Exploring two interaction mechanisms for in-vehicle touch screens: Peripheral Vision and Muscle Memory

Ayse Eren, Gary Burnett, Catherine Harvey, David Large

University of Nottingham

Human Factors Research Group

ezxale@nottingham.ac.uk

Introduction

Background

- Develop a set of design recommendations for in-vehicle touch screens to achieve non-visual interaction
- Previous studies focussed on display characteristics:
  - Button size
  - Button location
  - Number of buttons
  - Contrast levels

- Understanding strategies adopted by drivers when interacting with in-vehicle displays
- Peripheral vision and muscle memory in literature:
  - Research focuses on using peripheral vision to keep an eye on the road during secondary tasks (Summala et al., 1996; Horrey and Wickens, 2004)
  - Muscle memory can be used as an interaction mechanism to decrease eyes off road time (Proteau et al., 1987)

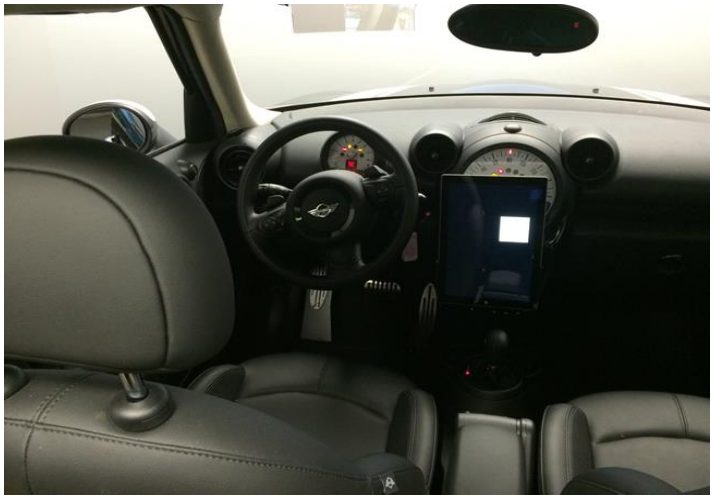
Method

Aim: Investigate the effects of interaction mechanism (peripheral vision and muscle memory) and button size (small, medium and large) on secondary task performance

- 25 participants – 12 Female, 13 Male
- Mean age = 25.5 years
- All participants held a US driving licence
- Driving simulator at Virginia Tech, US
- Independent variables
  - Interaction Mechanism – Peripheral Vision and Muscle Memory
  - Button Size – small (6x6cm), medium (10x10cm) and large (14x14cm)
- Dependant variables:
  - Task time
  - NASA TLX

Method

- 24 button presses for each condition
- 6 conditions in total (3 button sizes x 2 interaction mechanisms)
- Button location stayed the same in each condition but changed between conditions
- Peripheral vision condition:
  - Participant looks straight ahead throughout
- Muscle memory condition
  - Participant wears glasses to block peripheral vision
- “Perform the task as quickly and as accurately as possible”

