



Detecting Variation in Mental Workload Levels within Everyday Work Tasks using fNIRS

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Mental Workload

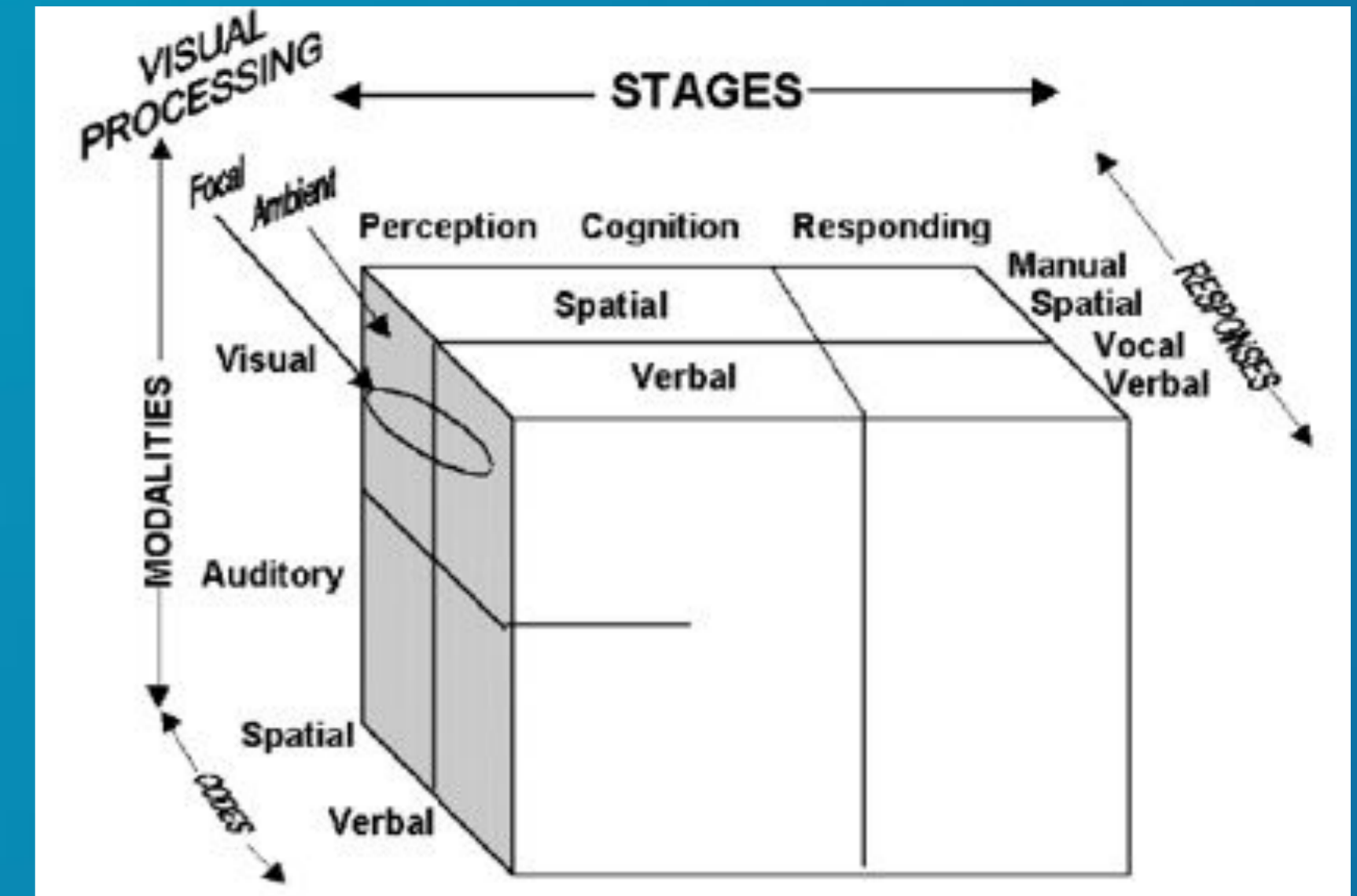
- Can be described as the amount of mental effort required to complete a task [1].

