

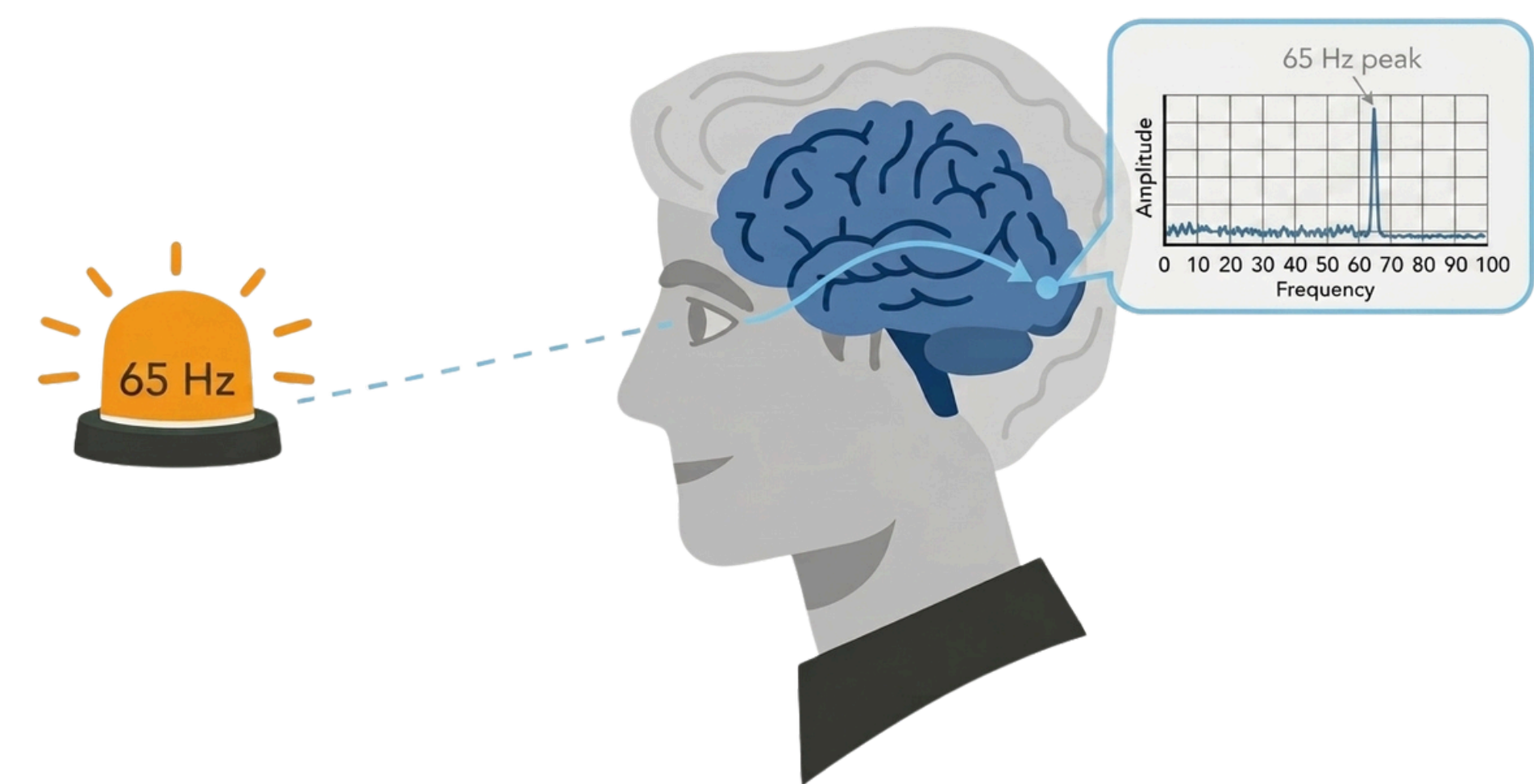
Evaluating Rapid Invisible Frequency Tagging (RIFT) in a dry EEG system using a gamified Posner task