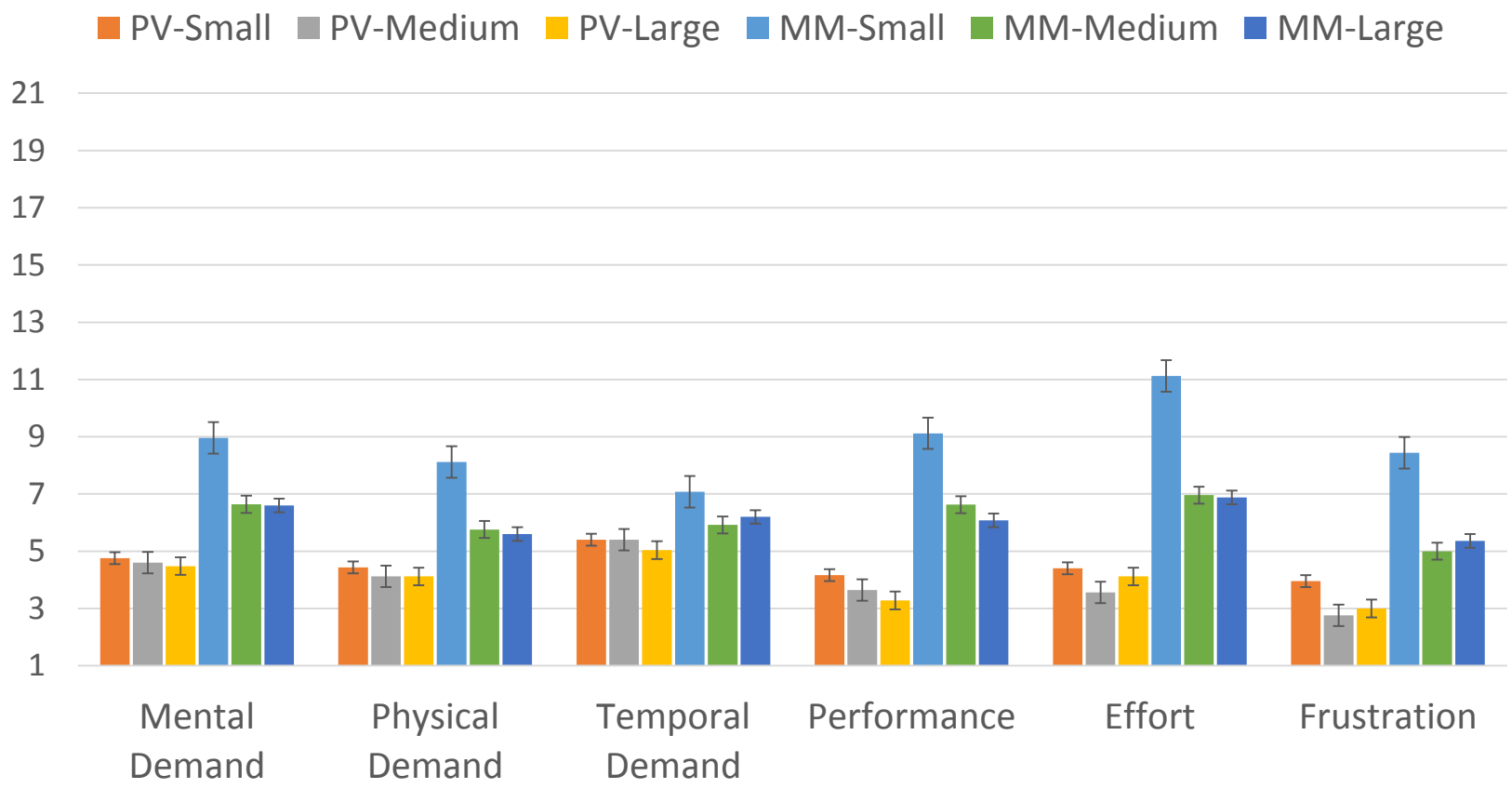


Hypotheses

1. During muscle memory conditions task time (time to select a single button) will initially be high, however this will gradually decrease due to the muscle memory build up over a number of exposures;
2. Small button muscle memory condition will have the highest task time as this is expected to be the most difficult task which will require more effort;
3. As peripheral vision does not change throughout each condition (participants were asked to focus on the car ahead hence peripheral vision stayed constant) it is expected that task time for peripheral vision conditions (small, medium and large button size) will stay constant within each condition;
4. Overall, peripheral vision conditions will have a lower task time compared to the muscle memory conditions.

