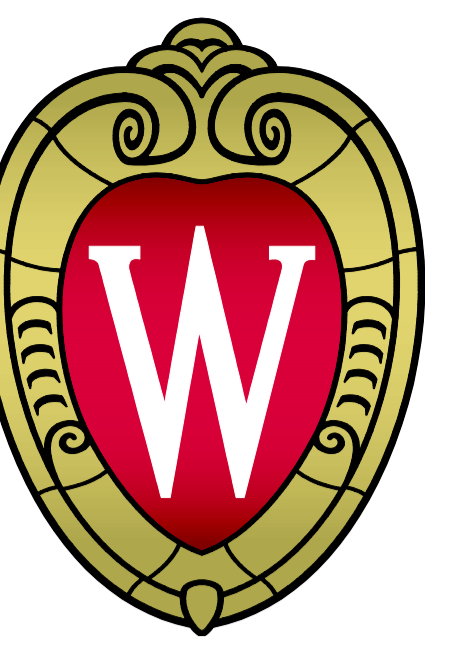
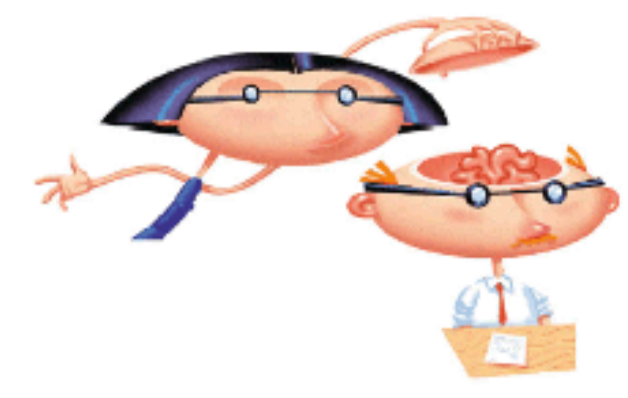


Effect of theta burst stimulation on visual representation during a short-term memory task

