Pupil Dilation in Time Perception

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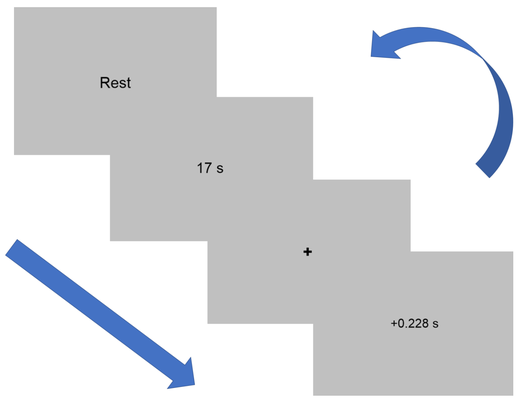
INTRODUCTION

- Time perception is an individual's subjective sense of the passage of time and relates to how they comprehend the duration, order, and pace of events in their environment.
- It is well established that demands on attention, working memory, decision-making, perception, memory recall, etc., cause pupil size to enlarge. These studies demonstrate that **throughout any type of effortful work, pupil size increases**.
- Longer tasks need the organization and control of thought and behavior across longer time periods. It has been demonstrated that while the present workload increased pupil size, the duration of the task at hand lowered it (Akgur, Gezici, and Farooqui, 2022).
- Based on previous studies, pupil size increases at any kind of load, especially when the task is difficult, thus, pupil size should be larger when participants replicate longer time periods. **We measured pupil size change across short and long time intervals in this study.**

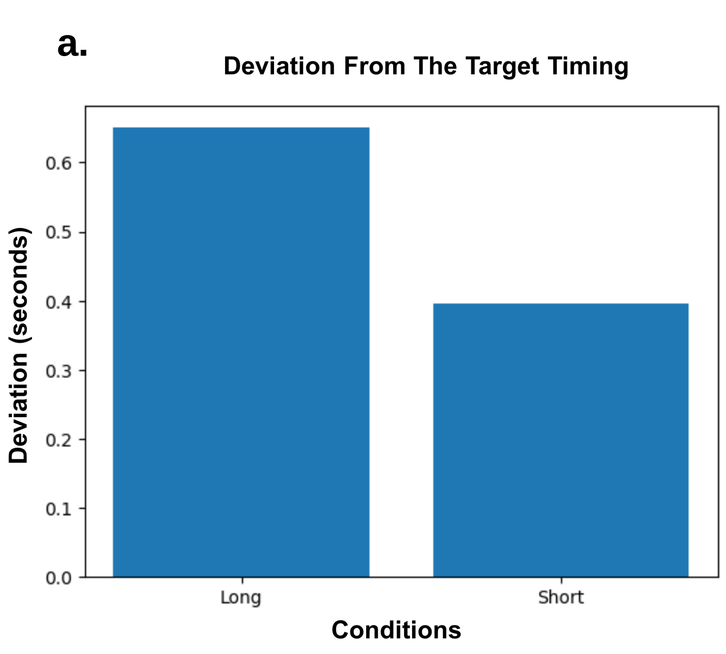
METHODS

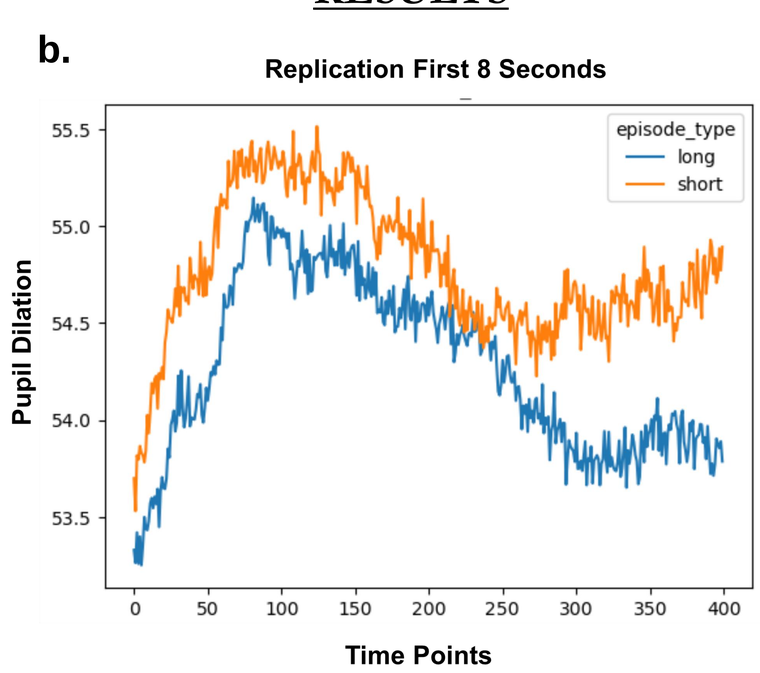
Experiment :

