Supplemental Information for "Using oscillating sounds to manipulate sleep spindles"

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Supplemental Data Analysis

OWN did not increase slow spindles over frontal electrodes during 12-Hz stimulation

The *a priori* decision to use frontopolar electrodes was made because 1) we found maximum slow spindle density at frontopolar sites in our previous study (Antony et al., 2012), and 2) we wanted to maximize spatial discrimination between the two spindle types. Although slow spindle density was again maximal at frontopolar locations in the current study (Figure S1), slow spindle power was maximal at frontal locations. To address the possibility that our frontopolar analysis (see text) might have missed interesting effects present frontally, we ran additional spindle analyses using a frontal cluster (F3, Fz, and F4). We found significantly enhanced fast spindles in the 15-Hz condition [in spindles/minute – slow OWN: 3.14 ± 0.20, slow CWN: 3.05 ± 0.18, $t(10) = 0.70$, $p > 0.49$; fast OWN: 1.71 ± 0.19, fast CWN: 1.35 ± 0.18, $t(10) = 4.82$, $p < 0.001$]. Whereas one might predict that slow spindles would be enhanced frontally with 12-Hz stimulation, we found no significant difference in slow or fast spindles in the frontal cluster with 12-Hz stimulation [in spindles/minute – slow OWN: 2.56 ± 0.26, slow CWN: 2.50 ± 0.26, $t(10) = -0.13$, $p > 0.58$; fast OWN: 1.34 ± 0.14, fast CWN: 1.36 ± 0.16, $t(10) = 0.56$, $p > 0.89$].

Table S1. Spindle characteristics between OWN and CWN for each group over the parietal cluster. No significant differences were seen in any contrast, although there was a marginal trend for a decrease in duration in the 15-Hz group. Power values represented the average maximum amplitude of each spindle. Duration represents the amount of time the spindle RMS signal remained above the spindle threshold.

Group	Measurement	OWN	SEM	CWN	SEM	*p*
12 Hz	**Frequency (Hz)**	13.69	0.06	13.79	0.04	<0.01
	Duration (s)	0.87	0.02	0.87	0.02	0.84
	Power (μV)	16.96	0.79	16.83	0.80	0.63
15 Hz	**Frequency (Hz)**	13.64	0.08	13.58	0.11	0.13
	Duration (s)	0.88	0.03	0.90	0.03	0.09
	Power (μV)	17.56	1.49	17.24	1.40	0.20
50 Hz	**Frequency (Hz)**	13.65	0.02	13.66	0.02	0.79
	Duration (s)	0.95	0.02	0.91	0.01	0.28
	Power (μV)	14.46	0.38	14.55	0.39	0.76

Table S2. Sleep architecture and overall slow and fast spindle densities did not differ between conditions. Mean time spent in each sleep stage (left) and mean slow and fast spindle densities for the frontopolar (Fp) and parietal (P) clusters (right) are shown. No significant differences were seen in any sleep stage or spindle density type or cluster across the three conditions.

Group		Time in each stage (min)					Spindle density (#/min)			
		Wake	**N1**	**N2**	**N3**	**REM**	**Fp - slow**	**P - slow**	**Fp - fast**	**P - fast**
12 Hz	**Mean**	20.82	9.32	37.18	17.59	5.59	3.88	1.61	1.17	3.38
	SEM	4.29	1.95	4.50	4.66	1.99	0.21	0.13	0.24	0.23
15 Hz	**Mean**	18.59	7.86	34.86	15.23	6.05	4.06	1.85	0.90	2.80
	SEM	2.54	1.55	3.12	3.93	2.39	0.23	0.18	0.09	0.31
50 Hz	**Mean**	25.95	11.55	29.35	16.60	3.85	3.64	1.83	1.19	2.94
	SEM	7.04	2.37	3.96	5.76	1.88	0.32	0.15	0.13	0.34

Figure S1. Slow and fast spindle density differed topographically during CWN periods. Data for slow (11-13.5 Hz) and fast (13.5-16 Hz) spindle density from each of 21 EEG electrodes (small black circles), as recorded during CWN periods in this experiment, are shown with interpolation topographically on a view of the head from above. Note the predominance of slow spindles in the three locations designated the frontopolar electrode cluster and of fast spindles in the three locations designated the parietal electrode cluster.

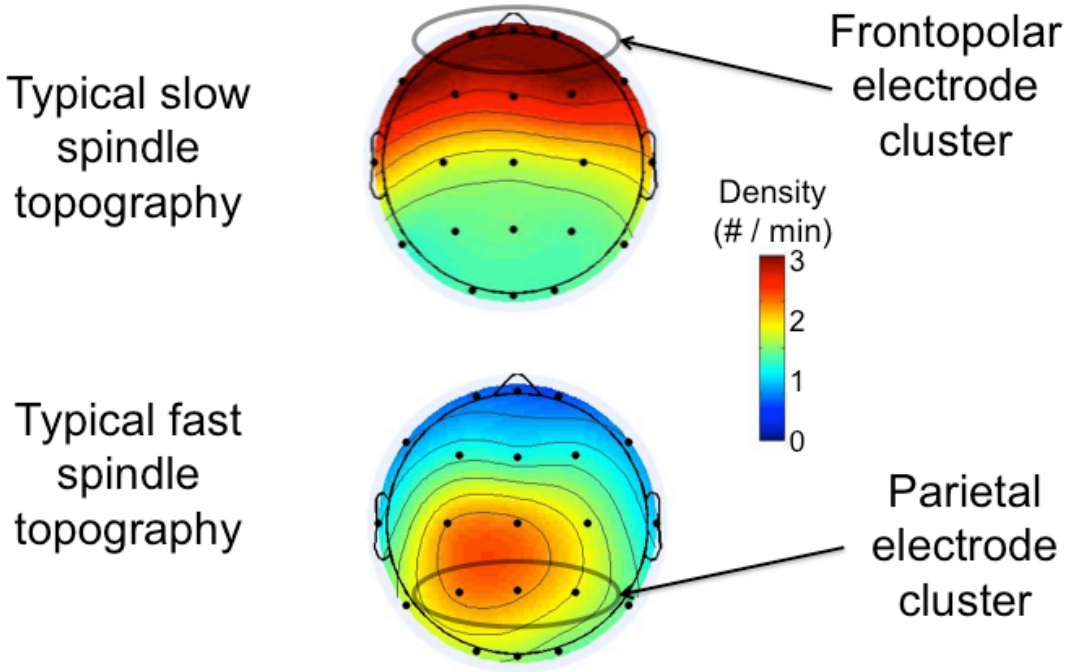

Figure S2. Topographic similarity between spindles during OWN and CWN periods. Topographic maps depict average spindle power across the scalp in each period for fast spindles in the 15-Hz condition (left) and slow spindles in the 12-Hz condition (right). Power measures submitted to an electrode by sound type (OWN vs. CWN) ANOVA revealed no significant topographic differences between sound types (see text).