

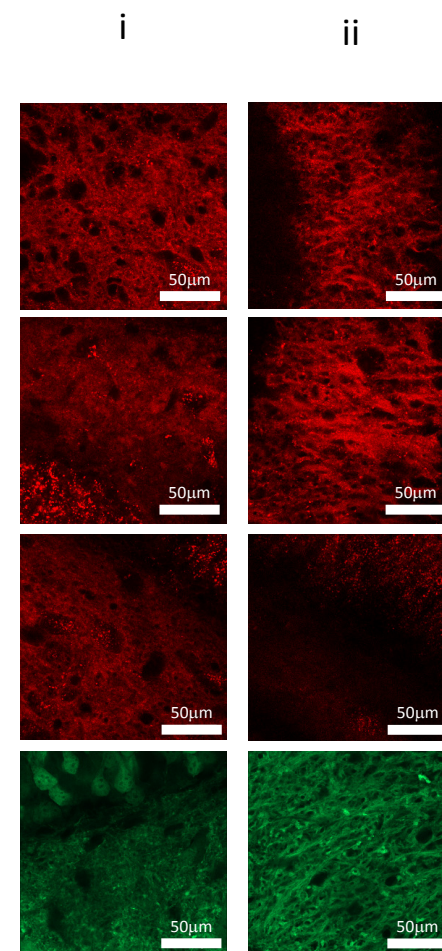
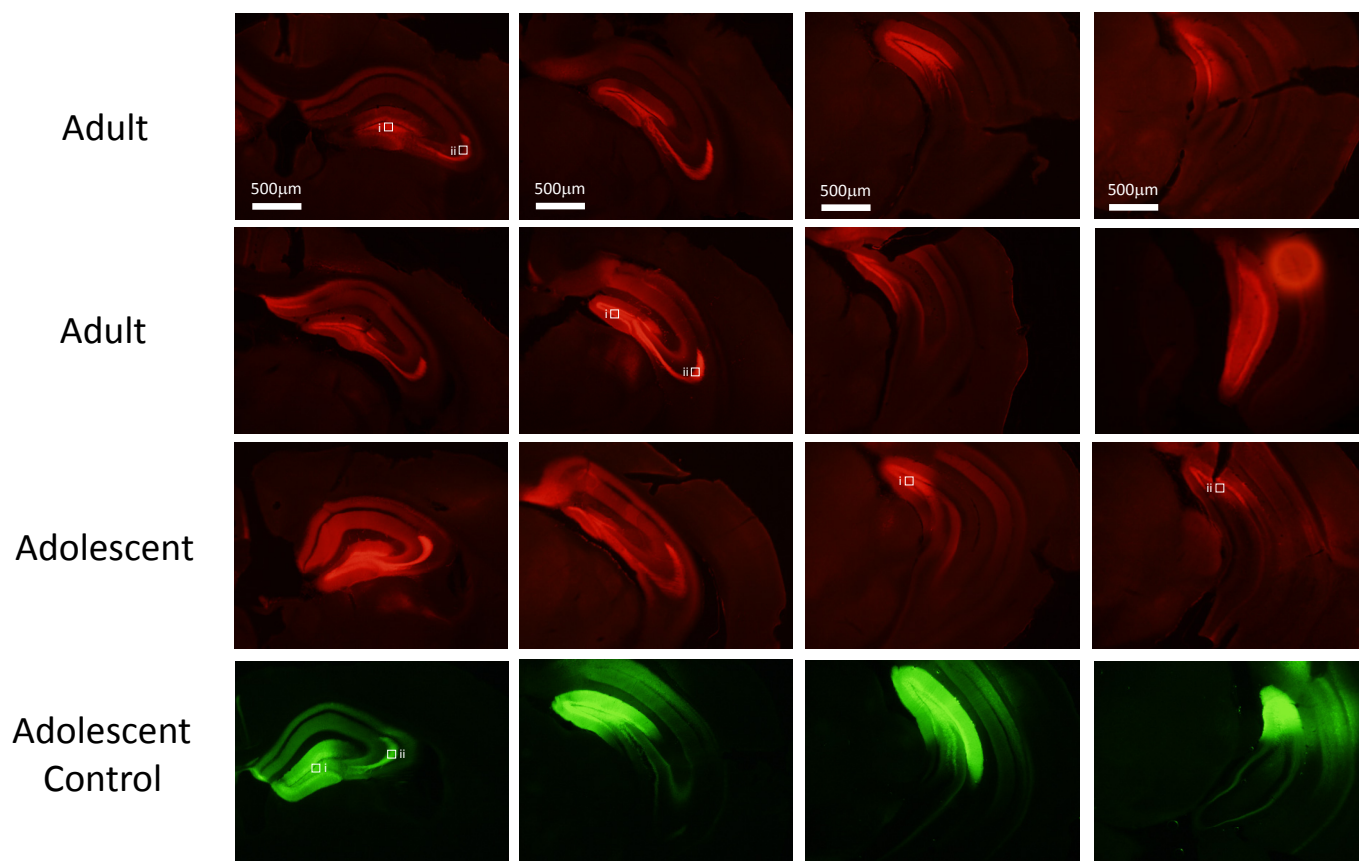
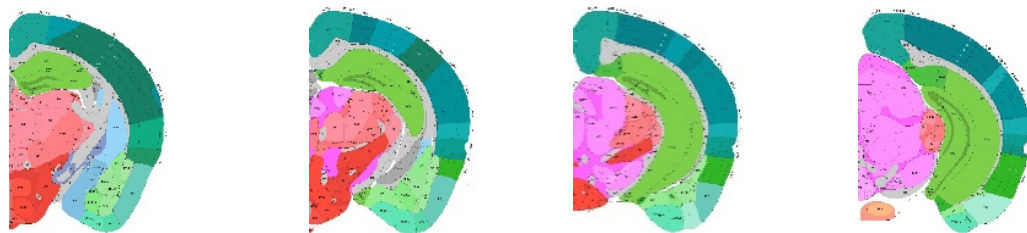


