

Reporting Summary

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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 (<i>n</i>) 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 <i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i>
☒	☐ 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. <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>
☒	☐ 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 <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	Python custom code (Psychopy environment) available at https://doi.org/10.5281/zenodo.13913505
Data analysis	R software , version 4.1.3 (2022-03-10) (R-studio environment) and JASP sotware (version 0.18.3.0), code available at https://doi.org/10.5281/zenodo.13913505

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](#)

All data, code, and materials used in the analysis are available through Zenodo <https://doi.org/10.5281/zenodo.13913505>

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

Neither sex nor gender was considered in the study design, thus no sex- or gender-based analysis was conducted as they were irrelevant for our hypothesis. Information about sex is reported as a general description of the sample in the manuscript, while individual gender information for all the participants is available at the online repository and in the source data file.

Reporting on race, ethnicity, or other socially relevant groupings

No socially relevant categorization variables were used in this manuscript. The only variable of interest across groups was cultural exposure to left-to-right biases, for example, left-to-right writing system.

Population characteristics

See below

Recruitment

As for Himba sample, upon arrival at each village, our first step was to seek permission from the village chief to set up our tent and experimental tables outside the village. Participants were then informed by the translator and the village chief about the opportunity to take part in an experiment. It was entirely voluntary for them to decide whether or not to participate, and we gave priority based on their arrival time. If all translators were occupied conducting experiments, the next participant would request the translator to add their name to a list. After each participant was finished with an experiment, the translator would read out the next name on the list to invite them. We excluded participants under 18 years of age or those who had visual impairments preventing them from seeing the computer screen. Apart from these criteria, we accepted all participants unconditionally.

It is important to acknowledge that certain biases may have influenced the results. Since participation was voluntary, it is reasonable to assume that those who were most curious, open-minded, or motivated by incentives were more likely to join the experiments. Some women participated while holding their babies against their chests, while some men were occupied leading goat herds during the daytime and thus were unable to participate.

Italian Adults were recruited through the social media group of the University of Trento as they responded to posts advertising the study. After getting in touch with the participant we scheduled the test session. Italian preschooler were recruited through the collaboration with "Servizio attività educative per l'infanzia della provincia di Trento". The chief of the Servizio informed the schools in the nearby of our institution of the opportunity to take part in the experiment. Then we got in contact with the teachers that gave their availability to promote the study to their class. We met with the teacher to explain the study and we asked them to the parents the informative materials. After a couple of days, we came back to the school to start testing, and only the children that returned the informed consent form signed by the parent took part in the study.

Ethics oversight

University of Trento Research Ethics Committee (for Italian children and adults' study), the ethics committee of Inserm (for Himba studies; opinion number 21-855) and University of Namibia Decentralized Ethics Committee (DEC) (Ethical Clearance Reference Number: SAHS37/23).

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

Behavioural & social sciences study design

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

Study description

The study is a behavioral study that collects quantitative data; two experiments were performed:- Display of cards on the table where objective measure for spatial disposition was recorded (Experiment 1)- Go/No-go Task where Reaction Times and Accuracy were recorded (Experiment 2)

Research sample

- 191 Himba adults, an indigenous group with an oral culture from northern Namibia, with little or no formal education, were recruited in small villages. All were monolingual native speakers of OtjiHimba, a dialect of the Otjiherero language. Data has been collected in two different missions, one in October/November 2021 (90 Himba people tested in 4 villages) and the other one year later November 2022 (101 Himba people tested in 2 other villages); it is important to mention that there is some uncertainty regarding the age of some participants, as it is culturally rare to track count of age
- 43 children (21 females; mean age = 5.1 ± 0.3 years) were included in the final sample, and they were all reported by their parents as being unable to read/write;
- 47 young adults (36 female; mean age = 21.7 ± 2.3 years), recruited through the social media group of the University of Trento, took part in the study.

We chose to investigate the above samples as representative of populations with different levels of cultural exposure, especially referred to left-to-right writing system:

- Himba are a native population with an oral culture from Northern Namibia, with limited mathematical knowledge and no formal schooling;
- Italian preschoolers have little to no exposure to formal education, especially the "Number Line" concept;
- Italian adults are strongly exposed to the left-to-right writing system.

Sampling strategy

As for the Himba sample, due to the challenges of locating participants within the Himba community, we opted for convenience sampling as our approach. We didn't perform a sample size calculation, but we had a specific timeframe and budget for fieldwork in the bush. Our main objective was to test as many participants as possible during this allocated period. Fieldwork can be unpredictable, with potential issues like generator or car malfunctions, making it difficult to determine an exact sample size in advance. Despite these uncertainties, we managed to gather a significant sample of 191 participants during both research trips, which is particularly noteworthy considering the complexities involved in collecting cross-cultural data.

A similar issue arises when working with children, as it is difficult to find lots of schools and teachers available to participate in the study. For this reason, we tested as many children as possible, contacting six different schools in the nearby of our Institution. As for the Italian sample, we tested a number that was comparable to the Italian preschooler so as to not create too many difference in the design matrix.

Please note that our work has a sample size compatible with other studies conducted on the same topic. In particular, we referenced to Pitt., et al 2021 as they also had 3 groups: an Indigenous population, Western adults, and preschoolers. Our sample sizes are comparable (or even larger) to theirs.

Data collection

To record data in the two tasks we used:

- computer software (Psychopy) to directly collect Italian adults' data and Himba data, paper and pen to collect Italian preschoolers' data. Pictures of Himba cards' disposition also were taken (Experiment 1);
- computer software (Psychopy) to record Reaction Times/Accuracy (Experiment 2)

For Himba data collection two local translators were present beside the researchers

Timing

As for Himba sample, we conducted two separate fieldwork expeditions in Namibia. In each expedition, we visited multiple villages to carry out our research. During the first fieldwork in 2021, we conducted tests in the following villages: Otuzuma in September (21, 22, 23, 24, 25, 26, 28, 29, 30), Okatutura in October (5, 6, 7), Otjirumbu in October (13, 14, 15), and Otjeme in October (18, 19, 20). In the second fieldwork expedition in 2022, we tested participants in Epembe during September (29, 30) and continued in October (1, 2, 3, 4, 5, 6), and then in Orotjitombo during October (17, 18, 19, 20). All experiments were conducted during the daytime between 9 am and 6 pm. The villages we visited were quite similar to one another and were all situated in the vicinity of Opuwo.

As for Italian preschooler we collected the data during school hours, from 1 pm to 3 pm, in June 2022 (6,7,9,10,13,15) July 2022 (13,20,21), and in November 2022 (22,23,24,25,28,29). The long break was due to the summer vacation and the difficulty to find new schools willing to collaborate.

As for Italian adults, we collected the data in November 2022 (8,9,10,11,14,15,16,17,18) during the daytime between 9 am and 6 pm.

Data exclusions

In Experiment 2 we excluded participants that responded at or below chance (62.5% accuracy), resulting in the removal of 5 Himba 2021, 6 Himba 2022, and 5 pre-schoolers.

This criterion was chosen as corresponded to the accuracy score they could have obtained by performing at chance level.

Non-participation

Two additional Italian preschoolers dropped out during the study session as they were not willing to complete the tasks.

Randomization

Participants were not allocate in experimental groups

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