

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

No software was used to collect data, given we make use of publicly available data from existing repositories.

Data analysis

Oracle SQL Developer (version 24.3.1) was used to query an external database. Stata 18 was used to process and clean raw data extracts, construct the weighting panels, estimate the database of mobility indices, and to compute the results of our empirical application. We have also previously run the code on Stata versions 14 and 16 and can confirm backward compatability. ArcGIS Pro (version 3.2) was used to construct shapefiles based on modifications to existing shapefile data sets. In addition to the construction of figures, these shapefiles were used to make within-polygon calculations for control variables with a geospatial component (conducted in ArcGIS Pro version 3.7). Once these control measures were computed, they were exported and subsequently imported to Stata. All main computational results and figures were computed using Stata 18 with the exception of Figure 1A-C in the main text and Figure 4A-C in the Supplementary Information, both of which were constructed in ArcGIS Pro (version 3.7).

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 used to construct the indices and perform the analysis are publicly accessible, and described in the Materials. The raw data used in this analysis are available as follows: The European Social Survey data can be downloaded from <https://ess.sikt.no/>. The surface groups data derived from daytime satellite imagery can be downloaded from <https://www.swissbase.ch/de/catalogue/studies/20253/19048/overview>. The E-OBS dataset from the EU-FP6 project UERRA (<https://www.uerra.eu/>), the Copernicus Climate Change Service, and the data providers in the ECA&D project, can be downloaded from <https://www.ecad.eu/>. For the patent data (specifically, PATSTAT version 2024a), see <https://www.epo.org/en/searching-for-patents/business/patstat> for access information. The Luxembourg Income Study can be accessed via LISSY at <https://www.lisdatacenter.org/our-data/lis-database/>, though an account is needed and a data use agreement digitally signed. EUROSTAT data can be downloaded from <https://ec.europa.eu/eurostat/databrowser/>. The shapefiles used to construct our composite shapefile are available from <https://ec.europa.eu/eurostat/web/gisco/geodata/statistical-units/territorial-units-statistics> for the European Commission – Eurostat/GISCO NUTS 0, NUTS 1, and NUTS 2 shapefile data sets, and via <https://www.arcgis.com/home/item.html?id=2b93b06dc0dc4e809d3c8db5cb96ba69> for the ESRI World Countries Generalized Map shape file data sets (data providers ESRI, Garmin International, Inc., U.S. Central Intelligence Agency (The World Factbook), and National Geographic Society). The latter of which is available via the catalog in ArcGIS Pro with a valid ArcGIS subscription. While the EUROPE-IGM-ATLAS itself, constructed as part of this project, will continue to be updated in future, a static version has been archived along with the replication package, and can be accessed via the following DOI: <https://doi.org/10.17605/OSF.IO/MQDSK>.

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

Any human data used in our study comes from an existing data set, the European Social Survey. We use 11 waves of this survey to compute regional level indicators of intergenerational educational mobility. We therefore do not report on sex and gender, though we do use self-reported gender as a control when computing the regional measures.

Reporting on race, ethnicity, or other socially relevant groupings

We do not report on race, ethnicity etc. given we compute regional level indicators that are weighted summaries of the entire region's population. We do use migration background (self-reported, first or second generation) to construct subsamples, but only to the extent we iteratively exclude migrants from the sample. We do not report statistics for migrants.

Population characteristics

See above.

Recruitment

We did not recruit participants. We make use of an existing, publicly available, representative European dataset.

Ethics oversight

The European Social Survey European Research Infrastructure Consortium Research Ethics Board provides ethical oversight to the ESS itself. We are secondary consumers of anonymized publicly released data, and do not work directly with human participants.

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)

Behavioural & social sciences study design

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

Study description

We use 11 full waves of a quantitative cross-sectional, multinational, biennial survey (European Social Survey) to construct the birth cohort-specific indices of intergenerational educational mobility. All other calculations and results use the geographic region as the unit of interest, and corresponding national or regional statistics (e.g. GVA/GDP, geographic measures).

Research sample

We use the existing cross-national harmonized European Social Survey (ESS) data set as the basis of our panel of intergenerational educational mobility indices. The ESS is a representative biennial survey established to study the attitudes, beliefs, and behavior patterns of diverse populations in Europe. The survey is conducted every two years in around 36 European countries, including both EU and non-EU members. We only use information from the Core modules, on e.g., self-reported gender, own and parental education, age, region of residency, and whether or not the individual has a migration background (used to select sub-samples). The ESS was selected for three key reasons. First, unlike national household surveys, there is not a co-residency bias associated with the

	sample (which arises when parents and their adult children are only included because they are members of the same household). Second, the ESS was designed to a harmonized cross-national representative survey, which is important when comparing countries with different educational systems. Third, the ESS is one of few European surveys that collects information about the region of the respondent, which is important given the goal was to build a sub-national panel.
Sampling strategy	The ESS is known for its rigorous methodology, and uses stratified random sampling to obtain representative samples of individuals with corresponding analytical weights that we make use of when computing the indices of mobility. We made no sampling restrictions personally, given we make use of an existing dataset. Gender is used as a control when estimating the mobility indices. It is not used to select subsamples.
Data collection	No data collection was done personally given we make use of existing data sets.
Timing	We use 11 full waves of the ESS, conducted between 2002 and 2023.
Data exclusions	We estimate the indices separately for the whole sample, for a sub-sample excluding first generation migrants, and for a sub-sample additionally excluding second generation migrants (e.g., where the parents have a migration background). These sub-sample exclusions are made because the purpose of this study is to estimate regional intergenerational educational mobility. Thus it may not make sense to include a) those educated elsewhere, or b) those with parents who were educated elsewhere.
Non-participation	The ESS is a cross-sectional survey.
Randomization	This study does not involve an experimental treatment. The ESS, which is the basis of our indices, does use stratified random sampling. Summary statistics are population representative after weighting.

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

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.