Supplementary Material

Figure 1: Radiographic marker alignment and EPI images after TMS. Figure 1 shows the marker-alignment scans (on the left) from a representative subject with three radiographic markers (in yellow circles) placed on the subject's head. The subject's head was strapped to the TMS-coil holder to insure a direct contact with the TMS coil. Each scan was about 15 sec (TR = 330 ms, TE = 1.33 ms, flip angle = 15º, FOV = 220 mm, slice thickness = 2 mm, slices = 80 per slab, acquisition matrix = 256 x 256). It was acquired immediately before and after the concurrent TMS-rfMRI scans. These marker-alignment scans were used to estimate the shift in TMS-coil position during the scans. On average, the subjects' head movement was minimum (translation: x < 0.1 mm [± 0.2], y < 0.3 mm [± 0.5], z < 0.2 mm [± 0.6]; rotation: < 0.01 mm [± 0.01] in x, y, z directions). The EPI images on the right of the figure shows little visible TMS-induced artifact in the EPI images immediately after a High (120%) TMS pulse and 4 TRs (9.2 sec) post 120% TMS.

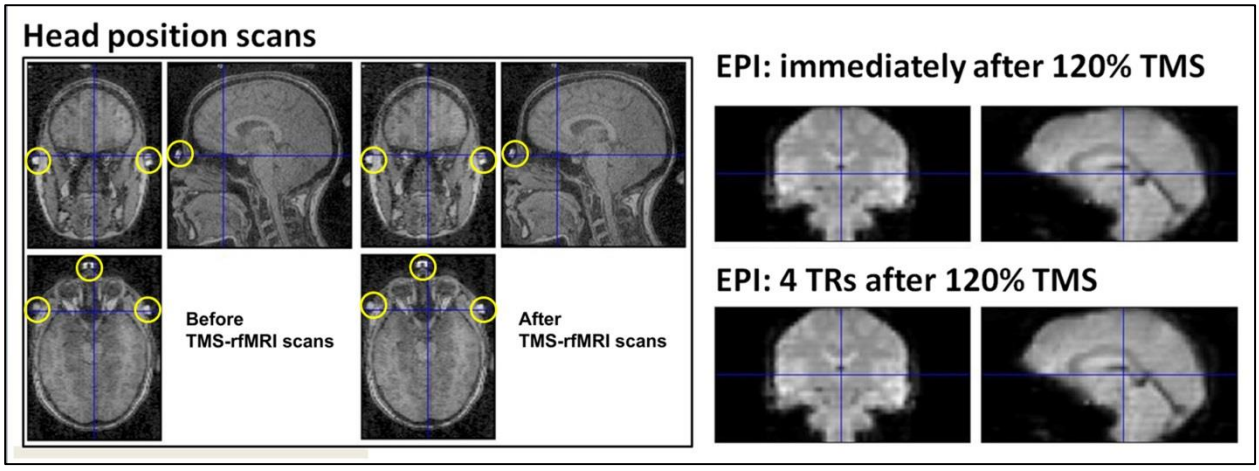


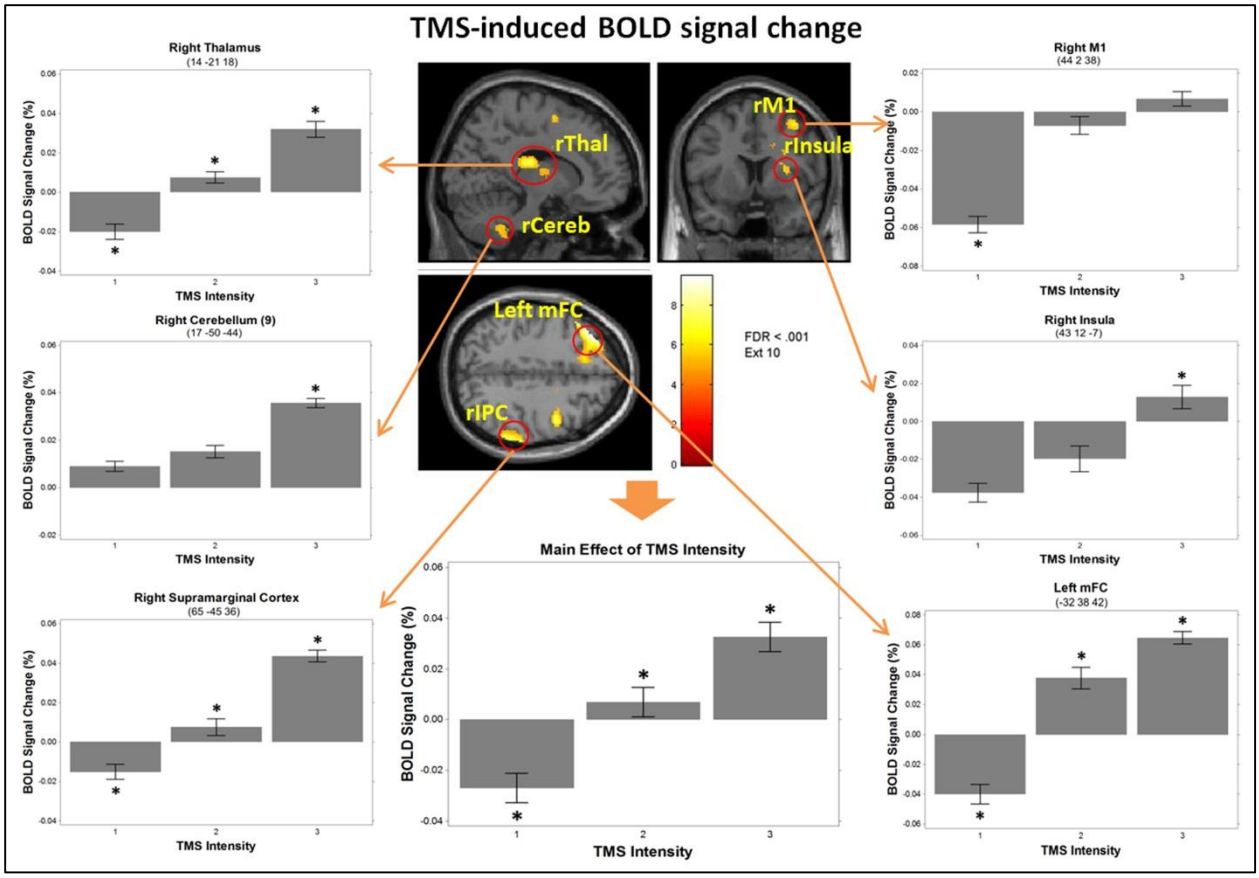
Table. Phantom results of MR signal intensity and signal-to-noise ratio with or without TMS

