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The Social Class Test Gap: A Worldwide Investigation of the Role of Academic Anxiety and Income Inequality in Standardized Test Score Disparities

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OPEN DATA OPEN MATERIALS PREREGISTERED

We conducted three preregistered studies using the Organization for Economic Co-operation and Development Programme for International Student Assessment (PISA) data to provide a worldwide estimation of the standardized test gap between students from lower and higher social classes. We investigated: (a) the degree to which academic anxiety contributes to this gap and (b) the role of country-level income inequality in widening this gap. In Study 1, we used PISA 2003 data (250,000+ students from 41 countries) and demonstrated that anxiety accounts for approximately one-fifth of the performance gap between students with less educated parents and those with more educated parents. Unexpectedly, the social class test gap was weaker in more unequal countries than in more equal countries. In Studies 2a and 2b, we used the PISA 2012 and 2015 data (totaling over a million students from 65 countries and 72 countries, respectively) and differentiated the cultural dimension (parental education, cultural capital) and the economic dimension (economic capital) of social class. Regardless of the dimension, anxiety again accounted for between one-tenth and one-fifth of the performance gap between students from lower and higher social classes. Moreover, (a) the culturally based social class achievement gap was weaker in more unequal than in more equal countries, and (b) the economically based social class achievement gap was larger in more unequal than in more equal countries. Unexpectedly, we also find a robust association between national income inequality and academic anxiety across all three studies. Results are discussed in relation to the multidimensionality of social class and literature on the psychology of income inequality.

Educational Impact and Implications Statement

Standardized tests purport to measure of skills, achievement, or ability, in a manner uninfluenced by family background, although social class remains a robust predictor of test performance. Analyses of three Organization for Economic Co-operation and Development Programme for International Student Assessment data sets (750,000+ students from a total of 70+ countries observed in 2015, 2012, and 2003) showed that academic anxiety contributes to one-tenth and one-fifth of the social class test gap. In addition, national income inequality impacted the social class test gap, in the opposite direction for cultural and economic capitals, as well as increased students' academic anxiety. This research supports the intricate interplay between microlevel socioeconomic factors, macrolevel economic features, highlighting the need for a comprehensive approach in interventions aimed at addressing the social class test gap, including both individual processes and broader societal considerations.

Keywords: social class, income inequality, anxiety, performance, standardized test

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Standardized tests are used in most school systems across the world, shaping the future of millions of students every year (Rotberg, 2006). Proponents of standardized tests argue that they ensure fairness because they consist of impartial evaluations solely based on educational performance (Sackett & Kuncel, 2018). However, critics of these tests argue that they are not as neutral as one might think, because test scores are heavily influenced by family social class (Au, 2013). This phenomenon—called the "social class test gap"—is often attributed to structural factors such as differential access to resources (Pascarella et al., 2004), although psychological factors such as anxiety are also suspected to play a role (Easterbrook et al., 2019).

Importantly, the social class test gap varies across countries. The national average differences in standardized test scores between families in the bottom and top socioeconomic status (SES) deciles range between 1 and 2 *SD*s (Chmielewski, 2019). The exact reasons for this cross-national variation remain unclear, and in this research, we aim to investigate the role of a critical macroeconomic force in modern societies: income inequality. Specifically, we use three Organization for Economic Co-operation and Development (OECD) Programme for International Student Assessment (PISA) data sets[1] to provide a worldwide estimation of the social class test gap while focusing on two main objectives: (a) to investigate whether academic anxiety act as a key psychological factor that underlies the global social class gap, and (b) to examine whether national income inequality acts as a contextual moderator, by exacerbating social class anxiety and further widening the gap.

The Social Class Test Gap

Conceptualization of Social Class

Family social class is defined by unequal access to a combination of resources such as goods and services, influential social networks, or culturally valorized activities (Manstead, 2018). Two forms of family resources are particularly critical when it comes to predicting test performance: economic and cultural capital.

On one hand, economic capital refers to access to economic resources and is typically measured using household income and material possessions. Parents with more economic capital may invest in out-of-school education, such as one-to-one private tutoring or exam preparatory courses, which can help their child succeed in school (Zwier et al., 2020). On the other hand, cultural capital refers to access to cultural resources and is typically measured using parental education and cultural possessions. Parents with more cultural capital may transmit norms better suited to the academic environment and engage in activities valued by the education system, which can also help their child succeed in school (Chin & Phillips, 2004; Gaddis, 2013).

Economic capital and cultural capital are related yet conceptually distinct. Although both these forms of capital are conducive to children's academic success, they are associated with different psychological processes and school experiences (Cowan et al., 2012). Extant studies in the literature often operationalized social class as a combination of economic and cultural capital (Batruch et al., 2021), which makes it difficult to disentangle their relative contributions to children's academic outcomes (for related research, see Diemer et al., 2013; Kraus & Stephens, 2012). Additionally, many studies on the social class test gap do not fully capture the multidimensional aspect of family social class, and some authors have claimed that more theoretical justification is needed when operationalizing family social class (Harwell et al., 2017).

The Role of Anxiety in Accounting for the Social Class Test Gap

Standardized tests are tests administered under controlled conditions and designed to compare individuals' knowledge or skills (Berends & Boerema, 2007). Although standardized tests purport to measure of skills, achievement, or ability, in a manner uninfluenced by family background, evidence suggests otherwise. Indeed, students with wealthier or more educated parents perform better on these tests than students with poorer or less educated parents (Au, 2013), a relation that holds true after partialing out the variance accounted for by heritability (Krapohl et al., 2014), language proficiency (Goudeau et al., 2023), or academic ability (Machin & Vignoles, 2004). Herein, we ask about the role of academic anxiety in explaining this social class test gap.

Academic anxiety is a general process that refers to the anticipation of future threats related to the school experience (Cassady, 2022). Academic anxiety can take various forms (e.g., see Caviola et al., 2022) and be specific to a domain, such as mathematics (math anxiety), or specific to an object, like academic tests (test anxiety) (Zeidner, 1998). While different forms of anxiety may have different attributes, they also share a conceptual core (Hill et al., 2016). For instance, Kazelskis et al. (2000) have documented a large correlation ($r \cong .50$) between mathematics anxiety and test anxiety. Likewise, meta-analyses have revealed that both domain-specific and domain-general anxiety are negatively associated with school performance: Mathematics anxiety has a medium-sized negative effect ($\bar{r} = -.34$) on mathematics performance (Namkung et al., 2019), whereas test anxiety has a comparable-sized negative effect ($\bar{r} = -.26$) on exam performance (von der Embse et al., 2018). Generally, extant work suggests that anxiety, including academic anxiety, leads to intrusive thoughts that deplete working-memory resources available to perform on the test (for a review, see Moran, 2016) and induce attentional biases (Putwain et al., 2020). This is not only lowers academic self-concept, self-efficacy (Robson et al., 2023), but also undermines performance (for reviews, see Foley et al., 2017; Hembree, 1990).

The antecedents of academic anxiety can be located at various levels, ranging from the individual (e.g., perfectionism; Eum & Rice, 2011) to the teacher (e.g., teacher's support; Putwain et al., 2010), and extending to the broader school environment (e.g., high-stake testing; Segool et al., 2013). Herein, we focus on a particular kind of antecedent, namely family social class, and outline three different lines of research that suggests that the social class test gap can be accounted for by academic anxiety. First, according to social reproduction theory, students from lower-class families (particularly those with less cultural capital) are less familiar with the social practices and values promoted in schools (Bourdieu & Passeron, 1977). These social class differences in familiarity lead students from lower-class families to become targets of negative stereotypes regarding their competence, which threatens their self-evaluation and generates anxiety in evaluative contexts (Croizet et al., 2017, 2019).

[1] OECD and PISA stand for Organization for Economic Co-operation and Development and Programme for International Student Assessment, respectively.

Second, the selection function of school (i.e., the process through which school systems select the best students on the basis of merit) shapes teaching practices and learning experiences, which can be psychologically damaging for students from working-class or less educated families (Batruch et al., 2019; Easterbrook et al., 2019). The emphasis on selection and meritocracy negatively affects the outcomes related to anxiety in test performance for students from lower social classes, such as self-threat or fear of failure (Jury et al., 2017).

Third, educational systems tend to promote independent norms (encouraging students to develop their own needs and preferences), whereas students from lower social classes tend to construe their self as interdependent (adjusting their needs and preferences to those of other people (Stephens, Fryberg, et al., 2012). This creates a cultural mismatch between self-construal and school norms, hindering the ability of students from lower social classes to cope with academic demands and increasing negative psychological states, including anxiety (Stephens, Townsend, et al., 2012).

To our knowledge, no empirical study has tested the extent to which academic anxiety explains the relationship between social class and performance on standardized tests. Therefore, the first goal of our research is to test the following hypothesis:

Hypothesis 1a (H1a): The lower the social class, the lower the standardized test performance.

Hypothesis 1b (H1b): A relationship that is mediated by greater anxiety.

