National Institute of Mental Health

Light-independent pupillary fluctuations predict sensory perceptual sensitivity, MEG, and whole brain fMRI signals

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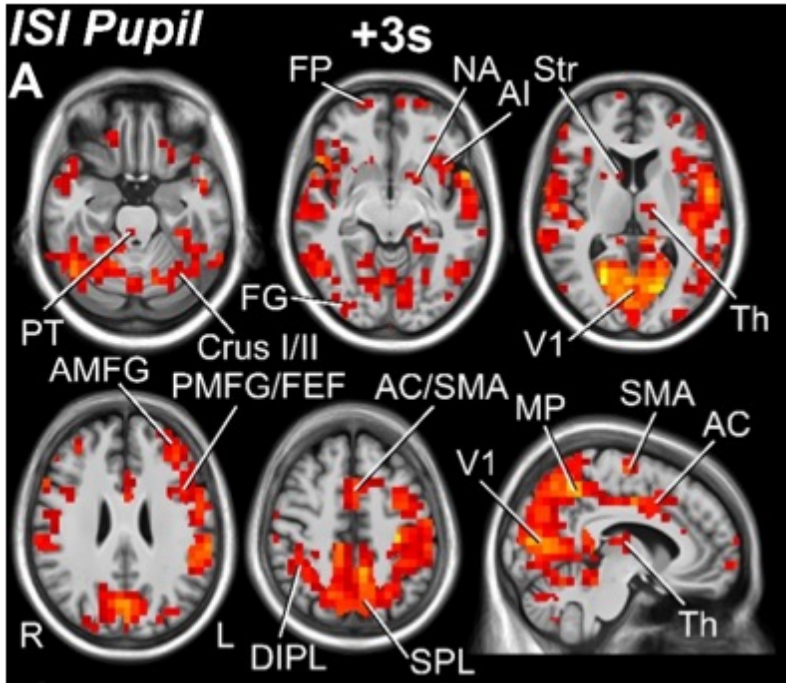
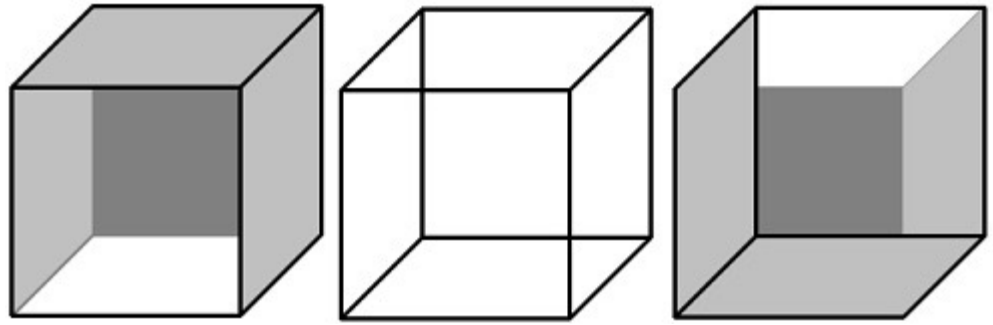
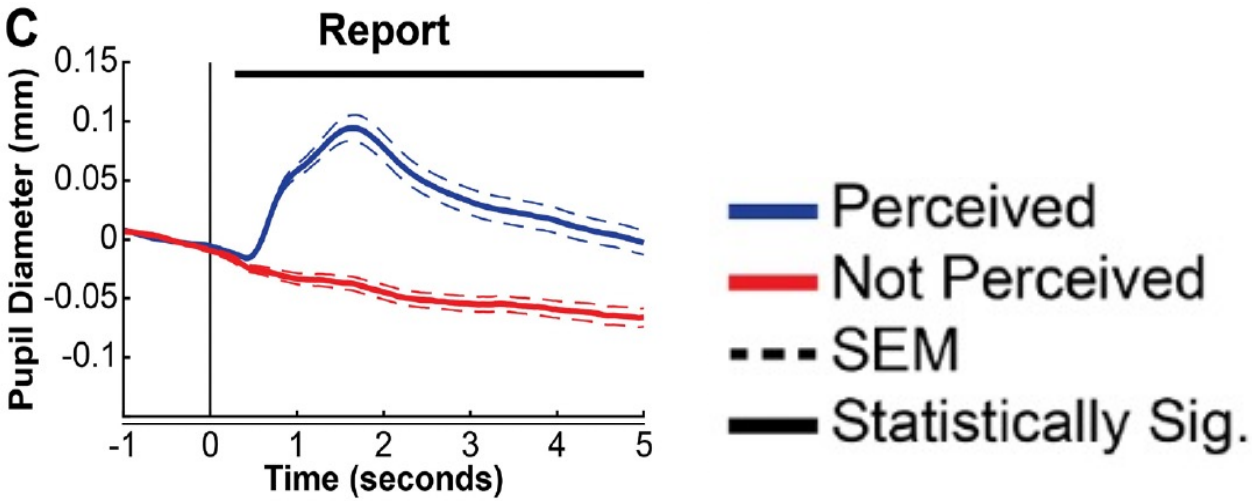
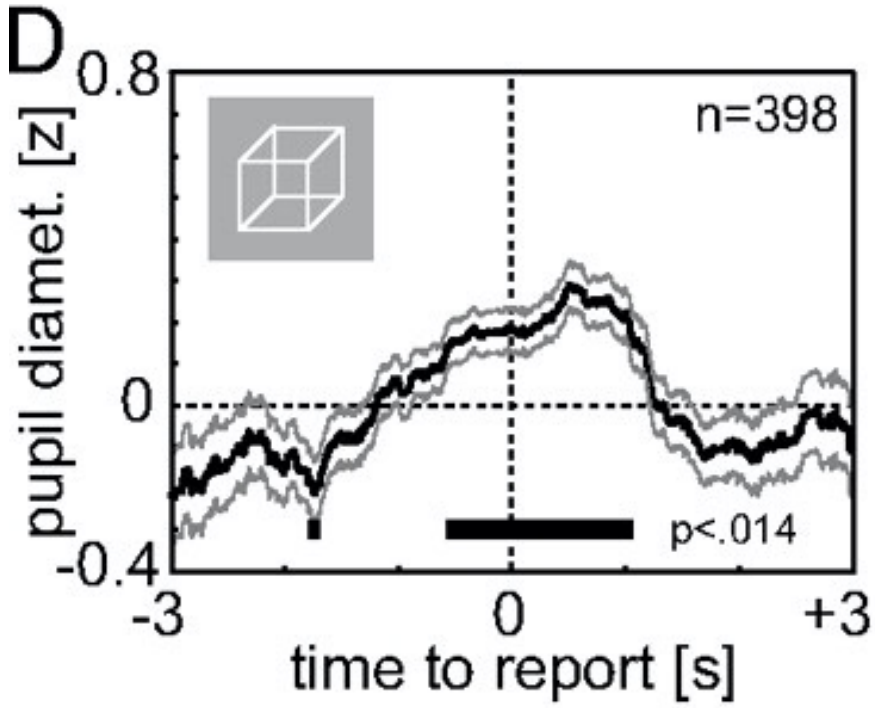


