

Spare mental capacity is related to oxyhemoglobin concentrations (HbO) in the prefrontal cortex and heart rate (variability)

Exploring the relationship between changes in spare mental capacity and multimodal (psycho)physiological measurements in a multitask environment

INTRO

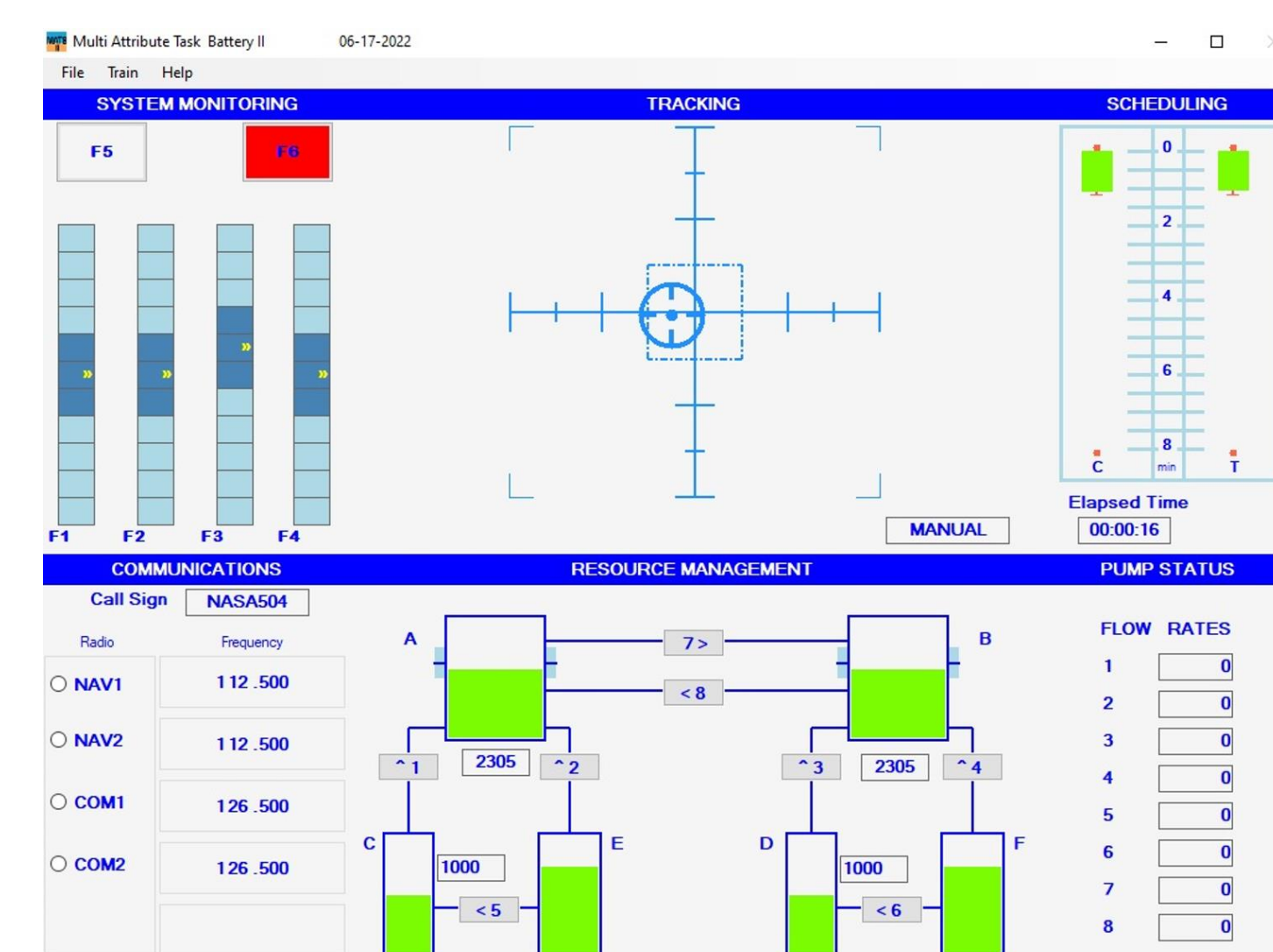
- Previous research focused on assessing the spare mental capacity of operators within high-risk jobs with self-ratings and performance
- Current study explores whether (psycho)physiological measures such as oxyhemoglobin concentrations in the prefrontal cortex (HbO), heart rate and heart rate variability (HRV) are related to the spare mental capacity

