

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 checked="" type="checkbox"/> | <input 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 No software was used.

Data analysis All analyses were conducted using R 4.2.2. For the data analysis packages used, please refer to Supplementary Materials.

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, analysis code, and research materials are available at https://osf.io/pmdfg/?view_only=ceb9dce2d3b2431395d3d2964546eff0.

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

We confirm and report the following information: We have used the terms sex and gender appropriately. Our experimental design and data analyses did not involve sex or gender as variables. Information on participants' sex was obtained through self-report. The raw dataset includes participants' sex information, but no data on gender were collected. To protect privacy, no data contain personally identifiable information or allow traceability to individual participants. A total of 930 participants were included in this study, of whom 475 were identified as female. We conducted sex-based analyses; however, as no significant sex differences were found, these results are not reported.

Reporting on race, ethnicity, or other socially relevant groupings

In our study, participants' race was identified as Han Chinese, and the names of their cities of residence were reported. Participants' socioeconomic status was classified as middle level based on the size of their residential cities. We confirm that these socially constructed or socially relevant categorization variables were appropriately used and described. The social information of participants was collected by the experimenters. No categorization, analysis, or discussion was conducted regarding these socially relevant variables.

Population characteristics

See above.

Recruitment

Participants were recruited in schools; all students in each class participated due to their high willingness, eliminating any potential selection bias.

Ethics oversight

The study was approved by the Ethics Committee of the Department of Psychological and Cognitive Sciences, Tsinghua University. The approved project titles are "Research on Children's Social Cognitive Development" (approval code: 201806) and "Research on the Development and Mechanisms of Prosocial Behavior" (approval code: 202126). Because we chose anonymous peer review, we placed all information that could potentially reveal the authors' identities in the "Title Page" file.

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

All data collected in this study were quantitative in nature.

Research sample

Participants were primary school children from Huaibei City in Anhui Province, eastern China (population ≈2.18 million). The city reflects a typical mid-sized urban area with an average socioeconomic status, making the sample broadly representative. The sample included 930 participants, 475 of whom were girls, ranging in age from 6 to 12 years, with an average age of 8.81 years and a standard deviation of 1.74 years.

Sampling strategy

The study adopted a convenience sampling approach, selecting two primary schools and inviting as many students as possible to participate. The sample size was determined using G*Power 3.1.

Data collection

Each child was individually tested in a quiet room at school. An experimenter presented a narrated story with train illustrations via PowerPoint. Four gender-neutral cartoon characters were printed on paper to represent group members, with the first character (from left to right) representing the participant. Children were randomly assigned to either the Self-Leader or Other-Leader condition. In the Self-Leader condition, the participant served as the leader; in the Other-Leader condition, the second character was the leader, and the participant was a group member. A red "Group Leader" badge marked the leader, and all children correctly identified the leader on their first attempt. Children then completed two tasks: the Paying Task and the Gaining Task. In the Paying Task, children heard a story about buying train tickets for a group train ride. Each member received five coins, and the train fare varied across trials (3, 4, or 5 coins). After learning the cost, participants decided how many coins each member should contribute by transferring coins to the experimenter. To avoid order effects, the 4-coin condition (which allowed both equal and unequal contributions) was always presented first, followed by the 3- and 5-coin conditions in counterbalanced order. Train colors and prices were randomized. In the Gaining Task, the group received 3, 4, or 5 rewards, and participants decided how to distribute them by placing coins in front of each character. During each session, the experimenter was present with the participant, and data were recorded on paper materials. Although the experimenter was aware of the study's purpose, they were instructed to provide the same standardized instructions to all participants.

Timing

Data for Experiment 1 were collected from November 30 to December 1, 2020; for Experiment 2, from October 21 to November 7, 2024; for Experiment 3, from April 20 to May 13, 2021; and for Experiment 4, from July 4 to July 20, 2021.

| | |
|-------------------|---|
| Data exclusions | In Experiment 1, one participant indicated that they were unable to complete the task, and their data were excluded. In Experiment 3, data from 11 participants were excluded due to incorrect responses. No other data were excluded. |
| Non-participation | This study was not longitudinal; all data were collected in a single session. In Experiment 1, one participant who reported not knowing how to complete the task was excluded, while all other participants who initially agreed to take part completed the experiment. |
| Randomization | All participants were randomly allocated to the 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 |
|-------------------------------------|--|
| <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 |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Plants |

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 |

Plants

| | |
|-----------------------|---|
| Seed stocks | Report on the source of all seed stocks or other plant material used. If applicable, state the seed stock centre and catalogue number. If plant specimens were collected from the field, describe the collection location, date and sampling procedures. |
| Novel plant genotypes | Describe the methods by which all novel plant genotypes were produced. This includes those generated by transgenic approaches, gene editing, chemical/radiation-based mutagenesis and hybridization. For transgenic lines, describe the transformation method, the number of independent lines analyzed and the generation upon which experiments were performed. For gene-edited lines, describe the editor used, the endogenous sequence targeted for editing, the targeting guide RNA sequence (if applicable) and how the editor was applied. |
| Authentication | Describe any authentication procedures for each seed stock used or novel genotype generated. Describe any experiments used to assess the effect of a mutation and, where applicable, how potential secondary effects (e.g. second site T-DNA insertions, mosaicism, off-target gene editing) were examined. |