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Introduction

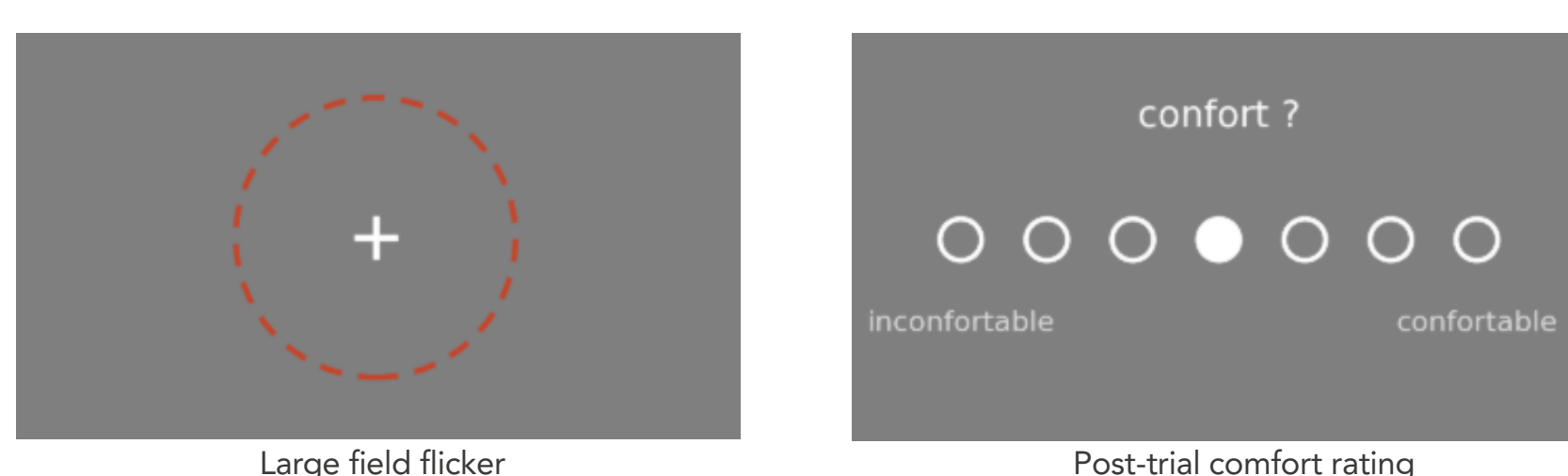
- **Rapid Invisible Frequency Tagging (RIFT)** uses high-speed sinusoidal flicker (50-80 Hz) to generate SSVEPs
- RIFT flicker is **invisible** yet robust enough to index cognitive modulations of attention, making it an exciting new paradigm for unobtrusively probing attentional mechanisms
- To date RIFT has been demonstrated in MEG and conventional wet EEG, i.e., expensive lab settings
- We sought to validate RIFT in a potentially field-deployable system (dry EEG and well-characterized 480 Hz display)



Task 1

Can we capture RIFT-evoked SSVEP with dry EEG?

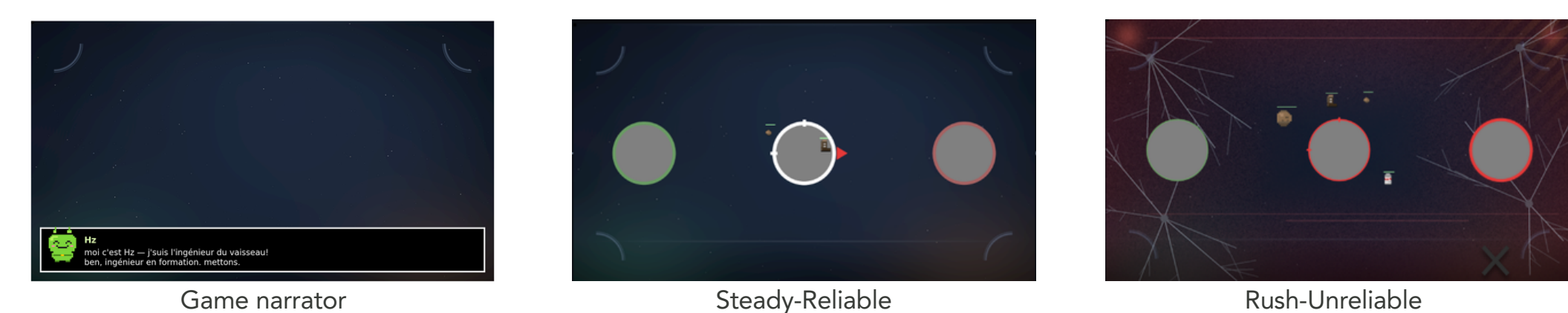
- PROPiXX projector @ 480 Hz refresh
- DSI-VRVEP EEG @ 600 Hz sampling
- 5 tag frequencies x 2 luminance/contrast swings
- 10 degree patch with Gaussian spatial filter
- 90 s passive exposure with RT task



Task 2

Do we have sufficient resolution to measure attentional modulations of RIFT in dry EEG?

