Figure S1

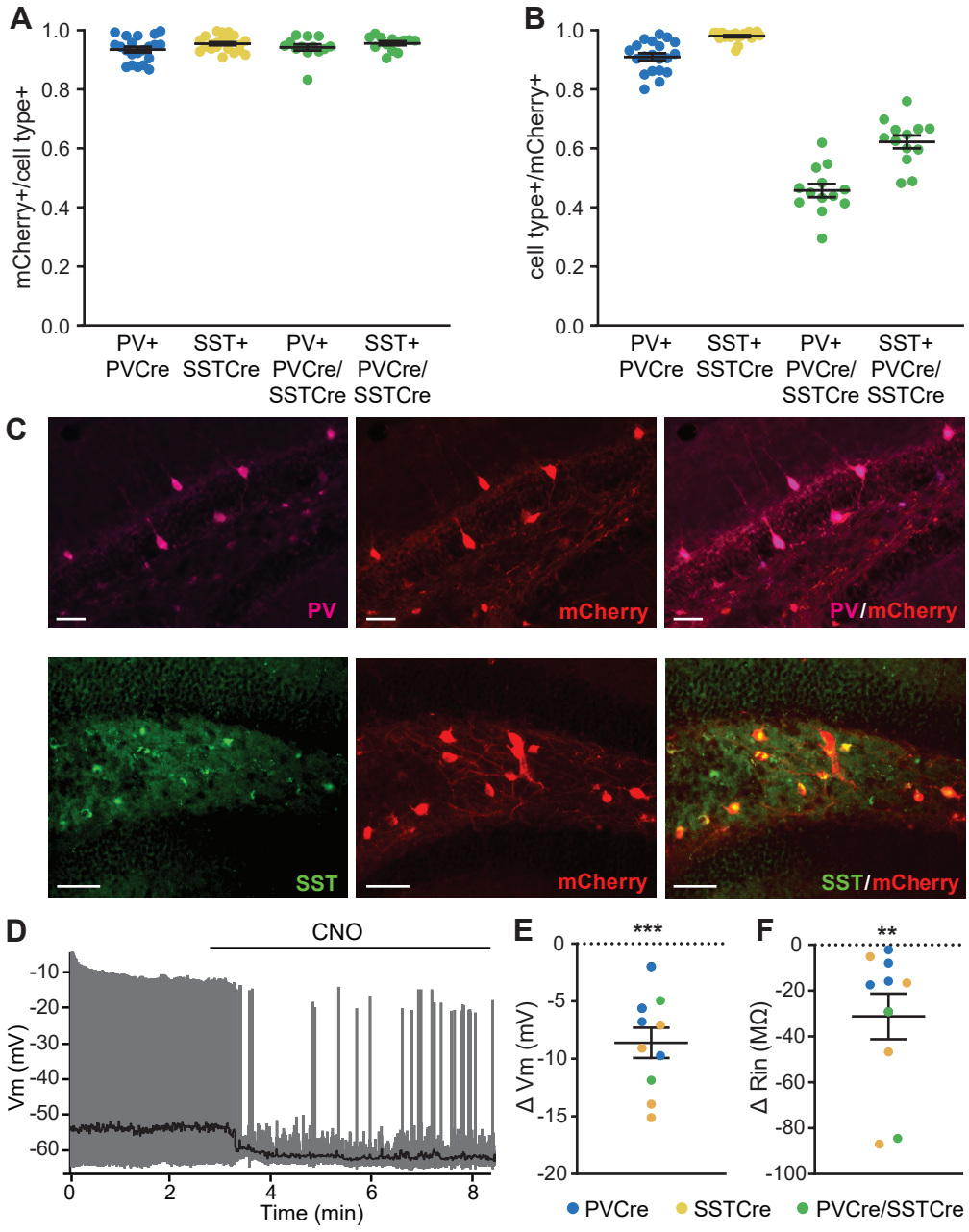
A
mCherry+/cell type+
1.0
0.8
0.6
0.4
0.2
0.0
PV+ PVCre
SST+ SSTCre
PV+ PVCre/ SSTCre
SST+ PVCre/ SSTCre
B
cell type+/mCherry+
C
PV
mCherry
PV/mCherry
SST
SST/mCherry
D
CNO
Vm (mV)
-10
-20
-30
-40
-50
-60
0
2
4
6
8
Time (min)
E
***
Δ Vm (mV)
0
-5
-10
-15
-20
F
**
Δ Rin (MΩ)
-20
-40
-60
-80
-100
PVCre
SSTCre
PVCre/SSTCre

**Figure S1. DREADDs function and expression in $PV^+$ and $SST^+$ interneurons in DG and CA3. Related to Figure 1.**

(A, B) Proportion of (A) $mCherry^+$ cells in $PV^+$ and $SST^+$ cells and (B) $PV^+$ and $SST^+$ cells in $mCherry^+$ cells. N = 16 PV-Cre mice, n = 16 SST-Cre mice, and n = 13 PV-Cre/SST-Cre mice.

(C) Example of mCherry coexpression with PV (top) and SST (bottom) in DG. Scale bars are 50 μm.

(D) CNO application to *ex vivo* hippocampal sections from a PV-Cre animal reduces the firing rate and resting membrane potential (black trace) of a $PV^+$ interneuron expressing hM4D.

(E,F) CNO application to *ex vivo* hippocampal section with $PV^+$ and $SST^+$ interneurons expressing hM4D (E) hyperpolarizes cells (1-sample t test, $t(9)=6.57$, $p = 0.0001$) and (F) increases input resistance (1-sample Wilcoxon test, $W = -55$, $p = 0.002$). N = 4 PV-Cre slices, n = 4 SST-Cre slices, and n = 2 PV-Cre/SST-Cre slices.

Error bars are mean ± SEM. ***$p < 0.001$. See also Table S1.

Figure S2

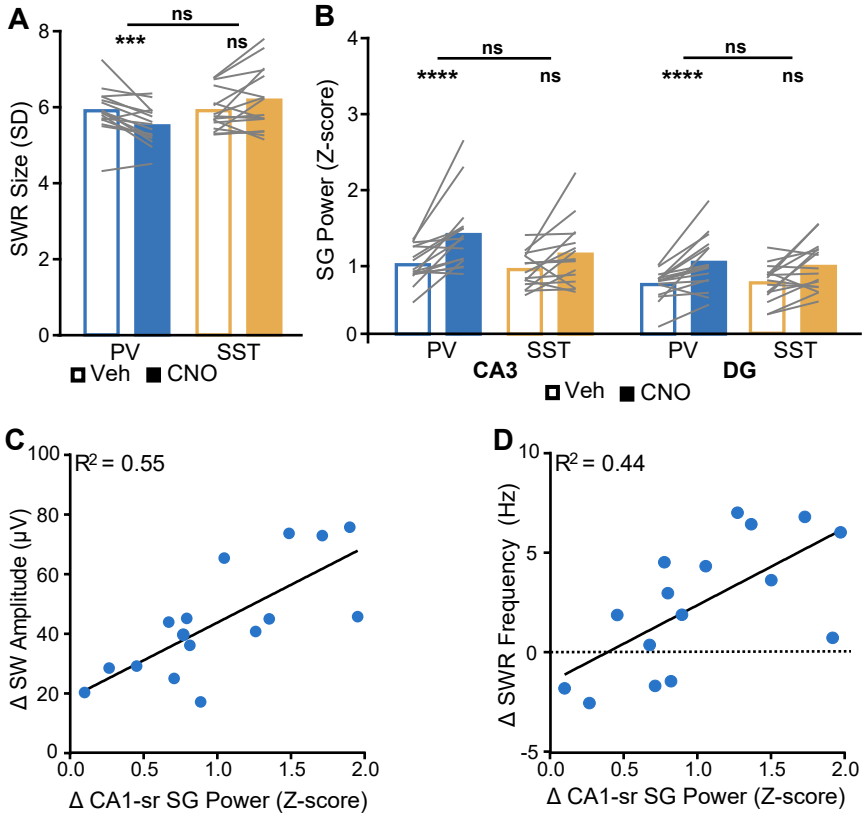
A
B
C
D
SWR Size (SD)
SG Power (Z-score)
ns
***
****
PV
SST
Veh
CNO
CA3
DG
R² = 0.55
R² = 0.44
Δ SW Amplitude (μV)
Δ SWR Frequency (Hz)
Δ CA1-sr SG Power (Z-score)

**Figure S2. Additional properties of SWRs during interneuron suppression. Related to Figures 3 and 4.**

(A) SWR size (PV: $p = 0.00048$; SST: $p = 0.07$; PV vs SST: $p = 0.011$).

(B) Normalized SG power during SWRs in CA3 (PV: $p = 2x10^{-5}$; SST: $p = 0.068$; PV vs SST: $p = 0.96$) and DG (PV: $p = 2.2x10^{-5}$; SST: $p = 0.0058$; PV vs SST: $p = 0.95$).

(C,D) Change SWR-coincident SG power in CA1 in PV-Cre animals upon CNO treatment predicts (C) change in SW amplitude ($F(1,14) = 17.29$, $p = 0.001$) and (D) change in SWR frequency ($F(1,14) = 10.97$, $p = 0.0051$). Pearson correlation.

N = 16 PV-Cre and n = 16 SST-Cre mice. Statistical details in Table S3. F test of the LMM for treatment effects, likelihood ratio test for genotype-treatment interaction effects. **p < 0.01; ***p < 0.001; ****p < 0.0001. See also Tables S2–S7.

