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### Pupillometric Investigation of Spontaneous Action and Intention Awareness

Kate M. Harder

*Chapman University*, [harder@chapman.edu](mailto:harder@chapman.edu)

Ruby Moss

*Chapman University*, [rmoss@chapman.edu](mailto:rmoss@chapman.edu)

Jake Gavenas

*Chapman University*, [gavenas@chapman.edu](mailto:gavenas@chapman.edu)

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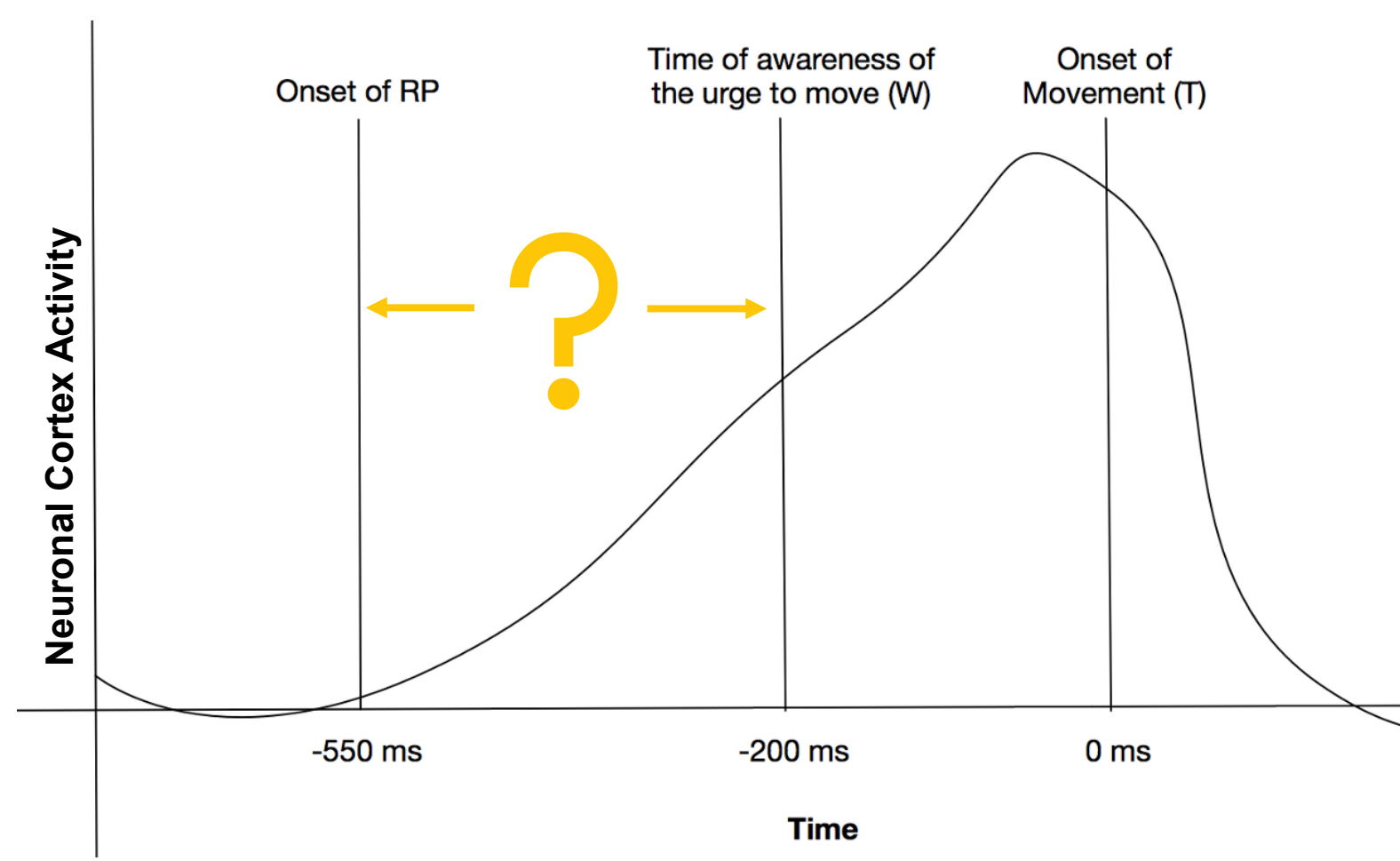
## RESEARCH QUESTION

Can we use pupillometry to *objectively* measure the onset of intention?

