

A Pilot Study Investigating Pupil Diameter and HRV for Mental Workload Assessment in Cyclists

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Introduction

- Previous studies have investigated objective measures for mental workload (MWL) during non-competitive cycling based on heart rate variability (HRV) and pupil diameter.
- These studies assume that infrastructure designs (such as road layouts and bike lane widths) influence MWL.
- There has been no systematic comparison of the suitability of these measures for assessing changes in MWL.

Objective

- Evaluating the ability of HRV measures and pupil diameter in differentiating levels of MWL during cycling.

Method

Design

- MWL manipulation surrounding traffic

Traffic-Free



Traffic-Present



Sample

- $N = 13$ (6 f); age $M = 23$, $SD = 1.59$
- all right-handed; no prior experience with cycling simulators ($n = 11$)

UniBw M Cycling Simulator

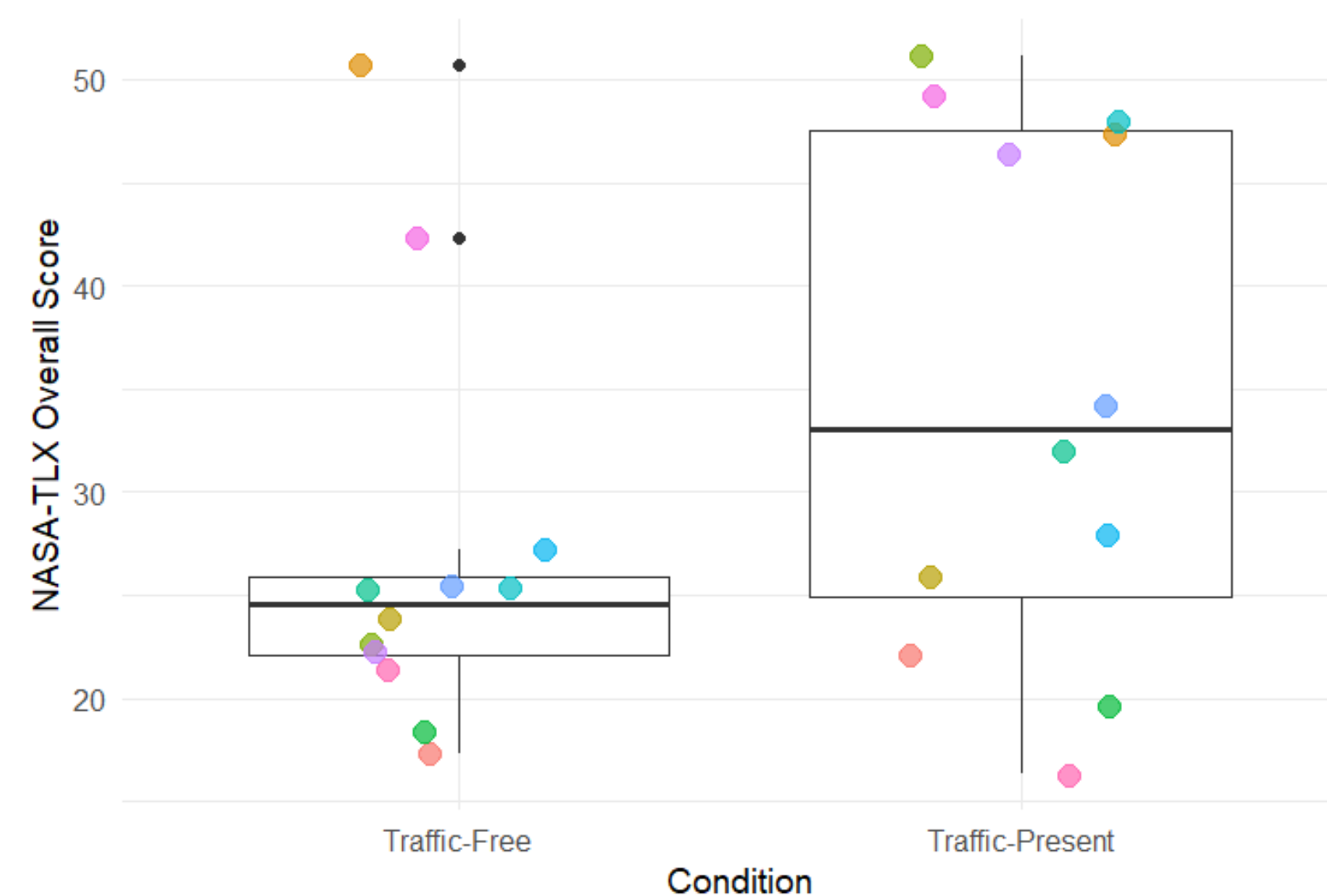


Measures

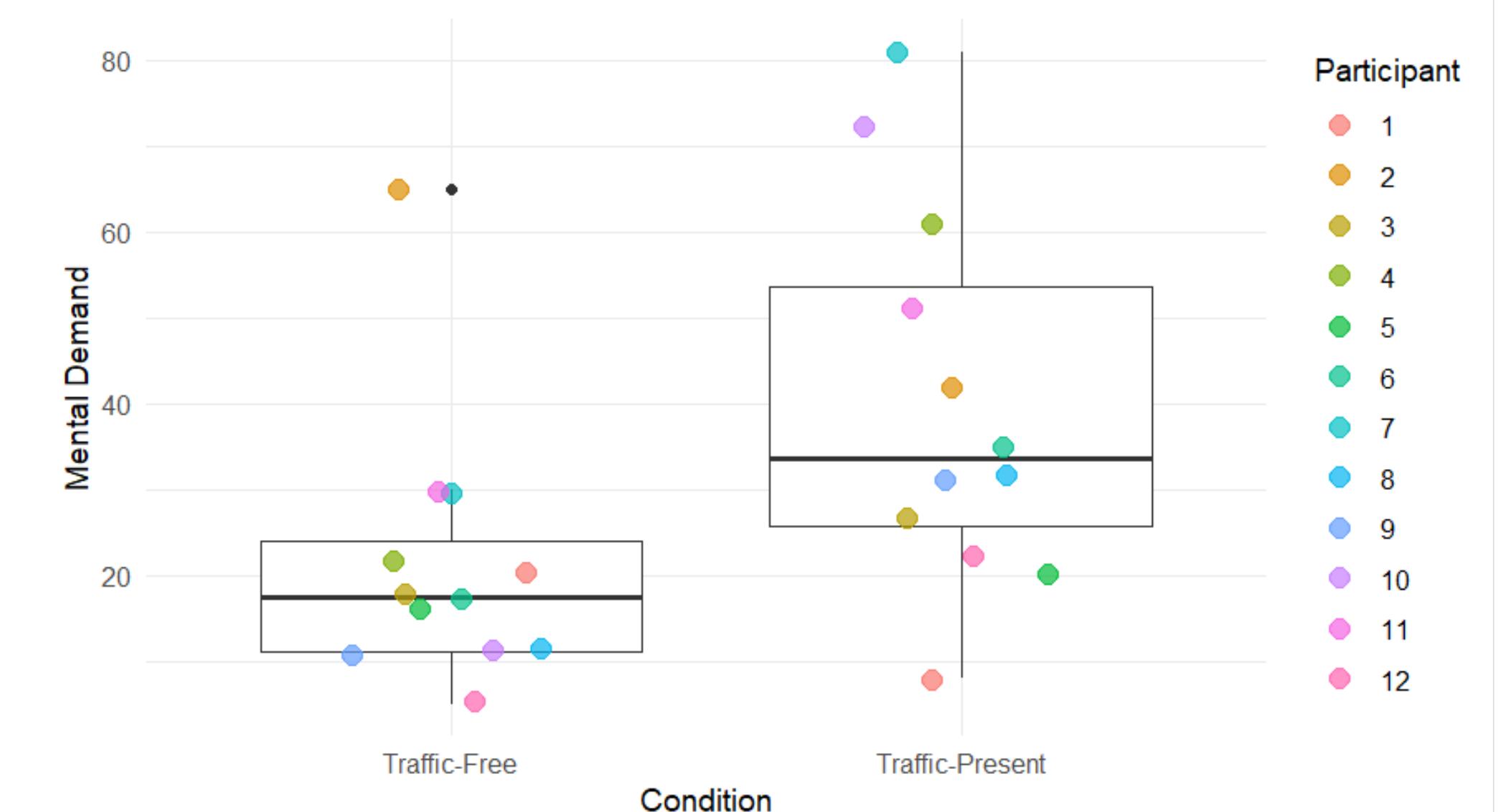
- NASA-TLX** as ground truth
- HRV** (BIOPAC MP160 & ECG100C)
- Pupil Diameter** (Tobii Pro Glasses 3)

