The Possibilities of Pupillometry as a Novel Biomarker

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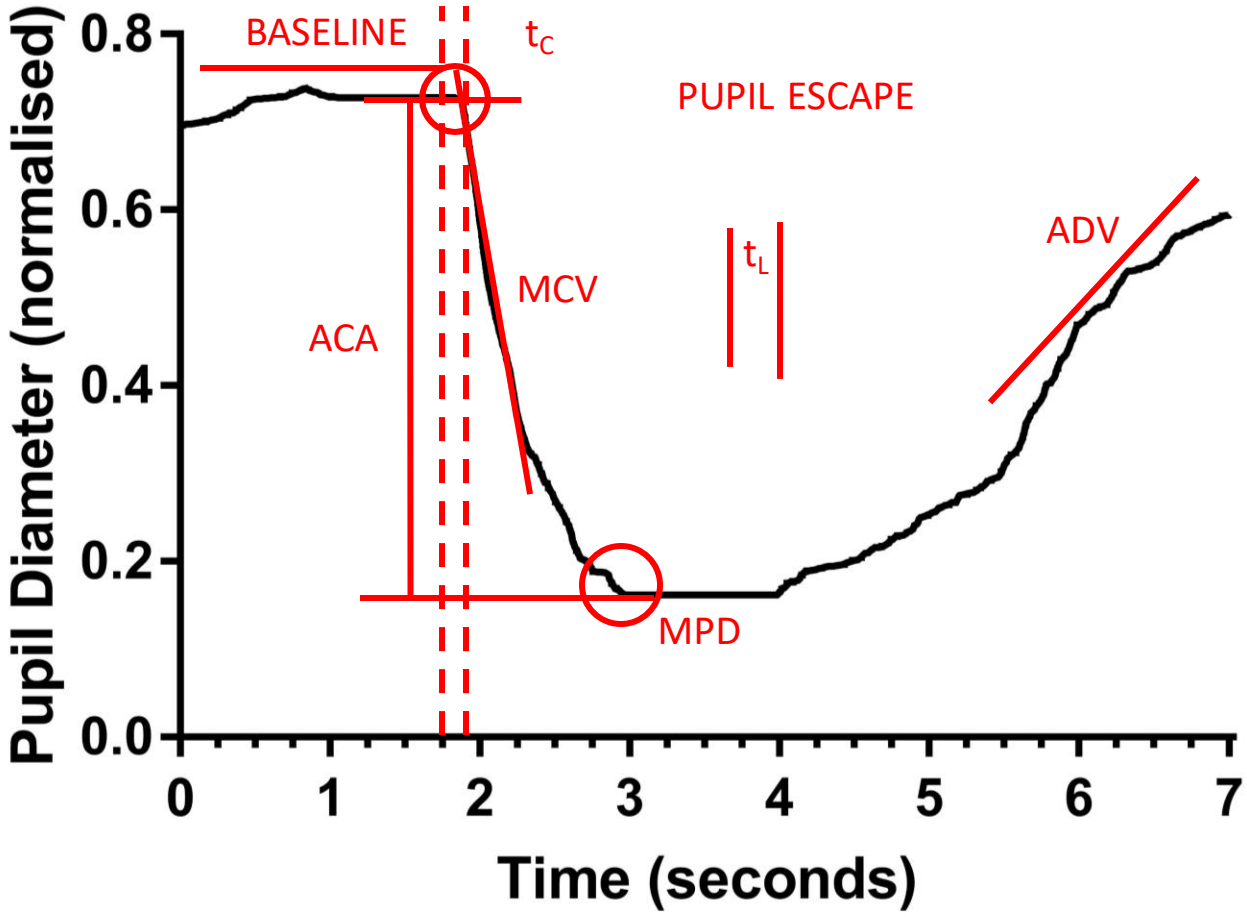
What is Pupillometry?

