

ADAPTIVE AND WARNING DISPLAYS WITH BRAIN-COMPUTER INTERFACES : ENHANCED VISUOSPATIAL ATTENTION PERFORMANCE

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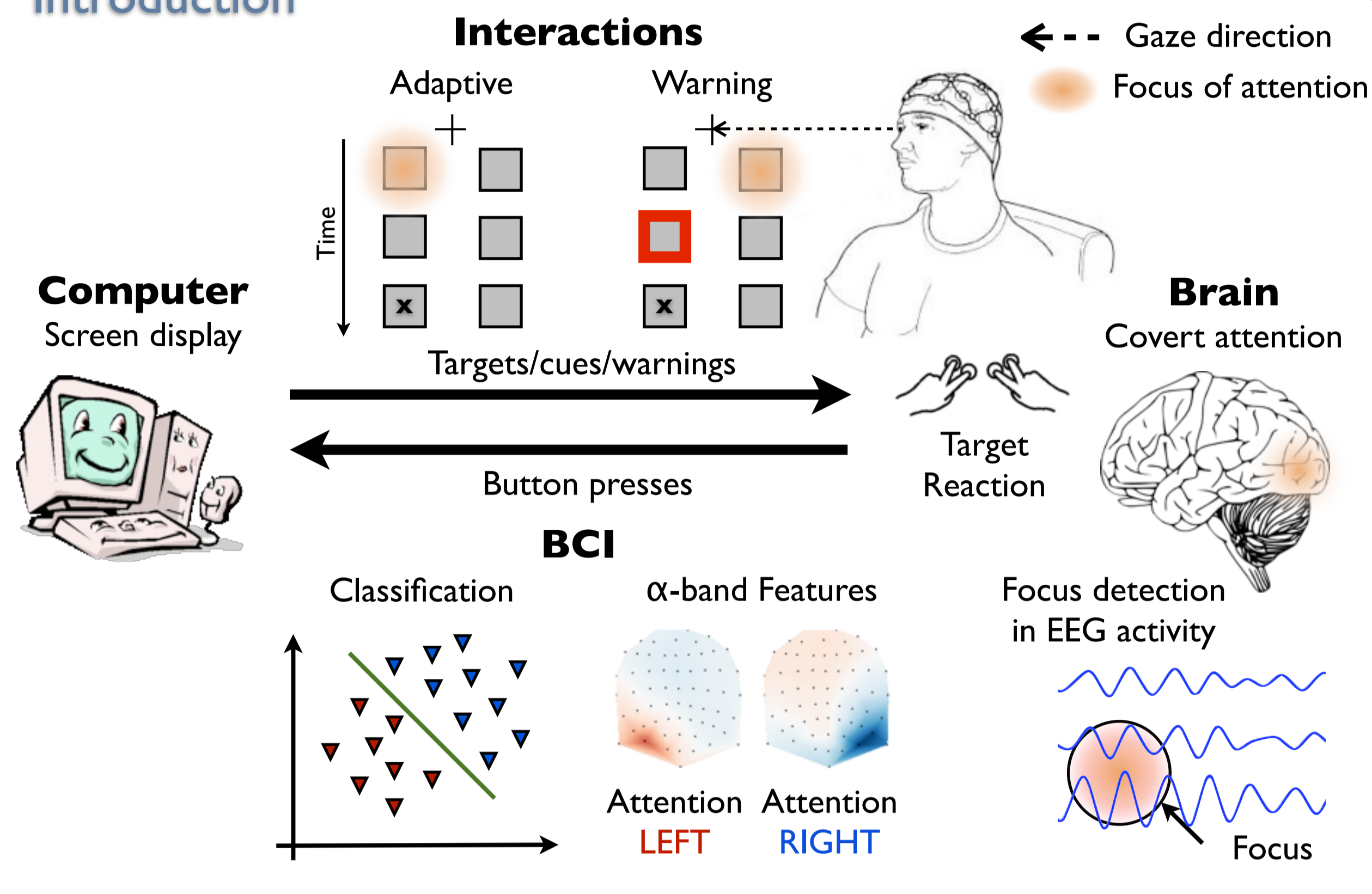
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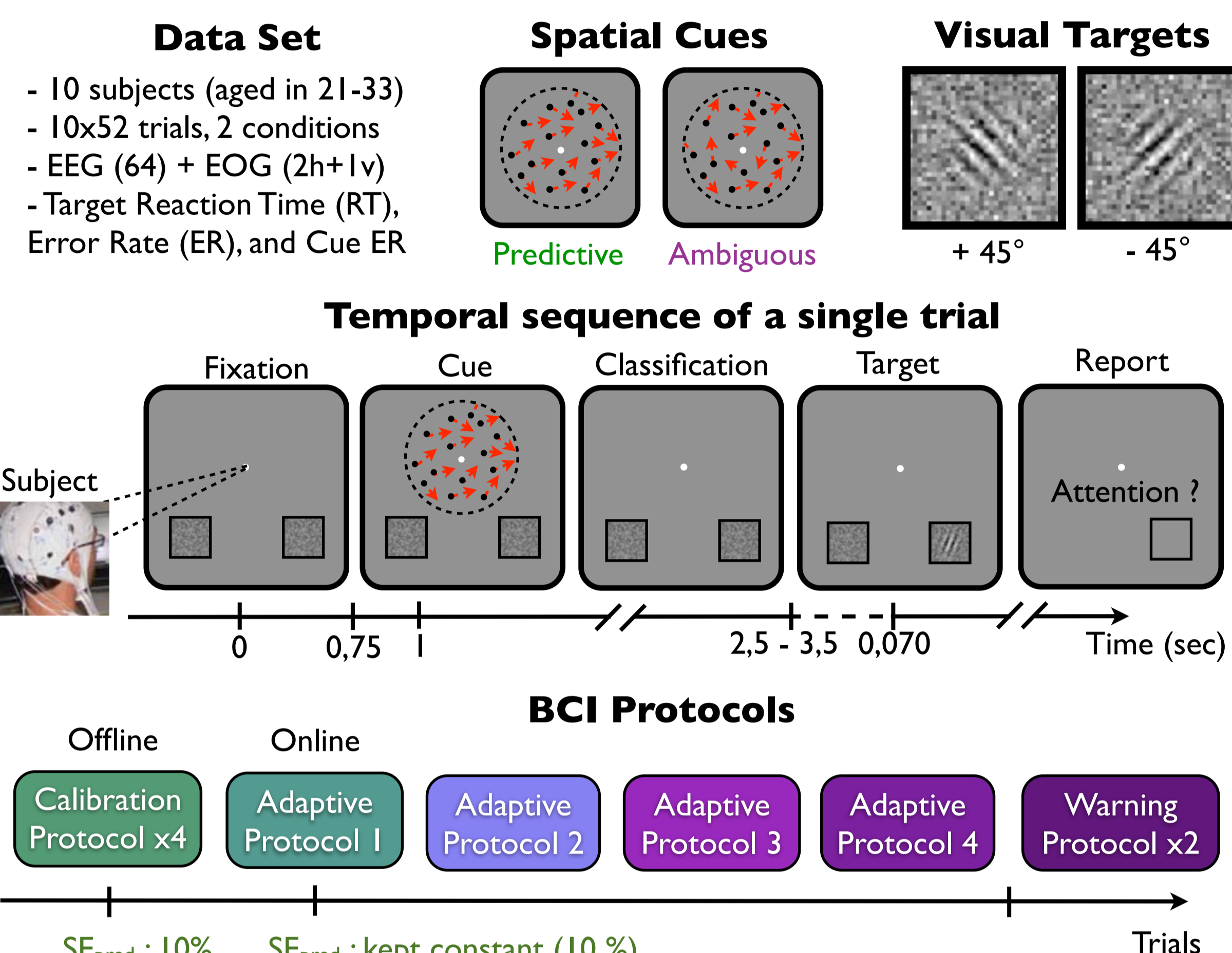