Income Inequality and the Social Class Test Gap

The Psychology of Income Inequality

Across the OECD countries, the income of the lower classes has increased modestly over the past three decades while the income of the higher classes has grown at a much faster rate, leading to historic levels of income inequality (OECD, 2019). By definition, income inequality heightens the salience of economic segmentation (i.e., the rich and the poor are further apart on the pay scale), which has long been seen as creating a social divide between classes (Wilkinson, 1999). At the psychological level, people in more economically unequal places are more likely to categorize individuals into the "haves" and the "have-nots" (Peters et al., 2022) and assign more importance to personal success and social status (Du et al., 2024). This twofold phenomenon fuels a culture of upward economic comparison, whereby people in more economically unequal places are more prone to compete against one another for status (Payne et al., 2017; Sommet et al., 2019), which can create a pervasive anxiety about one's social status (for relevant reviews, see Buttrick & Oishi, 2017; Peters & Jetten, 2023; Sommet & Elliot, 2023).

Evidence points out that individuals from lower social classes are particularly vulnerable to the detrimental effects of income inequality. Residing in places with high income inequality leads individuals facing precarious financial situations to report more negative feelings such as having the blues or suffering from anxiety (Sommet et al., 2018). Similarly, living in contexts with high income inequality reduces the ability of individuals from lower social classes to rely on their community, thereby exposing them to greater financial hardship (Jachimowicz et al., 2020). Generally speaking, income inequality is thought to strengthen the effect of social class on psychological outcomes because individuals from lower social classes perceive having insufficient resources to cope with the competition engendered by inequality and appraise inequality as an aversive threat (Sommet & Elliot, 2023).

Income Inequality in the School Environment

Importantly, the psychological effects of income inequality are not limited to adults in the economic environment, but also apply to children in the school environment. Recent research using cross-national data shows that as income inequality grows in societies, so does the pressure to obtain the best grades at school and join the highest income groups possible, leading students to perceive their classmates as competitive and to be competitive themselves (Sommet, Weissman, & Elliot, 2023). According to another study, students from disadvantaged families are particularly affected by the detrimental effects of income inequality in the school environment: When income inequality is higher, students from families with low economic, social, and cultural status are more likely to report a lower sense of school belonging (King et al., 2022), an outcome that is typically associated with less anxiety (Pikulski et al., 2020) and better academic achievement (K. Allen et al., 2018).

To the best of our knowledge, Workman (2022) is the only study that has tested whether income inequality interacts with family social class in predicting standardized test performance (for a study focused on the main effect of income inequality, see King et al., 2024; Thorson & Gearhart, 2018). The author used the National Assessment of Educational Progress data,[2] a nationally representative sample following U.S. children who took annual standardized tests in reading and math from kindergarten (ages 5–6) to fifth grade (ages 10–11). He reported that the higher the level of income inequality, the wider the social class test gap in reading, whereas he did not document any significant effect regarding math.

While informative, Workman's (2022) research is limited in four important aspects. First, the research was conducted in the U.S., meaning that the results cannot be generalized to other cultural contexts and school systems. Second, the research focuses on elementary students, despite the fact that standardized tests are more impactful in secondary school (when having gatekeeping and tracking functions). Third, the research uses a composite indicator of social class, which does not allow for distinguishing the effects of different aspects of social class. Fourth, the research only tests for school- or parent-level mediators (e.g., school poverty rate, parental educational expectations), while disregarding student-level psychological processes.

In this research, we aim to address these limitations by (a) using three large-scale international databases covering a total of nearly 80 different countries, (b) focusing on secondary school students (aged approximately 15 years), (c) relying on fine-grained social class indicators that distinguish between economic and cultural capital, and (d) testing anxiety as a psychological mediator. The second goal of our research is to test the following hypothesis:

Hypothesis 2a (H2a): The higher the income inequality, the stronger the effect of family social class on standardized test performance.

Hypothesis 2b (H2b): A relationship that is mediated by anxiety.

[2] NAEP stands for "National Assessment of Educational Progress."

Overview of the Studies

To test our hypotheses, we used the observational OECD PISA data sets. PISA is a series of triennial cross-national studies based on large, nationally representative samples of 15-year-old students. Each PISA wave includes standardized assessments of mathematics, reading, and science (usually with a focus on one particular domain), as well as a background questionnaire measuring students' psychological outcomes, such as anxiety.

In Study 1, we used the data from PISA 2003, which focused on parental education as an indicator of social class (parental education) and domain-specific measures of performance and anxiety (mathematics performance and anxiety). Our aim was to test H_1 (social class → anxiety → performance) and H_2 (Income Inequality × Social Class → anxiety → performance).

In Studies 2a–2b, we used data from PISA 2012 and 2015, which focused on both culturally based (parental education, family cultural capital) and economically based (family economic capital) indicators of social class. PISA 2012 used domain-specific measures of performance and anxiety (again, mathematics performance, and anxiety), whereas PISA 2015 used domain-general measures (mathematics, reading, and science performance and test anxiety). Our aim was (a) to replicate $H_{1–2}$, (b) to test whether the operationalization of family social class (culturally vs. economically based social class) alters the direction of findings, and (c) to generalize our findings from domain-specific to domain-general contexts.

We choose to work with PISA 2003, 2012, and 2015 because they are the only three PISA studies that assess two different forms of academic anxiety and we wanted to perform as many replications as possible. All studies were preregistered and complete materials including data and R script reproducing the findings are available on OSF (https://osf.io/92bnw/?view_only=c05a685f73b94847aed605df8c39b414).

Study 1: Parental Education, Income Inequality, and Mathematic Performance

In Study 1, we tested the following preregistered hypotheses: The lower the social class, the lower the standardized test performance (H1a);[3] the higher the income inequality, the stronger the effect of social class on mathematics performance (H2a). We also aimed to test whether a decrease in mathematics anxiety mediated the association between social class and mathematics performance (H1b), and the interaction between income inequality and social class in predicting mathematics performance (H2b) (for the preregistration, see https://osf.io/kcmab/?view_only=ca6ab4bd171240dbaf0731d96d4a53be).

Method

Participants

We used the data from PISA 2003. The sample comprised 276,165 students nested in 41 countries. Table 1 presents descriptive statistics of the sample.

Variables

Table S1 in the online supplemental materials presents correlation matrices for student-level and country-level variables.

Parental Education. We used PISA's measure of the highest number of years of education completed by either parent, which could range from 0 years (i.e., neither parent went to school) to 17 years (i.e., at least one parent holds an advanced postgraduate qualification; $M = 12.38$, $SD = 3.77$).

Mathematics Performance. We used PISA's five plausible values in mathematics performance. PISA provides several plausible values of performance rather than one single value to increase the accuracy of the measurement. These plausible values are essentially multiple imputations of the latent performance in the PISA standardized mathematics test, thereby representing a range of possible performance scores for each student (PISA, 2005). The metrics used by PISA are such that the weighted mean of the five plausible values is $M = 500$ ($SD = 100$). The intraclass correlation coefficient (ICC) is given as ICC = .243.[4]

Mathematics Anxiety. We used PISA's four-item measure of mathematics anxiety—for example, "I often worry that it will be difficult for me in mathematics classes," from 1 = *strongly agree*, to 4 = *strongly disagree*; the pooled within country Cronbach's α was $M(\alpha) = 0.76$, $SD(\alpha) = 0.06$; $M = 2.49$, $SD = 0.67$, ICC = .031.

Income Inequality. We used the Gini coefficients from The World Income Inequality (WIID; UNU-WIDER, 2021). The Gini coefficient represents the household income distribution in a country and can range from 0 (*perfect equality: every household in the country receives the same income*) to 1 (*perfect inequality: one household in the country has all the income*). As preregistered, we averaged the 2003 Gini coefficients for each country or, if the 2003 estimates were not available, the next most recent Gini coefficients (within a ±2 year-range) ($M = 0.36$, $SD = 0.07$).[5]

Results

Overview of the Multilevel Analysis Using Plausible Values

We used multilevel modeling, treating students (Level 1) as nested in 10,274 schools (Level 2) and 41 countries (Level 3). Maximum likelihood with the optimizer Bobyqa was used as the method of estimation.

Multilevel Models. We built two series of multilevel models. Our focal outcome variable was mathematics performance. In the model testing H_1, we first regressed the plausible values in mathematics performance on parental education; then, we carried out mediation analysis testing the mediating role of anxiety. In the model testing H_2, we first regressed the plausible values in mathematics performance on parental education, income inequality, and their interaction; then, we carried out moderated mediation analysis testing the mediating role of anxiety.

[3] In this and all subsequent studies, we preregistered our hypotheses with a focus on the effects of social class. For example, here we preregistered the hypothesis as follow: "Social class is a positive predictor of mathematics performance." Obviously, this slight variation in wording does not alter the nature of the expected effect.

[4] ICC should be interpreted as the degree to which students within the same country resemble each other. Its value can range from 0 (*no between-country variation*) to 1 (*no within-country variation*). Here, 24% of the variance in performance is accounted for by between-country difference.

