Precision of visual working memory is modulated by the cardiac cycle

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1. INTRODUCTION

Research has shown that **transient bodily fluctuations**, such as those linked to the cardiac cycle, impact the processing of external stimuli [1,2].

➢ Perceptual sensitivity tends to increase during **diastole** (when the heart relaxes and fills with blood) and decrease during **systole** (when the heart contracts and ejects blood) [3,4,5]. Yet, it remains unclear how the cardiac cycle influences later stages of cognitive processing.

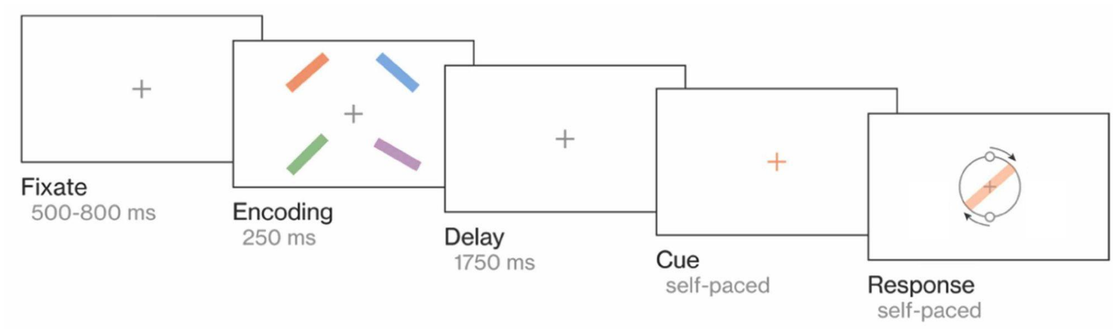
Hypothesis: If transient bodily fluctuations alter how we perceive stimuli, their temporary retention in Working Memory (WM) should be similarly affected

➢ We tested this by analyzing data previously collected by Nasrawi et al. (2025) [6], with the aim of informing a pre-registered study.

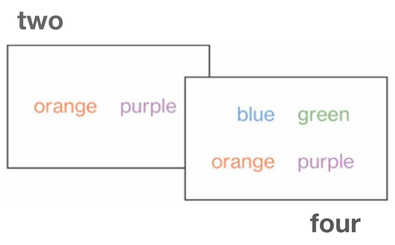
2. METHOD

Task and design

24 participants performed a **visual WM task** while their Electroencephalography (**EEG**) and Electromyography (EMG) were recorded. Electrocardiography (**ECG**) signal was derived from the EMG recording.



MEMORY LOAD



Participants memorized two or four items (memory load) and then reproduced the tilt of a cued item using a response dial (e.g., in the example above, they had to reproduce the tilt of the orange bar).

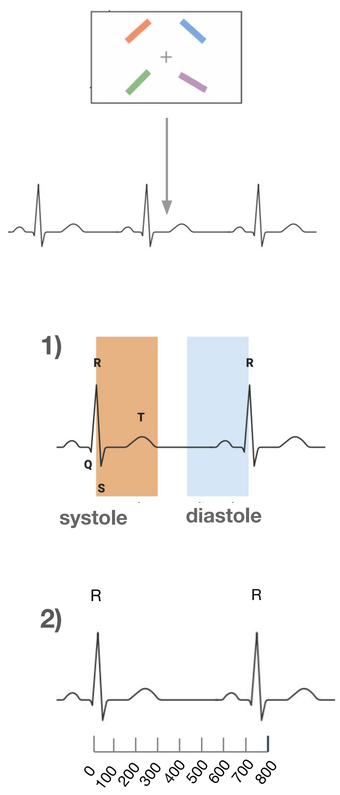
Pre-processing and analyses

WM precision, defined as the difference in degrees between the target orientation and the reproduced tilt, was computed based on the timing of **encoding** relative to:

1) **Cardiac Phase** (systole vs diastole)

