People from Historically Rice-Farming Cultures Perform Better on Exams

Suqin Ge, Virginia Tech
Quqiong He, Dongbei University of Finance and Economics
Sudipta Sarangi, Virginia Tech
Thomas Talhelm, University of Chicago

Abstract

Why do some countries do so much better than other countries in education? Resources are an obvious explanation. Genes for IQ are a controversial explanation. We argue that cultural differences in valuing hard work are an important factor. To test this idea, we studied paddy rice farming because it required about twice the labor of other common crops like wheat and corn. Historians have documented traditions in rice-farming cultures that celebrate hard work, such as festivals to get energized for periods of hard work. We found that cultures with a history of rice farming scored higher on standardized tests across countries. Differences remained even when we compared students in the same countries but with parents born in other cultures. One limitation is that much rice farming is in East Asia, which raises the question of whether the differences are due to some other aspect of East Asian culture. We took advantage of the fact that China has both rice-farming and wheat-farming regions. Students who were born in rice-farming counties outperformed students from wheat counties in a large, nationally representative Chinese sample. Rice areas also outperformed wheat areas in the imperial exam during the Ming and Qing dynasties. Finally, we tested differences in attitudes toward hard work. People in rice-farming cultures or who have parents from rice-farming cultures endorsed hard work more. Together, these results highlight culture as an enduring influence on educational performance.

1. Introduction

Rice farming was hard work. Anthropologists surveying farms in the early 1900s estimated that paddy rice took about twice the hours per hectare as the other major grain crops like wheat, corn, and barley (Buck, 1935; Fei, 1945). They also observed customs that helped farmers cope with the higher labor demands by encouraging a spirit of hard work. For example, rice farmers near Shanghai held "Green Sprouts Gatherings," where they would drink freely, "shout in a drunken fashion and mutually encourage each other to endure the bitter work" (Elvin, 2006, p. 211). Rice farmers also passed on songs called "mountain ditties" to sing in the fields while they worked. Those songs described working through exhaustion in the dark while swatting mosquitoes, with themes of "the economic need to endure discomfort" (Elvin, 2006, p. 210). One song even talked about how "the lazy workers are put in front" so that the more diligent farmers can keep an eye on them and keep them from slacking off (Elvin, 2006, p. 210).

We ask whether the heavy labor demands of rice farming left an imprint on cultures that persists into the modern day, even among people who have never farmed a day in their life. The basic idea is that the history of rice farming led to cultural values emphasizing hard work, which in turn contributes to performance in education.

Much of the research on academic performance emphasizes the importance of genetic and cognitive skills (Boe et al., 2002; Borghans et al., 2016; Guiso et al., 2008; Jensen, 2015). But there is also evidence that effort matters. Observational studies have found that students who put forth more effort score higher on tests (Anaya and Zamarro, 2020; Boe et al., 2002; Borgonovi and Biecek, 2016; Eklöf, 2010; Zamarro et al., 2019). This real-world correlation aligns with experiments that randomly assigned some students to work harder (Braun et al., 2011; Gneezy et al., 2019; Jalava et al., 2015; Levitt et al., 2016). For example, one study paid students for their performance on a math test (Gneezy et al., 2019). Researchers randomly assigned students to take the test with or without payment for each question they got correct. The payment increased students' math scores, at least for students in schools that tended to score lower on the test. Importantly, because the incentives were randomized, differences in genetics or baseline IQ cannot explain the increase in test scores.

Our study looks at cultural attitudes toward hard work, which we define as emphasizing effort and perseverance. There are several other dimensions of personality and culture that go by different names but also incorporate attitudes toward hard work. For example, perseverance and delay of gratification both involve continuing to do something difficult, which is linked to academic success (Mischel et al., 1989). Another related concept is long-term orientation, defined as a focus on "future rewards, in particular, perseverance and thrift" (Hofstede 2001, p. 359). The overlap between perseverance and long-term orientation is evident in how researchers measure long-term orientation. Hofstede's measure includes the survey item, "Persistent efforts are the surest way to results."

There is evidence that people from cultures that endorse perseverance tend to have better outcomes in school. For example, one study compared students in the same Florida school system but with parents from different cultural backgrounds (Figlio et al., 2019). Comparing within the same school system helps by minimizing differences in the quality of the school system and the general incentive structure. The long-term orientation scores (including this question about "persistent efforts") of their parents' home country predicted students' test scores, attendance records, and graduation rates. This was true even controlling for a host of factors, like their parents' education and the GDP of their parents' birth country.

Our study goes beyond the Florida study by testing whether historical rice farming helps explain the differences in academic performance and attitudes toward hard work. We compared performance on standardized tests worldwide and found that cultures with a history of rice farming scored higher on standardized tests across countries. The differences remained even when we compared students in the same countries but with parents from different cultures. One limitation is that much rice farming took place in East Asia, which raises the question of whether the differences are due to some other aspects of East Asian culture. To address this, we compared rice-farming and wheat-farming regions within China. Students from rice-farming counties outperformed those from wheat counties in a large, nationally representative sample. The effect of rice farming was three times larger than the effect of family income. Rice also explained regions' success in China's imperial exam system as far back as the 1300s.

After analyzing differences in test scores, we compare different explanations for test performance. We tested whether cultural emphasis on hard work showed up in people's attitudes and behavior. We find that people in rice-farming cultures, or with parents from rice-farming cultures, were more likely to endorse hard work and to spend more time working. We also tested other explanations for East Asia's strong performance on tests—competitive attitudes, belief in education, Confucianism, and clan structures—but found little evidence that these alternatives could explain the success of rice regions.

2. Ecological Theories of Hard Work

Researchers have developed ecological theories to explain cultural differences (Talhelm and Oishi, 2019). These theories argue that climatic, geographic, and social ecology shape human culture. For example, one study linked cultures' history of water scarcity to higher long-term orientation (Harati and Talhelm, 2023). We explore whether farming systems influenced attitudes toward hard work. Farming is a logical place to look because farming systems differed in how much labor they required, and rice was particularly labor-demanding (Buck, 1935; Fei, 1945).

One reason is transplanting. Under the system of transplanting, farmers grow rice seedlings on a small patch of land (often near home) so they can carefully monitor water levels (Fei, 1945). Once the plants show three or four leaves, farmers pull them up and plant them in the main field. The alternative is to plant the seeds directly into the field, such as by throwing them (called "broadcasting," Elvin, 2006). Transplanting requires more work than broadcasting but produces much higher yields (Bray, 1986). It also requires fewer seeds (Elvin, 2006).

Even for tasks that crops like wheat and rice shared, such as weeding, rice had it worse. Rice grows best in standing water, but that water creates muddy fields. That mud makes tasks like weeding harder (Talhelm and Oishi, 2018).

Another reason rice is labor-intensive is irrigation. To flood and drain their fields, rice farmers built elaborate irrigation networks. These networks were not just a one-time cost. Dredging the channels and repairing the walls created "unending labor" (Elvin, 2006, p. 128). In many villages, farmers even had to pump the water using foot-powered machines (Talhelm and Oishi, 2018).

Despite its high labor demand, societies developed rice farming because it has an extraordinary productivity per acre. Historically, rice could yield three to five times more output than wheat (Perkins, 1969). Crop records from the 1500s to the 1700s found that rice farmers in China produced about 10 times the yield of European wheat farmers (Elvin, 2006, p. 208).

The idea is that, over the long run, people living in regions suited to farming more labor-intensive crops developed cultural values emphasizing hard work (Davidson, 2009; Fouka and Schlaepfer, 2020; Galor and Ozak, 2016). What's more, these values persisted into modern societies, even among people no longer farming. If cultures generalize the norms about hard work, they should apply to domains outside of just farming. Parents and broader cultures transmit norms and values to children, sustaining the differences over time. Thus, students from rice-farming areas may put more effort and patience into the learning process, which leads to better performance on standardized tests.

3. Rice and International Test Scores

To test the hypothesis that historical rice farming affects students' performance on tests today, we first analyzed data from the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS). The strength of the PISA and TIMSS data is that they allow us to compare students from around the world taking the exact same test. This offers a more controlled comparison than metrics like grade point average or the percentage of people with university degrees, which can mean different things in different countries.

Data and Potential Confounds

The Organization for Economic Cooperation and Development (OECD) conducts PISA to measure 15-year-olds' ability in reading, math, and science. PISA began in 2000, with new waves every three years. We used the 2018 wave because it covers the largest number of regions. In 2018, 79 education systems and more than 600,000 students participated worldwide. The test measures students' ability to apply their math, science, and reading skills in a variety of contexts. In addition, the 2018 PISA asked about students' demographic information, learning environment, and educational experiences. The study also gathered information from school principals about the schools and school population.

To measure rice farming, we used data from the Food and Agriculture Organization (FAO) of the United Nations on the percentage of farmland devoted to rice at the country level in 1961—the earliest year for which FAO data are available. We linked these rice cultivation statistics to each country in PISA 2018.[1]

We followed previous research by controlling for a set of individual and school characteristics that could explain differences in academic performance (Nollenberger et al., 2016). Individual characteristics include grade level, gender, parental education, and parental employment status. We also controlled for a household wealth index constructed by PISA 2018 to capture the study environment of students.[2] School characteristics include the percentage of female students, whether the school is private, and whether the school is in a city (urban).

In addition, we controlled for typical economic and geographic characteristics that could be correlated with rice cultivation. For example, we included ruggedness of terrain, which influences both suitability for farming and long-run economic development (Nunn and Puga, 2012); distance

[1] PISA reports scores for some regions that are not technically countries (e.g., Macau). For simplicity, we use the term "country" as shorthand for "country/region" throughout the paper. We provide more details on rice statistics in Supplemental Section 1.

[2] The household wealth index combines indicators of family wealth (such as cars and televisions), cultural possessions (such as works of art), and home educational resources (such as books and computers).

to the sea, a factor that influenced economic development throughout history; and latitude, which affects ecological conditions such as disease prevalence and is also correlated with rice cultivation because rice tends to grow at more southern latitudes. Following Galor and Ozak (2016), we also control for log GDP per capita and average elevation. Finally, because an earlier study linked water scarcity to long-term orientation, which includes attitudes toward hard work and perseverance (Harati and Talhelm, 2023), we controlled for freshwater availability. These controls help reduce the risk of spurious correlations between rice and test scores.

After excluding observations with incomplete rice statistics or controls, the full sample for our regression analysis has 279,071 students from 52 countries. Table S1 reports summary statistics for the PISA 2018 sample.

To check the robustness of the results, we repeated the analysis using TIMSS, another large-scale international assessment conducted by the International Association for the Evaluation of Educational Achievement that measures math and science achievement in the fourth and eighth grades every four years since 1995. Our sample came from TIMSS 2019, focusing on eighth-grade test scores to ensure comparability with PISA 2018. Like PISA, TIMSS collects contextual data on family background and school environment, though less extensively. After matching TIMSS data with FAO rice farming data and excluding observations with missing values, our regression sample consists of 91,119 students from 31 countries. Table S2 reports summary statistics for the TIMSS 2019 sample.

International Test Results

First, we ran simple correlations between rice farming and countries' average standardized test scores. Table 1 shows that rice farming is positively correlated with scores in the PISA and TIMSS. Figures 1 and 2 present scatter plots of historical rice farming against PISA and TIMSS scores.

Table 2A reports the regression results using data from PISA 2018.[3] Columns 1-3 examine the relationship between rice farming and individual scores in math, science, and reading, controlling for student characteristics. These controls include grade level, gender, parental education (high school or college graduate, with less than high school as the reference), parental employment status, and household wealth. Columns 4-6 add controls for school characteristics, including the share of female students, school type (private vs. public), and urban location. Columns 7-9 further incorporate characteristics of countries- and regions , such as GDP per capita, distance to the sea, latitude, elevation, terrain ruggedness, and freshwater availability. Across specifications, the results show that students from rice-farming cultures achieve higher test scores, and these differences persist even after accounting for household, school, economic, and geographic confounds.

How large are these differences? We can compare cultures with no rice farming (e.g., Saudi Arabia) to those with the highest levels of rice farming, devoting about 80% of farmland to rice (e.g., Singapore), as shown in Figure 1. Columns 7 and 8 indicate that moving from 0 to 80% rice farming is associated with gains of roughly 60 points[4] on the math test and 38 points on the science test. For comparison, students whose fathers completed college scored only 12 points

[3] We provide detailed descriptions of the empirical specifications and econometric methods in Supplemental Section 2.
[4] We calculated these estimates as the regression coefficient times 80%, such as 75.37 x 0.8. Test scores range from 0 to 1,000.

higher in math and 13 points higher in science than those whose fathers did not finish high school.[5] Rice-farming cultures show a smaller advantage in reading (18 points), but even this effect is comparable to having a father who completed college (12 points).

To test the robustness of the PISA results, we turn to data from TIMSS 2019 and report the estimation results in Table 2B, which follows a structure similar to Table 2A. The findings replicate the patterns observed in PISA: cultures with a history of rice farming consistently score higher on both math and science tests. Taken together, the TIMSS results confirm that these international differences are robust across datasets.

Holding Countries Constant: Second-Generation Immigrants

Although statistically controlling for cross-country differences is useful, it has important limitations. Some cultural and institutional characteristics may remain unmeasured, and these could be correlated with both rice farming and test scores. To address these concerns, we leverage a unique feature of the PISA data: information on students' parental origins. This allows us to identify second-generation immigrants, students born in a host country with at least one parent born abroad, and to compare the influence of rice-farming heritage while holding constant the institutional environment of the host country. Parents transmit cultural beliefs from their country of origin to their children, even after migration, making rice farming in the parental country of ancestry independent of institutional differences across host countries. For our main analysis, we define second-generation immigrants as students with at least one foreign-born parent to maximize sample size, though results are similar when restricting to those with both parents born abroad. The PISA dataset includes 8,669 such students from 51 different countries of ancestry. Table S1 reports summary statistics for both the full sample and the second-generation subsample.

As before, we account for individual, school, and country-of-ancestry characteristics, but this analysis goes further by including host-country fixed effects. In practical terms, this means we are comparing students with parents of different cultural backgrounds while netting out all host-country influences—such as school systems, levels of economic development, and teaching styles.

Table 3 presents the results from PISA 2018 second-generation immigrant sample. Columns 1-3 show that students with either parent from a predominantly rice-farming foreign culture (80%) scored approximately 63 points higher in math, 42 points higher in science, and 40 points higher in reading compared to students whose parents came from non-rice cultures. To test robustness, we applied alternative definitions of second-generation immigrants: having a foreign-born mother (Columns 4-6), a foreign-born father (Columns 7-9), and both parents born in the same foreign country (Columns 10-12).[6] Across all definitions, the estimated effect of rice-farming heritage remained consistent.

Reverse Causality: Instrumental Variable Analysis

One potential concern in analyzing rice farming data is reverse causality. It is possible that rice farming does not shape attitudes toward hard work; rather, pre-existing cultural values about

[5] In the PISA, parental education categories were: (0) none; (1) primary education; (2) lower secondary; (3) vocational/pre-vocational upper-secondary; (4) upper-secondary and/or non-tertiary post-secondary; (5) vocational tertiary; and (6) theoretically oriented tertiary and post-graduate. We define (0), (1) and (2) as the "middle school or below," (3) and (4) as "high school," and (5) and (6) as "college."

[6] This excludes students whose parents were born in different foreign countries. Such mixed heritage would require doubling the number of ancestry-country controls and would complicate the analysis.

hard work might influence whether communities chose to cultivate rice. In this view, some regions may have already placed a high value on diligence and therefore adopted rice farming, while others, even if ecologically capable of growing rice, may have opted against it because they put less value on hard work.

To address this possibility, we employ an instrumental variable (IV) strategy. Our instrument is the agro-ecological suitability index for wetland (paddy) rice, which is largely determined by natural conditions rather than human choice. The United Nations' Global Agro-Ecological Zones (GAEZ) database constructs this index based on average climatic data from 1961 to 1990.[7] This measure captures the ecological *potential* for rice cultivation, independent of cultural preferences. If variation in rice farming generated by ecological suitability continues to predict academic performance, the likelihood of reverse causality is reduced.

Table 4 presents the two-stage least squares (2SLS) estimates of the effect of rice farming on test scores. The first-stage results in Panel A show that ecological suitability for rice is a strong predictor of rice farming across datasets. Columns 1-3 use the full PISA 2018 sample, Columns 4-5 use the TIMSS 2019 sample, and Columns 6-8 use the PISA second-generation immigrant sample. In the second stage (Panel B), the coefficients on rice farming are uniformly positive and statistically significant, even after controlling for individual, school, and country characteristics.

Across different datasets and samples—whether examining the full student population or second-generation immigrants—rice farming, instrumented by ecological suitability for rice, consistently predicts higher test scores. These results suggest that reverse causality is unlikely to account for the observed relationship between rice farming and educational outcomes.

4. Rice and Test Scores Within a Single Country

Despite converging evidence across countries and among second-generation immigrants, the analysis still relies on countries and regions as the unit of comparison. These are relatively coarse units of analysis. A key limitation is that most rice-dominant countries are in East Asia, raising the concern that some other regional factor, rather than rice farming itself, may be driving the observed effect. One way to address this concern is to compare regions within the same country.

Data: The China Family Panel Study

To examine the relationship between rice and test scores within a single country, we analyzed data from the China Family Panel Study (CFPS). This allows us to (a) compare regions that differ in rice farming intensity but all fall within the broader East Asian cultural sphere, (b) increase the number of geographic units to 156, and (c) capture a full spectrum of rice farming, from regions that farm no rice at all to regions that plant over 80% of farmland with rice.

Launched in 2010, the CFPS is a nationally representative biennial survey of Chinese families and individuals. The baseline 2010 wave covers 25 provinces and measures a wide range of behaviors, attitudes, and values. Crucially, it also includes math and vocabulary tests for children. These tests were administered in the 2010, 2014, and 2018 waves, but we use the 2010 data because it provides the largest sample size.[8]

---

[7]The database uses complex models that take into account the growing requirements of wetland rice, local temperature, rainfall, evaporation, humidity, soil qualities, and slope to assign a suitability index for each area of land roughly 56 kilometers by 56 kilometers. The GAEZ database reports more details at http://www.fao.org/nr/gaez.
[8]The results are consistent if we use the 2014 or 2018 wave instead.

The math test has 24 standardized questions, sorted from easy to difficult. Respondents start at different difficulty levels based on their education. Then they keep answering questions until they get three consecutive questions wrong, at which point the test stops. We calculated math scores as the rank of the most difficult question that the respondent answered correctly.

The vocabulary test has a similar structure with 34 questions. Participants see a word and read it in Mandarin. They see harder and harder words until they read three consecutive words incorrectly, at which point the test stops. Importantly, the instructions tell interviewers to ignore aspects of dialects (such as tone) that would unfairly penalize people from regions where Mandarin is not the local dialect. In other words, this is a test of word recognition, not of pronunciation based on a single dialect.

Our analytic sample includes children aged 10-15 at the time of the survey. Rice farming is measured using county-level statistics on the percentage of farmland devoted to rice farming in 1957, the earliest available from China's Ministry of Agriculture (Planning Department of the Agricultural Ministry, 1959). We successfully linked historical rice shares to birth counties for 2,772 children across 156 counties.[9] The average age of children in the sample was 12.5 years (SD = 1.71). Table S3 reports descriptive statistics.

We then tested whether the percentage of farmland devoted to rice in a child's birth county predicted performance on math and vocabulary tests. We controlled for a series of individual and school characteristics (listed in Table S3) and fixed effects for province-of-residence and birth-province, which account for geographic, political, and economic differences across provinces.

Test Results Within China

Table 5 shows that students from counties with more rice farming performed better on both math and vocabulary tests. To illustrate the magnitude, consider a comparison between counties with no rice farming and counties that devote about 80% of farmland to rice, such as areas around Shanghai and Hong Kong. Children from high-rice counties answered, on average, one more question correctly on the math test and nearly two more questions correctly (1.86) on the vocabulary test. By contrast, doubling family wealth is associated with only a 0.27 increase in math and a 0.51 increase in vocabulary. In other words, the association between rice farming and test performance is larger than the effect of doubling household income.

We also estimated instrumental variable models using the CFPS data, replacing actual rice farming with rice predicted by ecological suitability for rice (Table 4, Columns 7-8). The instrumented results remained significant, suggesting that reverse causality is unlikely to explain the observed relationship.

5. Rice and Success in China's Civil Service Exam

Rice cultivation in China dates back thousands of years (Perkins, 1969; Talhelm and Oishi, 2018). Early practices were relatively simple, and labor-intensive techniques such as transplanting, continuous cultivation without fallowing, and human irrigation did not become widespread until much later (Elvin, 2006; Talhelm, 2015). By 1100 CE, however, these practices were common enough that an official from the Shanghai region criticized farmers in remote areas of failing to transplant seedlings, lamenting that "nothing is more wasteful of seed!" (Bray, 1986, p. 38).

If intensive rice farming was established that far back in history, it raises the question of

[9]Results were similar if we assigned rice statistics based on the father's birth county or the mother's birth county.

whether the effect on education stretches back into history too. If so, it would also rule out potential confounds of the many historical events and institutions that came later in history. For example, the Cultural Revolution was a massive disruption on the education system in China, and it did not influence all regions equally (Wang, 2021). If rice-farming areas had more educational success earlier in history, it could not be explained by factors like the Cultural Revolution.

China's Imperial Exam (*Keju*)

To investigate historical differences, we analyzed outcomes in imperial China's civil service exam, known as the *Keju* (科举). The imperial government used the civil service exam to recruit talented people to serve in the bureaucracy. The exam focused on Confucian moral philosophy and literary skills. The goal was to produce morally upright, capable civil servants who could govern according to Confucian ideals.

There were three levels of exams: the prefecture exam, the provincial exam, and the national exam. If people passed the prefecture exam, they earned the qualification of a *shengyuan* (生员, literally "student member") and became eligible to take the provincial exam. *Shengyuan* who passed the provincial exam earned the qualification of *juren* (举人, "recommended person") and could take the national exam. People who passed the final exam became a *jinshi* (进士, "advanced scholar") and won an attractive government job.

Historical Data on Rice and the Imperial Exam

We used data on success on the civil service exam across 272 prefectures[10] during the Ming and Qing dynasties (1368-1905 CE; Chen et al., 2020). We measure performance by prefecture-level *jinshi* density.[11] Figure 3 shows how rare success on the national exam was. Even the most successful prefectures had success rates of less than one in a thousand people. Figures S2 and S3 map success in the *juren* and *shengyuan* exams. Table S4 provides summary statistics.

We wanted a measure of rice farming far enough back in history that it pre-dated the Ming Dynasty and so could represent long-term cultural legacies that were in place before our imperial exam data. The best data we could find was a study that used historical texts to categorize whether prefectures were predominantly herding, dryland farming (such as millet), or wetland rice farming (Lu, 2014).[12] That study provided data for the Han dynasty (202 BCE-220 CE) and the Sui dynasty (581-618 CE). Since the broad climatic differences between regions are fairly stable, the estimates from the two dynasties are strongly correlated, $r(270) = 0.92$, $P < 0.001$. However, we ran separate tests using estimates from each dynasty to check the robustness of the analysis.

One obvious control variable is economic prosperity because people in wealthy areas could invest more in education. Thus, we controlled for two proxies of economic prosperity: the percentage of urban residents and the average population density between 1393 and 1910 (Cao, 2000, 2015).[13] We also controlled for general ecological suitability for agriculture because agriculture was a major source of economic prosperity in Chinese history (Chen et al., 2020). This

[10] In China, a prefecture is the administrative unit between a province and a county.
[11] In our regressions, *jinshi* density is measured as the logarithm of the number of *jinshi* per 10,000 prefecture residents, plus one. For visualization, Figure 3 maps the number of *jinshi* per 100,000 residents by prefecture to avoid values that are too small to interpret easily.
[12] Lu put prefectures into categories, rather than trying to estimate a percentage of rice. That means the rice variable is a dummy variable that takes the value of either 0 or 1.
[13] Of course, there is no data for every year going that far back in history. The data is based on estimates from 1391, 1580, 1776, 1820, 1851, 1880, and 1910.

allows us to separate rice farming in particular from agriculture in general.

Quotas are another important factor to account for. The government used a quota system to ensure different regions and ethnic groups had representation. The *shengyuan* quota was apportioned to counties and prefectures based on their population size, tax obligations, and past exam achievements (Chang, 1955). Unlike *jinshi* and *juren*, the *shengyuan* quota stayed the same over time (Bai and Jia, 2016). The government apportioned *jinshi* and *juren* quotas to provinces instead of prefectures or counties. One concern is that the prevalence of *jinshi* was fixed to the quotas and therefore does not properly measure academic performance. We tested for this possibility by controlling for *shengyuan* quotas. We also controlled for province fixed effects, which would account for provincial quotas for *jinshi* and *juren*.[14]

Results from the Imperial Exam

The first test confirmed the strength of the instrumental variable. Ecological suitability for rice predicted actual rice farming in the Han and Sui Dynasties (Table 6, Columns 1-2). Next, we used rice suitability to predict rice farming across regions. Using this data, rice regions consistently produced more *jinshi* per capita (Columns 3-4).

One plausible problem with analyzing regional differences is that some people move between regions, which can make their cultural heritage harder to categorize. To get around this problem, we re-ran the analysis after excluding the 2.7% of *jinshi* whose birthplace was different from the prefecture they took the exam (Columns 5-6).[15] After excluding movers, rice remained significant.

We also analyzed other potential explanations that researchers have suggested influenced success in the imperial exams (Table 7). One study found evidence that people did better in places that had more pine trees or bamboo (Chen et al., 2020). Pine and bamboo were important because they were two common materials for printing at that time. Our results were consistent with prior research, finding that there were fewer *jinshi* in areas farther from pine or bamboo (Columns 1-2). We also took into account distance to the capital of the province (Columns 3-4). Being closer to the capital could also reflect access to educational resources. However, distance to the capital was not significant.

Across specifications, rice-farming regions consistently outperformed others in producing *jinshi.* These findings suggest that rice-related cultural legacies promoting education date back centuries. The imperial exam was a very different system from modern schooling. Modern education is often compulsory and universal, whereas the imperial exam was voluntary and reached far fewer people. The imperial exam also focused on philosophy and literary skills—what would now be called "humanities," as opposed to the international standardized tests, which focus more on math and science. The fact that rice predicted success in such a distinct educational setting suggests that its cultural influence is broad and persistent.

6. Attitudes About Hard Work and Perseverance

So far, we have focused on outcomes—namely, that rice-farming cultures tend to achieve higher test scores. Our proposed explanation is cultural: rice farming fostered values of hard work

---

[14] Importantly, ethnic quotas often favored northern groups such as the Manchu and Mongols (Kracke, 1957), which, if anything, would bias against rice-growing regions.

[15] Moving was rare. This excludes 1,370 out of 46,908 *jinshi* between 1371-1904 CE.

and perseverance. To examine this mechanism directly, we analyze multiple datasets on cultural attitudes and behavioral markers of perseverance.

Hard Work and Perseverance: Evidence from the World Values Survey

We begin with the World Values Survey (WVS), which asks respondents about the importance of hard work. While several waves are available, we focus on the 2017 wave because it contains more detailed data on immigrant origins. The 2017 wave includes 54,889 respondents from 37 countries, among whom 3,389 are second-generation immigrants with ancestry from 68 countries. We analyze both the full sample and the second-generation subsample. Summary statistics are in Table S5.

The survey has two questions about hard work. The first asks people to choose a number from 1 ("Hard work doesn't generally bring success—it's more a matter of luck and connections") to 10 ("in the long run, hard work usually brings a better life"). The second asks about raising children: "Here is a list of qualities that children can be encouraged to learn at home. Which, if any, do you consider to be especially important?" Participants see a list of 11 qualities and can choose up to five. The list includes qualities such as good manners, independence, and obedience. Our two key choices were "hard work" and "determination, perseverance."

We find that people in rice-farming cultures or with parents from rice cultures show stronger endorsement of hard work (Table 8, Columns 1, 2, 4, 5) and perseverance (Table 8, Columns 3, 6). Results hold in both the full sample and the second-generation subsample.

Hard Work: Evidence from the General Social Survey

To test robustness, we turn to the General Social Survey (GSS), a nationally representative dataset collected by the University of Chicago National Opinion Research Center in the United States since 1972. Although the GSS does not report respondents' states—only broad regions (e.g., East North Central, East South Atlantic)—it offers two advantages: a longer time horizon and detailed ancestry data.

The GSS asks a similar question to the WVS about hard work: "Do you think to work hard is the most important thing on the list for a child to learn to prepare him or her for life?"[16] Responses range from 0 ("*least important*") to 4 ("*most important*"), with data available from 1986 through 2021.

One advantage of the GSS is that it has data on two types of ancestry. Like the WVS, it has data on where people's parents were born. That allows us to analyze differences among people whose parents were born outside the US (1,611 respondents from 36 countries of ancestry). But it also has data on people's ancestry, which can go back many generations (14,102 respondents from 36 countries of ancestry). Table S6 reports summary statistics on the samples.

People whose ancestors came from rice-farming cultures tended to agree more that children need to learn hard work. This was true whether that was ancestry in general (Table 8, Column 7) or the narrower sub-sample of second-generation immigrants (Table 8, Column 8). The fact that both immediate and distant ancestry predicted people's attitudes toward hard work suggest that these cultural differences are persistent across generations. This gives evidence that historical rice farming left a lasting influence on people's attitudes towards hard work.

[16] The list includes to obey, to be popular, to think for himself or herself, to work hard, and to help others when they need help.

Behavioral Markers of Perseverance: Evidence from Ungraded Survey Questions on the PISA and TIMSS

Previous researchers devised a creative way to infer perseverance on standardized tests like the TIMSS—whether students complete all the survey questions (Boe et al., 2002). After the students complete the exam portion, they have a set amount of time to fill out a survey that asks about their attitudes and demographics. Researchers calculated the percentage of survey questions that students completed as a marker of perseverance. Then they found that it is "one of the strongest predictors of national differences in mathematics and science achievement" (Boe et al., 2002, p. 5).

We followed their approach with the TIMSS and extended it to the PISA test. If anything, the PISA is probably a stronger test of perseverance for two reasons. In our sample, students saw 297 survey questions on the PISA versus 176 on the TIMSS on average[17]. First, the PISA had more survey questions than the TIMSS. Second, the main exam was longer on the PISA than the TIMSS. That means the students would presumably be more tired after completing the main exam questions on the PISA.

The burden of the PISA survey is clear in the completion rates (Figure 4). In the TIMSS, all countries completed more than 96% of the survey questions. For the PISA, the average was 93%, and some countries completed less than 75% of the questions.

Students in rice-farming cultures completed more of the ungraded survey questions on average (Figure 4). For example, on the PISA, students from cultures little or no rice farming (< 1%) completed 94% of the ungraded questions compared to 98% in cultures that are majority rice farming (> 50%).

Table 9 reports the results for the instrumental variable analysis using rice suitability as the instrument. Students from rice-farming cultures completed more of the ungraded survey questions even after controlling for individual, school, and country characteristics (Columns 1 and 3). Looking at second-generation immigrants in PISA 2018 (Column 2), having a parent from a rice-farming country also predicted more perseverance. One benefit of this perseverance data is that it is measured through people's behavior, which avoids the inevitable downsides of using attitude questions, such as social desirability and response style differences (Harzing, 2006).

Hard Work: Time Spent Studying in the CFPS

Next, we looked at another behavioral marker of hard work between regions in China—the number of hours per day children study. The survey asked the children how many hours per day they studied in the most recent academic month (excluding holidays).[18] The survey asked three questions: time spent in school, time studying for school (such as doing homework), and time on extracurricular learning (such as taking a weekend class outside of school). We combined these three questions into average study hours per day.

We call study time a "behavioral marker" because the questions ask about a concrete behavior, rather than an abstract attitude. However, some readers may be skeptical about children's reports

[17] Some students received more questions than other students. This could be a problem for comparing completion rates. In Supplemental Section 3, we present analyses controlling for the number of survey questions students saw. Rice farming continues to predict completion rates after accounting for the number of survey questions (Table S13).

[18] The survey asked about study hours on weekdays and weekends separately. We multiplied the weekday study hours by 5 and the weekend study hours by 2 and added them up. We then calculated how many hours they studied per day by dividing the sum by 7.

of how much they study. Students could feel pressure to say they study more than they really do. But it is hard to fake performance on the test questions in the survey. And students' self-reported study hours were significantly correlated with their performance on the math questions ($B = 0.40$, $P < 0.001$, $r = 0.25$) and the vocabulary questions ($B = 0.57$, $P < 0.001$, $r = 0.23$). This suggests children's self-reported study hours are tapping into reality.