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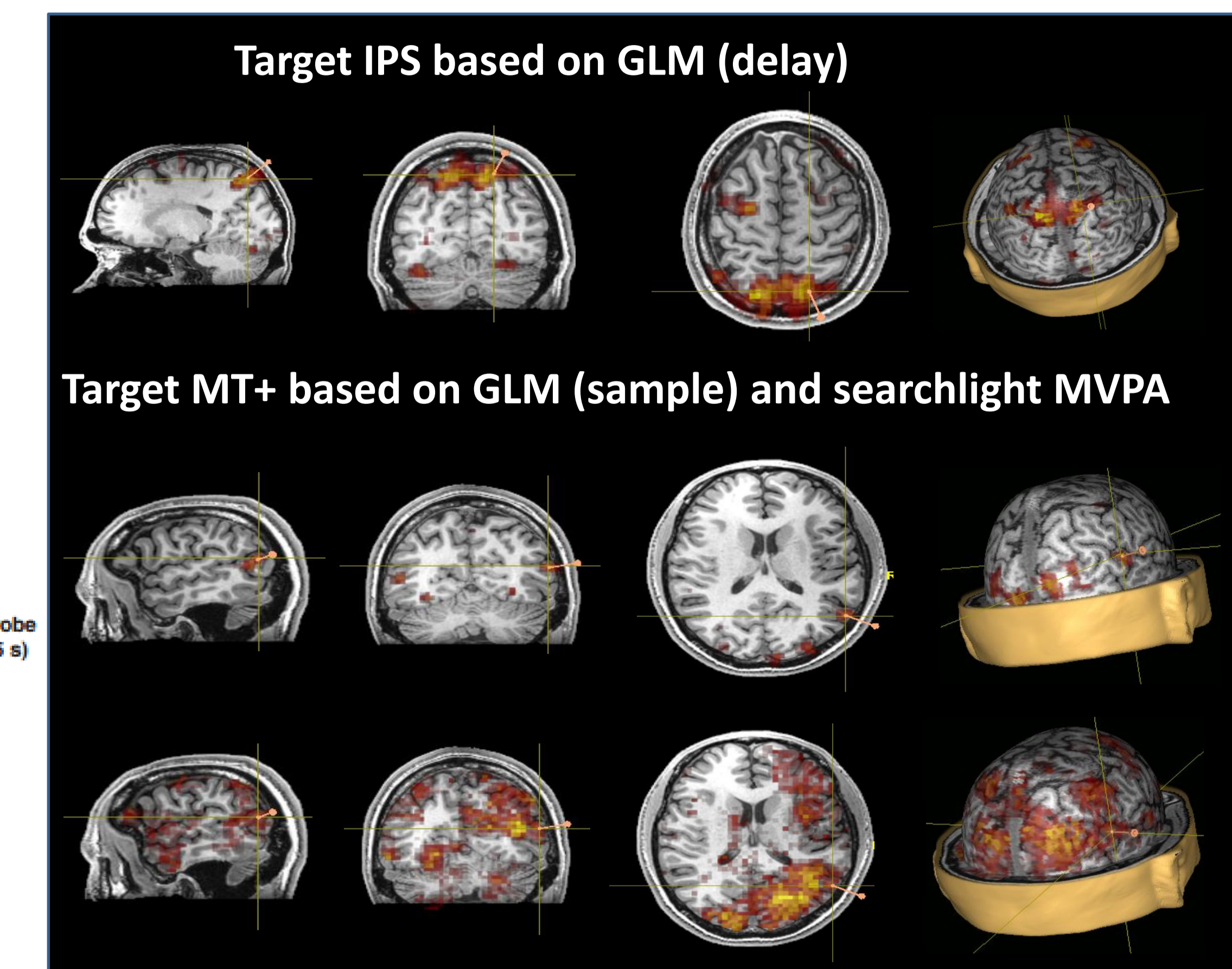
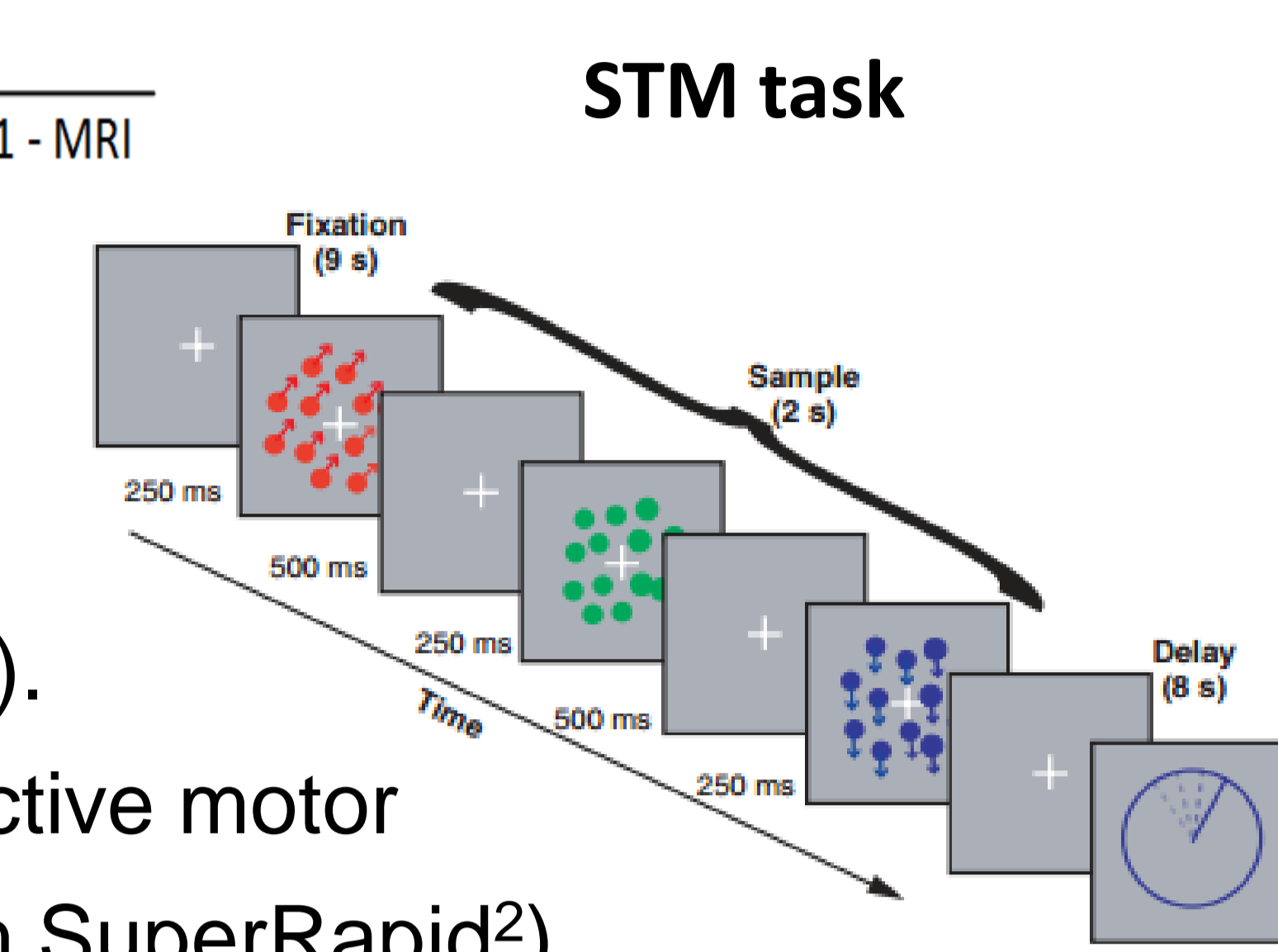