Signal Intensity	**Slice Closest to TMS Coil**			**Slice furthest from TMS Coil**		
TMS intensity	Low	Mid	High	Low	Mid	High
1st volume after TMS	$971.3^{+/-2}$	$972.7^{+/-3}$	$973.5^{+/-2}$	$1058.6^{+/-2}$	$1058.1^{+/-2}$	$1057.4^{+/-2}$
4th volume after TMS	$972.9^{+/-2}$	$972.7^{+/-2}$	$972.4^{+/-3}$	$1058.6^{+/-1}$	$1057.7^{+/-2}$	$1057.7^{+/-2}$
No TMS	$970.9^{+/-4}$	$970.7^{+/-4}$	$972.6^{+/-2}$	$1057.3^{+/-2}$	$1058.5^{+/-2}$	$1057.6^{+/-1}$
Signal-to-noise ratio	**Slice Closest to TMS Coil**			**Slice furthest from TMS Coil**		
TMS intensity	Low	Mid	High	Low	Mid	High
1st volume after TMS	542	546	548	583	582	583
4th volume after TMS	546	544	546	582	583	585
No TMS	544	542	545	581	583	580

Note: “No TMS” = identical volumes from the scans without TMS.

The above Table shows the results of the MR signal quality tests with a spherical phantom (contained deionized water, sodium chloride, sodium azide, and 40% PVP) using the exact hardware setup and EPI sequences for the TMS-fMRI scans to examine the MR signal intensity and signal-to-noise ratio (SNR). We did two scans with no TMS stimulation and two scans with TMS stimulation during the fMRI acquisitions. Here are the results of the MR signal intensity and SNR measured in two slice locations (1=immediately under the TMS coil about 1 cm beneath the coil which is similar to where the cortex starts, and 2 = the slice furthest away from the TMS coil). The sampling ROI was a 4^3 mm cubic box. For each TMS intensity condition, we extracted values from the first volume immediately after TMS and the forth volume after TMS as the baseline control (both from the scans with TMS and the scans without TMS). We also extracted identical volumes from the no-TMS scans as a second baseline. The phantom results showed that although both the intensity and SNR were slightly higher in the slice furthest away from the TMS coil, they are virtually identical across TMS conditions and scan volumes post TMS. These results indicate that the MRI signal intensity and SNR were not affected by the TMS and the change in TMS amplitude. Both the MR signal intensity and SNR were similar to those in the No-TMS scans.

Figure 2: Results of the whole-brain analysis. The whole-brain analysis showed a significant (FDR < .001) effect of TMS intensity in several brain regions including: right M1, insula, superior parietal cortex (SPC), thalamus, cerebellum, and left middle frontal cortex (mlFC). A one-way within-subject ANOVA including the peak voxels of these six regions showed a significant main effect of TMS intensity ($F_{(2,32)}$ = 103.5, MSe = 8.8, $p < .0001$). Post hoc F test ($p < .05$) showed that the BOLD signal change (%) between the three TMS-intensity conditions were significantly different from each other. Relative to the baseline, the Low TMS condition showed an overall decrease in BOLD signal and the Mid and High TMS condition an increase in the BOLD signal. The significant differences between the TMS conditions in BOLD signal change distal to the right preSMA suggest that TMS stimulation may influence neural activity in other brain regions directly or indirectly through the stimulation site. Separate one-way ANOVAs with TMS intensity as the within-subject factor for each of the regions showing a significant main effect of TMS intensity for all these regions. Post hoc Tukey's tests ($p < .05$) again showed significant differences between the TMS conditions for each of these regions. * = significant post hoc Tukey's test with $p < .05$.


TMS-induced BOLD signal change
Right Thalamus
(14 -21 18)
Right M1
(44 2 38)
Right Cerebellum (9)
(17 -50 -44)
Right Insula
(43 12 -7)
Right Supramarginal Cortex
(65 -45 36)
Main Effect of TMS Intensity
Left mFC
(-32 38 42)
rThal
rCereb
rM1
rInsula
Left mFC
rIPC
FDR < .001
Ext 10
BOLD Signal Change (%)
TMS Intensity