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# Pearls and Perils of Pupillometry Using a Webcam

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# Pearls and Perils of Pupillometry using a Webcam

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## Background and Objectives

Online testing is becoming more prevalent in the field of psychology and has greatly increased recruitment efforts, particularly for reaching out to special populations (e.g., patients, infants). To assess some psychological phenomena, observing physiological responses to stimuli is valuable. It was recently shown that it is possible to measure heart rate using a webcam online [2]. Pupil dilation, another physiological measure, has been shown to be a feasible and dependent means for characterizing level of cognition, whereby an increase in pupil diameter is associated with increased attention to meaningful information [3]. In the study herein, **we examine whether pupil size can be measured online with a webcam in response to cognitively demanding stimuli** [1]

## Methods

We investigated best parameters for pupil acquisition over Mturk through successive studies, then measured the best participants in response to cognitive load.

**Participants:**
- Recruited from Amazon's Mturk  (N = 133)

**Procedure:**
- Stimuli and webcam recording through Flash and Wowza media streaming server.
- A 2x2 crossover design was implemented where participants were randomly allocated to one of four conditions:
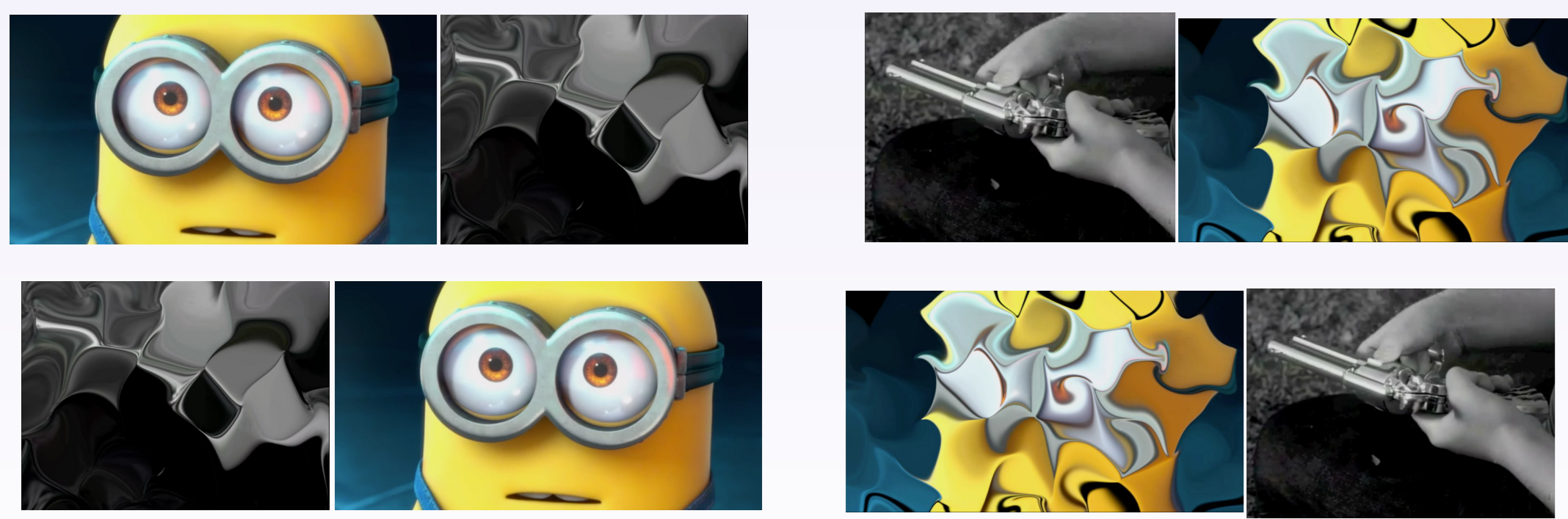
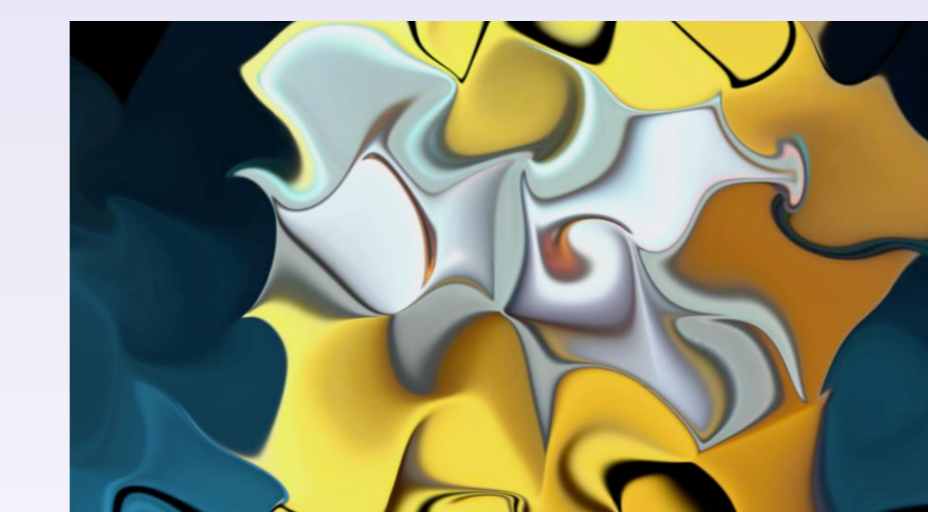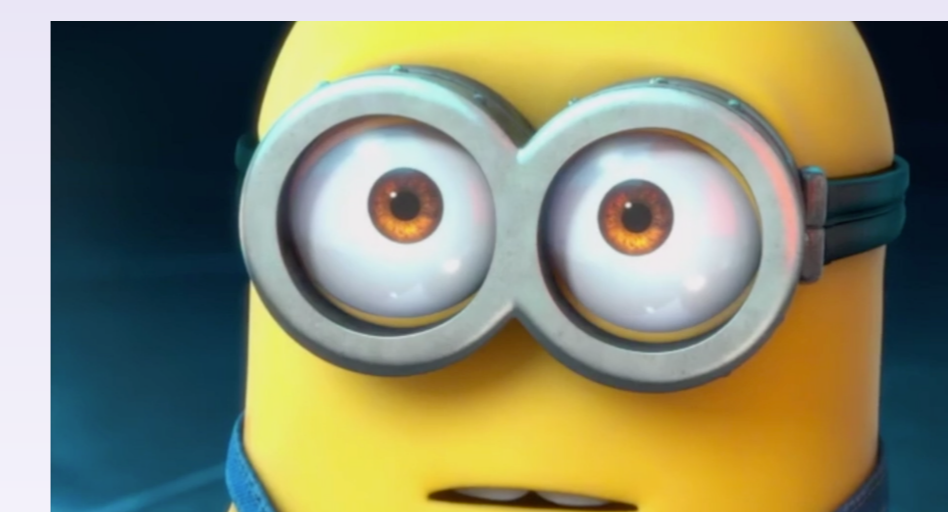- All participants saw two different videos, one scrambled, one intact.