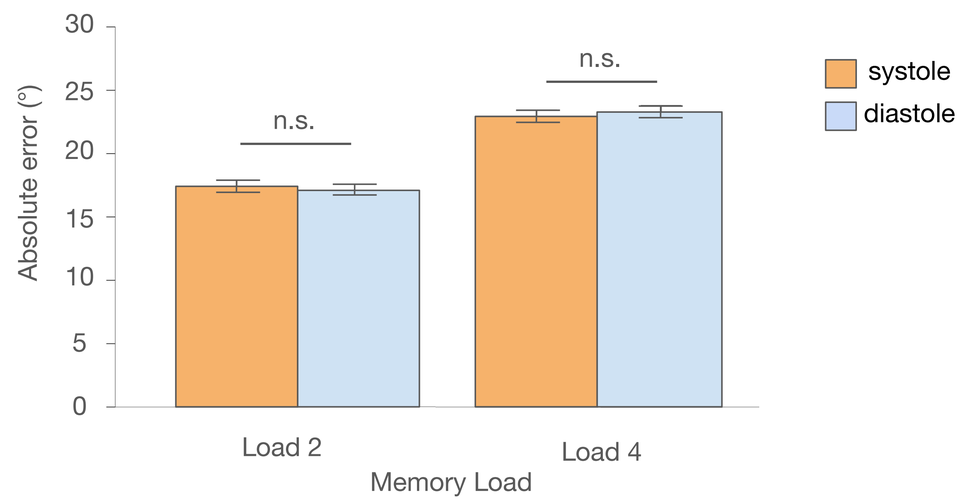
2) **Time after each heartbeat** (measured from the R-peak in consecutive 100ms bins)

The systolic and diastolic windows, and the timing relative to the R-peak were defined a posteriori for each cardiac cycle, from consecutive R-R peaks.

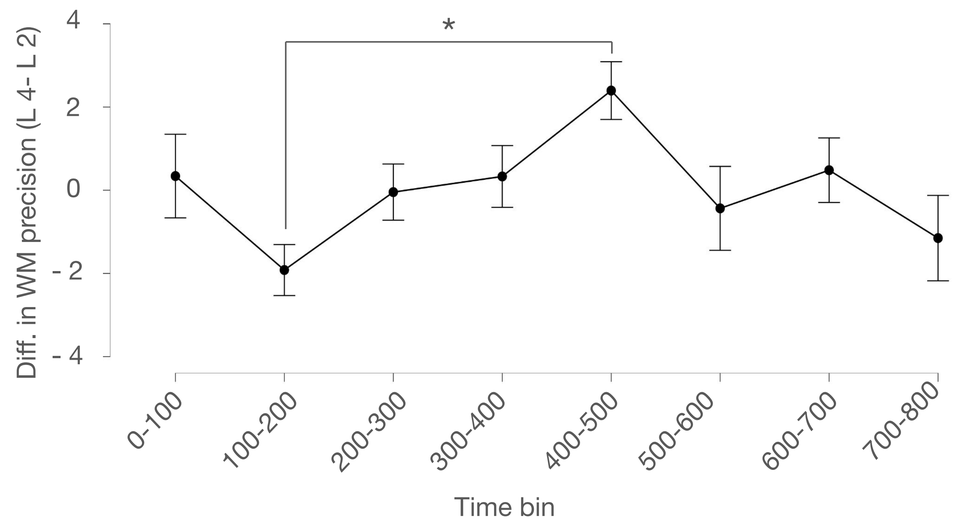


3. RESULTS

a) Working Memory precision as a function of cardiac phase



b) Diff. in WM precision as a function of time relative to the start of the cardiac cycle



a) Average absolute error (in degrees) for stimuli encoded in systole (orange) and diastole (blue) in low (left) and high memory conditions (right). The 2x2 rmANOVA (memory load x cardiac phase) revealed no significant effect of cardiac phase (p= 0.46) on WM precision.

b) Difference (Load 4 – Load 2) in mean-centered error (in degrees) over time from the R-peak. Negative scores indicate higher precision in load 4 compared to load 2. The 2×8 rmANOVA (memory load x cardiac timing) showed a significant interaction between memory load and cardiac timing ($p = 0.026$). Post-hoc comparisons indicated that stimuli encoded between 100–200 ms were recalled with greater precision than those encoded between 400–500 ms ($p = 0.027$), but only in the high memory load condition (Load 4).

4. DISCUSSION

➢ These findings provide preliminary evidence that the cardiac cycle influences WM processing, indicating that transient bodily fluctuations impact not only perception of sensory stimuli but also their storage and manipulation.

NEXT STEP To understand the underlying mechanisms, we will investigate whether EEG activity phase-locked to the cardiac cycle (i.e., Heartbeat Evoked Potentials [HEPs]) predicts WM precision.

5. REFERENCES

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