Study Aims

- Although fNIRS has been shown to reliably detect mental workload levels, this has primarily been determined using controlled laboratory tasks [2].
- If cognition has the potential to be tracked in daily life, it seems logical to explore whether fNIRS can detect mental workload levels in tasks that are fundamental to this context, capitalising on the movement tolerance of fNIRS.
- Thus, we used fNIRS to detect mental workload levels in comprehension (reading) and composition (writing) tasks. Further aimed to increase ecological validity and manipulate mental workload within conditions using natural distractors.

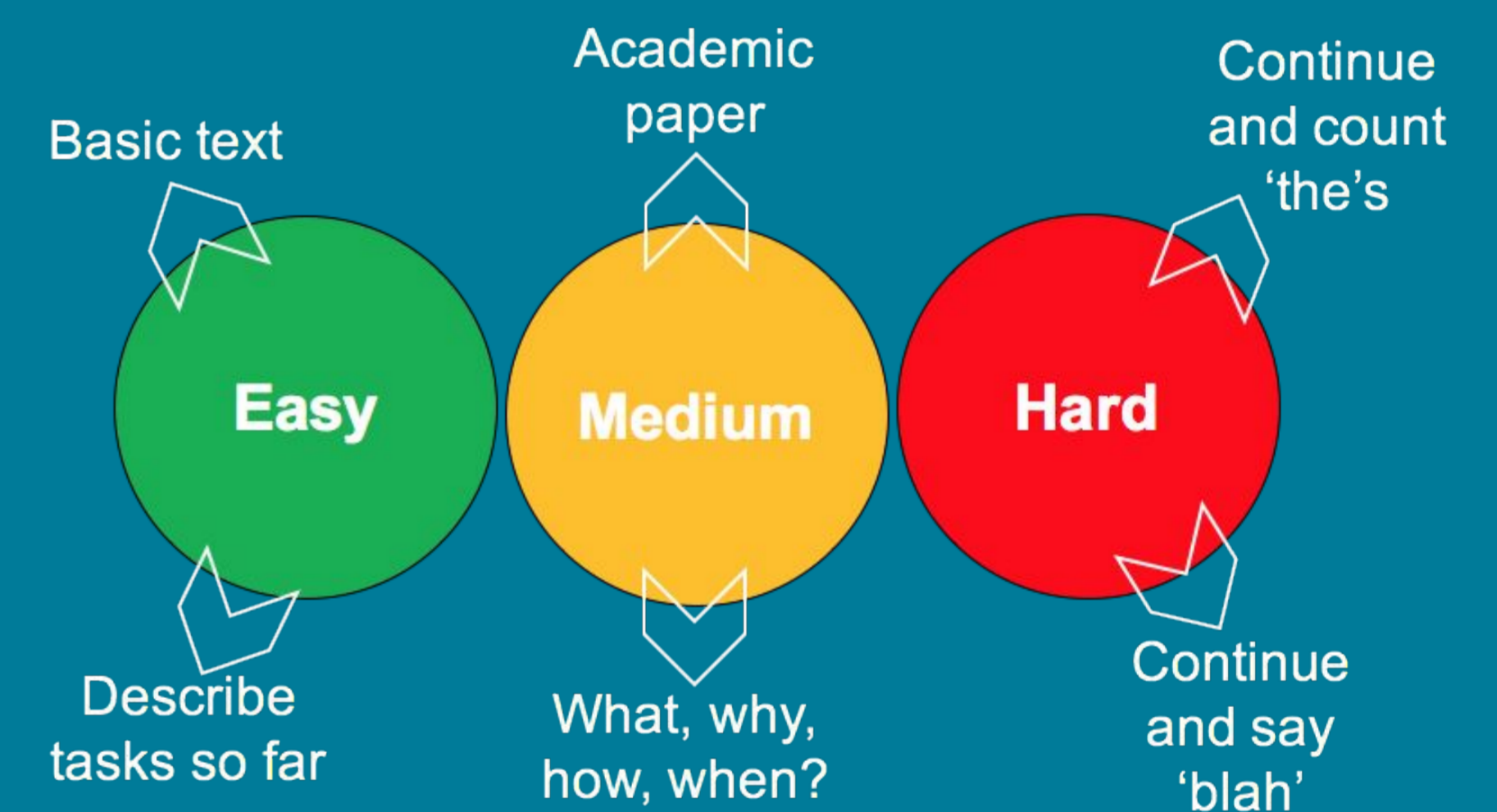
Hypotheses

1. fNIRS measurements will align with subjective ratings of mental workload.
2. Significant difference in brain activity between the easy, medium and hard difficulty conditions in both tasks.
3. Within condition mental workload variation will be observed to coincide with natural distractors.