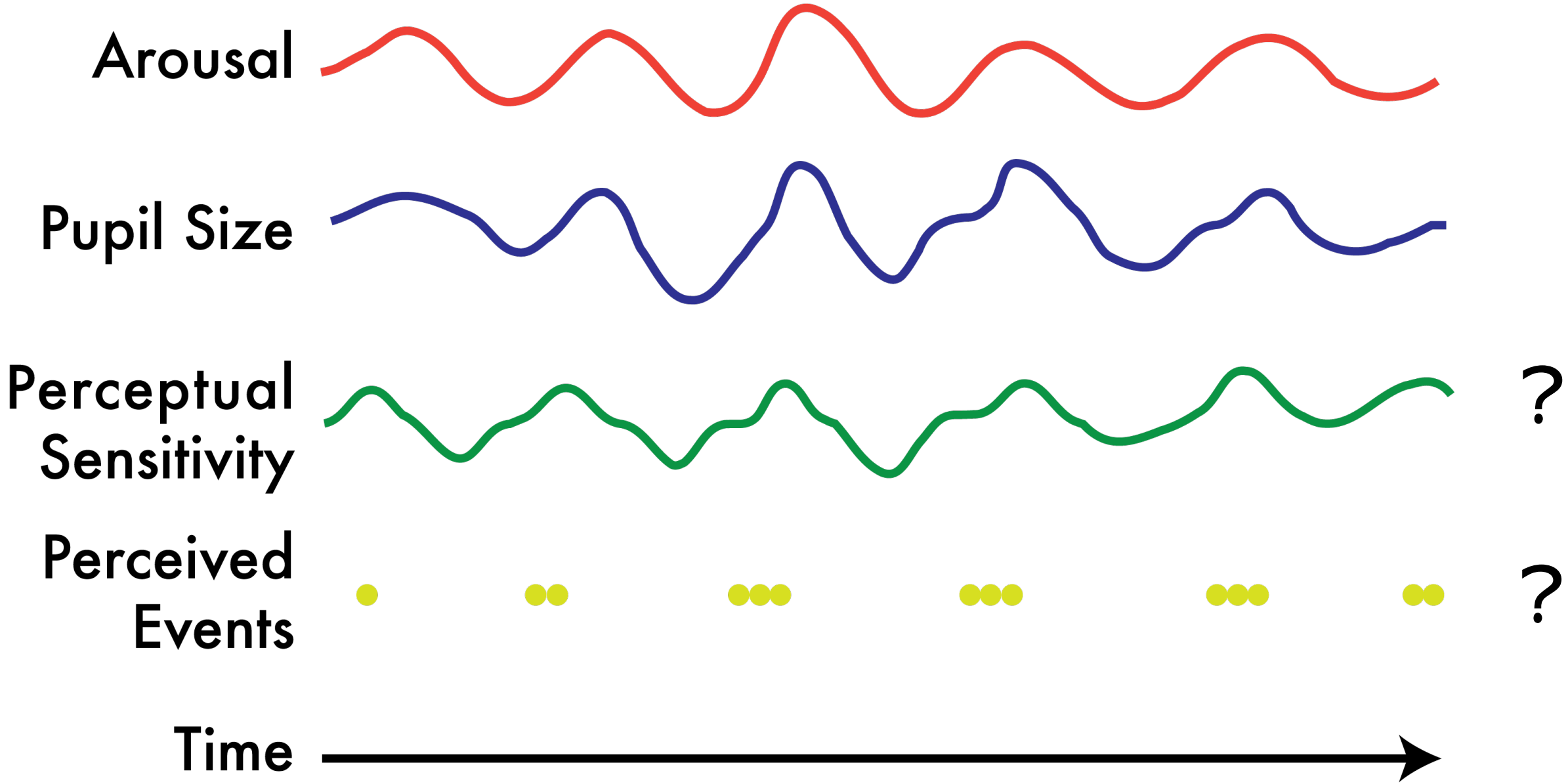






Kronemer, et al., Nature Communications, 2022

Einhauser, et al., PNAS, 2008


Arousal
Pupil Size
Perceptual Sensitivity
?
Perceived Events
?
Time

Can pupillary fluctuations predict changes in perceptual sensitivity, MEG and whole brain fMRI signals?

Pupil size as a real-time proxy to measure perceptual sensitivity/conscious perception.

Specific Aims