Fig. S1

Fig. S1: Additional images of vector expression.

Images of the hippocampus in adolescent and adult mice showing expression of the fluorescent markers associated with the DREADD (mCherry/red) or control vector (EGFP/green). Enlarged images of the indicated regions, showing expression in the hilus or terminals in CA3, are shown on the right, indicating limited expression in cell bodies in the hilus, and a lack of labeled cell bodies in CA3. Reference images from Allen Mouse Brain Atlas, mouse.brain-map.org and atlas.brain-map.org.

a

Raw Examples of Hyper Synchronous Events

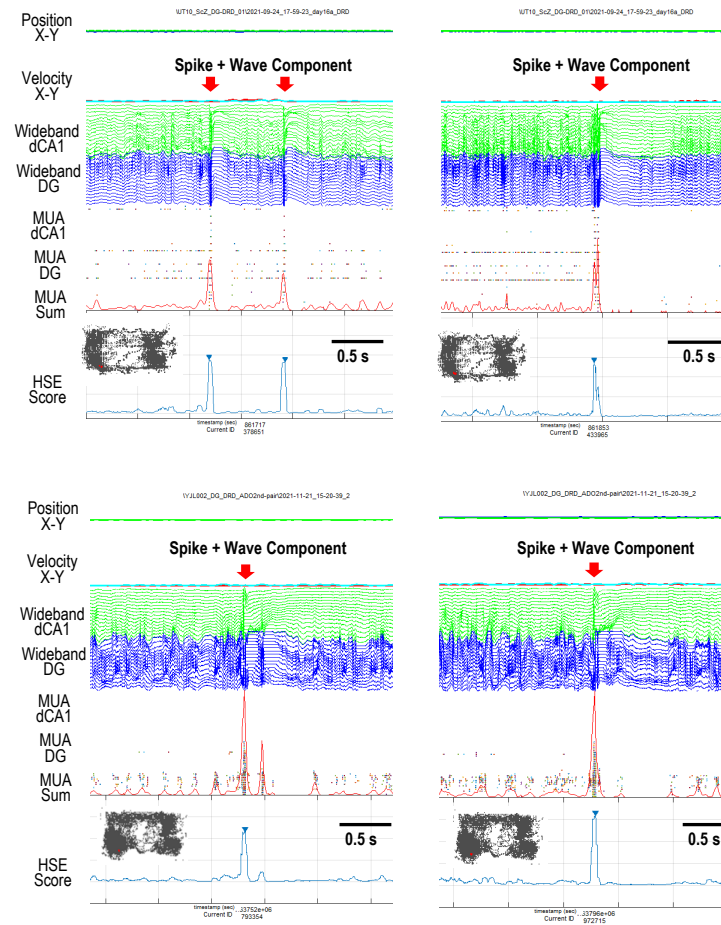


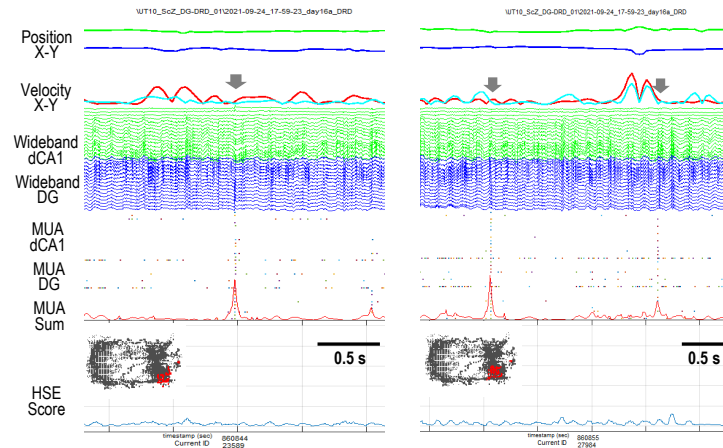
Fig. S2

Fig. S2: Distinct Wide-Band Raw Waveforms and Associated MUAs and Position Data during HSEs.