Figure S3

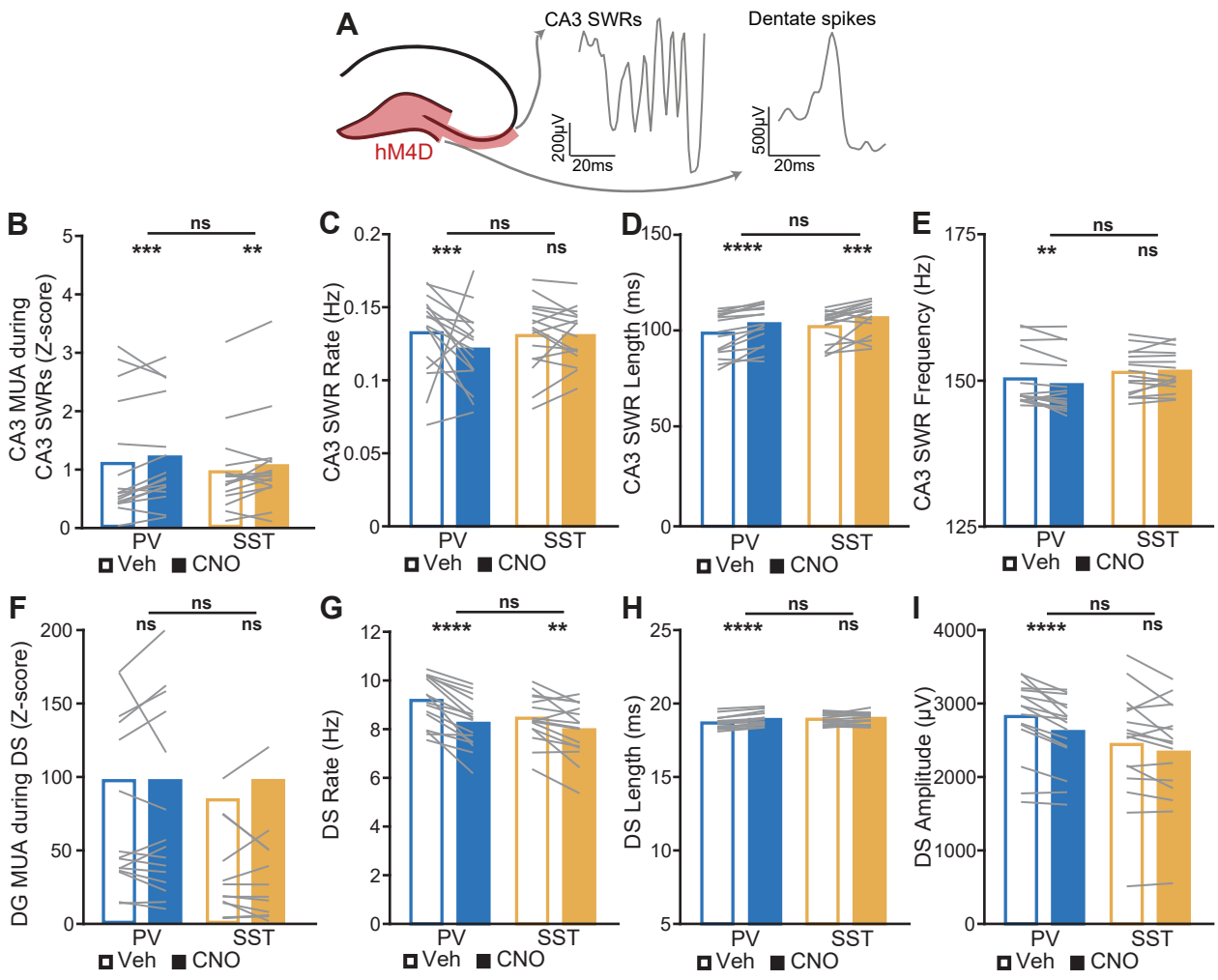
A
CA3 SWRs
Dentate spikes
hM4D
200μV
20ms
500μV
20ms
B
CA3 MUA during CA3 SWRs (Z-score)
C
CA3 SWR Rate (Hz)
D
CA3 SWR Length (ms)
E
CA3 SWR Frequency (Hz)
F
DG MUA during DS (Z-score)
G
DS Rate (Hz)
H
DS Length (ms)
I
DS Amplitude (μV)
ns
PV
SST
Veh
CNO

**Figure S3. Suppressing $PV^+$ or $SST^+$ interneurons modulate local CA3 SWRs and DG spikes. Related to Figure 3.**

(A) Interneurons in DG and CA3 (magenta) were inhibited while SWRs in CA3-pyr and dentate spikes in DG granule cell layer (gc) were assessed. Representative raw traces of a SWR from a CA3-pyr site and a dentate spike from a DG-gc site of a PV-Cre mouse during vehicle treatment.

(B) Normalized recruitment of CA3 MUA to CA3 SWRs (PV: $p = 0.00044$; SST: $p = 0.0062$; PV vs SST: $p = 1$).

(C) CA3 SWR rate (PV: $p = 0.00072$; SST: $p = 0.77$; PV vs SST: $p = 0.28$).

(D) CA3 SWR temporal length (PV: $p = 7.14 \times 10^{-6}$; SST: $p = 0.0055$; PV vs SST: $p = 0.86$).

(E) CA3 SWR instantaneous frequency (PV: $p = 0.00057$; SST: $p = 0.88$; PV vs SST: $p = 0.42$).

(F) DG MUA during dentate spikes (PV: $p = 0.47$; SST: $p = 0.26$; PV vs SST: $p = 0.15$).

(G) Dentate spike rate (PV: $p = 3 \times 10^{-19}$; SST: $p = 0.0027$; PV vs SST: $p = 0.27$).

(H) Dentate spike temporal length (PV: $p = 2.6 \times 10^{-11}$; SST: $p = 0.26$; PV vs SST: $p = 0.23$).

(I) Dentate spike amplitude (PV: $p = 1.6 \times 10^{-7}$; SST: $p = 0.044$; PV vs SST: $p = 0.61$).

N = 16 PV-Cre and n = 16 SST-Cre mice. Statistical details in Table S3. F test of the LMM for treatment effects, likelihood ratio test for genotype-treatment interaction effects. **$p < 0.01$; ***$p < 0.001$; ****$p < 0.0001$. See also Tables S2–S7.

Figure S4

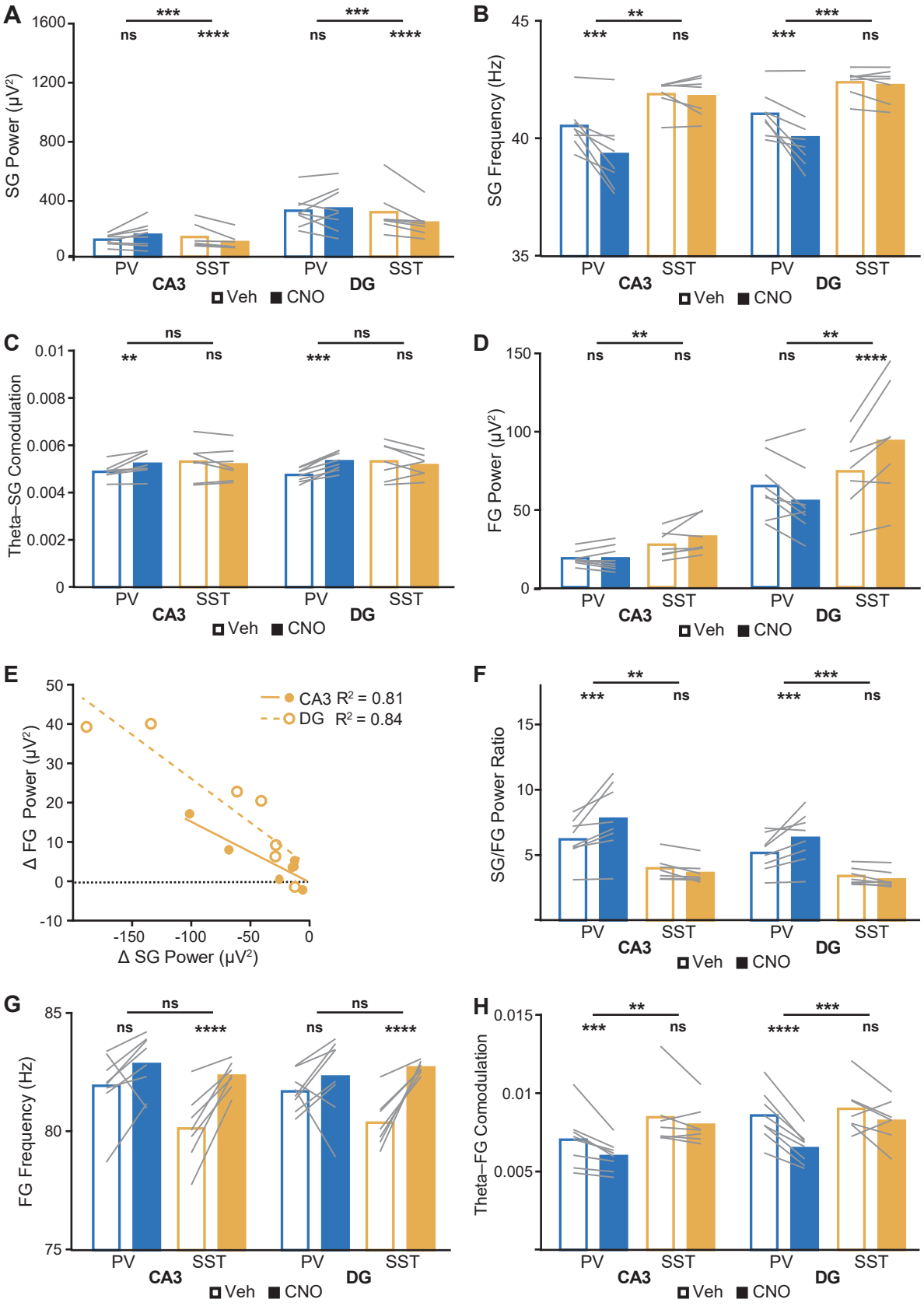
A
SG Power (μV²)
1600
1200
800
400
0
***
ns
****
***
ns
****
PV
SST
PV
SST
CA3
DG
Veh
CNO
B
SG Frequency (Hz)
45
40
35
**
***
ns
***
***
ns
C
Theta–SG Comodulation
0.01
0.008
0.006
0.004
0.002
0
ns
**
ns
ns
***
ns
D
FG Power (μV²)
150
100
50
0
**
ns
ns
**
ns
****
E
Δ FG Power (μV²)
Δ SG Power (μV²)
50
40
30
20
10
0
-10
-150
-100
-50
0
CA3 R² = 0.81
DG R² = 0.84
F
SG/FG Power Ratio
15
10
5
**
***
ns
***
***
ns
G
FG Frequency (Hz)
85
80
75
ns
ns
****
ns
ns
****
H
Theta–FG Comodulation
0.015
0.01
0.005
**
***
ns
***
****
ns

**Figure S4. Properties of SG and FG in DG and CA3 during interneuron suppression. Related to Figures 5 and 6.**

(A) SG power in CA3 (PV: p = 0.15; SST: p = $5.2 \times 10^{-5}$; PV vs SST: p = 0.00088) and DG (PV: p = 0.5; SST: p = $1.3 \times 10^{-7}$; PV vs SST: p = 0.00042).

(B) SG instantaneous frequency in CA3 (PV: p = 0.00023; SST: p = 0.8; PV vs SST: p = 0.0025) and DG (PV: p = 0.0005; SST: p = 0.37; PV vs SST: p = 0.00015).

(C) Theta modulation of SG power in CA3 (PV: p = 0.0011; SST: p = 0.16; PV vs SST: p = 0.0049) and DG (PV: p = 0.0003; SST: p = 0.22; PV vs SST: p = 0.0054).

(D) FG power in CA3 (PV: p = 0.42; SST: p = 0.0076; PV vs SST: p = 0.0027) and DG (PV: p = 0.81; SST: p = $1.9 \times 10^{-5}$; PV vs SST: p = 0.0025).

(E) Change in SG power in SST-Cre animals upon CNO treatment predicts change in FG power in CA3 ($F(1,5) = 20.7$, p = 0.0061) and DG ($F(1,5) = 26$, p = 0.0038). Pearson correlation.

(F) Ratio of SG power to FG power in CA3 (PV: p = 0.00036; SST: p = 0.0071; PV vs SST: p = 0.002) and DG (PV: p = 0.00031; SST: p = 0.002; PV vs SST: p = 0.00064).

(G) FG instantaneous frequency in CA3 (PV: p = 0.02; SST: p = $2.6 \times 10^{-9}$; PV vs SST: p = 0.12) and DG (PV: p = 0.23; SST: p = $4.1 \times 10^{-11}$; PV vs SST: p = 0.062).

(H) Theta modulation of FG power in CA3 (PV: p = 0.00041; SST: p = 0.19; PV vs SST: p = 0.0026) and DG (PV: p = $7.5 \times 10^{-11}$; SST: p = 0.11; PV vs SST: p = 0.00053).

N = 8 PV-Cre and n = 7 SST-Cre mice. Statistical details in Table S3. F test of the LMM for treatment effects, likelihood ratio test for genotype-treatment interaction effects. **p < 0.01; ***p < 0.001; ****p < 0.0001. Central values are means and individual points are mean per animal. See also Tables S3–S7.

