

## Supplementary Tables

**Table S1.** Categorization of studies based on implemented methodology.

Category	High	Moderate	Low
Objective measure to determine sleep stages as recommended by AASM	Sleep EEG measured with the minimum number of electrodes for each recommended region.	Sleep EEG measured with the minimum number of electrodes for each recommended region.	Sleep EEG measured with less than minimum number of electrodes for each recommended region or no EEG measurement. <sup>3</sup>
Control of confounding variables	Baseline and experimental measurements were performed in the lab and compared to measurements without vestibular input.	Baseline and experimental measurements performed in the lab.	Only experimental measurement in the lab or application of experimental stimulation by participants at home.
Effect of motion on sleep based on the study design	Participants were assigned by study experimenter to passive vestibular stimulation conditions. <sup>2</sup>	Participants chose the type of passive vestibular stimulation condition. <sup>2</sup>	Participants chose the type of passive vestibular stimulation or no report of applied stimulation.
Participant selection <sup>1</sup>	Men and women tested.	Only men tested.	Only men tested.
<p>High quality for one study [15], moderate for seven studies [11-14,38-40], and low for five studies [33-37].</p> <p><sup>1</sup>In studies with human participants.</p> <p><sup>2</sup>If more than one passive vestibular stimulation intensity/type/axis was applied to participants.</p> <p><sup>3</sup>Not applicable for respiration studies [9,10].</p>			

**Table S2.** Mean  $\pm$  SD for sleep macro-architecture outcomes.

Paper	SO (min)		N1		N2		N3		REM		W		SE	
	B	R	B	R	B	R	B	R	B	R	B	R	B	R
Woodward et al. (1990) <sup>[38]1</sup>	18.44 ± 13.1	14.25 ± 8.4	3.57 ± 1.1	4.66 ± 1.13	54.19 ± 3.05	51.82 ± 3.39**	9.05 ± 1.78 <sup>7</sup>	9.79 ± 2.06 <sup>7</sup>	26.72 ± 2.97	27.41 ± 3.22	17.88 ± 3.96 <sup>9</sup>	19.81 ± 4.36 <sup>9</sup>	92.49 ± 2.69	92.37 ± 2.26
Bayer et al. (2011) <sup>[11]1</sup>	8.85 ± 6.48	5.35 ± 4.93**	12.4 ± 5.09	7.9 ± 3.7**	12.2 ± 6.13	16.9 ± 32.89	0.3 ± 0.95	0.87 ± 1.64	NA	NA	5.45 ± 3.42 <sup>9</sup>	4.85 ± 2.85** <sup>9</sup>	73.1 ± 18.15	73.65 ± 8.79
Shibagaki et al. (2017) <sup>[39]2</sup>	NA <sup>5</sup>	NA <sup>5</sup>	NA	NA	NA <sup>5</sup>	NA <sup>5</sup>	NA <sup>5</sup>	NA <sup>5</sup>	NA	NA	NA	NA	NA	NA
Omlin et al. (2018) <sup>[12]2</sup>	8.48 ± 5.8	9.67 ± 5.43	10.54 ± 7.79	12.89 ± 11.57	232.5 ± 37.11	238.67 ± 28.63	88.24 ± 23.92	85.41 ± 22.36	NA	NA	6.87 ± 16.52	5.81 ± 9.4	96.77 ± 4.22	96.5 ± 3.07
			1.5 ± 1.52 <sup>6</sup>	2.31 ± 3 <sup>6</sup>	46.09 ± 13 <sup>6</sup>	52.41 ± 11.45* <sup>6</sup>	50.98 ± 12.11 <sup>6</sup>	46.2 ± 10.19 <sup>6</sup>			1.44 ± 4.48 <sup>5</sup>	0.67 ± 1.2 <sup>5</sup>	91.73 ± 7.43 <sup>5</sup>	90.82 ± 6.18 <sup>5</sup>
			B: 341.6 ± 24.08		R: 347.3 ± 22.17		61.6 ± 2.6				65.7 ± 7.97	316.6 ± 24.25	306.9 ± 19.4	
Kompotis et al. (2019) <sup>[15]2,3</sup>	NA <sup>5</sup>	NA <sup>5</sup>	B: 387.3 ± 13.49		R:382 ± 21.17		57.4 ± 6.35		50.2 ± 7.67	275.3 ± 12.44	287.8 ± 24.61	NA	NA	
			B: 397.8 ± 9.62		R:446.1 ± 16.97*		54.8 ± 3.96		54.1 ± 6.22	267.4 ± 9.33	219.7 ± 17.82*			
			B: 406 ± 20.4		R:491.6 ± 32.4*		54 ± 5.7		43 ± 12.3*	260 ± 20.1	185.4 ± 25.2*			
			B: 378 ± 8.4		R:374.4 ± 5.7		63.9 ± 11.1		66.7 ± 8.1	278.2 ± 102.9	278.9 ± 9.6			
Perrault et al. (2019) <sup>[13]1</sup>	16.72 ± 14.93	10.08 ± 6.53*	6.22 ± 2.76	5.58 ± 2.59	44.26 ± 6.02	41.28 ± 7	22.37 ± 6.79	27.41 ± 7**	22.26 ± 3.9	21.29 ± 3.95	4.89 ± 2.29	4.44 ± 2.33	92.73 ± 3.56	93.76 ± 2.38
van Sluijs et al. (2020a) <sup>[14]1,4</sup>	10.4 ± 2.4	10.8 ± 5.2	22.1 ± 11.5	12.2 ± 9.9**	56.9 ± 17.7	51.1 ± 20.2	11.3 ± 13.7	33.9 ± 24.8*	NA	NA	9.4 ± 16.5	2.7 ± 3.1	90.2 ± 16.6	97.2 ± 3.2
	8.7 ± 5.2	11.3 ± 6.1	11.3 ± 14	11.1 ± 10.4	44.7 ± 15.9	58.3 ± 22	38.7 ± 24.1	26.7 ± 25.8			5.4 ± 13.7	3.9 ± 6	94.6 ± 13.7	96.1 ± 6
Van Sluijs et al. (2020b) <sup>[40]1</sup>	8.7 ± 5.8	11.4 ± 8	9.5 ± 5.9	10.1 ± 6.2	48.8 ± 7.1	48.5 ± 11.5	20.3 ± 8.8	21.6 ± 11.8	21.4 ± 5.2	19.7 ± 4.5	9.9 ± 7.4	12.5 ± 13.1	90.7 ± 6.5	88.6 ± 8.8