## Analysis and Design of Stimuli

Manual measurements of pupil diameter normalized to iris diameter, using ImageJ (~59 frames per video)
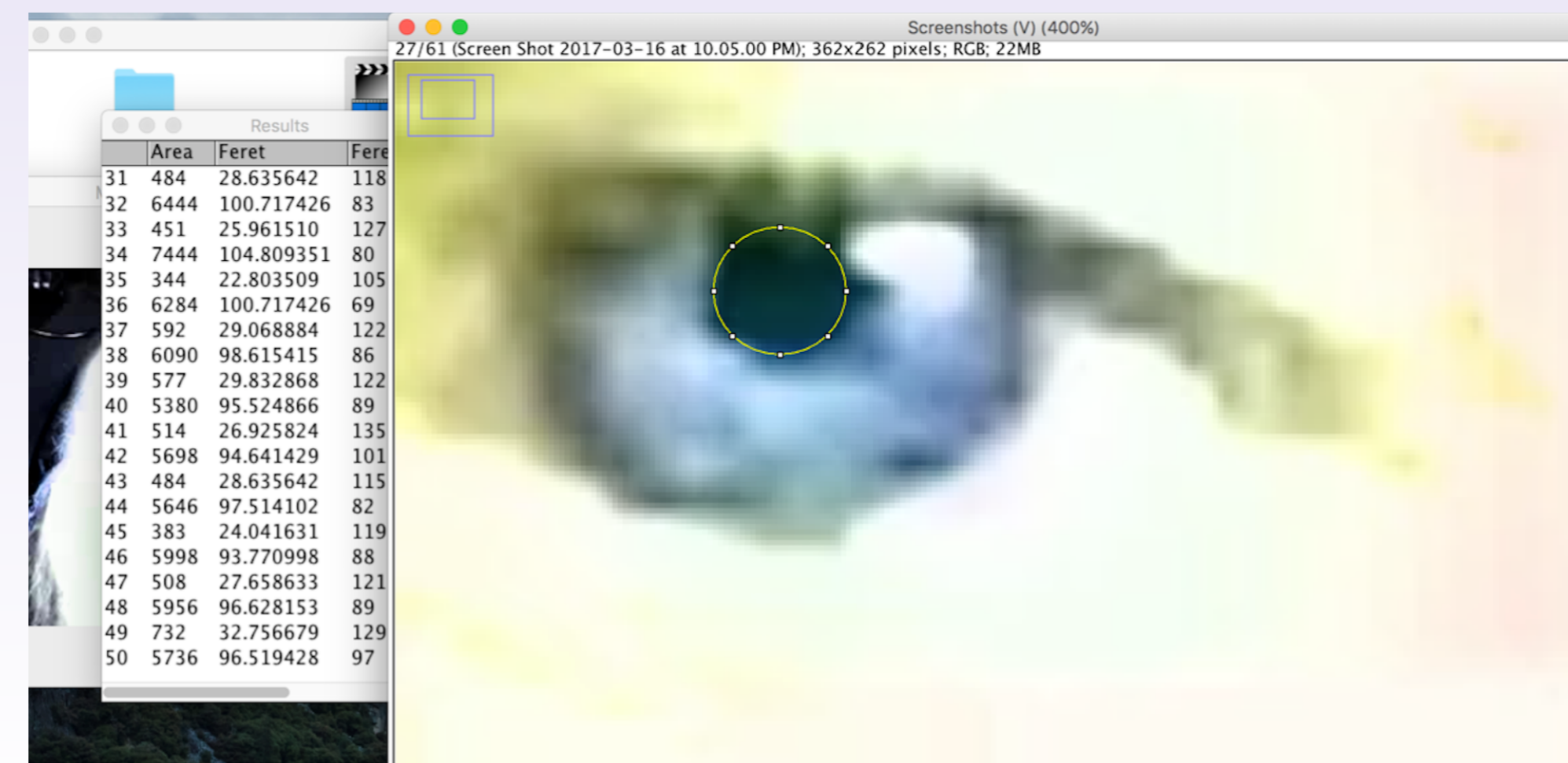