

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
<i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i> |
| ☐ | ☒ 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
<i>Give P values as exact values whenever suitable.</i> |
| ☒ | ☐ 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 | All the behavioral tasks were administered using PsychoPy (version: 2020.2.10; https://www.psychopy.org/); EEG data were recorded using the amplifier from the eego system (ANT neuro, Netherlands, https://www.ant-neuro.com). |
| Data analysis | Matlab (2019b); FieldTrip (20191206); EEGLAB (eeglab2021.1); Yet Another Spindle Algorithm (YASA, https://raphaelvallat.com/yasa/build/html/index.html) |

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](#)

All preprocessed data necessary to evaluate the main conclusions of this study are available in the Open Science Framework (OSF): <https://osf.io/4e7bx/>.

Research involving human participants, their data, or biological material

Policy information about studies with [human participants or human data](#). See also policy information about [sex, gender \(identity/presentation\), and sexual orientation](#) and [race, ethnicity and racism](#).

Reporting on sex and gender	A total of 35 participants (26 females; mean age $\pm$ SD: 22 $\pm$ 2.79 years) were included in the analysis.
Reporting on race, ethnicity, or other socially relevant groupings	All participants were native Chinese speakers.
Population characteristics	Prior to participation, all participants underwent pre-screening for sleep quality using the Pittsburgh Sleep Quality Index (PSQI) and the Insomnia Severity Index (ISI), ensuring overall good sleep quality. They had not taken any sleep-aid medicines in the past month prior to the experiment. All participants were not diagnosed with any neurological or psychiatric disorders and had normal or corrected-to-normal vision.
Recruitment	Participants were recruited from a local university via mass emails and additional online platforms.
Ethics oversight	The study was approved by the Research Ethics Committee of the University of Hong Kong. All participants gave written informed consent prior to participation.

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

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	The sample size was 35 participants.
Data exclusions	Two additional participants who exhibited significant body movements during pre-sleep learning/ post-sleep mental retrieval sessions were excluded during initial data visual inspection and screening.
Replication	The study employed a within-subject experimental design, with each participant contributing data across all conditions, providing internal replication at the individual level. Reported effects were consistently observed across participants and confirmed as robust by both within-subject and cross-subject statistical tests.
Randomization	All participants went through all experimental conditions. Memory cues and pictures were randomly paired for each participant and presented in a randomized order.
Blinding	All participants were blinded to the experimental purpose related to memory transformation throughout the entire experiment.

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
☒	☐ Clinical data
☒	☐ Dual use research of concern
☒	☐ Plants

Methods

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

Plants

Seed stocks

N.A.

Novel plant genotypes

N.A.

Authentication

N.A.