[5] Two countries for which income inequality estimates were not available in the WIID could not be included in this analysis involving this variable (Macao and Luxembourg). The imputed median countries for each control variables are available in Table S2 in the online supplemental materials.

Table 1

Studies 1, 2a, and 2b: Description of the PISA 2003, 2012, and 2015 Samples and Variables

Variable	Study 1 PISA 2003	Study 2a PISA 2012	Study 2b PISA 2015
Student-level sample characteristics			
M_{age}	15.80 ± 0.29	15.78 ± 0.29	15.79 ± 0.29
Percent of school girls	50.26	50.48	50.11
Percent of native students	89.39	88.59	88.61
Country-level sample mean characteristics			
National population (millions)	53.16 ± 63.41	48.62 ± 60.91	68.71 ± 188.04
GDP per capita (2010 USD, thousands)	29.58 ± 20.37	29.72 ± 2.18	28.01 ± 21.57
Unemployment rate (%)	6.61 ± 4.30	8.59 ± 5.82	9.34 ± 6.86
Poverty ratio at 2011 PPP $1.90 a day (%)	0.99 ± 1.48	1.50 ± 1.79	1.43 ± 1.63
Share of GDP spent on education (%)	4.76 ± 1.12	4.84 ± 1.06	4.83 ± 1.16

Note. Country-level control variable estimates were collected from the World Bank. PISA = Programme for International Student Assessment; GDP = general domestic product; USD = U.S. dollars; PPP = purchasing power parity.

Control Variables. We tested each model while excluding or including the same preregistered set of control variables used in Sommet, Weissman, and Elliot (2023). There were three Level 1 control variables (age, sex [−0.5 = *girls*; 0.5 = *boys*], and origin [−0.5 = *nonnative*; 0.5 = *native*]) and five Level 3 control variables (total population, poverty head-count ratio, unemployment rate, general domestic product (GDP), and percentage of government expenditure on education). Missing data on student-level variables were treated using listwise deletion, whereas missing data on country-level variables were imputed using the median.

Centering Decisions. We country-mean centered social class, subtracting the country mean of social class from each response. This process meant that a negative value on the variable indicated a lower social class than the country average, whereas a positive value indicated a higher social class than the country average. This approach enabled us to obtain an unbiased estimation of the pooled within-country effect of social class, while avoiding comparisons of students from different countries (Enders & Tofighi, 2007). For instance, had we not country-mean centered the parental education measure, we would have ended up directly comparing students from Turkey (whose parents have the lowest average number of years of education; $M = 8.98$, $SD = 4.21$) with students from Norway (whose parents have the highest average number of years of education; $M = 14.58$, $SD = 2.07$), thereby biasing the analysis (Bell et al., 2018). Using the cluster-mean centering for estimating the effect of parental education had the advantage of only comparing Turkish students with other Turkish students and Swedish students with other Swedish students. We also used country-mean centering for the other continuous Level 1 predictors.

Plausible Values. To derive a single coefficient estimate and standard error term from the five plausible values for mathematics performance, we used the procedure recommended by PISA (2009) and Jerrim et al. (2017). In plain language, the procedure involved running separate multilevel models with each plausible value as the outcome, and then combining theesulting coefficient estimates (on the one hand) and standard errors (on the other hand) for each predictor of the model. Specifically, the procedure involved the following steps: (a) We ran each multilevel model using each plausible value as the outcome and generated five coefficient estimates β_{pv} and five sampling error terms σ_{pv} for each predictor; (b) we averaged the plausible value-specific coefficient estimates to obtain an average coefficient estimate β_* for each predictor (Equation 1) and used the same procedure to obtain an average sampling error term σ_* (Equation 2); and (c) we computed the estimate of the magnitude of the imputation error δ_* (Equation 3) and multiplied the sampling error term with the imputation error terms to obtain the final standard error σ_* (Equation 4). We used these estimates to calculate the confidence intervals (CIs) and derive the p values:

$$\beta_* = \left(\frac{\sum_{pv=1}^{5} \beta_{pv}}{n_{pv}} \right), \quad (1)$$

$$\sigma_* = \left(\frac{\sum_{pv=1}^{5} \sigma_{pv}}{n_{pv}} \right), \quad (2)$$

$$\delta_* = \left[\frac{\sum_{pv}^{5} (\beta_{pv} - \beta_*)^2}{n_{pv} - 1} \right], \quad (3)$$

$$\sigma_* = \left[\sqrt{\sigma_*^2 + \left(1 + \frac{1}{PV}\right) \times \delta_*^2} \right]. \quad (4)$$

Effect Size. In multilevel modeling, there are no unbiased effect size estimates available (LaHuis et al., 2014). In this and the subsequent study, to provide a sense of the magnitude of the effect, we therefore standardized all variables and reported the standardized coefficients. The standardization process entailed subtracting the grand or cluster mean from the variables and then rescaling them using the standard deviation at the appropriate level. Standardized estimates can be interpreted as pseudo effect sizes (Sommet & Morselli, 2021), with small, medium, and large effects roughly corresponding to values of .10, .17, and .24, respectively (Sommet, Weissman, Cheutin, & Elliott, 2023).

Analyses

Tables 2 and 3 present the full results and multilevel equation regression for the model excluding control variables and Tables S3 and S4 in the online supplemental materials present the same information for the model including control variables (results were identical).

H_1: Social Class and Performance. We regressed mathematics performance on parental education. Consistent with H1a, the analysis revealed that parental education was a positive predictor of mathematics

Table 2

Studies 1, 2a, and 2b, H1a: Coefficients and 95% CI From the Multilevel Regressions Testing the Effects of Social Class on Performance While Excluding Control Variables

Variable	Study 1 PISA 2003 Coef.	Study 1 PISA 2003 95% CI	Study 2a PISA 2012 Coef.	Study 2a PISA 2012 95% CI	Study 2b PISA 2015 Coef.	Study 2b PISA 2015 95% CI
Parental education						
Intercept	.03	[−.14, .19]	.01	[−.13, .15]	−.05	[−.17, .07]
Parental education	.12***	[.10, .14]	.12***	[.10, .14]	.09***	[.07, .10]
Random slope	.006		.006		.004	
Country-level residuals	.243		.257		.250	
Level 1 residuals	.478		.450		.513	
Covariance	.016		.016		.014	
Cultural capital						
Intercept			.01	[−.13, .15]	−.04	[−.16, .08]
Cultural capital			.09***	[.07, .10]	.11***	[.10, .13]
Random slope			.003		.003	
Country-level residuals			.266		.243	
Level 1 residuals			.449		.510	
Covariance			.014		.013	
Economic capital						
Intercept			.00	[−.14, .14]	.06	[−.05, .18]
Economic capital			.04***	[.03, .05]	.02***	[.01, .03]
Random slope			.002		.003	
Country-level residuals			.268		.256	
Level 1 residuals			.459		.521	
Covariance			−.001		−.001	

Note. The multilevel equation is $Y = B_{000} + (B_{100} + u_{1jk}) \times \text{SocialClass}_{ijk} + v_{00k} + u_{0jk} + e_{ijk}$, with $i = 1, 2, \ldots, N$ participants, $j = 1, 2, \ldots, K$ schools, $k = 1, 2, \ldots, L$ countries, where u_{10k} represent the variation of the effects of social class from one country to another, and v_{00k}, u_{0jk}, and e_{ijk} represent the country-level, school-level, and student-level residuals, respectively. For the regression equations with control variables, see the online supplemental materials, p. 2. Coef. represents β for the fixed effects (rows: "intercept," "parental education," "cultural capital," and "economic capital") and the variance terms for random effects (rows: "random slope," "country-level residual," "Level 1 residuals," and "slope-intercept covariance"). The random intercepts for the school level were included in the models but are not reported in the table. They range between .226 and .258. Table S5 in the online supplemental materials presents the fit indices (AIC, BIC, −2loglik). CI = confidence interval; PISA = Programme for International Student Assessment; Coef. = Coefficient; AIC = Akaike information criterion; BIC = Bayesian information criterion; −2loglik = −2log likelihood.
*** $p < .001$.

performance: The higher the parental education, the higher the mathematics performance, β = .12 [.10, .14],[6] $p < .001$.

Then, we examined the role of mathematics anxiety in accounting for this association. Consistent with H1b, the analysis revealed a parental education → mathematics anxiety → mathematics performance mediation in the expected direction: Parental education was negatively associated with mathematics anxiety, β = −.09 [−.11, −.07], $p < .001$, which accounted for 17%[7] of the positive association between parental education and mathematics performance, indirect effect = .02 [.02, .03], $p < .001$ (Figure 1, upper panel).

H_2: Income Inequality, Social Class, and Performance. We regressed mathematics performance on parental education, income inequality, and the interaction. Inconsistent with H2a, the analysis revealed that the higher the income inequality, the weaker the social class test gap in mathematics, β = −.04 [−.06, −.02], $p < .01$ (Figure 2, upper left panel). Simple slope analysis revealed that in more unequal countries (+1 *SD*), the social class test gap was weaker, β = .08 [.04, .11], $p < .001$, than in less unequal countries (−1 *SD*), β = .15 [.11, .18], $p < .001$.

