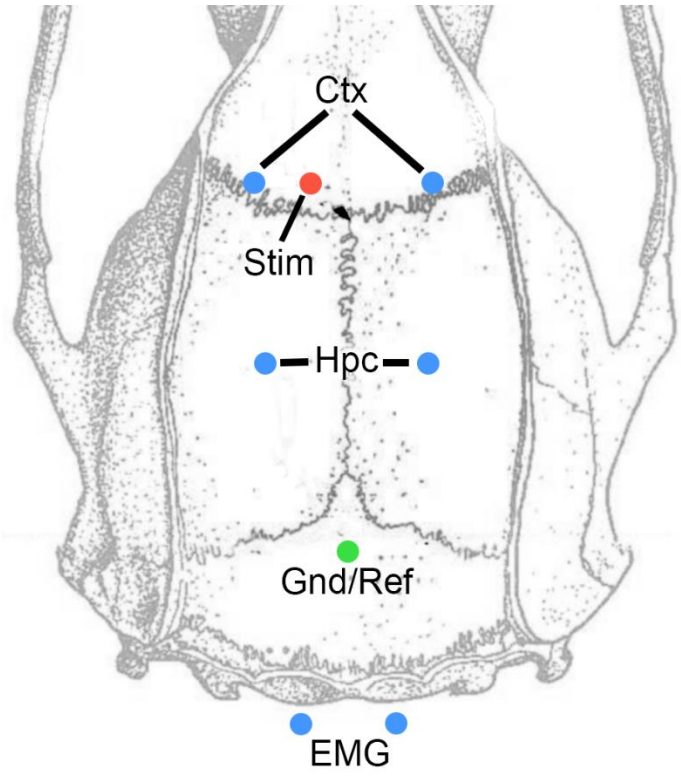

Figure S1. Surgery methods. Twisted bipolar electrodes (Teflon-insulated stainless steel, ID: 76 um) were implanted bilaterally in the motor cortex for recording (1.0 mm anterior, 3.0 mm lateral), in the corpus callosum adjacent to the motor cortex for stimulating (1.0 mm anterior, 1.5 mm lateral), in the hippocampus for recording (3.5 mm posterior, 2.6 mm lateral, 2.6 ventral). Multi-strand stainless steel wire was inserted in the neck muscle to record EMG activity.

Fisher 344 – Brown Norway rats were between 4-8 months old and weighed between 350-450g at the time of surgery. They were housed individually in a vivarium on a 12 h light cycle (7am lights on), and they had free access to food and water. Following surgery, rats were given Metacam for 3 days as an analgesic, and Baytril antibiotic for 5 days. They were allowed 1 week of recovery prior to the start of experiments. Recordings were done during the light cycle.