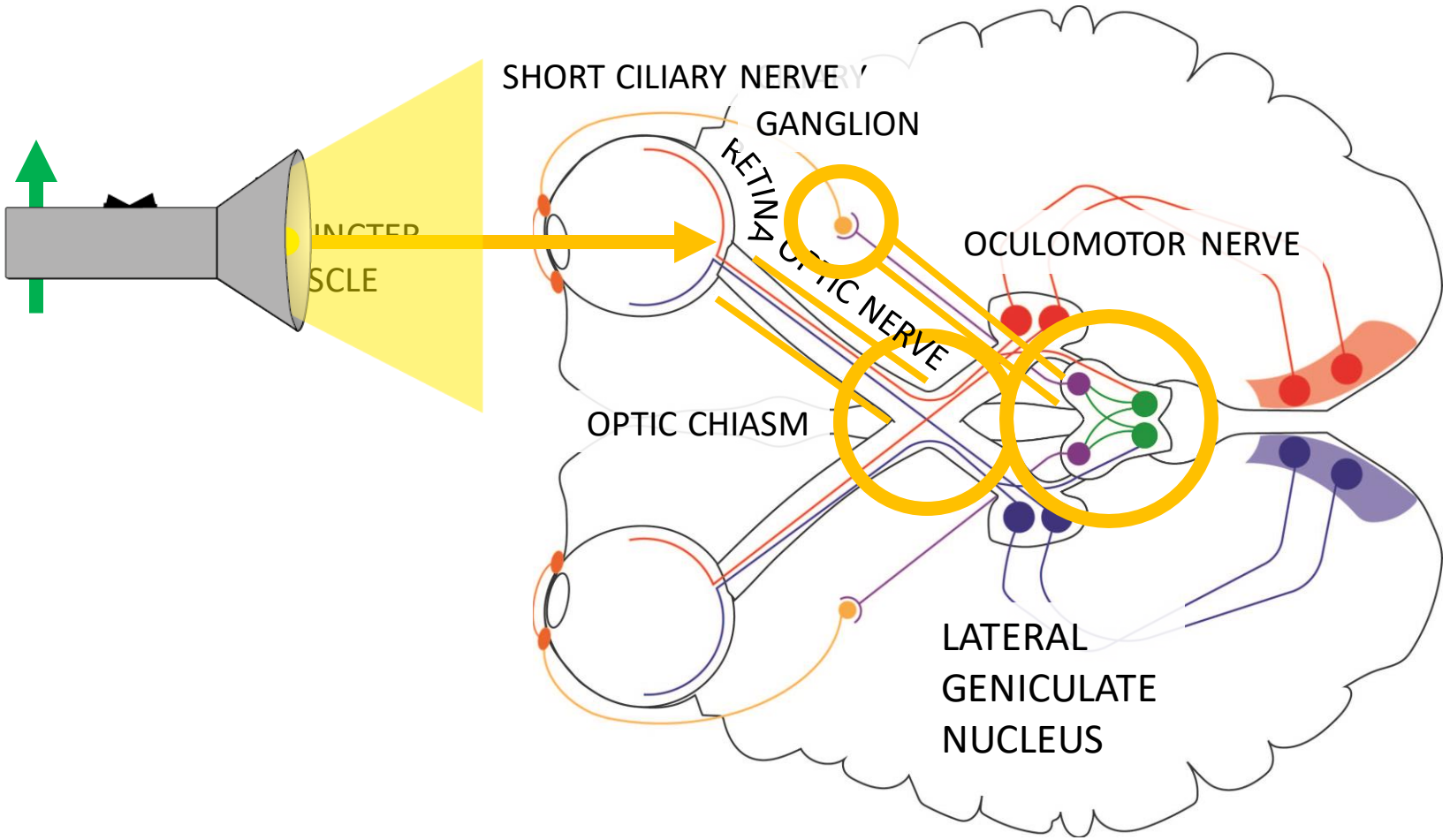
- The measurement of pupil diameter and reactivity in response to a stimulus.
  - LIGHT – Pupillary Light Reflex (PLR)
  - NEAR FIXATION – Pupil Near Response (PNR)
  - COGNITIVE ACTIVITY – Psychosensory Pupil Response (PPR)
- Two main types of Pupillometry:
  - Dynamic Pupillometry
  - Chromatic Pupillometry