Background

Elevated delay-period fMRI activity is observed in the prefrontal and parietal cortices during short-term memory (STM) for the direction of motion. Multivariate pattern analysis (MVPA) fails to find evidence for stimulus representation in these regions but stimulus identity is decodable from extrastriate cortex¹. When memory load is increased, signal intensity in frontoparietal areas increases and MVPA decoding performance from posterior cortex declines monotonically, as does behavioral measure of mnemonic precision².

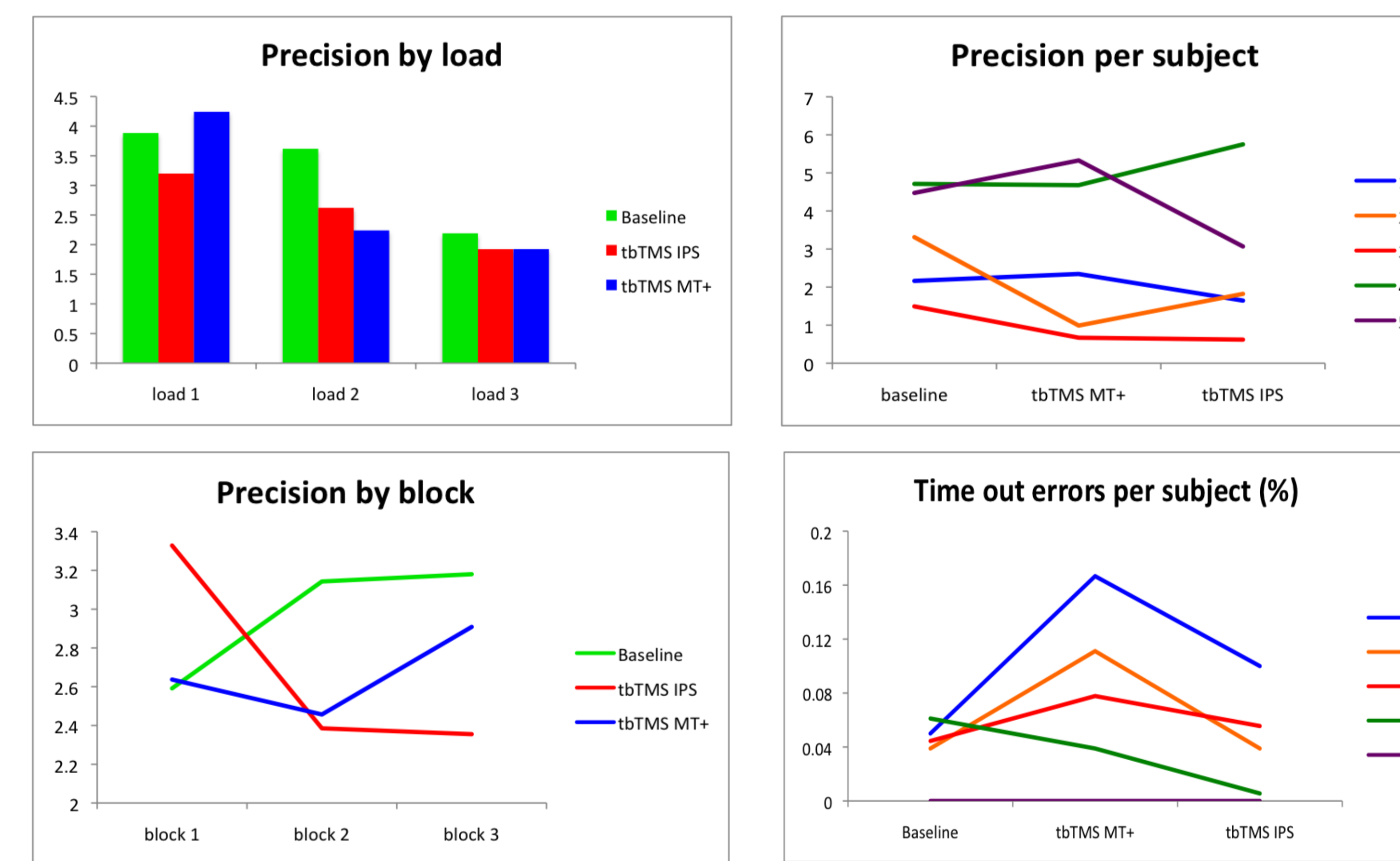
Methods

- Procedure: DAY 1 (2h) Structural and functional MRI | DAY 2 (4h) aMT&TBS target 1 - MRI - TBS target 2 - MRI | DAY 3 (3h) TBS target 2 - MRI - TBS target 1 - MRI
- Tasks in 3T MRI: visual perception (2 runs of 60 trials per day) and STM for motion with different loads (6 runs of 180 trials per day).
- Two fMRI STM-related TbsTMS targets: intraparietal (IPS) and middle temporal cortex (MT+) using a neuronavigated system (NBS Nexstim).
- Continuous tbTMS in 5 participants (1 female, mean age 23y): 80% active motor threshold (aMT), trains of 3 pulses every 200 ms for 40 sec (Magstim SuperRapid²).
- Analyses: precision and time out errors for behavior. General linear model (GLM) and multivariate pattern analysis (MVPA) for fMRI.