NA for variable not analysed in the study; SO = sleep onset, N1 = non-rapid eye-movement sleep 1, N2 = non-rapid eye-movement sleep 2, N3 = non-rapid eye-movement sleep 3, REM = rapid eye-movement sleep, W = wake, SE = sleep efficiency; B = Baseline, R =

Rocking Condition.

\*  $p < .05$ , \*\*  $p < .01$ .

<sup>1</sup>Sleep stages reported as a percentage of total sleep time.

<sup>2</sup>Sleep stages reported as duration in min.

<sup>3</sup>The first four rows correspond to different stimulation intensities (4.9 cm/s<sup>2</sup> (n=3), 19.7 cm/s<sup>2</sup> (n=7), 79 cm/s<sup>2</sup> (n=8) & 177.7 cm/s<sup>2</sup> (n=9)) and the fifth row corresponds to mice with no functional otoliths vestibular input (79 cm/s<sup>2</sup> (n=9)).

<sup>4</sup>Upper row corresponds to the low intensity group and the lower row corresponds to the high intensity group but both represent values of the medium intensity (25cm/s<sup>2</sup>).

<sup>5</sup>No detailed values reported in a tabular form, only in figures.

<sup>6</sup>During the first two hours after sleep onset.

<sup>7</sup>Sleep stage 3.

<sup>8</sup>Sleep stage 4.

<sup>9</sup>Number of awakenings per session.

