



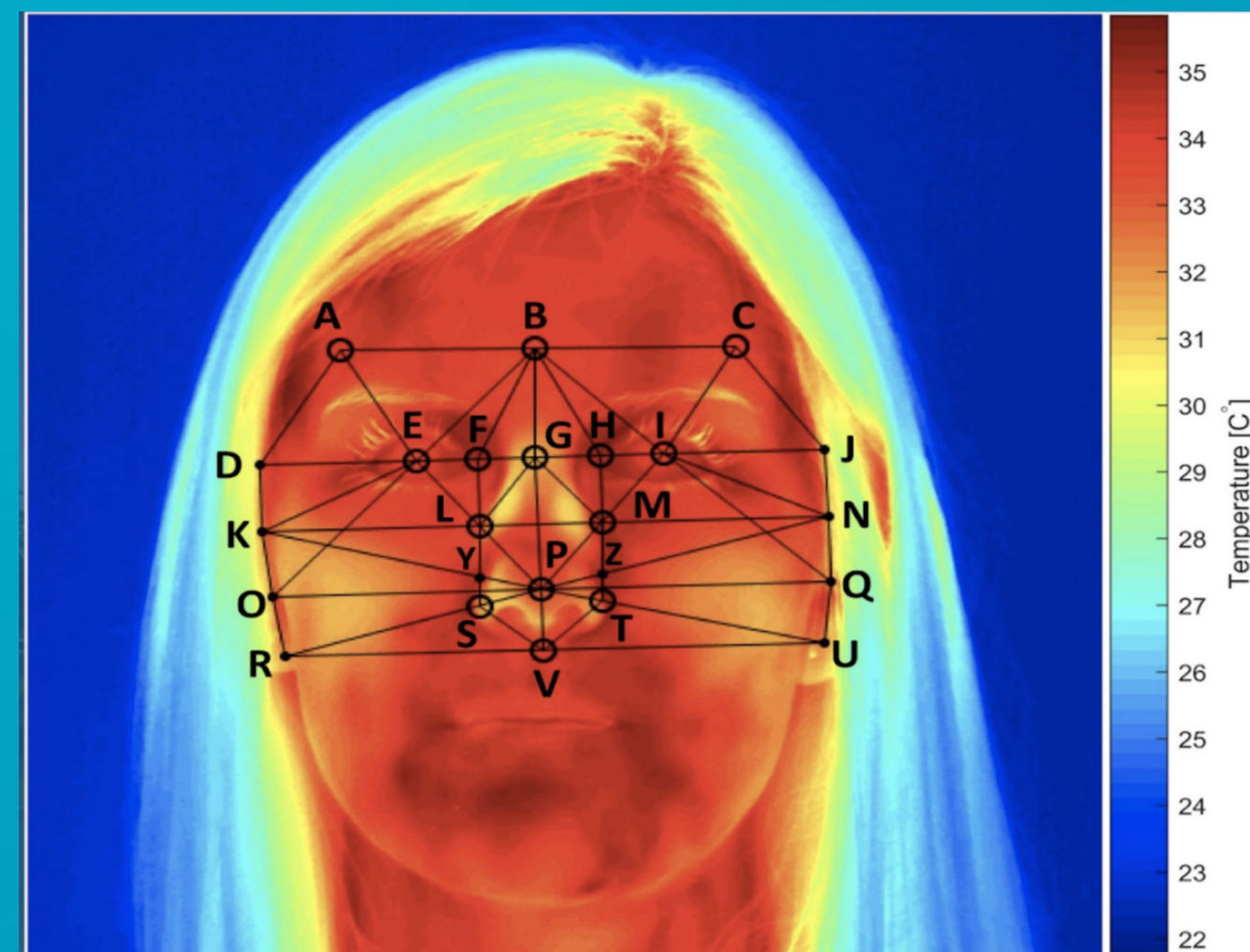
Comparing fNIRS and Facial Thermography for Assessing Mental Workload

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fNIRS and Facial Thermography

