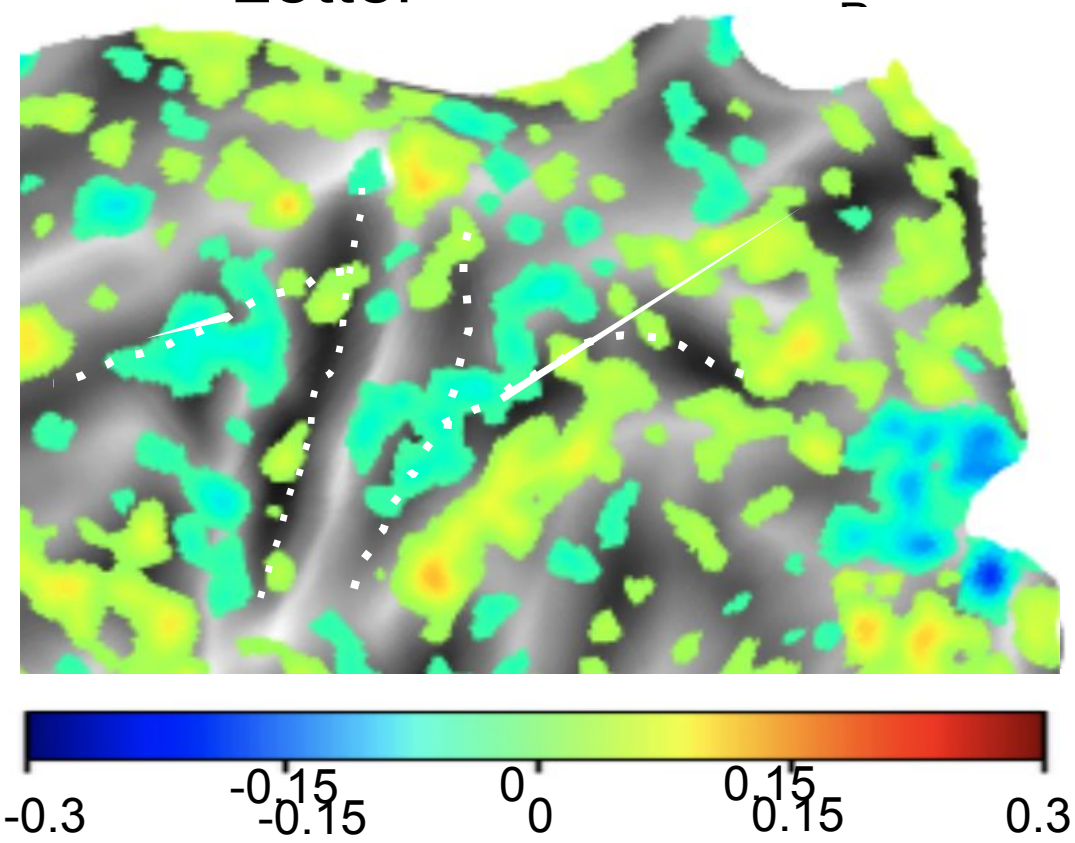
2

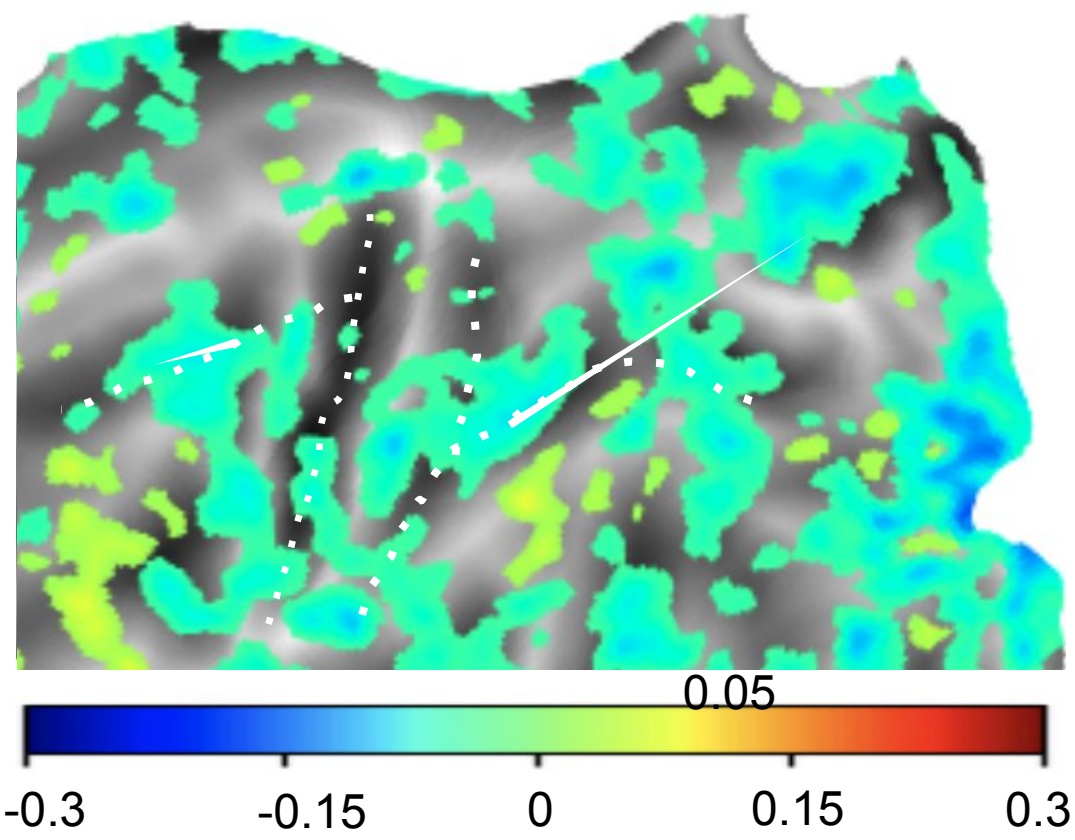
RS effects within cues



RS effects across cues

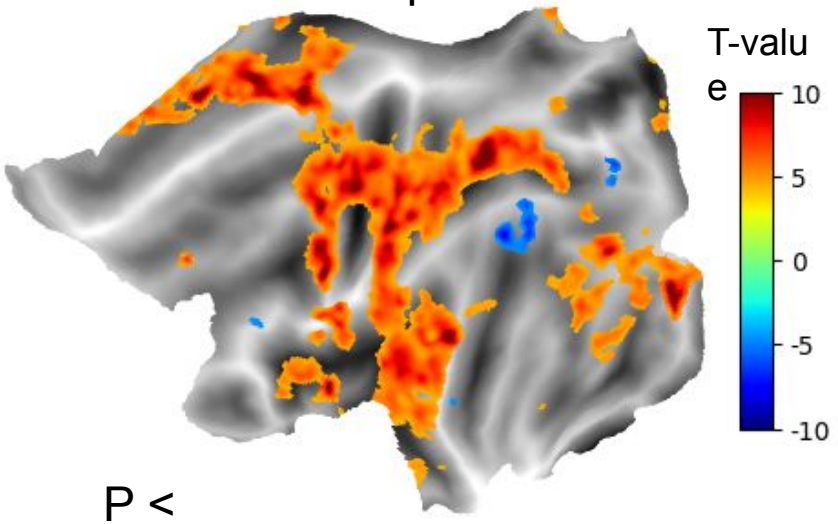
Visual ➡
Letter





Defining regions of interest (ROIs)

Task-related region using a separate data



P < 0.001

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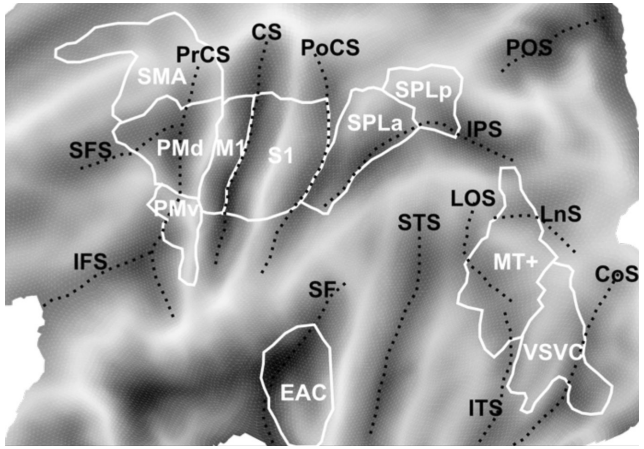
ROIs (Shahbazi et al., 2024)