This study presents Brain-Computer Interface (BCI) protocols for enhancing human performance in a visuospatial attention task with complex cues. We designed new BCIs for warning the subject and adapting visual targets based on EEG α -band (8-14Hz) power features to detect the focus of covert attention. Results show a reduction of spatial errors in cue identification, enhanced response speed and accuracy to visual target with BCI-based display protocols. This work could provide innovative solutions for adaptive human-computer interactions in risk critical command and control tasks.

Introduction

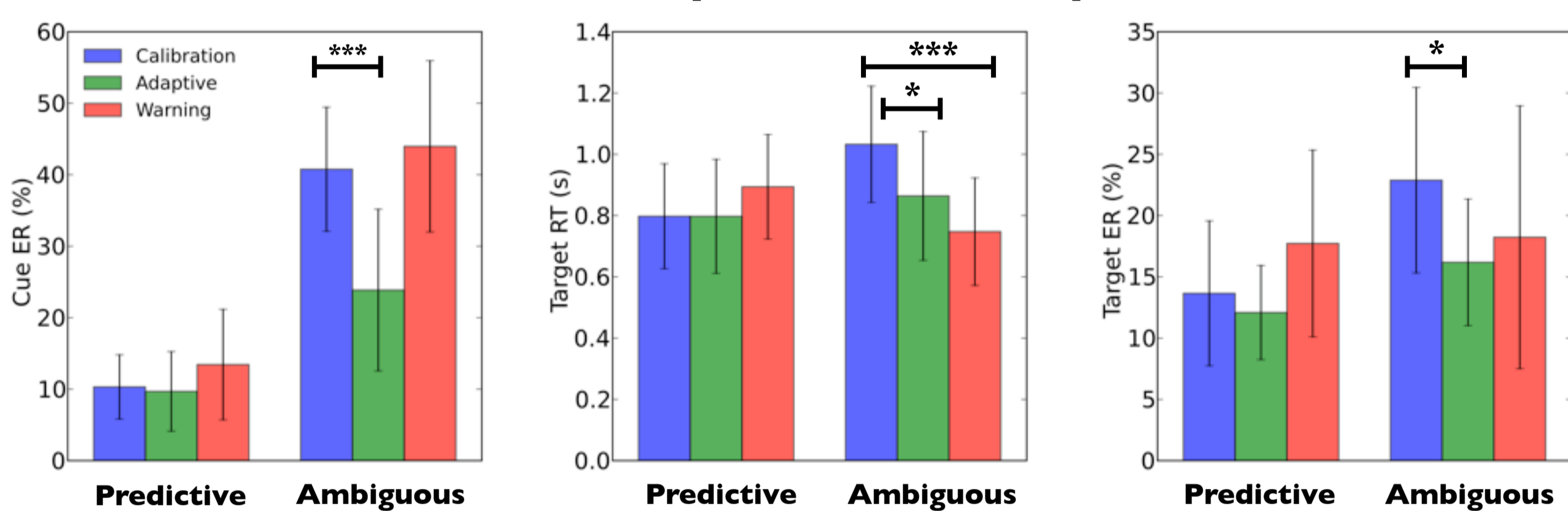


Experiment and Methods

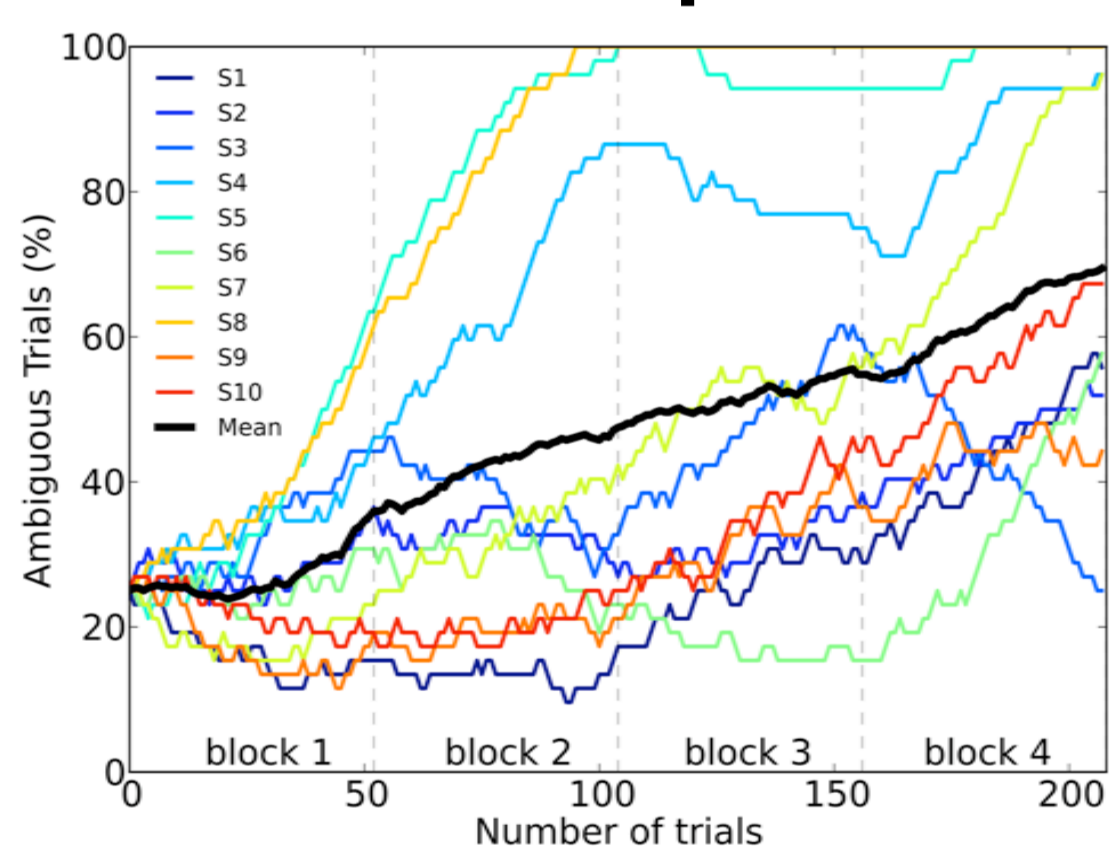


Results

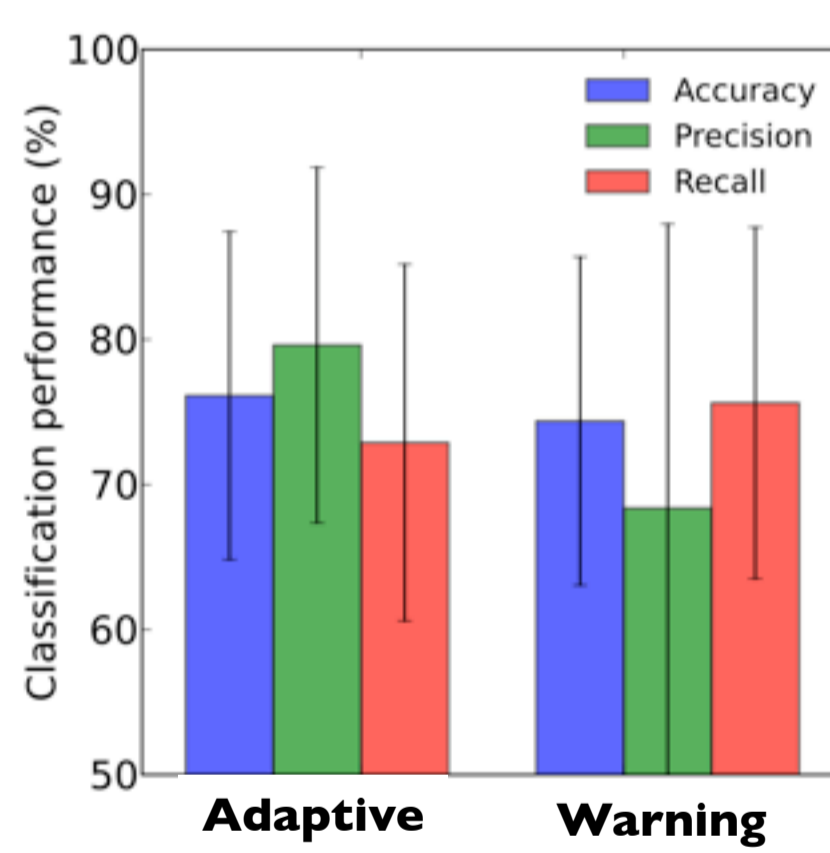
Enhanced visuospatial attention performance



