

**Supplementary Table 1. Spatial and temporal firing patterns in the hippocampus of control and MEC-lesioned rats.**

<b>Linear track</b>							
<b>Entire session</b>							
	Mean $\pm$ SEM		Median		<i>P</i>	<i>U</i>	<i>z</i>
	Control	MEC lesion	Control	MEC lesion			
Field size (cm) <sup>b</sup>	42.30 $\pm$ 2.36	63.48 $\pm$ 2.10	40.79	65.84	1.18 $\times 10^{-6}$	3622	4.86
Information (bits per spike) <sup>a</sup>	1.07 $\pm$ 0.08	0.52 $\pm$ 0.03	0.95	0.41	1.59 $\times 10^{-11}$	7531	-6.74
Rate by pass (Hz) <sup>a</sup>	13.75 $\pm$ 0.83	10.30 $\pm$ 0.40	12.49	9.83	9.19 $\times 10^{-5}$	605	-3.91
Max firing rate (Hz) <sup>a</sup>	12.26 $\pm$ 1.04	8.22 $\pm$ 0.44	10.15	6.81	2.91 $\times 10^{-4}$	6407	-3.62
Mean firing rate (Hz) <sup>a</sup>	3.61 $\pm$ 0.31	3.48 $\pm$ 0.22	3.65	2.63	0.34	5443	-0.95
Proportion bursts per cell <sup>a</sup>	0.13 $\pm$ 0.01	0.15 $\pm$ 0.01	0.14	0.14	0.19	4626	1.31
Control: <sup>a</sup> 50 cells (peak rate > 2 Hz), <sup>b</sup> 51 fields, 4 rats MEC lesion: <sup>a</sup> 153 cells (peak rate > 2 Hz), <sup>b</sup> 164 fields, 6 rats							
<b>PSSF</b>							
Field size (cm) <sup>b</sup>	44.71 $\pm$ 2.66	40.15 $\pm$ 2.06	45.80	37.05	0.13	1843	1.53
Information (bits per spike) <sup>a</sup>	1.02 $\pm$ 0.08	0.88 $\pm$ 0.04	0.96	0.84	0.20	1618	-1.31
Rate by pass (Hz) <sup>a</sup>	14.41 $\pm$ 0.94	16.58 $\pm$ 0.81	13.80	16.18	0.51	611	0.65
Max firing rate (Hz) <sup>a</sup>	18.78 $\pm$ 1.25	20.47 $\pm$ 0.99	18.60	18.60	0.37	1347	0.89
Mean firing rate (Hz) <sup>a</sup>	5.58 $\pm$ 0.38	5.97 $\pm$ 0.37	5.15	5.32	0.81	1427	0.24
Proportion bursts per cell <sup>a</sup>	0.13 $\pm$ 0.01	0.15 $\pm$ 0.01	0.13	0.14	0.55	1384	0.59
Theta ratio <sup>c</sup>	20.08 $\pm$ 1.75	5.61 $\pm$ 0.44	18.47	5.07	5.70 $\times 10^{-10}$	1613	-6.20
Mean resultant vector length <sup>c</sup>	0.26 $\pm$ 0.04	0.20 $\pm$ 0.02	0.20	0.19	0.57	1129	-0.56
Single cell theta frequency (Hz) <sup>d</sup>	8.40 $\pm$ 0.19	6.70 $\pm$ 0.27	8.54	6.84	3.90 $\times 10^{-6}$	301	-4.62
LFP theta frequency (Hz) <sup>e</sup>	7.43 $\pm$ 0.14	6.92 $\pm$ 0.06	7.45	6.84	0.0052	71	N.A.
LFP theta power in CA1 ( $\mu\text{V}^2\text{Hz}^{-1}$ ) <sup>f</sup>	10.54 $\pm$ 2.10	6.02 $\pm$ 1.69	9.50	3.50	0.015	634	-2.45
Control: <sup>a</sup> 31 cells (peak rate > 2 Hz), <sup>b</sup> 31 fields, <sup>c</sup> 30 cells (as in Fig. 2), <sup>d</sup> 29 cells (theta ratio > 5), <sup>e</sup> 6 sessions, <sup>f</sup> 20 tetrodes in 4 rats; MEC lesion: <sup>a</sup> 62 cells (peak rate > 2 Hz), <sup>b</sup> 73 fields, <sup>c</sup> 41 cells (as in Fig. 2), <sup>d</sup> 21 cells (theta ratio > 5), <sup>e</sup> 9 sessions, <sup>f</sup> 30 tetrodes in 5 rats							