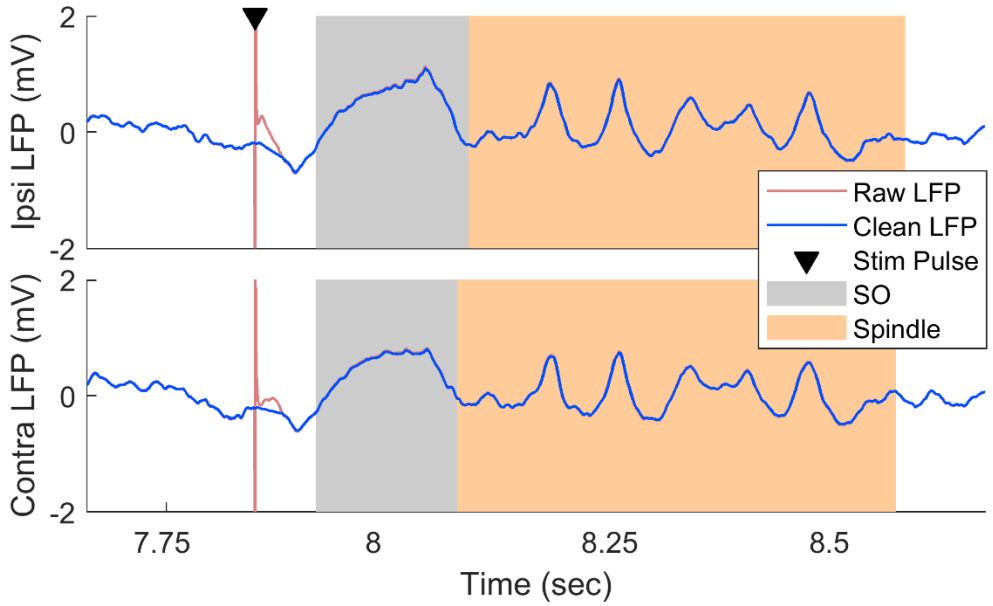

Figure S2. Removal of artifact caused by the stimulation pulse (enlarged from Fig. 1A). Artifact times were identified by finding the 99.95 percentile of the first derivative of the LFP. The first part of the artifact, containing the largest deflections, was removed by reducing the amplitude with an inverted Blackmann window (width 6-9 ms). Subsequent slower electrical transients were removed by subtracting a smoothed signal (2.5 ms rectangular window, step size 1 sample) from the raw signal, effectively high-passing the signal with ½ amplitude frequency of 90 Hz. The duration of the second part of the correction ranged between 25-27 ms, and did not impact SO or spindle detection.

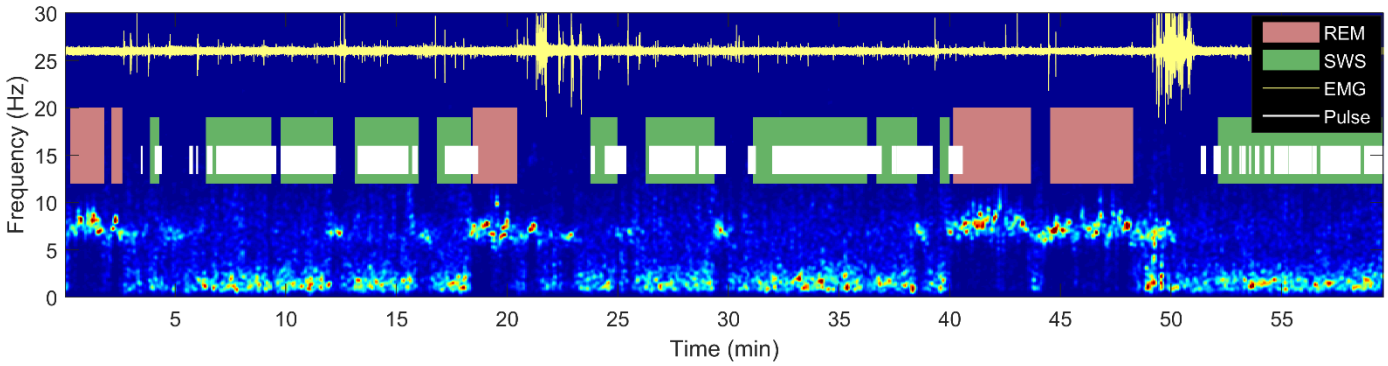

Figure S3. Real-time detection of SWS and delivery of stimulation pulses during a representative stimulation session. Background image shows the spectrogram of the hippocampal LFP, and the EMG trace is in yellow at top. Red/green patches show offline detection of REM and SWS. White patches show times when SWS was detected in real-time and stimulation pulses were delivered.

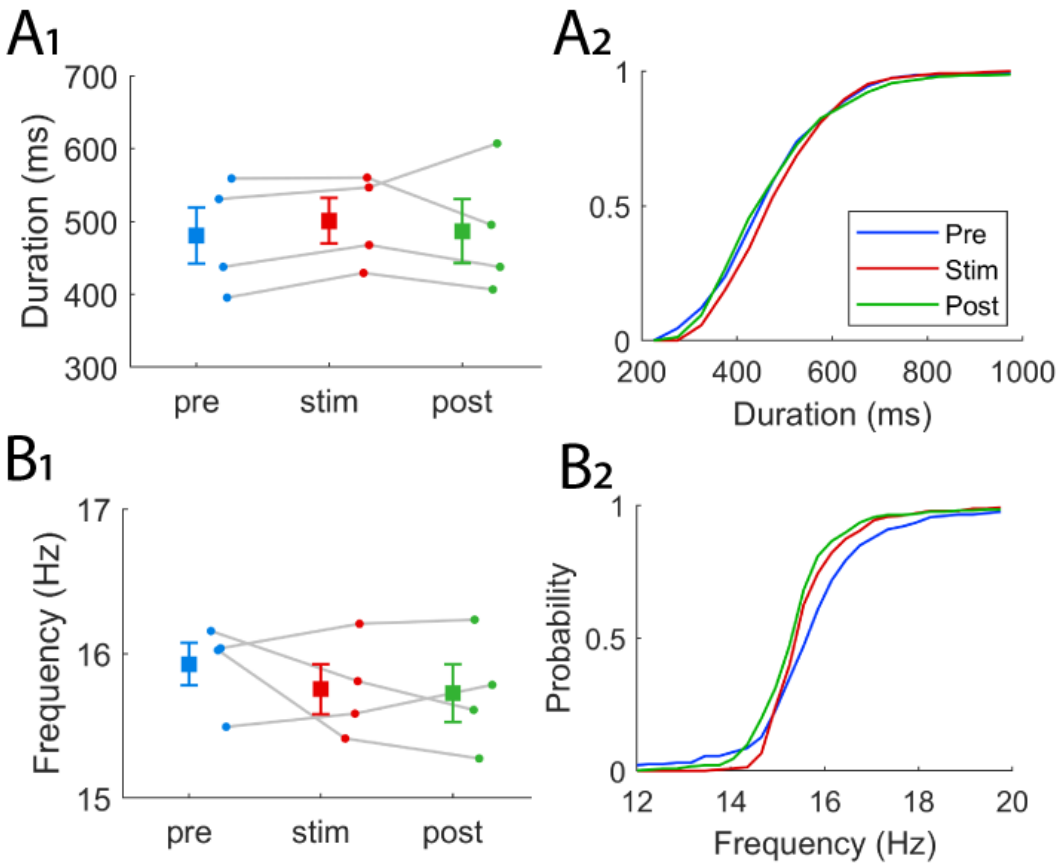

Figure S4. Stimulation does not alter duration (A1,2) or frequency (B1,2) of spindles.

