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Reporting Summary

Nature Research wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Research policies, see our Editorial Policies and the Editorial Policy Checklist.

Statistics

For all statistical analyses, confirm that the following items are present in the 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
☐	☒ A statement on 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 statistical parameters 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

Our web collection on statistics for biologists contains articles on many of the points above.

Software and code

Policy information about availability of computer code

Data collection	Recordings were conducted using the Intan RHD2000 interface board, and visualized using Neurosuite software. Glucose measurements were made with the Medtronic iPro2 and uploaded using their proprietary software into a CSV format for analysis. Once collected, all data was analyzed with custom MATLAB software that is freely available.
Data analysis	All analysis was conducted in MATLAB and is freely available (https://github.com/buzsakilab/buzcode). Specific code for glucose data handling and some analyses will be uploaded in a separate repository that will be specific to this manuscript (https://github.com/DavidTingley/papers).

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 and reviewers. 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

All data is currently accessible and most code are currently available (data: https://buzsakilab.com/wp/database/ and code: https://github.com/buzsakilab/buzcode).

Field-specific reporting

Please select the one below that is 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/documents/nr-reporting-summary-flat.pdf

Life sciences study design

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

Sample size	We did not make an a priori calculation of sample size. We chose to use at least 6 animals per cohort for the study. The rationale for this was that it would allow for examination of individual variability and be a large enough cohort to assess population averages. Typical cohort sizes for many papers which examine sharp wave-ripples is on the order of 3-4 animals. Foster and Wilson 2006; Grosmark and Buzsaki 2016;
Data exclusions	No animals were excluded from analysis. For the optogenetic stimulation cohort of animals, the light intensity calibration period (typically day 1) was excluded from further analysis. During this time the light intensity was steadily increased (typically ~10 100-millisecond pulses) until reliable ripples of a similar magnitude to naturally occuring ripples could be induced. Once this value was determined, the animals were allowed to rest until the following day, when the stimulation protocol was started and all data thereafter was included.
Replication	All attempts to replicate the initial finding that sharp wave-ripples negatively correlate with future glucose concentration decreases have succeeded (N = 30). Two of the animals in the optogenetic ripple induction cohort did not have significant correlations between stimulation rate and glucose changes (6/8 were significant). These animals also had technical issues in that one of the two optrode devices (one in each hemisphere) was unable to induce reliable ripples due to incorrect positioning and insufficient range on the microdrive. We had implanted the optrode too far from CA1 and the microdrive did not have sufficient range to reach CA1 after surgery. We chose not to exclude these animals as the population level analyses were not drastically changed.
Randomization	Rather than cross-subject control groups, we used a within subject circular shuffle to generate a null hypothesis (Figure 4D and 6D; grey bounds). Thus the same variability and autocorrelation structure present in each signal is preserved in our null distributions.
Blinding	Blinding was not used in the present study, except for the subjective assessment of transfection location (Extended Data Figure 10).

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☐	☒ Animals and other organisms
☒	☐ Human research participants
☒	☐ Clinical data
☒	☐ Dual use research of concern

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	adult Male and Female Long Evans rats (N = 45). Age 4-10 months.
Wild animals	No wild animals were used
Field-collected samples	No field-collected samples were used.
Ethics oversight	Institutional Animal Care and Use Committee at New York University Medical Center.

Note that full information on the approval of the study protocol must also be provided in the manuscript.