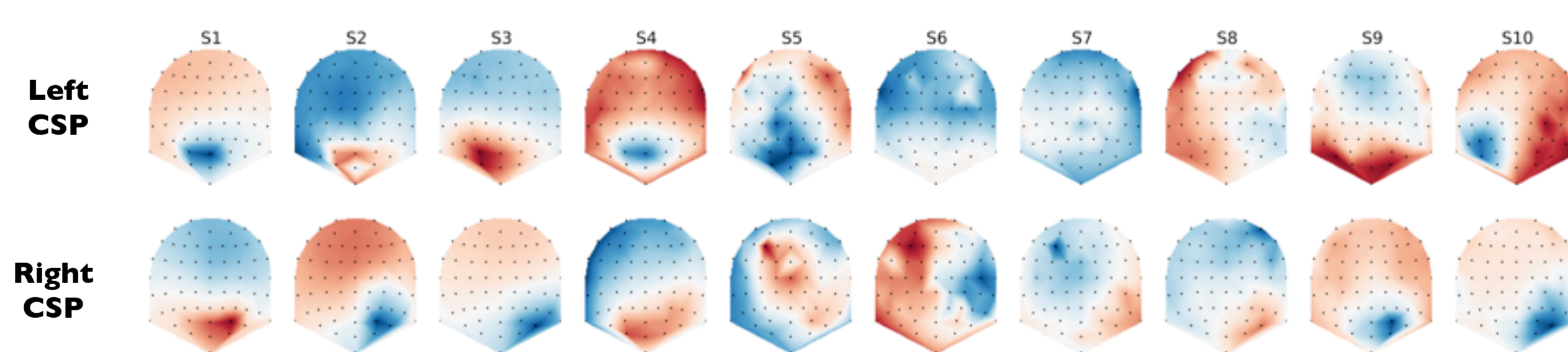
Online adaptation



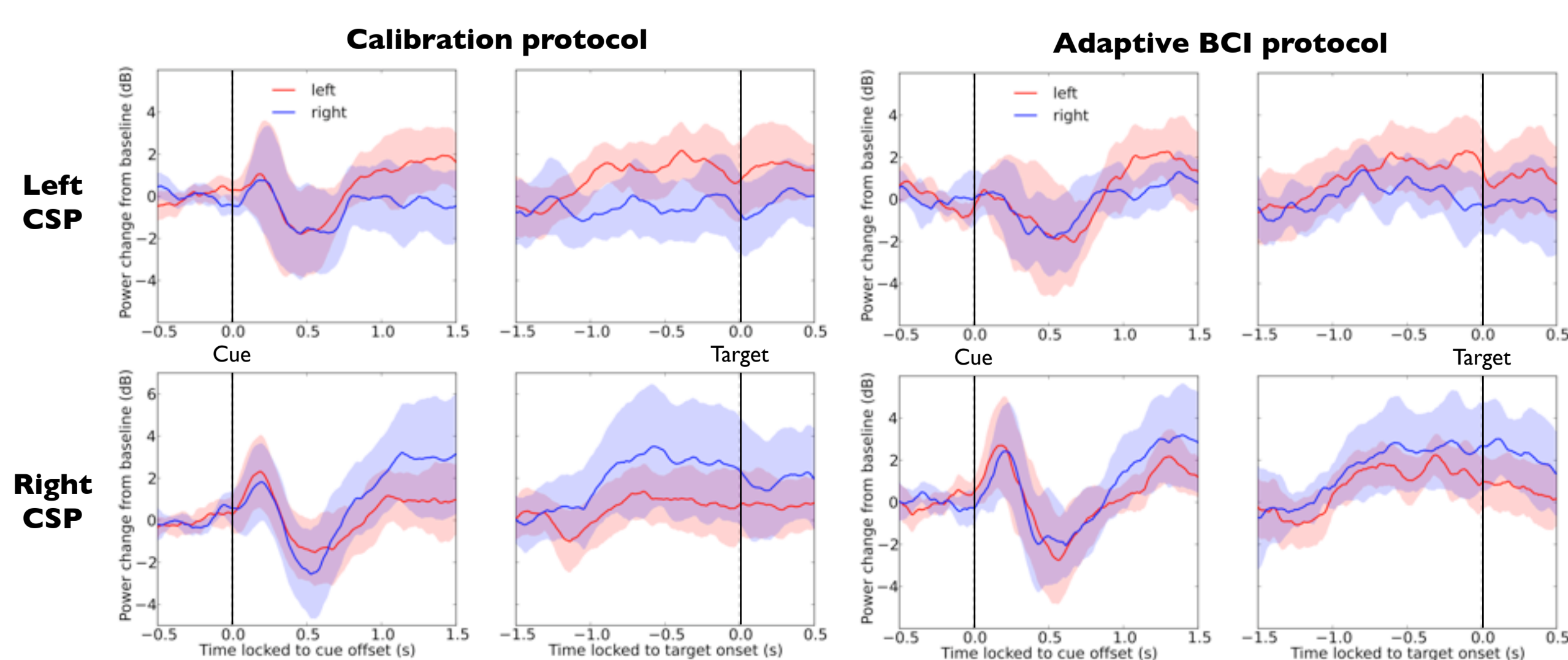
Classification



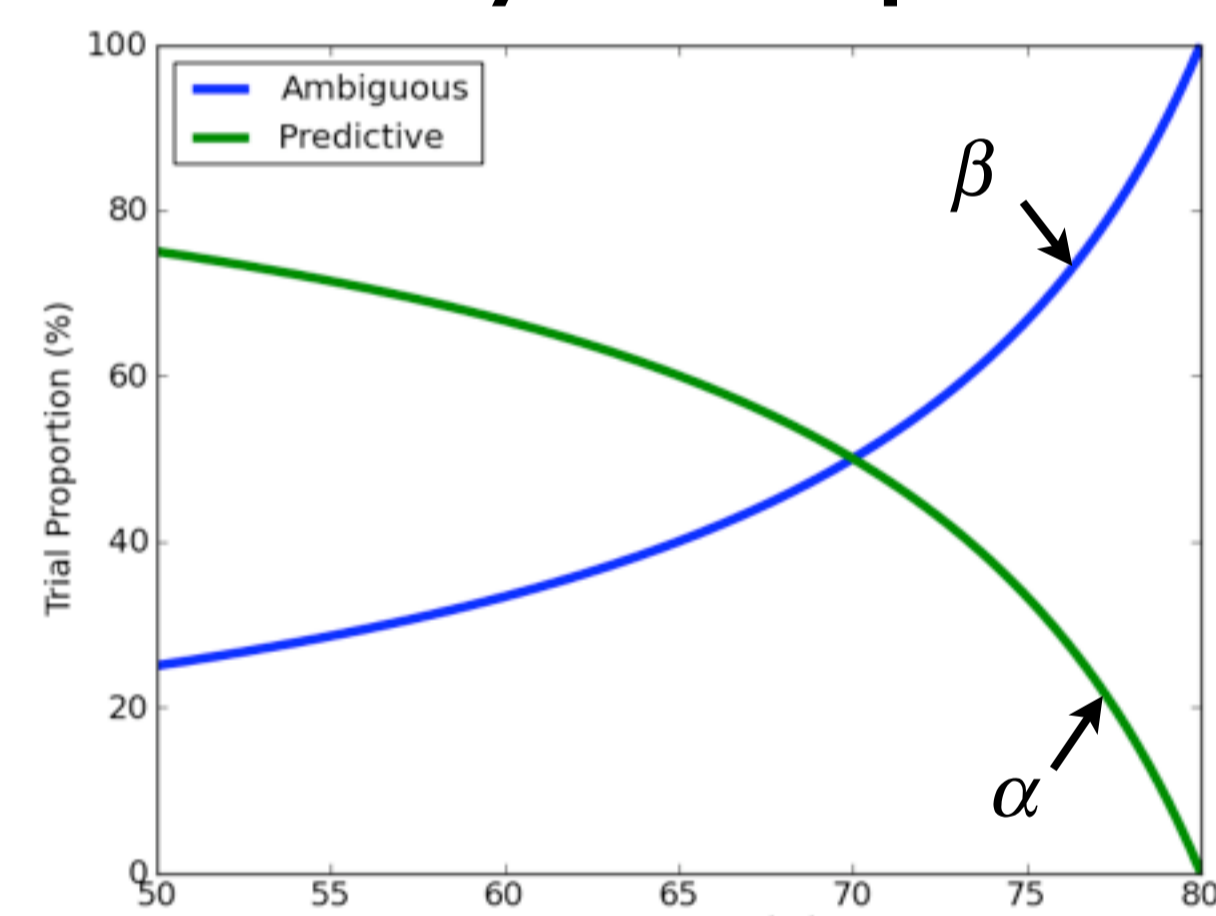
Selected CSP Patterns



Power modulations



Trial-by-trial adaptation

