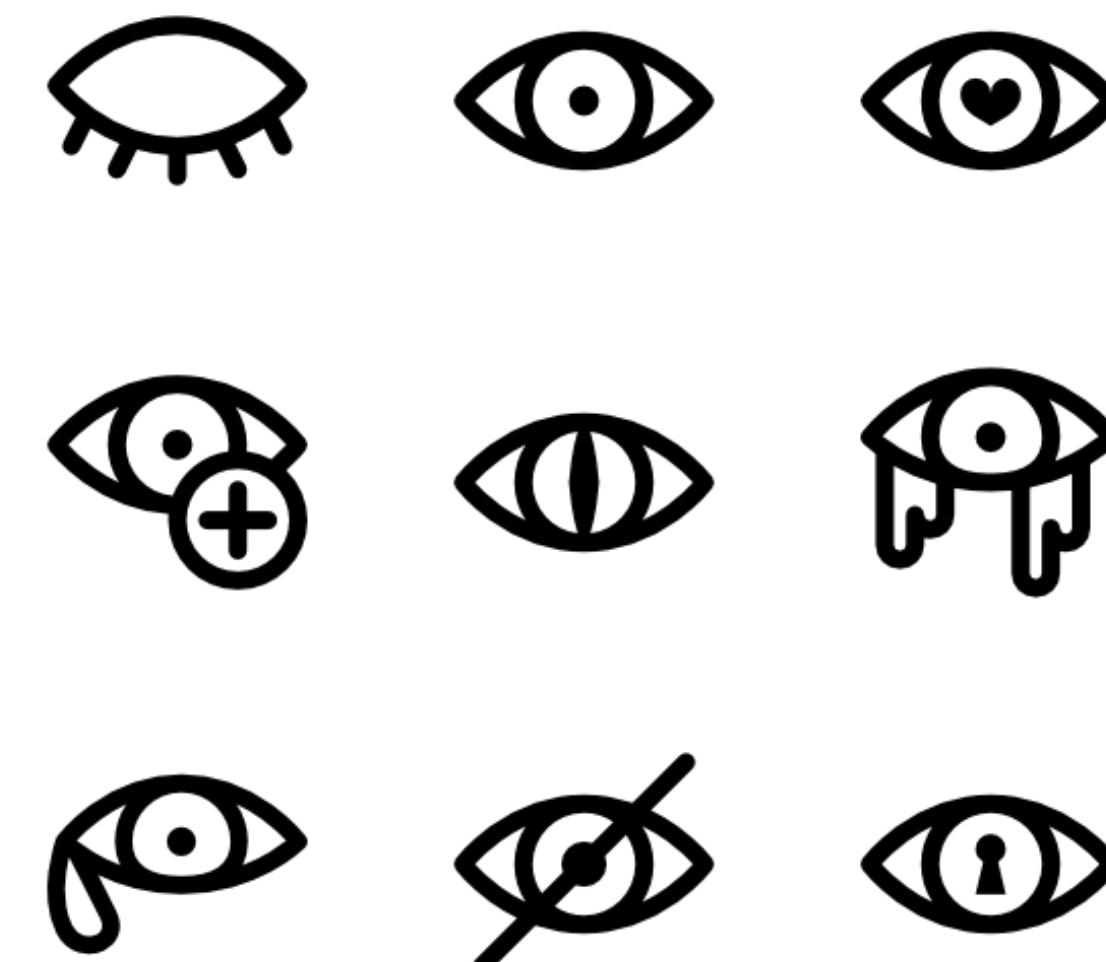


EPOS

Eyetracking

Course



start

Pupil



Pupil size fluctuations:

Used to determine brain state, or arousal-mediated brain responses.

Old topic, but novel angle; link between neurophysiology and pupil has been rediscovered.

How is pupil size behaviourally relevant?

Pupil

Pupil is the gate-keeper to the light input to the retina

Pupil constrictions prevent damage to the eye

Pupil dilations are necessary to see in the dark

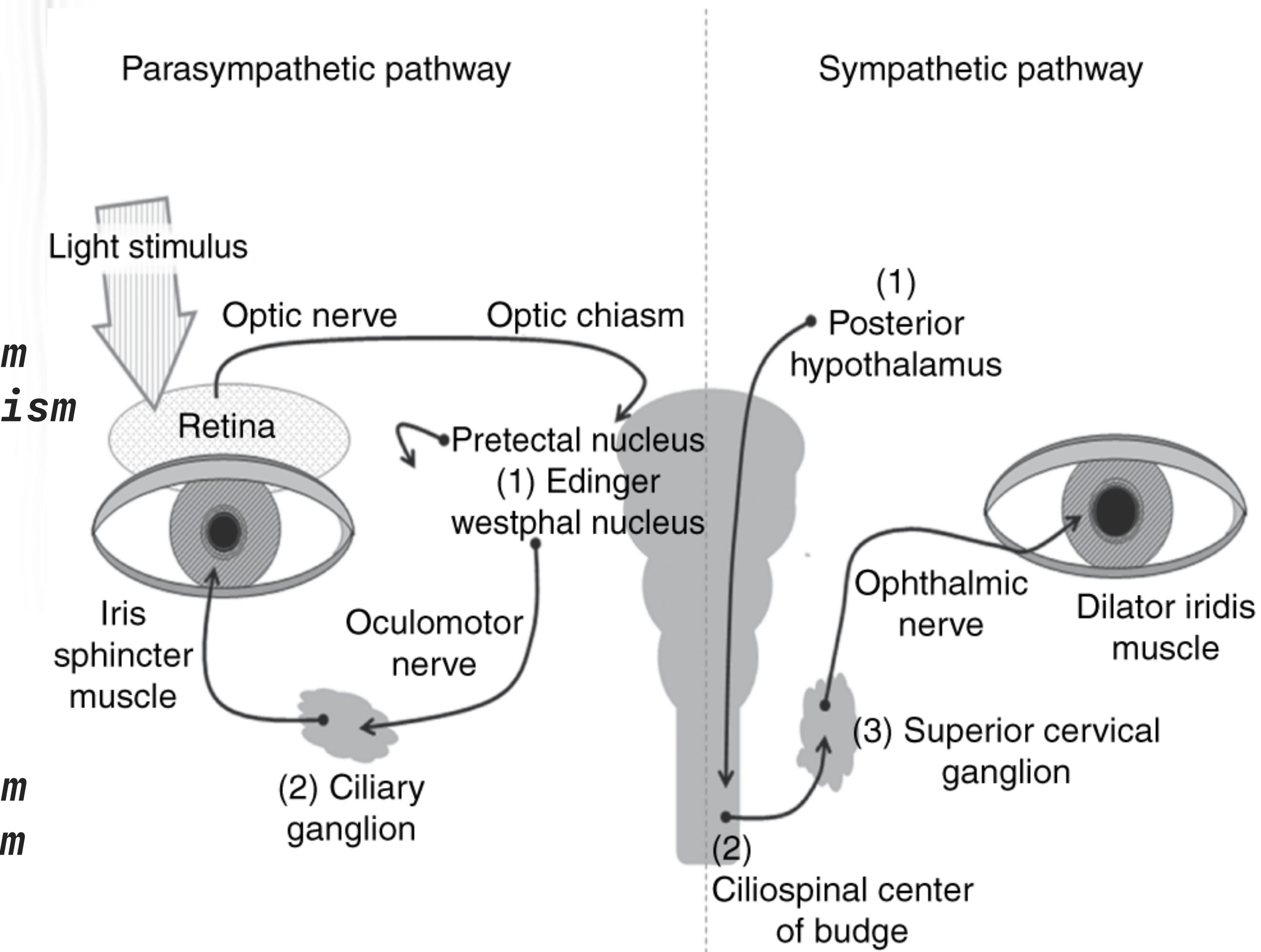
Dilation and Constriction

Constriction:

1. **Miosis**
2. **Acetylcholine agonism**
Noradrenergic antagonism
3. **Parasympathetic**

Dilation:

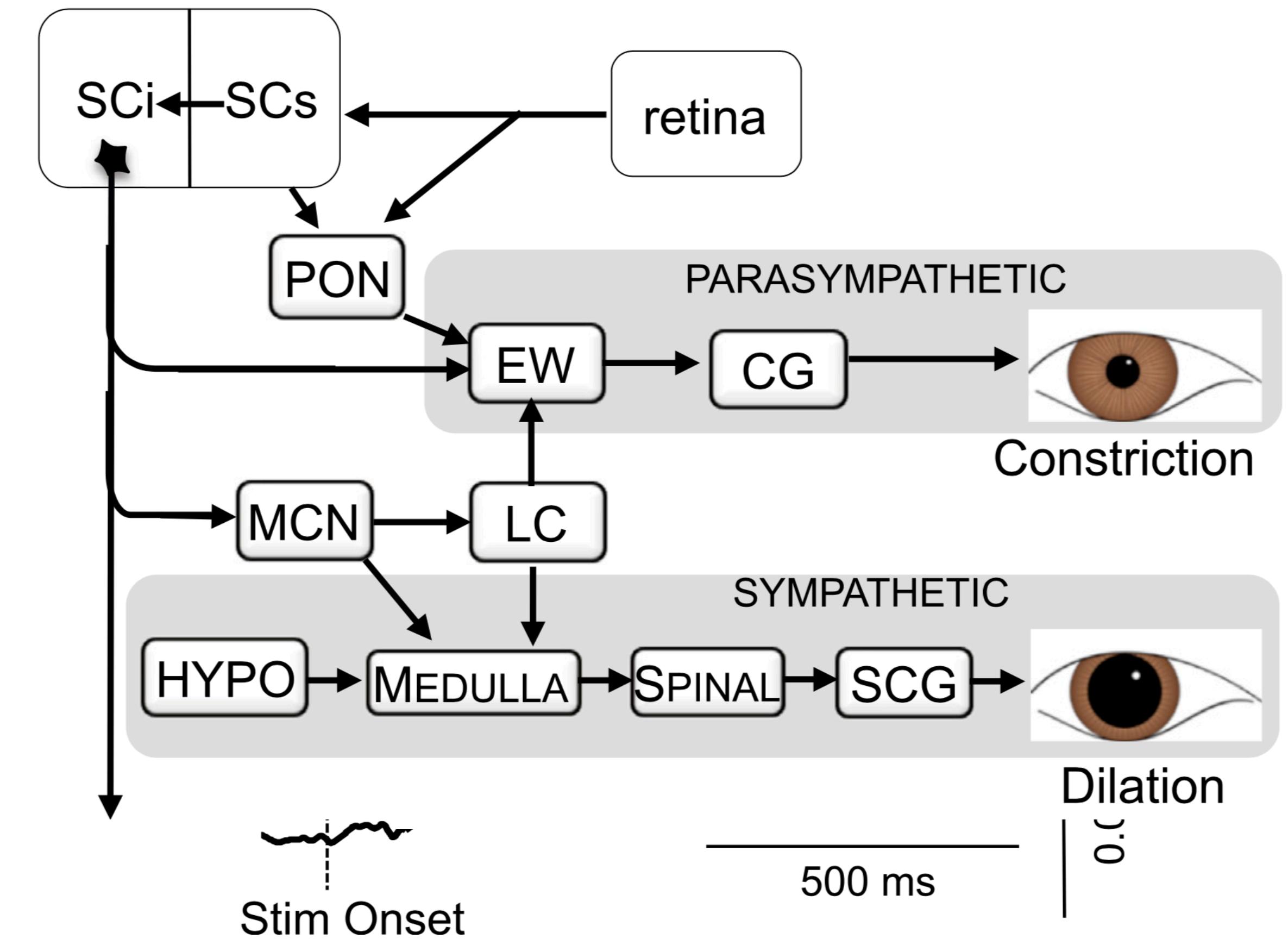
1. **Mydriasis**
2. **Noradrenaline agonism**
Cholinergic antagonism
3. **Sympathetic**