Figure S5

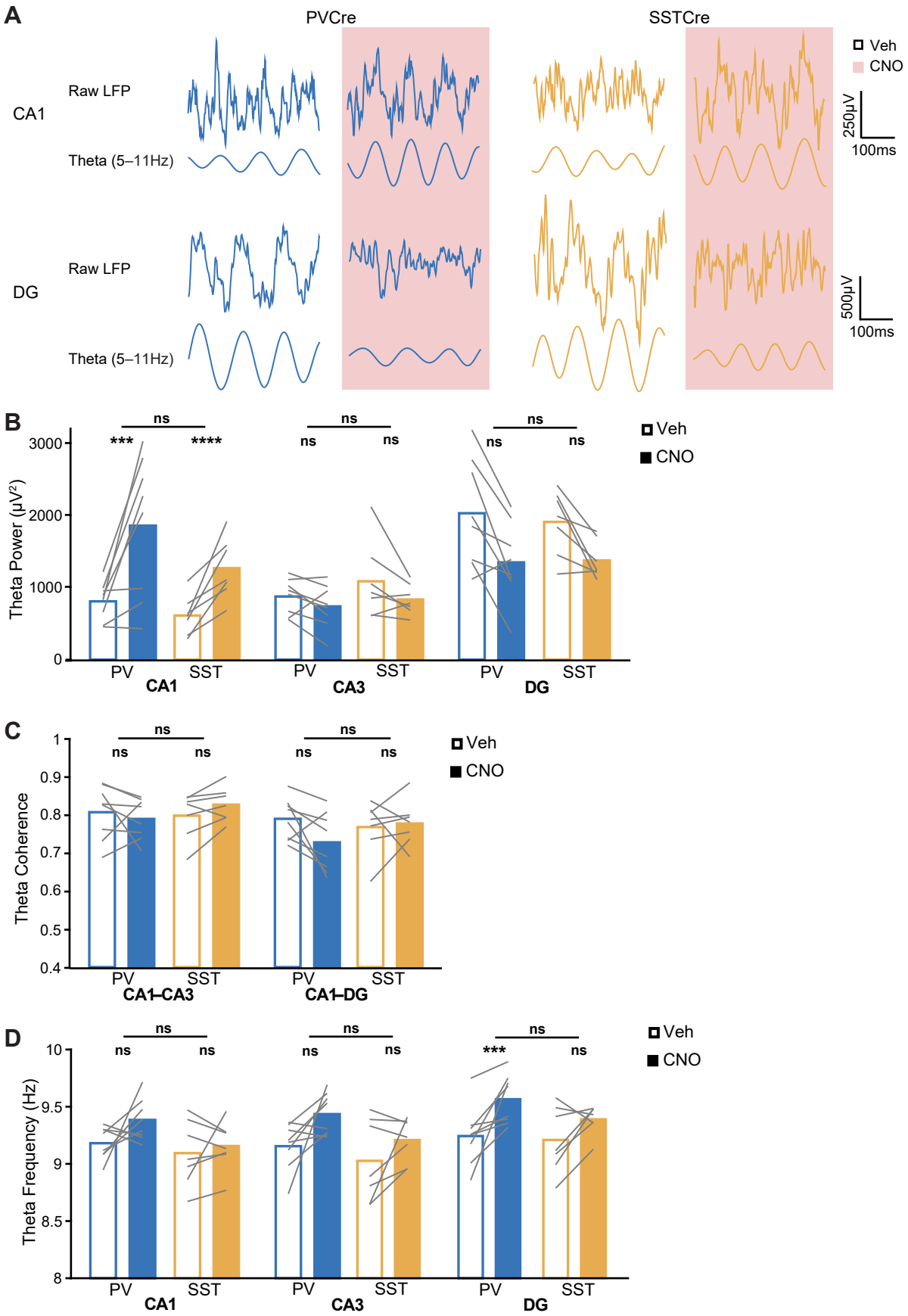
A
PVCre
SSTCre
Veh
CNO
CA1
Raw LFP
Theta (5–11Hz)
250μV
100ms
DG
Raw LFP
Theta (5–11Hz)
500μV
100ms
B
Theta Power (μV²)
3000
2000
1000
0
ns
***
****
ns
ns
ns
ns
ns
ns
Veh
CNO
PV
SST
CA1
CA3
DG
C
Theta Coherence
1
0.9
0.8
0.7
0.6
0.5
0.4
ns
ns
ns
ns
ns
ns
Veh
CNO
PV
SST
CA1–CA3
CA1–DG
D
Theta Frequency (Hz)
10
9.5
9
8.5
8
ns
ns
ns
ns
ns
***
ns
Veh
CNO
PV
SST
CA1
CA3
DG

**Figure S5. Suppressing $PV^+$ or $SST^+$ interneurons unidirectionally modulates theta during movement. Related to Figures 5 and 6.**

(A) Example raw and theta-filtered LFP traces from CA1 pyramidal layer (top) and DG granule cell layer (bottom) sites from a PV-Cre (left) and an SST-Cre (right) mouse.

(B) Theta power in CA1 (PV: $p = 0.00032$; SST: $p = 4.2 \times 10^{-5}$; PV vs SST: $p = 0.52$), CA3 (PV: $p = 0.81$; SST: $p = 0.13$; PV vs SST: $p = 0.3$), and DG (PV: $p = 0.12$; SST: $p = 0.0097$; PV vs SST: $p = 0.85$).

(C) Theta frequency band coherence between CA1 and CA3 (PV: $p = 0.57$; SST: $p = 0.047$; PV vs SST: $p = 0.62$) and between CA1 and DG (PV: $p = 0.024$; SST: $p = 0.76$; PV vs SST: $p = 0.89$).

(D) Theta instantaneous frequency in CA1 (PV: $p = 0.0082$; SST: $p = 0.29$; PV vs SST: $p = 0.06$), CA3 (PV: $p = 0.0077$; SST: $p = 0.1$; PV vs SST: $p = 0.3$), and DG (PV: $p = 0.00061$; SST: $p = 0.1$; PV vs SST: $p = 0.67$).

N = 8 PV-Cre and n = 7 SST-Cre mice. Statistical details in Table S3. F test of the LMM for treatment effects, likelihood ratio test for genotype-treatment interaction effects. **$p < 0.01$; ***$p < 0.001$; ****$p < 0.0001$. Central values are means and individual points are mean per animal. See also Tables S3–S7.

Figure S6

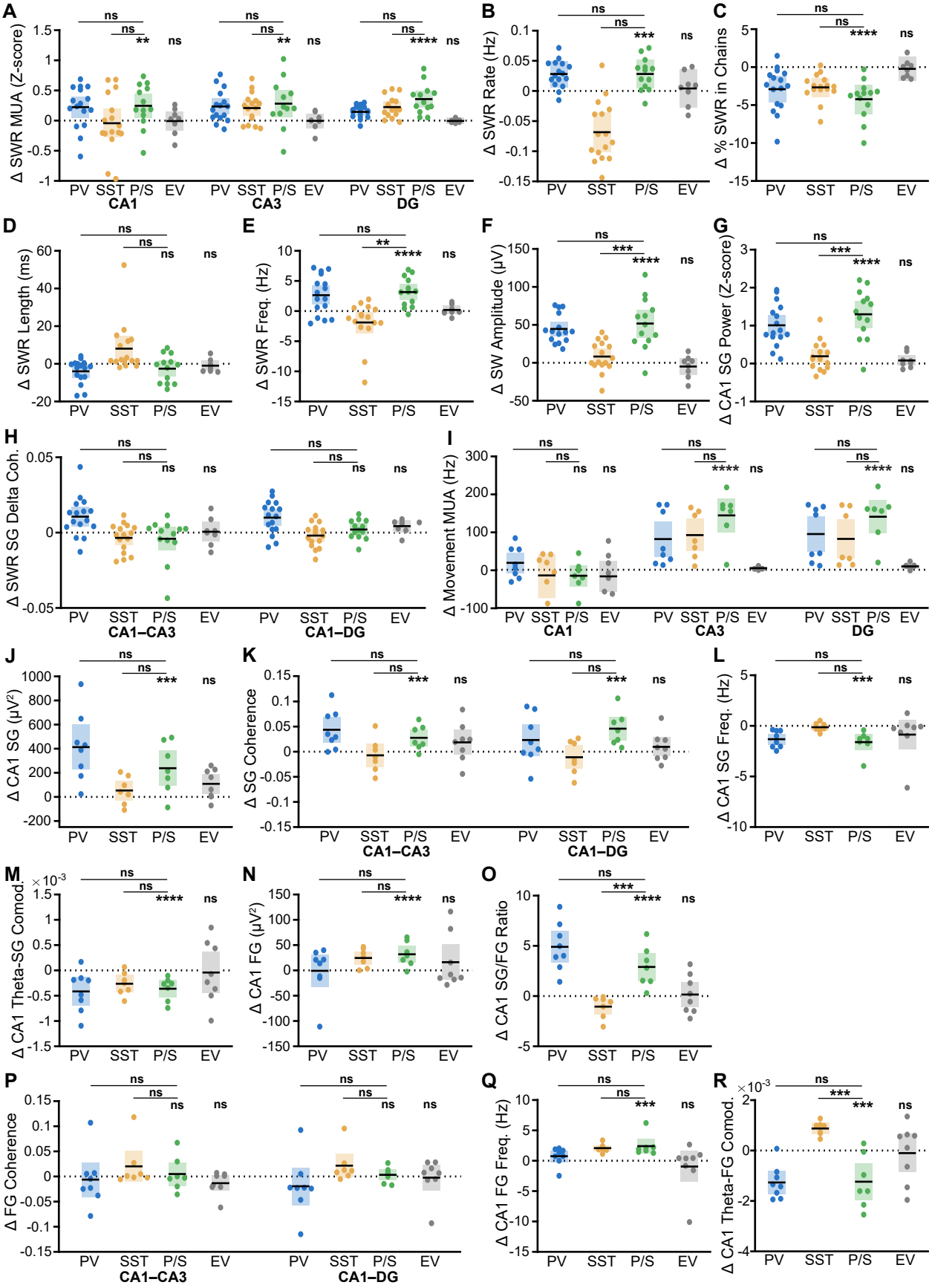
A
Δ SWR MUA (Z-score)
PV SST P/S EV PV SST P/S EV PV SST P/S EV
CA1
CA3
DG
B
Δ SWR Rate (Hz)
C
Δ %-SWR in Chains
D
Δ SWR Length (ms)
E
Δ SWR Freq. (Hz)
F
Δ SW Amplitude (μV)
G
Δ CA1 SG Power (Z-score)
H
Δ SWR SG Delta Coh.
CA1–CA3
CA1–DG
I
Δ Movement MUA (Hz)
J
Δ CA1 SG (μV²)
K
Δ SG Coherence
L
Δ CA1 SG Freq. (Hz)
M
Δ CA1 Theta-SG Comod.
N
Δ CA1 FG (μV²)
O
Δ CA1 SG/FG Ratio
P
Δ FG Coherence
Q
Δ CA1 FG Freq. (Hz)
R
Δ CA1 Theta-FG Comod.
ns
**
***
****

**Figure S6. Suppressing both $PV^+$ and $SST^+$ interneurons increases CA3 coupling onto CA1. Related to Figures 3–6.**

(A) Normalized recruitment to SWRs of MUA in CA1 (PV-Cre/SST-Cre (P/S): p = 0.0074; PV vs P/S: p = 1; SST vs P/S: p = 1; Empty Vector (EV): p = 0.89), CA3 (P/S: p = 0.0053; PV vs P/S: p = 1; SST vs P/S: p = 1; EV: p = 0.66), and DG (P/S: $p = 9x10^{-7}$; PV vs P/S: p = 1; SST vs P/S: p = 1; EV: p = 0.23).

