

Regional variability in the BOLD HRF assessed using concurrent TMS-fMRI



Eva Feredoes^{1,2}, Tom Johnstone³, Giulio Tononi⁴, Todd S. Woodward² & Bradley R. Postle^{1,4}
 Department of ¹Psychology and ²Psychiatry, University of Wisconsin-Madison

Empirical question: what is the shape of the BOLD HRF response across different cortical areas?

We applied transcranial magnetic stimulation (TMS) during fMRI over several brain regions to directly evoke responses.

Methods: Concurrent TMS-fMRI

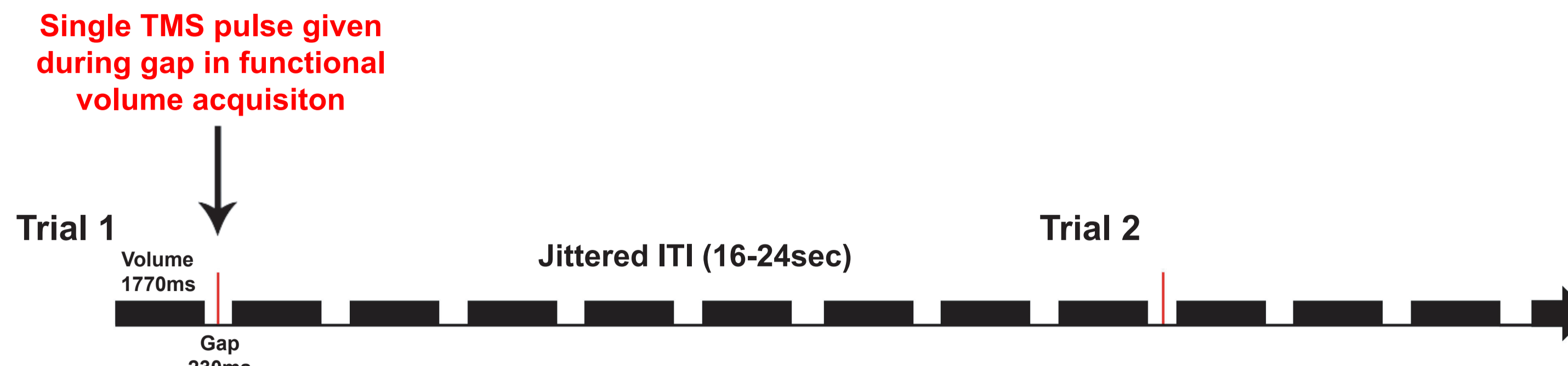
TMS-fMRI

"Button press runs"

