

Reporting Summary

Nature Portfolio 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 Portfolio 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 Serial EM 3.7.4, Amber ver.16, NAMD 2.12b1 for Linux-x86_64-MPI, VMD for LINUXAMD64 version 1.9.3, jClamp

Data analysis RELION3.0, PHENIX-1.14-3260, COOT-0.9.6, Cuemol 2.2.3.443, Prism 8, UCSF Chimera (version 1.14), cpptraj (AmberTools16), jClamp

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 Portfolio [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 description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our [policy](#)

Cryo-EM density maps of thermostabilized human prestin have been deposited in the Electron Microscopy Data Bank under the accession codes EMD-31757 (chloride-bound), 31758 (sulfate-bound) and 31759 (salicylate-bound). Atomic coordinates have been deposited in the Protein Data Bank under IDs 7V73 (chloride-bound), 7V74 (sulfate-bound) and 7V75 (salicylate-bound).

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](https://www.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	For whole-cell NLC recording, $n \geq 3$ is sufficient for our primary purpose to assess the presence of NLC.
Data exclusions	In NLC data analysis, noisy data collected from cells with low membrane resistance ($R_m < 150 \text{ M}\Omega$) were excluded.
Replication	In NLC recording, reproducible heterologous expression of the prestin constructs in HEK293T cells was always confirmed visually using a fluorescence microscope prior to whole-cell recording.
Randomization	Not relevant for highly objective/quantitative NLC recording.
Blinding	Not relevant for highly objective/quantitative NLC recording.

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

Eukaryotic cell lines

Policy information about [cell lines](#)

Cell line source(s)	HEK293S GnTI- (N-acetylglucosaminyl-transferase I-negative) cells used for structural analysis were purchased from ATCC. HEK293T cells used for NLC measurement were purchased from ATCC.
Authentication	The cell lines listed above were not authenticated after purchased from ATCC.
Mycoplasma contamination	The cell lines listed above were not tested for mycoplasma contamination after purchased from ATCC.
Commonly misidentified lines (See ICLAC register)	Commonly misidentified cell lines were not used in this study.

Animals and other organisms

Policy information about [studies involving animals](#); [ARRIVE guidelines](#) recommended for reporting animal research

Laboratory animals	Wild-type FVB/NJ mice of both sexes were used.
Wild animals	Wild animals were not used in this study.
Field-collected samples	This study did not use samples collected from the field.

Ethics oversight

For the use of FVB/NJ mice, care and use of the animals were approved by the National Institutes of Health and the Animal Care and Use Committee at Northwestern University.

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