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Probing for Intention: Latent Awareness or Metacognitive Reflection

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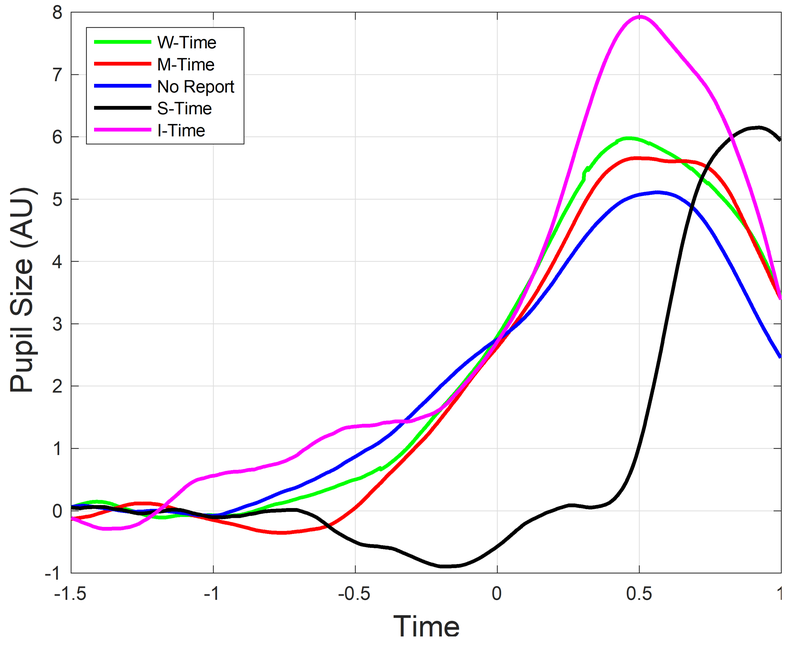
Research Question

Can people be latently aware of having an intention to move, or are prior findings attributable to metacognition?

Background

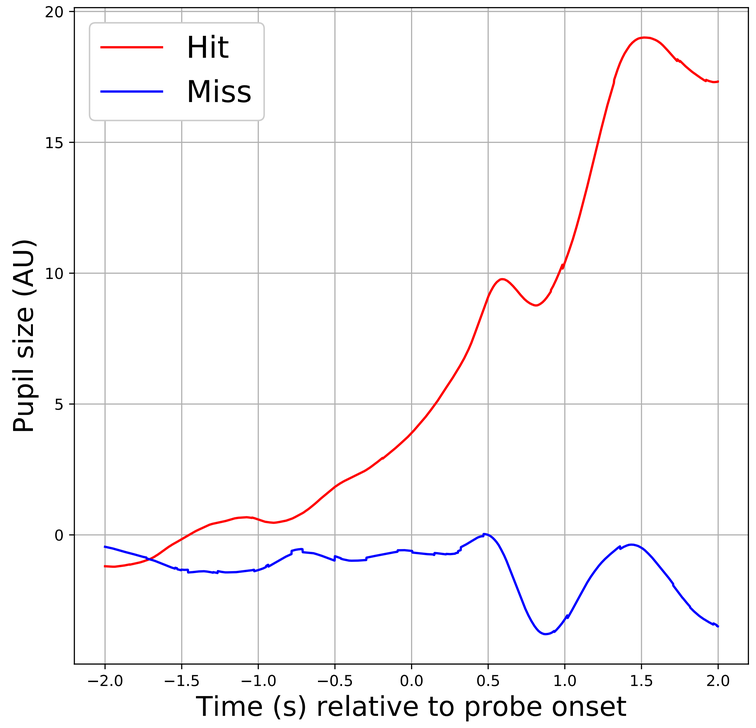
- Explicit awareness of intention ~200ms before movement.[1]
- Interruption/probe method estimates intention onset earlier, ~800 ms[2]; does this reflect a *latent* awareness?
- Pupil dilations reflect mental processes: awareness and attention[3,4], decision making[5], and cognitive load[6].
- Pupil dilations before spontaneous actions reflect non-motor processes (below), perhaps latent awareness?

Prior experiment: Pupil dilations & spontaneous actions



- Method (N=11): move spontaneously, report timing of intention (W), movement (M), or no report. Controls: don't move & report time of a sound (S) or imagine moving and report time of imagined movement (I).
- Replicate finding that pupil dilates before movements[7].
- Dilations similar for all trials except for S, indicates process is non-motoric, doesn't reflect attention to intention.

Pilot: Pupil Dilations Reflect Latent Awareness

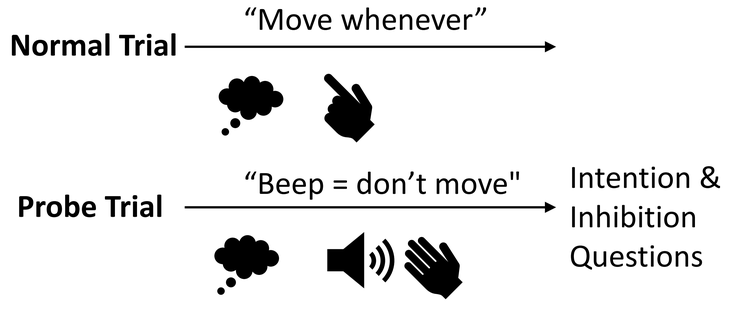


- Method (N=4): move spontaneously, fixation cross may turn red. If cross turns red and subjects had intention (hit), press space after it turns green again (1 sec). If no intention (miss), do not move.
- Compare pre-probe pupil size of hit and miss trials. Elevated pupil size in hit trials means pre-movement dilations associated with latent awareness of an intention; dilations only after probe would suggest metacognitive relfection.
- Pupil dilates before hit-probes, suggests latent awareness.
- Echoes EEG results relating pre-movement signal to latent awareness[8].

Discussion + Future Directions

- Pre-movement pupil dilations may reflect latent awareness of upcoming movements.
- Two issues to resolve:
  - Unclear if "latent awareness" is a legitimate construct, or if participants make a metacognitive judgment
  - Does not control for explicit awareness/ preparatory process.

- **New paradigm:**
  - Use a sound as the "probe" instead of colored fixation cross.
  - Always inhibit when probe occurs.
  - Ask participants about intention *plus confidence,* and ask participants about *whether they inhibited a movement.*
  - See if drift-diffusion model accounts for intention awareness + confidence
  - Record EEG, link readiness potential to pupil size, theta oscillations to inhibitory control.



References: (1) Libet et al., *Brain* (1983); **(2)** Matsuhashi & Hallett, *Eur. J. Neurosci.* (2006); **(3)** Wierda et al., *PNAS* (2012); **(4)** Kang & Wheatley, *Consciousness and Cognition* (2015); **(5)** Einhauser et al., *Front. Hum. Neurosci.* (2010); **(6)** Gavas et al., *IEEE* (2017); **(7)** Richer & Beatty, *Psychophysiology* (1985); **(8)** Parés-Pujolràs et al., *Neuroimage* (2019)