

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
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 | We used custom visible-light optical coherence tomography hardware and software to acquire the data used in this work. Retinal oxygenation data were extracted using customized Matlab code.

Data analysis | We used custom code to analyze oxygen saturation in retinal blood vessels. The step-by-step algorithm is described in great detail in the manuscript.

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 datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Human research participants

Policy information about [studies involving human research participants and Sex and Gender in Research](#).

Reporting on sex and gender	<input checked="" type="checkbox"/> We have equal gender distribution among our volunteers
Population characteristics	<input type="checkbox"/> Ages ranging from 21 to 62 years old. The median age is 33.5 years old (average 38.1 years old)
Recruitment	<input type="checkbox"/> We recruited volunteers without known ocular diseases and known systemic diseases.
Ethics oversight	<input type="checkbox"/> Research IRBs was approved by New York University and Northwestern University

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	<input type="checkbox"/> Our dataset includes 125 unique vessels from 18 volunteers. Since we present a novel method for noninvasive measurement of retinal oxygen saturation, potential uncertainties and effect sizes in the data were not known until data was acquired. However, the number of measured arteries (n = 72 total; 36 larger arteries; 36 small arteries) and veins (n = 53) were sufficiently high to differentiate statistically significant differences as detailed in the manuscript well beyond 95% confidence.
Data exclusions	<input type="checkbox"/> Vessel diameter smaller than 35 micrometers were excluded. Data was excluded according to sufficiently low coefficient of regression (R ²) or physically unreasonable sO ₂ , as described in the manuscript.
Replication	<input type="checkbox"/> The new adaptive algorithm greatly improved the repeatability of retinal oxygenation measurement. Repeated measurements of individual vessels were made when possible, as described in the manuscript. Repeated measurements were performed only at times comfortable and convenient for the volunteer.
Randomization	<input type="checkbox"/> Volunteers were randomly selected. We analyzed data from volunteers without any known adverse health conditions affecting vision. Arterial vessels were separated into large and small groups due to the statistically significant influence of diameter on oxygen saturation. We did not separate such groups for veins, since there was no statistically significant influence of diameter on oxygen saturation.
Blinding	<input type="checkbox"/> All imaged vessels from all volunteers were used without any grouping.

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 checked="" type="checkbox"/>	<input type="checkbox"/> Antibodies
<input checked="" type="checkbox"/>	<input type="checkbox"/> Eukaryotic cell lines
<input checked="" type="checkbox"/>	<input type="checkbox"/> Palaeontology and archaeology
<input checked="" type="checkbox"/>	<input 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

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