METHODS

- N = 20
- Collected during **five** conditions:
 - performance on all tasks,
 - subjective workload and
 - (psycho)physiological measures: Heart Rate (Variability), HbO and HbR
- Tested with linear mixed-effects model analyses

CONDITIONS

- Primary task with **varying** difficulty: Multi-Attribute Task Battery (MATB-II)

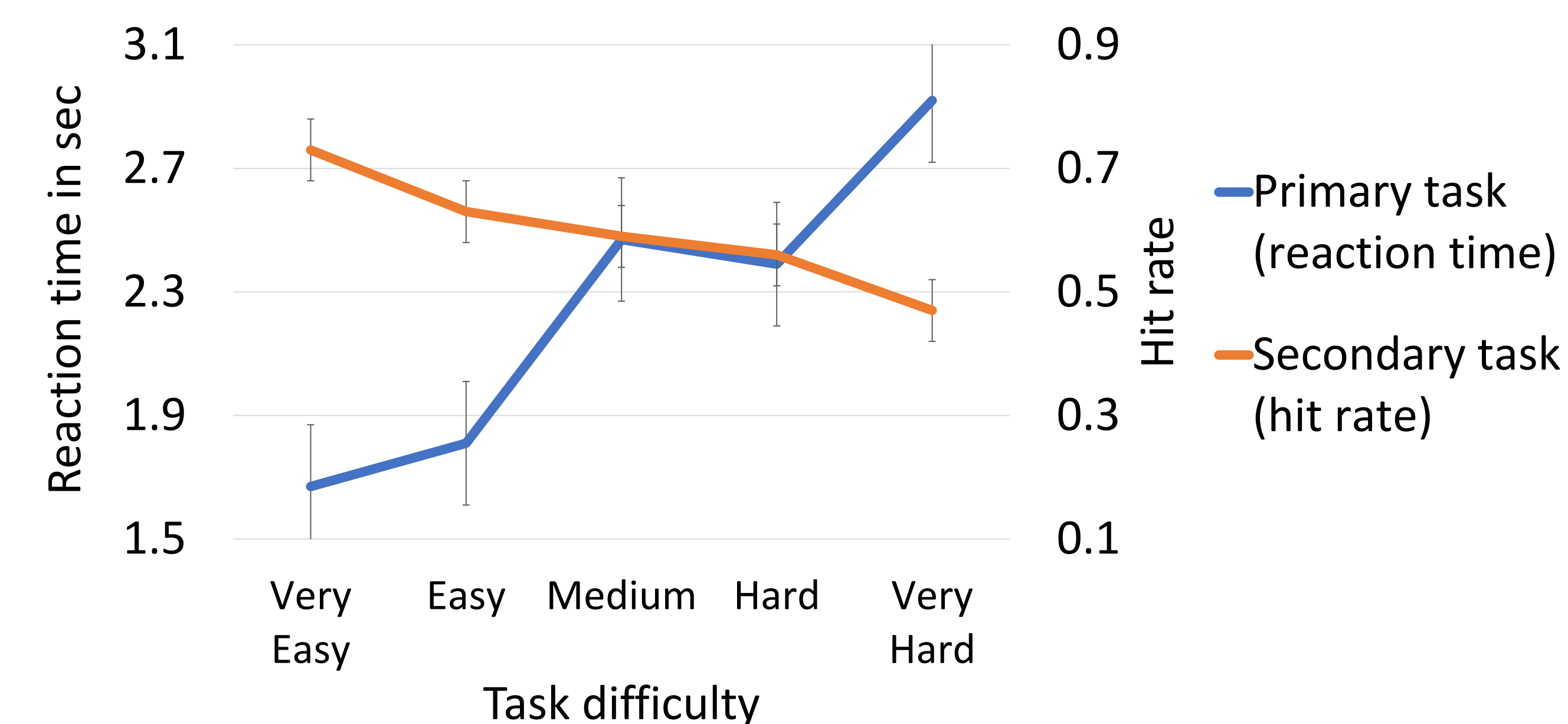


- Secondary task with **equal** difficulty: Auditory 1-back Task

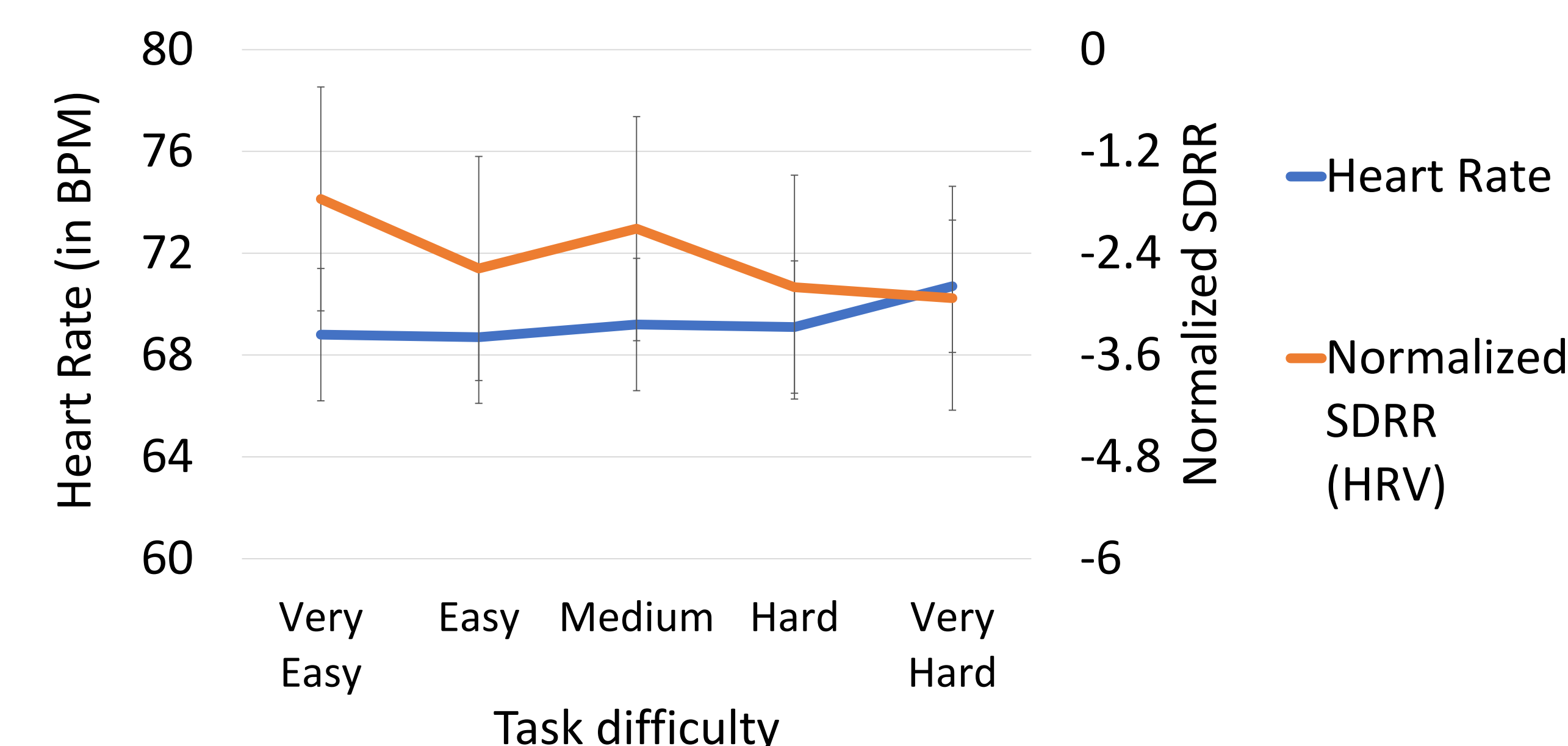
SPARE MENTAL CAPACITY