(B) SWR rate (P/S: p = 0.00035; PV vs P/S: p = 0.87; SST vs P/S: p = 0.021; EV: p = 0.74).

(C) Percent of SWRs following another SWR within 200 ms (P/S: $p = 1.4x10^{-5}$; PV vs P/S: p = 1; SST vs P/S: p = 0.82; EV: p = 0.77).

(D) SWR length (P/S: p = 0.49; PV vs P/S: p = 0.8; SST vs P/S: p = 0.089; EV: p = 0.68).

(E) SWR instantaneous frequency (P/S: $p = 4.2x10^{-6}$; PV vs P/S: p = 0.2; SST vs P/S: p = 0.0017; EV: p = 0.62).

(F) SW amplitude (P/S: $p = 5.2x10^{-8}$; PV vs P/S: p = 0.066; SST vs P/S: p = 0.00055; EV: p = 0.47).

(G) Normalized SG power during SWRs in CA1 (P/S: $p = 8.6x10^{-12}$; PV vs P/S: p = 1; SST vs P/S: p = 0.00089; EV: p = 0.13).

(H) Increase during SWRs of SG frequency band coherence between CA1 and CA3 (P/S: p = 0.32; PV vs P/S: p = 1; SST vs P/S: p = 1; EV: p = 0.89 and between CA1 and DG (P/S: p = 0.23; PV vs P/S: p = 1; SST vs P/S: p = 1; EV: p = 0.13).

In A–H, n = 16 PV-Cre, n = 16 SST-Cre, n = 13 PV-Cre/SST-Cre and n = 8 empty vector mice.

(I) MUA during movement in CA1 (P/S: p = 0.033; PV vs P/S: p = 0.98; SST vs P/S: p = 0.15; EV: p = 0.23), CA3 (P/S: $p = 1.1x10^{-9}$; PV vs P/S: p = 0.51; SST vs P/S: p = 0.89; EV: p = 0.36), and DG (P/S: $p = 1.2x10^{-9}$; PV vs P/S: p = 0.43; SST vs P/S: p = 0.031; EV: p = 0.6).

(J) SG power in CA1 (P/S: p = 0.00065; PV vs P/S: p = 0.78; SST vs P/S: p = 0.73; EV: p = 0.067).

(K) SG frequency band coherence between CA1 and CA3 (P/S: p = 0.00058; PV vs P/S: p = 0.6; SST vs P/S: p = 0.45; EV: p = 0.13) and between CA1 and DG (P/S: p = 0.00098; PV vs P/S: p = 0.95; SST vs P/S: p = 0.26; EV: p = 0.3).

(L) SG instantaneous frequency in CA1 (P/S: p = 0.0001; PV vs P/S: p = 0.95; SST vs P/S: p = 0.036; EV: p = 0.28).

(M) Theta modulation of SG power in CA1 (P/S: p = $7.2x10^{-7}$; PV vs P/S: p = 0.66; SST vs P/S: p = 0.93; EV: p = 0.87).

(N) FG power in CA1 (P/S: p = $1.6x10^{-6}$; PV vs P/S: p = 0.05; SST vs P/S: p = 1; EV: p = 0.71).

(O) Ratio of SG power to FG power in CA1 (P/S: p = $3.8x10^{-6}$; PV vs P/S: p = 0.5; SST vs P/S: p = 0.00086; EV: p = 0.92).

(P) FG frequency band coherence between CA1 and CA3 (P/S: p = 0.68; PV vs P/S: p = 0.54; SST vs P/S: p = 0.1; EV: p = 0.1) and between CA1 and DG (P/S: p = 0.68; PV vs P/S: p = 0.13; SST vs P/S: p = 0.16; EV: p = 0.82).

(Q) FG instantaneous frequency in CA1 (P/S: p = 0.00012; PV vs P/S: p = 0.51; SST vs P/S: p = 0.0056; EV: p = 0.44).

(R) Theta modulation of FG power in CA1 (P/S: p = 0.00019; PV vs P/S: p = 0.53; SST vs P/S: p = 0.00017; EV: p = 0.91).

In I–R, n = 8 PV-Cre, n = 7 SST-Cre, n = 7 PV-Cre/SST-Cre and n = 8 empty vector mice.

Statistical details in Table S5. F test of the LMM for treatment effects, likelihood ratio test for genotype-treatment interaction effects. **p < 0.01; ***p < 0.001; ****p < 0.0001. Central values are LMM fixed effect coefficients β ± 95% confidence intervals and individual points are the fitted conditional response for each mouse. See also Figures S7 and Table S5.

Figure S7

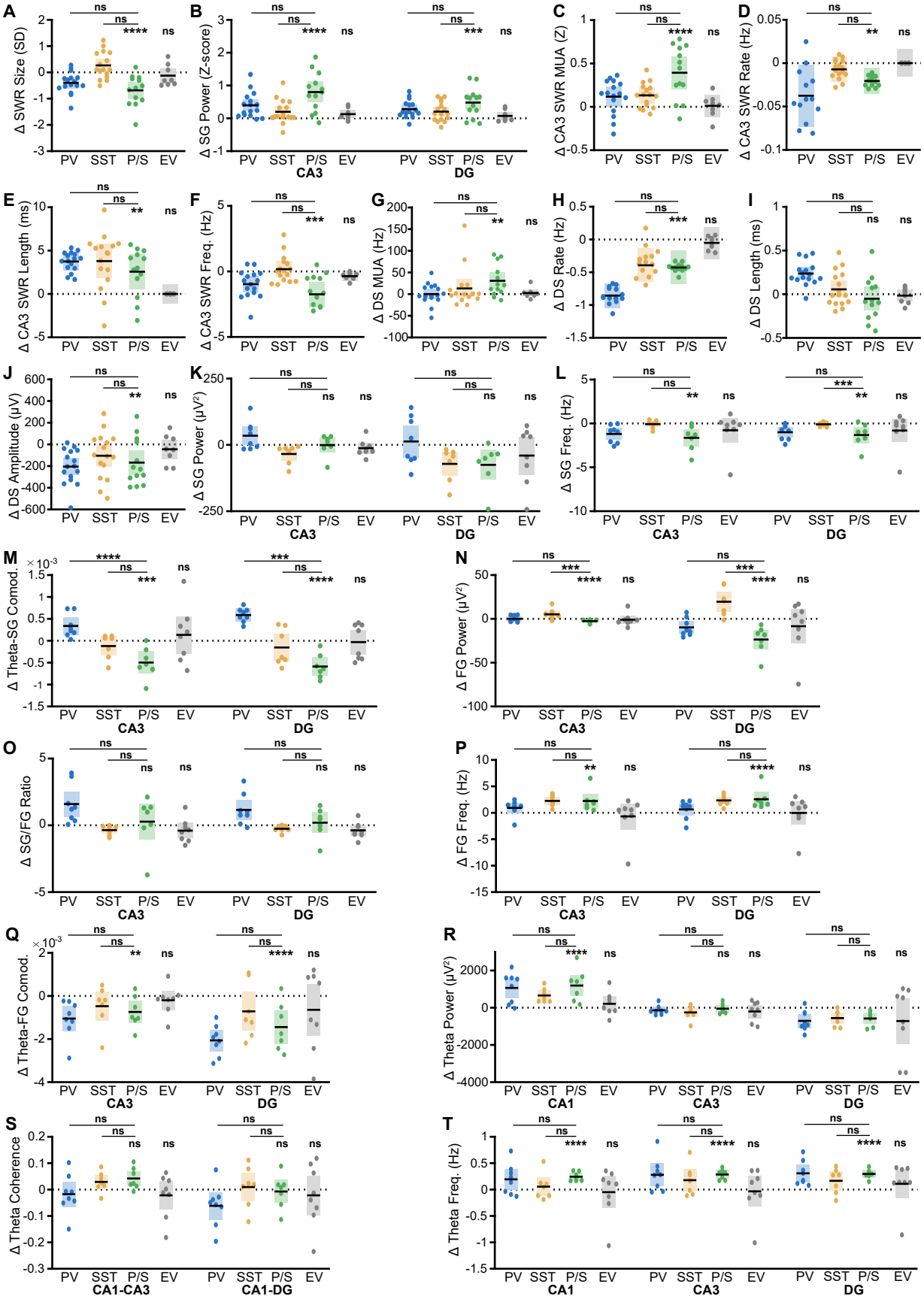
A
Δ SWR Size (SD)
B
Δ SG Power (Z-score)
C
Δ CA3 SWR MUA (Z)
D
Δ CA3 SWR Rate (Hz)
E
Δ CA3 SWR Length (ms)
F
Δ CA3 SWR Freq. (Hz)
G
Δ DS MUA (Hz)
H
Δ DS Rate (Hz)
I
Δ DS Length (ms)
J
Δ DS Amplitude (μV)
K
Δ SG Power (μV²)
L
Δ SG Freq. (Hz)
M
Δ Theta-SG Comod.
N
Δ FG Power (μV²)
O
Δ SG/FG Ratio
P
Δ FG Freq. (Hz)
Q
Δ Theta-FG Comod.
R
Δ Theta Power (μV²)
S
Δ Theta Coherence
T
Δ Theta Freq. (Hz)
PV SST P/S EV
CA3
DG
CA1
CA1-CA3
CA1-DG
ns
**
***
****

**Figure S7. Additional properties demonstrating suppressing both $PV^+$ and $SST^+$ interneurons increases CA3 coupling onto CA1. Figures 3–6 and S2–S4.**

(A) SWR size (PV-Cre/SST-Cre (P/S): $p = 7.2x10^{-6}$; PV vs P/S: p = 0.56; SST vs P/S: p = 0.031; Empty Vector (EV): p = 0.48).

(B) Normalized SG power during SWRs in CA3 (P/S: $p = 1.1x10^{-6}$; PV vs P/S: p = 1; SST vs P/S: p = 1; EV: p = 0.062) and DG (P/S: p = 0.00013; PV vs P/S: p = 1; SST vs P/S: p = 1; EV: p = 0.22).

(C) Normalized recruitment of CA3 MUA to CA3 SWRs (PV/SST: $p = 4.2 x10^{-5}$; PV vs PV/SST: p = 0.12; SST vs PV/SST: p = 0.23; EV: p = 0.86).

(D) CA3 SWR rate (PV/SST: p = 0.0066; PV vs PV/SST: p = 0.43; SST vs PV/SST: p = 0.52; EV: p = 1).

(E) CA3 SWR temporal length (PV/SST: p = 0.0031; PV vs PV/SST: p = 0.36; SST vs PV/SST: p = 0.3; EV: p = 1).

(F) CA3 SWR instantaneous frequency (PV/SST: p = 0.00039; PV vs PV/SST: p = 0.55; SST vs PV/SST: p = 0.062; EV: p = 0.076).

(G) DG MUA during dentate spikes (PV/SST: p = 0.0013; PV vs PV/SST: p = 0.94; SST vs PV/SST: p = 1; EV: p = 0.98).

(H) Dentate spike rate (PV/SST: p = 0.00094; PV vs PV/SST: p = 0.3; SST vs PV/SST: p = 0.87; EV: p = 0.67).