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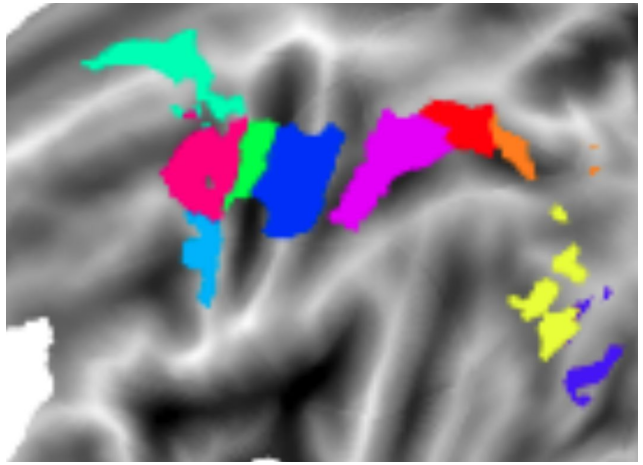
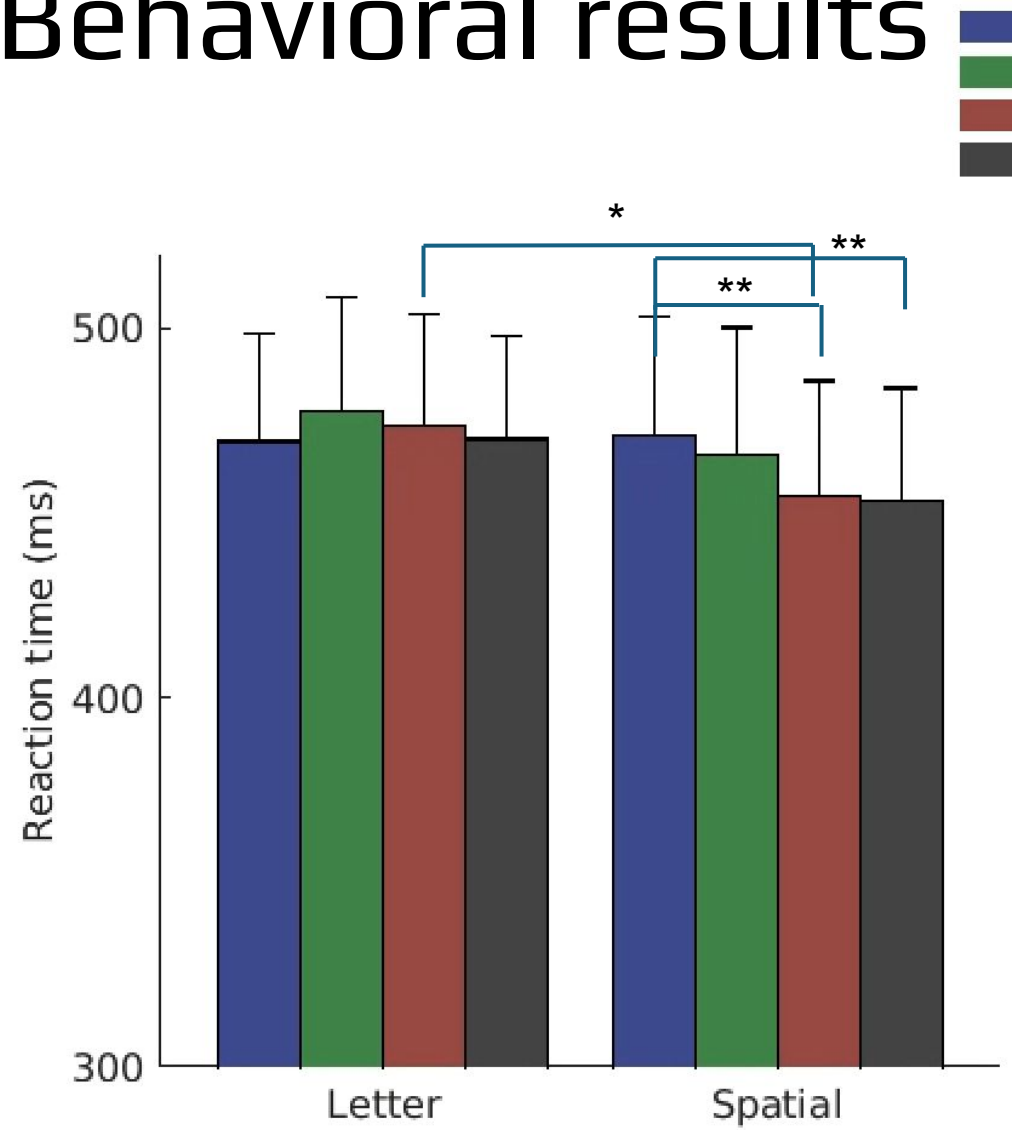
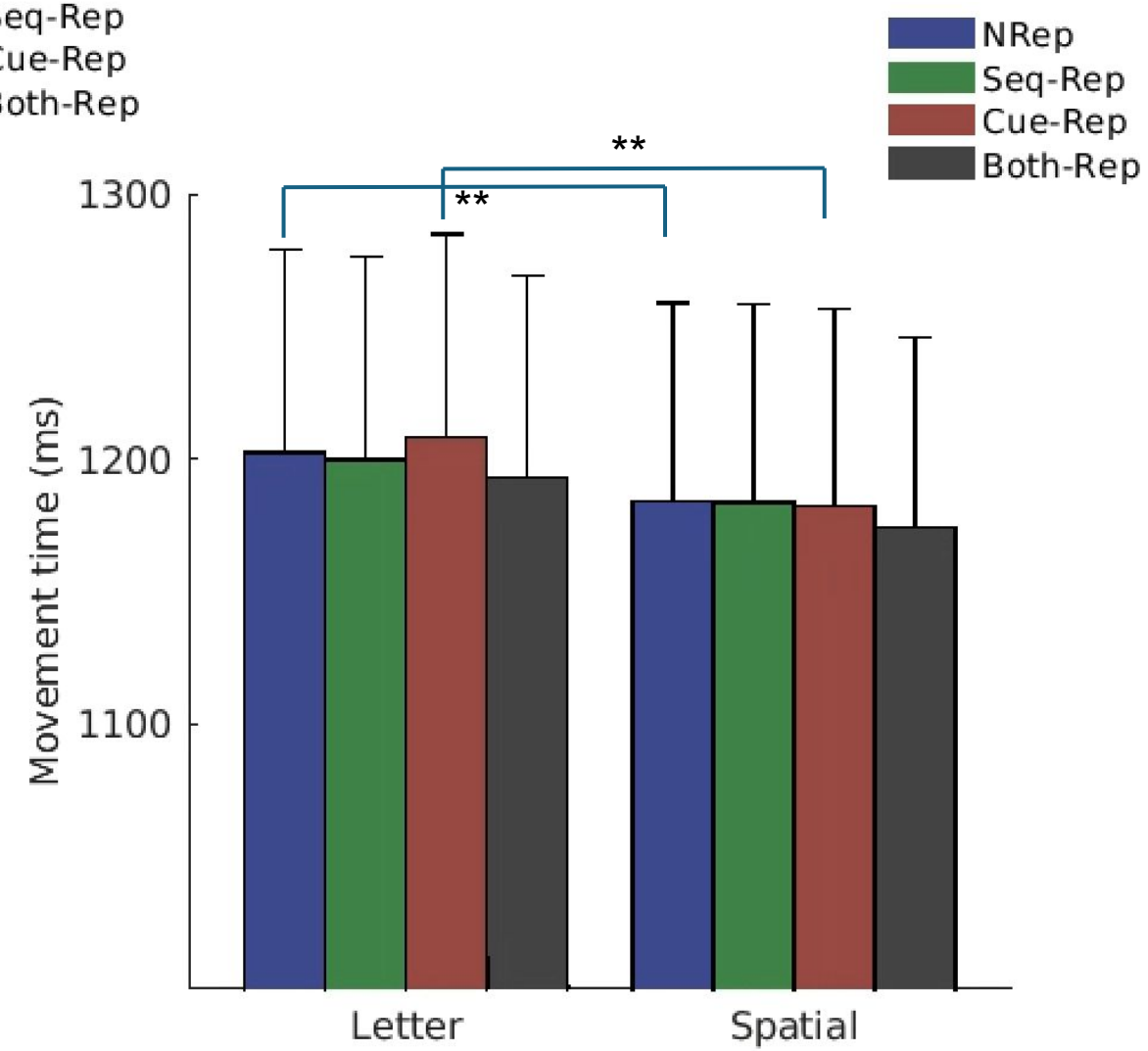
Final ROIs