Children from rice counties reported studying more than students from non-rice counties (Table 9, Column 4). In terms of time, children from counties with the most rice farming (80%) reported spending about an hour and 23 minutes more per day across the week. Table S7 further shows that this difference holds for both weekdays and weekends.

7. Alternative Mechanisms

Hard work is not the only plausible explanation for why rice-farming cultures score better on tests. In this section, we test whether alternative mechanisms can explain the impact of rice cultures on test outcomes. We explore mechanisms such as competitive mindset, Confucianism, educational aspirations, and family clans.

Competitive Mindset

One alternative explanation is competition. Rice-farming cultures score higher on psychological measures of interdependence, and it is easy to think of interdependence as about harmony and avoiding competition (Talhelm et al., 2014). However, studies have found that people in interdependent cultures tend to endorse competition more (Furnham et al., 1994; Różycka-Tran et al., 2015; Wu and Talhelm, 2024).

An anthropologist observing life in a rice-farming village in Japan reported that competition was threaded throughout everyday life, even though people were rarely confrontational about it (Smith, 1977). In China, a study found that people from rice-farming provinces were more likely than people from wheat-farming provinces to think that classmates and coworkers would compete with them in sneaky ways, such as pretending to help with an assignment but actually sabotaging it (Liu et al., 2019). In Korea, parents value the education of their children *relative* to the education of other children (Kim et al., 2024). Based on this evidence, perceptions of competition could push people to study harder and perform better.

We were able to compare perceptions of competition because the PISA included a question about competition. Students rated how much they agreed with the statement, "It is important for me to perform better than other people on a task" from 1 (*strongly disagree*) to 4 (*strongly agree*). The results were consistent with previous research linking interdependence to competition. Students from countries with a history of rice farming agreed more (Table S8). The same was true comparing second-generation immigrants.

Competition was also linked to better performance on the test. Students who agreed more about competition tended to score higher on the math test, for example ($P < 0.001$). This makes the competitive mindset explanation more plausible.

Given that, we ran mediation tests to compare competition and perseverance (using the ungraded survey questions). We used the "mediate" package in the program R, with bootstrapping and 500 simulations. These mediation tests allow us to estimate how much of the performance of people from rice-farming cultures can be explained through competition and perseverance.

Both competition and perseverance were significant in the mediation tests (Table S9A). This suggests they can both explain some of the relationship between rice and test scores. However, perseverance explained much more variance (Figure 5). Competition explained 3% of the relationship between rice and science scores, but perseverance explained 28%. Perseverance also explained more of the variance in math and reading scores. Perseverance explained more variance on the PISA than the TIMSS, perhaps because the PISA had more ungraded survey questions to complete, making it a better measure of perseverance. In sum, the results showed some support for the competitive mindset explanation but stronger support for the perseverance explanation.

Confucianism

Some researchers have explained East Asia's strong performance in education as stemming from Confucianism (Baumann et al., 2019; Minkov, 2008). This is a plausible explanation because Confucianism emphasized the importance of education in creating *junzi,* noble or virtuous people. Confucian texts often extolled the virtues of learning. For example, one of the classic Confucian texts is called the *Da Xue* (大学), which literally means "great learning." It also happens to be the modern word for "university."

Confucianism broadly influenced cultures in East Asia, but there is still variation in how prevalent it was across China. That makes it possible to compare different regions in China with more or less influence from Confucianism (such as Du, 2015). We used three measures to capture regional differences in Confucianism. First, we used a historical dataset documenting the number of Confucian academies in each prefecture during the Ming-Qing period. In addition, we examined two modern indicators: the number of Confucian academies and the number of Confucius temples in each prefecture. The modern measures have the advantage of being easier to obtain and potentially more precise. Moreover, if regional differences in Confucian influence are relatively stable across generations, the modern measures can also shed light on historical variation while improving measurement accuracy. However, we checked the robustness of the results by testing all three measures.

Prefectures with more temples or academies did not perform significantly better on the imperial exam (Table S10) or on the test questions for children in the China Family Panel Study (Table S11). Meanwhile, rice farming remained significant after accounting for regional differences in Confucian temples or academies. These results suggest that Confucianism cannot explain the differences between rice and wheat regions in China.

Belief in Education: Aspirations

A plausible alternative explanation is that people in rice cultures do better on tests because they believe more in the value of education. For example, perhaps people in rice cultures are more convinced that education leads to success in life. If so, parents may put more pressure on their kids to focus on education.

We tested for differences in belief in education using survey data from the TIMSS and the China Family Panel Study, which asked about educational aspirations. The TIMSS asked students their aspirations for their education from 1 (*lower secondary*) to 6 (*postgraduate*). The China Family Panel Study asked parents their aspiration for their kids from 0 (*none*) to 7 (*doctoral*). These questions do not ask directly about belief in education, but we assume that people who believe more in the value of education will tend to aspire to get more education.

The results showed that people in rice-farming cultures had higher aspirations for education, both when asking students themselves and their parents (Table S12). This was true even after controlling for a list of potential confounds, such as how educated their parents were. That makes aspirations a plausible mechanism.

Thus, we tested whether educational aspirations could explain the relationship between rice and test scores. However, in the TIMSS data, aspirations explained less than 2% of the effect of rice (Table S9A and Figure 6). In the China Family Panel Study, parental aspirations explained more of the effect—12% on math scores and 13% on vocabulary (Figure 7).

One possibility is that parental aspirations are a better predictor than children's aspirations of education outcomes. Unfortunately, we could not test parental aspirations in the PISA or TIMSS data because they only had data on students' aspirations. In sum, there was some evidence for aspirations as a mechanism, although perseverance explained more of the effect of rice (8-20%) than aspirations ($\leq$ 1.5%) in the TIMSS data.

Maybe Success on the Imperial Exam Changed Regional Outcomes?

Chen and colleagues (2020) argued that success on the imperial exam was an influence in and of itself. Their idea is that success on the exam led to lasting regional differences in human capital. That raises the possibility that modern-day rice areas have better test scores because of their history of success on the imperial exam.

We tested whether regional success on the imperial exam could explain the relationship between rice farming and test scores on the CFPS by adding regional success on the imperial exam (*jinshi* density) into the model (Table S11, Columns 4 and 8). Prefectures with a higher historical concentration of *jinshi* performed significantly better on CFPS test questions, echoing the findings from Chen and colleagues (2020). However, rice farming remained a robust predictor of test performance even after accounting for regional differences in *jinshi* density. This suggests that success on the imperial exam itself cannot fully explain differences in the high test performance of rice areas.