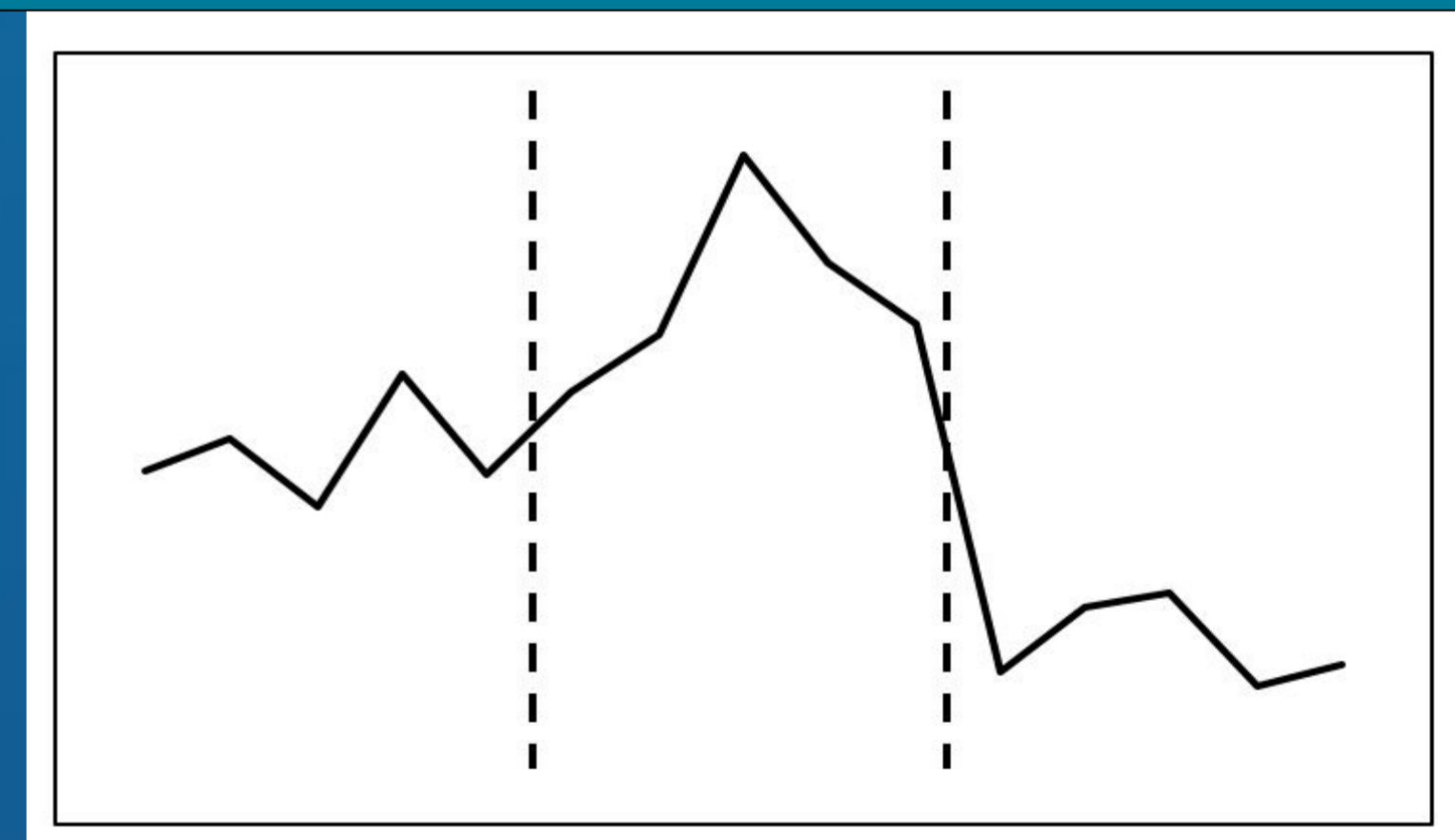