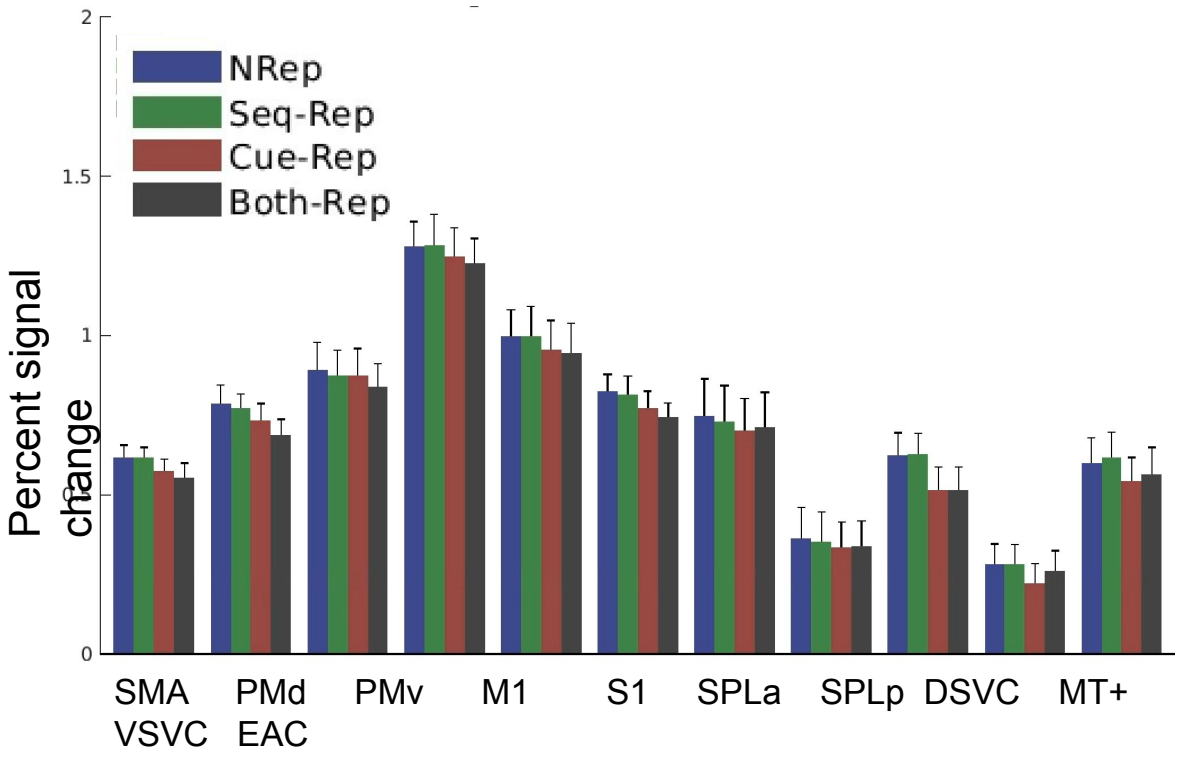


Behavioral results

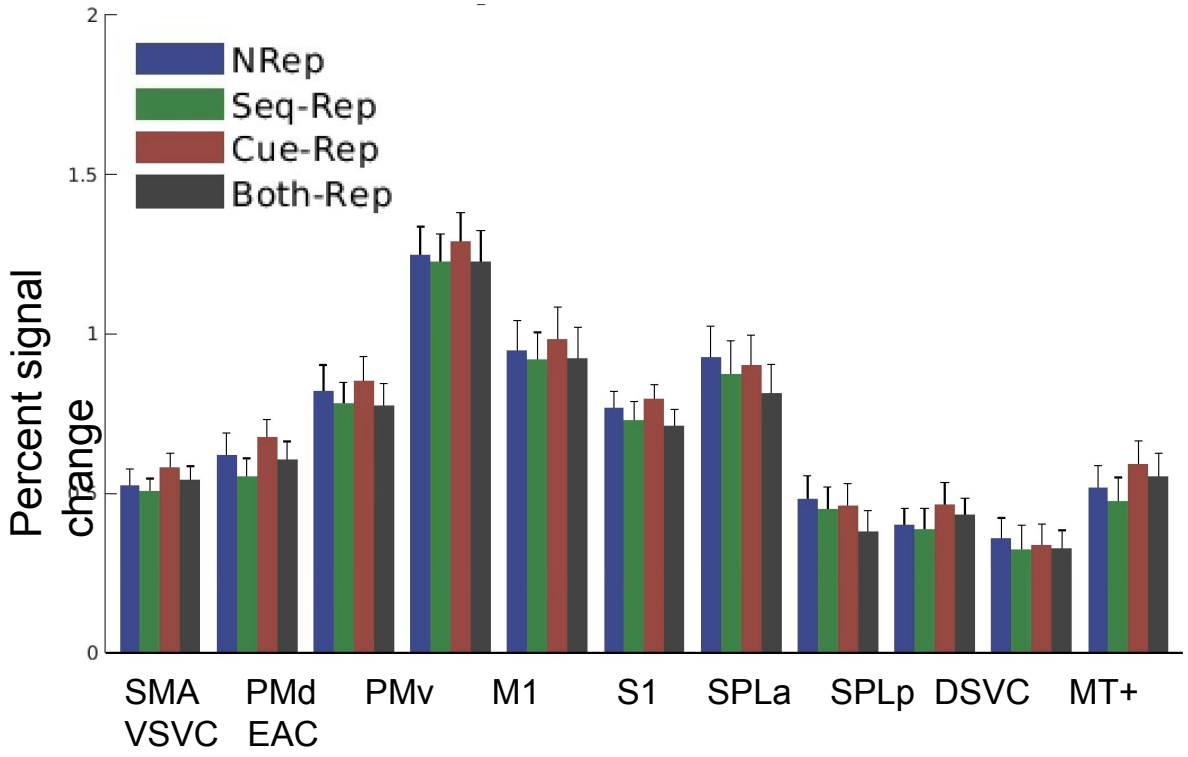




