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Reporting Summary

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Statistical parameters

When statistical analyses are reported, confirm that the following items are present in the relevant location (e.g. figure legend, table legend, main text, or Methods section).

n/a	Confirmed	
☐	☒	The exact sample size (*n*) for each experimental group/condition, given as a discrete number and unit of measurement
☒	☐	An indication of whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
☐	☒	The statistical test(s) used AND whether they are one- or two-sided *Only common tests should be described solely by name; describe more complex techniques in the Methods section.*
☒	☐	A description of all covariates tested
☐	☒	A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
☐	☒	A full description of the statistics including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
☐	☒	For null hypothesis testing, the test statistic (e.g. *F*, *t*, *r*) with confidence intervals, effect sizes, degrees of freedom and *P* value noted *Give P values as exact values whenever suitable.*
☒	☐	For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
☒	☐	For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
☒	☐	Estimates of effect sizes (e.g. Cohen's *d*, Pearson's *r*), indicating how they were calculated
☐	☒	Clearly defined error bars *State explicitly what error bars represent (e.g. SD, SE, CI)*

Our web collection on statistics for biologists may be useful.

Software and code

Policy information about availability of computer code

Data collection	In vitro electrophysiology data was collected using Spike2 v6 or v7 (Cambridge Electronic Design, Ltd., UK). In vivo electrophysiological data was collected using Intan RHD2000 system (Intan technologies, USA) with provided Matlab toolbox. Numerical simulations were done in Matlab software. Data from patients was acquired using Neurovista implantable device or using Schwarzer GmbH amplifiers and Stellate Inc. software. Data collection is described in detail Materials and Methods section of the manuscript.
Data analysis	In vitro data was analyzed using Spike2 software (Cambridge Electronic Design, Cambridge, UK) and programmes written in our laboratories and running under Matlab (Mathworks Inc., USA). In vivo data, human data and data from numerical simulations were analyzed using Matlab software. The SPSS software v15.0 (SPSS Inc.) was used for selected statistical analyses.

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors/reviewers upon request. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Research guidelines for submitting code & software for further information.

Data

Policy information about availability of data

All manuscripts must include a data availability statement. This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A list of figures that have associated raw data
- A description of any restrictions on data availability

Recorded data and analytical tools that support the findings of this study are available from the corresponding author upon request.

Field-specific reporting

Please select the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☒ Life sciences ☐ Behavioural & social sciences ☐ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see nature.com/authors/policies/ReportingSummary-flat.pdf

Life sciences study design

All studies must disclose on these points even when the disclosure is negative.

Sample size	We did not implement any statistical approach to a priori define the sample sizes. Our sample sizes correspond to sample sizes that are generally used in this field of research and based on our previous experience with similar experiments or those that have been routinely used in studies applying analogous methodological approaches and published in Nature Neuroscience.
Data exclusions	Only spontaneously seizing slices without spreading depression were included. Criteria for excluding (neuronal) spikes during spike sorting procedures are described in section 'Materials and Methods', sub-section 'In vitro data analyses', the third paragraph. Only animals developed spontaneous seizures were used in the in vivo section. Data containing missing segments due to telemetry dropouts or ECoG channels containing artifacts were also removed from analysis. For the statistical analysis, patients with <10 clinical seizures were excluded. In Materials and Methods - human data recording and analysis.
Replication	All experiments were reliably reproduced and high-potassium model of seizures is well established model of in vitro ictogenesis. Perfusion of the isolated CA1 and hippocampal slices with 8-10 mM high potassium concentration ACSF induces spontaneous electrographic seizures in ~35% of cases. The experimental conditions and procedures (i.e temperature, perfusion rate, slice thickness, ACSF composition etc.) were kept constant to allow for the replication of the experiments.
Randomization	Animals for in vitro and in vivo experiments were randomly provided by the animal facilities (In the 'Materials and Methods', section 'Animal and Slice preparation' and section 'Tetanus toxin model of temporal epilepsy and in vivo electrophysiology'). The comparison under two or more pharmacological conditions in vitro, experiments were performed before the drug application, during the drug application or after the wash-out. In human telemetry study, no randomization was performed due to the nature of the study.
Blinding	Data were collected with no blinding. It is reported in 'Materials and Methods', subsection 'Statistical analysis'. Subsequent analyses were performed using automatic and semi-automatic techniques of detection and feature extraction.

Reporting for specific materials, systems and methods

Materials & experimental systems

n/a	Involved in the study
☒	☐ Unique biological materials
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology
☐	☒ Animals and other organisms
☐	☒ Human research participants

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Animals and other organisms

Policy information about studies involving animals; ARRIVE guidelines recommended for reporting animal research

Laboratory animals	We used male Sprague-Dawley (weight 180-225 g, age 6-7 weeks) or Wistar rats (weight 140-210 g, age 5-7 weeks)) for in vitro experiments. Male Wistar rats (weight 350-540 g, 9-17 weeks) were used for in vivo experiments. Materials and Methods - 'Animal and slice preparation' and 'Tetanus toxin model of temporal epilepsy and in vivo electrophysiology'
Wild animals	The study did not involve wild animals.
Field-collected samples	The study did not involve samples collected from the field.

Human research participants

Policy information about studies involving human research participants

Population characteristics	Twelve patients with implantable seizure prediction device were included in this study. Patient 1 - male, 26 years; Patient 2 - male, 44 years; Patient 3 - female, 22 years; Patient 4 - male, 61 years; Patient 5 - male, 62 years; Patient 6 - male, 52 years; Patient 7 - male, 48 years; Patient 8 - female, 51 years; Patient 9 - female, 50 years; Patient 10 - female, 53 years; Patient 11 - male, 50 years; Patient 12 - male, 36 years. The full description of population characteristics (age at diagnosis, antiepileptic drugs, previous resection) are included in the cited article Cook et al., Lancet Neurology, 2013.
Recruitment	The study was done at three clinical centres in Australia — Austin Health, the Royal Melbourne Hospital, and St Vincent's Hospital, all of which are part of the Melbourne University Epilepsy Group. Patients were recruited between March 24, 2010, and June 21, 2011. Enrolment dates were broadly defined prospectively to provide reasonable enrolment windows. Patients were selected mainly on the basis of suitable seizure frequency (between 2 and 12 seizures per month); patients were adults who had a level of independence sufficient to make the monitoring device useful in the management of daily activities. Complete lists of inclusion and exclusion criteria are in the appendix of the article by Cook et al., Lancet Neurology, 2013.