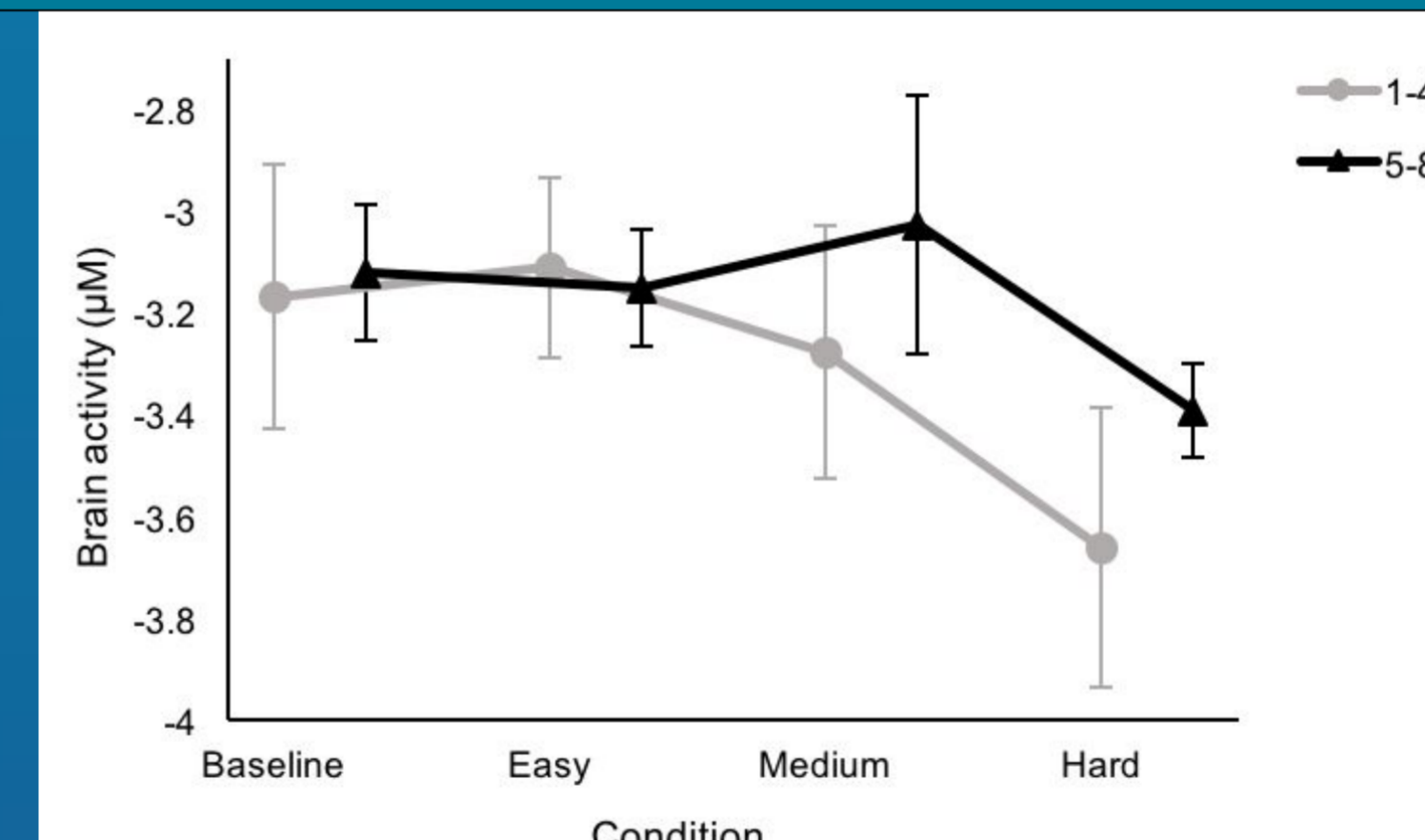
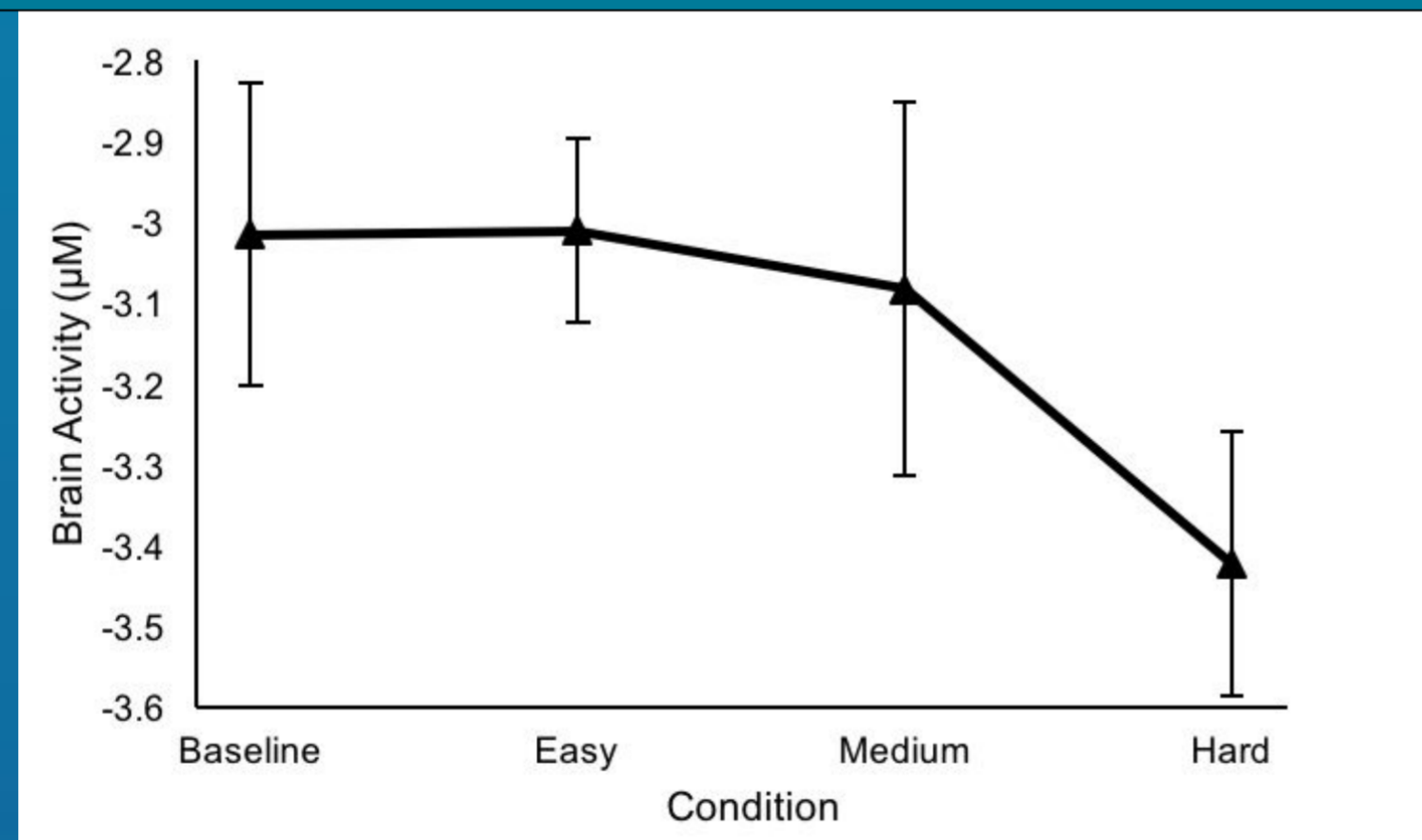