Orienting responses and Pupil

**Surprise, surprise:
Superior Colliculus
plays a role in pupil
constrictions**

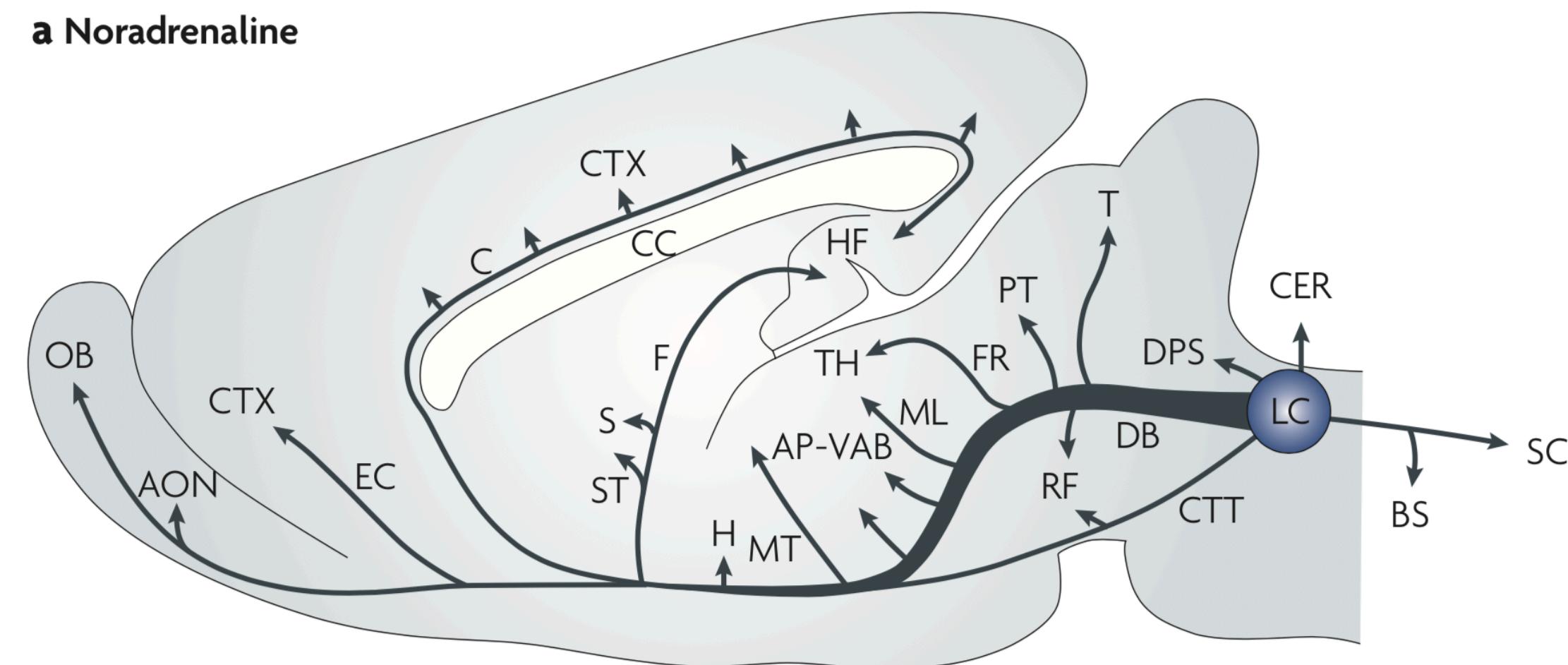
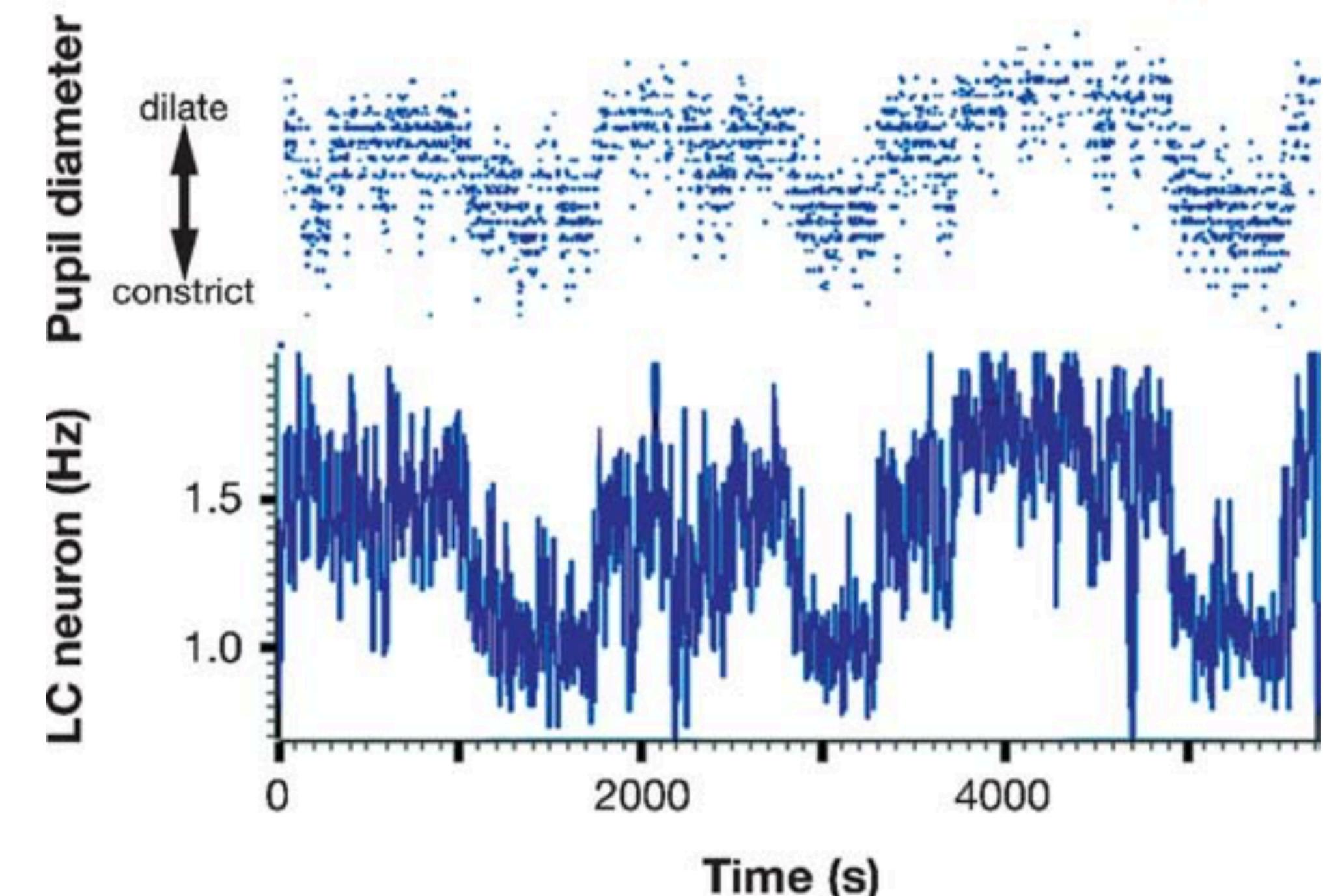
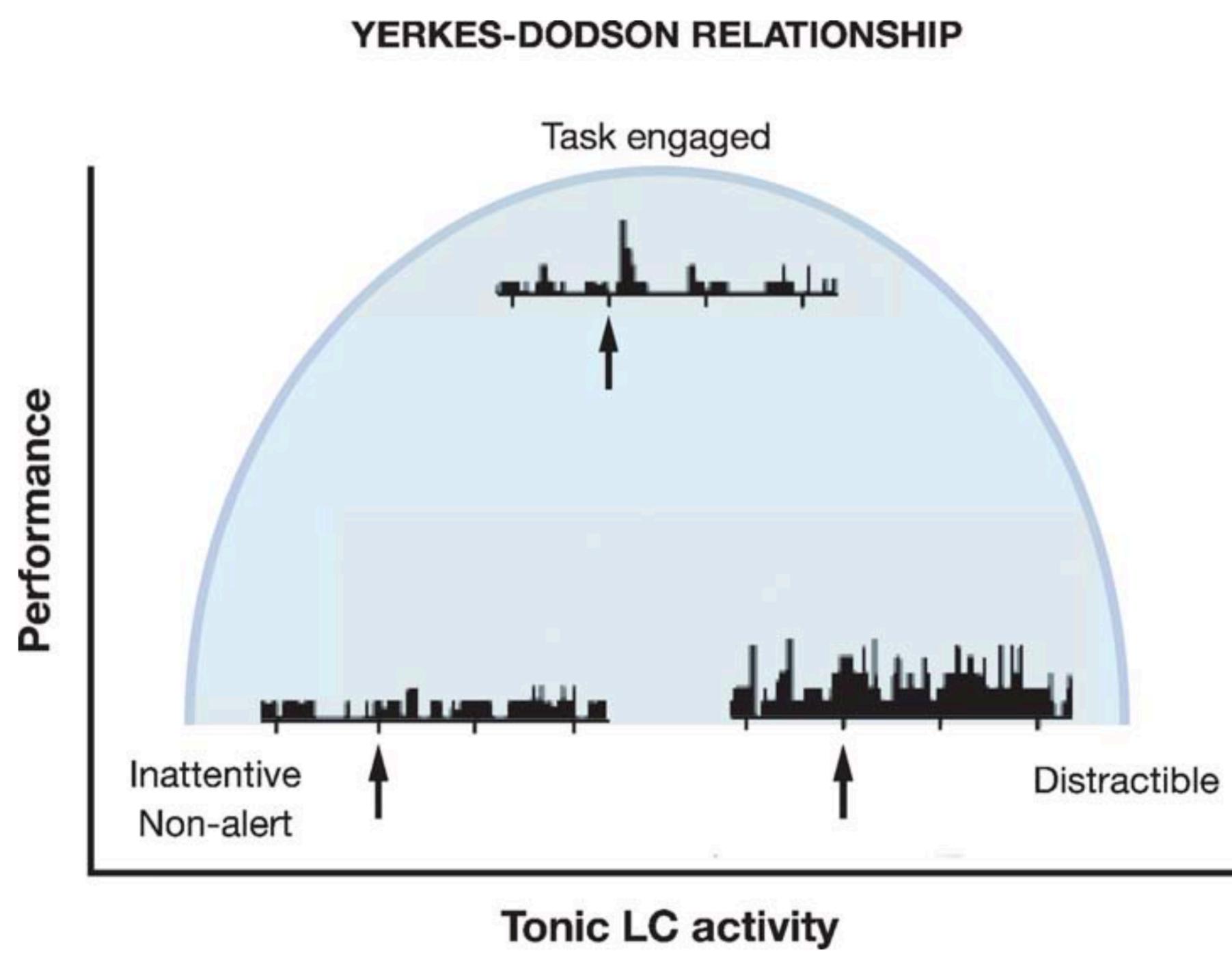
School of thought 1:
– Fast orienting
responses in pupil
– Focuses on SC/IC