**Table S3.** Mean  $\pm$  SD for sleep micro-architecture outcomes.

Paper	Delta Power ( $\mu V^2$ )		#SSO		SSO Density		#SS		SS Density	
	B	R	B	R	B	R	B	R	B	R
Bayer et al. (2011) <sup>[11]</sup>	NA <sup>2</sup>	NA <sup>2</sup>	NA	NA	NA	NA	29.15 $\pm$ 19.83	57.5 $\pm$ 29.31**	1.2 $\pm$ 1.8	1.64 $\pm$ 2.21**
Omlin et al. (2018) <sup>[12]</sup>	366.13 $\pm$ 119.77	375.47 $\pm$ 137.34	5265.83 $\pm$ 1717.31	5557.44 $\pm$ 2064.26	6.27 $\pm$ 2.15	6.4 $\pm$ 2.32	638.22 $\pm$ 184.36	671.33 $\pm$ 183.39	2.24 $\pm$ 0.61	2.3 $\pm$ 0.62
	569.72 $\pm$ 214.98 <sup>3</sup>	543.58 $\pm$ 196.22 <sup>3</sup>	2747.33 $\pm$ 979.71 <sup>3</sup>	2681.17 $\pm$ 851.04 <sup>3</sup>	10.56 $\pm$ 3.78 <sup>3</sup>	9.97 $\pm$ 3.32 <sup>3</sup>	170 $\pm$ 44.39 <sup>3</sup>	195.61 $\pm$ 66.56* <sup>3</sup>	2.12 $\pm$ 0.5 <sup>3</sup>	2.3 $\pm$ 0.71 <sup>3</sup>
Kompotis et al. (2019) <sup>[15]</sup>	NA <sup>2</sup>	NA <sup>2</sup>	NA	NA	NA	NA	NA <sup>2</sup>	NA <sup>2</sup>	NA <sup>2</sup>	NA <sup>2</sup>
Perrault et al. (2019) <sup>[13]</sup>	NA	NA	2334 $\pm$ 653.37 <sup>4</sup>	2763 $\pm$ 487.9* <sup>4</sup>	10.9 $\pm$ 2.25 <sup>4</sup>	10.7 $\pm$ 1.7 <sup>4</sup>	416.2 $\pm$ 193.04 <sup>5</sup>	537.7 $\pm$ 223.16* <sup>5</sup>	1.9 $\pm$ 0.55 <sup>5</sup>	2.05 $\pm$ 0.68* <sup>5</sup>
							313.4 $\pm$ 105.22 <sup>6</sup>	442.5 $\pm$ 133.64* <sup>6</sup>	1.53 $\pm$ 0.68 <sup>6</sup>	1.77 $\pm$ 0.72* <sup>6</sup>
van Sluijs et al. (2020a) <sup>[14]</sup>	106.4 $\pm$ 32.7 <sup>4</sup>	118.7 $\pm$ 35.5 <sup>4</sup>	194.3 $\pm$ 212.9	331 $\pm$ 288.5	4 $\pm$ 2.1	6.6 $\pm$ 2.3*	26.7 $\pm$ 15.93	47 $\pm$ 23.32* <sup>4</sup>	1.56 $\pm$ 0.91 <sup>4</sup>	1.78 $\pm$ 0.93 <sup>4</sup>
	164.4 $\pm$ 85 <sup>4</sup>	166.7 $\pm$ 110.8 <sup>4</sup>	572.6 $\pm$ 389.3	447.9 $\pm$ 451.6	7.1 $\pm$ 2.9	5.7 $\pm$ 3.6	57.55 $\pm$ 37.66	49.82 $\pm$ 42.22	1.86 $\pm$ 0.89	1.95 $\pm$ 1.15
Van Sluijs et al. (2020b) <sup>[40]</sup>	349.3 $\pm$ 138.9 <sup>4</sup>	306.5 $\pm$ 93.9 <sup>4</sup>	1145.2 $\pm$ 720.6	1038.8 $\pm$ 574.5	1.6 $\pm$ 0.6	1.5 $\pm$ 0.5	1.7 $\pm$ 0.7	1.6 $\pm$ 0.6	424.1 $\pm$ 187.8	397.7 $\pm$ 163.3

NA for variable not analysed in the study; #SSO = number of sleep slow oscillations, SSO Density = sleep slow oscillations density, #SS = number of sleep spindles, SS Density = sleep spindle density; B = Baseline, R = Rocking Condition.

\*  $p < .05$ , \*\*  $p < .01$ .

<sup>1</sup>Upper row corresponds to the low intensity group and the lower row corresponds to the high intensity group but both represent values of the medium intensity (25cm/s<sup>2</sup>).