Then, we regressed mathematics performance on anxiety, parental education, income inequality, and the interaction between parental education and income inequality. Inconsistent with H2b, the analysis revealed a Parental Education × Income Inequality → mathematics anxiety → mathematics performance moderated mediation in the opposite direction of that expected: The higher the income inequality, the weaker the effect of parental education on anxiety, β = .03 [.01, .04], $p = .005$, which accounted for 53% of the parental education × income inequality interaction in predicting mathematics performance, $Z = 2.66$, $p = .007$. Unexpectedly, supplementary analyses also revealed that income inequality was positively associated with mathematics anxiety, β = .20 [.13, .27], $p < .001$ (Figure 3, upper left panel).

Discussion

Study 1 revealed two basic sets of findings. First, consistent with H1a, social class was positively associated with mathematics performance, and consistent with H1b, mathematics anxiety partially

[6] Brackets indicate 95% CIs.

[7] The percentage represents the proportion of the social class test gap attributable to anxiety, calculated using the Sobel–Goodman tests. It is determined by the ratio between the standardized coefficients of the c and c' paths in the analysis and is computed as follows (Wang & Wang, 2015): $1 - \beta_{c'}/\beta_c \times 100$.

Table 3

Studies 1, 2a, and 2b, H2a: Coefficients and 95% CI From the Multilevel Regressions Testing the Effects of Parental Education on Performance as Moderated by Income Inequality While Excluding Control Variables

	Study 1 PISA 2003		Study 2a PISA 2012		Study 2b PISA 2015	
Variable	Coef.	95% CI	Coef.	95% CI	Coef.	95% CI
Intercept	−.04	[−.19, .12]	−.06	[−.20, .08]	−.06	[−.18, .6]
Parental education	.12***	[.10, .14]	.12***	[.10, .14]	.09***	[.07, .11]
Income inequality	−.25***	[−.40, −.09]	−.12	[−.26, .02]	−.11	[−.23, .02]
Parental Education × Income Inequality	−.04**	[−.06, −.01]	−.01	[−.03, .01]	−.02**	[−.03, −.00]
Random slope	.005		.005		.003	
Country-level residuals	.191		.230		.214	
Level 1 residuals	.478		.446		.514	
Covariance	.009		.015		.010	

Note. The multilevel equation is $Y = B_{000} + (B_{100} + u_{1jk}) \times \text{ParentalEducation}_{ijk} + B_{001} \times \text{Gini}_{ijk} + B_{101} \times \text{ParentalEducation}_{ijk} \times \text{Gini}_{ijk} + v_{00k} + u_{0jk} + e_{ijk}$, with $i = 1, 2, \ldots, N$ participants, $j = 1, 2, \ldots, K$ schools, $k = 1, 2, \ldots, L$ countries, where u_{10k} represent the variation of the effects of parental education from one country to another and v_{00k}, u_{0jk}, and e_{ijk} represent the country-level, school-level, and student-level residuals. Coef." represents β for the fixed effects (rows: "intercept," "parental education," "income inequality," and " Parental Education × Income Inequality") and the variance terms for random effects (rows: "random slope," "country-level residual," "Level 1 residuals," and "slope-intercept covariance"). The random intercepts for the school level were included in the models but are not reported in the table. They range between .216 and .252. Table S5 in the online supplemental materials presents the fit indices (AIC, BIC, −2loglik). CI = confidence interval; PISA = Programme for International Student Assessment; Coef. = Coefficient; AIC = Akaike information criterion; BIC = Bayesian information criterion; −2loglik = −2log likelihood..
** $p < .01$. *** $p < .001$.

mediated this association. These results are consistent with the extant research (e.g., Zeidner, 1998) and further illustrate the role of affective mechanisms (herein anxiety) in accounting for this relation (e.g., Jeffries & Salzer, 2022; Tempelaar et al., 2017; Thomas et al., 2017).

Second, inconsistent with H2a–2b, the results showed that the higher the income inequality, the weaker the association between social class and mathematics performance, an interaction that was accounted for by a decrease in mathematics anxiety. This may be explained by the fact that our measure of social class, parental education, is culturally based. As argued in the literature, income inequality increases the salience of social stratification, but possibly only of the economic dimension (Sommet & Elliot, 2023). When income inequality is low, it is plausible that aspects of social stratification other than the economic dimensions matter to a greater extent. While in unequal countries, parental investment in money on academic success through financial means (e.g., homeschooling, enrolling one's child in a private school) may be the main contributor to the social class achievement gap (Schneider et al., 2018), in more equal countries, parental cultural resources could have a greater impact than economic resources on school performance. If true, this would suggest that the moderation between income inequality and social class depends on the social class dimension. In Studies 2a and 2b, we thus aimed to replicate the results from Study 1 and to test whether the operationalization of social class (culturally based vs. economically based) alter the direction of findings.

Study 2: Culturally and Economically Based Family Social Class, Income Inequality, and Performance

In Study 2, we aimed to test the following preregistered hypotheses: The lower the social class, the lower the standardized test performance (H1a); the higher income inequality, the weaker the effect of cultural capital on test performance; the higher income inequality, the higher the effect of economic capital on test performance (H2a′).[8] As in Study 1, we also aimed to test whether a decrease in test anxiety mediated the association between social class and test performance (H1b), and the interaction between income inequality and social class in predicting test performance (H2b′). For the preregistrations, see https://osf.io/8dnzs/?view_only=be7f41896e224991be61725275091526 and https://osf.io/pqm8z/?view_only=0295174168c84145b0a261bbf727251f.

Method

Participants

In Study 2a, we used the data from PISA 2012 and in Study 2b, we used the data from PISA 2015. The samples comprised 480,174 students nested in 65 countries and 519,334 students nested in 72 countries, respectively. Table 1 presents descriptive statistics for Study 2.

Variables

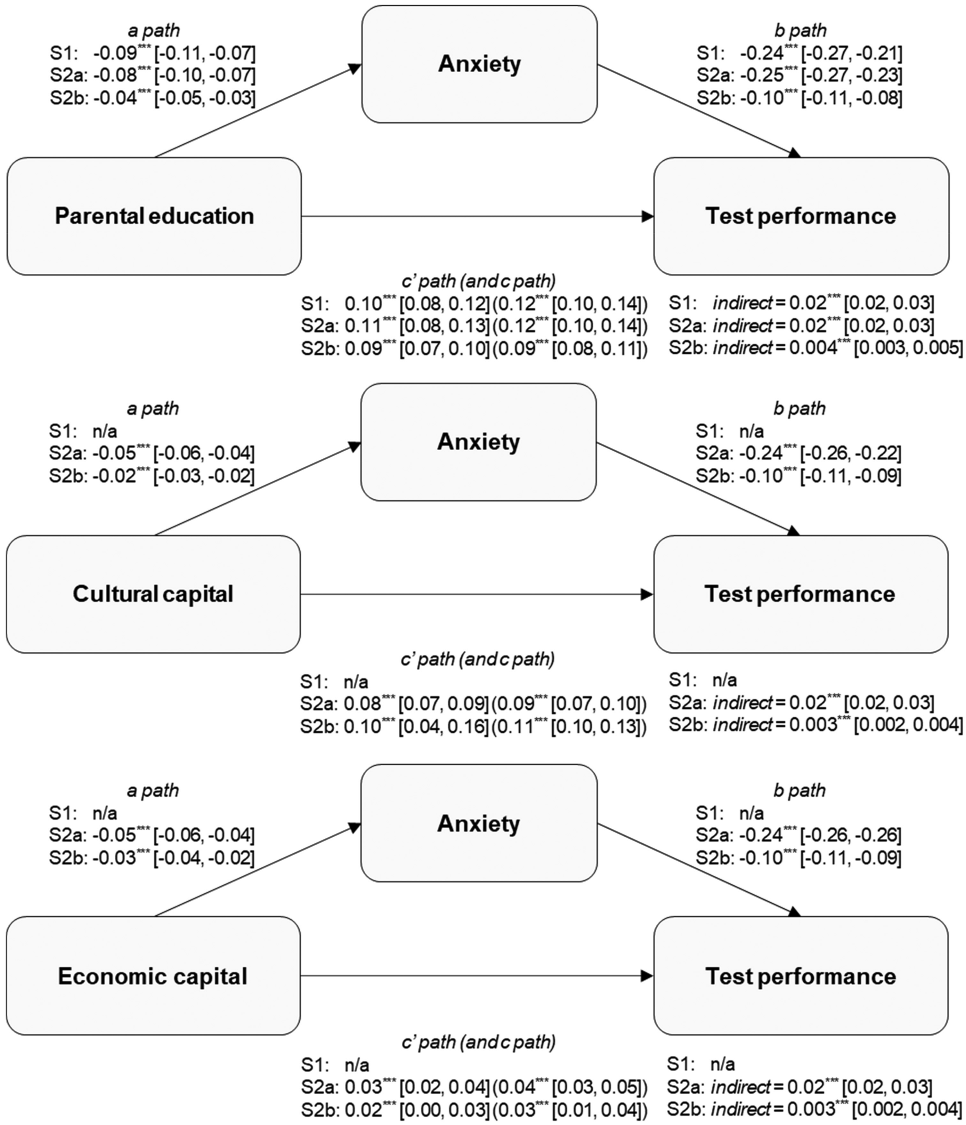
Social Class Indicators. Table S6 in the online supplemental materials presents the correlation matrices for social class indicators.

Parental Education (Culturally Based Social Class). As in Study 1, we again used PISA's measure of the highest number of years of education completed by either parent (Study 2a: $M = 12.98$, $SD = 3.41$; Study 2b: $M = 13.34$, $SD = 3.25$).

[8] We formulated a nondirectional hypothesis in Study 2a's preregistration.

Figure 1

Studies 1, 2a, and 2b: Association Between Social Class (Upper Panel: Parental Education; Middle Panel: Cultural Capital; Lower Panel: Economic Capital) and Performance, as Mediated by Anxiety



Note. S1 = Study 1; S2a = Study 2a; S2b = Study 2b; n/a = not applicable.
*** $p < .001$.

Family Cultural Capital (Culturally Based Social Class). We used PISA's three-item measure of cultural possessions (e.g., "In your home, do you have: Classical literature"; 1 = *yes*, 0 = *no*). As preregistered, we calculated the ratio of the sum of all items over the maximum score of valid responses (Study 2a: $M = 0.53$, $SD = 0.37$; Study 2b: $M = 0.50$, $SD = 0.31$).

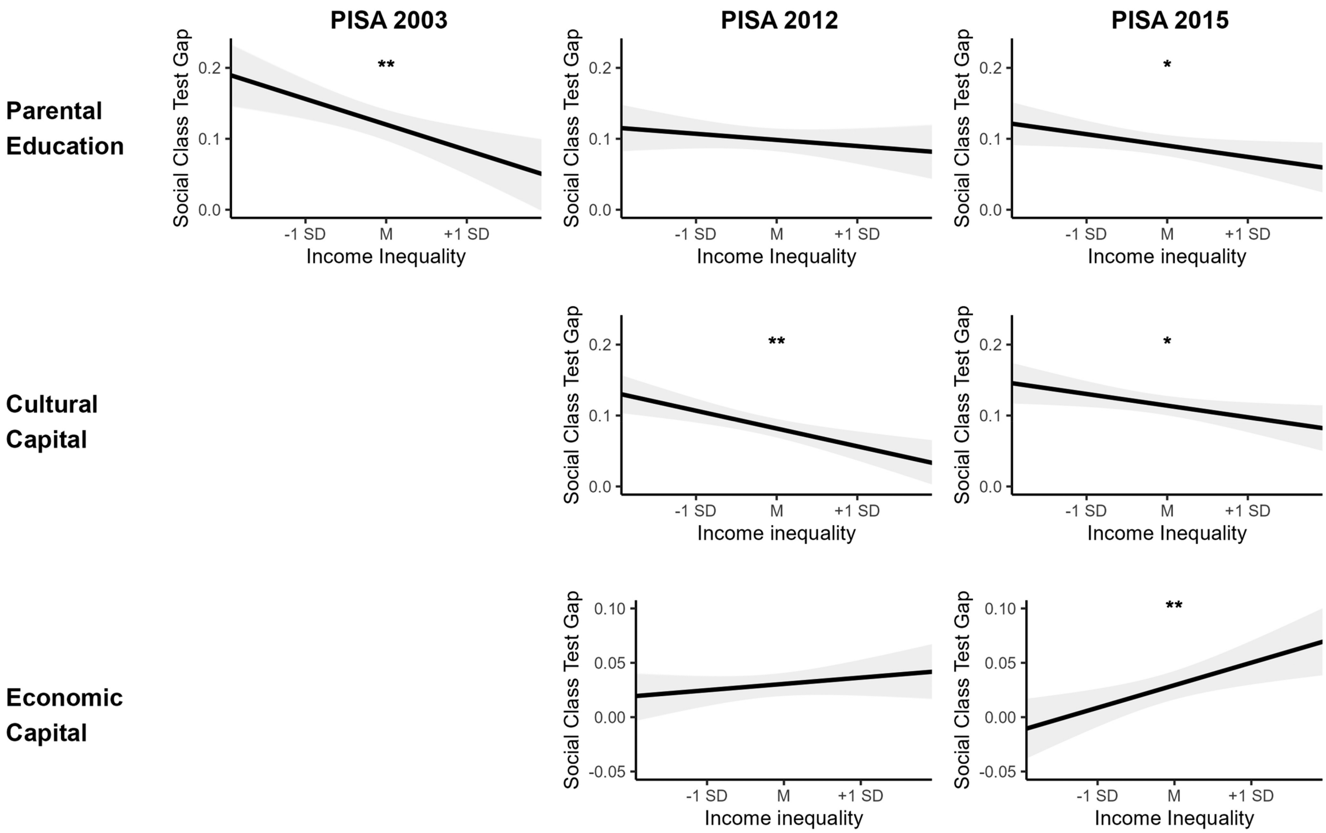
Family Economic Capital (Economically Based Social Class). We used PISA's 12-item measure of wealth (e.g., "In your home, do you have: A room for your own"; 1 = *yes*, 0 = *no*; "How many of [televisions] are there at your home"; rescaled[9] from 0 = *none* to 1 = *three or more*). Again, we calculated the ratio of the sum of all items over the maximum score of valid responses (Study 2a: $M = 0.68$, $SD = 0.20$; Study 2b: $M = 0.59$, $SD = 0.19$).

Standardized Test Performance. In Study 2a, we again used PISA's five domain-specific plausible values in mathematics, $M = 500$ ($SD = 100$, ICC = .282). In Study 2b, we used PISA's 10 domain-general plausible values in mathematics, science, and reading, $M = 500$ ($SD = 100$) for each domain (ICC comprised between .242 and .268).

[9] We slightly deviated from the preregistration of Study 2a when calculating the index of economic capital. To avoid giving too much weight to item ST027 (which uses a 4-point scale), we used the same approach used in Study 2b and rescaled the items in equal intervals from 0 to 1 (i.e., using the same response scale as the other items). Results were identical with both calculations.

Figure 2

Studies 1, 2a, and 2b, H2a: Association Between National Income Inequality and the Social Class Test Gap (Upper Panel: Based on Parental Education; Middle Panel: Culturally Based; Lower Panel: Economically Based)



Note. PISA = Programme for International Student Assessment.
* $p < .05$. ** $p < .01$.

Anxiety.

Mathematics Anxiety. In Study 2a, we used PISA's five-item measure of mathematics anxiety—for example, "I often worry that it will be difficult for me in mathematics classes," from 1 = *strongly agree*, to 4 = *strongly disagree*; $M(\alpha) = 0.80$, $SD(\alpha) = 0.07$; $M = 2.50$, $SD = 0.68$, ICC = .035.

Test Anxiety. In Study 2b, we used PISA's five-item measure of test anxiety—for example, "I often worry that it will be difficult for me taking a test," from 1 = *strongly agree*, to 4 = *strongly disagree*; $M(\alpha) = 0.81$, $SD(\alpha) = 0.05$; $M = 2.67$, $SD = 0.69$, ICC = .037.

Income Inequality. In both Studies 2a and 2b, we again used the Gini coefficients from the WIID. As preregistered, we averaged the Gini coefficients or—if the estimates were not available—the next most recent within $\pm$ 2 year-range, Study 2a: $M = 0.38$, $SD = 0.06$; Study 2b: $M = 0.37$, $SD = 0.06$.[10]

Results

Overview of the Multilevel Analysis Using Plausible Values

We built two series of multilevel models testing H_1 and H_2', again treating students (Level 1) nested in 18,139 schools (Level 2) and 65 countries (Level 3) in Study 2a (with 17,911 schools and 72 countries in Study 2b). We used the same analytical approach used in Study 1, with the addition of repeating the analyses while substituting parental education by cultural capital and, subsequently, by economic capital (in three separate series of model models). We tested each model while excluding or including the same preregistered set of control variables, making the same centering decisions, and relying on the same method to handle plausible values as in Study 1. In Study 2a, we followed the same procedure used in Study 1 to derive one coefficient estimate and 1 *SE* from the domain-specific plausible value of mathematics. In Study 2b, we derived one coefficient estimate and 1 *SE* for each predictor from all three domain-specific estimates to obtain one domain-general estimate.

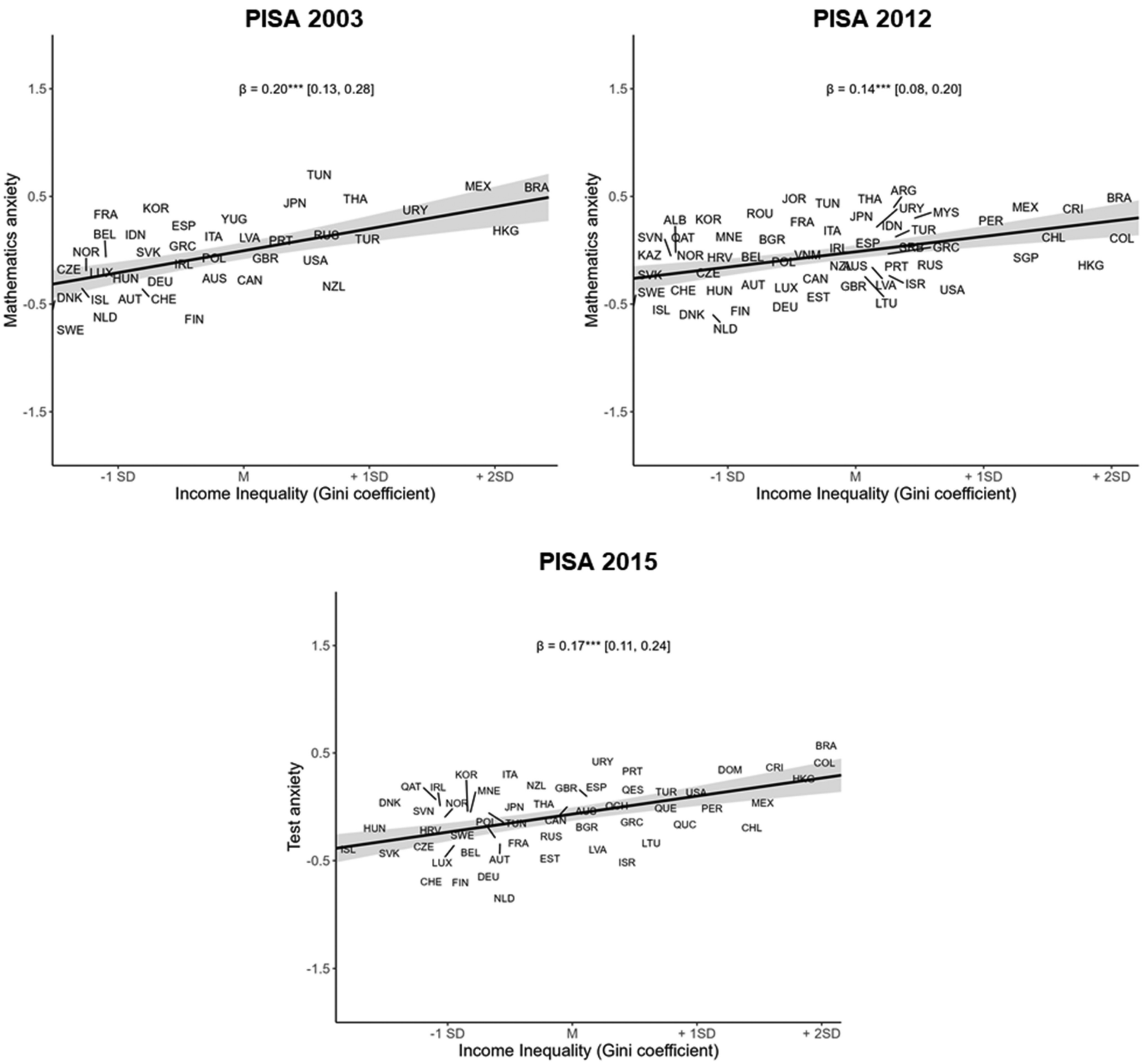
Analyses

Tables 2–4 present the full results and multilevel equation regression for the model excluding control variables, and Tables S7, S11–S13 (for Study 2a) and Tables S17, S22–S24 (for Study 2b) in the

[10] Countries for which income inequality estimates were not available in the WIID could not be included in the analysis involving this variable (Study 2a: United Arab Emirates, Liechtenstein, Macao, Shanghai, Perm, and Chinese Taipei; Study 2b: Albania, United Arab Emirates, Algeria, Lebanon, Macao, Singapore, Chinese Taipei, Trinidad, and Tobago). The imputed median countries for each control variables are available in Table S2 in the online supplemental materials.

Figure 3

Studies 1, 2a, and 2b, Unexpected Finding: Associations Between Income Inequality and Anxiety in Study 1 (Upper Left Panel), Study 2a (Upper Right Panel), and Study 2b (Lower Panel)



Note. The regression lines were derived from the models without control variables. The national averages of the outcome variable are indicated by the position of their ISO 3166-1 alpha-3 codes. Gray areas represent 95% confidence intervals. PISA = Programme for International Student Assessment.
*** $p < .001$.

online supplemental materials present the same information for the model including control variables.

Hypothesis 1 (H1): Social class and performance.

We regressed performance on each of our social class indicators in three separate models. Consistent with H1a, across Studies 2a and 2b, the analyses revealed that all three social class indicators—parental education, family cultural capital, and family economic capital—were positive predictors of test performance; Study 2a: $\beta = .12$ [.10, .14], $p < .001$, $\beta = .09$ [.07, .10], $p < .001$, and $\beta = .04$ [.03, .05], $p < .001$, respectively; Study 2b: $\beta = .09$ [.08, .11], $p < .001$, $\beta = .11$ [.10, .12], $p < .001$, and $\beta = .03$ [.01, .04], $p < .001$, respectively.

Then, we regressed mathematics performance on anxiety, parental education, income inequality, and the interaction between parental education and income inequality. Consistent with H1b, across Studies 2a and 2b, the analyses revealed social class → anxiety → test performance mediations in the same direction as that expected for all

Table 4

Studies 2a and 2b, H2a: Coefficients and 95% CI From the Multilevel Regressions Testing the Effects of Cultural and Economic Capitals on Performance as Moderated by Income Inequality While Excluding Control Variables

	Study 2a PISA 2012		Study 2b PISA 2015	
Variable	Coef.	95% CI	Coef.	95% CI
Cultural capital				
Intercept	−.06	[−.19, .08]	−.04	[−.15, .07]
Cultural capital	.09***	[.07, .10]	.11***	[.10, .13]
Income inequality	−.12	[−.26, .01]	−.09	[−.21, .03]
Cultural Capital × Income Inequality	−.03	[−.04, −.01]	−.02*	[−.03, −.00]
Random slope	.002		.030	
Country-level residuals	.226		.209	
Level 1 residuals	.444		.511	
Covariance	.012		.010	
Economic capital				
Intercept	.00	[−.14, .14]	−.06	[−.18, .05]
Economic capital	.04***	[.03, .05]	.03***	[.01, .04]
Income inequality	−.12	[−.26, .02]	−.10	[−.22, .01]
Economic Capital × Income Inequality	.01	[−.00, .02]	.02**	[.00, .03]
Random slope	.002		.003	
Country-level residuals	.228		.244	
Level 1 residuals	.455		.521	
Covariance	−.001		−.001	

Note. The multilevel equation is $Y = B_{000} + (B_{100} + u_{1jk}) \times \text{Capital}_{ijk} + B_{001} \times \text{Gini}_{ijk} + B_{101} \times \text{Capital}_{ijk} \times \text{Gini}_{ijk} + v_{00k} + u_{0jk} + e_{ijk}$, with $i = 1, 2, \ldots, N$ participants, $j = 1, 2, \ldots, K$ schools, $k = 1, 2, \ldots, L$ countries, where u_{10k} represent the variation of the effects of capital from one country to another and v_{00k}, u_{0jk}, and e_{ijk} represent the country-level, school-level, and student-level residuals. Coef." represents β for the fixed effects (rows: "intercept," "cultural capital," "income inequality," "Cultural Capital × Income Inequality," "economic capital," and "Economic Capital × Income Inequality") and the variance terms for random effects (rows: "random slope," "country-level residual," "Level 1 residuals," and "slope-intercept covariance"). The random intercepts for the school level were included in the models but are not reported in the table. They range between .216 and .274. Table S5 in the online supplemental materials presents the fit indices (AIC, BIC, −2loglik). CI = confidence interval; PISA = Programme for International Student Assessment; Coef. = Coefficient; AIC = Akaike information criterion; BIC = Bayesian information criterion; −2loglik = −2log likelihood.
* $p < .05$. ** $p < .01$. *** $p < .001$.

indicators. The negative effect of anxiety accounted for between 10% and 19% of the positive association between social class indicators (i.e., parental education, family cultural capital, and family economic capital) and test performance; Study 2a: all indirect effects ≥ .01, all $ps < .001$; Study 2b, all indirect effects ≥ .002, all $p < .001$. In Study 2b, we repeated the analysis using domain-specific performance scores (rather than combining mathematics, reading, and science performance), and we obtained similar findings (see Tables S14–S16 and S18–S21 in the online supplemental materials).

> *Hypothesis 2′ (H2′):* Income inequality, social class, anxiety, and test performance.

> *Hypothesis 2a′ (H2a′):* Interaction between income inequality and social class.