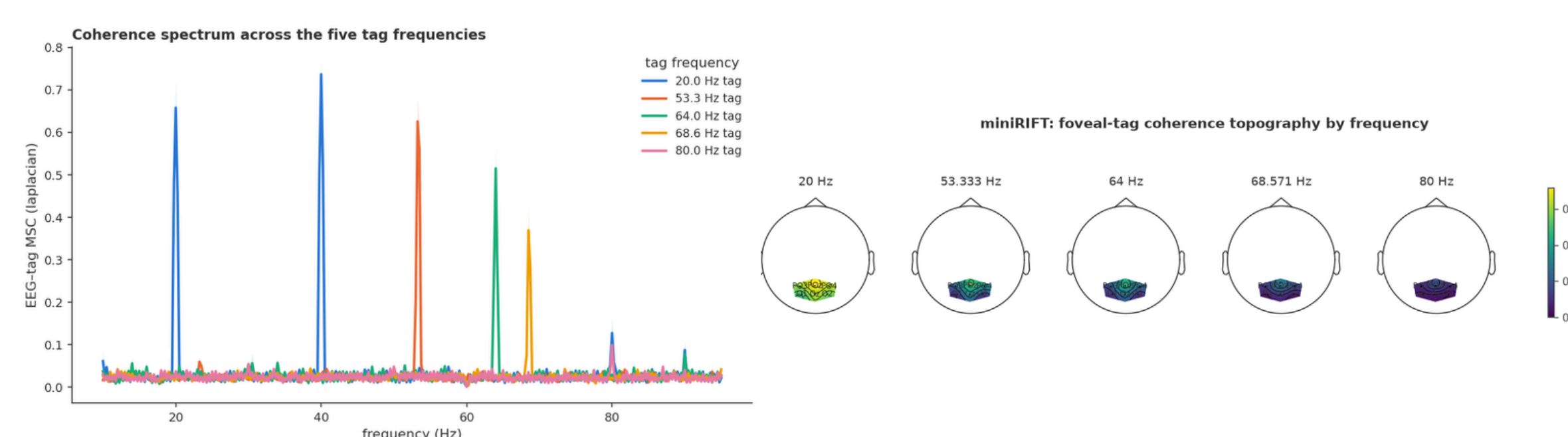
- Shooting 'space junk' during Posner task
- 2 x 2 manipulation:
 - Workload: (targets increased 2 → 5 during rush)
 - Reliability: "crash" narrative + cue reliability drop partway through game



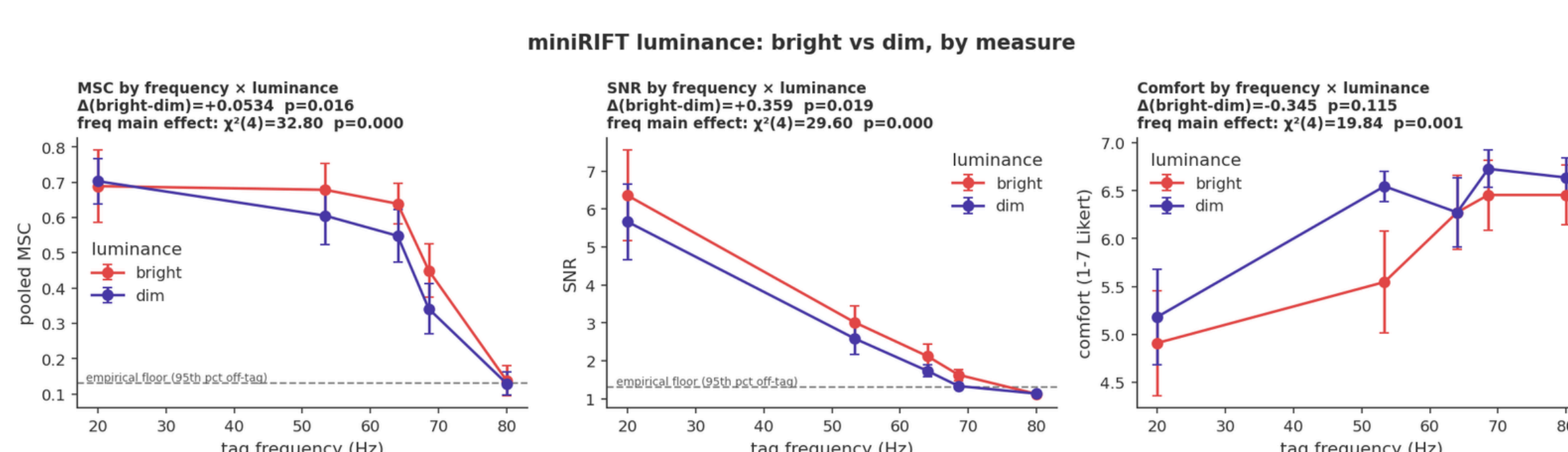
Key Results

Task 1:

- All 11 participants showed a RIFT response tapering off with frequency; tags visible as faint 'shimmer'



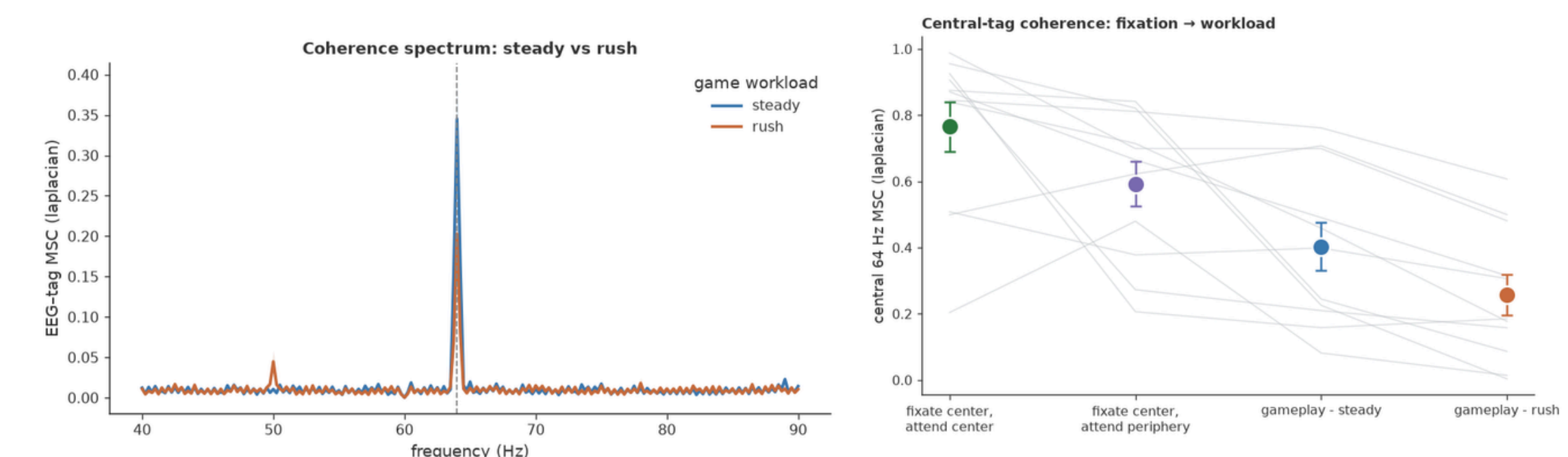
- Brighter/100% contrast flicker produces stronger response; comfort ratings increase with frequency



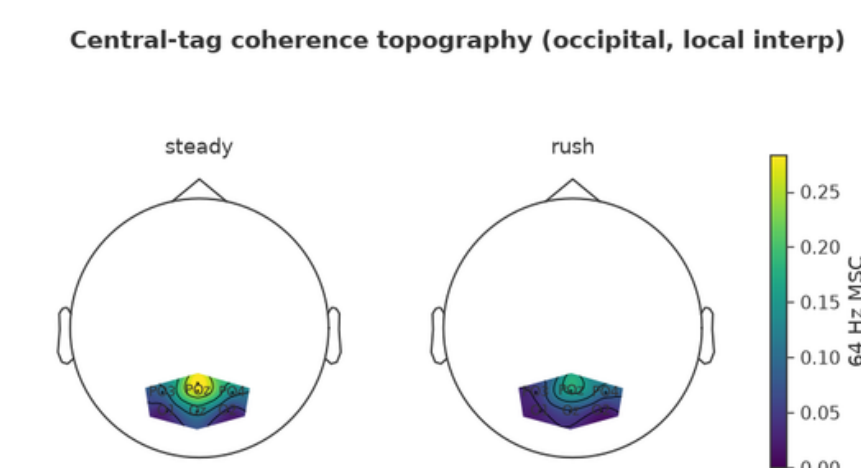
- No correlation between tag coherence and response time

Task 2:

- Strong reaction time effects for both manipulations, validated design
- **Significant central workload effect:** SNR and coherence significantly drop from baseline steady gameplay → rush gameplay



- Peripheral tags hit noise floor during covert attention at baseline; **all reliability-driven effects on tags n.s.**



Conclusions

- **First successful demonstration of RIFT in portable dry EEG** (SSVEP from 53-69 Hz and a cognitive modulation)
- Next: optimizing flicker imperceptibility @ 480 Hz refresh, optimizing tag/sensor placement, streaming capabilities, and a direct comparison to wet EEG
- RIFT + dry EEG shows promise for **cost-effective, scalable attention research beyond the lab**