<sup>2</sup>No detailed values reported in the running text/tabular form but in figures only.

<sup>3</sup>During the first two hours after sleep onset.

<sup>4</sup>In N3.

<sup>5</sup>Fast Spindles (2.5-15.5 Hz) measured on Pz.

<sup>6</sup>Slow Spindles (8.5-12 Hz) measured on Fz.

**Table S4.** Mean differences for all the reported sleep macro- and micro-architecture outcomes and Hedges' g for all the significant differences.

Paper	SO	N1	N2	N3	REM	W	SE	Delta Power	#SSO	SSO Density	#SS	SS Density
	Diff (g)	Diff (g)	Diff (g)	Diff (g)	Diff (g)	Diff (g)	Diff (g)	Diff (g)	Diff (g)	Diff (g)	Diff (g)	Diff (g)
Woodward et al. (1990) <sup>[38]1</sup>	-4.19	1.09	-2.37 (0.7)**	$\frac{0.74^7}{-0.14^8}$	0.69	1.93 <sup>9</sup>	-0.12	NA	NA	NA	NA	NA
Bayer et al. (2011) <sup>[11]1</sup>	-3.5 (-0.58)**	-4.5 (-0.97)**	4.7 (0.13)**	0.57	NA	-0.6 (-0.12)**	0.55	NA <sup>5</sup>	NA	NA	28.35 (1.12)**	0.44 (0.21)**
Shibagaki et al. (2017) <sup>[39]2</sup>	NA <sup>5</sup>	NA	NA <sup>5</sup>	NA <sup>5</sup>	NA	NA	NA	NA	NA	NA	NA	NA
Omlin et al. (2018) <sup>[12]2</sup>	1.19	2.35	6.17	-2.83	NA	-1.06	-0.27	9.34	291.61	0.13	33.11	0.06
		0.81 <sup>6</sup>	6.32 (0.51)* <sup>6</sup>	-4.78 <sup>6</sup>		-0.77 <sup>6</sup>	-0.91 <sup>6</sup>	-26.14 <sup>6</sup>	-66.16 <sup>6</sup>	-0.59 <sup>6</sup>	25.61 (0.44)* <sup>6</sup>	0.18 <sup>6</sup>
			5.7			4.1	-9.7					
			-5.3			-7.2	12.5					
			48.3 (3.3)*			-0.7	-47.7 (-3.17)*	NA	NA <sup>5</sup>	NA	NA <sup>5</sup>	NA <sup>5</sup>
Kompotis et al. (2019) <sup>[15]1,3</sup>	NA <sup>5</sup>		85.6 (3.01)*		NA	-11 (-1.1)*	85.6 (3.01)*					
			-3.6			2.8	0.7					
Perrault et al. (2019) <sup>[13]1</sup>	-6.64 (-0.57)*	-0.64	-2.98	5.04 (0.71)**	-0.97	-0.45	1.03	NA	429 (0.72)* <sup>10</sup>	-0.2 <sup>9</sup>	121.5 (0.57)* <sup>11</sup>	0.15 (0.23)* <sup>11</sup>
											129.1 (1.05)* <sup>12</sup>	0.24 (0.33)* <sup>12</sup>
van Sluijs et al. (2020a) <sup>[14]1,4</sup>	-0.4	-9.9 (-0.88)**	-5.8	22.6 (1.08)*	NA	-6.7	7	12.3 <sup>10</sup>	136.7	4 (1.73)*	20.3 (0.97)*	0.22
	2.6	-0.2	13.6	12		-1.5	1.5	2.3 <sup>10</sup>	-0.2	-1.4	-7.73	0.09
Van Sluijs et al. (2020b) <sup>[40]1</sup>	2.7	0.6	-0.3	1.3	1.7	2.6	-2.1	-42.8 <sup>10</sup>	-106.4	-0.1	-0.1	-26.4

NA for variable not analysed in the study; SO = sleep onset, N1 = non-rapid eye-movement sleep 1, N2 = non-rapid eye-movement sleep 2, N3 = non-rapid eye-movement sleep 3, REM = rapid eye-movement sleep, W = wake, SE = sleep efficiency, #SSO = number of sleep slow oscillations, SSO Density = sleep slow oscillations density, #SS = number of sleep spindles, SS Density = sleep spindle density.