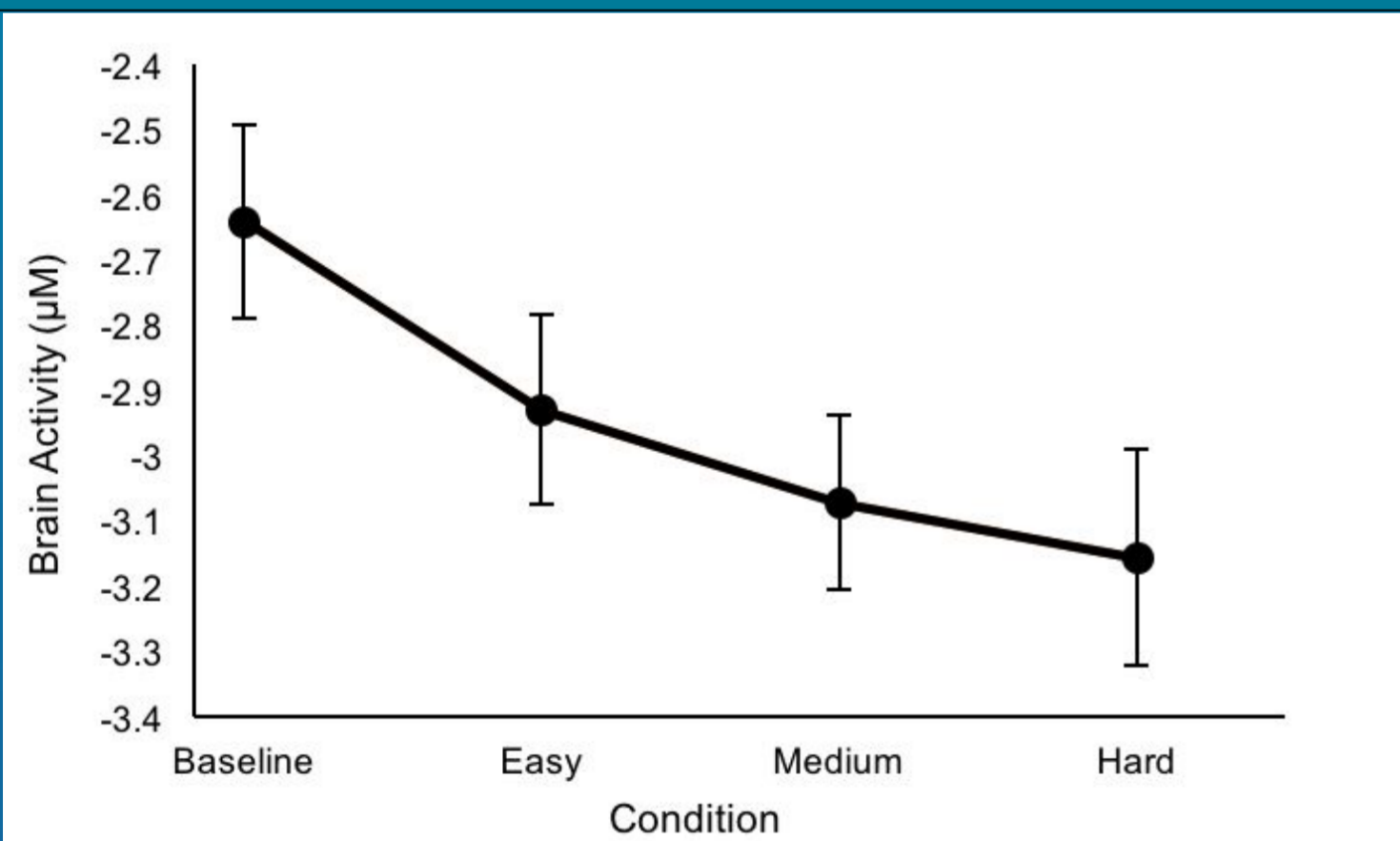