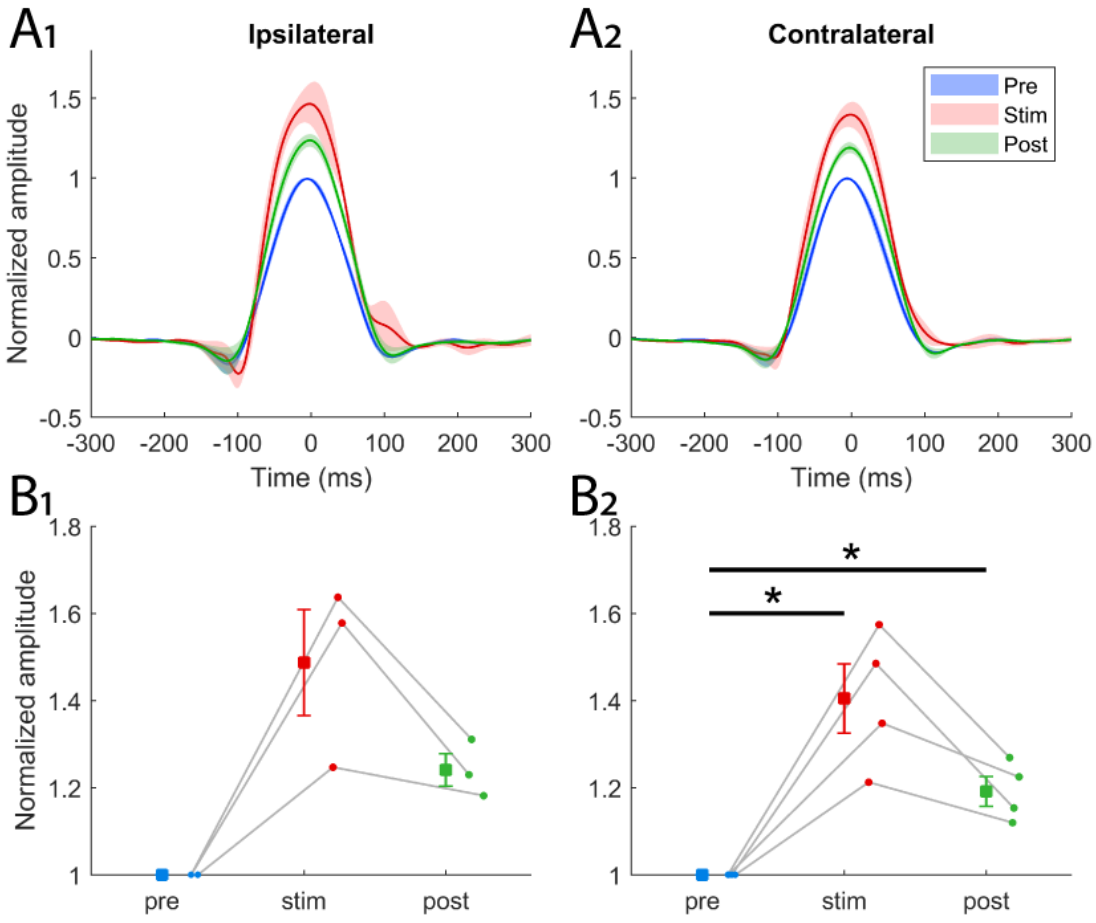

Figure S5. Comparison of spontaneous and evoked SOs. (A1,2) Average waveforms of spontaneous and evoked SOs. Amplitude is normalized to peak of spontaneous SO in each rat. Shaded region is SEM of n = 3 (Ipsilateral) or 4 (Contralateral) rats. (B1,2) Quantification of amplitude across recording sessions (*$p < 0.05$, Bonferroni corrected; pre-stim $t_3 = 5.12$, stim-post $t_3 = 5.68$).

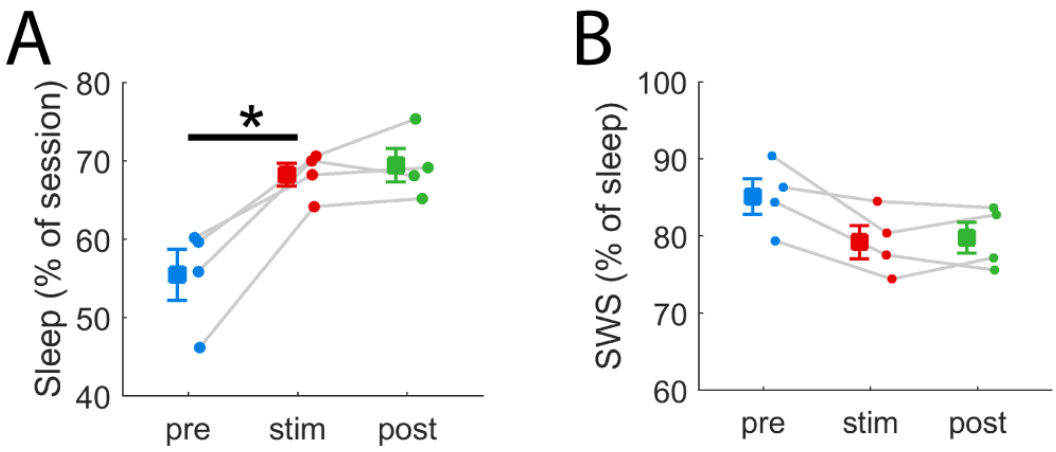

Figure S6. Sleep structure across recording sessions. (A) Percent of time spent sleeping was less during the pre-stim epoch, likely because the rat had been transported from the colony room and was still aroused (*$p < 0.05$, $t_3 = 5.98$, Bonferroni corrected). The amount of sleep during the stim and post-stim sessions was similar. (B) The proportion of SWS was not significantly different across sessions, indicating that stimulation did not alter sleep structure significantly.

