nature portfolio

Corresponding author(s): Raunak Sinha

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# 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<br>*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<br>*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 | Data was acquired at 10–kHz using a Multiclamp 700B amplifier (Molecular Devices), Bessel filtered at 3–kHz (900–CT, Frequency Devices), digitized using an NiDaq 6343 analog-digital board (National Instruments) and acquired using the Symphony acquisition software package (http://symphony-das.github.io). |
| Data analysis | Data was analysed using Matlab (Mathworks) and Igor Pro (Wavemetrics Inc) softwares. |

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

The data that support the findings of this study are available from the corresponding author upon request.

## 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 | n/a |
| Reporting on race, ethnicity, or other socially relevant groupings | n/a |
| Population characteristics | *Describe the covariate-relevant population characteristics of the human research participants (e.g. age, genotypic information, past and current diagnosis and treatment categories). If you filled out the behavioural & social sciences study design questions and have nothing to add here, write "See above."* |
| Recruitment | *Describe how participants were recruited. Outline any potential self-selection bias or other biases that may be present and how these are likely to impact results.* |
| Ethics oversight | *Identify the organization(s) that approved the study protocol.* |

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 | We have performed a power analysis (using https://www.bu.edu/researchsupport/compliance/animal-care/working-with-animals/research/sample-size-calculations-iacuc/) with an expected d=2 and will require a sample size of 5-10 cells per experimental condition for a 90% chance of detecting a significant difference by an unpaired t-test. We will generate our dataset of 5-10 cells using 3 animals per experimental condition. Each experimental condition here refers to a different retina location and recording from two cone photoreceptor types in the retina across a range of stimuli. We strive to use as few as animals as possible to gain statistical significance for our experiments as determined by power analysis. |
| Data exclusions | Data exclusions is based on cell sensitivity to light. We retained data only from cones with responses to bright flash that exceeded 8 mV. This was necessary to relate our results to what may be the case in vivo. This cell selection criterion is mentioned in the methods. |
| Replication | Our results are consistent with previous data. For eg. the slower cone responses in fovea and periphery is highly reproducible and consistent with previously published results and data. We also have used an exhaustive dataset in this study to ensure we can reproduce our results across multiple retinas from different animals.<br>The primate blue (S) cone data in Figure 6A-C and Supplemental Fig 6 in the revised manuscript utilize our previously published dataset in Baudin et al, eLife 2018. We have used this published data to perform a different and completely new analysis of adaptation and found novel differences in adaptation between primate blue vs red and green cones. We have mentioned this explicitly in the text. This doesn't constitute dual publication as the analysis is new and the results are different. We feel this is a great use of published primate data which prevented us to waste precious animal (non-human primate) resources. |
| Randomization | Tissue (retina) collection from animals and recordings from each location were random. |
| Blinding | This was difficult to achieve during data collection since it is important to mark the precise location of the retina we collect data from. However, during data analysis we have validated the results from the two locations (fovea and periphery) by blinding the data. |

# 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 |

# 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 | Macaca Fascicularis, Macaca Nemestrina, Macaca Mulatta ; age 2-20 yrs. |
| Wild animals | the study did not involve wild animals |
| Reporting on sex | data collected from either sex. |
| Field-collected samples | n/a |
| Ethics oversight | IUCAC |

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