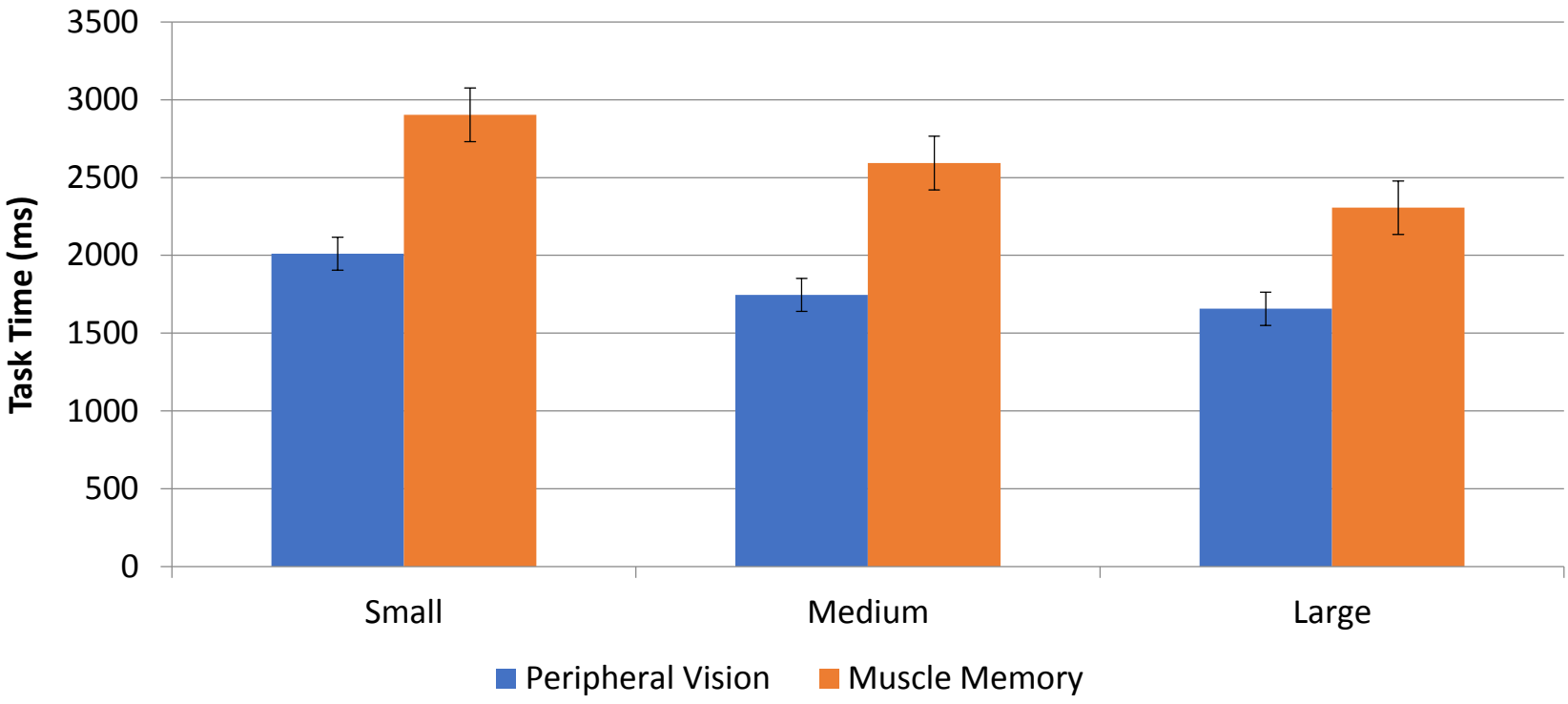
Results

NASA TLX



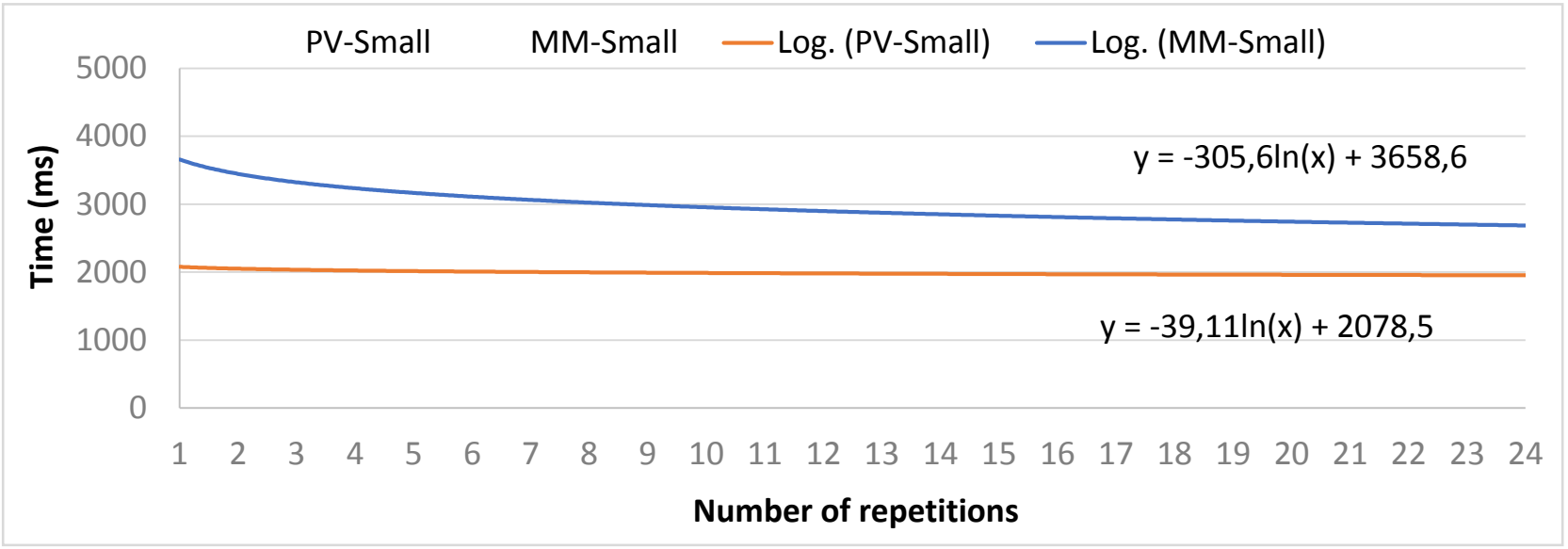
No significant difference. However a trend was observed; muscle memory conditions have higher workload scores

