

Pupil Dilation Reflects the Dynamics and Content of a Perceptual Decision



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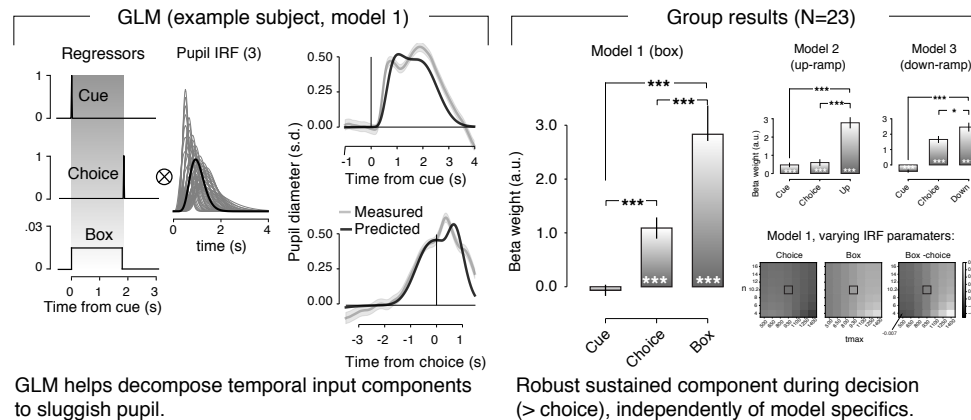
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Purpose

- Pupil dilation at constant luminance indexes changes in neuromodulatory state (possibly noradrenaline release from the locus coeruleus) (1,2).
- Pupil dilation has been associated with perceptual decision-making (1).
- We tested if pupil dilation during a simple visual decision task:
 - is driven throughout the decision process, or only during the final choice.
 - reflects the content or the accuracy of the final choice.

Sustained drive of pupil throughout decision formation



Summary & conclusions

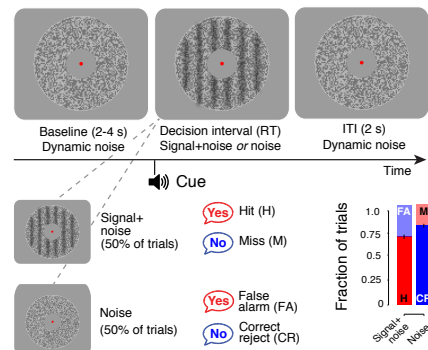
- Pupil dilation exhibits a stronger sustained (ramping) component during decision formation (bigger than at choice).
- Pupil dilation reflects the content ("yes" vs. "no"), not the accuracy of the choice.
- This choice effect depends on the decision-maker's bias.

Conclusion:

Pupil-linked changes in neuromodulatory state occur while decisions unfold and reflect the individual's bias. This might shape the decision process.

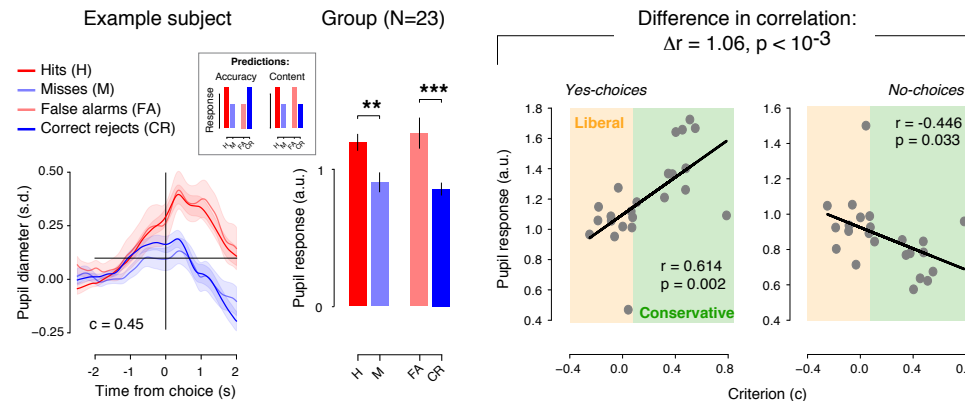
Task design

Yes-no (simple forced choice) contrast detection



- Target contrast titrated to 75% correct level.
- Dynamic noise constantly present.
- Protracted decisions (median RT > 1 s).

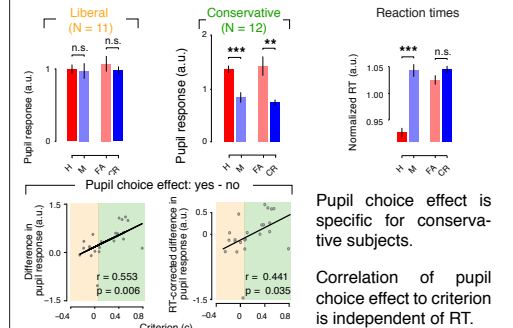
Pupil reflects decision content and criterion



Bigger pupil dilation during "yes" than "no" choices, irrespective of choice accuracy (H = FA > M = CR).

Interacting effects of decision content and criterion: the more conservative the subject, the bigger the dilation during "yes" and the smaller during "no" choices.

Controls



References

1. Aston-Jones G & Cohen JD (2005) An integrative theory of locus coeruleus-norepinephrine function: adaptive gain and optimal performance. *Annu Rev Neurosci* 28:403-450.
2. Eider E, Cohen JD, & Niv Y (2013) The effects of neural gain on attention and learning. *Nat Neurosci* 16:1146-1153.
3. Hoeks B & Levitt WJM (1993) Pupillary dilation as a measure of attention: a quantitative systems analysis. *Behav Res Meth, Instr, & Computers* 25 (1):16-26.