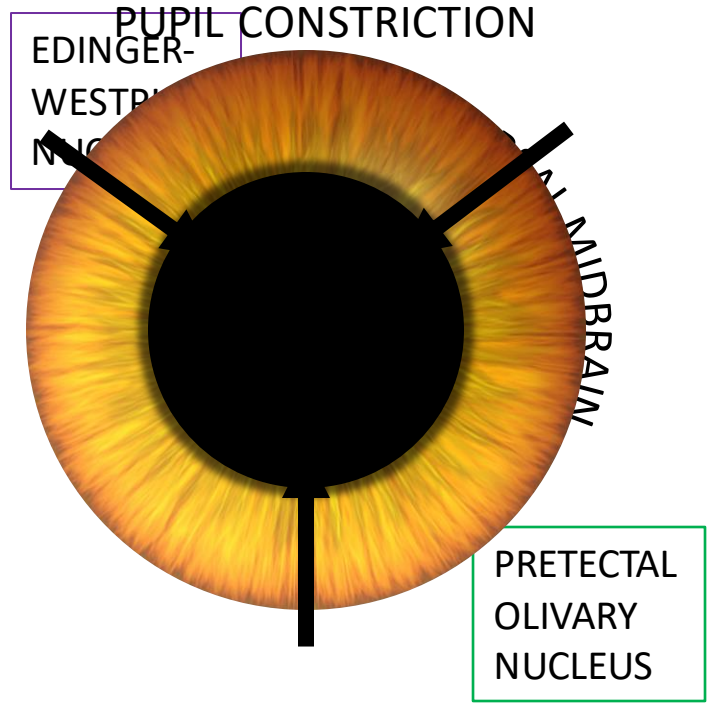
Pupillogram



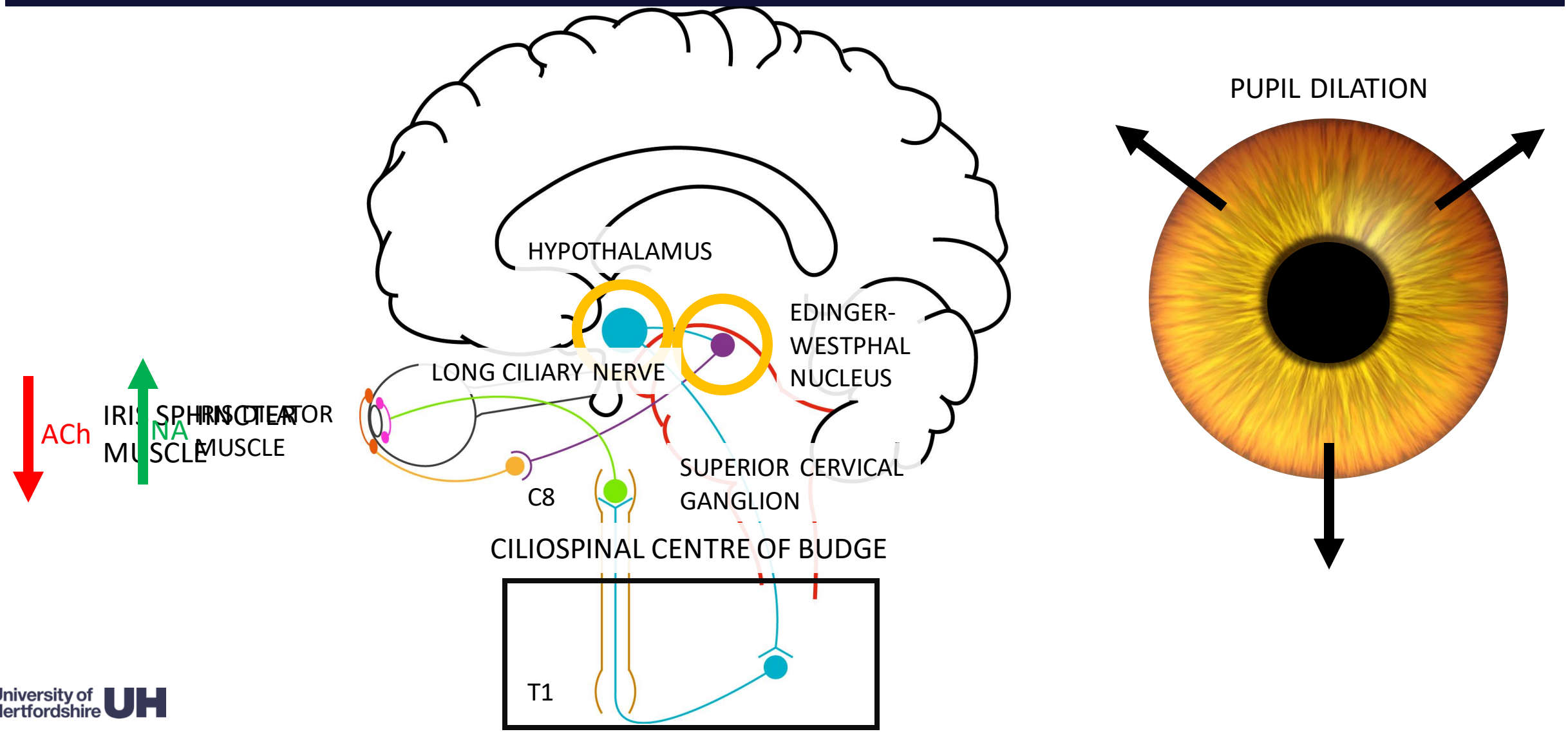
- Latency (t_L)
- Minimum Pupil Diameter (MPD)
- Constriction time (t_c)
- Maximum Constriction Velocity (MCV)
- Absolute Constriction Amplitude (ACA)
- Absolute Dilation Velocity (ADV)

Neurophysiology of the PLR (Constriction Pathway)





Neurophysiology of the PLR (Dilation Pathway)



Summary of PLR

Anything that can affect the ACh/NA balance within the CNS will have an effect on the Pupillary Light Reflex.

Musc… mechanism	
Nervous system control	
Main neurotransmitter	

Some Known Effects of CO…

- Binding to haemoglobin.
- Changes in visual function (Blumenthal, 2001).
- Central nervous system dysfunction
  - Disturbances of normal pupillary reactions (Wilmer, 1921).
  - Dysfunction of acetylcholinergic neurons (Nabeshima *et al.* 1991).

Other Toxicological Examples…

- Organophosphates including Sarin (Gore *et al.*, 2014), Soman (Genovese *et al.* 2010) and Dichlorvos (Taylor *et al.*, 2008).
- Botulinum toxin (Zheng and Azar, 2014).
- Solanaceae/Nightshades including Devil's snare (Hansen and Clerc, 2002) and Angel trumpet (Andreola *et al.*, 2008).
- Mercury intoxication (Milioni *et al.*, 2017).

Summary

- Pupillometry offers insight into nervous system health.
- Disruptions to the ACh/NA balance can affect the PLR.
- Carbon monoxide intoxication can impair CNS function.

THEREFORE...

Central nervous system disruption is likely to be reflected in the PLR of a patient exposed to CO.

Current/Future work…

P.E.E.C.O

Pupillary Evaluation of Exposure to Carbon Monoxide

- Evaluating the use of a novel pupillometer as a sensitive indicator of low-level CO exposure.
  - Chromodynamic Pupillometry

Present research

- Reproducibility of CDP.
- Optimisation of CDP stimuli.

Future research

- Investigate dose response of CO.
- Investigate age effects.

- Project funded by the CO Research Trust.

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Thank you!