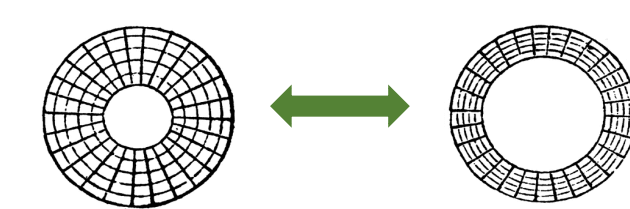
## BACKGROUND

### ➤ The Libet Experiment (Libet et al., 1983)

➤ Result: intention onset *after* RP onset



### ➤ The pupil



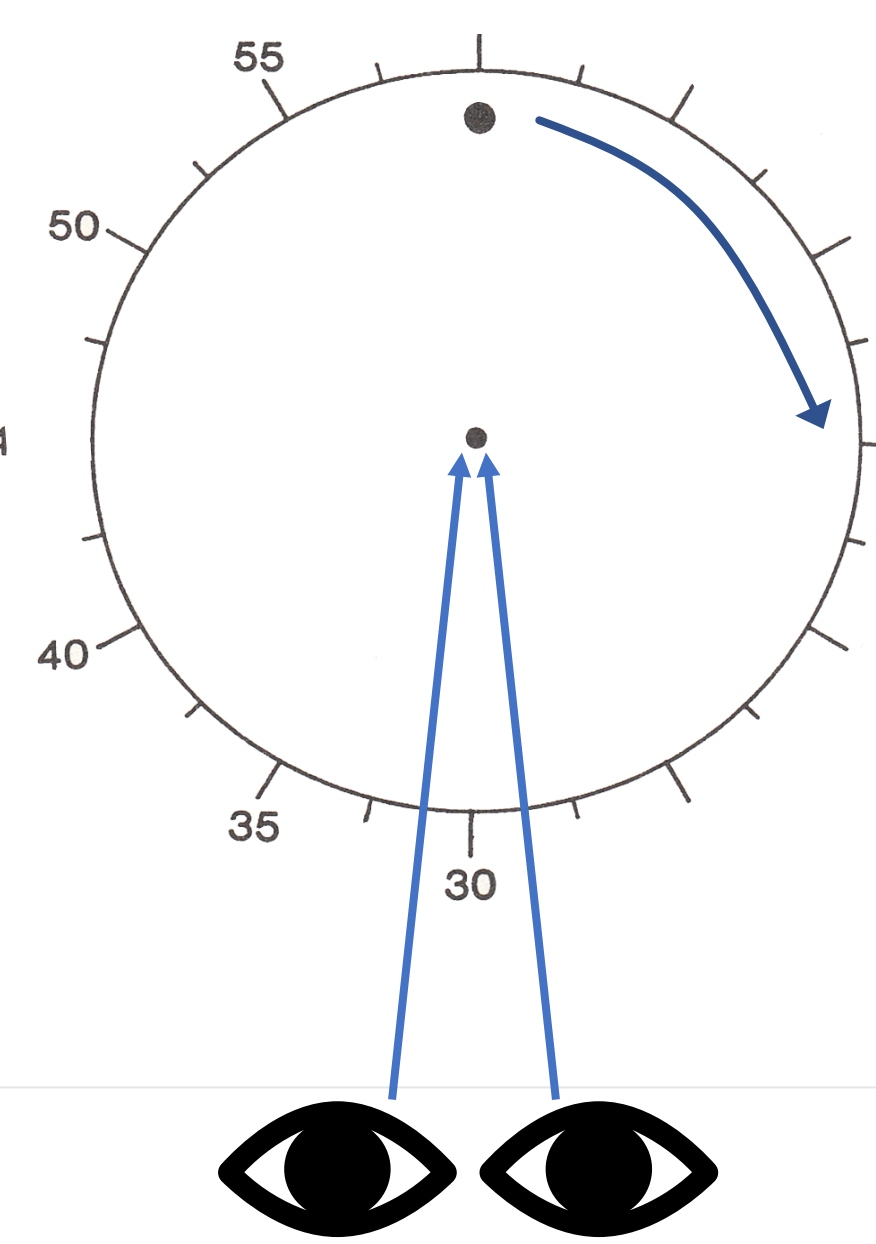
➤ Dilations reflect attentional processing, decision making, cognitive load.