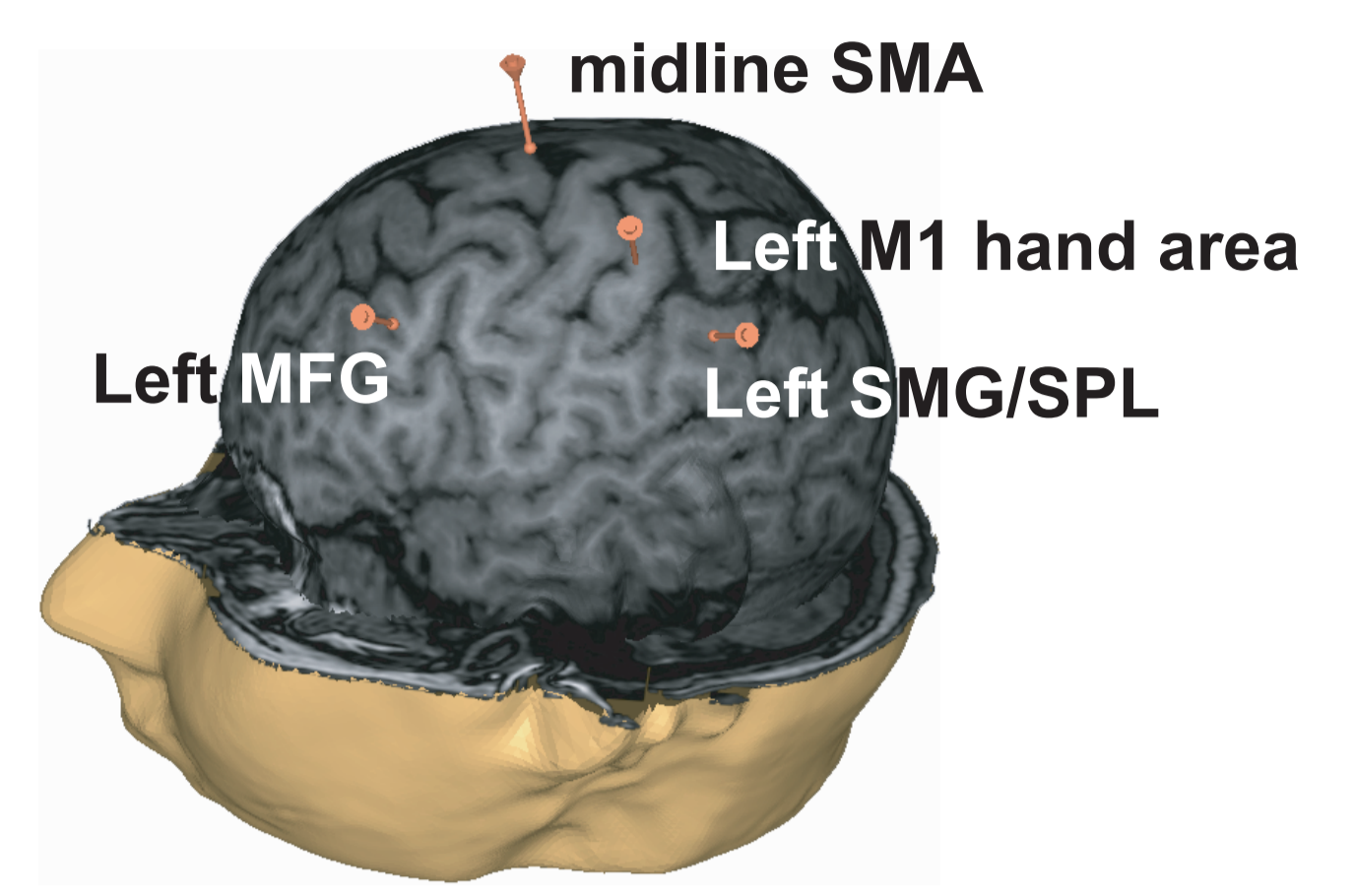
- Visual cue = right thumb button press (20x per run)
- To evoke HRFs in somatosensory cortex
- Two separate runs to show variability of responses across time i.e. test-retest approach

"TMS runs"

- 20 single TMS pulses per run
- 110% of rMT intensity, scap-cortex distance corrected



Targeted brain regions for N=6:

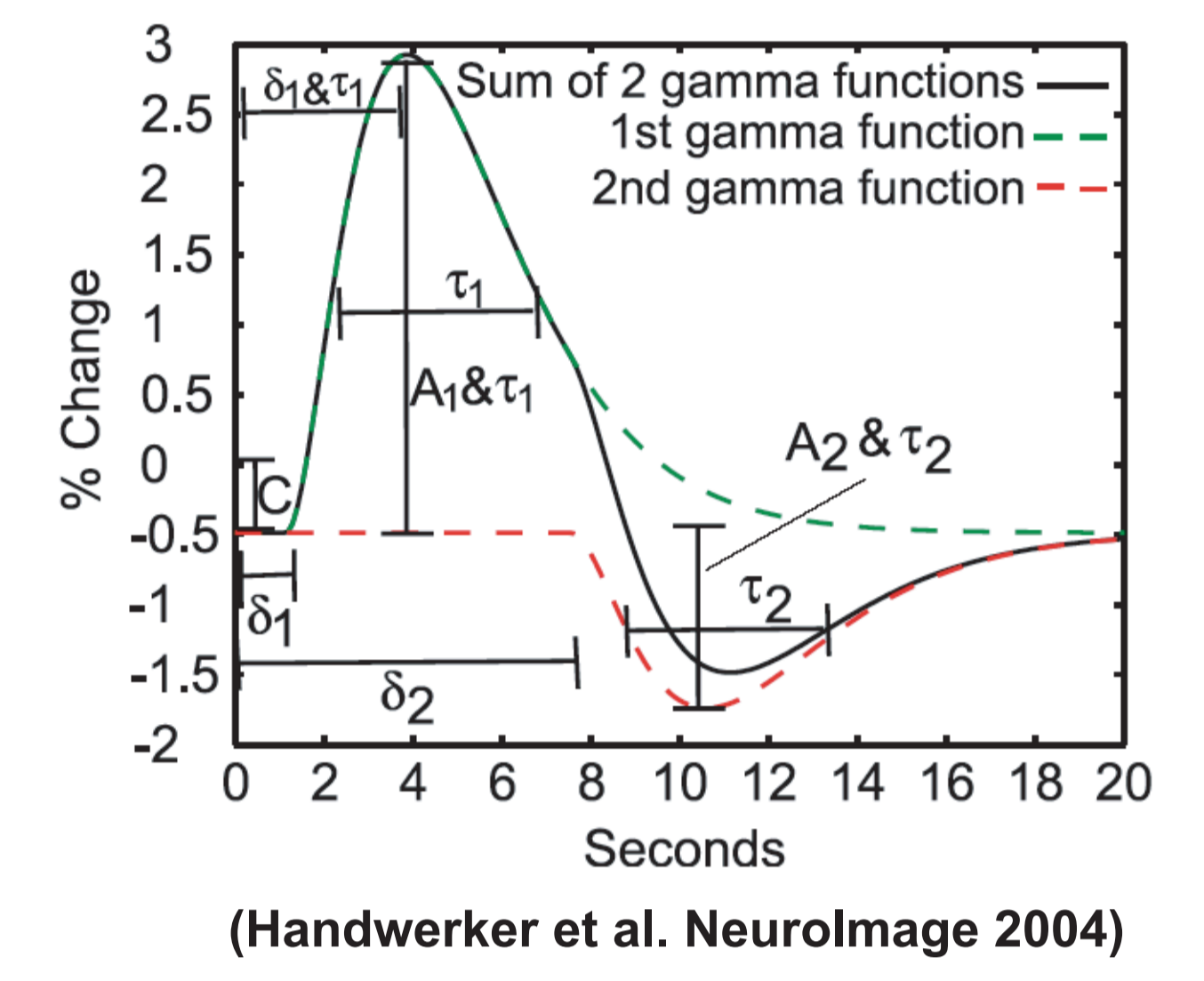


Methods: Statistical analyses

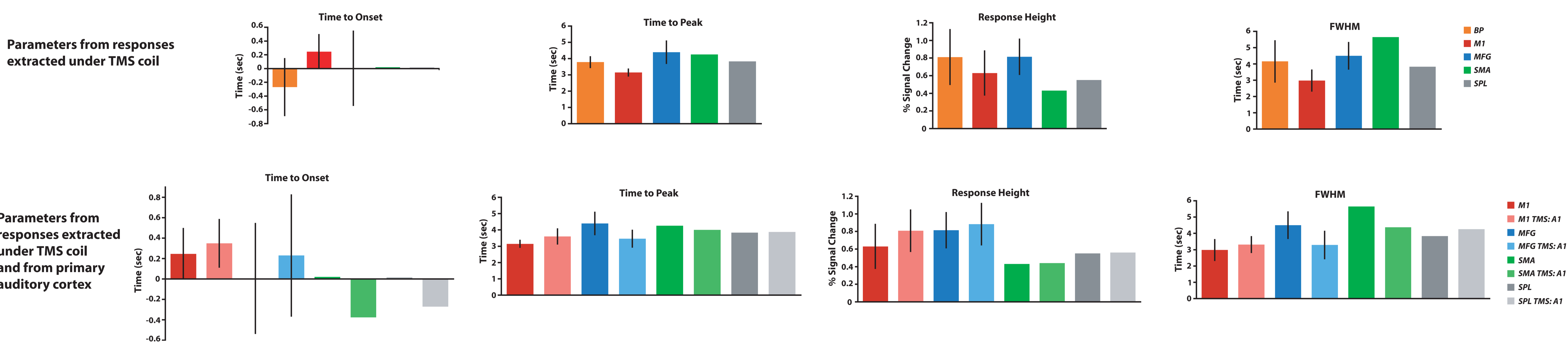
FIR-based constrained principal component analysis (cPCA)