Arousal and Pupil

School of thought 2:

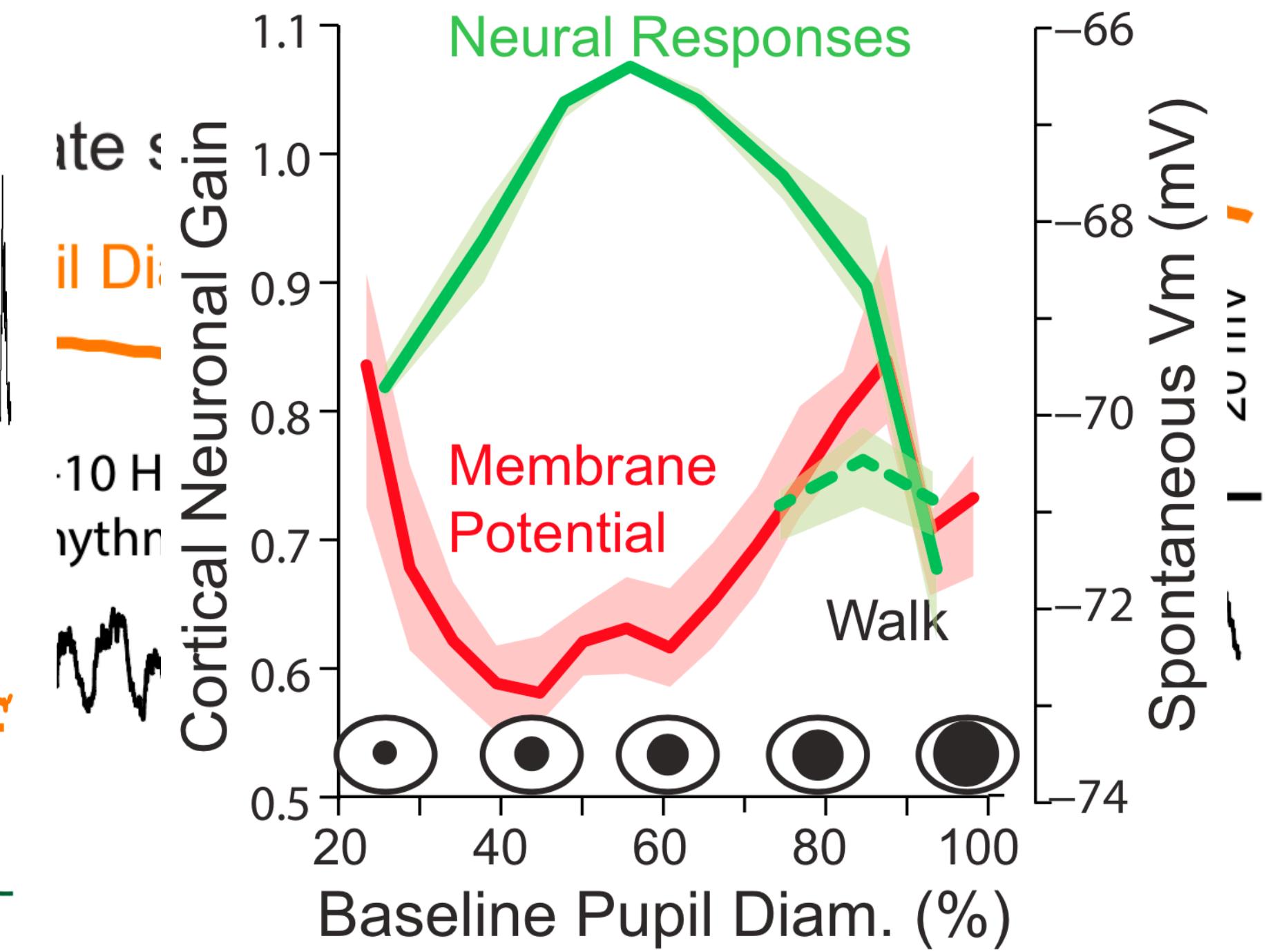
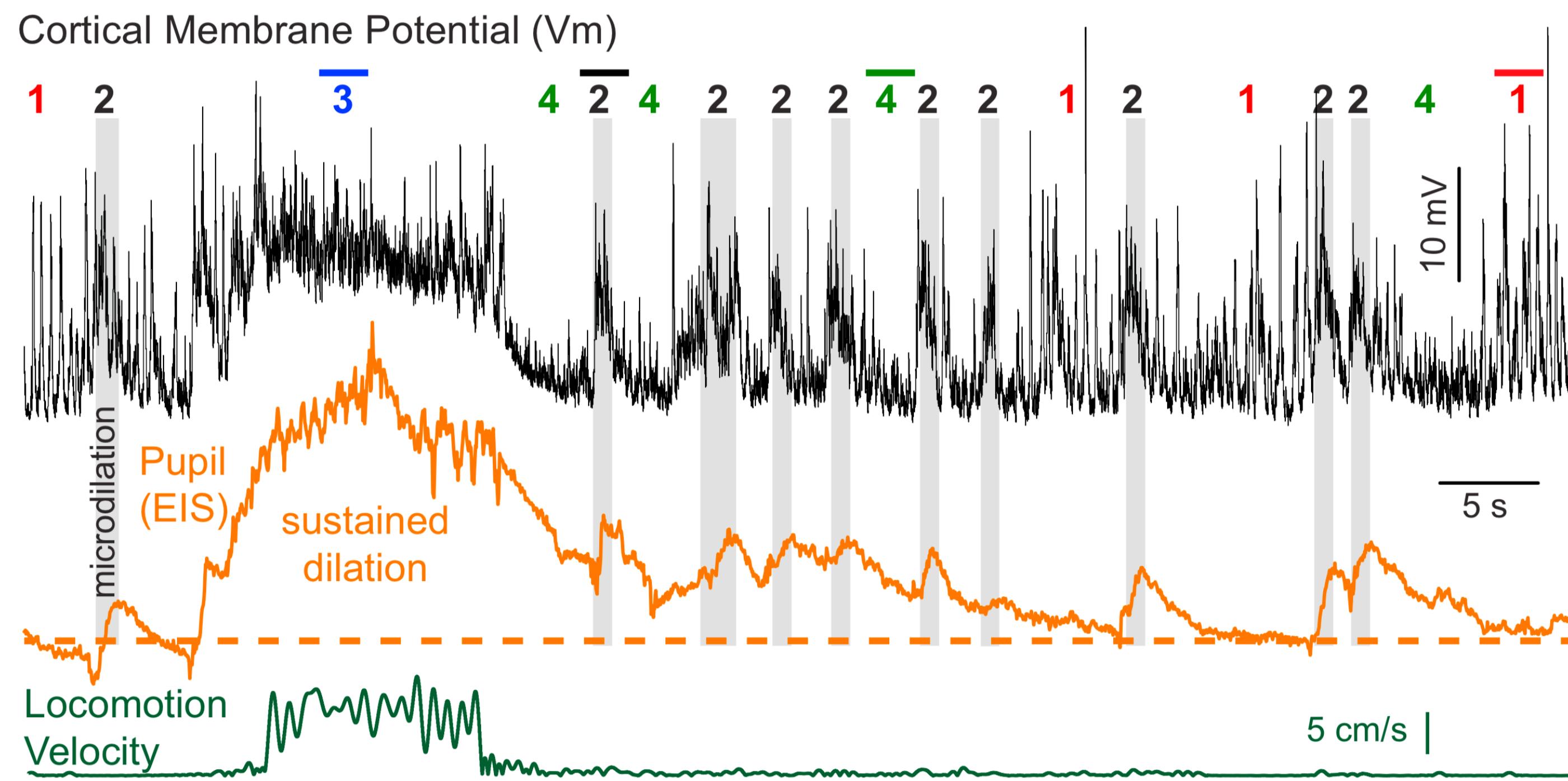
- Slower and really slow responses in pupil
- Focuses on Locus Coeruleus / NA