30 participants (21 females, ages 18-27) performed the task while their pupil size was measured via an eye-tracker. Participants were asked to replicate a time interval (ie. 17s) which was conveyed via a self-paced cue screen. After the cue screen, participants needed to keep an internal track of the time and press a key to mark the end of the episode when they thought the time interval had been reached. There were two types of episodes that determined the target replication interval: **short** (8-12 seconds) and **long** (14-18 seconds). After the episode ended, feedback was given to show how much they deviated from the target interval.



RESULTS





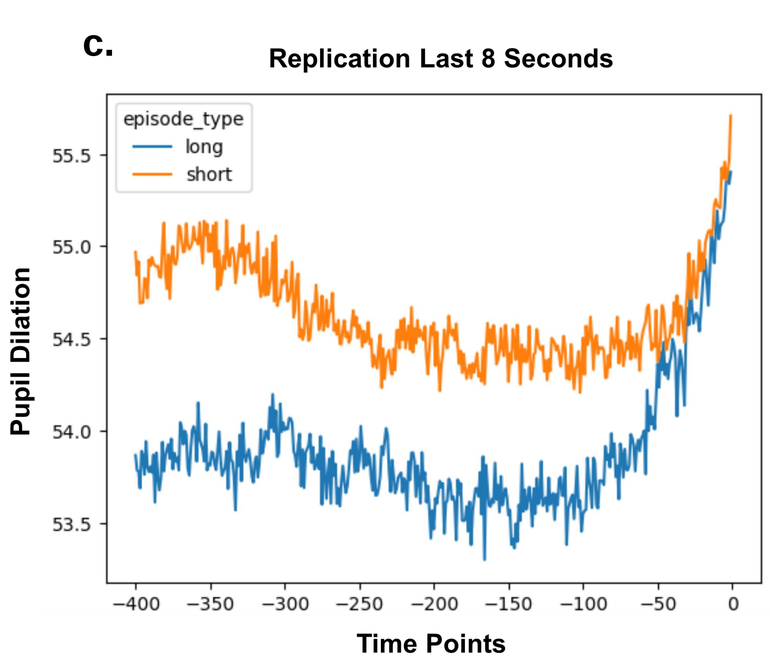


Figure. *a: Mean deviation difference between short and long time intervals while replicating the target. b: Pupil size time-series (1-time point = 20 ms) for the first 8 seconds in the replication task. c: Pupil size time-series (1-time point = 20 ms) for the last 8 seconds in the replication task.*

RESULTS

- The pupil size was expected to be larger in relation to a more demanding task, in longer time intervals.
- In contrast to the hypothesis, participants' pupil size was **larger** in short time intervals both at the beginning and end of the replication period.
- Whereas, there was no significant interaction effect found between conditions and pupil dilation in the first 400 time points, there was a **statistically significant interaction effect** in the last 400 time points.
- At the behavioral data, there was a **statistically significant mean difference** found between the deviation of the short and long conditions.

DISCUSSION

- We demonstrated that a particular type of cognitive load, contrary to the more widely known type, does not raise but rather **reduces** pupil size.
- At the replication task, each individual may use different higher-order cognitive processes like attention, recall, and decision-making which include multidimensional processes, and data from various sensory inputs. Thereby, it is not entirely clear which mechanism is used in time perception.
- Time perception can be influenced by internal states like arousal and mood (Suzuki, Kunimatsu, and Tanaka, 2016).
- Repeated time intervals may have shorter subjective duration than less repeated items due to a decrease in cognitive response to repeated presentations of the same component (Matthews, 2011).

REFERENCES

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