Raw Examples of Hyper Synchronous Events (HSEs). Top panel: Animal's X-Y position (green-blue) and X-Y head velocity (red-cyan). Middle Top panel: Wide-band LFP traces from the 32-channel silicon probe. Green traces: CA1, Blue traces: DG. Middle bottom panel: Detected multi-unit activities (MUAs). Different colors represent different spiking events. Smoothed sum of the MUAs are indicated by red traces. Bottom panel: Animal's position indicated by red dots with synchronized HSE score (calculated from raw LFP amplitudes) on the bottom traces. Red arrows indicate HSE events.

a

Raw Examples of Movement Artifacts



b

Raw Examples of Sharp-Wave Ripples

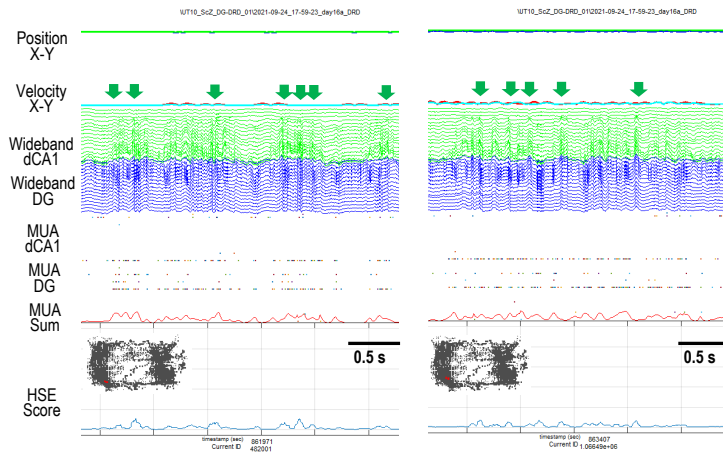
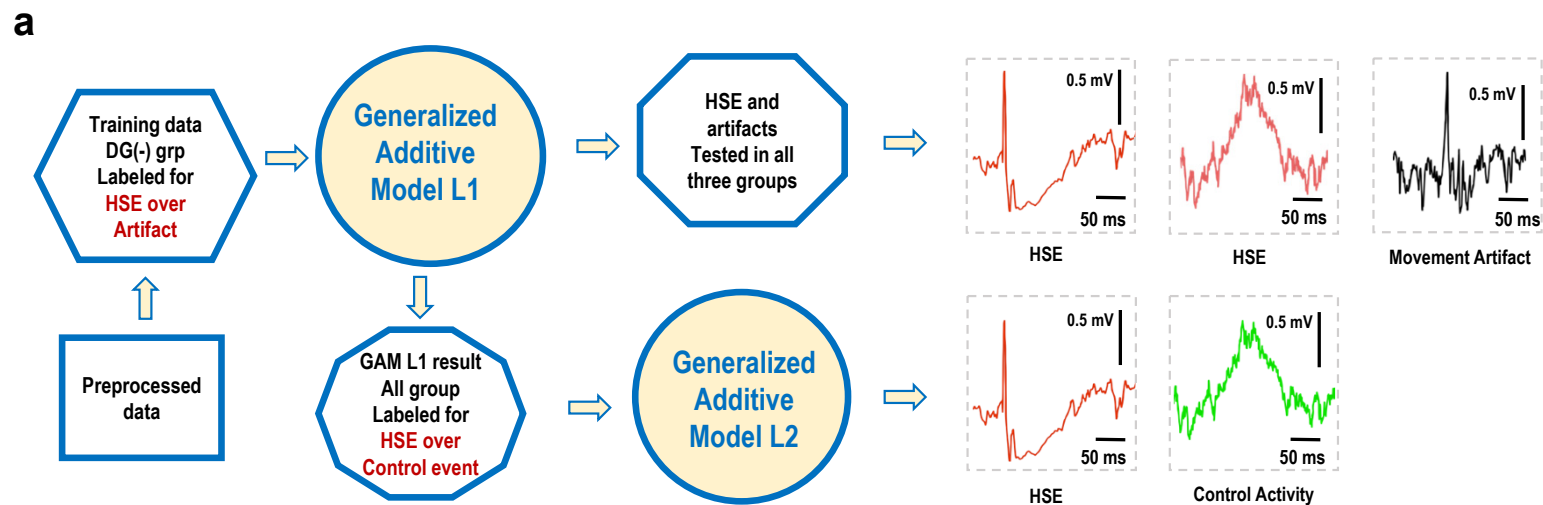