Open field							
	Mean $\pm$ SEM		Median		<i>P</i>	<i>U</i>	<i>z</i>
	Control	MEC lesion	Control	MEC lesion			
Theta ratio <sup>a</sup>	27.39 $\pm$ 1.60	12.16 $\pm$ 1.49	26.24	9.68	4.40 x 10 <sup>-8</sup>	405	-5.47
Mean resultant vector length <sup>a</sup>	0.14 $\pm$ 0.02	0.14 $\pm$ 0.02	0.11	0.11	0.52	892	0.65
Theta frequency single cell (Hz) <sup>b</sup>	8.19 $\pm$ 0.09	6.62 $\pm$ 0.28	8.06	7.08	3.36 x 10 <sup>-7</sup>	402	-5.10
Frequency difference (Hz) <sup>b</sup>	0.48	-0.57	0.60	-0.12	0.0015	-3.17	549
Cell-LFP LFP theta frequency (Hz) <sup>c</sup>	7.68 $\pm$ 0.11	7.14 $\pm$ 0.14	7.70	7.20	0.0096	99.5	N/A
LFP theta power in CA1 ( $\mu$ V <sup>2</sup> Hz <sup>-1</sup> ) <sup>d</sup>	3.73 $\pm$ 1.07	4.44 $\pm$ 1.00	2.30	2.46	0.76	431	0.31

Control: <sup>a</sup>45 cells (fields < 0.25 m<sup>2</sup>), <sup>b</sup>45 cells (theta ratio > 5), <sup>c</sup>7 sessions, <sup>d</sup>16 tetrodes, 3 rats  
MEC lesion: <sup>a</sup>24 cells (fields < 0.25 m<sup>2</sup>), <sup>b</sup>23 cells (theta ratio > 5), <sup>c</sup>12 sessions, <sup>d</sup>39 tetrodes, 4 rats

Supplementary Table 2. Comparisons of slopes from fields of control and MEC-lesioned rats.

Linear track – pooled-pass analysis						
Control						
	Unrestricted all slopes	Unrestricted significant slopes	Fields < 60 cm all slopes	Fields < 60 cm significant slopes	PSSFs all slopes	PSSFs significant slopes
	46 fields in 4 rats	35 fields in 4 rats	38 fields in 4 rats	29 fields in 4 rats	31 fields in 4 rats	25 fields in 4 rats
<b>Normal</b>	Yes	Yes	Yes	Yes	Yes	Yes
<b>Mean ± SEM</b>	-0.38 ± 0.06	-0.39 ± 0.07	-0.36 ± 0.07	-0.37 ± 0.09	-0.38 ± 0.08	-0.37 ± 0.08
<b>t test</b>						
<b>P</b>	$1.34 \times 10^{-7}$	$7.84 \times 10^{-6}$	$9.50 \times 10^{-6}$	$2.17 \times 10^{-4}$	$3.33 \times 10^{-5}$	$6.19 \times 10^{-5}$
<b>df</b>	45	34	37	28	30	24
<b>t</b>	-6.25	-5.26	-5.13	-4.24	-4.87	-4.84
MEC lesion						
	128 fields in 6 rats	56 fields in 6 rats	40 fields in 6 rats	13 fields in 5 rats	50 fields in 5 rats	18 fields in 4 rats
<b>Normal</b>	Yes	Yes	Yes	Yes	Yes	Yes
<b>Mean ± SEM</b>	-0.09 ± 0.07	-0.23 ± 0.10	0.02 ± 0.13	-0.28 ± 0.22	-0.04 ± 0.10	-0.30 ± 0.13
<b>t test</b>						
<b>P</b>	0.17	0.03	0.91	0.23	0.73	0.039
<b>df</b>	127	55	39	12	49	17
<b>t</b>	-1.38	-2.30	0.12	-1.26	-0.35	-2.23