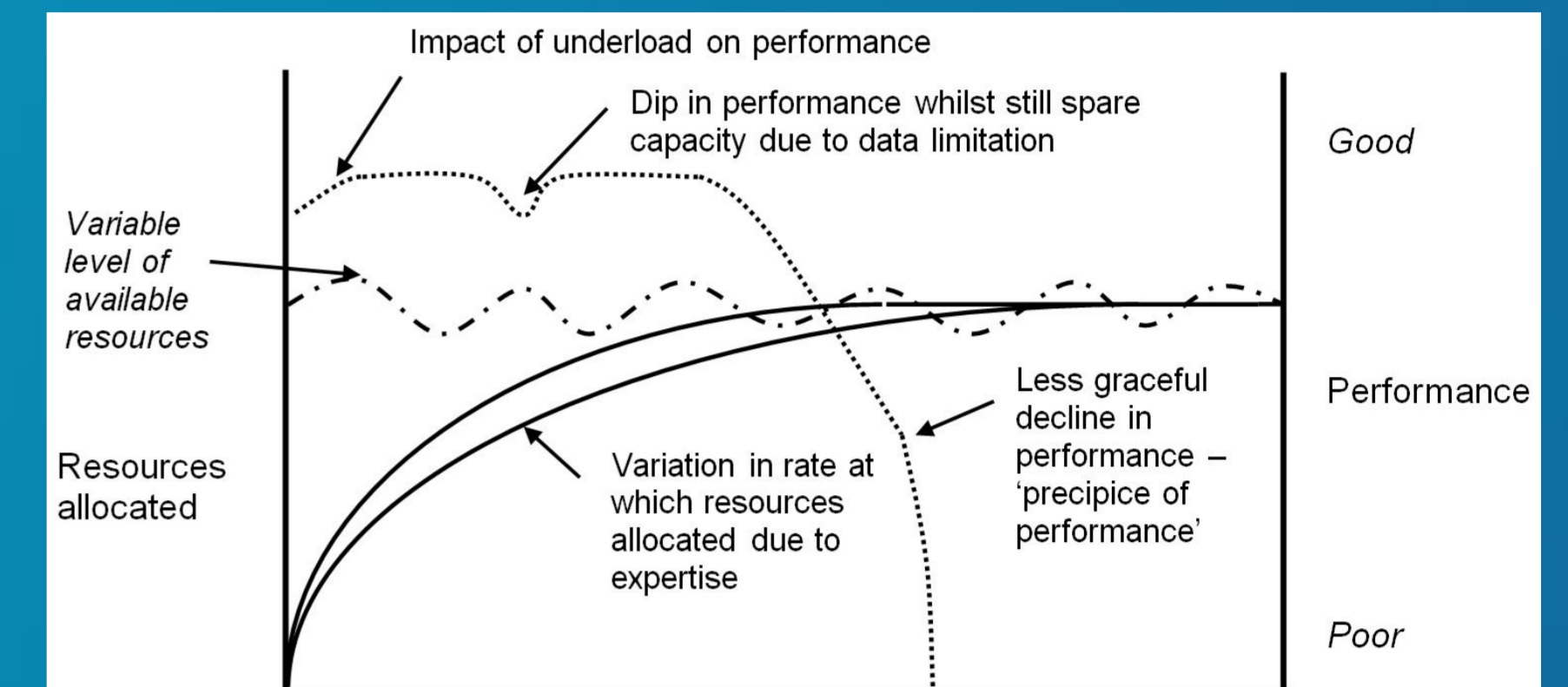
Our team have also studied **Facial Thermography** - off-body measurements of face temperature from a thermal camera. Results from prior work [1] show that it can estimate Mental Workload well.

Essentially, nose temperature drops with high Mental Workload.



Mental Workload

An established concept from Human Factors clearly manipulated by psychology tasks e.g. n-back