Fig. S3

Fig. S3: Representatives of Wide-Band Raw Waveforms and Associated MUAs and Position Data of Motion Artifact and Hippocampal Sharp-Wave Ripples.

- a.** Raw Examples of Motion Artifacts. Top panel: Animal's X-Y position (green-blue) and X-Y head velocity (red-cyan). Middle Top panel: Wide-band LFP traces from the 32-channel silicon probe. Green traces: CA1, Blue traces: DG. Middle bottom panel: Detected multi-unit activities (MUAs). Different colors represent different spiking events. Smoothed sum of the MUAs are indicated by red traces. Bottom panel: Animal's position indicated by red dots with synchronized HSE score (calculated from raw LFP amplitudes) on the bottom traces. Red arrows indicate HSE events. Grey arrows indicate artifacts.
- b.** Raw Examples of Normal Sharp-Wave Ripples. All panels are shown in the same way as in panel a. Green arrows indicate normal sharp-wave ripples.



b

GAM Layer 1 Training	GAM Layer 1 Testing	GAM Layer 2 Training	GAM Layer 2 Testing
Time Series Position Label 1 0	HSE Artifact	Only Time Series amp Label 1 0	HSE Control
DG(-) Adolescent group Same time series from random animals	Tested on All groups	Both DG(-) Adolescent group and Control group time series cleaned up data post GAM layer 1 from each animal	Tested on All groups

Fig. S4

Fig. S4: Schematic representation of use of Generalized Additive Model (GAM) in this study:

a. Data from the DG (-) Adolescent group was structured into comma separated value files containing the timestamps, averaged amplitude from all 32 channels, animal head position, and labels. The abnormal fast spikes termed hypersynchronous events (HSEs) were labeled as 1 while movement associated artifacts were labeled as 0 within randomly selected time series files. The length of the data chosen was about 100 minutes with each file length at varying duration of 1-60 minutes. The resultant training data was from 2 random mice across 6 days (N=5 animals).

The initial layer, Generalized Additive Model (GAM) layer 1 (L1), established non-linear associations among data features like amplitude, position, and target labels (HSEs or artifacts) via a matrix of basis functions. This layer achieved a classification accuracy of ~99% across all three groups: DG (-) Adolescent group, Adolescent control group, and Adult control group. However, it notably identified more HSE-like events in the control groups. Subsequent analysis revealed no significant differences in the time duration and amplitude of HSEs and control events. To address this, a second layer, GAM L2, was introduced to distinguish between true HSEs and control events.

For GAM L2, individual channel time series data from CA1 (10) and DG (20) were randomly selected from each of the 13 animals. Unlike the first layer, position data was omitted in GAM L2 since GAM L1 had already preserved the cleaned-up labels of HSEs. Training data for GAM L2 comprised individual channel raw amplitude (two channels), normalized amplitude, timestamps, and labels, utilizing the entire ~60 minutes length of data for training, totaling ~1500 minutes. GAM L2 achieved a classification accuracy of ~88% in distinguishing HSEs and control events.

The model included two layers of processing: first to remove artifacts and then to determine the true number of HSEs per hour. Post-processing analysis of the model results revealed a significantly higher number of HSEs in the DG (-) Adolescent group compared to the control groups (both adolescent and adult).

b. Table of input and output for GAM L1 and L2: The first column shows the label for combined amplitude and position data. Training data included data from only the DG (-) Adolescent group. The second column depicts the GAM L1 test categories (HSE in red and artifact in black) from all three groups: DG (-) Adolescent, Adolescent control, and DG (-) Adult control. The Third column shows how input to GAM L2 was labelled for only amplitude. Training data was used from DG (-) Adolescent group and control group (results of the previous layer) and the fourth column lists the GAM L2 test categories (HSE in red and artifact in black) from all three groups: DG (-) Adolescent, Adolescent control, and DG (-) Adult control.