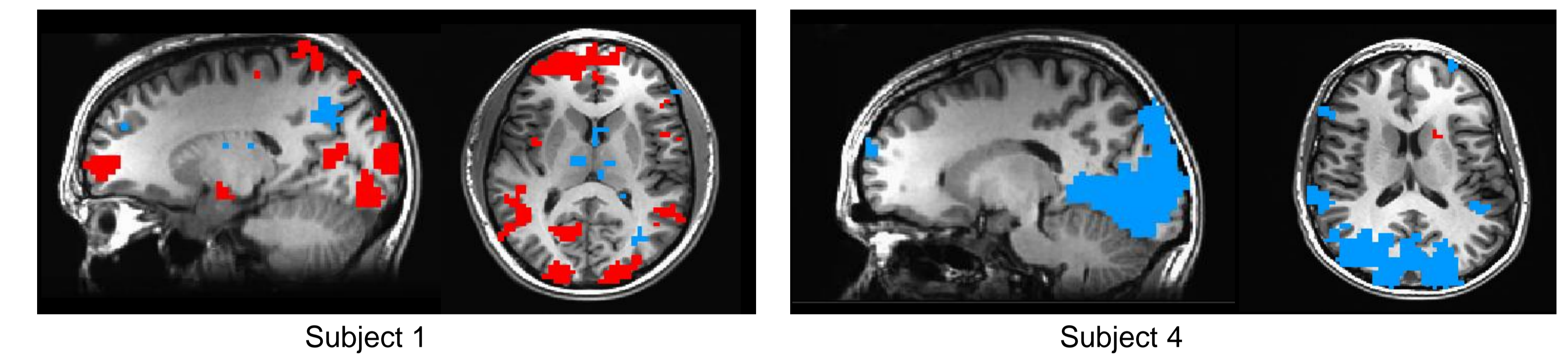


Results

Behavior