## METHODS

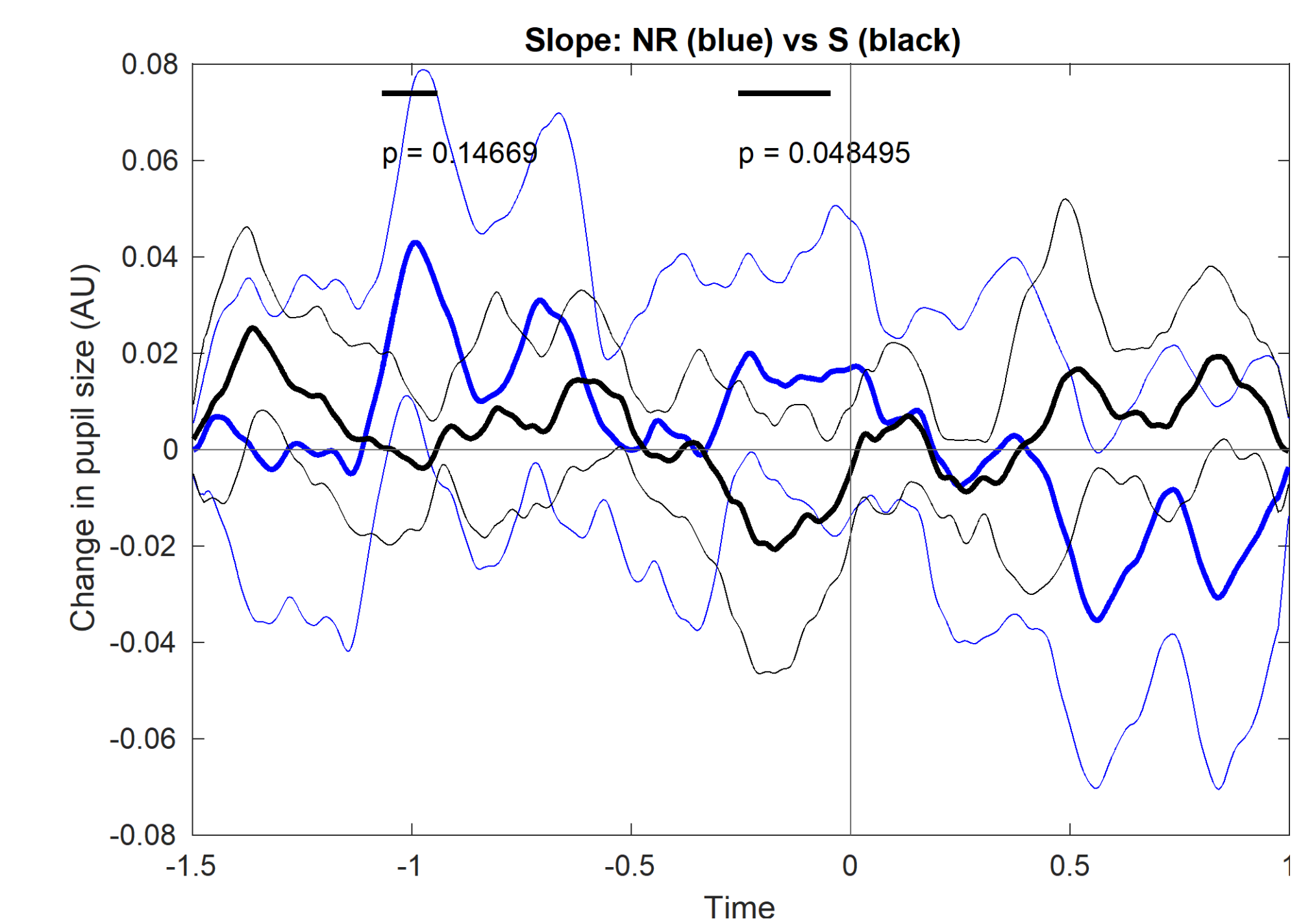
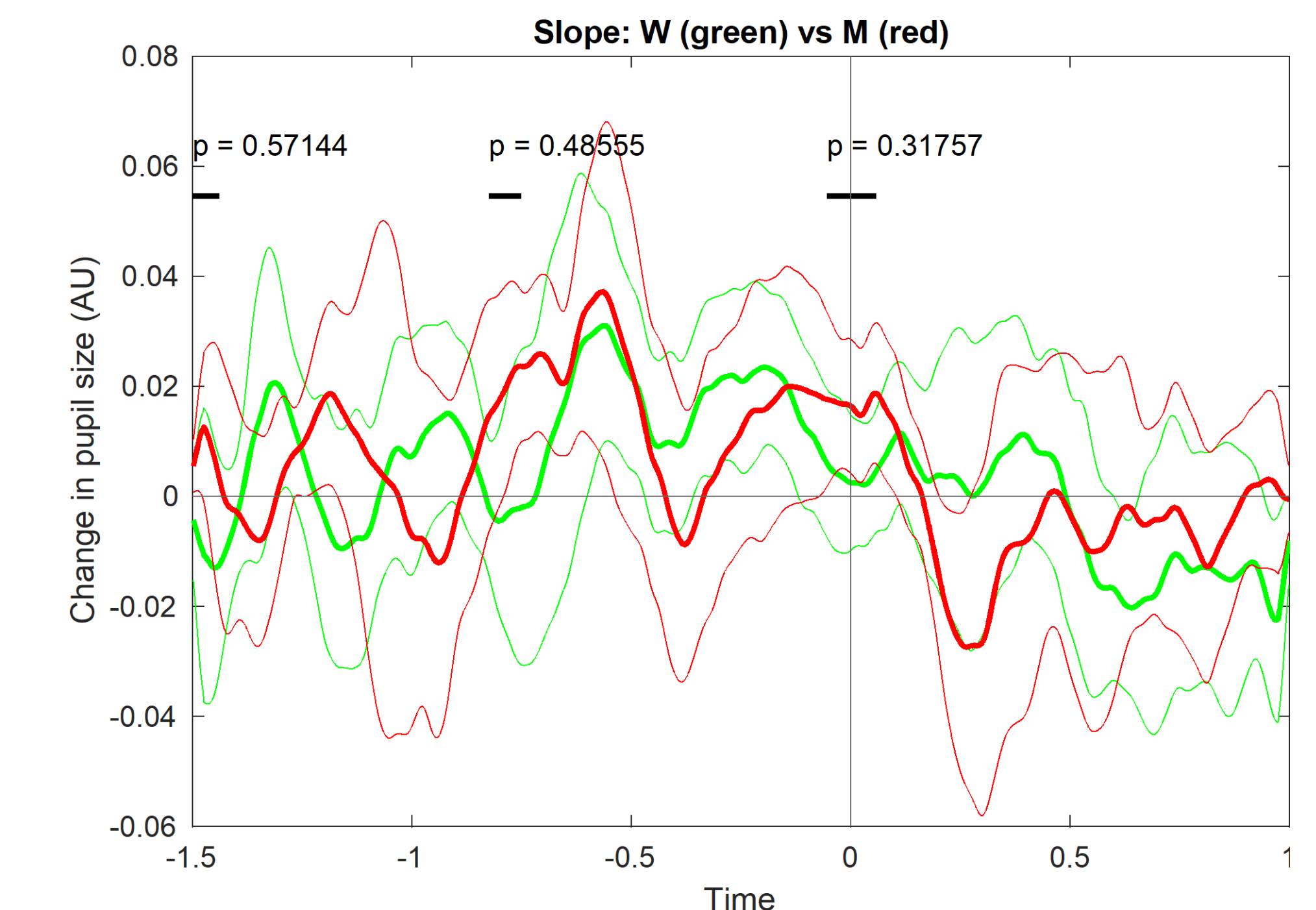