(I) Dentate spike temporal length (PV/SST: p = 0.45; PV vs PV/SST: p = 0.017; SST vs PV/SST: p = 0.62; EV: p = 0.64).

(J) Dentate spike amplitude (PV/SST: p = 0.0033; PV vs PV/SST: p = 0.82; SST vs PV/SST: p = 0.97; EV: p = 0.31).

In A–J, n = 16 PV-Cre, n = 16 SST-Cre, n = 13 PV-Cre/SST-Cre and n = 8 empty vector mice.

(K) SG power in CA3 (P/S: p = 0.84; PV vs P/S: p = 0.47; SST vs P/S: p = 0.49; EV: p = 0.087) and DG (P/S: p = 0.017; PV vs P/S: p = 0.35; SST vs P/S: p = 0.69; EV: p = 0.63).

(L) SG instantaneous frequency in CA3 (P/S: p = 0.0029; PV vs P/S: p = 0.7; SST vs P/S: p = 0.012; EV: p = 0.32) and DG (P/S: p = 0.0045; PV vs P/S: p = 0.8; SST vs P/S: p = 0.00055; EV: p = 0.27).

(M) Theta modulation of SG power in CA3 (P/S: p = 0.00036; PV vs P/S: p = $7.3x10^{-5}$; SST vs P/S: p = 0.0048; EV: p = 0.63) and DG (P/S: p = $8.4x10^{-11}$; PV vs P/S: p = 0.00018; SST vs P/S: p = 0.28; EV: p = 1).

(N) FG power in CA3 (P/S: p = $2x10^{-6}$; PV vs P/S: p = 0.037; SST vs P/S: p = 0.00023; EV: p = 0.36) and DG (P/S: p = $1x10^{-10}$; PV vs P/S: p = 0.018; SST vs P/S: p = 0.00019; EV: p = 0.64).

(O) Ratio of SG power to FG power in CA3 (P/S: p = 0.39; PV vs P/S: p = 0.52; SST vs P/S: p = 0.022; EV: p = 0.23) and DG (P/S: p = 0.29; PV vs P/S: p = 0.66; SST vs P/S: p = 0.012; EV: p = 0.15).

(P) FG instantaneous frequency in CA3 (P/S: p = 0.0013; PV vs P/S: p = 0.39; SST vs P/S: p = 0.092; EV: p = 0.51) and DG (P/S: p = $8.6x10^{-5}$; PV vs P/S: p = 0.061; SST vs P/S: p = 0.0089; EV: p = 0.74).

(Q) Theta modulation of FG power in CA3 (P/S: p = 0.0024; PV vs P/S: p = 0.68; SST vs P/S: p = 0.79; EV: p = 0.22) and DG (P/S: p = $8.6x10^{-5}$; PV vs P/S: p = 0.75; SST vs P/S: p = 0.96; EV: p = 0.35).

(R) Theta power in CA1 (P/S: p = $2.8x10^{-8}$; PV vs P/S: p = 0.69; SST vs P/S: p = 0.51; EV: p = 0.1), CA3 (P/S: p = 0.35; PV vs P/S: p = 0.004; SST vs P/S: p = 0.018; EV: p = 0.67), and DG (P/S: p = 0.014; PV vs P/S: p = 0.013; SST vs P/S: p = 0.028; EV: p = 0.61).

(S) Theta frequency band coherence between CA1 and CA3 (P/S: $p = 0.0064$; PV vs P/S: $p = 0.66$; SST vs P/S: $p = 1$; EV: $p = 0.36$) and between CA1 and DG (P/S: $p = 0.66$; PV vs P/S: $p = 0.9$; SST vs P/S: $p = 0.91$; EV: $p = 0.59$).

(T) Theta instantaneous frequency in CA1 (P/S: $p = 1.4 \times 10^{-8}$; PV vs P/S: $p = 0.056$; SST vs P/S: $p = 0.55$; EV: $p = 0.68$), CA3 (P/S: $p = 5.7 \times 10^{-8}$; PV vs P/S: $p = 0.16$; SST vs P/S: $p = 0.86$; EV: $p = 0.74$), and DG (P/S: $p = 9.4 \times 10^{-12}$; PV vs P/S: $p = 0.69$; SST vs P/S: $p = 0.54$; EV: $p = 0.8$).

In K–T, n = 8 PV-Cre, n = 7 SST-Cre, n = 7 PV-Cre/SST-Cre and n = 8 empty vector mice.

Statistical details in Table S5. F test of the LMM for treatment effects, likelihood ratio test for genotype-treatment interaction effects. **$p < 0.01$; ***$p < 0.001$; ****$p < 0.0001$. Central values are LMM fixed effect coefficients $\beta \pm 95\%$ confidence intervals and individual points are the fitted conditional response for each mouse. See also Table S5.

**Table S1. Specificity of viral expression to $PV^+$ and $SST^+$ interneurons. Related to Figures 1 and S1.**

| Cohort | Animal | Genotype | (mCherry+ PV+)/ PV+ | (mCherry+ SST+)/ SST+ | (mCherry+ PV+)/ mCherry+ | (mCherry+ SST+)/ mCherry+ |
|---|---|---|---|---|---|---|
| 1 | Beverly | PV-Cre | 0.997 | - | 0.909 | - |
| 1 | Bones | PV-Cre | 0.993 | - | 0.993 | - |
| 1 | Chakotay | PV-Cre | 0.923 | - | 0.923 | - |
| 1 | Nerys | PV-Cre | 0.944 | - | 0.944 | - |
| 1 | Odo | PV-Cre | 0.882 | - | 0.938 | - |
| 1 | Rain | PV-Cre | 0.867 | - | 0.929 | - |
| 1 | SevenOfNine | PV-Cre | 0.875 | - | 0.981 | - |
| 1 | Sulu | PV-Cre | 0.875 | - | 0.997 | - |
| 1 | Worf | PV-Cre | 0.982 | - | 0.969 | - |
| 2 | Adobo | PV-Cre | 0.882 | - | 0.917 | - |
| 2 | Caraway | PV-Cre | 0.951 | - | 0.958 | - |
| 2 | Chives | PV-Cre | 0.958 | - | 0.933 | - |
| 2 | Cinnamon | PV-Cre | 0.919 | - | 0.983 | - |
| 2 | Fenugreek | PV-Cre | 0.951 | - | 0.951 | - |
| 2 | Garam Masala | PV-Cre | 0.933 | - | 0.994 | - |
| 2 | Salt | PV-Cre | 0.988 | - | 0.938 | - |
| 3 | Aphid | PV-Cre | 0.944 | - | 0.944 | - |
| 3 | Fruitfly | PV-Cre | 0.933 | - | 0.966 | - |
| 3 | Grasshopper | PV-Cre | 0.982 | - | 0.964 | - |
| 3 | Honeybee | PV-Cre | 0.952 | - | 0.952 | - |
| 3 | Rolypoly | PV-Cre | 0.906 | - | 0.967 | - |
| 1 | Garrett | SST-Cre | - | 0.800 | - | 0.996 |
| 1 | Guinan | SST-Cre | - | 0.850 | - | 0.985 |
| 1 | Keeler | SST-Cre | - | 0.826 | - | 0.995 |
| 1 | Kes | SST-Cre | - | 0.906 | - | 0.988 |
| 1 | Neelix | SST-Cre | - | 0.960 | - | 0.990 |
| 1 | OBrien | SST-Cre | - | 0.977 | - | 0.973 |
| 1 | Picard | SST-Cre | - | 0.987 | - | 0.974 |
| 1 | Quark | SST-Cre | - | 0.920 | - | 0.986 |
| 1 | Riker | SST-Cre | - | 0.904 | - | 0.992 |
| 1 | Sato | SST-Cre | - | 0.917 | - | 0.946 |
| 2 | Baharat | SST-Cre | - | 0.862 | - | 0.986 |
| 2 | Cardamom | SST-Cre | - | 0.912 | - | 0.978 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | Jerk | SST-Cre | - | 0.963 | - | 0.981 |
| 2 | Mace | SST-Cre | - | 0.932 | - | 0.983 |
| 2 | Tarragon | SST-Cre | - | 0.864 | - | 0.989 |
| 2 | Vanilla | SST-Cre | - | 0.970 | - | 0.931 |
| 3 | Cicada | SST-Cre | - | 0.946 | - | 0.992 |
| 3 | Cricket | SST-Cre | - | 0.858 | - | 0.979 |
| 3 | Ladybug | SST-Cre | - | 0.906 | - | 0.992 |
| 3 | Mantis | SST-Cre | - | 0.948 | - | 0.977 |
| 1 | Bashir | PV-Cre/ SST-Cre | 0.944 | 0.965 | 0.439 | 0.625 |
| 1 | Dax | PV-Cre/ SST-Cre | 0.929 | 0.977 | 0.451 | 0.663 |
| 1 | Doctor | PV-Cre/ SST-Cre | 0.926 | 0.906 | 0.387 | 0.666 |
| 1 | Scotty | PV-Cre/ SST-Cre | 0.947 | 0.953 | 0.295 | 0.760 |
| 1 | TPol | PV-Cre/ SST-Cre | 0.984 | 0.975 | 0.417 | 0.647 |
| 1 | Tuvok | PV-Cre/ SST-Cre | 0.833 | 0.966 | 0.619 | 0.483 |
| 2 | Basil | PV-Cre/ SST-Cre | 0.945 | 0.962 | 0.433 | 0.698 |
| 2 | Cumin | PV-Cre/ SST-Cre | 0.937 | 0.970 | 0.547 | 0.489 |
| 2 | Dill | PV-Cre/ SST-Cre | 0.981 | 0.944 | 0.484 | 0.600 |
| 2 | Nutmeg | PV-Cre/ SST-Cre | 0.960 | 0.923 | 0.414 | 0.667 |
| 2 | Paprika | PV-Cre/ SST-Cre | 0.938 | 0.967 | 0.535 | 0.563 |
| 2 | Parsley | PV-Cre/ SST-Cre | 0.981 | 0.989 | 0.461 | 0.636 |
| 2 | Sumac | PV-Cre/ SST-Cre | 0.944 | 0.931 | 0.466 | 0.596 |