Linear track – single-pass analysis						
Control						
	Unrestricted all slopes	Unrestricted significant slopes	Fields < 60 cm all slopes	Fields < 60 cm significant slopes	PSSFs all slopes	PSSFs significant slopes
	47 fields in 4 rats	39 fields in 4 rats	38 fields in 4 rats	30 fields in 4 rats	31 fields in 4 rats	25 fields in 4 rats
<b>Normal</b>	Yes	Yes	Yes	Yes	Yes	Yes
<b>Mean ± SEM</b>	-0.34 ± 0.04	-0.51 ± 0.07	-0.33 ± 0.05	-0.44 ± 0.06	-0.33 ± 0.07	-0.37 ± 0.08
<b>t test</b>						
<b>P</b>	6.21 x 10 <sup>-11</sup>	1.82 x 10 <sup>-9</sup>	1.60 x 10 <sup>-8</sup>	2.50 x 10 <sup>-8</sup>	2.61 x 10 <sup>-5</sup>	1.51 x 10 <sup>-4</sup>
<b>df</b>	46	38	37	29	30	24
<b>t</b>	-8.46	-7.85	-7.19	-7.56	-4.96	-4.49
MEC lesion						
	133 fields in 6 rats	89 fields in 6 rats	41 fields in 6 rats	21 fields in 5 rats	50 fields in 5 rats	27 fields in 4 rats
<b>Normal</b>	Yes	Yes	Yes	Yes	Yes	Yes
<b>Mean ± SEM</b>	-0.17 ± 0.04	-0.21 ± 0.10	-0.14 ± 0.10	-0.17 ± 0.22	0.01 ± 0.22	-0.11 ± 0.18
<b>t test</b>						
<b>P</b>	2.05 x 10 <sup>-4</sup>	0.035	0.17	0.44	0.90	0.53
<b>df</b>	132	88	40	20	49	26
<b>t</b>	-3.82	-2.14	-1.40	0.79	0.13	-0.64

Open field – pooled-pass analysis				
Control				
	Unrestricted all slopes	Unrestricted significant slopes	Fields < 0.25 m <sup>2</sup> all slopes	Fields < 0.25 m <sup>2</sup> significant slopes
	50 fields in 3 rats	38 fields in 3 rats	46 fields in 3 rats	35 fields in 3 rats
<b>Normal</b>	Yes	Yes	Yes	Yes
<b>Mean ± SEM</b>	-0.40 ± 0.06	-0.47 ± 0.05	-0.48 ± 0.05	-0.53 ± 0.04
<b>t test</b>				
<b>P</b>	6.56 x 10 <sup>-8</sup>	8.37 x 10 <sup>-11</sup>	6.64 x 10 <sup>-12</sup>	1.41 x 10 <sup>-16</sup>
<b>df</b>	50	37	45	34
<b>t</b>	-6.33	-8.96	-9.20	-15.02
MEC lesion				
	48 fields in 6 rats	13 fields in 5 rats	21 fields in 4 rats	8 fields in 3 rats
<b>Normal</b>	Yes	Yes	Yes	Yes
<b>Mean ± SEM</b>	0.12 ± 0.13	-0.06 ± 0.20	0.10 ± 0.20	-0.15 ± 0.17
<b>t test</b>				
<b>P</b>	0.36	0.78	0.61	0.39
<b>df</b>	44	17	20	7
<b>t</b>	0.92	-0.29	0.52	-0.92

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**Open field – single-pass analysis**

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**Control**

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	Unrestricted all slopes	Unrestricted significant slopes	Fields < 0.25 m <sup>2</sup> all slopes	Fields < 0.25 m <sup>2</sup> significant slopes
	51 fields in 3 rats	49 fields in 3 rats	47 fields in 3 rats	45 fields in 3 rats
<b>Normal</b>	Yes	Yes	Yes	Yes
<b>Mean ± SEM</b>	-0.39 ± 0.04	-0.50 ± 0.08	-0.39 ± 0.04	-0.52 ± 0.08
<b>t test</b>				
<b>P</b>	1.66 x 10 <sup>-13</sup>	3.41 x 10 <sup>-8</sup>	1.44 x 10 <sup>-12</sup>	2.81 x 10 <sup>-8</sup>
<b>df</b>	50	49	46	44
<b>t</b>	-9.98	-6.54	-9.60	-6.73