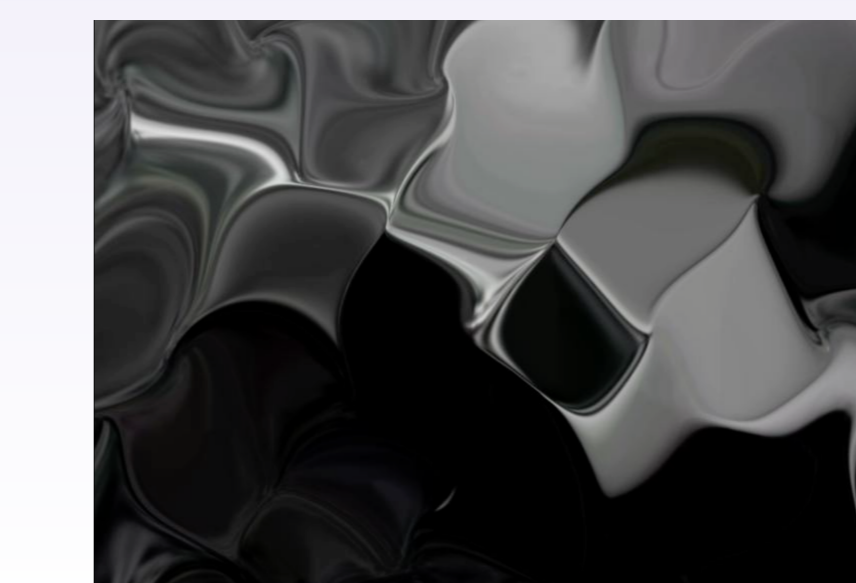
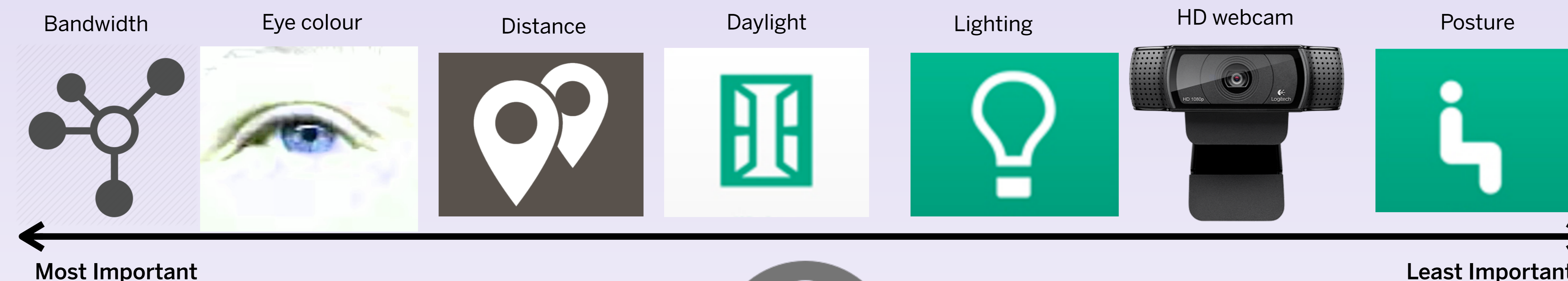Diffeowarping: Preserves perceptual characteristics while removing semantics