Aim 1: Conduct a visual/auditory perceptual task

Aim 2: Complete a MEG study with eyetracking

Aim 3: Complete a retrospective analysis of 7T resting state fMRI with eyetracking

Aims 1&2 Experimental Task

Auditory/Visual Perceptual Task (Aim 1)

+

Eye-tracking (Right eye) + *rtPupilPhase*

+

MEG (Aim 2)

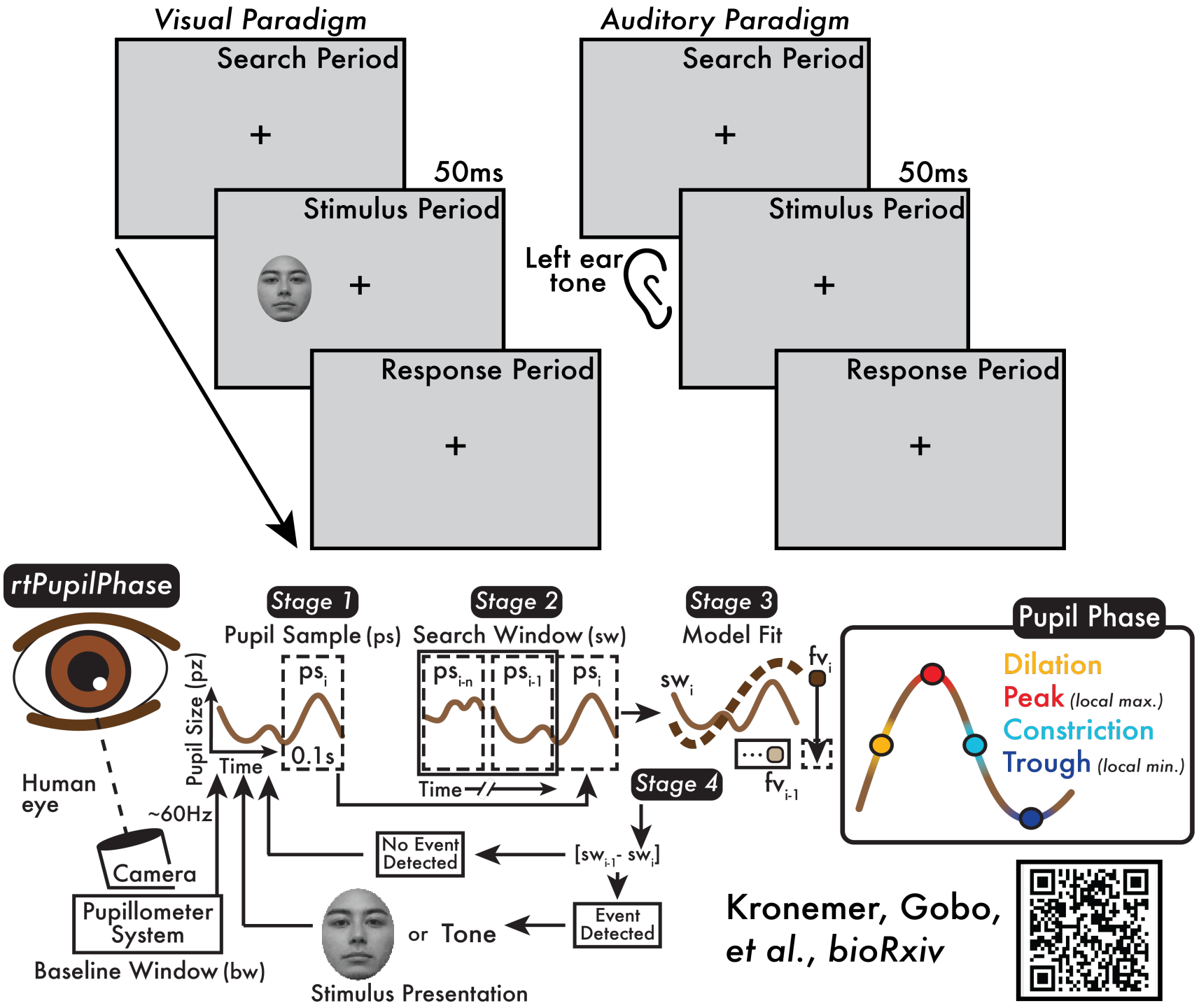
Aims 1&2 Experimental Task

Auditory:

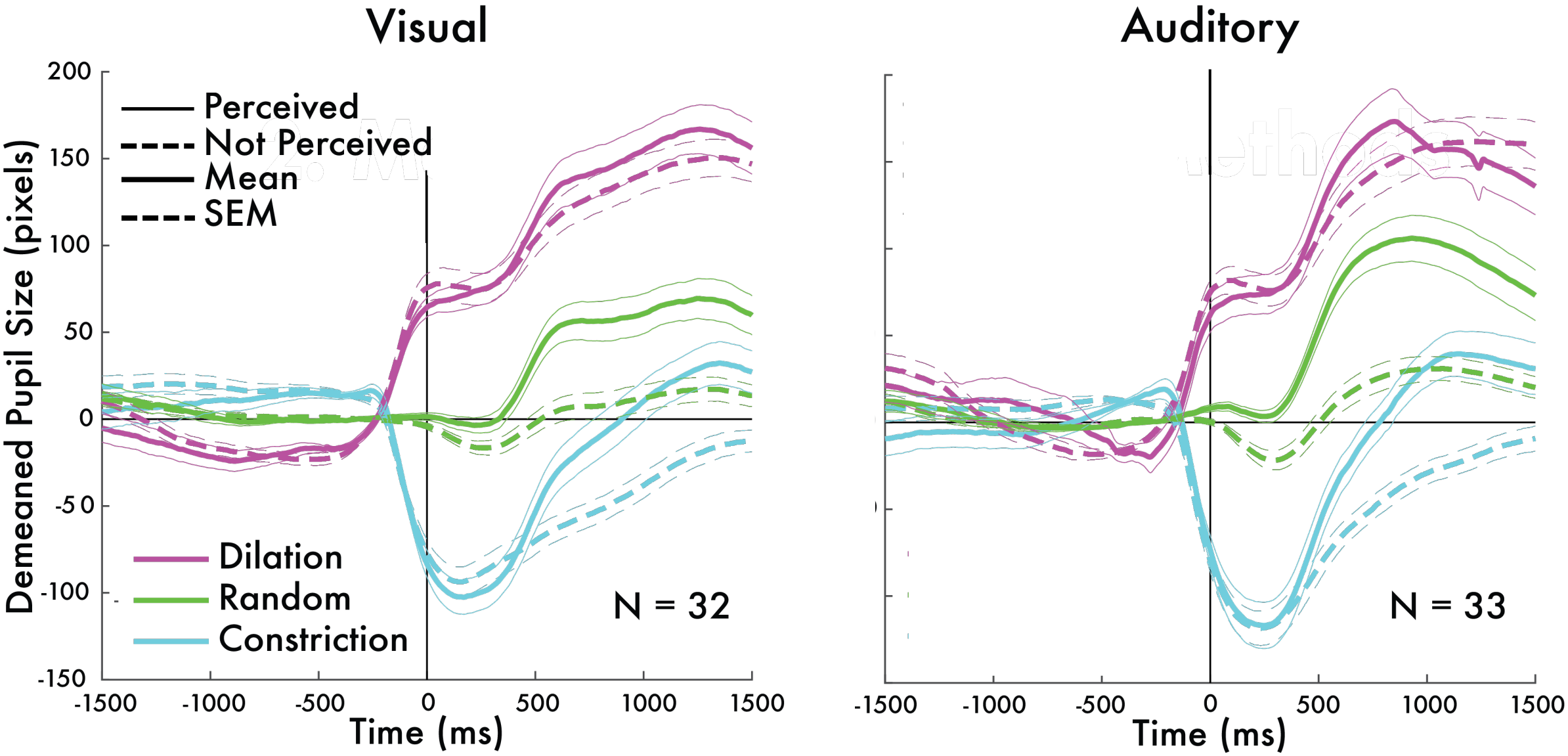
37 healthy adult participants; Male = 15;
Average age = 29.4

Visual:

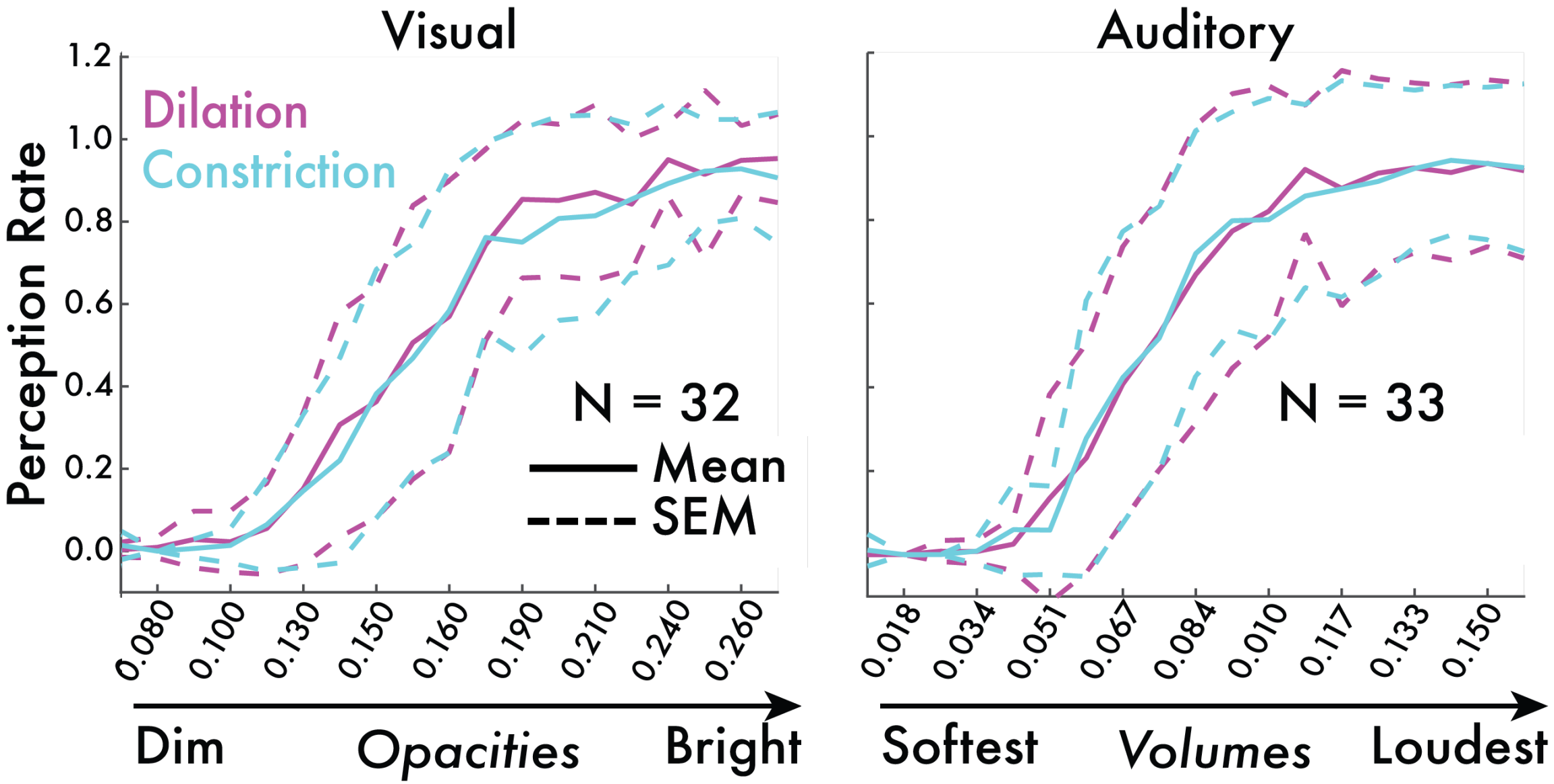
34 healthy adult participants; Male = 14;
Average age = 29.8:


Visual Paradigm
Search Period
+
50ms
Stimulus Period
+
Response Period
+
Auditory Paradigm
Search Period
+
50ms
Stimulus Period
Left ear tone
+
Response Period
+
rtPupilPhase
Stage 1
Pupil Sample (ps)
Stage 2
Search Window (sw)
Stage 3
Model Fit
Pupil Phase
Dilation
Peak (local max.)
Constriction
Trough (local min.)
Pupil Size (pz)
Time
0.1s
Human eye
~60Hz
Camera
Pupillometer System
Baseline Window (bw)
Stage 4
No Event Detected
Event Detected
or Tone
Stimulus Presentation
Kronemer, Gobo, et al., bioRxiv