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**MEC lesion**

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	54 fields in 6 rats	35 fields in 6 rats	25 fields in 4 rats	14 fields in 4 rats
<b>Normal</b>	Yes	Yes	Yes	Yes
<b>Mean ± SEM</b>	0.02 ± 0.08	0.00 ± 0.14	0.02 ± 0.16	-0.02 ± 0.14
<b>t test</b>				
<b>P</b>	0.79	0.98	0.91	0.89
<b>df</b>	50	40	24	14
<b>t</b>	0.26	-0.02	0.11	-0.14

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**Supplementary Table 3. Comparisons of slopes from fields recorded before and during septal inactivation.**

<b>Open field</b>							
<b>Single-pass analysis</b>							
	<b>Baseline all slopes</b>	<b>30 min into septal inactivation all slopes</b>	<b>2 h into septal inactivation all slopes</b>	<b>Baseline significant slopes</b>	<b>30 min into septal inactivation all slopes</b>	<b>2 h into septal inactivation all slopes</b>	
	52 fields in 4 rats	46 fields in 4 rats	44 fields in 4 rats	45 fields in 4 rats	30 fields in 4 rats	32 fields in 4 rats	
<b>Normal</b>	Yes	Yes	Yes	No	Yes	Yes	
<b>Mean</b>	-0.32	-0.04	-0.30	-0.48	0.04	-0.41	
<b>± SEM</b>	± 0.06	± 0.07	± 0.06	± 0.09	± 0.13	± 0.12	
<b>Median</b>	-0.37	-0.042	-0.28	-0.62	-0.11	-0.61	
<b>t test</b>							
<b>P</b>	1.01 x 10 <sup>-5</sup>	0.54	2.09 x 10 <sup>-5</sup>	9.33 x 10 <sup>-9</sup>	0.86	0.020	
<b>df</b>	51	45	43	4	14	9	
<b>t</b>	-4.90	-0.62	-4.78	N/A	N/A	N/A	
<b>Sign test<sup>1</sup></b>							
<b>P</b>							
<b>Sign</b>							
<b>z</b>							
<b>Pooled-pass analysis</b>							
	51 fields in 4 rats	44 fields in 4 rats	42 fields in 4 rats	39 fields in 4 rats	20 fields in 4 rats	23 fields in 4 rats	
<b>Normal</b>	No	Yes	Yes	No	Yes	Yes	
<b>Mean</b>	-0.40	-0.31	-0.42	-0.39	-0.30	-0.51	
<b>± SEM</b>	± 0.064	± 0.12	± 0.08	± 0.07	± 0.11	± 0.09	
<b>Median</b>	-0.40	-0.31	-0.38	-0.42	-0.37	-0.45	
<b>t test</b>							
<b>P</b>	1.97 x 10 <sup>-11</sup>	3.88 x 10 <sup>-4</sup>	5.63 x 10 <sup>-9</sup>	2.84 x 10 <sup>-9</sup>	4.02 x 10 <sup>-4</sup>	5.72 x 10 <sup>-6</sup>	
<b>df</b>	3	10	3	2	2	1	
<b>t</b>	N/A	N/A	N/A	N/A	N/A	N/A	
<b>Sign test<sup>1</sup></b>							
<b>P</b>							
<b>Sign</b>							
<b>z</b>							

<sup>1</sup>When one of the distributions was not normal, the nonparametric test was used for all corresponding comparisons.