Arousal and Pupil

Recent animal findings:

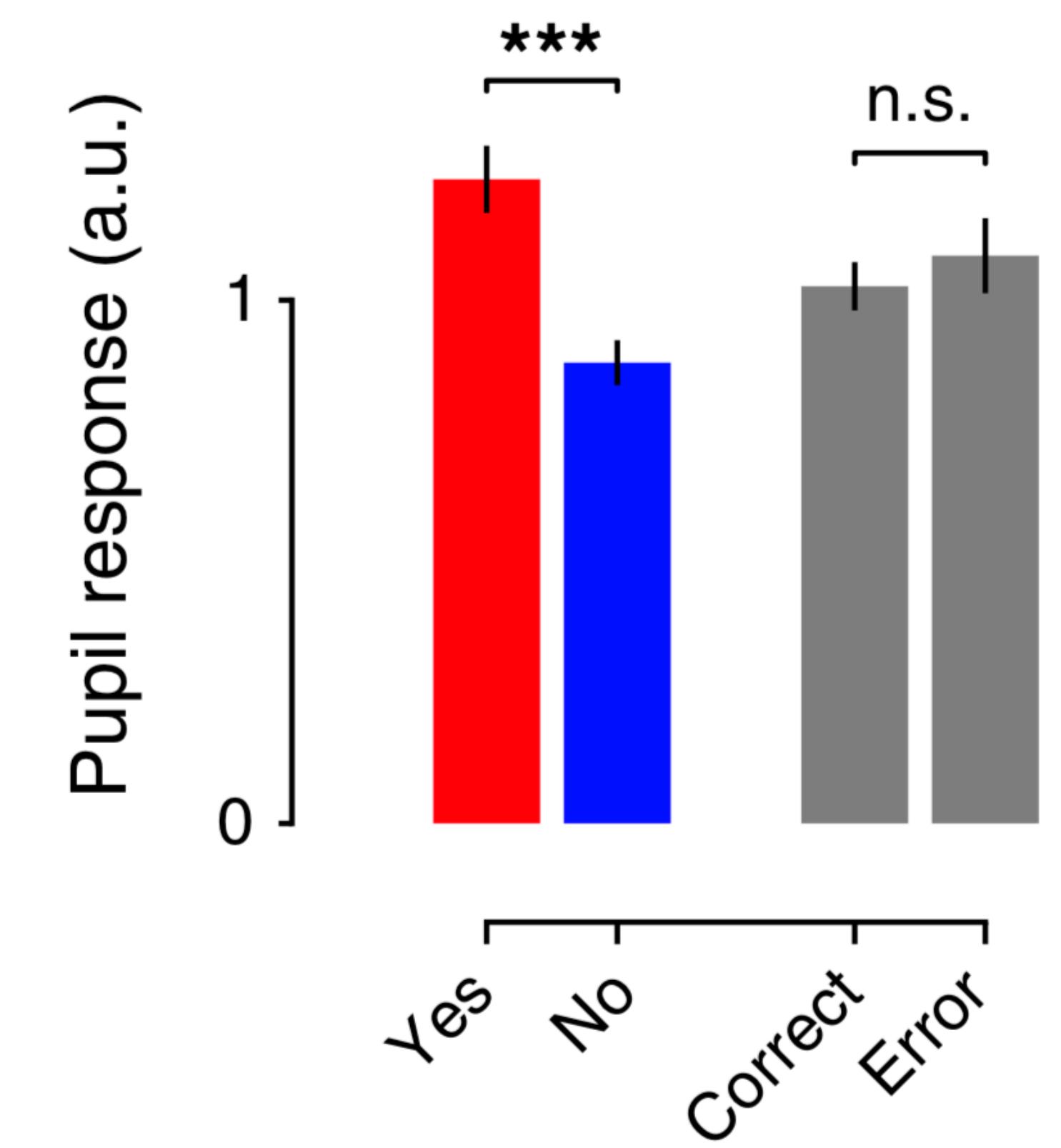
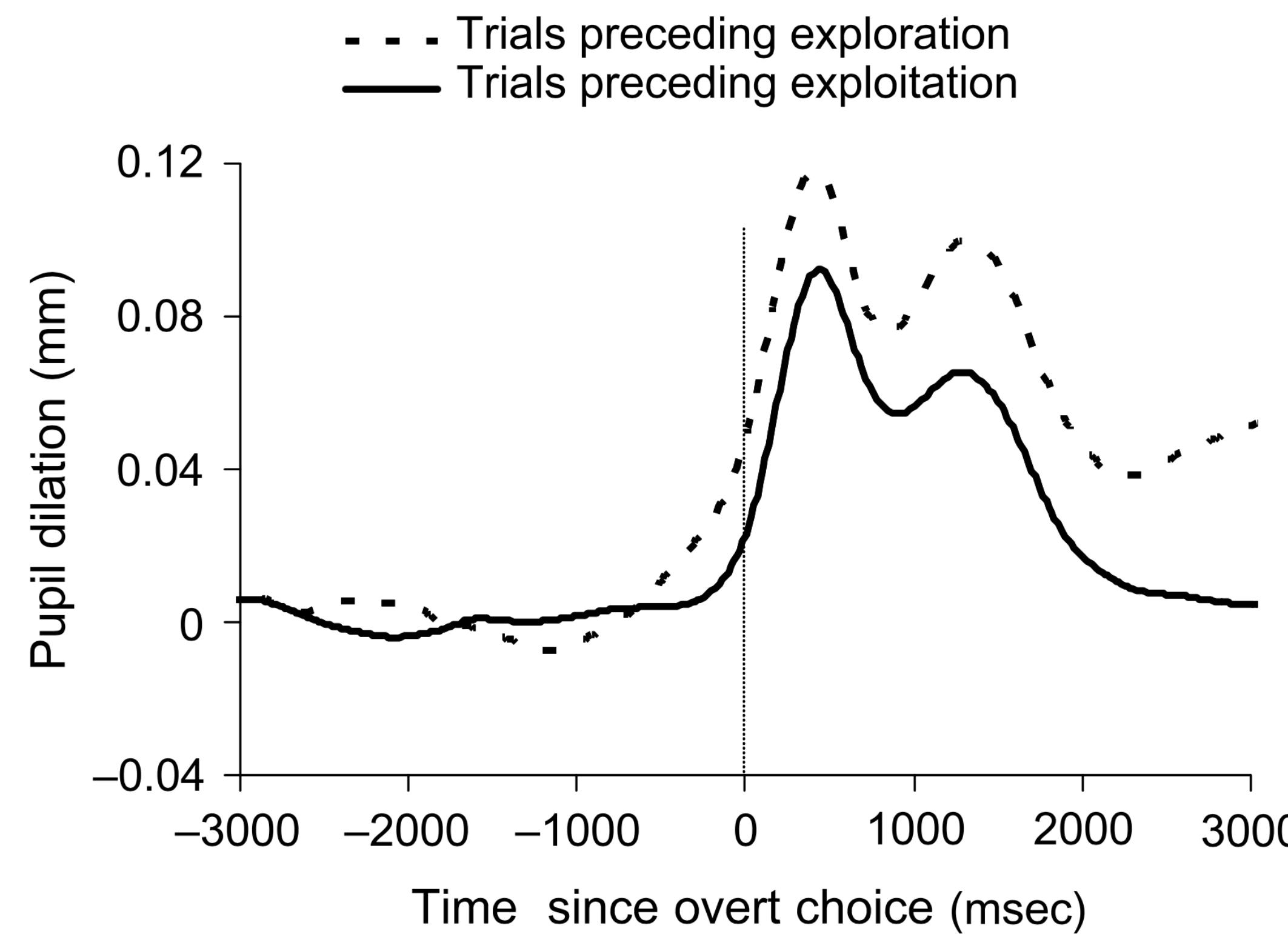
Cortical state changes are associated with changes in pupil size