Pupillary Timecourse



Psychometric Curves

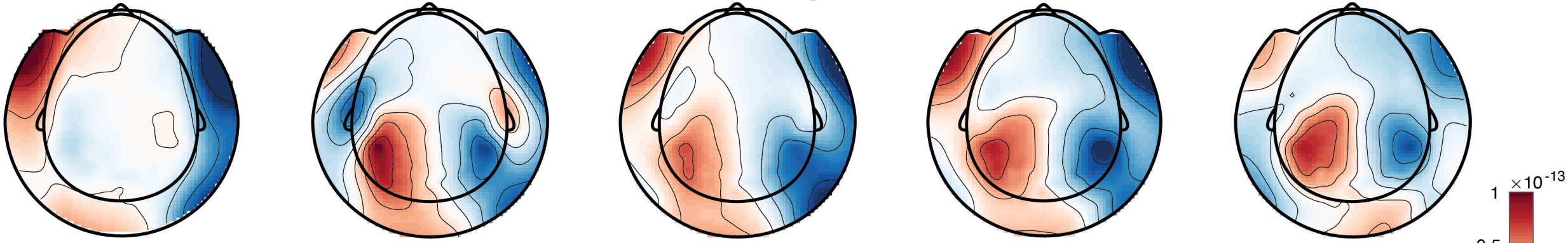


MEG Topoplots

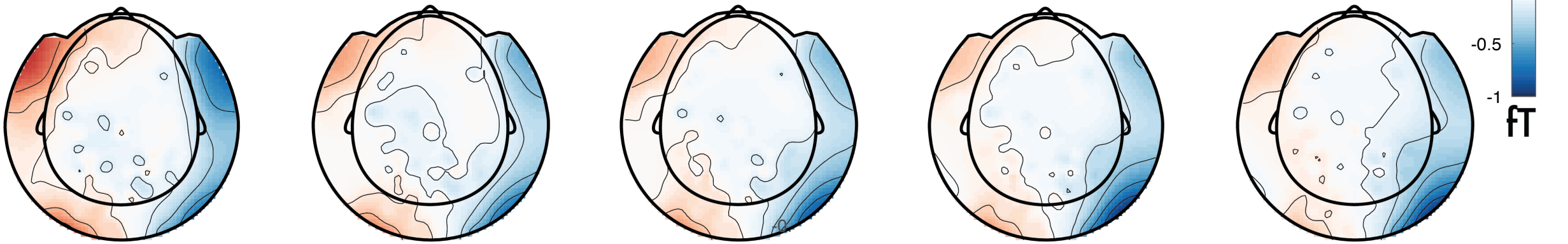
Perceived

Auditory

N = 24

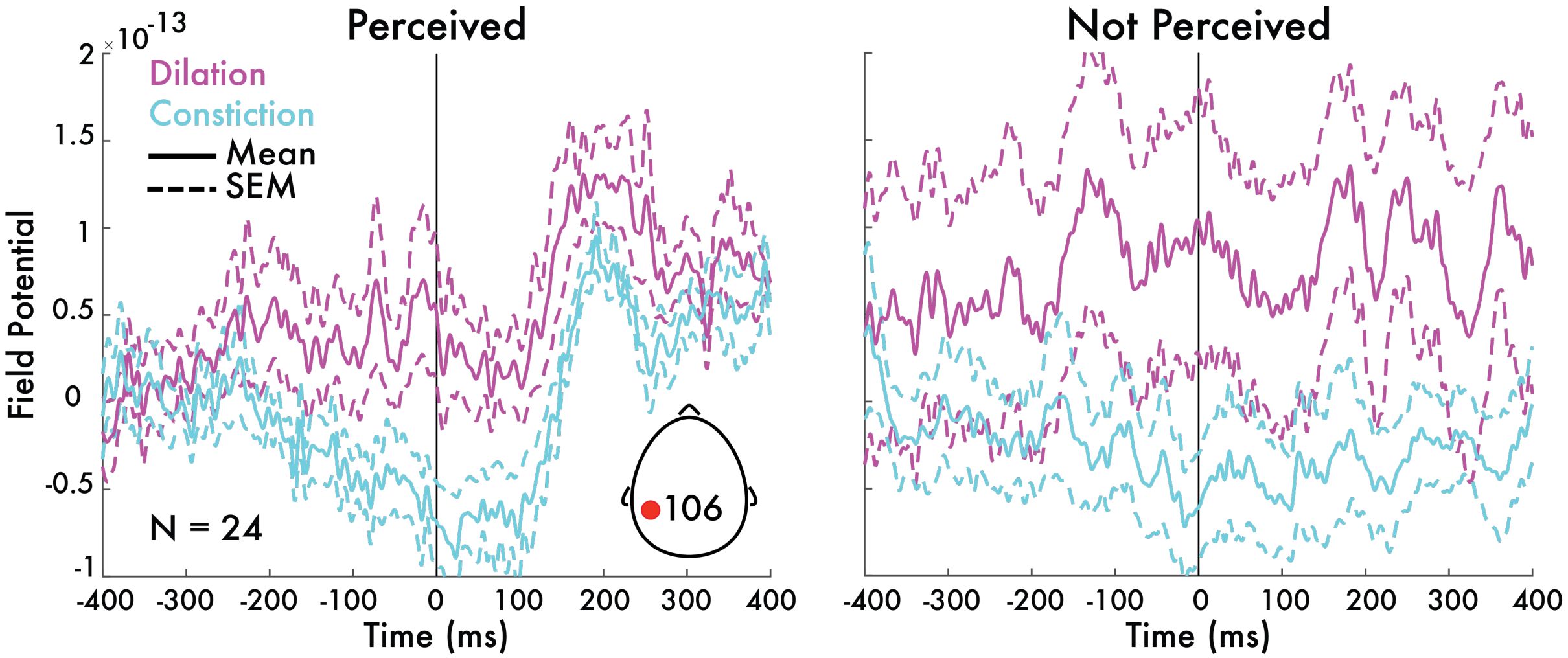


Not Perceived



0ms 100ms 200ms 300ms 400ms

MEG Field Potential Timecourses



Aims 3 Analysis