**Supplementary Table 4. Comparison of temporal firing patterns and phase precession slopes between MEC-lesioned rats and rats with septal inactivation.**

<b>LFP - Theta frequency (Hz)</b>				
	MEC lesion	Baseline	30 min into septal inactivation	2 h into septal inactivation
	12 tetrodes in 4 rats	5 tetrodes in 4 rats	5 tetrodes in 4 rats	5 tetrodes in 4 rats
Normal	No	No	No	No
Median	7.20	7.70	7.08	7.08
Mean	7.14	7.52	7.13	7.08
SEM	0.14	0.14	0.33	0.32
	Baseline vs. MEC lesion		MEC lesion vs. 30 min into septal inactivation	MEC lesion vs. 2 h into septal inactivation
<i>P</i>	0.29		1.00	1.00
<i>U</i>	N/A		N/A	N/A
<i>z</i>	N/A		N/A	N/A
<b>Single cell - Theta ratio</b>				
	MEC lesion	Baseline	30 min into septal inactivation	2 h into septal inactivation
	24 cells in 4 rats	35 cells in 4 rats	39 cells in 4 rats	41 cells in 4 rats
Normal	no	no	no	no
Median	9.68	23.70	8.29	8.18
Mean	12.16	28.87	8.69	10.44
SEM	1.49	2.44	0.78	1.15
	Baseline vs. MEC lesion		MEC lesion vs. 30 min into septal inactivation	MEC lesion vs. 2 h into septal inactivation
<i>P</i>	1.89 x 10 <sup>-6</sup>		0.14	0.26
<i>U</i>	425		897	793
<i>z</i>	-4.98		1.82	1.12
<b>Single cell - theta frequency (Hz)</b>				
	MEC lesion	Baseline	30 min into septal inactivation	2 h into septal inactivation
	23 cells in 4 rats	40 cells in 4 rats	31 cells in 4 rats	30 cells in 4 rats
Normal	no	no	no	no
Median	7.08	8.30	7.81	7.57
Mean	6.60	8.29	8.06	7.62
SEM	0.31	0.10	0.21	0.14
	Baseline vs. MEC lesion		MEC lesion vs. 30 min into septal inactivation	MEC lesion vs. 2 h into septal inactivation
<i>P</i>	1.68 x 10 <sup>-7</sup>		0.0010	0.027
<i>U</i>	376		435	498
<i>z</i>	-5.18		-3.47	-2.21



<b>Frequency difference (Cell – LFP, Hz)</b>				
	MEC lesion	Baseline	30 min into septal inactivation	2 h into septal inactivation
	23 cells in 4 rats	40 cells in 4 rats	31 cells in 4 rats	30 cells in 4 rats
Normal	no	no	no	no
Median	-0.12	0.60	0.49	0.24
Mean	-0.57	0.66	0.73	0.34
SEM	0.30	0.09	0.20	0.11
	Baseline vs. MEC lesion		MEC lesion vs. 30 min into septal inactivation	MEC lesion vs. 2 h into septal inactivation
<i>P</i>	0.00023		0.0038	0.026
<i>U</i>	460		455	497
<i>z</i>	-3.95		-3.10	-2.22
<b>Single-pass analysis (all passes)</b>				
	MEC lesion	Baseline	30 min into septal inactivation	2 h into septal inactivation
	25 fields in 4 rats	52 fields in 4 rats	46 fields in 4 rats	44 fields in 4 rats
Normal	yes	no	yes	yes
Median	-0.07	-0.37	-0.04	-0.28
Mean	0.02	-0.32	-0.04	-0.30
SEM	0.16	0.06	0.07	0.06
	Baseline vs. MEC lesion		MEC lesion vs. 30 min into septal inactivation	MEC lesion vs. 2 h into septal inactivation
<i>P</i>	0.028		0.97	0.13
<i>U</i>	1215		904	1023
<i>z</i>	2.61		0.042	1.84
<b>Pooled-pass analysis (all passes)</b>				
	MEC lesion	Baseline	30 min into septal inactivation	2 h into septal inactivation
	21 fields in 4 rats	51 fields in 4 rats	44 fields in 4 rats	42 fields in 4 rats
Normal	yes	no	yes	yes
Median	0.08	-0.40	-0.37	-0.38
Mean	0.10	-0.40	-0.31	-0.42
SEM	0.20	0.064	0.12	0.08
	Baseline vs. MEC lesion		MEC lesion vs. 30 min into septal inactivation	MEC lesion vs. 2 h into septal inactivation
<i>P</i>	0.036		0.081	0.037
<i>U</i>	970		818	834
<i>z</i>	2.51		1.75	2.35

<sup>1</sup>When one of the distributions was not normal, the nonparametric test was used for all corresponding comparisons.