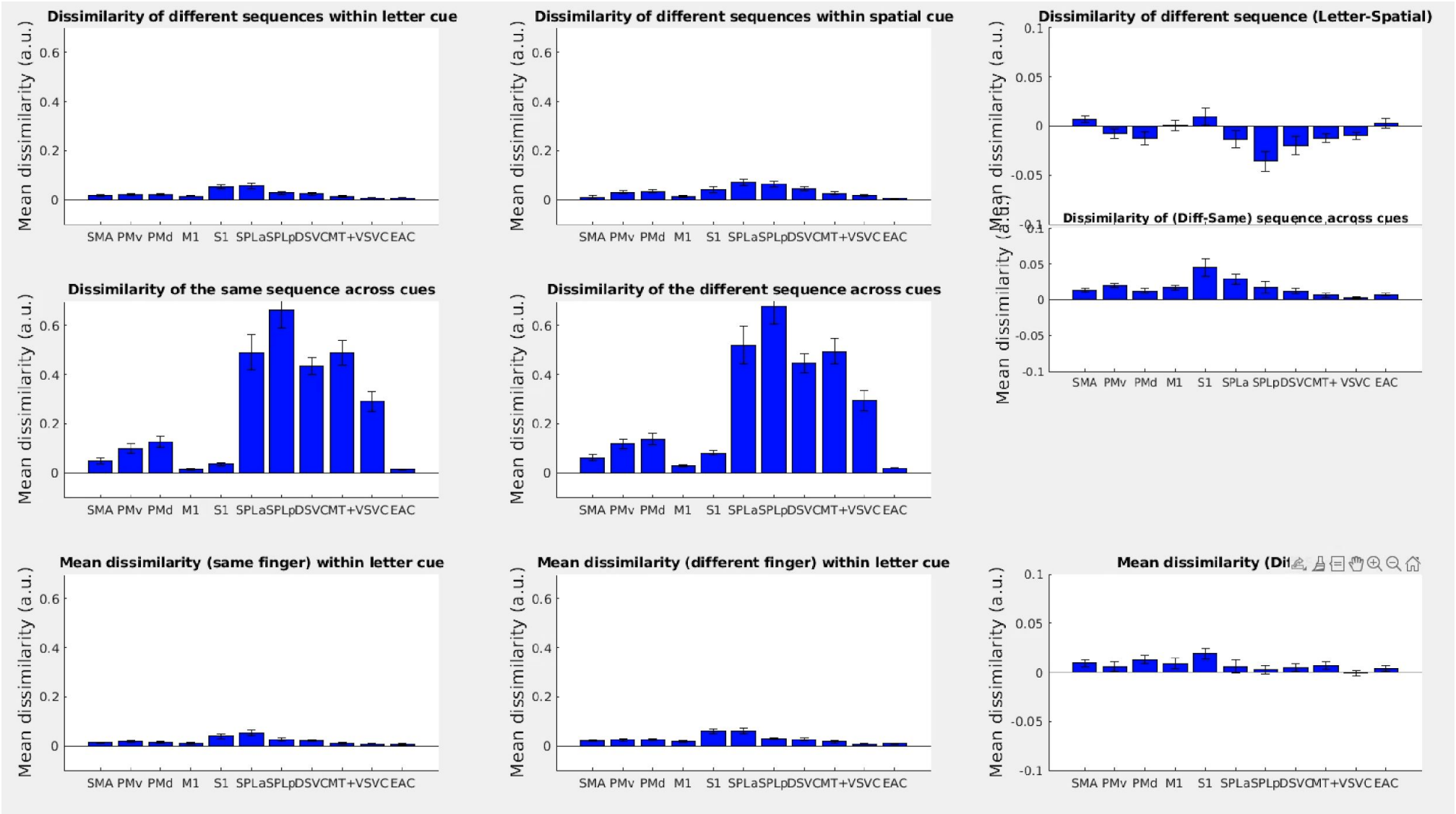
RS effects (Univariate analysis)