Method

- 20 participants.
- 3 reading and writing conditions; fixation as baseline.
- Personalised materials.
- Verbal interruptions and uncontrolled coffee consumption.
- fNIRS and subjective measures taken.



Results: HHb levels



Reading: means indicated increasing brain activity between each condition; significance was found between the baseline and medium and baseline and hard difficulty conditions.

Writing: easy and medium had significantly more brain activity than hard difficulty condition; in alignment with subjective ratings.

Writing channel analysis: combined 1-4 results aligned with subjective measures and expected results, contrasting to 5-8.

Verbal interruption extract: observed decreased brain activity coinciding with distractors.

Discussion

- Considerable support for fNIRS as a measure of mental workload in an ecologically valid context.
- Mental workload appeared to be manipulated within conditions and detected by fNIRS despite temporal delay.
- If mental workload was tracked in daily life the measures would be individualised, not averaged across participants.
- Future work should move to a continuous work context.

References

1. Maior, H. A., Pike, M., Sharples, S., & Wilson, M. L. (2015, April). Examining the reliability of using fNIRS in realistic HCI settings for spatial and verbal tasks. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (pp. 3039-3042). ACM.
2. Ayaz, H., Shewokis, P. A., Bunce, S., Izzetoglu, K., Willems, B., & Onaral, B. (2012). Optical brain monitoring for operator training and mental workload assessment. *Neuroimage*, 59(1), 36-47.