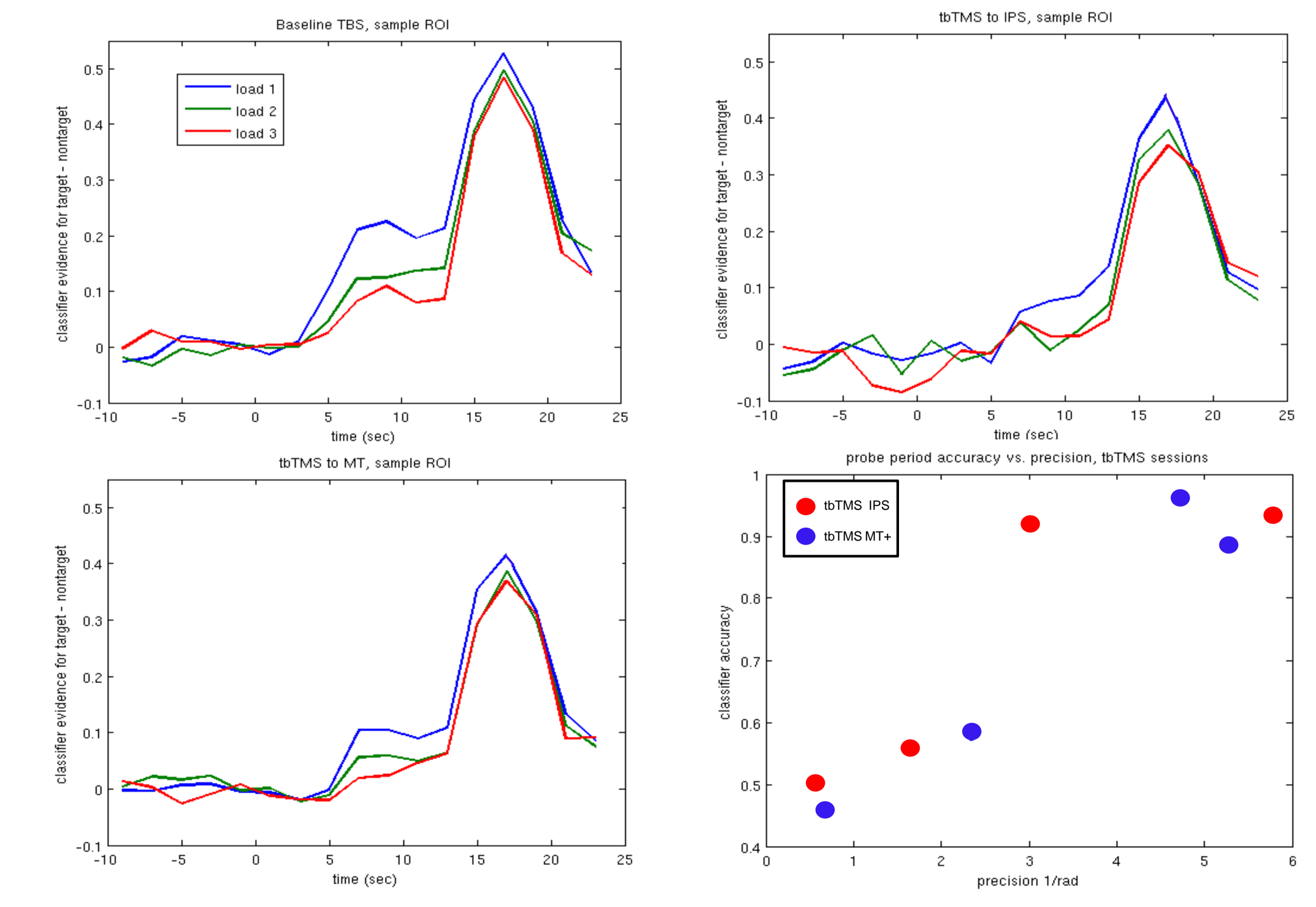
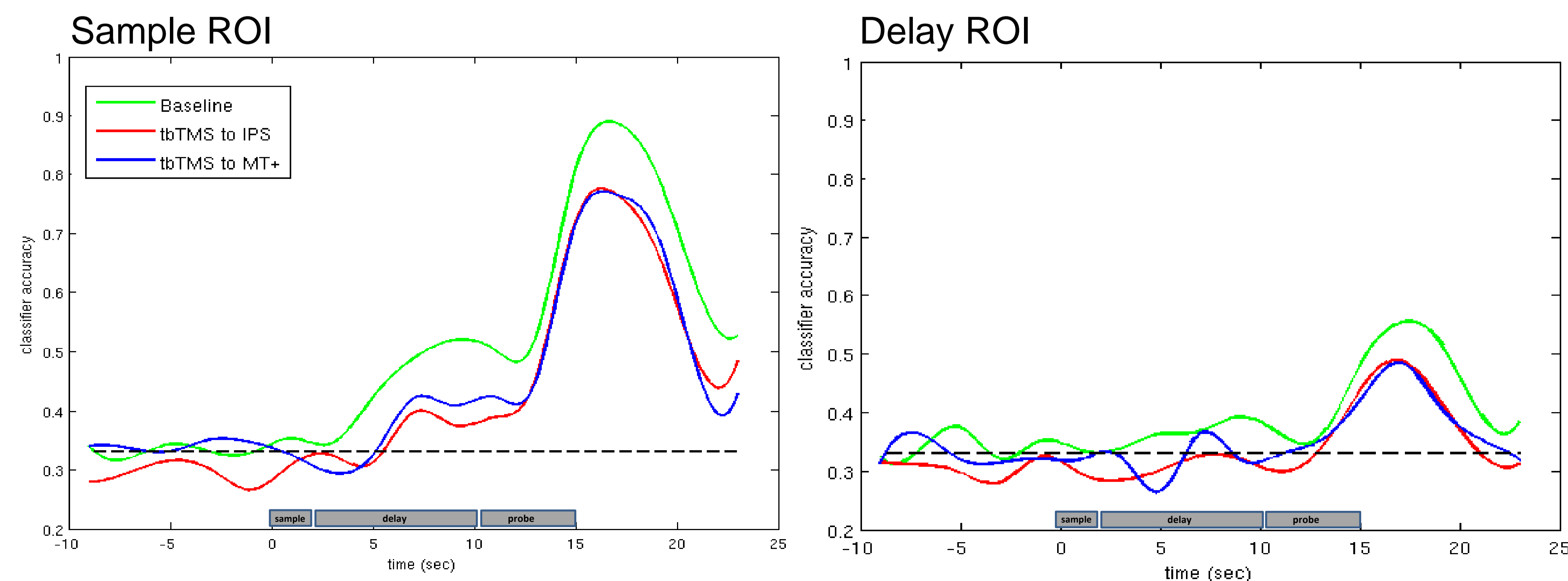