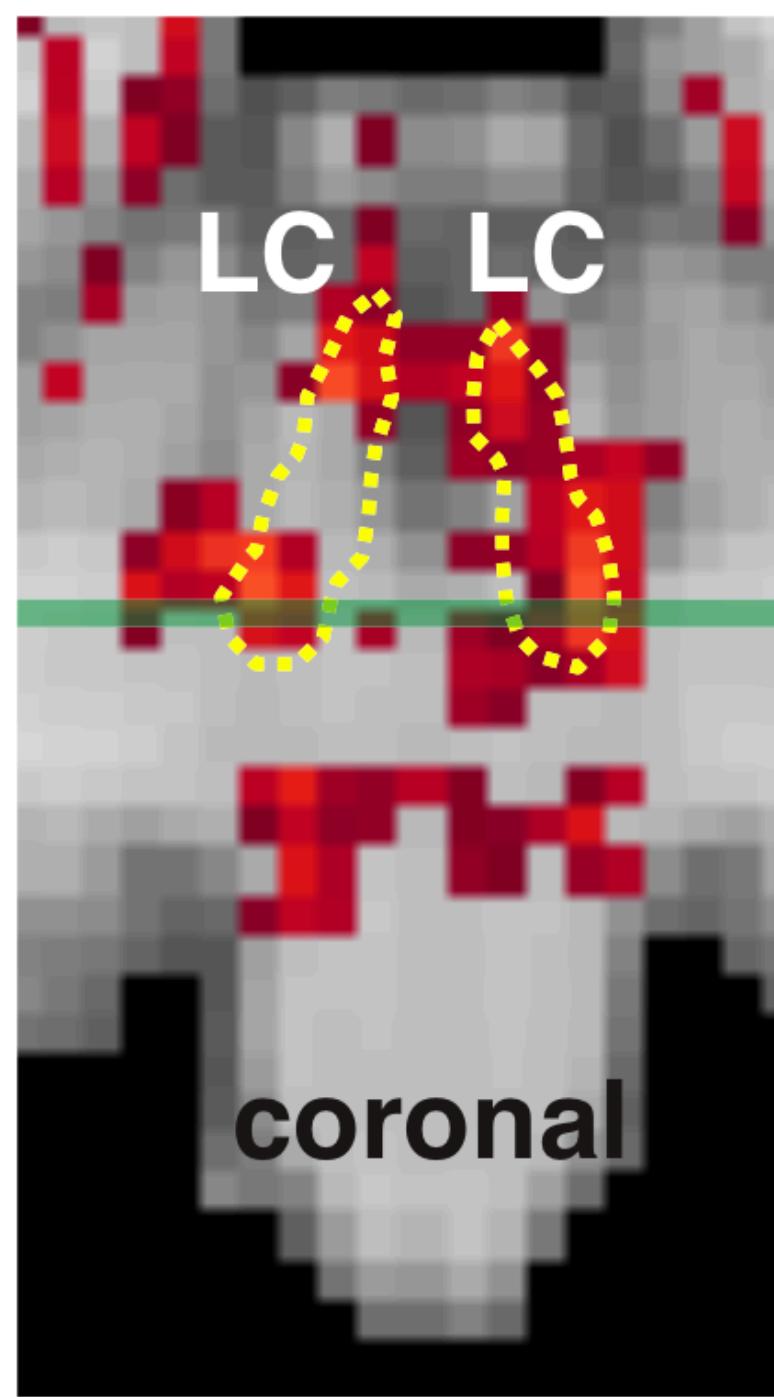
Arousal and Behaviour

Determines behavioural explore/exploit trade-off

Larger pupil responses: more likely to say 'yes' in a detection task



Pupil changes & Brain signals



axial

2 9

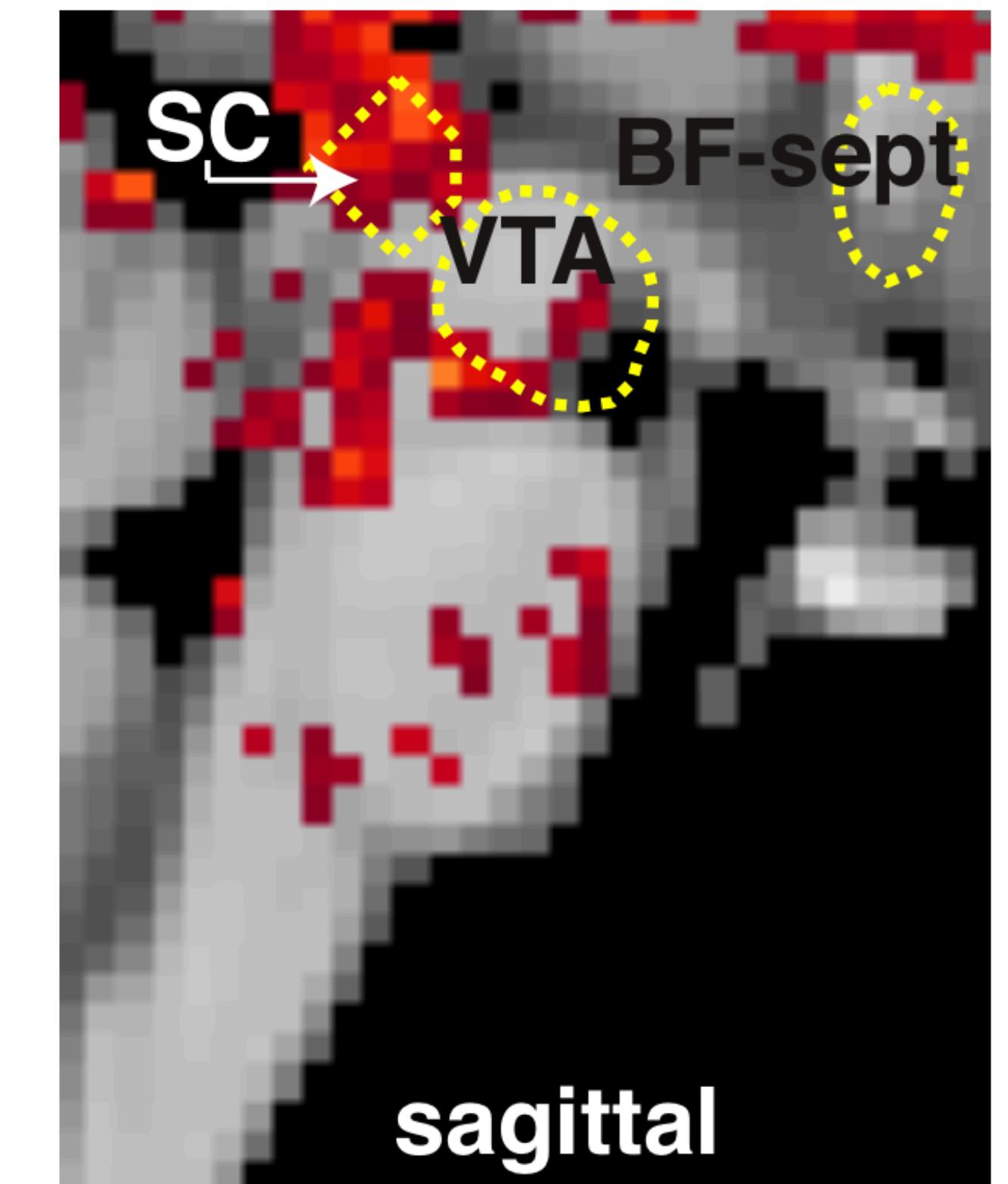
Correlation to TPR
(t-score)