*Despicable me* (DM) (Intact left panel, warped right panel)

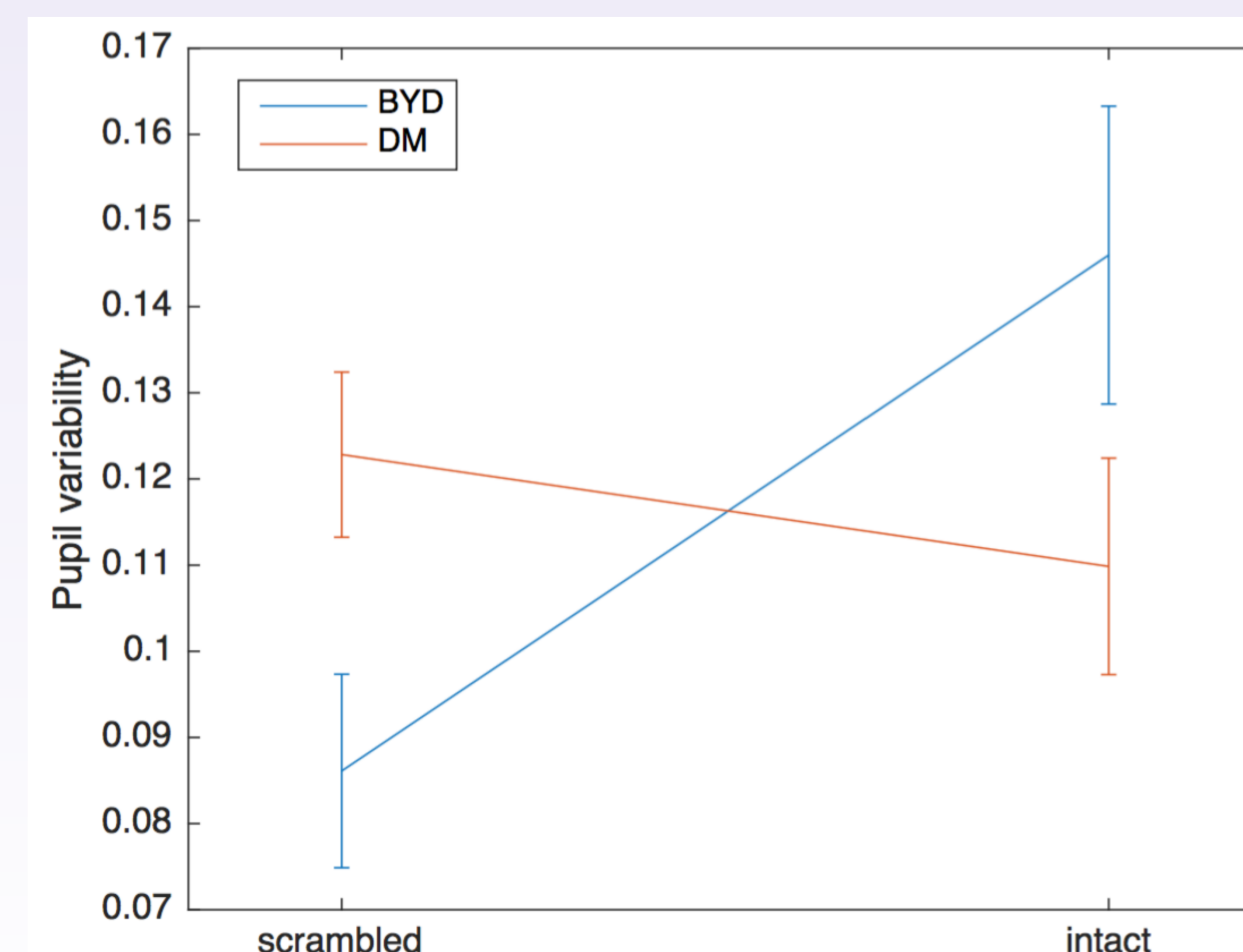*Bang! You're dead* (BYD) (Intact left panel, warped right panel)