Spatial

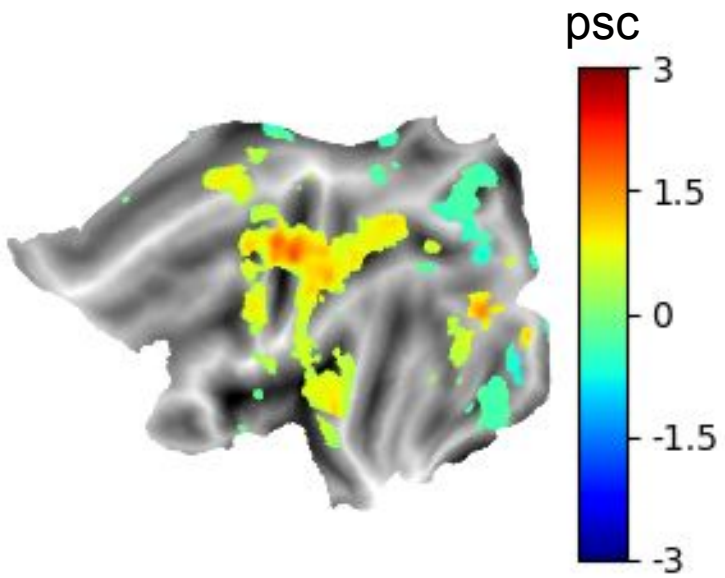


Multivariate: pattern dissimilarity



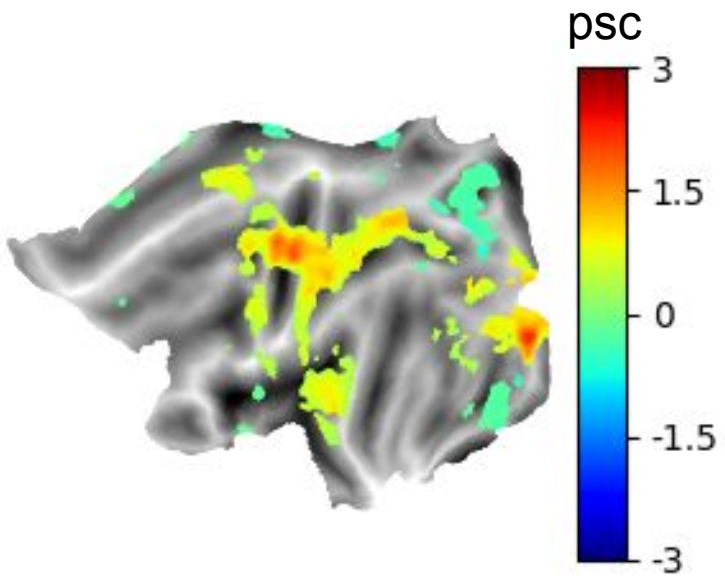
Task-related regions

Letter



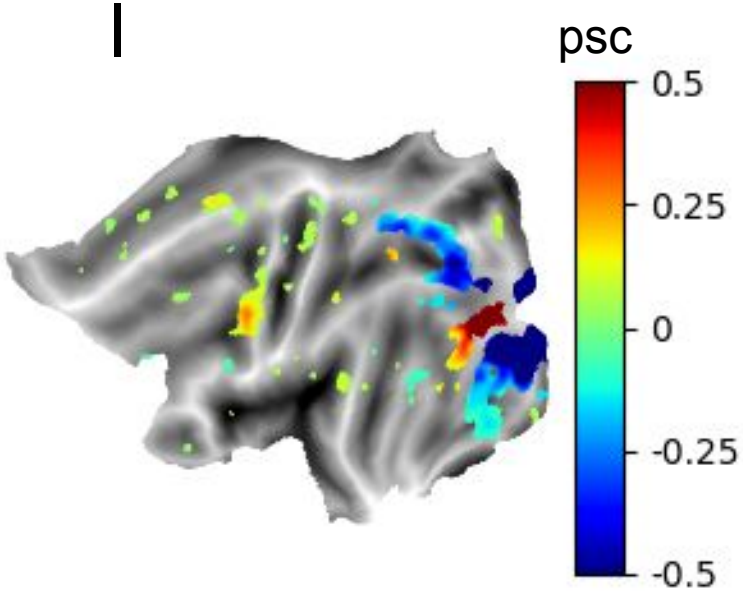
p < 0.001

Spatial



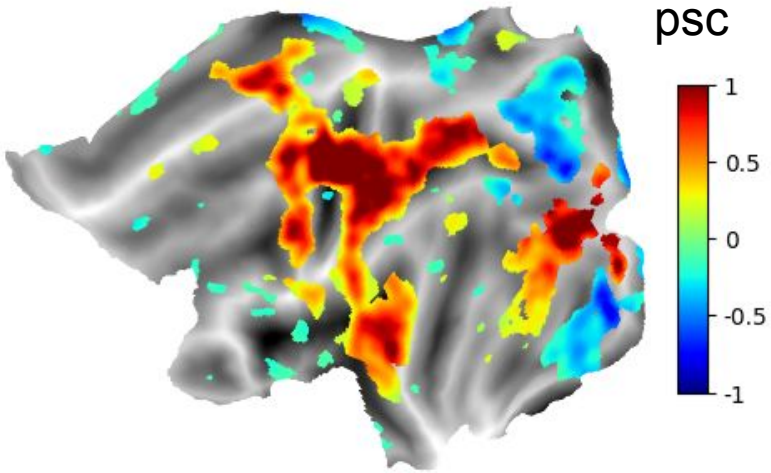
p < 0.001

