

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 (n) 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 type="checkbox"/> | <input checked="" 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 type="checkbox"/> | <input checked="" type="checkbox"/> 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> |
| <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 type="checkbox"/> | <input checked="" type="checkbox"/> 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 | Pictures from the dorsal head were converted to binary white/black images using NIH ImageJ public domain software. The density of positive pixels was used to determine the pigmentation index. The free online software, Kinovea version 0.8.15, was used to track the movement of tadpoles to determine the locomotor performance. |
| Data analysis | The statistical significance ($p < 0.05$) between treatments was determined with GraphPad Prism 9 by using multiple ANOVA followed by Bonferroni's post hoc test or t-test ($n \geq 8$; $N \geq 3$). |

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](#)

Data have been deposited in the Dryad repository site with an assigned unique digital object identifier (DOI): doi:10.5061/dryad.6q573n61f. Cloned sequences were deposited in Gene Bank with access numbers provided in Supplementary table 1

Human research participants

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

Reporting on sex and gender	N/A
Population characteristics	N/A
Recruitment	N/A
Ethics oversight	N/A

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)

Ecological, evolutionary & environmental sciences study design

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

Study description	Using <i>Xenopus laevis</i> as a model system, we study two responses in ectotherms that contribute to temperature regulation: 1) A skin coloration response where dorsal pigmentation of the tadpole is adjusted to the environmental temperature to change the light refractory conditions, and 2) A behavioural response where the locomotor performance of the organism aligns with the ambient temperature. We explore both the molecular thermosensors, and the relationship between skin colour change and the locomotor preference in response to an ethologically-relevant cold temperature (24 and 6 Celsius degrees).
Research sample	Data were collected in a laboratory using <i>Xenopus laevis</i> tadpoles at two developmental time, stage 42/43 and stage 45/46. For all experiments, sample size in each group (control or treated) was between 8 and 12 tadpoles ($n \geq 8$); The experiments were performed three times ($N=3$).
Sampling strategy	Twelve tadpoles were set in a 60 mm dish at 24 degrees for 24/48 h before exposure to cooling temperatures. Individuals with developmental malformations (e.g. twisted tails, edemas etc) were removed before data collection (skin pigmentation or locomotor performance). Thus a minimum of 8 tadpoles were analyzed.
Data collection	Data were collected by Mr. Hannan Malik and Dr. Gabriel Bertolesi. For skin pigmentation studies, pictures of the dorsal head were taken with identical conditions of light, exposure time and diaphragm aperture, and converted to binary white/black images using NIH ImageJ public domain software. Pigmentation level (arbitrary units) was automatically converted by the software. For locomotor performance, a tray containing 9-12 tadpoles set individually in 35 mm dishes were recorded for one minute, every 5 minute during a total time of 30 minutes. The free online software, Kinovea version 0.8.15, was used to track the movement (mm) of each tadpole.
Timing and spatial scale	Skin pigmentation data were obtained between November 2018 and September 2021, unless correlation with locomotor performance was required. Locomotor performance data were obtained between July 2021 and March 2022.
Data exclusions	Tadpoles showing developmental malformation (e.g. twisted tails, edemas etc) were excluded for data collection.
Reproducibility	Skin pigmentation level changes considerably between hatches, therefore a representative experiment from at least three independent experiments (hatches) is shown. Also common is variation in the locomotor performance between hatches. Importantly cooling the temperature produced the same trend in all the experiments.

Randomization

Blinding

Did the study involve field work? Yes No

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	Included in the study
<input type="checkbox"/>	<input checked="" type="checkbox"/> Antibodies
<input type="checkbox"/>	<input checked="" 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

Methods

n/a	Included 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

Validation

Eukaryotic cell lines

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

Cell line source(s)

Authentication

Mycoplasma contamination

Commonly misidentified lines (See [ICLAC](#) register)

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

Wild animals

Reporting on sex

Field-collected samples

Ethics oversight

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