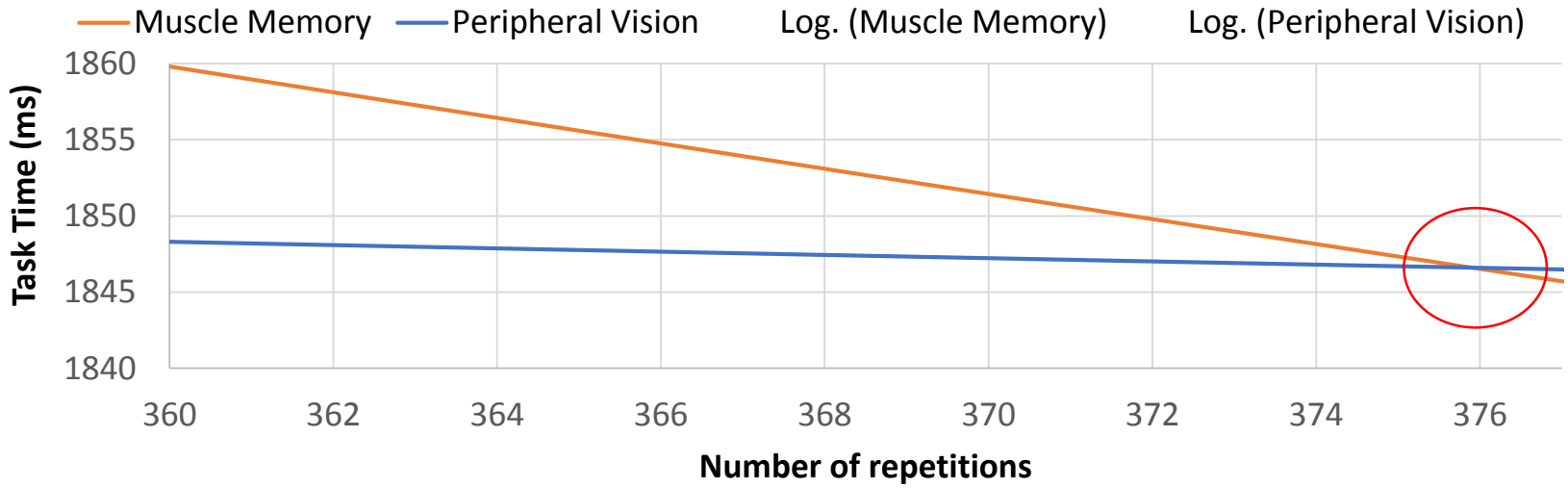
Task Time



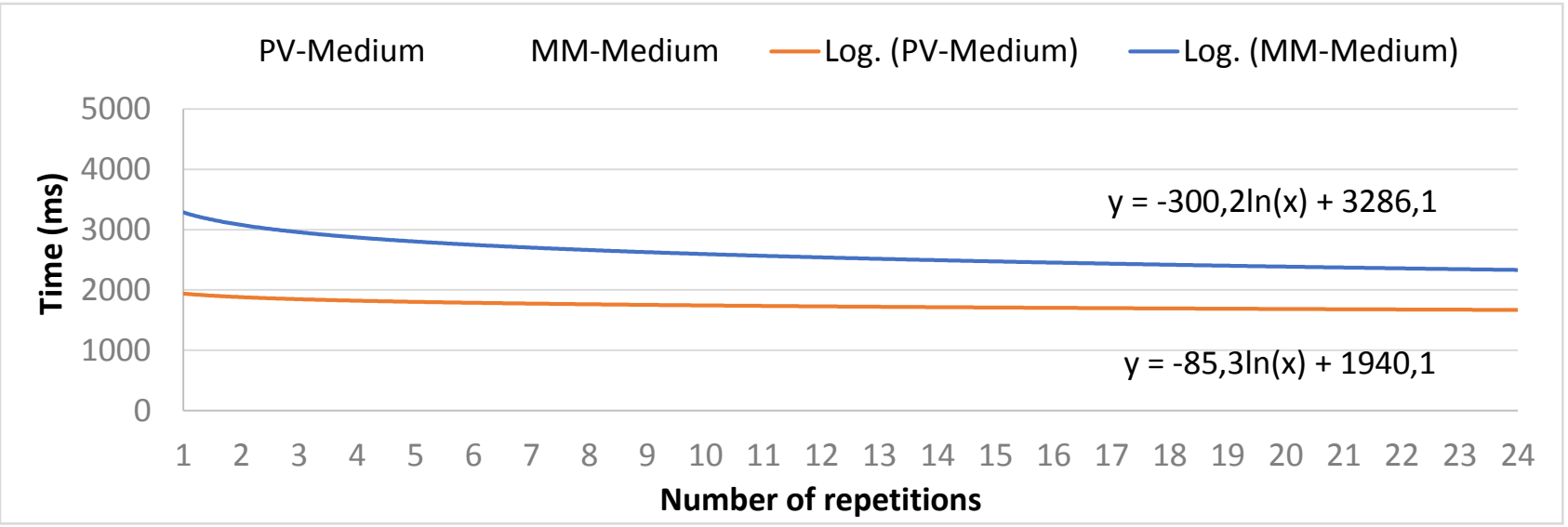
Task time is higher in muscle memory conditions compared to peripheral vision. Small buttons also have a higher task time than medium and large buttons.

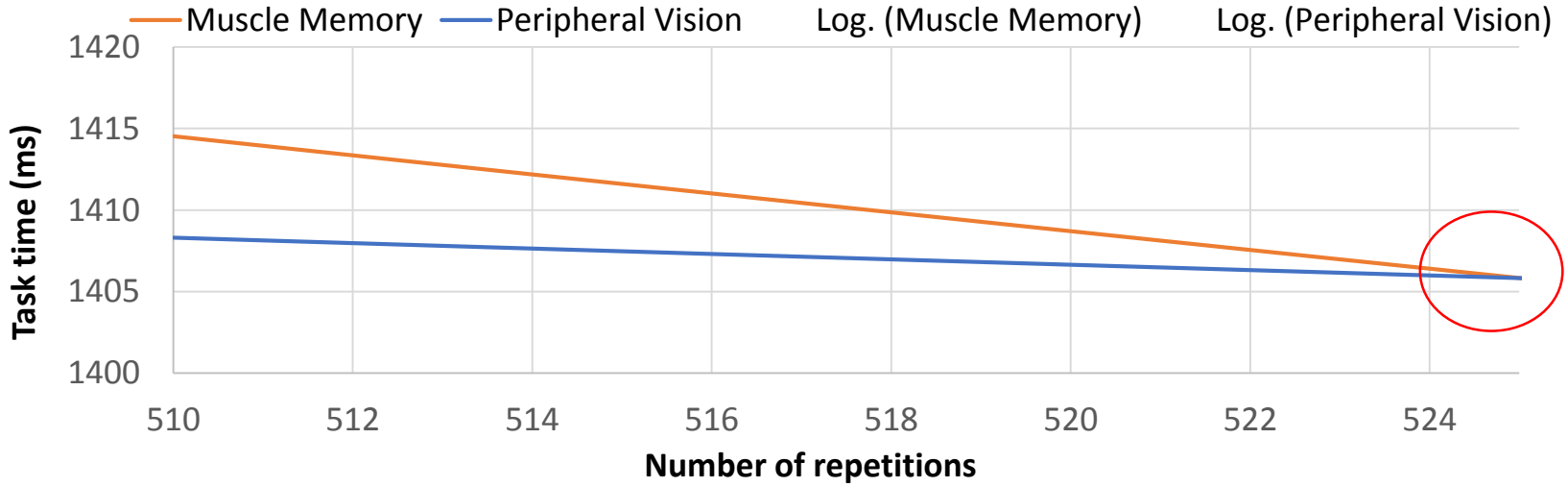
Task Time (Small Buttons)