\* p < .05, \*\* p < .01.

<sup>1</sup>Sleep stages reported as a percentage of total sleep time.

<sup>2</sup>Sleep stages reported as duration in min.

<sup>3</sup> The first four rows correspond to different stimulation intensities (4.9 cm/s<sup>2</sup> (n=3), 19.7 cm/s<sup>2</sup> (n=7), 79 cm/s<sup>2</sup> (n=8) & 177.7 cm/s<sup>2</sup> (n=9)) and the fifth row corresponds to mice with no functional otoliths and a vestibular input of 79 cm/s<sup>2</sup> (n=9).

<sup>4</sup>Upper row corresponds to the low intensity group and the lower row corresponds to the high intensity group but both represent values of the medium intensity (25cm/s<sup>2</sup>).

<sup>5</sup>No detailed values reported in the running text/tabular form but in figures only.

<sup>6</sup>During the first two hours after sleep onset.

<sup>7</sup>Sleep stage 3.

<sup>8</sup>Sleep stage 4.

<sup>9</sup>Number of awakenings per session.

<sup>10</sup>In N3.

<sup>11</sup>Fast Spindles (2.5-15.5 Hz) measured on Pz.

<sup>12</sup>Slow Spindles (8.5-12 Hz) measured on Fz.

**Table S5.** Mean  $\pm$  SD and the mean differences for all the reported memory outcomes, along with Hedges' g for all the significant differences.

Paper	Initial Recall			Delayed Recall			Overnight Performance Improvement			Initial Acquisition Rate		
	B	R	Diff (g)	B	R	Diff (g)	B	R	Diff (g)	B	R	Diff (g)
Omlin et al. (2018) <sup>[12]</sup> <sup>1</sup>	NA <sup>3</sup>	NA <sup>3</sup>	NA <sup>3</sup>	NA <sup>3</sup>	NA <sup>3</sup>	NA <sup>3</sup>	6.72 $\pm$ 3.76	6.69 $\pm$ 3.43	-0.03	NA <sup>3</sup>	NA <sup>3</sup>	NA <sup>3</sup>
Perrault et al. (2019) <sup>[13]</sup>	15.59 $\pm$ 38.51 <sup>4</sup>	15.47 $\pm$ 48.12 <sup>4</sup>	-0.12 <sup>4</sup>	16.59 $\pm$ 43.42 <sup>4</sup>	17.41 $\pm$ 50.18 <sup>4</sup>	0.82 <sup>4</sup>	1.53 $\pm$ 5.98	4.71 $\pm$ 4.16*	3.18 (0.60)	NA <sup>3</sup>	NA <sup>3</sup>	NA <sup>3</sup>
Van Sluijs et al. (2020a) <sup>[14]</sup>	22.4 $\pm$ 6.2	21.8 $\pm$ 6.3	-0.6	30 $\pm$ 6.2	30.1 $\pm$ 6.3	0.1	7.6 $\pm$ 3.2	8.3 $\pm$ 3.4	0.7	74.2 $\pm$ 11.1	71.9 $\pm$ 10.8	-2.3
Van Sluijs et al. (2020b) <sup>[40]</sup> <sup>1</sup>	15.8 $\pm$ 7	16.1 $\pm$ 7.5	0.3	17.2 $\pm$ 7.8	19 $\pm$ 9	1.8	1.5 $\pm$ 2.5	2.9 $\pm$ 3.7	1.4	100 $\pm$ 40.7	90.8 $\pm$ 32.4	9.2

NA for variable not analysed/reported in the study; Overnight Performance Improvement = Delayed Recall - Initial Recall, Initial Acquisition Rate = Initial Recall/ Delayed Recall\*100. \* p < .05.

<sup>1</sup>Reported as Hits

<sup>2</sup>Reported as Accuracy = Hits – Errors.

<sup>3</sup>No detailed values reported in the running text/tabular form but in figures only.

<sup>4</sup>Baseline-Experimental analyses with Accuracy (i.e., Hits – Errors) but values in tabular form available in Hits.