

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
<input type="checkbox"/>	<input checked="" type="checkbox"/> The exact sample size ( <i>n</i> ) for each experimental group/condition, given as a discrete number and unit of measurement
<input type="checkbox"/>	<input checked="" type="checkbox"/> A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
<input type="checkbox"/>	<input checked="" type="checkbox"/> 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>
<input checked="" type="checkbox"/>	<input type="checkbox"/> A description of all covariates tested
<input type="checkbox"/>	<input checked="" type="checkbox"/> A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
<input type="checkbox"/>	<input checked="" type="checkbox"/> 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)
<input checked="" type="checkbox"/>	<input type="checkbox"/> For null hypothesis testing, the test statistic (e.g. <i>F</i> , <i>t</i> , <i>r</i> ) with confidence intervals, effect sizes, degrees of freedom and <i>P</i> value noted <i>Give P values as exact values whenever suitable.</i>
<input checked="" type="checkbox"/>	<input type="checkbox"/> For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
<input checked="" type="checkbox"/>	<input type="checkbox"/> For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
<input checked="" type="checkbox"/>	<input type="checkbox"/> Estimates of effect sizes (e.g. Cohen's <i>d</i> , Pearson's <i>r</i> ), 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	Histological data were drawn on a computerised microscope with the software Neurolucida (Microbrightfield Ltd). Neurophysiological data were acquired using a combination of a Blackrock recording system and a custom suite of Matlab (Mathworks) based programmes (MET) which run the behavioural task, displayed the stimuli (based on Psychtoolbox 3.0.14) and integrated the eye traces (collected with an SMI Primate Eyetracker).
Data analysis	Histological analysis of cell density was carried out in Matlab (Mathworks) as described in Figure 1F. Spike sorting was carried out with Blackrock Offline Spike Sorted (BOSS) (Blackrock Microsystems LLC, USA). All further neurophysiological data analysis in Matlab (Mathworks).

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](#)

For our type of data, there are no standardised formats and repositories. We will make the data available on request with guidance on the formats and additional information (e.g. stimuli; eye traces) to allow proper usage. The histological cell positions and boundaries are stored in a large number of individual text files - we will make these available on request in .xcel files. The neurophysiological, spike sorted data are available as Matlab arrays with spike counts for the different trials, sorted by animal, neuron, experiment and stimulus.

In the Supplementary Data, we provide the numerical source data for the graphs.

## 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 We do not include human data. We fully report the sex of the animals used. See specific section below.

Reporting on race, ethnicity, or other socially relevant groupings We do not include human data.

Population characteristics See above.

Recruitment See above.

Ethics oversight See above.

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](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 The sample size was determined based on previous experience with non-human primate studies and the expected effect size. For the histological studies, we used 6 animals, 3 per injection site. Since the results were clear and broadly comparable for each injection site, we did not carry out any more.  
We used two animals for the neurophysiological studies carrying out multiple recordings with acute penetration in each of these.

Data exclusions For the histological data, all brains with a valid injection into LIP were included.  
For the neurophysiological data, we included all neurons with a completed experiment. Statistical exclusions for tuning criteria etc. are fully described in the paper

Replication The neuroanatomical results for each injection site were replicated in 1-2 additional individuals. All replications are shown.  
We completed neurophysiological recordings from 111 LIP neurons across two monkeys, which passed spike-sorting offline.

Randomization We randomly interleaved the probed visual field positions, saccade target location or visual stimulus condition in each block for the neurophysiological recordings.

Blinding As the injection site is visible in the histological analysis, blinding is not possible. We drew only clearly filled cell bodies and criteria were double checked by a 2nd experimenter.  
The neurophysiological analysis of response properties is automatised in Matlab.

## 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
<input type="checkbox"/>	<input checked="" type="checkbox"/> Antibodies
<input checked="" type="checkbox"/>	<input type="checkbox"/> Eukaryotic cell lines
<input checked="" type="checkbox"/>	<input type="checkbox"/> Palaeontology and archaeology
<input type="checkbox"/>	<input checked="" type="checkbox"/> Animals and other organisms
<input checked="" type="checkbox"/>	<input type="checkbox"/> Clinical data
<input checked="" type="checkbox"/>	<input type="checkbox"/> Dual use research of concern
<input checked="" type="checkbox"/>	<input type="checkbox"/> Plants

## Methods

n/a	Involved in the study
<input checked="" type="checkbox"/>	<input type="checkbox"/> ChIP-seq
<input checked="" type="checkbox"/>	<input type="checkbox"/> Flow cytometry
<input checked="" type="checkbox"/>	<input type="checkbox"/> MRI-based neuroimaging

## Antibodies

Antibodies used

For the histological analysis, we used standard, commercially available primary antibody against cholera toxin b subunit (List Biological laboratories) diluted 1:9000 for sections stained for CTb or rabbit anti-fluorogold (Fluorochrome LCC) diluted 1:1000 for sections stained for FG. This was followed with the standard, commercially available secondary antibody anti-goat or anti-rabbit IgG Biotin (Sigma) diluted 1:400 or 1:300.

Validation

<https://listlabs.com/product/buy-anti-cholera-toxin-b-subunit-goat/>  
<https://fluorochrome.com/antibodies/>

## Animals and other research organisms

Policy information about [studies involving animals](#); [ARRIVE guidelines](#) recommended for reporting animal research, and [Sex and Gender in Research](#)

Laboratory animals

Rhesus macaques (macaca mulatta)

Wild animals

This study did not involve wild animals.

Reporting on sex

We report the sex of the macaques monkeys in this study. The histology involved two male and four female monkeys, the neurophysiological study was carried out in two males.

Field-collected samples

This study did not involved field-collected samples.

Ethics oversight

All animals procedures were approved by the United Kingdom Home Office Licences and conformed to the European Communities Council Directives in force at the time.

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

## Plants

Seed stocks

This study does not involve plants.

Novel plant genotypes

See above.

Authentication

See above.