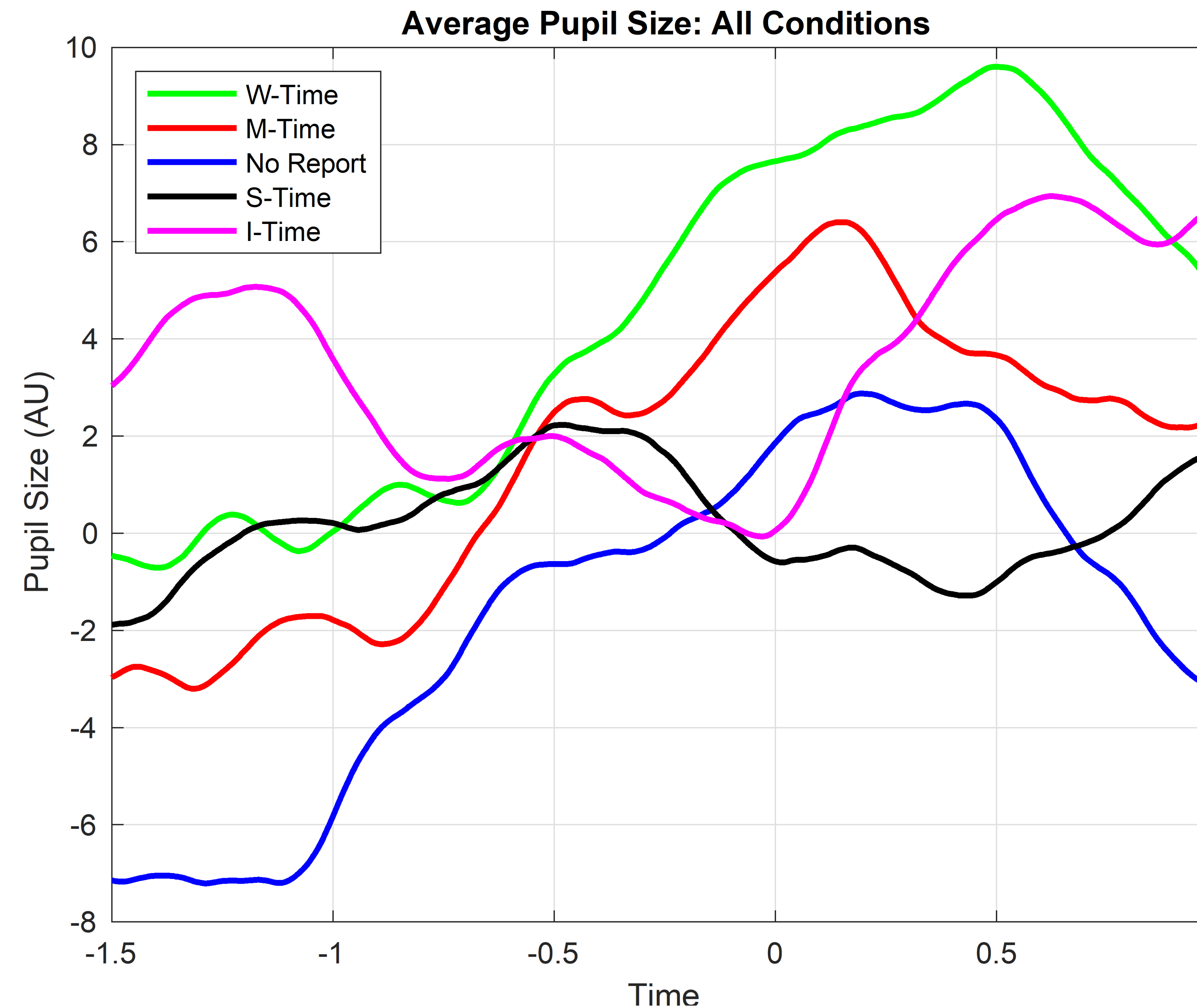
**N=19, fixate while clock onscreen**