Letter-Spatial



p < 0.01

Letter



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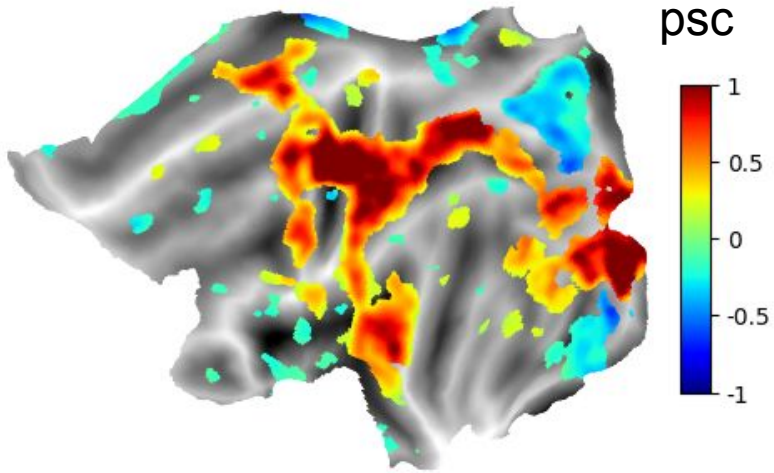

Letter-Spatia
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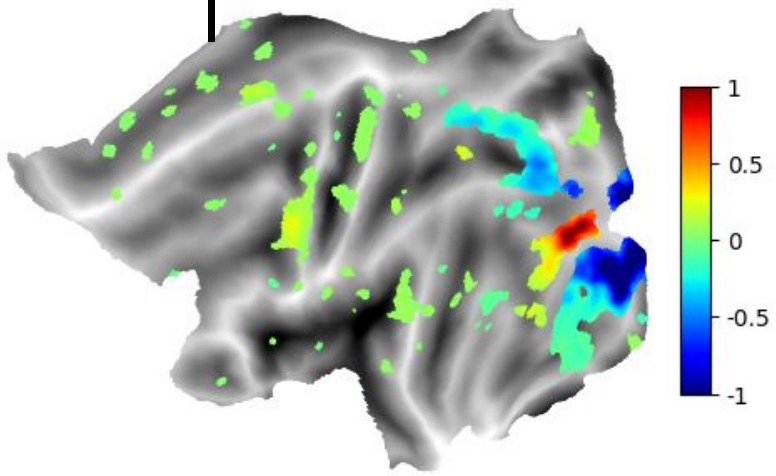
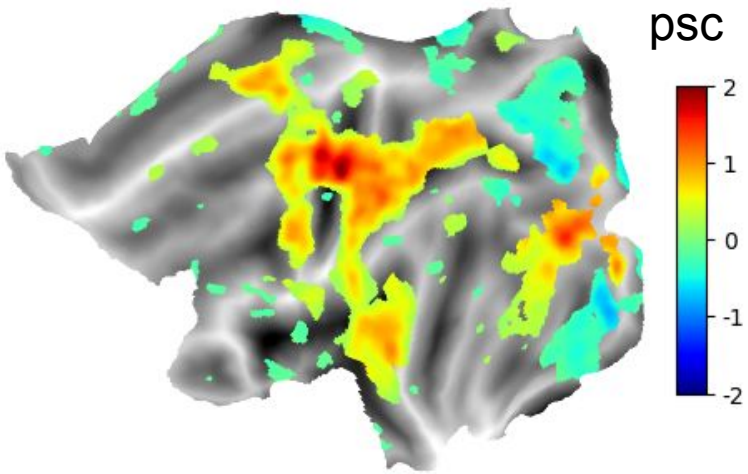