*Decision-triggered
correlation with
pupil size:*

*Strong correlations
with **Locus Coeruleus***

*And:
Superior Colliculus*

*But:
Only **LC** corresponds
to **pupil's effects on
decision-making***

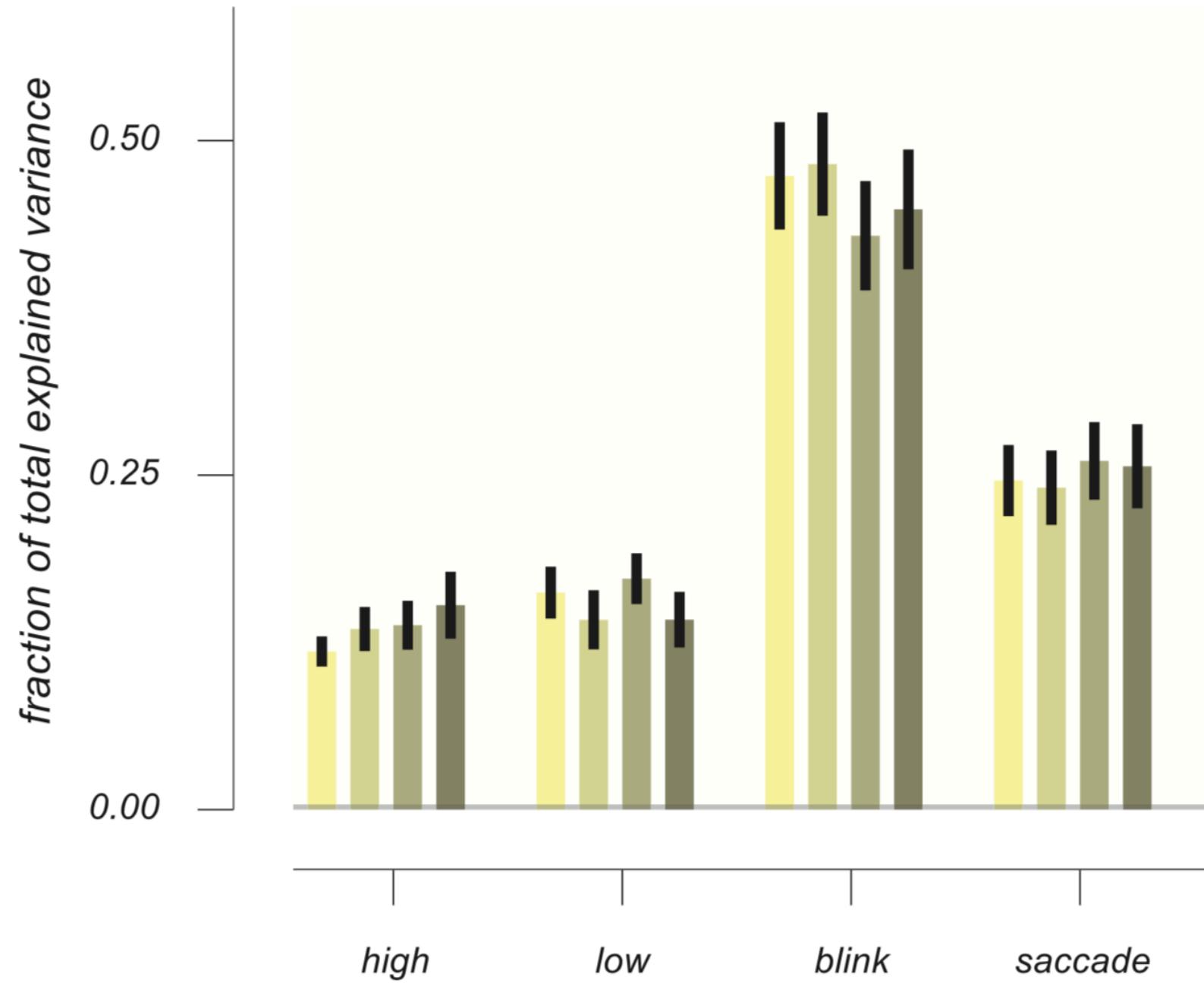
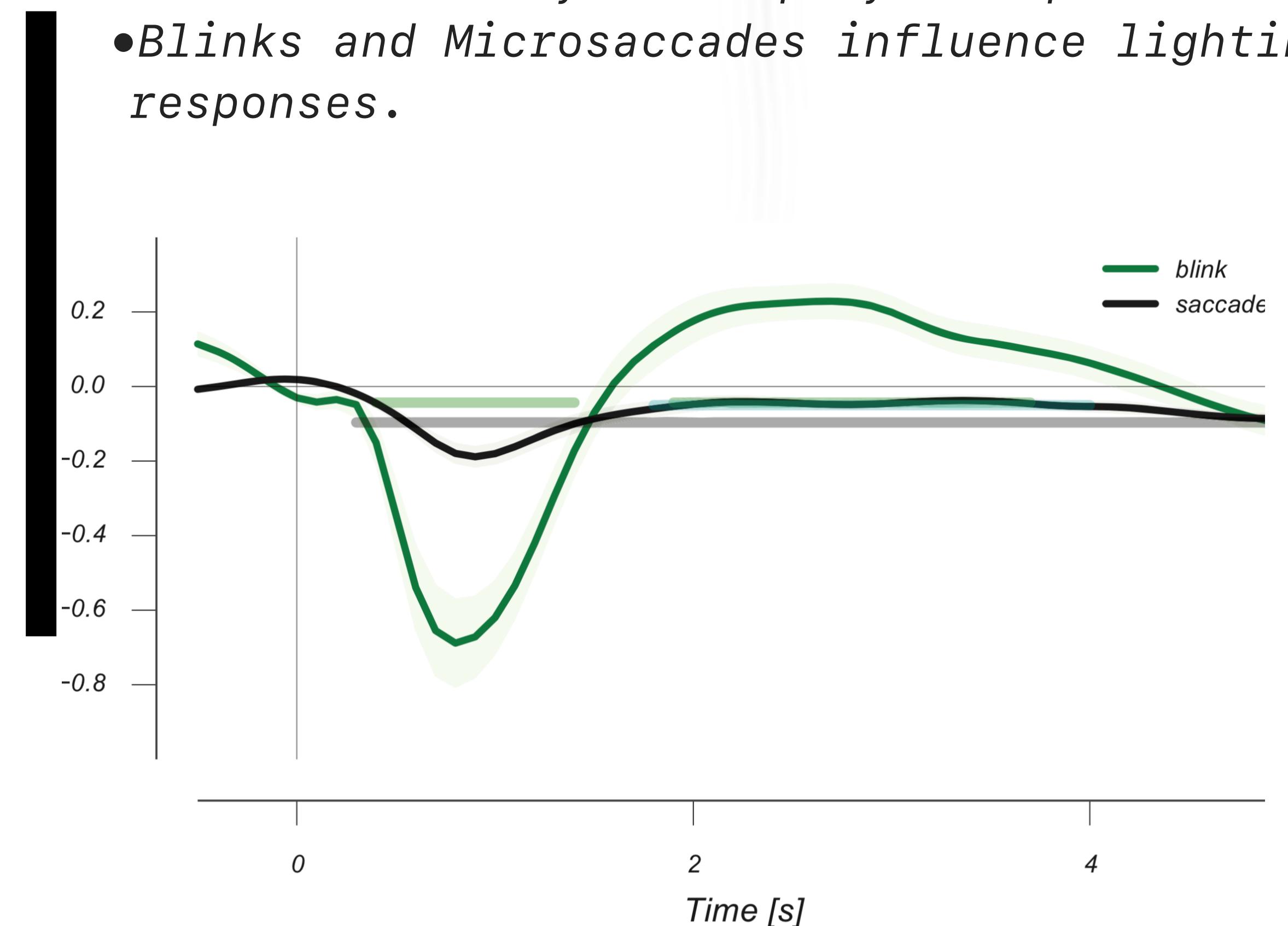


sagittal

How to measure and understand Pupil?

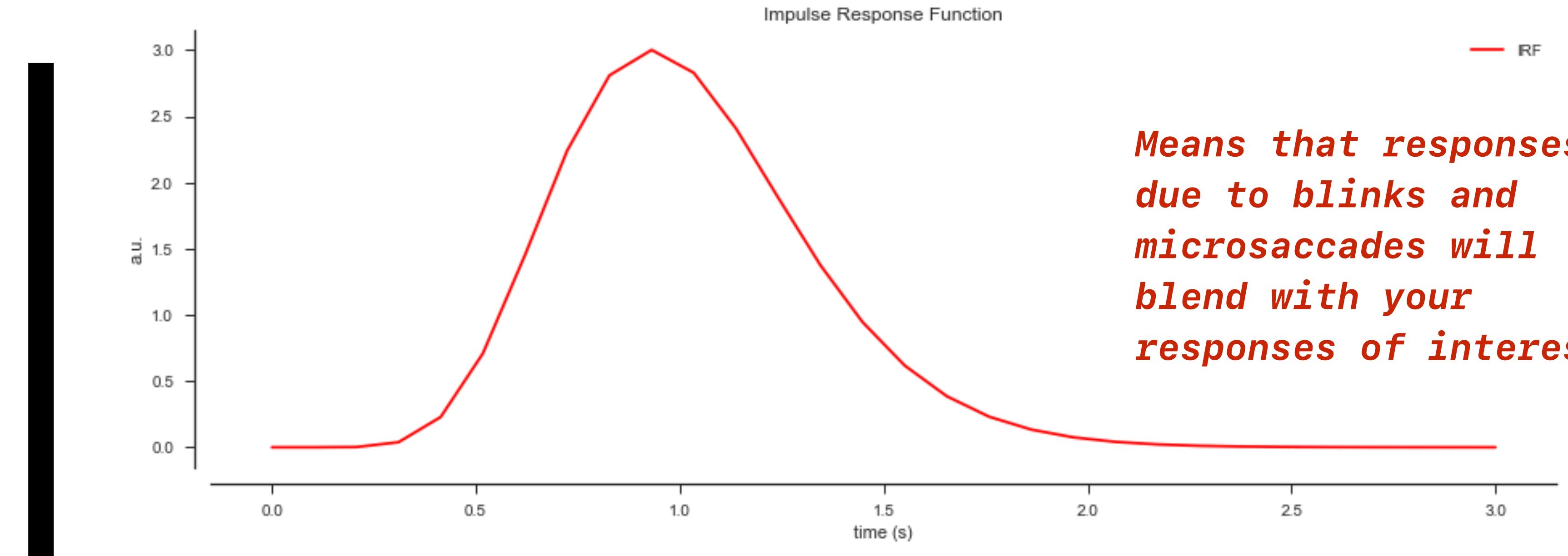
!! Primary function of pupil is to regulate retinal illumination !!

- Make sure that your display is equiluminant.
- Blinks and Microsaccades influence lighting, so they will cause pupil responses.



How to measure and understand Pupil?

Realize that the pupil's responses to light and cognition are slow!!



Means that responses due to blinks and microsaccades will blend with your responses of interest

*Look familiar?
BOLD responses behave similarly: perhaps we should adopt GLM methods?*