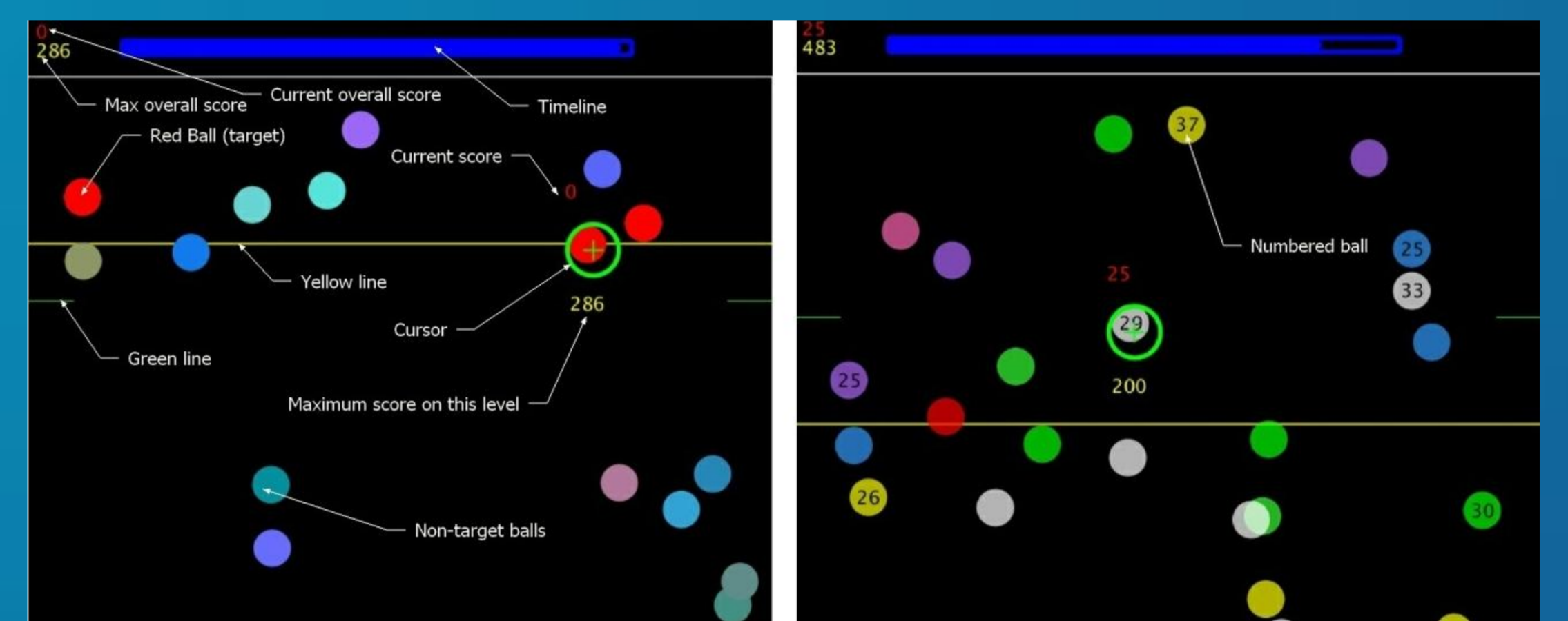


Research Aims

1. Compare the ability of fNIRS and Facial Thermography to estimate Mental Workload
2. Evaluate their *sensitivity, reliability, diagnosticity, and acceptability* [2]

We made these assessments in the context of subjective ratings (Instantaneous Self Assessment (Verbal)) and Zephyr strap data.