Results

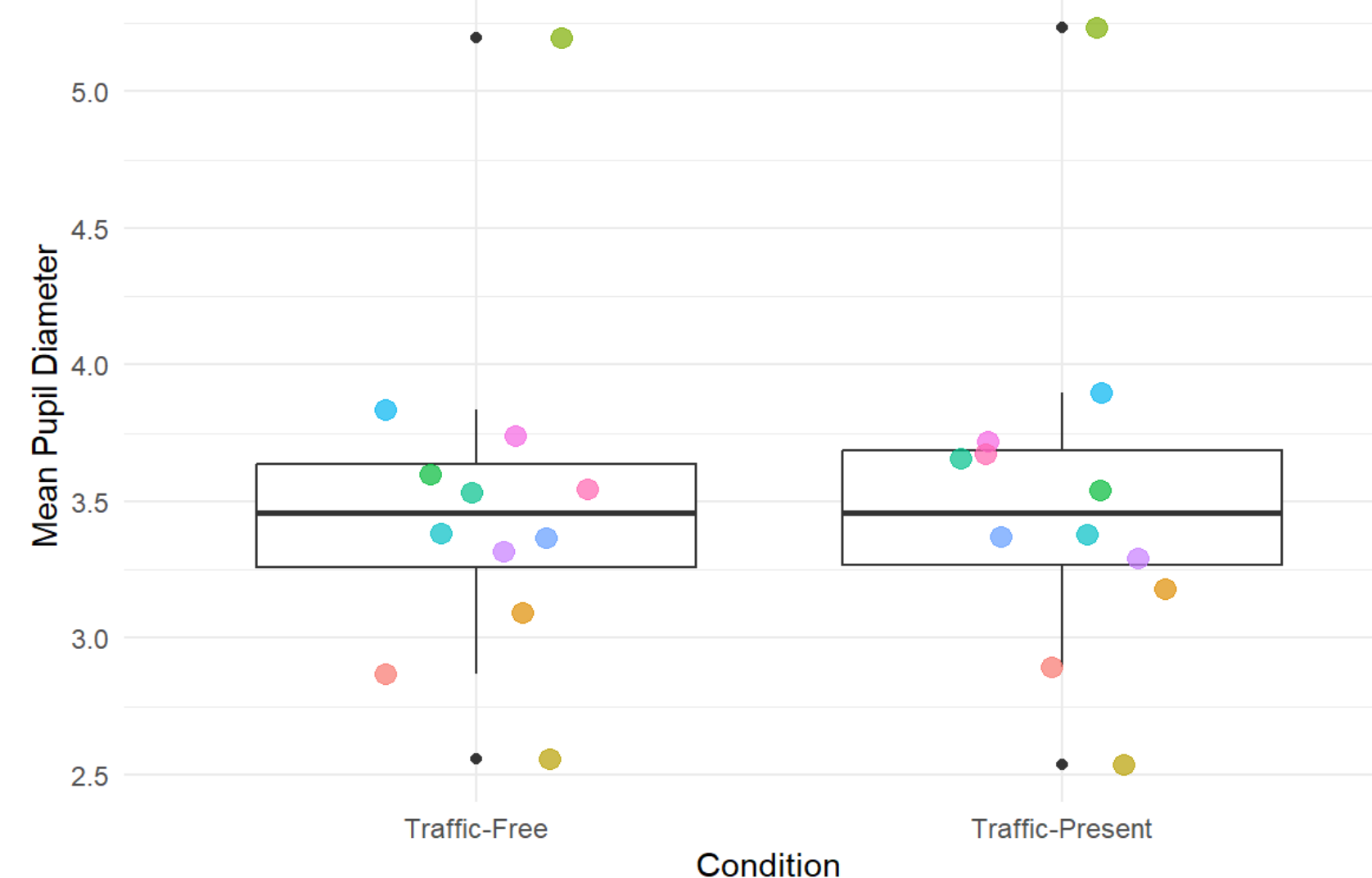
NASA-TLX Overall Score



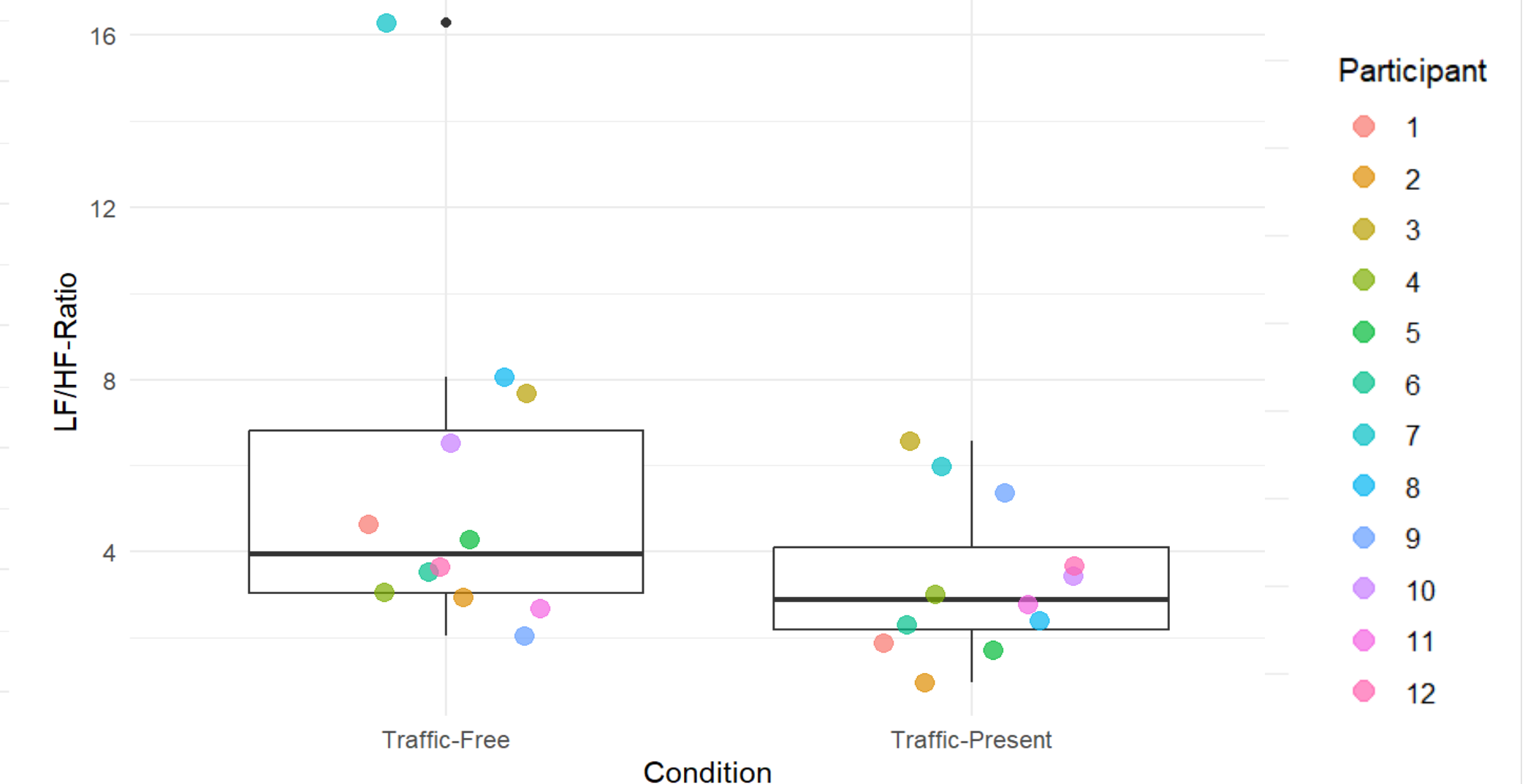
NASA-TLX Mental Demand



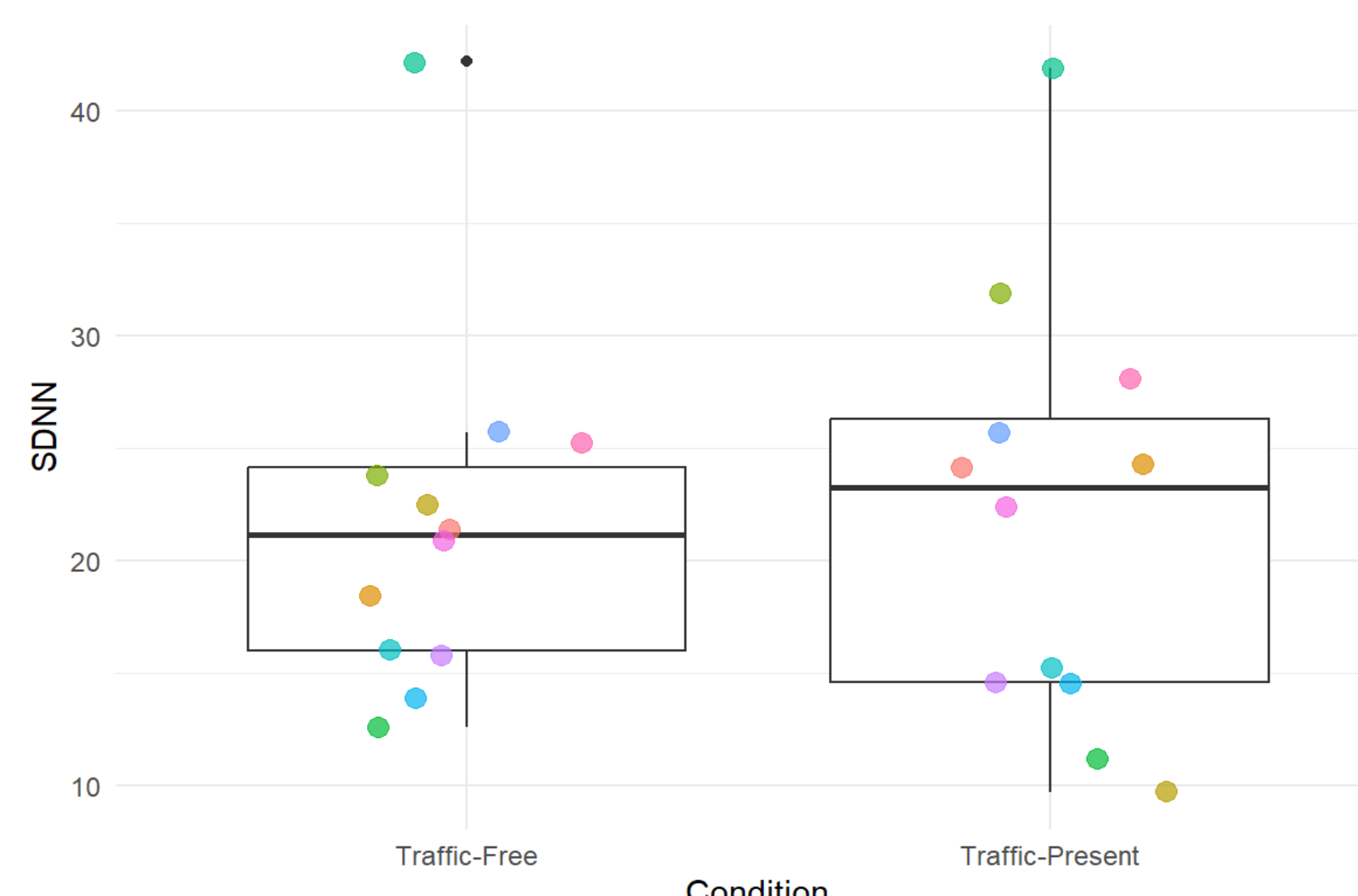