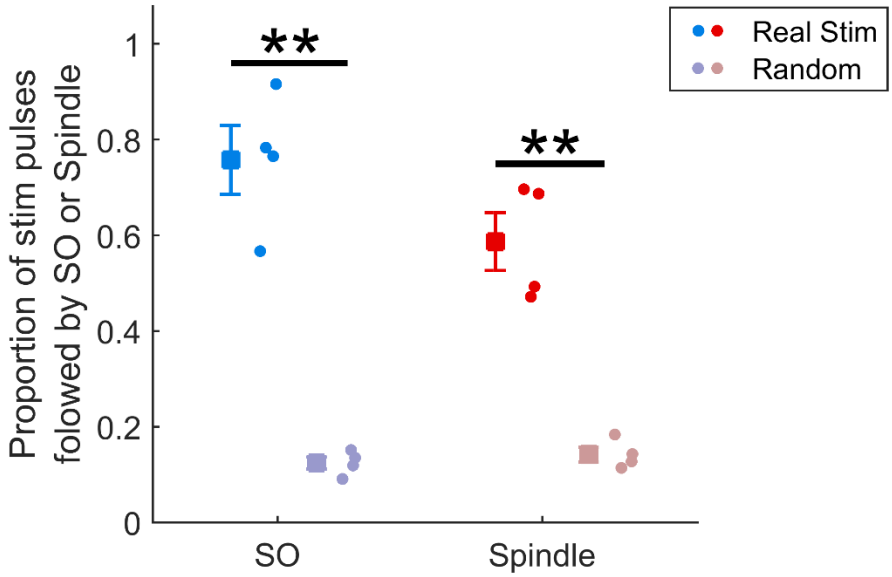

Figure S7. Reliability of stimulation measured by the proportion of pulses that evoke SOs or spindles. The proportion of SOs and spindles following real stimulation pulses (SO: < 500 ms; Spindle: < 750 ms) was significantly greater than an equivalent number of randomly distributed times during SWS (**p < 0.01; SO: $t_3 = 8.20$; spindle: $t_3 = 7.61$, $p < 0.01$).