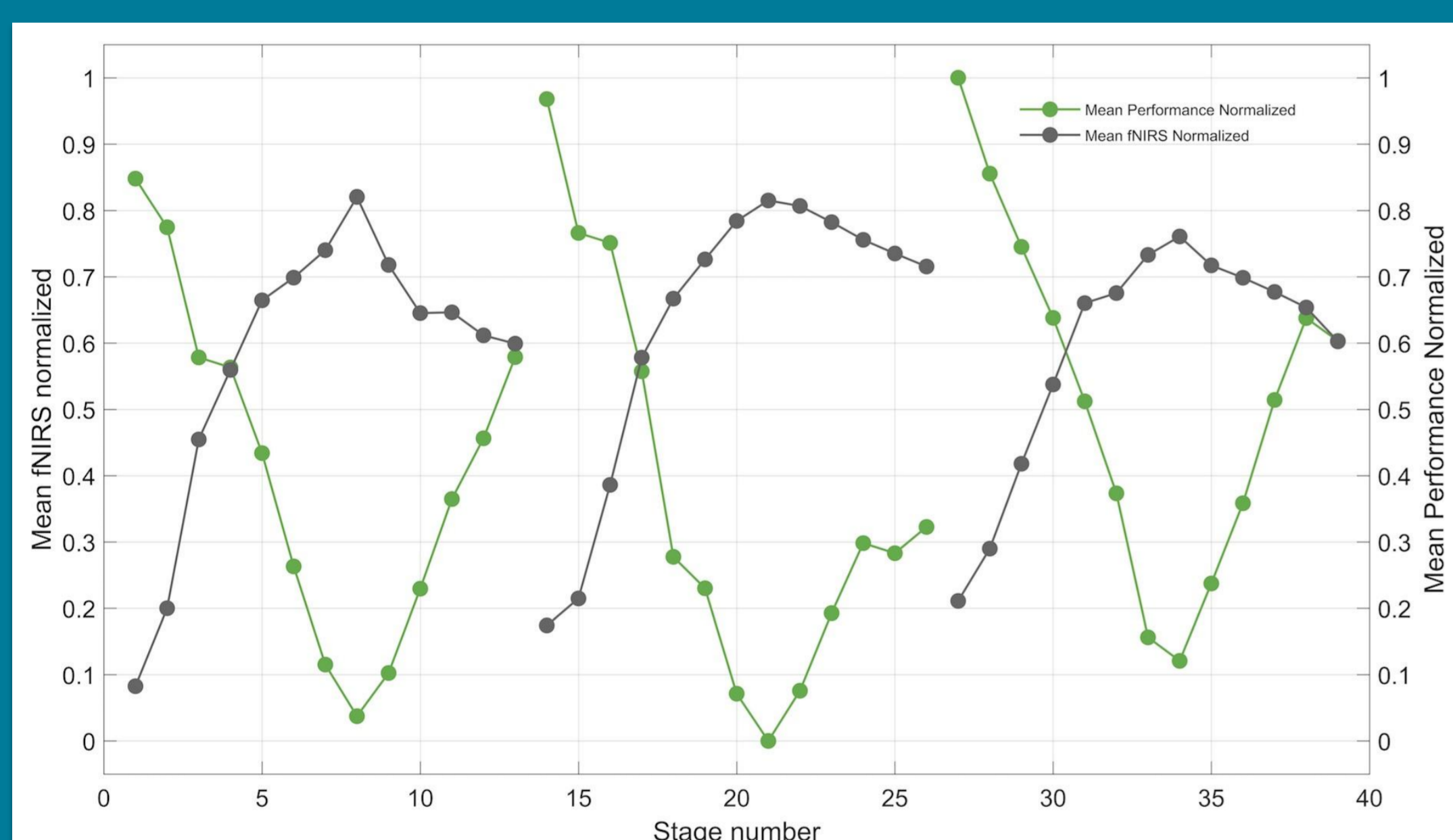
Task Demand (Game)



