

## 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](#).

Please do not complete any field with "not applicable" or n/a. Refer to the help text for what text to use if an item is not relevant to your study. For final submission: please carefully check your responses for accuracy; you will not be able to make changes later.

### 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
- Data analysis

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](#)

Cytokine multiplexing data were archived on ImmPort (<https://import.niaid.nih.gov/home>) under accession number SDY2394. All other datasets generated are available from the corresponding author upon reasonable 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  | <input type="text"/>   |
| Reporting on race, ethnicity, or other socially relevant groupings | <input type="text"/>   |
| Population characteristics   | <input type="text"/>   |
| Recruitment  | Peripheral blood samples from healthy study participants (n = 5; 26–45 years old) was collected after written informed consent was obtained in accordance with the Declaration of Helsinki and as approved by the Ethics Committee of Boston Children's Hospital (BCH) |
| Ethics oversight   | protocol number X07-05-0223)   |

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     | 5    |
| Data exclusions | None |
| Replication     | N/A  |
| Randomization   | N/A  |
| Blinding        | N/A  |

## Behavioural & social sciences study design

All studies must disclose on these points even when the disclosure is negative.

|                   |                      |
|-------------------|----------------------|
| Study description | <input type="text"/> |
| Research sample   | <input type="text"/> |
| Sampling strategy | <input type="text"/> |
| Data collection   | <input type="text"/> |
| Timing            | <input type="text"/> |
| Data exclusions   | <input type="text"/> |
| Non-participation | <input type="text"/> |
| Randomization     | <input type="text"/> |

# Ecological, evolutionary & environmental sciences study design

All studies must disclose on these points even when the disclosure is negative.

|                          |                      |
|--------------------------|----------------------|
| Study description        | <input type="text"/> |
| Research sample          | <input type="text"/> |
| Sampling strategy        | <input type="text"/> |
| Data collection          | <input type="text"/> |
| Timing and spatial scale | <input type="text"/> |
| Data exclusions          | <input type="text"/> |
| Reproducibility          | <input type="text"/> |
| Randomization            | <input type="text"/> |
| Blinding                 | <input type="text"/> |

Did the study involve field work?  Yes  No

## Field work, collection and transport

|                        |                      |
|------------------------|----------------------|
| Field conditions       | <input type="text"/> |
| Location               | <input type="text"/> |
| Access & import/export | <input type="text"/> |
| Disturbance            | <input type="text"/> |

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

### Methods

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

## Antibodies

|                 |  |
|-----------------|--|
| Antibodies used | <input type="text" value="anti-CD14-PE (Clone M5E2, catalog (cat# 557154), anti-CD56-PerCP-Cy5.5 (Clone B159, cat# 560842), anti-CD20-PE-Cy7 (Clone L27, cat# 335793), anti-CD86-AF700 (Clone 2331, cat# 561124), anti-CD197-PE-Cy7 (Clone 3D12, cat# 557648), anti-CD4-V450 (Clone RPA-T4, cat# 560345), anti-CD8-V450 (Clone RPA-T8, cat# 561426), anti-CD134-PE (Clone L106, cat# 340420), anti-CD154-APC (Clone 89-76, cat# 648887), anti-CD25-FITC (Clone M-A251, cat# 555431), anti-CD16-FITC (Clone B73.1, cat# 561308), anti-CD40-FITC (Clone 5C3, cat# 555588) (BD Biosciences, East Rutherford, NJ), anti-CD3e-AF647 (Clone UCHT1) (Invitrogen, Waltham, MA), anti-CD123-APC-eFluor780 (Clone 6H6, cat# 47-1239-42) (eBioscience, San Diego, CA), anti-CD1c-PB (Clone L161, cat# 331508), and anti-HLA-DR-BV605 (Clone L243, cat# 307639) (Biolegend, San Diego, CA)."/> |
| Validation      | <input type="text"/>   |

## Eukaryotic cell lines

Policy information about [cell lines and Sex and Gender in Research](#)

|  |                      |
|--|----------------------|
| Cell line source(s)  | <input type="text"/> |
| Authentication   | <input type="text"/> |
| Mycoplasma contamination   | <input type="text"/> |
| Commonly misidentified lines<br>(See <a href="#">ICLAC</a> register) | <input type="text"/> |

## Palaeontology and Archaeology

|   |                      |
|---|----------------------|
| Specimen provenance   | <input type="text"/> |
| Specimen deposition   | <input type="text"/> |
| Dating methods  | <input type="text"/> |
| <input type="checkbox"/> Tick this box to confirm that the raw and calibrated dates are available in the paper or in Supplementary Information. |                      |
| Ethics oversight  | <input type="text"/> |

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

## 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      | <input type="text" value="C57BL/6J mice"/>   |
| Wild animals            | <input type="text"/>   |
| Reporting on sex        | <input type="text" value="Female"/>  |
| Field-collected samples | <input type="text"/>   |
| Ethics oversight        | <input type="text" value="All animal studies complied with all relevant ethical regulations for animal testing and research set by the Swiss Federal Law on the Protection of the Animals, and the Association for the Assessment and Accreditation of Laboratory Animal Care International (AAALAC) and have received ethical approval from the animal care and use committee (IACUC) regulatory committee at Boston Children's Hospital (protocol number 00001573)."/> |