Pupil Diameter



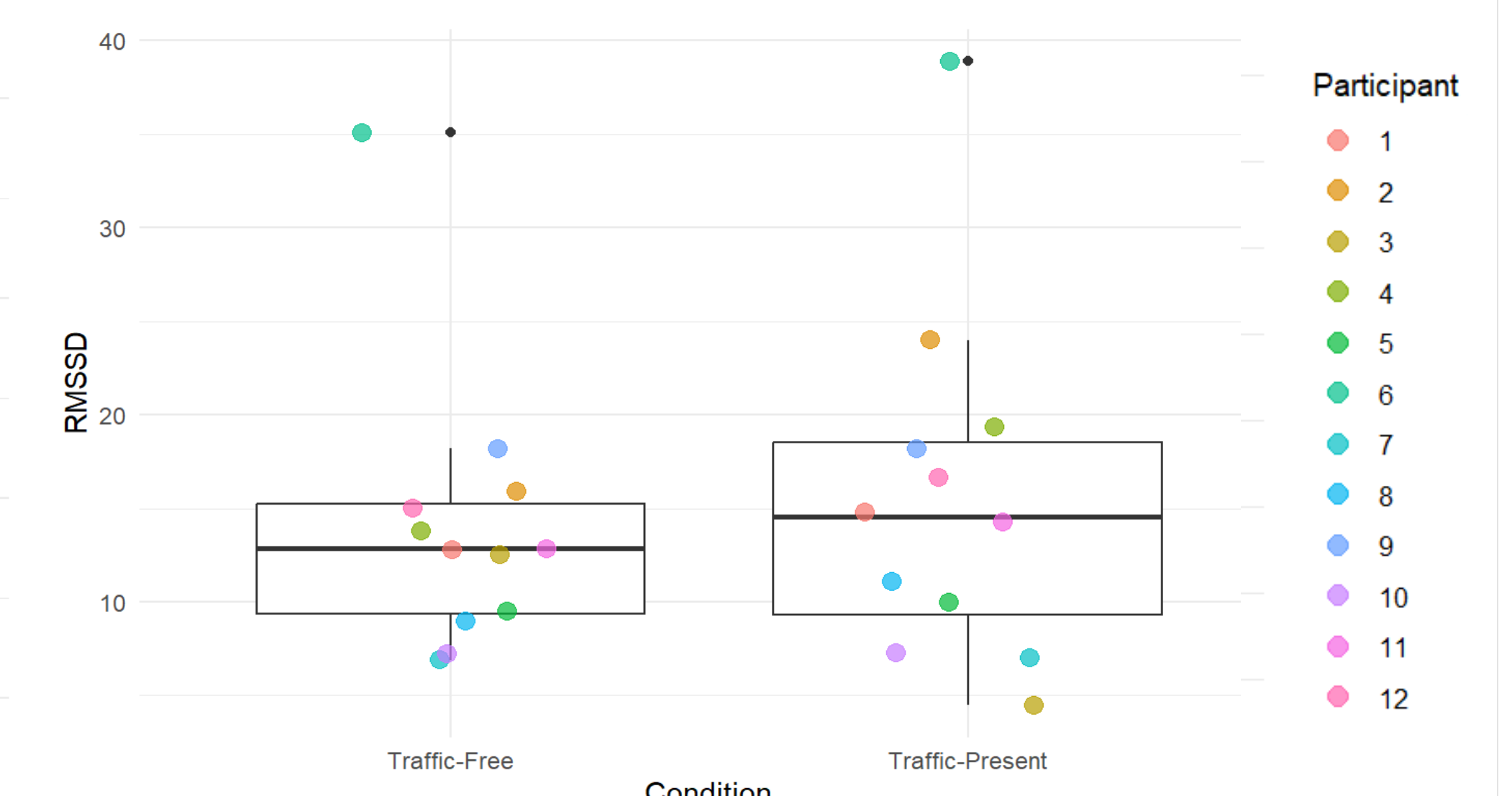
HRV Low-to-High Frequency Ratio



HRV Standard Deviation of NN intervals



HRV Root Mean Square of Successive Differences



- $t(11) = -1.63$, $p = .066$
- no significant effect of MWL levels

- $t(11) = 2.16$, $p = .027$
- increased MWL $\rightarrow$ decreased LF/HF-Ratio

Conclusion

- Traffic-induced MWL differences in simulated cycling only showed in reduced LF/HF-Ratio



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