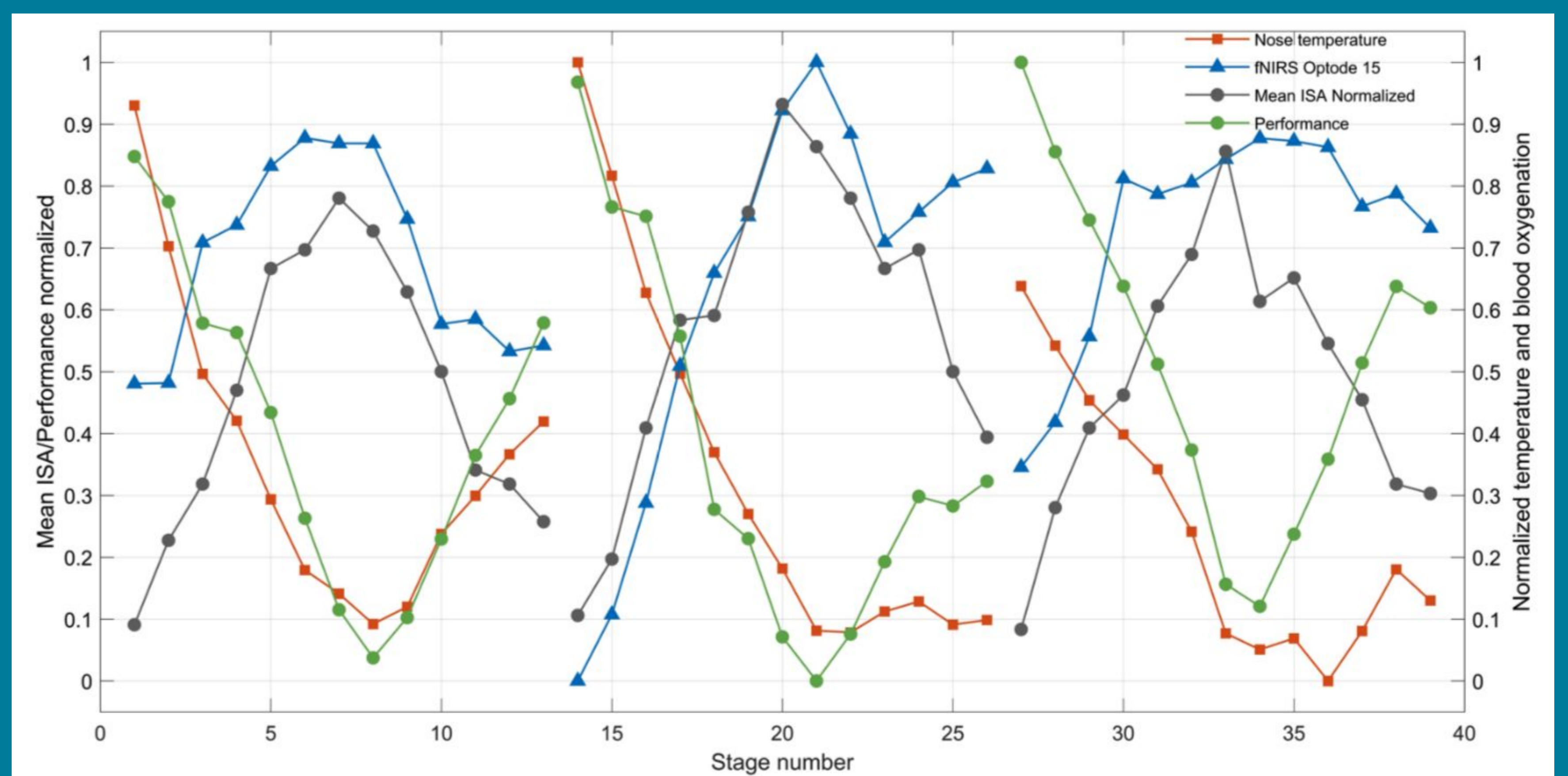
Easy: shoot red falling targets

Hard: odd numbered red targets

Findings



Comparison between Task performance and the fNIRS data across participants



Relationship between subjective workload scores (ISA), fNIRS, Facial Thermography and Performance (an example from one participant).

9	0.8	0.7	0.6	0.5	0.6	0.6	0.6	0.1	0.6	0.7	0.6	0.6	0.7	0.7	0.7
8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0	0.7	0.3	0.8	0.7	0.7	0.7	0.7
7	0.7	0.8	0.8	0.9	0.6	0.6	0.6	0.5	0.8	0.7	0.8	0.7	0.8	0.7	0.8
6	0.6	0.6	0.7	0.7	0.6	0.7	0.7	0.7	0.6	0.7	0.7	0.6	0.6	0.7	0.7
5	0.5	0.3	0.6	0.5	0.5	0.5	0.5	0.6	0.6	0.5	0.6	0.5	0.6	0.4	0.5
4	0	0.2	0	0.3	0.1	0.2	0.4	0.1	0.2	0.2	0.3	0.1	0	0	0
3	0.7	0.5	0.6	0.3	0.7	0.7	0.7	0.5	0.7	0.5	0.6	0.4	0.5	0.4	0.8
2	0.4	0.3	0.3	0.1	0	0.6	0.1	0	0.1	0	0	0	0.1	0.4	0.3
1	0.6	0.1	0.6	0.6	0.6	0.6	0.7	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.7

Correlation table of ISA subjective workload and fNIRS workload measure per channel and participant

Comparison between techniques

- Subjective workload scores using ISA correlated strongly with performance for 11/11 participants.
- fNIRS correlated strongly with performance for 7/7 (data loss).
- Facial thermography correlated with performance for only 4/11.
- Subjective workload scores using ISA also correlated with fNIRS and facial thermography

References

- [1] Adrian C. Marinescu, Sarah Sharples, Alastair C. Ritchie, Tomas Sánchez López, Michael McDowell, and Hervé P Morvan (2017). Physiological parameter response to variation of mental workload. Human factors, Vol 60, Issue 1, pp. 31 - 56.
- [2] Sharples, Sarah and Megaw, Ted (2015). Definition and Measurement of Human Workload. In Evaluation of human work, Wilson John R and Sharples Sarah (Eds.). CRC Press.

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