**Table S2. Effects of suppressing $PV^+$ or $SST^+$ interneurons on SWR and SG detection. Related to Figures 3, 4, S2, and S3.**

| Feature | Layer | Genotype | Veh. Mean | CNO Mean | statistic | df | test value | p |
|---|---|---|---|---|---|---|---|---|
| Ripple Freq. Mean (μV) | CA1-pyr | PV-Cre | 72.39 | 70.96 | Z | NA | 1.6 | 0.1 |
| | | SST-Cre | 61.53 | 58.67 | Z | NA | 1.24 | 0.2 |
| Ripple Freq. SD (μV) | CA1-pyr | PV-Cre | 77.3 | 76.69 | t | 15 | 0.32 | 0.8 |
| | | SST-Cre | 64.04 | 65.76 | t | 15 | 0.66 | 0.5 |
| Fast Ripple Rate (Hz) | CA1-pyr | **PV-Cre** | **0.0004** | **0.0035** | **Z** | **NA** | **2.93** | **0.003** |
| | | SST-Cre | 0.0015 | 0.0013 | Z | NA | 1.17 | 0.2 |
| Rest MUA (Hz) | CA1-pyr | PV-Cre | 10.61 | 10.91 | Z | NA | -0.41 | 0.68 |
| | | SST-Cre | 12.28 | 11.49 | Z | NA | -0.16 | 0.88 |
| | CA3-pyr | PV-Cre | 8.1 | 7.4 | Z | NA | 1.71 | 0.09 |
| | | SST-Cre | 6.58 | 5.75 | Z | NA | 1.6 | 0.11 |
| | DG-gc | PV-Cre | 7.05 | 6.51 | Z | NA | 0.98 | 0.33 |
| | | SST-Cre | 5.78 | 5.91 | Z | NA | 0.21 | 0.84 |
| Rest SG Freq. Mean ($\mu V^2$) | CA1-sr | **PV-Cre** | **109.51** | **127.6** | **t** | **15** | **4.03** | **0.001** |
| | | SST-Cre | 114.49 | 104.57 | t | 15 | 1.8 | 0.09 |
| | CA3 | PV-Cre | 152.26 | 157.61 | t | 15 | 1.49 | 0.2 |
| | | SST-Cre | 140 | 138.21 | t | 15 | 0.6 | 0.6 |
| | DG | PV-Cre | 353.58 | 352.37 | t | 15 | 0.15 | 0.9 |
| | | SST-Cre | 338 | 338.89 | t | 15 | 0.1 | 0.94 |
| Rest SG Freq. SD ($\mu V^2$) | CA1-sr | **PV-Cre** | **109.06** | **226.98** | **Z** | **NA** | **3.52** | **0.0004** |
| | | SST-Cre | 130.07 | 130.39 | t | 15 | 0.1 | 0.96 |
| | CA3 | **PV-Cre** | **161.1** | **252.93** | **t** | **15** | **3.94** | **0.001** |
| | | SST-Cre | 158.63 | 180.56 | Z | NA | 1.4 | 0.16 |
| | DG | **PV-Cre** | **343.52** | **450.84** | **t** | **15** | **3.47** | **0.003** |
| | | SST-Cre | 355.87 | 382.82 | t | 15 | 1.4 | 0.19 |
| CA3 Ripple Freq. Mean (μV) | CA3-pyr | PVCre | 81.72 | 79.63 | Z | NaN | 1.49 | 0.14 |
| | | SSTCre | 73.57 | 68.7 | t | 30 | 0.58 | 0.57 |
| CA3 Ripple Freq. SD (μV) | CA3-pyr | PVCre | 46.96 | 49 | Z | NaN | 0.06 | 0.95 |
| | | SSTCre | 42.88 | 42.01 | t | 30 | 0.16 | 0.88 |
| DS Freq. Mean (μV) | DG-gc | PVCre | 0 | -0.05 | Z | NaN | 2.43 | 0.02 |
| | | SSTCre | 0 | 0.01 | Z | NaN | -0.43 | 0.66 |
| DS Freq. SD (μV) | DG-gc | PVCre | 1903.24 | 1984.49 | t | 30 | -0.56 | 0.58 |
| | | SSTCre | 1807.8 | 1891.84 | t | 30 | -0.38 | 0.71 |

Paired t tests when the test statistic given is t and Wilcoxon matched pairs signed rank test when the test statistic given is Z. Significant comparisons are bolded. N = 16 PV-Cre and n = 16 SST-Cre mice.

**Table S3. Statistical details for Figures 2–6 and S2–S5.**

| Rest Features | PV-Cre (n = 16) | | SST-Cre (n = 16) | | PV-Cre vs SST-Cre | |
|---|---|---|---|---|---|---|
| | df | F | df | F | df | $\chi^2$ |
| CA1-sr CSD Source | 28124 | 11.72 | 44670 | 16.59 | 9 | -52369.26 |
| CA1-sr CSD Sink | 28124 | 14.72 | 44670 | 59.61 | 9 | -37362.77 |
| CA1 MUA during SWRs (Z-score) | 112503 | 2.33 | 124415 | 0.54 | 9 | 19.33 |
| CA3 MUA during SWRs (Z-score) | 112503 | 11.36 | 124415 | 11.33 | 9 | 14.84 |
| DG MUA during SWRs (Z-score) | 112503 | 20.64 | 124415 | 17.21 | 9 | 16.38 |
| SWR Rate (Hz) | 4023 | 22.81 | 4496 | 16.65 | 9 | 27.92 |
| % SWR in Chains | 112503 | 10.79 | 124415 | 17.78 | 9 | 2.32 |
| SWR Length (ms) | 112503 | 4.54 | 124415 | 9.3 | 9 | 30.65 |
| SWR Frequency (Hz) | 112503 | 10.48 | 124415 | 4.56 | 9 | 19.96 |
| SW Amplitude (μV) | 381794 | 115.42 | 428868 | 1.34 | 9 | 23.57 |
| SWR CA1 SG Power (Z-score) | 381794 | 99.81 | 428868 | 2.14 | 9 | 27.9 |
| SWR CA1–CA3 Delta Coh. | 903633 | 10.59 | 1182100 | 1.89 | 9 | 39.49 |
| SWR CA1–DG Delta Coh. | 843957 | 10.89 | 866644 | 0.61 | 9 | 24.47 |
| SWR Size (SD) | 112503 | 12.2 | 124415 | 3.28 | 9 | 21.36 |
| SWR CA3 SG Power (Z-score) | 360566 | 18.19 | 453379 | 3.32 | 9 | 3.15 |
| SWR DG SG Power (Z-score) | 327914 | 17.98 | 317642 | 7.61 | 9 | 3.3 |
| CA3 MUA during CA3 SWRs (Z-score) | 82196 | 12.34 | 95385 | 7.5 | 9 | -50950.7 |
| CA3 SWR Rate (Hz) | 4023 | 11.45 | 4496 | 0.09 | 9 | 11 |
| CA3 SWR Length (ms) | 82196 | 54.88 | 95381 | 13.42 | 9 | 7.27 |
| CA3 SWR Frequency (Hz) | 82196 | 9.7 | 95381 | 0.35 | 9 | 11.02 |
| DG MUA during DS (Hz) | 2245583 | 0.53 | 2272359 | 1.26 | 9 | 13.35 |
| DS Rate (Hz) | 4023 | 81.28 | 4497 | 9.02 | 9 | 11.03 |
| DS Length (ms) | 2245583 | 44.43 | 2272359 | 1.25 | 9 | 11.77 |
| DS Amplitude (μV) | 2245583 | 27.49 | 2272359 | 4.04 | 9 | 7.28 |
| Run Features | PV-Cre (n = 8) | | SST-Cre (n = 7) | | PV-Cre vs SST-Cre | |
| | df | F | df | F | df | $\chi^2$ |
| CA1 MUA (Hz) | 92444 | 0.13 | 145684 | 0.01 | 9 | 10.15 |
| CA3 MUA (Hz) | 92444 | 12.06 | 145684 | 7.89 | 9 | 4.55 |
| DG MUA (Hz) | 92444 | 13.62 | 145684 | 7.47 | 9 | 7.44 |
| CA1 SG Power ($\mu V^2$) | 31496 | 22.12 | 51582 | 2.33 | 9 | 41.12 |
| CA1–CA3 SG Coh. | 110477 | 13.23 | 166284 | 0.27 | 9 | 7.77 |
| CA1–DG SG Coh. | 116710 | 2.96 | 185217 | 1.07 | 9 | 11.26 |
| CA1 SG Freq. (Hz) | 1038019 | 22.17 | 1888216 | 0.33 | 9 | 23.06 |
| CA1 Theta–SG Comod. | 31496 | 2.43 | 51582 | 11.2 | 9 | 3.26 |
| CA1 FG Power ($\mu V^2$) | 31496 | 1.21 | 51582 | 17.24 | 9 | 29.45 |
| CA1 SG/FG ratio | 31496 | 105.64 | 51582 | 14.67 | 9 | 40.05 |
| CA1–CA3 FG Coh. | 105772 | 0.04 | 185217 | 1.66 | 9 | 11.57 |
| CA1–DG FG Coh. | 95893 | 1.21 | 166284 | 3.15 | 9 | 8.66 |

| | | | | | | |
|---|---|---|---|---|---|---|
| CA1 FG Freq (Hz) | 2150099 | 3.52 | 3752150 | 70.63 | 9 | 16.11 |
| CA1 Theta–FG Comod. | 31496 | 6.68 | 51582 | 83.1 | 9 | 33.69 |
| CA3 SG Power ($\mu V^2$) | 34017 | 2.07 | 48268 | 16.36 | 9 | 28.22 |
| DG SG Power ($\mu V^2$) | 34037 | 0.45 | 49647 | 27.87 | 9 | 30.09 |
| CA3 SG Freq. (Hz) | 1218601 | 13.56 | 1864300 | 0.07 | 9 | 25.49 |
| DG SG Freq. (Hz) | 1230393 | 12.13 | 1924686 | 0.81 | 9 | 32.71 |
| CA3 Theta–SG Comod. | 34017 | 10.62 | 48268 | 1.99 | 9 | 23.64 |
| DG Theta–SG Comod. | 34037 | 13.1 | 49647 | 1.48 | 9 | 23.38 |
| CA3 FG Power ($\mu V^2$) | 34017 | 0.64 | 48268 | 7.12 | 9 | 25.22 |
| DG FG Power ($\mu V^2$) | 34037 | 0.06 | 49647 | 18.28 | 9 | 25.42 |
| CA3 SG/FG ratio | 34017 | 12.72 | 48268 | 7.24 | 9 | 26.11 |
| DG SG/FG ratio | 34037 | 13 | 49647 | 9.51 | 9 | 29.04 |
| CA3 FG Freq. (Hz) | 2593454 | 5.43 | 3656285 | 35.46 | 9 | 14.05 |
| DG FG Freq. (Hz) | 2577250 | 1.42 | 3768666 | 43.56 | 9 | 16.25 |
| CA3 Theta–FG Comod. | 34017 | 12.5 | 48268 | 1.72 | 9 | 25.31 |
| DG Theta–FG Comod. | 34037 | 42.41 | 49647 | 2.51 | 9 | 29.54 |
| CA1 Theta Power ($\mu V^2$) | 31496 | 12.96 | 51582 | 16.78 | 9 | 8.15 |
| CA3 Theta Power ($\mu V^2$) | 34017 | 0.06 | 48268 | 2.25 | 9 | 10.68 |
| DG Theta Power ($\mu V^2$) | 34037 | 2.4 | 49647 | 6.69 | 9 | 4.84 |
| CA1–CA3 Theta Coh. | 95893 | 0.32 | 166284 | 3.94 | 9 | 7.13 |
| CA1–DG Theta Coh. | 105772 | 5.11 | 185217 | 0.09 | 9 | 4.29 |
| CA1 Theta Freq. (Hz) | 308329 | 6.99 | 574674 | 1.13 | 9 | 16.36 |
| CA3 Theta Freq. (Hz) | 296280 | 7.11 | 416176 | 2.68 | 9 | 10.69 |
| DG Theta Freq. (Hz) | 297566 | 11.76 | 432042 | 2.68 | 9 | 6.64 |

F test of the LMM for treatment effects, likelihood ratio test for genotype-treatment interaction effects.