Task-related regions

Letter



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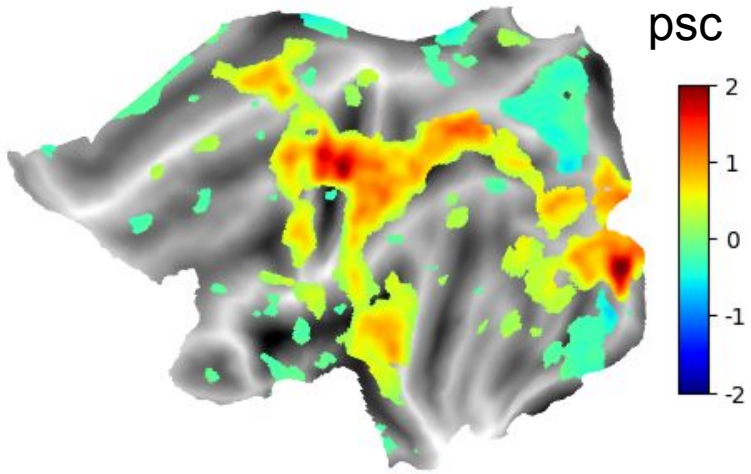

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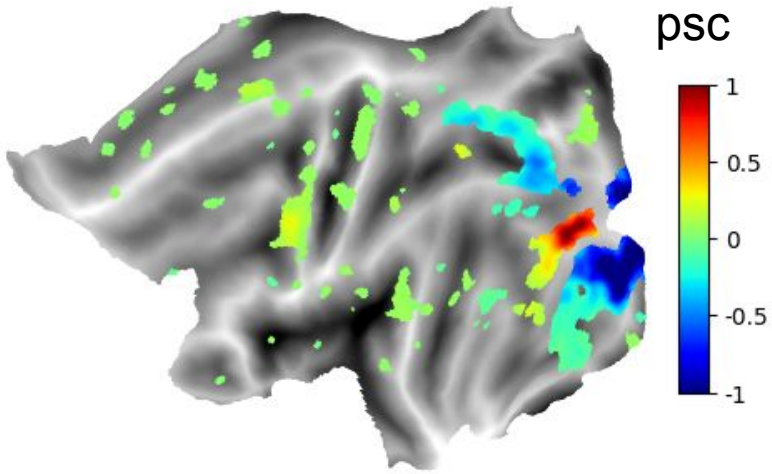

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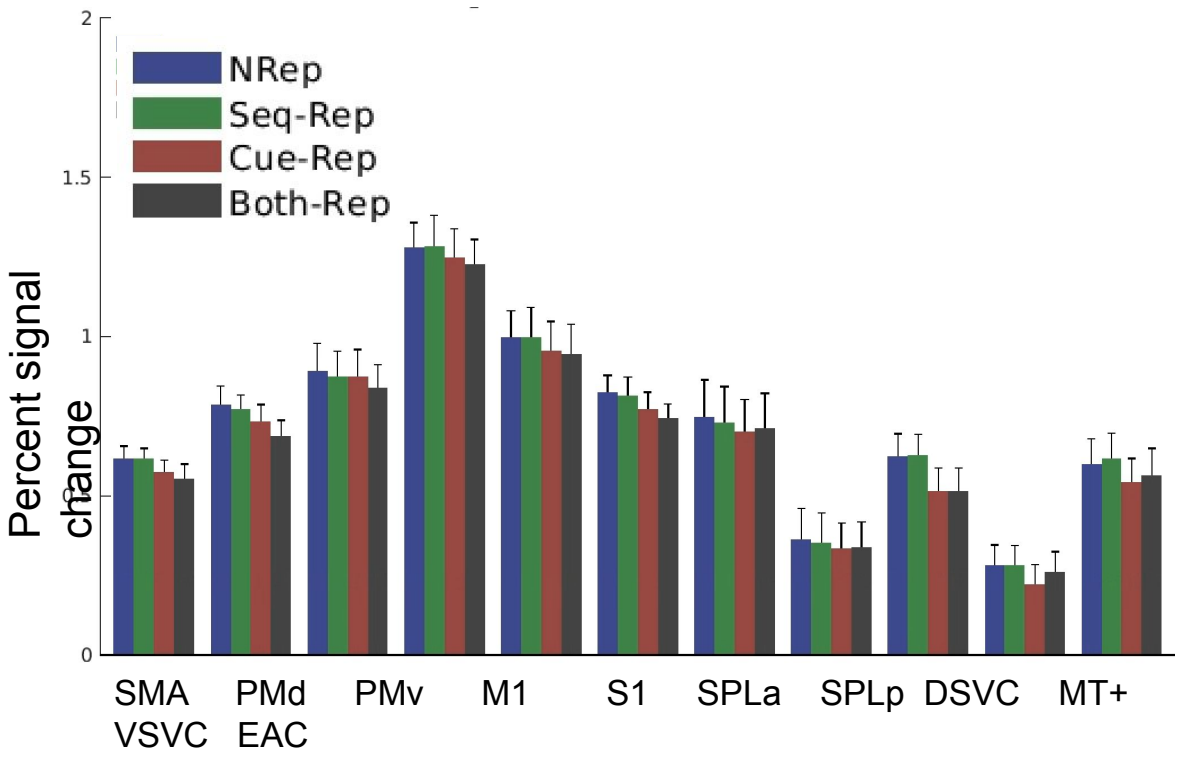

Spatial