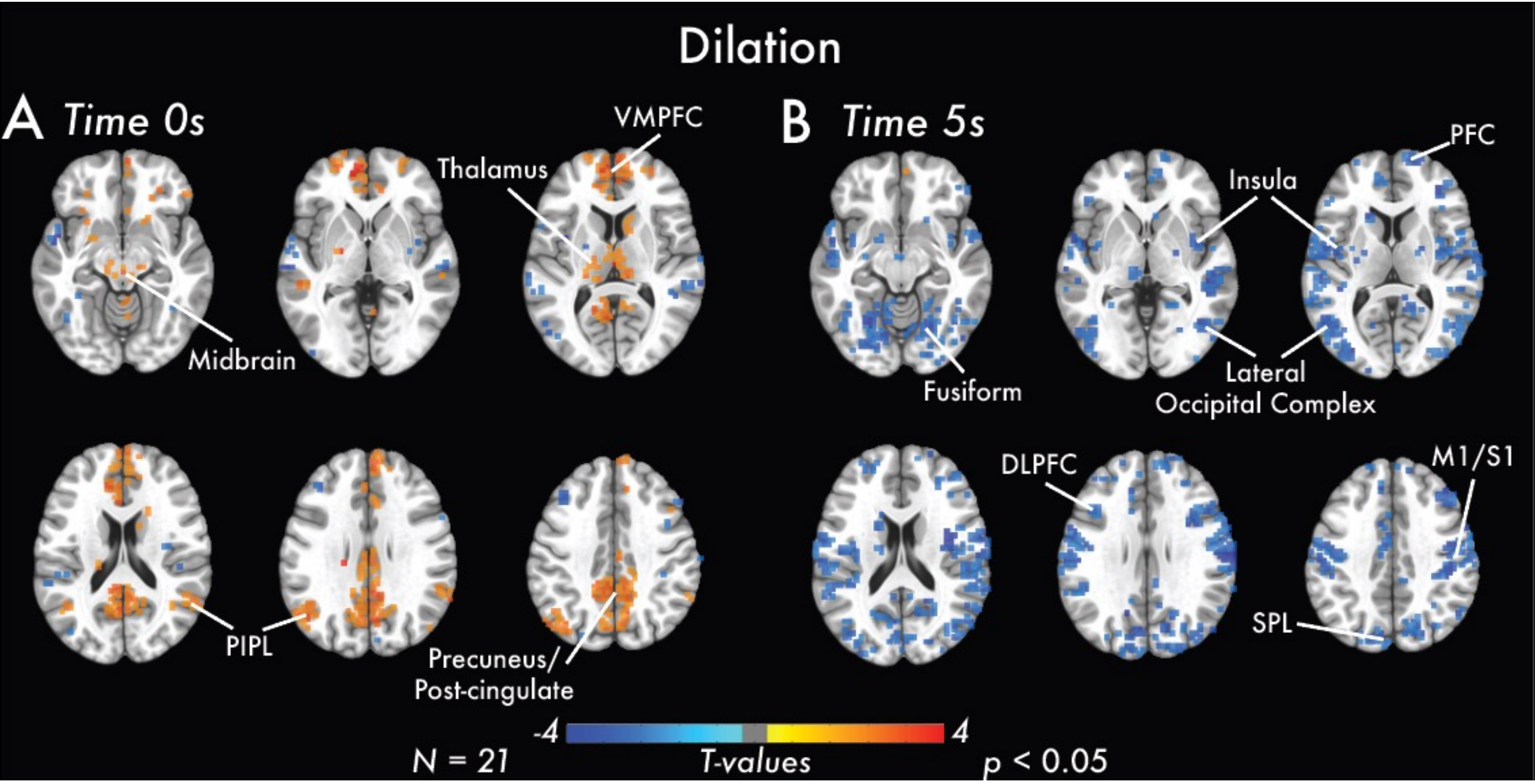
7T resting state HCP dataset

+

Eye-tracking

+

21 healthy adult participants


Dilation
A Time 0s
VMPFC
Thalamus
Midbrain
B Time 5s
PFC
Insula
Fusiform
Lateral
Occipital Complex
DLPFC
M1/S1
SPL
PIPL
Precuneus/
Post-cingulate
-4
4
T-values
N = 21
p < 0.05