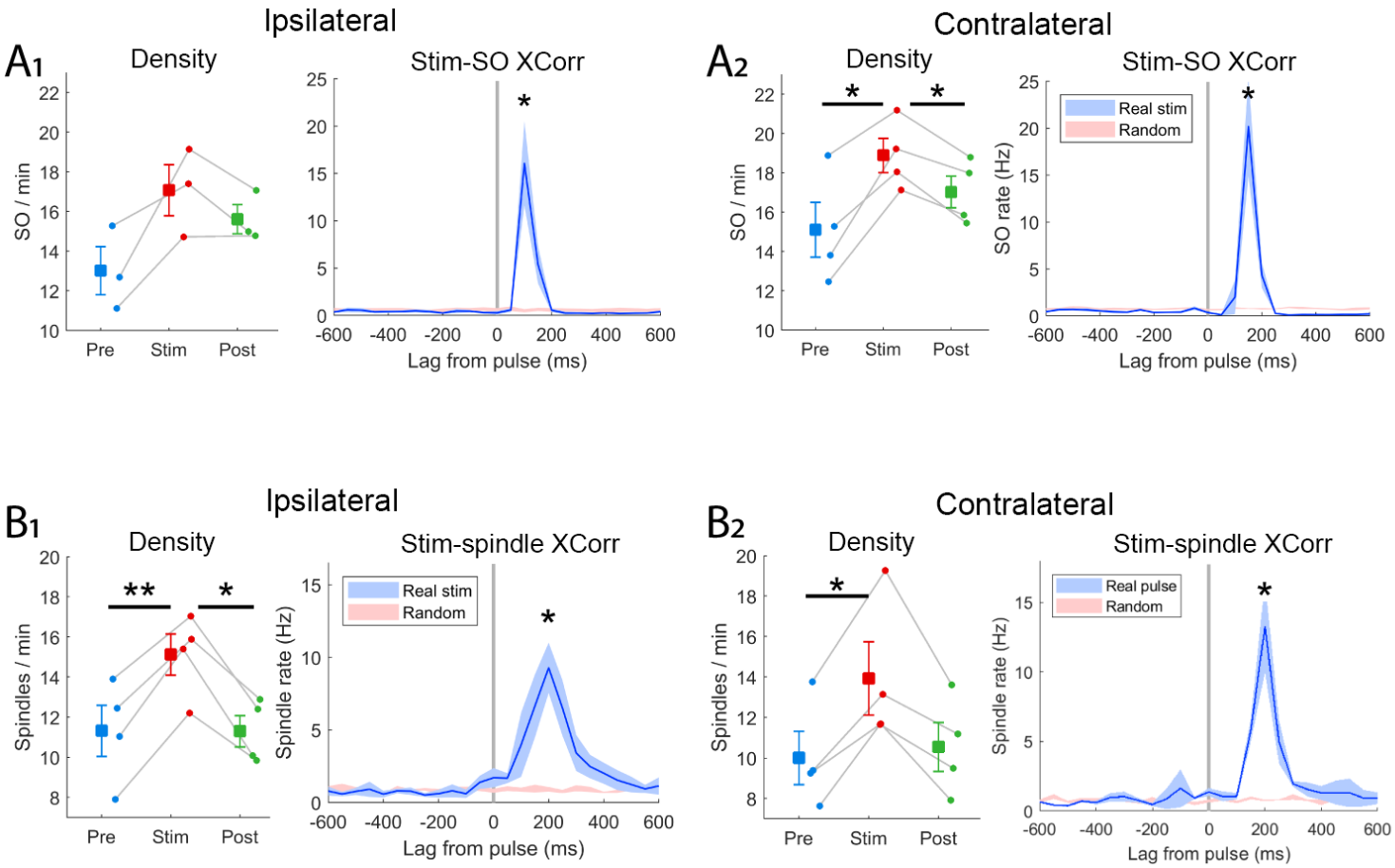

Figure S8. SO and Spindle measures by hemisphere (relative to stim electrode). (A1) Ipsilateral SO density (# / min) and cross correlation with stimulation pulses ($t_2 = 5.23$; n = 3 because one rat did not have measurable SO's). (A2) Contralateral SO density (pre-stim $t_3 = 5.10$, stim-post $t_3 = 5.16$) and cross correlation with stimulation pulses ($t_3 = 3.67$). (B1) Ipsilateral spindle density (pre-stim $t_3 = 12.4$; stim-post $t_3 = 5.56$) and cross correlation with stimulation pulses ($t_3 = 3.40$). (B2) Contralateral spindle density ($t_3 = 6.26$) and cross correlation with stimulation pulses ($t_3 = 5.75$). All panels: *$p < 0.05$, **$p < 0.01$, p-values in density panels are Bonferroni-corrected for 3 comparisons.