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

## Clinical data

Policy information about [clinical studies](#)

All manuscripts should comply with the ICMJE [guidelines for publication of clinical research](#) and a completed [CONSORT checklist](#) must be included with all submissions.

|                             |                      |
|-----------------------------|----------------------|
| Clinical trial registration | <input type="text"/> |
| Study protocol              | <input type="text"/> |
| Data collection             | <input type="text"/> |
| Outcomes                    | <input type="text"/> |

## Dual use research of concern

Policy information about [dual use research of concern](#)

### Hazards

Could the accidental, deliberate or reckless misuse of agents or technologies generated in the work, or the application of information presented in the manuscript, pose a threat to:

- |                                     |                          |                            |
|-------------------------------------|--------------------------|----------------------------|
| No                                  | Yes                      |                            |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Public health              |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | National security          |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Crops and/or livestock     |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Ecosystems                 |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Any other significant area |

## Experiments of concern

Does the work involve any of these experiments of concern:

- |                                     |                          |   |
|-------------------------------------|--------------------------|---|
| No                                  | Yes                      |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Demonstrate how to render a vaccine ineffective                             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Confer resistance to therapeutically useful antibiotics or antiviral agents |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Enhance the virulence of a pathogen or render a nonpathogen virulent        |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Increase transmissibility of a pathogen                                     |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Alter the host range of a pathogen  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Enable evasion of diagnostic/detection modalities                           |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Enable the weaponization of a biological agent or toxin                     |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Any other potentially harmful combination of experiments and agents         |

## Plants

|                       |                      |
|-----------------------|----------------------|
| Seed stocks           | <input type="text"/> |
| Novel plant genotypes | <input type="text"/> |
| Authentication        | <input type="text"/> |

## ChIP-seq

### Data deposition

- Confirm that both raw and final processed data have been deposited in a public database such as [GEO](#).
- Confirm that you have deposited or provided access to graph files (e.g. BED files) for the called peaks.

|  |                      |
|--|----------------------|
| Data access links<br><i>May remain private before publication.</i> | <input type="text"/> |
| Files in database submission                                       | <input type="text"/> |
| Genome browser session<br>(e.g. <a href="#">UCSC</a> )             | <input type="text"/> |

### Methodology

|                         |                      |
|-------------------------|----------------------|
| Replicates              | <input type="text"/> |
| Sequencing depth        | <input type="text"/> |
| Antibodies              | <input type="text"/> |
| Peak calling parameters | <input type="text"/> |
| Data quality            | <input type="text"/> |
| Software                | <input type="text"/> |

## Flow Cytometry

### Plots

Confirm that:

- The axis labels state the marker and fluorochrome used (e.g. CD4-FITC).
- The axis scales are clearly visible. Include numbers along axes only for bottom left plot of group (a 'group' is an analysis of identical markers).
- All plots are contour plots with outliers or pseudocolor plots.
- A numerical value for number of cells or percentage (with statistics) is provided.

### Methodology

|                           |   |
|---------------------------|---|
| Sample preparation        | Provided in the Methods                       |
| Instrument                | LSRFortessa flow cytometer (Becton Dickinson) |
| Software                  | Flowjo  |
| Cell population abundance | Provided as Supplementary Figures             |
| Gating strategy           | Provided as Supplementary Figures             |

Tick this box to confirm that a figure exemplifying the gating strategy is provided in the Supplementary Information.

## Magnetic resonance imaging

### Experimental design

|                                 |   |
|---------------------------------|---|
| Design type                     |   |
| Design specifications           |   |
| Behavioral performance measures |   |
| Imaging type(s)                 |   |
| Field strength                  |   |
| Sequence & imaging parameters   |   |
| Area of acquisition             |   |
| Diffusion MRI                   | <input type="checkbox"/> Used <input type="checkbox"/> Not used |

### Preprocessing

|                            |  |
|----------------------------|--|
| Preprocessing software     |  |
| Normalization              |  |
| Normalization template     |  |
| Noise and artifact removal |  |
| Volume censoring           |  |

### Statistical modeling & inference

|                           |   |
|---------------------------|---|
| Model type and settings   |   |
| Effect(s) tested          |   |
| Specify type of analysis: | <input type="checkbox"/> Whole brain <input type="checkbox"/> ROI-based <input type="checkbox"/> Both |

Statistic type for inference

(See [Eklund et al. 2016](#))

Correction

## Models & analysis

n/a | Involved in the study

- Functional and/or effective connectivity  
  Graph analysis  
  Multivariate modeling or predictive analysis

Functional and/or effective connectivity

Graph analysis

Graphpad Prism, individual plots generated as described in Figure legends

Multivariate modeling and predictive analysis