- Hit rate (from 0 to 1) on secondary task to assess spare mental capacity

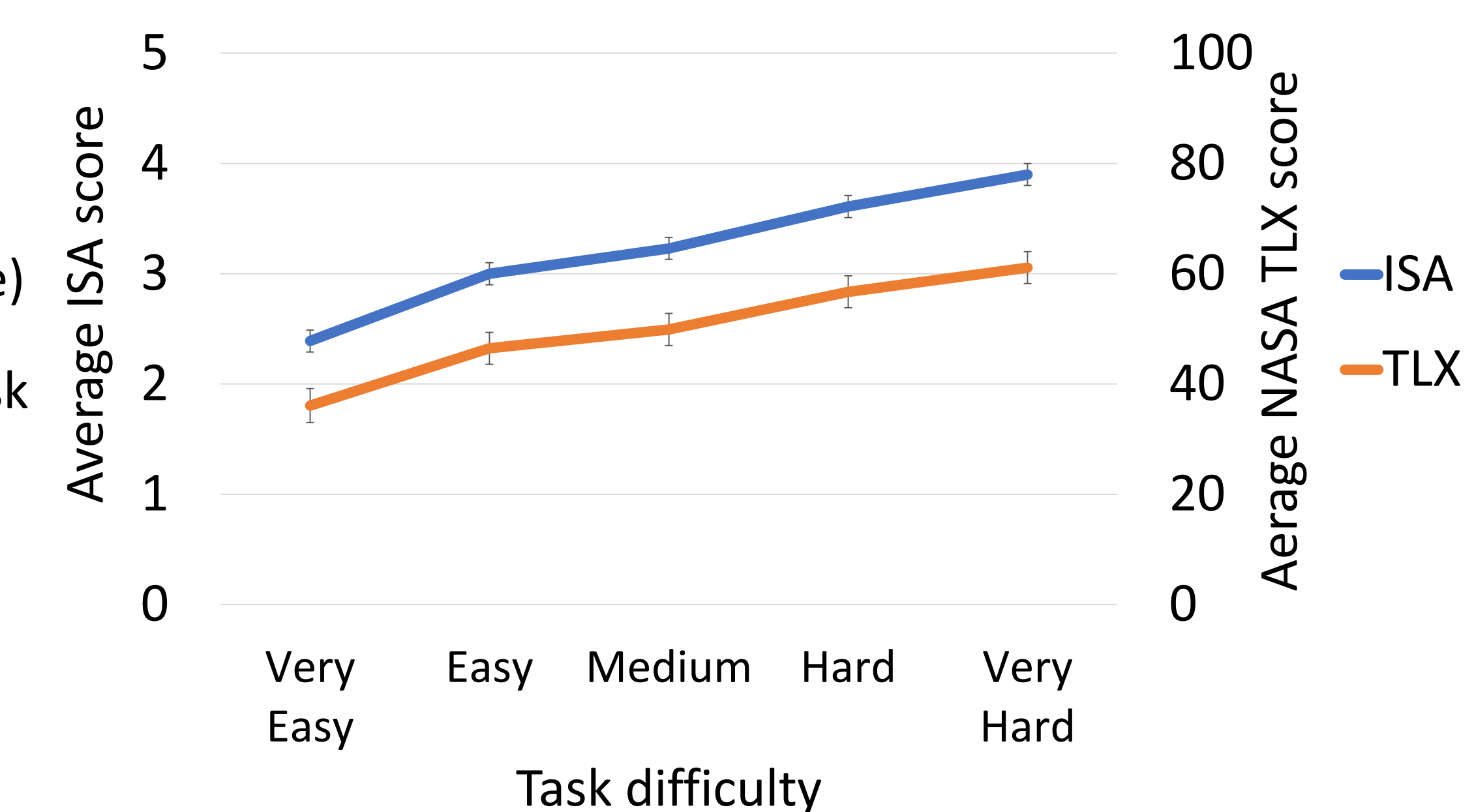
EFFECT ON PERFORMANCE & SPARE MENTAL CAPACITY



EFFECT ON HEART RATE (VARIABILITY)



EFFECT ON SUBJECTIVE WORKLOAD



EFFECT ON OXYHEMOGLOBIN CONCENTRATIONS



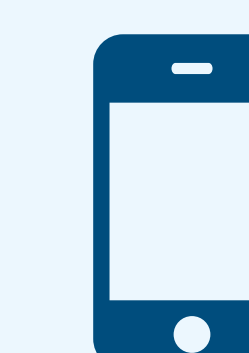
CONCLUSIONS

- Results on left show that condition had the expected significant effect:
 - Subjective workload ↑
 - Reaction time (performance) ↓
 - Hit rate (spare mental capacity) ↓
 - Heart Rate ↑
 - Heart Rate Variability ↓
 - HbO in prefrontal cortex ↑
- Decrease in spare mental capacity was significantly associated with an increase in HR and ΔHbO and a decrease in normalized SDRR.
- One unit change in spare mental capacity is associated with -1.38, 1.32 and -2.74 unit change in, respectively, normalized heart rate, normalized SDRR and ΔHbO.

APPLICABILITY

- fNIRS and ECG could be a next step in monitoring the workload of operators in a more non-intrusive, automatic and objective way

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