Next, we tested regional difference in imperial exam success as a possible mediator. Imperial exam success was a significant mediator (Figure S4). However, perseverance explained a higher percentage of the effect of rice (Table S9B).

Clans

Finally, we tested one other potential mechanism—family clans. Researchers have argued that family clans helped people prepare for the imperial exam because powerful clans accumulated educational resources such as books, teachers, and social connections (Chen et al., 2020). Because rice-farming cultures are more interdependent, and farmers often prefer to exchange labor with family rather than non-kin (Talhelm, 2015), clans may have been more common in rice areas. If so, clans offer an alternative explanation to hard work for why rice-farming areas performed better on the imperial exam.

We measured the prevalence of clans using the number of genealogies published in each prefecture during the Ming and Qing Dynasties (Chen et al., 2020). Researchers have used this metric as a proxy for clans because these sorts of family trees were an important task for clans. The data revealed that clans were more common in rice areas (Figure S5).

However, the results of mediation tests did not support the idea that clans could explain the success of rice regions (Figure S5). We ran analyses controlling for the presence of clans (Table

7, Columns 5-8). The direct effect of clans on imperial examination success was positive in some models, it was not statistically significant. Even after accounting for clans, rice continued to produce more *jinshi*. This result suggests the clan explanation is less likely.

8. Discussion

Education is a central concern for policymakers and researchers. One reason is that it is a strong predictor of life outcomes like income, crime, and health (e.g., Blau and Kahn, 2005; Figlio, 2006; Heckman et al., 2006). Education may also drive economic development (e.g., Balart et al., 2018; Hanushek and Kimko, 2000; Hanushek and Woessmann, 2012).

Genes clearly matter. For example, one study estimated that genes could account for 58% of performance in a national test for high school students in the UK (Shakeshaft et al., 2013). But effort matters too. And unlike genes, effort is within students' control. This makes it important to understand the role of effort in education.

Limitations and a Dark Side of Rice?

We looked at test performance in this study, but tests are only one form of education outcomes. It would be worthwhile to test whether these findings generalize to other outcomes, such as students' grade point averages and college graduation rates. There may be important outcomes outside of college, such as whether workers choose to enroll in training programs.

The results here seem uniformly positive for rice-farming cultures, but it is possible the results would be different if we had measured other outcomes. For example, rice farming's emphasis on hard work may encourage people to think of learning as hard work, rather than fun and interesting on its own. One study found that students' passion for subjects was a better predictor of their test scores in individualistic cultures and a worse predictor in collectivistic cultures (Li et al., 2021). Since rice-farming cultures tend to be more collectivistic, this could suggest they are less likely encourage passion for learning (Talhelm and Dong, 2024). Passion can be a source of fuel that pushes people to keep learning, even when there is no test or official system to reward it (Roberts et al., 2022). If we were to measure learning outside of the school system, it is possible that rice-farming cultures would fare worse. This remains to be tested.

Another outcome not covered in most standardized tests is creativity. There is some initial evidence that students in rice-farming areas of China score lower on what the researchers called "boundary-breaking creativity" (He and Wong, 2022). Because our study looked only at standardized tests, we could not test for differences in creativity.

The Long-Run Roots of Education

This study builds on a growing body of research on subsistence theory—the idea that how cultures made a living historically shapes differences in the modern day. The findings add to studies linking rice to technology adoption (Ang, 2019), innovation (Zhu et al., 2019), social norms (Talhelm and English, 2020), and cooperation (Ge et al., 2024). The larger idea is that the economic production systems of the past seem to leave a lasting imprint on societies.

These differences were not trivially small. On the PISA, rice was associated with differences on math scores that were on par with the differences between wealthy countries like the US and countries with far fewer resources, like the Dominican Republic. These findings support the idea that historical rice farming can explain modern-day differences in beliefs and behaviors—even among people who have never planted a seed or lifted a plow.

References

Anaya, L., & Zamarro, G. (2020). The role of student effort on performance in PISA: Revisiting the gender gap in achievement. Working paper

Ang, J. B. (2019). Agricultural legacy and individualistic culture. Journal of Economic Growth, 24(4), 397-425.

Bai, Y. & Jia, R. (2016). 'Elite recruitment and political stability: the impact of the abolition of China's civil service exam', Econometrica, vol. 84(2), pp. 677-733.

Balart, P., Oosterveen, M., & Webbink, D. (2018). Test scores, noncognitive skills and economic growth. Economics of Education Review, 63, 134-153.

Baumann, C., Winzar, H., & Viengkham, D. (2019). Confucianism, discipline, and competitiveness. Routledge.

Blau, F. D., & Kahn, L. M. (2005). Do cognitive test scores explain higher US wage inequality? Review of Economics and statistics, 87(1), 184-193.

Boe, E. E., May, H., & Boruch, R. F. (2002). Student Task Persistence in the Third International Mathematics and Science Study: A Major Source of Achievement Differences at the National, Classroom, and Student Levels. Report no.2002-TIMSS1 (December), Center for Research and Evaluation in Social Policy, University of Pennsylvania, Philadelphia, PA. Retrieved from: http://eric.ed.gov/?id=ED478493

Borghans, L., Golsteyn, B. H., Heckman, J. J., & Humphries, J. E. (2016). What grades and achievement tests measure. Proceedings of the National Academy of Sciences, 113(47), 13354-13359.

Borgonovi, F., & Biecek, P. (2016). An international comparison of students' ability to endure fatigue and maintain motivation during a low-stakes test. Learning and Individual Differences, 49, 128-137.

Braun, H., Kirsch, I., & Yamamoto, K. (2011). An experimental study of the effects of monetary incentives on performance on the 12th-grade NAEP reading assessment. Teachers college record, 113(11), 2309-2344.

Bray, F. (1986). The rice economies: Technology and development in Asian societies. Blackwell.

Brodeur, A., Lé, M., Sangnier, M., & Zylberberg, Y. (2016). Star wars: The empirics strike back. American Economic Journal: Applied Economics, 8(1), 1-32.

Buck, J. L. (1935). Land utilization in China. Chicago, IL: University of Chicago Press.

Cao, S. (2000). Zhongguo Renkou Shi, Diwu Juan (History of Population in China, Volume 5), Shanghai: Fudan University Press.

Cao, S. (2015). Zhongguo Renkou Shi, Ming Shiqi (History of Population in China, the Ming Period), Manuscript.

Chang, C. (1955). The Chinese Gentry: Studies on Their Role in Nineteenth-Century Chinese Society, Seattle: University of Washington Press.

Chen, T., Kung, J. K. S., & Ma, C. (2020). Long live Keju! The persistent effects of China's civil examination system. The Economic Journal, 130(631), 2030-2064.