## Results

Bandwidth    Eye colour    Distance    Daylight    Lighting    HD webcam    Posture

Most Important               Least Important

Investigated instructions for improving pupil acquisition

BYD pupil size variance of intact stimuli was greater than scrambled. $t(9)=2.76$, $p<0.02$.

| Study | | Instructions | | | | | Measurable subjects |
|---|---|---|---|---|---|---|---|
| #(n) | Visibility | Lighting | Distance | Bandwidth | HD webcam | Daylight | >90% |
| **1**(5) | Pupil | N/A | N/A | N/A | N/A | N/A | 0/5 |
| **2**(5) | Pupil | Well-lit | N/A | N/A | N/A | N/A | 1/5 |
| **3**(5) | Pupil | Well-lit | N/A | N/A | N/A | N/A | 2/5 |
| **4**(6) | Pupil | Behind | N/A | N/A | N/A | N/A | 1/6 |
| **5**(6) | Pupil/Iris distinction | Behind | ~12" | >15mpbs | ✓ | N/A | 1.5/6 |
| **6**(16) | Pupil/Iris distinction | In front | ~12" | >15mpbs | ✓ | N/A | 5/16 |
| **7**(30) | Pupil/Iris distinction | In front | ~8" | >15mpbs | ✓ | N/A | 2/30 |
| **8**(30) | Pupil/Iris distinction | In front | <3" | >50mpbs | ✓ | ✓ | 6/30 |
| **9**(30) | Pupil/Iris distinction | In front | <3" | >50mpbs | ✓ | ✓ | 5/30 |

Increased pupil variation in response to meaningful versus control stimuli suggests that we are measuring cognitive load

## Conclusions

- Mturk can be used to acquire pupil measures (a surrogate measure for attention and cognition) using our in-house methods.

- We validated our measurement methods as a reliable tool for measuring cognitive load. Participants showed increase cognitive load during BYD intact, relative to BYD scrambled, which is in agreement with previous studies.

- Moreover, we found the most important parameters for pupil diameter acquisition to be: bandwidth, eye colour, distance and daylight.

- The methods may serve as a future means of characterizing cognitive activation and potential emergence of cognition in infants.

## References

1. Tran, M., Cabral, L., Patel, R., Cusack, R. (in press). Online Recruitment and Testing of Infants with Mechanical Turk, Journal of Experimental Child Psychology
2. Muender, T., Miller, M. K., Birk, M. V., & Mandryk, R. L. (2016). Extracting Heart Rate from Videos of Online Participants.
3. Costa, V. D., & Rudebeck, P. H. (2016). More than Meets the Eye: the Relationship between Pupil Size and Locus Coeruleus Activity. Neuron, 89(1), 8–10. York, USA: ACM Press.

## Acknowledgements

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