**Table S4. Differences between genotypes during vehicle treatment. Related to Figures 3–6 and S2–S5.**

| Rest Features | PV mean (n = 16) | SST mean (n = 16) | df | F | p |
|---|---|---|---|---|---|
| CA1 MUA during SWRs (Z-score) | 2.64 | 1.44 | 138109 | 2.2 | 0.14 |
| CA3 MUA during SWRs (Z-score) | 1.89 | 0.88 | 138109 | 4.1 | 0.042 |
| DG MUA during SWRs (Z-score) | 1.74 | 0.51 | 138109 | 0.082 | 0.77 |
| SWR Rate (Hz) | 0.45 | 0.44 | 4757 | 1.5 | 0.22 |
| % SWR in Chains | 0.2 | 0.21 | 137661 | 0.26 | 0.61 |
| SWR Length (ms) | 102.99 | 101.34 | 137661 | 0.0073 | 0.93 |
| SWR Frequency (Hz) | 156.24 | 156.15 | 137661 | 0.0004 | 0.98 |
| SW Amplitude (μV) | 375.21 | 384.95 | 471767 | 0.13 | 0.72 |
| SWR CA1 SG Power (Z-score) | 1.31 | 1.25 | 471767 | 0.045 | 0.83 |
| SWR CA1–CA3 Delta Coh. | 0.013 | 0.011 | 1189551 | 0.19 | 0.66 |
| SWR CA1–DG Delta Coh. | 0.011 | 0.0088 | 976070 | 2.4 | 0.12 |
| SWR Size (SD) | 5.93 | 5.93 | 137661 | 0.052 | 0.82 |
| SWR CA3 SG Power (Z-score) | 0.91 | 0.85 | 473237 | 3 | 0.085 |
| SWR DG SG Power (Z-score) | 0.65 | 0.67 | 359153 | 0.29 | 0.59 |
| CA3 MUA during CA3 SWRs (Z-score) | 1.07 | 0.93 | 103414 | 0.23 | 0.63 |
| CA3 SWR Rate (Hz) | 0.33 | 0.33 | 4831 | 0.029 | 0.86 |
| CA3 SWR Length (ms) | 82.64 | 85.44 | 105233 | 1.1 | 0.29 |
| CA3 SWR Frequency (Hz) | 150.22 | 151.34 | 105233 | 0.58 | 0.45 |
| DG MUA during DS (Hz) | 97.11 | 83.92 | 2637957 | 0.13 | 0.72 |
| DS Rate (Hz) | 9.18 | 8.45 | 4832 | 5.2 | 0.022 |
| DS Length (ms) | 18.67 | 18.93 | 2637957 | 3.4 | 0.066 |
| DS Amplitude (μV) | 2822.72 | 2441.86 | 2637957 | 2.8 | 0.092 |
| Run Features | PV mean (n = 8) | SST mean (n = 7) | df | F | p |
| CA1 MUA (Hz) | 87.61 | 136.28 | 155440 | 2.38 | 0.12 |
| CA3 MUA (Hz) | 283.88 | 216.70 | 155440 | 1.79 | 0.18 |
| DG MUA (Hz) | 294.51 | 296.34 | 155400 | 0.00 | 0.99 |
| CA1 SG Power ($\mu V^2$) | 512.08 | 400.01 | 28766 | 0.77 | 0.38 |
| CA1–CA3 SG Coh. | 0.6 | 0.6 | 100543 | $4.20 \times 10^{-5}$ | 0.99 |
| CA1–DG SG Coh. | 0.59 | 0.58 | 114500 | 0.04 | 0.84 |
| CA1 SG Freq. (Hz) | 40.24 | 41.2 | 1066217 | 4.6 | 0.032 |
| CA1 Theta–SG Comod. | 0.0051 | 0.0049 | 28766 | 0.0015 | 0.97 |
| CA1 FG Power ($\mu V^2$) | 79.36 | 63.72 | 28766 | 0.34 | 0.56 |
| CA1 SG/FG ratio | 6.35 | 5.71 | 28766 | 1 | 0.32 |
| CA1–CA3 FG Coh. | 0.54 | 0.56 | 110360 | 0.81 | 0.37 |
| CA1–DG FG Coh. | 0.52 | 0.53 | 95023 | 0.31 | 0.58 |

| | | | | | |
|---|---|---|---|---|---|
| CA1 FG Freq (Hz) | 79.7 | 78.93 | 2095627 | 1.3 | 0.25 |
| CA1 Theta–FG Comod. | 0.0079 | 0.0074 | 28766 | 0.036 | 0.85 |
| CA3 SG Power ($\mu V^2$) | 115.94 | 134.21 | 31822 | 1.2 | 0.28 |
| DG SG Power ($\mu V^2$) | 313.19 | 303.08 | 31169 | 0.11 | 0.74 |
| **CA3 SG Freq. (Hz)** | **40.54** | **41.9** | **1089935** | **12** | **0.00042** |
| **DG SG Freq. (Hz)** | **41.06** | **42.4** | **1241681** | **13** | **0.00025** |
| CA3 Theta–SG Comod. | 0.0049 | 0.0053 | 31822 | 2.2 | 0.14 |
| DG Theta–SG Comod. | 0.0047 | 0.0053 | 31169 | 4.5 | 0.034 |
| CA3 FG Power ($\mu V^2$) | 18.3 | 27.1 | 31822 | 5.6 | 0.018 |
| DG FG Power ($\mu V^2$) | 64.54 | 73.9 | 31169 | 2.3 | 0.13 |
| **CA3 SG/FG ratio** | **6.2** | **3.99** | **31822** | **11** | **0.00078** |
| **DG SG/FG ratio** | **5.16** | **3.4** | **31169** | **11** | **0.00071** |
| CA3 FG Freq. (Hz) | 81.99 | 80.18 | 2155990 | 5.2 | 0.022 |
| DG FG Freq. (Hz) | 81.75 | 80.42 | 2381526 | 6.7 | 0.0095 |
| CA3 Theta–FG Comod. | 0.007 | 0.0085 | 31822 | 4 | 0.046 |
| DG Theta–FG Comod. | 0.0086 | 0.009 | 31169 | 0.94 | 0.33 |
| CA1 Theta Power ($\mu V^2$) | 811.3 | 613.97 | 28766 | 0.21 | 0.64 |
| CA3 Theta Power ($\mu V^2$) | 878.78 | 1090.14 | 31822 | 2.3 | 0.13 |
| DG Theta Power ($\mu V^2$) | 2036.8 | 1927.36 | 31169 | 0.35 | 0.56 |
| CA1–CA3 Theta Coh. | 0.81 | 0.8 | 95023 | 0.046 | 0.83 |
| CA1–DG Theta Coh. | 0.79 | 0.77 | 110360 | 0.39 | 0.53 |
| CA1 Theta Freq. (Hz) | 9.18 | 9.09 | 312211 | 0.34 | 0.56 |
| CA3 Theta Freq. (Hz) | 9.15 | 9.03 | 246172 | 0.38 | 0.54 |
| DG Theta Freq. (Hz) | 9.24 | 9.21 | 270460 | 0.056 | 0.81 |

F test of the LMM for genotype effects. Significant comparisons are bolded.

**Table S5. Statistical details for Figures S6 and S7. Related to Figures 3-6 and Figures S6 and S7.**

| Rest Features | PV-Cre/ SST-Cre (n = 13) | | PV-Cre vs PV-Cre/ SST-Cre | | SST-Cre vs PV-Cre/ SST-Cre | | Empty Vector (n = 8) | |
|---|---|---|---|---|---|---|---|---|
| | df | F | df | $\chi^2$ | df | $\chi^2$ | df | F |
| MUA during SWRs (Z-score) | 76435 | 7.16 | 9 | -68724 | 9 | -54461 | 21480 | 0.02 |
| MUA during SWRs (Z-score) | 76435 | 7.78 | 9 | -49460 | 9 | -19733 | 21480 | 0.19 |
| MUA during SWRs (Z-score) | 76435 | 24.13 | 9 | -120845 | 9 | -6232 | 21480 | 1.42 |
| SWR Rate (Hz) | 2709 | 12.79 | 9 | 4.51 | 9 | 19.54 | 892 | 0.11 |
| % SWR in Chains | 75927 | 18.82 | 9 | 1.45 | 9 | 5.19 | 21310 | 0.08 |
| SWR Length (ms) | 75927 | 0.48 | 9 | 5.36 | 9 | 15.06 | 21310 | 0.17 |
| SWR Frequency (Hz) | 75927 | 21.2 | 9 | 12.28 | 9 | 26.56 | 21310 | 0.25 |
| SW Amplitude (μV) | 255972 | 29.64 | 9 | 16.03 | 9 | 29.41 | 66351 | 0.52 |
| CA1-sr SG Power (Z-score) | 255972 | 46.62 | 9 | -26019 | 9 | 28.18 | 66351 | 2.33 |
| SWR Delta SG Coherence | 750476 | 0.99 | 9 | -40005 | 9 | -35500 | 168587 | 0.02 |
| SWR Delta SG Coherence | 524754 | 1.44 | 9 | -97130 | 9 | -63661 | 142513 | 2.35 |
| SWR Size (SD) | 75927 | 20.15 | 9 | 7.7 | 9 | 18.37 | 21310 | 0.49 |
| SG Power (Z-score) | 303136 | 23.76 | 9 | -15146 | 9 | -26292 | 84625 | 3.48 |
| SG Power (Z-score) | 209470 | 14.65 | 9 | -5617 | 9 | -291 | 68253 | 1.5 |
| CA3 MUA during CA3 SWRs (Z-score) | 51194 | 16.77 | 9 | 14.11 | 9 | 11.76 | 17339 | 0.03 |
| CA3 SWR Rate (Hz) | 2709 | 7.4 | 9 | 9.08 | 9 | 8.17 | 872 | 0 |
| CA3 SWR Length (ms) | 51194 | 8.74 | 9 | 9.87 | 9 | 10.7 | 16608 | 0 |
| CA3 SWR Frequency (Hz) | 51194 | 12.6 | 9 | 7.86 | 9 | 16.23 | 17335 | 3.16 |
| DG MUA during DS (Hz) | 1484214 | 10.31 | 9 | 3.57 | 9 | 1.58 | 424321 | 0 |
| DS Rate (Hz) | 2709 | 10.96 | 9 | 10.7 | 9 | 4.52 | 892 | 0.18 |
| DS Length (ms) | 1484214 | 0.58 | 9 | 20.09 | 9 | 7.12 | 424321 | 0.22 |
| DS Amplitude (μV) | 1484214 | 8.66 | 9 | 5.21 | 9 | 2.75 | 424321 | 1.02 |
| Run Features | PV-Cre/ SST-Cre (n = 7) | | PV-Cre vs PV-Cre/ SST-Cre | | SST-Cre vs PV-Cre/ SST-Cre | | Empty Vector (n = 8) | |
| | df | F | df | $\chi^2$ | df | $\chi^2$ | df | F |
| CA1 MUA (Hz) | 140065 | 4.54 | 9 | 2.69 | 9 | 13.32 | 120735 | 1.44 |
| CA3 MUA (Hz) | 140065 | 37.10 | 9 | 8.28 | 9 | 4.24 | 120735 | 0.85 |
| DG MUA (Hz) | 140065 | 36.95 | 9 | 9.11 | 9 | 18.41 | 120735 | 0.27 |
| CA1 SG Power ($\mu V^2$) | 50966 | 11.62 | 9 | 5.56 | 9 | 6.07 | 45384 | 3.36 |
| CA1–CA3 SG Coh. | 204656 | 11.84 | 9 | 7.35 | 9 | 8.89 | 178143 | 2.26 |
| CA1–DG SG Coh. | 170411 | 10.86 | 9 | 3.28 | 9 | 11.26 | 167832 | 1.06 |
| CA1 SG Freq. (Hz) | 1817692 | 15.1 | 9 | 3.34 | 9 | 17.93 | 1649935 | 1.14 |
| CA1 Theta–SG Comod. | 50966 | 24.58 | 9 | 6.73 | 9 | 3.76 | 45384 | 0.02 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CA1 FG Power ($\mu V^2$) | 50966 | 23.04 | 9 | 16.9 | 9 | 1.37 | 49047 | 0.13 |
| CA1 SG/FG ratio | 50966 | 21.37 | 9 | 8.33 | 9 | 28.28 | 49047 | 0.01 |
| CA1–CA3 FG Coh. | 170411 | 0.17 | 9 | 7.95 | 9 | 14.52 | 173082 | 2.64 |
| CA1–DG FG Coh. | 204656 | 0.17 | 9 | 13.66 | 9 | 12.98 | 185143 | 0.05 |
| CA1 FG Freq (Hz) | 3744547 | 14.73 | 9 | 8.25 | 9 | 23.3 | 3333362 | 0.61 |
| CA1 Theta–FG Comod. | 50966 | 13.94 | 9 | 7.99 | 9 | 32.4 | 45384 | 0.01 |
| CA3 SG Power ($\mu V^2$) | 58724 | 0.04 | 9 | 8.69 | 9 | 8.4 | 59762 | 2.92 |
| DG SG Power ($\mu V^2$) | 48576 | 5.71 | 9 | 9.99 | 9 | 6.48 | 51661 | 0.24 |
| CA3 SG Freq. (Hz) | 2137020 | 8.89 | 9 | 6.36 | 9 | 21.1 | 2220964 | 1 |
| DG SG Freq. (Hz) | 1790505 | 8.08 | 9 | 5.33 | 9 | 29.44 | 1961970 | 1.2 |
| CA3 Theta–SG Comod. | 58724 | 12.75 | 9 | 34.51 | 9 | 23.71 | 59762 | 0.23 |
| DG Theta–SG Comod. | 48576 | 42.17 | 9 | 32.26 | 9 | 10.98 | 51661 | 0 |
| CA3 FG Power ($\mu V^2$) | 58724 | 22.57 | 9 | 17.82 | 9 | 31.67 | 59762 | 0.86 |
| DG FG Power ($\mu V^2$) | 48576 | 41.75 | 9 | 19.95 | 9 | 32.09 | 51661 | 0.21 |
| CA3 SG/FG ratio | 58724 | 0.74 | 9 | 8.14 | 9 | 19.44 | 59762 | 1.42 |
| DG SG/FG ratio | 48576 | 1.11 | 9 | 6.75 | 9 | 21.1 | 51661 | 2.11 |
| CA3 FG Freq. (Hz) | 4425768 | 10.28 | 9 | 9.55 | 9 | 14.96 | 4511384 | 0.43 |
| DG FG Freq. (Hz) | 3665938 | 15.43 | 9 | 16.3 | 9 | 22 | 3911662 | 0.11 |
| CA3 Theta–FG Comod. | 58724 | 9.18 | 9 | 6.54 | 9 | 5.48 | 59762 | 1.48 |
| DG Theta–FG Comod. | 48576 | 15.43 | 9 | 5.86 | 9 | 3.03 | 51661 | 0.88 |
| CA1 Theta Power ($\mu V^2$) | 50966 | 30.84 | 9 | 6.49 | 9 | 8.21 | 49047 | 2.7 |
| CA3 Theta Power ($\mu V^2$) | 58724 | 0.86 | 9 | 24.22 | 9 | 20.06 | 59762 | 0.18 |
| DG Theta Power ($\mu V^2$) | 48576 | 6.03 | 9 | 20.96 | 9 | 18.68 | 51661 | 0.26 |
| CA1–CA3 Theta Coh. | 204656 | 7.44 | 9 | 6.77 | 9 | 1.07 | 185143 | 0.84 |
| CA1–DG Theta Coh. | 170411 | 0.19 | 9 | 4.17 | 9 | 3.98 | 173082 | 0.29 |
| CA1 Theta Freq. (Hz) | 529462 | 32.2 | 9 | 16.59 | 9 | 7.85 | 473424 | 0.17 |
| CA3 Theta Freq. (Hz) | 508905 | 29.47 | 9 | 13.03 | 9 | 4.72 | 513283 | 0.11 |
| DG Theta Freq. (Hz) | 421267 | 46.45 | 9 | 6.52 | 9 | 7.92 | 451191 | 0.06 |