- Multivariate approach to statistical analysis of fMRI data
- Singular value decomposition of fMRI time series to derive eigenimages
- 10 FIR basis functions specified for the average number time points across trials
- Averaged, correlated BOLD signal for each time point revealed for extracted components
- "Thresholded" eigenimages to show top 5% most extreme eigenvalues

- Average response extracted from voxels under stimulating coil (or lh M1 for button press trials)
- Quantified the shape of evoked HRFs by fitting the sum of two gamma functions to the fMRI data
- Compared 4 parameters (time to onset, time to peak, response height, full width at half maximum (FWHM)) of TMS-evoked responses to button press evoked, and to responses evoked in primary auditory cortex (A1)

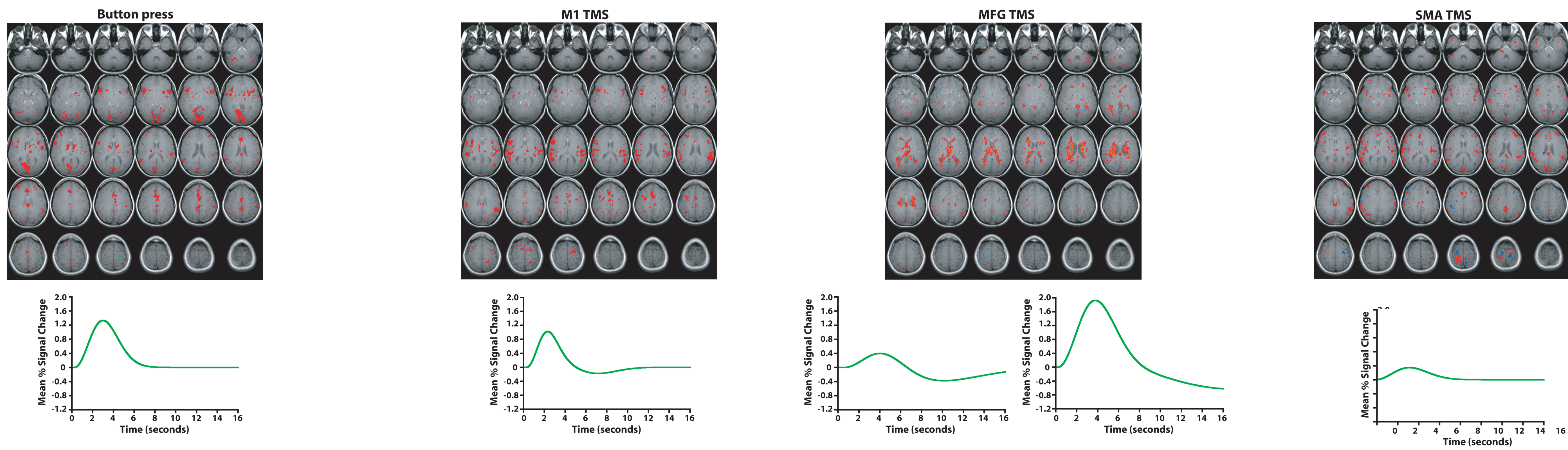


Results: HRF variability



* No significant differences detected between any parameters for any conditions

Example Subject:



Results: "Ping"

- A single TMS pulse propagates producing activation in multiple, anatomically distinct brain areas

Example Subject:

