

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 [Authors & Referees](#) and the [Editorial Policy Checklist](#).

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

TMHMM Server V2.0
Thermo Xcalibur 2.2 SP1.48
Bruker Daltonics Flexanalysis 3.3
Bruker TopSpin
Waters MassLynx v4.2

Data analysis

Thermo Xcalibur 2.2 SP1.48
Bruker Daltonics Flexanalysis 3.3
ACD/NMR Processor Academic Edition 12.01
MestReNova 9.0.1-13254
Waters MassLynx v4.2

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

Except for the data included in this published article, all the other data generated or analyzed during this study are available from the corresponding authors upon reasonable 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](https://www.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	Sample sizes were determined by literature precedence.
Data exclusions	No data excluded.
Replication	Except for the protein expression, all experiments were replicated for 3 copies. All attempts at replication were successful.
Randomization	Bacteria cells used for these experiments were grown under identical conditions, so randomization was not used.
Blinding	Bacteria cells used for these experiments were grown under identical conditions, so blinding was not used.

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

Unique biological materials

Policy information about [availability of materials](#)

Obtaining unique materials Initial expressing plasmid (pET28a) used in this study can be bought from Invitrogen. Other materials are available upon request.

Antibodies

Antibodies used	Anti-bodies were used for western blotting analysis: Anti-His, mouse mAB, code #HT501, Transgene (http://www.transgen.com.cn/attached/down/HT501-02_2018010215.pdf), Lot # L21129, 1:2000 dilution; Goat anti-mouse IgG, HRP, code #HS201-01, Transgene (http://www.transgen.com.cn/attached/down/HS201-01_2018010216.pdf), Lot #M10523, 1:5000 dilution.
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Anti-His, mouse mAB: validated for western blotting by manufacturer (blotting against His-Alg1, His-Trx-Alg2, His-Alg11, His-Mistic-Alg3, His-Mistic-Alg9, His-Alg12 in membrane fractions of E.coli).