Replication of Study 1. First, we regressed performance on parental education, income inequality, and the interaction. As in Study 1, the analysis revealed that the higher the income inequality, the weaker the effect of parental education on test performance in Study 2b (β = −.02 [−.03, −.01], $p = .047$); however, the interaction was not different from zero in Study 2a (β = −.01 [−.03, .01], $p = .321$, Figure 2, upper panel).

Distinguishing Cultural and Economic Capitals. Second, we regressed performance on each of the two forms of family capital, income inequality, and the interaction in two separate models. Consistent with H2a′, the direction of the interaction effect between income inequality and family social class on test performance depended on the type of indicator (family cultural capital or family economic capital).

On the one hand, analyses revealed that the higher the income inequality, the weaker the culturally based social class test gap (Study 2a: β = −.02 [−.03, −.01], $p < .001$; Study 2b: β = −.02 [−.03, −.00], $p = .029$). Simple slope analysis revealed that in more unequal country (+1 *SD*), the culturally based social class test gap was weaker (Study 2a: β = .06 [.05, .08], $p < .001$; Study 2b: β = .10 [.08, .12], $p < .001$), than in less unequal country (−1 *SD*, Study 2a: β = .09 [.08, .11], $p < .001$; Study 2b: β = .13 [.11, .15], $p < .001$, Figure 2, middle panel).

On the other hand, analyses revealed that the higher income inequality, the stronger the economically based social class test gap (Study 2a: β = .01 [−.01, .02], $p = .159$; Study 2b: β = .02 [.00, .03], $p = .007$). Note that the interaction in Study 2a was only significant when anxiety was included in the model (β = .01 [.0, .02], $p = .001$, see the online supplemental materials). Simple slope analysis revealed that in more unequal country (+1 *SD*), economically based social class test gap was higher (Study 2a: β = .05 [.03, .06],

$p < .001$; Study 2b: β = .05 [.03, .07], $p < .001$), than in less unequal country (−1 *SD*, Study 2a: β = .02 [.01, .03], $p < .001$; Study 2b: β = .01 [−.01, .03], $p = .407$, Figure 2, lower panel).

Hypothesis 2b′ (H2b′): Moderated mediation with anxiety.

Analyses revealed Inconsistent Social Class × Income Inequality → anxiety → test performance moderated mediation across social class indicators and across Studies 2a and 2b, making the overall analysis inconclusive. The only consistent finding from the supplementary analyses revealed that income inequality was systematically positively associated with anxiety, for example, in the model using parental education without control variables in Study 2a and Study 2b, respectively (β = .14 [.08, .20], $p < .001$ and β = .17 [.11, .24], $p < .001$, Figure 3). This main effect of income inequality on anxiety was always significant, regardless of the social class variable used as a covariate. In Study 2b, we again repeated the analysis using domain-specific performance scores, and we obtained similar findings (see Tables S25–S36 in the online supplemental materials).

Discussion

Studies 2a and 2b replicated and extended Study 1. First, consistent with H1a, not only parental education but also family cultural and economic capital were positively associated with performance, and consistent with H1b, anxiety partially mediated each of these associations. Second, consistent with H2a′, results show that the higher the income inequality, the weaker the culturally based social class test gap (based on parental education or cultural capital), but the stronger the economically based social class test gap (based on economic capital). Inconsistent with H2b′, these interactions were not consistently accounted for by changes in anxiety.

General Discussion

Using three large-scale cross-national data sets, this research provides empirical evidence regarding the role of anxiety as a mediator and income inequality as a moderator of the social class test gap. Specifically, we documented three key sets of findings, First, we found that anxiety accounts for between a 10th and a fifth of the social class test gap, across social class indicators (Studies 2a and 2b), forms of anxiety (mathematics anxiety in Studies 1 and 2a and test anxiety in Study 2b), and school domains (Study 2b). Second, we found that income inequality moderates the social class test gap (Studies 1, 2a, and 2b) and that the direction of the interaction depends on social class dimensions (negative for culturally based social class test gap, and positive for economically based social class test gap; Studies 2a and 2b). Third, we found a consistent, albeit unanticipated, main effect of income inequality on anxiety.

Finding 1. Anxiety Mediates the Social Class Test Gap

Consistent with the literature (Chmielewski, 2019), this research confirms a worldwide social class test gap across 178 countries-years units (750,000 + students) and three indicators of social class. While all indicators were significantly associated with test performance, we found that culturally based indicators of social class (parental education and cultural possession) are descriptively more strongly associated with test performance than the economically based indicator (family economic possession). Specifically, students with higher cultural capital (+1 *SD*) outperformed students with lower cultural capital (−1 *SD*) by approximately ±12%/±16%, whereas students with higher economic capital (+1 *SD*) outperformed students with lower social classes (−1 *SD*) by approximately ±3% test.

We found that anxiety serves as a psychological mediator of the social class test gap. Results confirm that students from lower social classes experience greater anxiety than students from higher social classes (e.g., Putwain, 2007; Stephens et al., 2014), and reveal that these differences in anxiety accounted for between 10% and 20% of test performance inequalities. To our knowledge, this research is the first to examine the degree to which academic anxiety (including mathematics and test anxiety) explains the relationship between social class and performance on standardized tests. These results underscore the role of affective mechanisms in this relation (e.g., Jeffries & Salzer, 2022; Tempelaar et al., 2017; Thomas et al., 2017).

In line with the literature on the effects of anxiety on performance, the heightened anxiety experienced by students from lower social classes may lead to intrusive thoughts and deplete the cognitive resources needed to perform well on tests (Moran, 2016). This supports the perspectives of authors who move beyond a deficit-perspective on social inequalities, arguing that there are no inherent social class differences in terms of cognitive resources, but rather differences in resource allocation (Fendinger et al., 2023; see also Mullainathan & Shafir, 2014). This also has important implications for standardized test: Standardized tests are not entirely neutral measures of competence, as up to a fifth of the score differences between students from higher and lower social classes reflects the varying experiences of anxiety among these groups.

Finding 2. Income Inequality Moderates the Social Class Test Gap

Across the three studies, we found that national income inequality serves as a moderator of the social class test gap. This research expands upon prior works (Workman, 2022, 2023), by incorporating a broad range of countries and distinguishing between different types of social class indicators. Specifically, while Workman (2022) demonstrated a positive relationship between income inequality and the social class test gap in the United States using a composite social class indicator, our results offer global evidence that the moderating effect of income inequality on social class hinges on the particular dimension of social class being examined. In general, the economically based social class test gap seems to be more pronounced in countries with higher income inequality, whereas the culturally based social class test gap is more pronounced in more equal countries.

The Positive Interaction Between Income Inequality and Economic Capital

Income inequality has long been argued to increase the salience of social hierarchy and competitiveness, thereby exacerbating social class inequalities (e.g., Wilkinson, 1997). Our results suggest that income inequality increases the effects of only the economic dimension of social class on test performance (i.e., the performance gap between students from wealthier and poorer families becomes wider). One explanation for these results is that parents from countries with greater levels of income inequality are more concerned about their children's success as the economic return to education is higher (Doepke et al., 2019), leading to adopt more intensive parenting including more financial investment in their children (Schneider et al., 2018). To put it simply, as the gap between the poor and the rich widens, so too does the importance of climbing the economic ladder, leading parents to increasingly invest in their children's education through means like tutoring, specialized extracurricular activities, and private schooling, all to enhance their academic success and career prospects. In this context, the social class test gap is more dependent on economic capital than other forms of capital, such as cultural capital, explaining why national income inequality contributes to the gap between students from poorer and wealthier family.

The Negative Interaction Between Income Inequality and Cultural Capital

In more equal contexts, the impact of economic differences on subjective social class is less pronounced and noneconomic markers of social class, such as education, becomes more important (for relevant empirical research, see Kim & Sommet, 2023). Our results suggest that income equality does increase the effects of the cultural dimension of social class on test performance, herein represented by parental education and cultural possessions (i.e., the performance disparity between students from families with more vs. less cultural capital becomes wider). The interaction between income inequality and cultural capital might appear more unexpected than the one involving income inequality and economic capital. We offer two explanations for this observation.

First, this finding resonates with research on "schooled societies" (Baker, 2014), which suggests that the growing importance of education in societies creates a social hierarchy predicated on the educational level. In such societies, education plays a pivotal role, with the school system serving as the primary pathway for social mobility but also for social reproduction (Hout et al., 2006, as cited by van Noord et al., 2023). Both schooled societies and income inequality increase the salience of social hierarchy and social class identity. However, in schooled societies, the cultural dimension is likely valued more than the economic dimension, ultimately shaping a social class test gap that revolves around culturally based social class differences rather than economically based social class differences. In more equal societies, it is conceivable that educational level and cultural capital become more prominent than economic capital in defining the social hierarchy, prompting these societies to evolve into a "schooled societies." This shift may explain why national income equality contributes to the widening gap in test performance between students from less educated and more educated families.