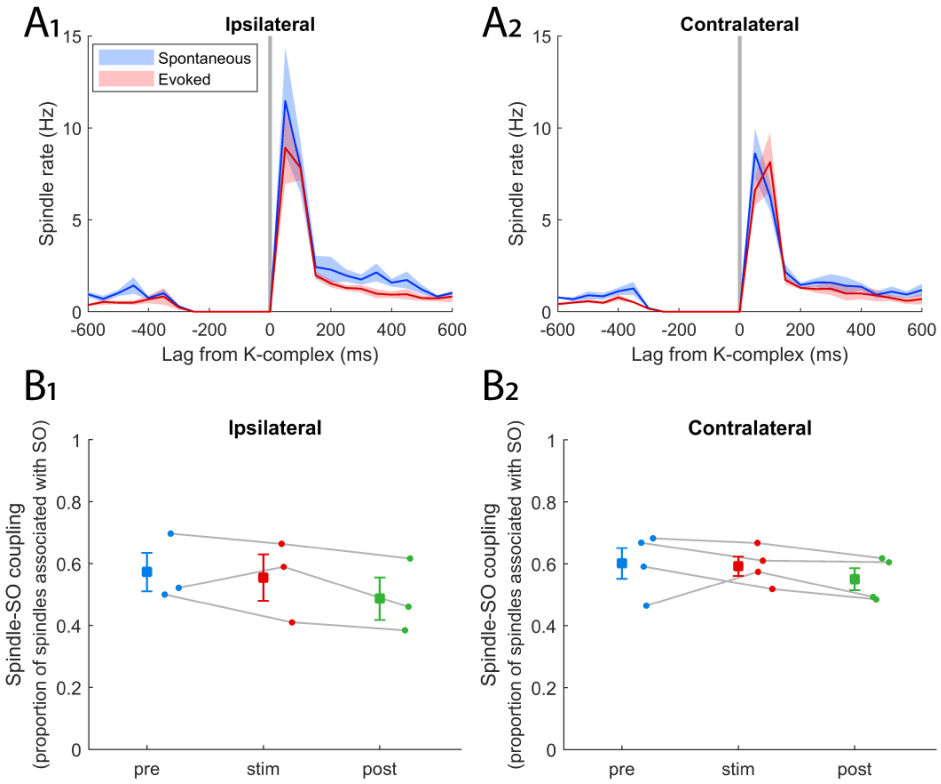

Figure S9. Stimulation does not affect coordination between SOs and spindles. (A 1,2) PSTHs of spindles locked to SO time for ipsilateral (n =3), and contralateral (n=4) hemispheres. (B 1,2) Spindle-SO coupling (proportion of spindles that occur within 750 ms of a SO) is not changed by stimulation.

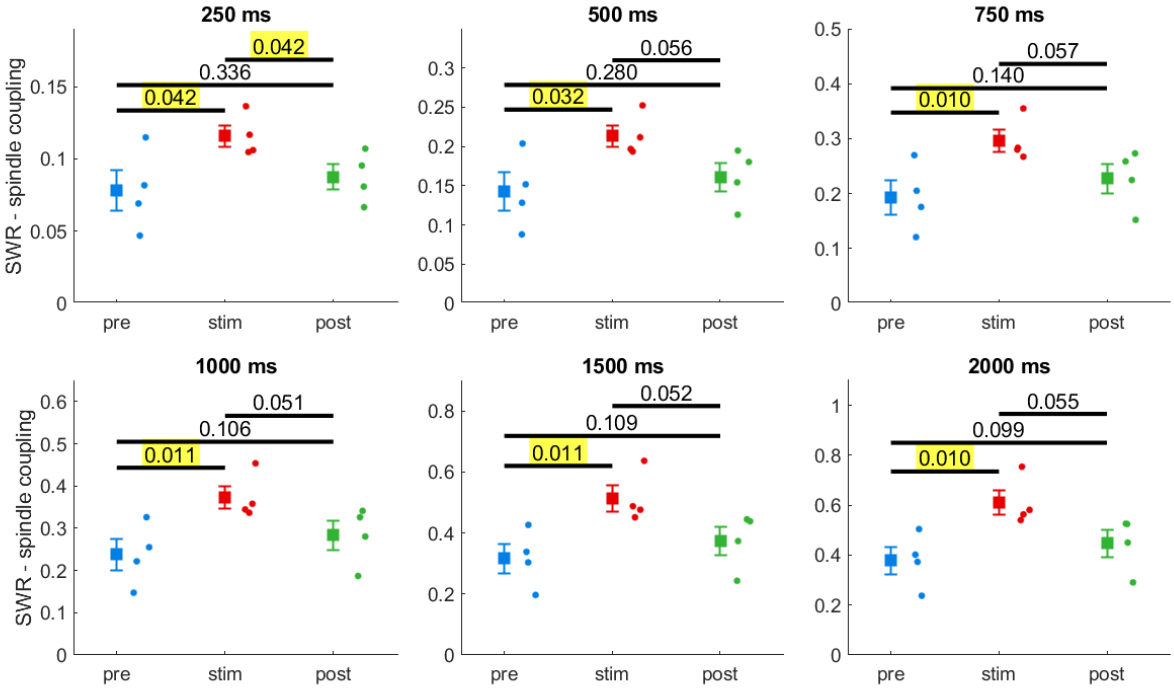

Fig. S10. Increased SWR-spindle coupling is significant when a range of inter-event gaps is tested (250 – 2000 ms). The title of each panel shows the maximum duration between a SWR and spindle for the spindle to be considered coupled to the SWR, and the values indicate the p-value for the comparison indicated by the bar. In all cases, the SWR-spindle coupling increases significantly during the stimulation session.