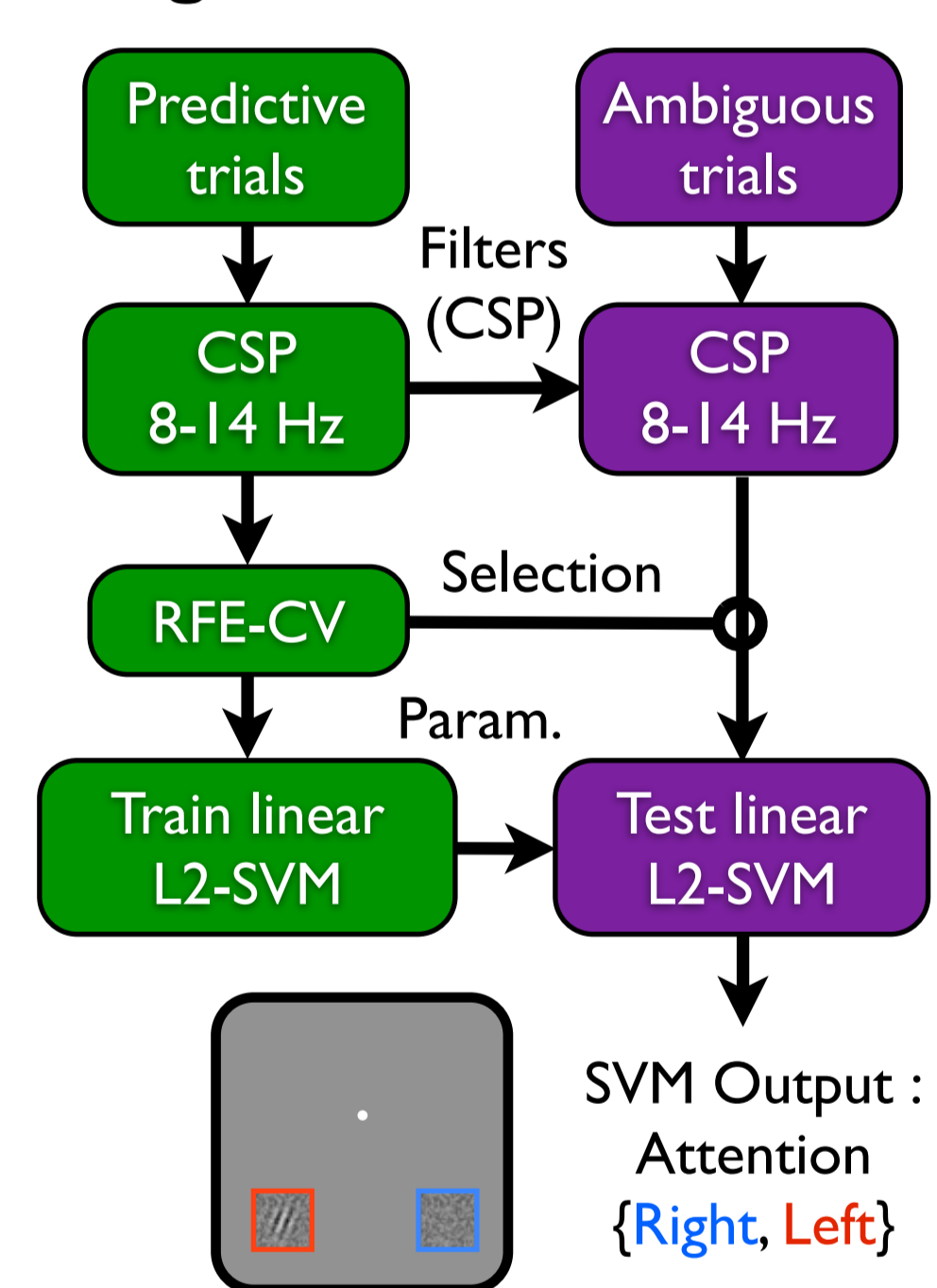


$$\alpha \times SE_{pred} + \beta \times SE_{ambi} = 20\%$$

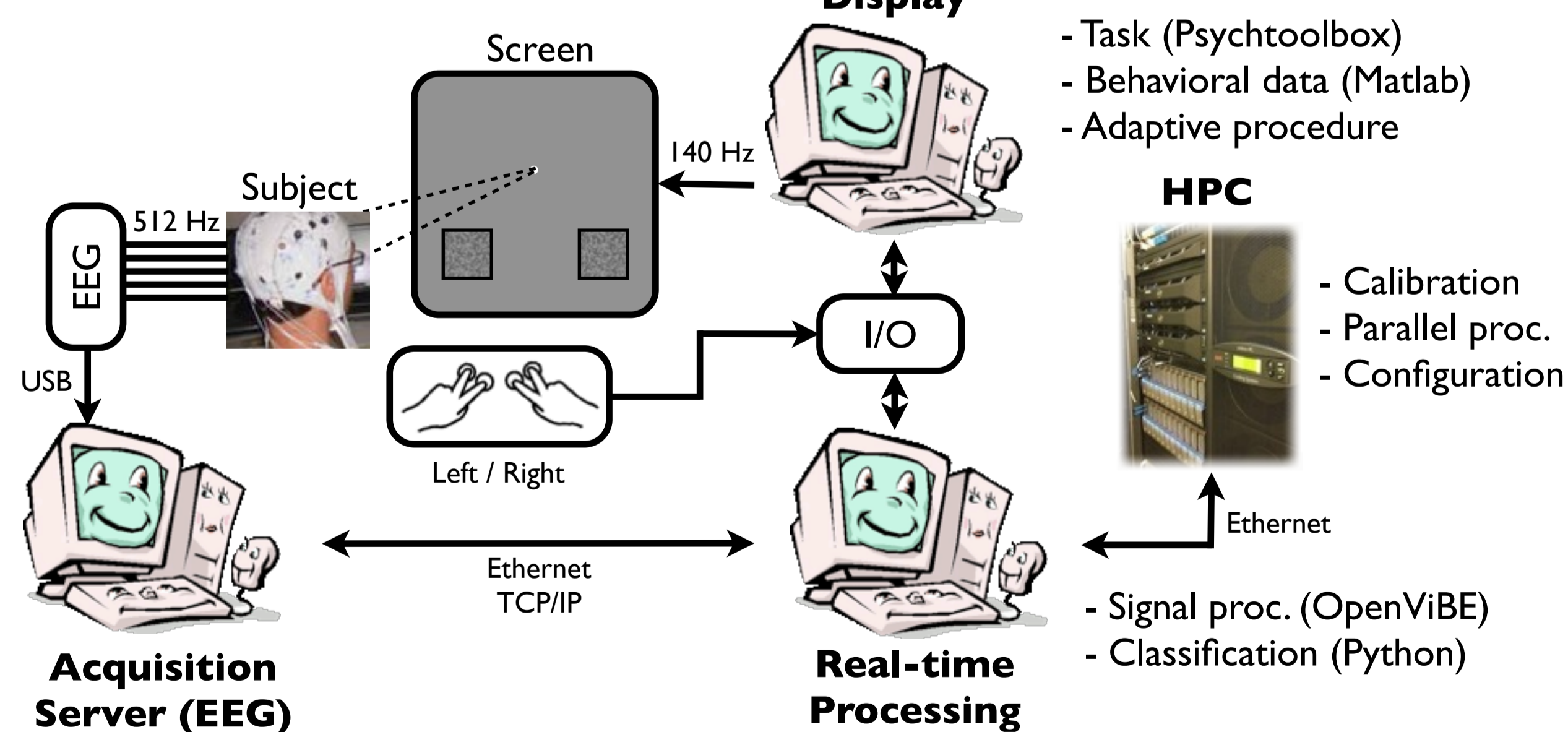
$$\alpha \times (100 - SE_{pred}) + \beta \times (100 - SE_{ambi}) = 80\%$$

Updating online the proportion of **ambiguous** (β) and **predictive** (α) trials.

Single-trial classification



Experimental setup



Conclusion

- Real-time classification of **covert** attention using occipital α -band power features.
- New BCIs enhancing visuospatial attention performance by **adapting** targets display at attended location or **warning** subjects at unattended location.
- **Spatial errors** reduced in the adaptive display protocol.
- **Reaction speed** and **accuracy** enhanced in both protocols.