GLM (tbTMS > baseline during delay)



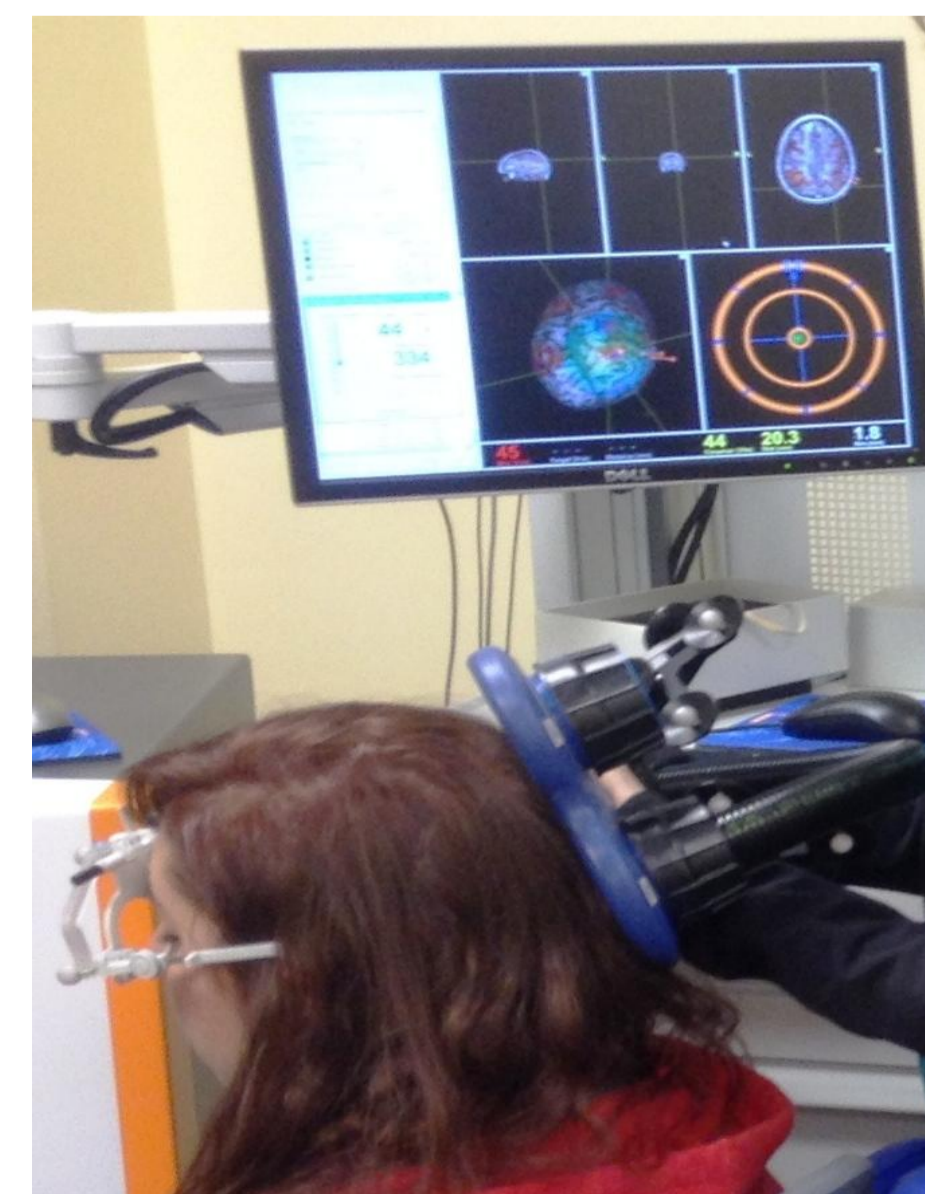
- STM precision declined from load-1 to load-3 and tbTMS exacerbated this effect.
- There is considerable between-subject variability in the effect of tbTMS on precision, but precision did decline across blocks after tbTMS.
- Stimulation of MT+ produced more failures to respond in the response period (time outs).
- The effect of tbTMS on delay-period activity was variable across subjects.
- tbTMS decreased decoding accuracy, and classifier evidence decreased as load increased. Classifier accuracy also correlated with behavioral precision after tbTMS.

MVPA



Theta burst transcranial magnetic stimulation (tbTMS) has been shown to induce robust performance-impairing effects during working memory tasks^{3,4}.

How are item-specific and load-specific visual STM representations affected by the perturbation of brain areas related to working memory?



References

- [1] Riggall, A.C., Postle, B.R. (2012). The relationship between working memory storage and elevated activity as measured with functional magnetic resonance imaging. *J Neurosci*. 19:32(38):12990-08. [2] Enrich, S.M., Riggall, A.C., Larocque, J.J., Postle, B.R. (2013). Distributed patterns of activity in sensory cortex reflect the precision of multiple items maintained in visual short-term memory. *J Neurosci*. 33(15):6516-23. [3] Lee, T.G. and D'Esposito, M. (2012). The dynamic nature of top-down signals originating from prefrontal cortex: a combined fMRI-TMS study. *J Neurosci*. 32(44):15458-66. [4] Morgan, H., Jackson, M., van Koningsbruggen, M., Shapiro, K., Linden, D. (2013). Frontal and parietal theta burst TMS impairs working memory for visual-spatial conjunctions. *Brain Stimul*. 6(2): 122-129.

Conclusions

These data suggest a non-specific effect of tbTMS on the precision of stimulus representation during visual STM. The load effect on behavioral precision and multivariate decoding remain the same with tbTMS. We next will use functional connectivity analyses to understand more subtle differences in the effects of tbTMS.