**Conditions (w/in Sx):**

- **No report**
  - Voluntary button press
- **W-Time**
  - Voluntary button press
  - Report time of urge
- **M-Time**
  - Voluntary button press
  - Report time of press
- **S-Time**
  - Tone played randomly
  - Report time of tone
- **I-Time**
  - Imagine button press
  - Report time of imagined press



## Results



- Grand-average pupil size over time shown.
- Anticipatory buildup in conditions with spontaneous actions.
- Artifacts impede analysis

- Pupil size change over time.
- *Top: W vs M, Bottom: NR vs S*
- NR pre-action dilation ( $p < 0.05$ )
- No significant effect of reporting

## Behavioral Results

- Mean reported times in relation to event onset ( $p < .001$ ):
  - W-Time:  $-130 \text{ ms} \pm 29 \text{ ms}$
  - M-Time:  $-18 \text{ ms} \pm 13 \text{ ms}$
  - S-Time:  $184 \text{ ms} \pm 10 \text{ ms}$
- Mean waiting time ( $p > 0.256$ ):
  - W-time:  $4.77 \text{ s} \pm 0.12 \text{ s}$
  - M-time:  $4.65 \text{ s} \pm 0.12 \text{ s}$
  - No report:  $4.43 \text{ s} \pm 0.16 \text{ s}$

## DISCUSSION

- Mean reported time of intention *after* onset of pupil dilation increase
- Pupil dilation change follows similar peaking pattern as RP
- No difference between reporting - pupil size may not reflect intention
  - Other potential source of anticipatory dilation?
- Consistent with existing literature on pupil change and external stimuli and movement.

## FUTURE DIRECTIONS

- Perfecting methods
- Full experiment
- Incorporation of EEG
- Deconvolution analysis
  - Wierda et al., 2012.
- Follow-up studies (cued movement)