Summary

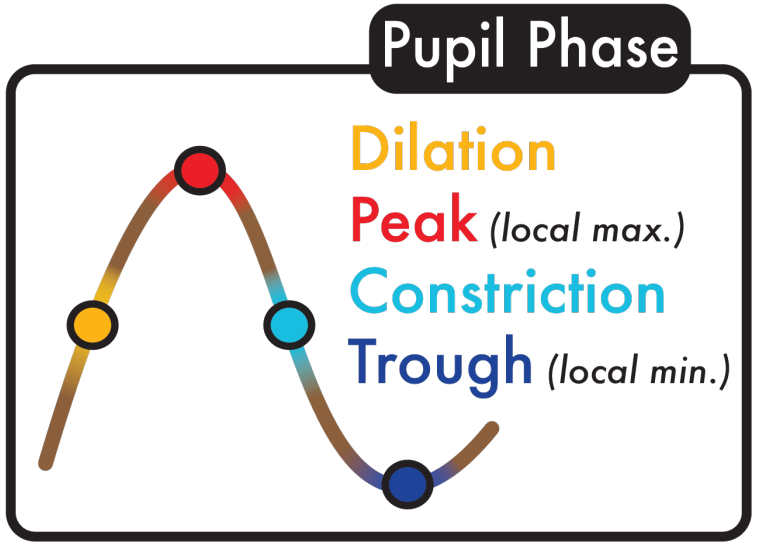
Aim 1: Pupil phase does not predict changes in perception rate

Aim 2: Perceived/not perceived and pupil phase events show differences in field potential

Aim 3: Pupil dilation is linked to widespread brain fMRI signal changes

Future Directions

- Pupil phase interactions in MEG
- Eye metric changes (saccades, blinks, microsaccades)
- Visual versus auditory MEG responses differences
- fMRI responses to other pupil phase events



Acknowledgements

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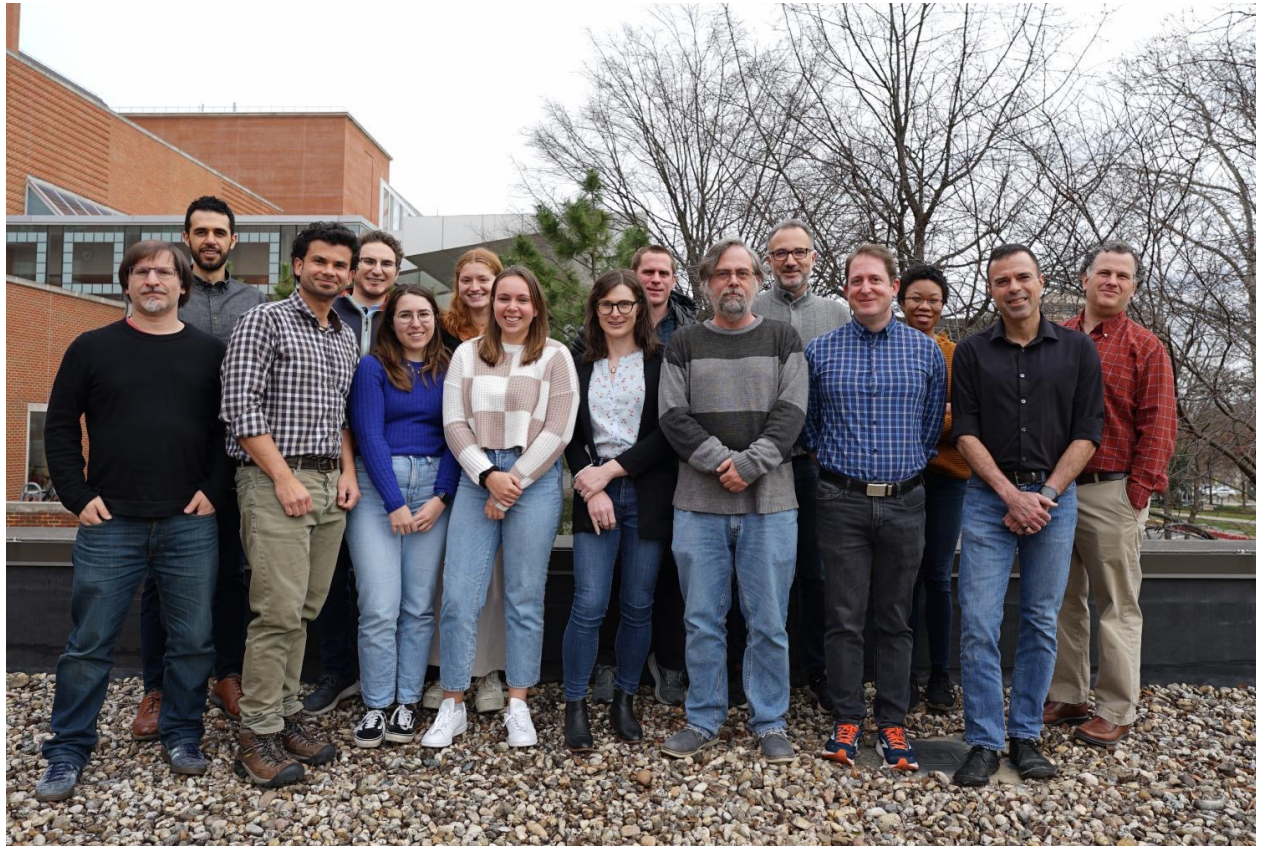

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Kronemer, Gobo, *et al., bioRxiv*

Questions?