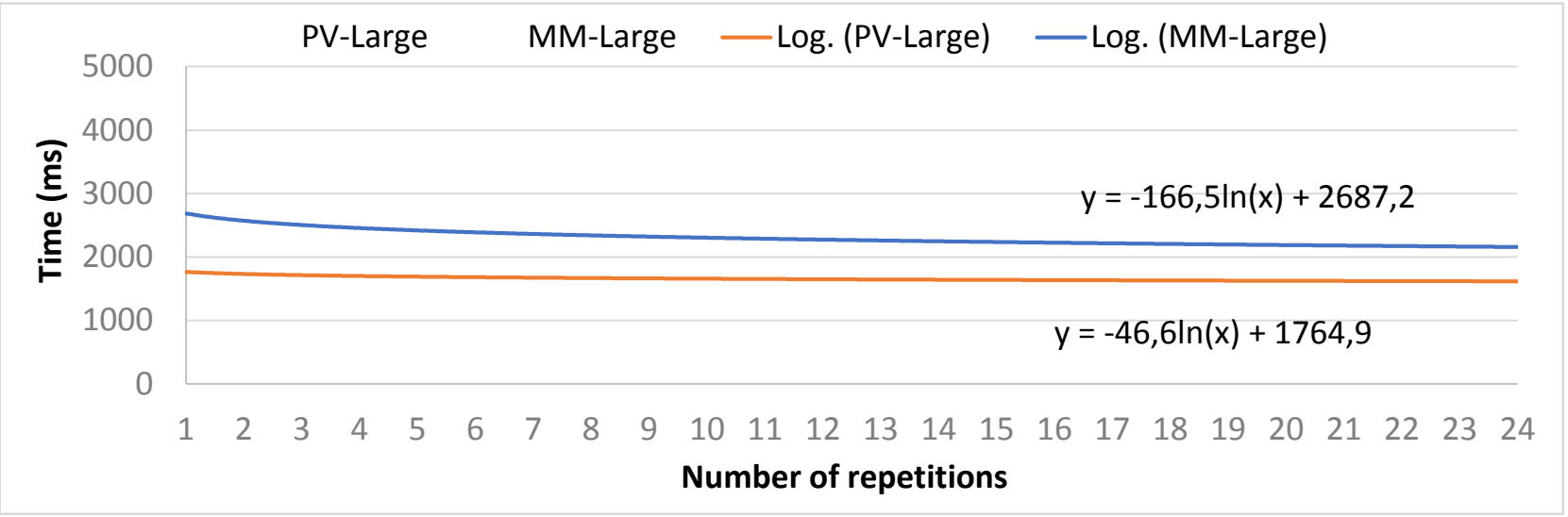


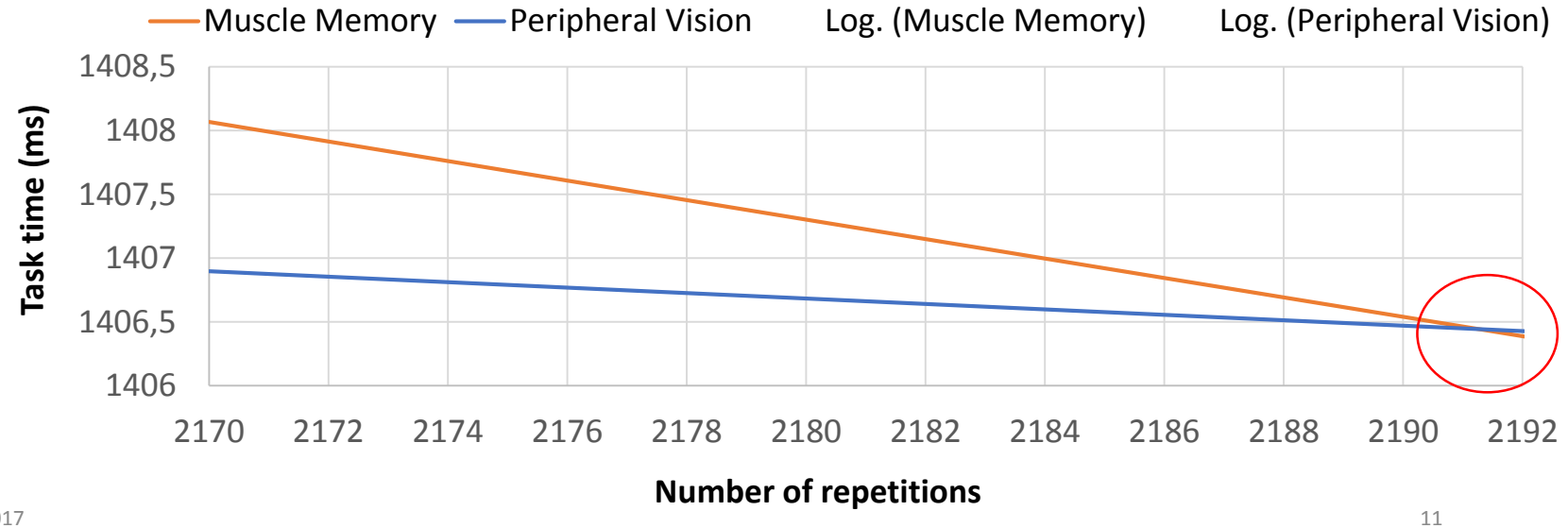
Task Time (Medium Buttons)





Task Time (Large Buttons)





Conclusions

1. Task time was initially higher for muscle memory conditions but decreased over time
2. Small button muscle memory condition had the highest task time and was also perceived to be the most demanding
3. Peripheral vision task time was relatively constant overall
4. Peripheral vision task time was lower than muscle memory task time overall

Peripheral vision is a viable interaction mechanism that would help achieve non-visual interaction

Future Work

- More number of buttons
- Introduction of driving task and different levels of complexity
- Comparison with foveal vision
- Design and testing of a prototype ‘peripheral vision friendly’ interface

Thank you

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