F test of the LMM for treatment effects, likelihood ratio test for genotype-treatment interaction effects.

**Table S6. Sex differences across all mice during vehicle treatment. Related to Figures 3–6 and S2–S7.**

| Rest Features | F mean (n = 26) | M mean (n = 27) | df | F | p |
|---|---|---|---|---|---|
| CA1 MUA during SWRs (Z-score) | 1.97 | 1.86 | 189147 | 3.2 | 0.074 |
| CA3 MUA during SWRs (Z-score) | 1.28 | 1.13 | 189147 | 0.35 | 0.56 |
| DG MUA during SWRs (Z-score) | 0.98 | 0.96 | 189147 | 2.1 | 0.15 |
| SWR Rate (Hz) | 0.42 | 0.44 | 6724 | 0.89 | 0.34 |
| % SWR in Chains | 0.21 | 0.21 | 189147 | 0.16 | 0.69 |
| SWR Length (ms) | 101.02 | 102.9 | 189147 | 0.31 | 0.58 |
| SWR Frequency (Hz) | 155.74 | 155.45 | 189147 | 0.07 | 0.79 |
| SW Amplitude (μV) | 356.84 | 416.36 | 642232 | 4.6 | 0.032 |
| SWR CA1 SG Power (Z-score) | 1.31 | 1.22 | 642232 | 1.2 | 0.27 |
| SWR CA1–CA3 Delta Coh. | 0.01 | 0.01 | 1666279 | 0.16 | 0.69 |
| SWR CA1–DG Delta Coh. | 0.01 | 0.01 | 1323512 | 0.28 | 0.6 |
| SWR Size (SD) | **6.36** | **5.92** | **189147** | **8** | **0.0046** |
| SWR CA3 SG Power (Z-score) | 0.89 | 0.92 | 679511 | 0.51 | 0.48 |
| SWR DG SG Power (Z-score) | 0.66 | 0.69 | 506782 | 0.07 | 0.79 |
| CA3 MUA during CA3 SWRs (Z-score) | 1.08 | 0.93 | 141580 | 0.51 | 0.47 |
| CA3 SWR Rate (Hz) | 0.31 | 0.32 | 6795 | 0.2 | 0.65 |
| CA3 SWR Length (ms) | 79.98 | 84.81 | 143326 | 5.9 | 0.015 |
| CA3 SWR Frequency (Hz) | 151.34 | 151.15 | 143326 | 0.023 | 0.88 |
| DG MUA during DS (Hz) | 63.96 | 115.84 | 3704734 | 3.6 | 0.058 |
| DS Rate (Hz) | 8.35 | 8.82 | 6799 | 1.7 | 0.19 |
| DS Length (ms) | 19.04 | 18.8 | 3704734 | 3.3 | 0.069 |
| DS Amplitude (μV) | 2611.7 | 2704.53 | 3704734 | 0.23 | 0.63 |
| Run Features | F mean (n = 15) | M mean (n = 15) | df | F | p |
| CA1 MUA (Hz) | 93.65 | 121.75 | 304843 | 0.19 | 0.67 |
| CA3 MUA (Hz) | 316.81 | 263.00 | 304843 | 4.36 | 0.04 |
| DG MUA (Hz) | 329.59 | 296.09 | 304803 | 4.32 | 0.04 |
| CA1 SG Power ($\mu V^2$) | 485.49 | 482.7 | 66893 | 0.016 | 0.9 |
| CA1–CA3 SG Coh. | 0.61 | 0.61 | 250460 | 0 | 0.99 |
| CA1–DG SG Coh. | 0.58 | 0.57 | 244915 | 0.2 | 0.65 |
| CA1 SG Freq. (Hz) | 40.48 | 40.76 | 2465138 | 0.33 | 0.56 |
| CA1 Theta–SG Comod. | 0 | 0.01 | 66893 | 2.2 | 0.14 |
| CA1 FG Power ($\mu V^2$) | 74.66 | 72.33 | 66893 | 0.36 | 0.55 |
| CA1 SG/FG ratio | 6.17 | 6.37 | 66893 | 0.35 | 0.55 |
| CA1–CA3 FG Coh. | 0.56 | 0.56 | 242401 | 0.0066 | 0.94 |
| CA1–DG FG Coh. | 0.53 | 0.53 | 246436 | 0.026 | 0.87 |

| | | | | | |
|---|---|---|---|---|---|
| CA1 FG Freq (Hz) | 79.12 | 78.93 | 4907656 | 0.0021 | 0.96 |
| CA1 Theta–FG Comod. | 0.01 | 0.01 | 66893 | 1.3 | 0.25 |
| CA3 SG Power ($\mu V^2$) | 133.15 | 135.51 | 77230 | 0.0069 | 0.93 |
| DG SG Power ($\mu V^2$) | 367.43 | 336.19 | 80834 | 1.1 | 0.3 |
| CA3 SG Freq. (Hz) | 41.03 | 41.11 | 2806688 | 0.034 | 0.85 |
| DG SG Freq. (Hz) | 41.49 | 41.81 | 2717918 | 0.49 | 0.48 |
| CA3 Theta–SG Comod. | 0.01 | 0.01 | 77230 | 0.22 | 0.64 |
| DG Theta–SG Comod. | 0.01 | 0.01 | 80834 | 0.62 | 0.43 |
| CA3 FG Power ($\mu V^2$) | 25.11 | 23.56 | 77230 | 0.026 | 0.87 |
| DG FG Power ($\mu V^2$) | 85.72 | 75.36 | 80834 | 0.4 | 0.53 |
| CA3 SG/FG ratio | 5.53 | 5.27 | 77230 | 0.12 | 0.73 |
| DG SG/FG ratio | 4.7 | 4.27 | 80834 | 0.64 | 0.42 |
| CA3 FG Freq. (Hz) | 81.24 | 80.63 | 5598054 | 0.27 | 0.6 |
| DG FG Freq. (Hz) | 80.65 | 80.91 | 5337353 | 0.7 | 0.4 |
| CA3 Theta–FG Comod. | 0.01 | 0.01 | 77230 | 1.3 | 0.26 |
| DG Theta–FG Comod. | 0.01 | 0.01 | 80834 | 0.16 | 0.69 |
| CA1 Theta Power ($\mu V^2$) | 795.65 | 885.27 | 66893 | 0.19 | 0.66 |
| CA3 Theta Power ($\mu V^2$) | 1153.66 | 1005.65 | 77230 | 1.1 | 0.29 |
| DG Theta Power ($\mu V^2$) | 2545.05 | 1940.38 | 80834 | 4.6 | 0.032 |
| CA1–CA3 Theta Coh. | 0.79 | 0.81 | 246436 | 0.88 | 0.35 |
| CA1–DG Theta Coh. | 0.78 | 0.77 | 280238 | 0.18 | 0.67 |
| CA1 Theta Freq. (Hz) | 9.16 | 9.13 | 713763 | 0.0071 | 0.93 |
| CA3 Theta Freq. (Hz) | 9.11 | 9.09 | 641545 | 0.12 | 0.73 |
| DG Theta Freq. (Hz) | 9.16 | 9.27 | 611269 | 0.37 | 0.54 |

F test of the LMM for sex effects. Significant comparisons are bolded.