Second, students from more equal societies may have a reduced awareness of the structural determinants of academic achievement and school performance. In these societies, signs of inequality are subtler, as it becomes difficult to differentiate between advantaged and disadvantaged people based visible markers of wealth like conspicuous consumption and luxury possessions (Walasek et al., 2018). Thus, students may overlook the inequalities in the distribution of cultural capital that shape opportunities and endorse stronger beliefs in descriptive meritocracy (for relevant research, see Batruch, Jetten, et al., 2023). This may eventually lead students from lower social classes to internalize stereotypes and attribute their failure to internal factors rather than structural causes. This dynamic could strengthen the social class test gap, akin to the gender-equality paradox (i.e., the gender gap in pursuing science, technology, engineering, and mathematic disciplines at college increases with national gender equality; Breda et al., 2020; Stoet & Geary, 2020). Here also, this may explain why national income equality contributes to the widening gap in test performance between students from less educated and more educated families. Unfortunately, PISA did not include items pertaining to parental perception of the value associated with achieving higher status or students' attributional causes of their success or failure, preventing us from investigating either this hypothesis or the preceding one, and leaving the question concerning the underlying mechanism unanswered.

It is worth noting that we tested whether anxiety explained the moderation between social class and income inequality in predicting test performance scores. However, the results of the moderated mediation analysis were inconsistent between studies: The effect of income inequality on the social class test gap appeared to be explained only by mathematics anxiety (Study 1 and Study 2a), but not by test anxiety (Study 2b). Consequently, the findings were considered inconclusive, and we will not elaborate on them further.

Finding 3. An Unexpected Main Effect of Inequality on Anxiety

Finally, this research uncovered an unexcepted yet robust main effect of income inequality on anxiety, showing that higher income inequality is associated with increased anxiety (though without directly exerting an effect on test performance). This unanticipated finding aligns with that of King et al. (2024), who also reported a positive association between income inequality and test anxiety. However, our results extend beyond those of these authors, as we found this association in not just one but three PISA editions, and not only for general anxiety but also for mathematics anxiety. Furthermore, we formally demonstrated that this effect applies to students from both lower and higher social classes. Both our findings and those of King et al. are in line with "the status anxiety hypothesis" (Layte & Whelan, 2014), which suggests that income inequality serves as a contextual stressor for everyone. More specifically, this hypothesis posits that income inequality makes socioeconomic differences more salient, thereby heightening concerns related to relative status for all individuals and fostering a general increase in anxiety (for a review, see Buttrick & Oishi, 2017; for critics, see Walasek & Brown, 2019). The significance of our results, however, lies in demonstrating that income inequality appears to increase anxiety among school-aged children, while most existing studies in this field focused on adults (e.g., Blake & Brooks, 2019; Melita et al., 2023; Sommet et al., 2018). Although unexpected, our results are consistent with recent research showing that national income inequality is associated with more competitiveness in school (Sommet, Weissman, & Elliot, 2023), and a lower sense of belonging at school (King et al., 2022), both of which contribute to fear of failure and anxiety (for relevant research, see K.-A. Allen et al., 2023; Weissman et al., 2022). This unanticipated finding will need to be confirmed in future studies; however, it could serve as a foundation to link the rise in income inequality to the apparent increase in well-being issues among adolescents (Marquez & Long, 2021).

Reflections on the Size of the Effects

In the three studies, we showed that the social class test gap has a relatively modest effect size ($\beta \approx .10$), particularly when operationalized using family economic capital ($\beta \approx .05$). These findings, although not trivial, are notably smaller than those documented in recent meta-analyses (Harwell et al., 2017; Liu et al., 2022). Our studies also revealed that academic anxiety accounted for 10%–20% of the effect of social class on performance. While this is substantial, it also suggests that a considerable amount of variance remains unexplained, opening the door for other potential mediators such as sense of belonging (Ostrove & Long, 2007), motivation (Jury et al., 2015), and self-concept (Suárez-Álvarez et al., 2014).

Regarding the interaction effects involving income inequality, we observed a modest difference ($\beta \approx \pm.05$) in the social class test gap between relatively equal (-1 *SD*) and relatively unequal ($+1$ *SD*) countries. While modest, this effect size is consistent with the typical effect size observed for interactions (Sommet, Weissman, Cheutin, & Elliot, 2023) and aligns with previous findings on the same topic (Workman, 2022). Equally important, the effects of inequality at broader geographic levels are notoriously small, suggesting that future research may benefit from exploring the interaction between social class and economic inequality at more localized levels, such as regions, school districts, or even schools. Interestingly, however, the unanticipated main effect of income inequality on anxiety was of a medium effect size ($\beta \approx .15$–.20), signaling a promising avenue for future research.

Limitations

The main limitation of this research is its correlational design, which prevents us from making causal inferences. This limitation manifests in two main ways: (a) the possibility for reverse causation and (b) the possibility of third-variable explanations.

Cross-Sectional Design and Causality

Regarding the first issue, it conceivable that students from lower social classes develop more anxiety due to their lower test performance, rather than the other way around. However, Foley et al. (2017) purposed that the association between anxiety and performance is bidirectional, meaning that each construct can impact and be influenced by the other. Moreover, experimental studies have demonstrated that psychological factors do account for the social class test gap (e.g., Batruch et al., 2019; Croizet et al., 2019, Stephens, Fryberg, et al., 2012), lending credence to the idea that anxiety could be part of the causal pathway linking social class to performance.

As for the second issue, although we have controlled for a comprehensive preregistered set of student-level and country-level control variables (e.g., GDP, government expenditure on education) to mitigate potential confounding effects, there remains the possibility that uncontrolled factors may have influenced the results. Such factors include, but are not limited to, the characteristics of the school systems (e.g., regarding tracking; Batruch, Geven, et al., 2023), variations country-level variations in belief in school meritocracy (Duru-Bellat & Tenret, 2012), and perceived educational quality (Spruyt et al., 2024)

Importantly, although it is possible to approach causality in observational data by building repeated cross-sectional data set and examining the effects of inequality changes over time (e.g., see Kim et al., 2022), this approach was not feasible in our study. The reason is that, PISA do not include core module with consistent items, making it impossible to track changes in response levels over time. For instance, regarding anxiety, PISA 2003 and 2012 focused on mathematics anxiety whereas PISA 2015 focused on test anxiety, using different item wording. As another example, the number of plausible values, measuring school performance, changed between 2012 and 2015. Future research using primary data and either repeated cross-sectional or longitudinal designs is needed to provide more insight about causal relationships.

Perspectives on Measurement

Compared to other publicly available data sets, the PISA surveys have many strengths in measurements. For instance, they use a set of plausible values rather than a single value to measure performance, thereby producing more accurate data (OECD, 2017). Moreover, they use multiitem scales rather than single-item scales to measure psychological constructs, thereby reducing measurement error (Diamantopoulos et al., 2012). Despite these strengths, specific concerns have been raised regarding the measurement of social classes in PISA. In particular, scholars have identified misreports of parental education (reported by students) up until PISA 2009, which limits the reliability of country comparisons using this indicator (Avvisati, 2020; Jerrim & Micklewright, 2014). Scholars have also expressed concerns about the nonlinear relationship between the economic capital scale and performance, particularly concerning students experiencing extreme poverty or from very wealthy families (Lee et al., 2019). Future studies on economic inequality, social class, and education outcomes should consider using alternative social class measures, such as subjective social class, and different economic measures like parental equivalized income.

Educational Implications

The literature on interventions designed to narrow the social class test gap spans various levels, from individual to structural (Dittmann & Stephens, 2017). In this context, our research has twofold implications. First, interventions targeting the social class test gap by focusing on individual processes, such as value affirmation (Harackiewicz et al., 2014), could be complemented by interventions from the field of health psychology focused on reducing academic anxiety (Cassady, 2022; Ginsburg & Smith, 2023). Research has shown promising effects of that psychological and study skills training interventions are effective in reducing students' anxiety levels as well as increasing performance (Huntley et al., 2019), and exploring these interventions as a means to narrow the social class test gap represents a promising direction for future research. Second, our findings suggest that the social class test gap may be rooted in broader structural variables, revealing that individual interventions may not be sufficient to fully address the gap, and that tackling educational inequality may necessitate thinking about societal inequality at large. We know from the literature that the meaning of social class varies across contexts, and researchers have argued features of the local educational environment need to be factor in when designing social psychological interventions (Easterbrook & Hadden, 2021). For instance, students from lower income groups may experience social identity threats in environments where they have historically faced prejudice, where academic tracking places them at a disadvantage, or where social diversity is low; these considerations have clear implications for interventions targeting these students. Furthermore, our results suggest that students from lower income groups may encounter additional challenges in economically unequal environments, which should be taken into account in future interventions aimed at reducing socioeconomic inequality in schools.

Conclusions

This research sheds light on how both microlevel socioeconomic features (family social class, and its various facets) and macrolevel economic features (income inequality) can predict and interact in predicting student anxiety and test performance. In particular, it highlights how structural variables and environmental factors influence the outcomes of standardized tests across the world, thereby illustrating that these tests cannot be seen as devoid of contextual influence when estimating performance.

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