Davidson, J. (2009). "We Work Hard": Customary Imperatives of the Diola Work Regime in the Context of Environmental and Economic Change. African Studies Review, 52(2): 119-141.

Dohmen, T., Falk, A., Huffman, D., & Sunde, U. (2010). Are risk aversion and impatience related to cognitive ability? American Economic Review, 100(3), 1238-1260.

Du, X. (2015). Does Confucianism reduce minority shareholder expropriation? Evidence from China. Journal of Business Ethics, 132(4), 661-716.

Eklöf, H. (2010). Skill and will: Test-taking motivation and assessment quality. Assessment in Education: Principles, Policy, & Practice, 17 (4), 345-56.

Elvin, M. (2006). The retreat of the elephants: An environmental history of China. New Haven, CT: Yale University Press.

Fei, X. [Fei, Hsiao-tung] (1945). Earthbound China: A study of rural economy in Yunnan. Chicago, IL: University of Chicago Press.

Fouka, V., & Schläpfer, A. (2020). Agricultural returns to labour and the origins of work ethics. The Economic Journal, 130(628), 1081-1113.

Figlio, D. N. (2006). Testing, crime and punishment. Journal of Public Economics, 90(4-5), 837-851.

Figlio, D., Giuliano, P., Özek, U., & Sapienza, P. (2019). Long-term orientation and educational performance. American Economic Journal: Economic Policy, 11(4), 272-309.

Furnham, A., Kirkcaldy, B. D., & Lynn, R. (1994). National attitudes to competitiveness, money, and work among young people: First, second, and third world differences. Human Relations, 47(1), 119-132.

Galor, O., & Özak, Ö. (2016). The agricultural origins of time preference. American Economic Review, 106, 3064-3103.

Ge, S., He, Q., & Sarangi, S. (2024). Reaping what you sow: Historical rice farming and contemporary cooperative behavior in China. Journal of Economic Behavior & Organization, 217, 581-613.

Gneezy, U., List, J. A., Livingston, J. A., Qin, X., Sadoff, S., & Xu, Y. (2019). Measuring success in education: the role of effort on the test itself. American Economic Review: Insights, 1(3), 291-308.

Guiso, L., Monte, F., Sapienza, P., & Zingales, L. (2008). Culture, gender, and math. Science, 320(5880), 1164-1165.

Hanushek, E. A., & Kimko, D. D. (2000). Schooling, labor-force quality, and the growth of nations. American Economic Review, 90(5), 1184-1208.

Hanushek, E. A., & Woessmann, L. (2012). Do better schools lead to more growth? Cognitive skills, economic outcomes, and causation. Journal of Economic Growth, 17(4), 267-321.

Harati, H., & Talhelm, T. (2023). Cultures in water-scarce environments are more long-term oriented. Psychological Science, 34(7), 754-770.

Harzing, A.-W. (2006). Response styles in cross-national survey research: A 26-country study. International Journal of Cross-Cultural Management, 6(2), 243-266.

He, W. J., & Wong, W. C. (2022). Middle school students from China's rice area show more adaptive creativity but less innovative and boundary-breaking creativity. Frontiers in Psychology, 12, 749229.

Heckman, J. J., Stixrud, J., & Urzua, S. (2006). The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior. Journal of Labor Economics, 24(3), 411-482.

Hofstede, G. (2001), Culture's Consequences: Comparing Values, Behaviors, Institutions, and Organization across Nations, Sage, Thousand Oaks, CA.

Hofstede, G., & Minkov, M. (2010). Long-versus short-term orientation: new perspectives. Asia Pacific Business Review, 16(4), 493-504.

Jalava, N., Joensen, J. S., & Pellas, E. (2015). Grades and rank: Impacts of non-financial incentives on test performance. Journal of Economic Behavior & Organization, 115, 161-196.

Jensen, M. (2015). Personality traits, learning and academic achievements. Journal of Education and Learning, 4(4), 91-118.

Kim, S., Tertilt, M., & Yum, M. (2024). Status externalities in education and low birth rates in Korea. American Economic Review, *114*(6), 1576-1611.

Kracke, E. A. (1957). Region, family and individual in the Chinese examination system. in Fairbank, John K. (ed.), Chinese Thoughts & Institutions, Chicago: University of Chicago Press.

Levitt, S. D., List, J. A., Neckermann, S., & Sadoff, S. (2016). The behavioralist goes to school: Leveraging behavioral economics to improve educational performance. American Economic Journal: Economic Policy, 8(4), 183-219.

Li, X., Han, M., Cohen, G. L., & Markus, H. R. (2021). Passion matters but not equally everywhere: Predicting achievement from interest, enjoyment, and efficacy in 59 societies. Proceedings of the National Academy of Sciences, 118(11), e2016964118.

Liu, S., Morris, M. W., Talhelm, T., & Yang, Q. (2019). Ingroup vigilance in collectivistic culture. Proceedings of the National Academy of Sciences, 116(29), 14538-14546.

Lu, X. (2014). Zhongguo Lishi de Kongjian Jiegou (The Spatial Structure of Chinese History), Guilin: Guangxi Normal University Press.

Minkov, M. (2008). Self-enhancement and self-stability predict school achievement at the national level. Cross-cultural Research, 42(2), 172-196.

Mischel, W., Shoda, Y., & Rodriguez, M. L. (1989). Delay of gratification in children. Science, 244(4907), 933-938.

Nollenberger, N., Rodríguez-Planas, N., & Sevilla, A. (2016). The math gender gap: The role of culture. American Economic Review, 106(5), 257-61.

Nunn, N., & Puga, D. (2012). Ruggedness: The blessing of bad geography in Africa. Review of Economics and Statistics, 94(1), 20-36.

Perkins, D. H. (1969). Agricultural development in China, 1368-1968. AldineTransaction.

Roberts, L. W., Keller, C. R., & Welsh, M. E. (2022). Spark: Students describe curiosity and passion for learning. Portal: Libraries and the Academy, 22(3), 613-630.

Różycka-Tran, J., Boski, P., & Wojciszke, B. (2015). Belief in a zero-sum game as a social axiom: A 37-nation study. Journal of Cross-Cultural Psychology, 46(4), 525-548.

Shakeshaft, N. G., Trzaskowski, M., McMillan, A., Rimfeld, K., Krapohl, E., Haworth, C. M. A., Dale, P. S., & Plomin, R. (2013). Strong Genetic Influence on a UK Nationwide Test of Educational Achievement at the End of Compulsory Education at Age 16. PLOS ONE, 8(12), e80341.

Smith, T. (1977). Nakahara: Family farming and population in a Japanese village. Stanford University Press.

Talhelm, T. (2015). The rice theory of culture (doctoral dissertation). University of Virginia, Charlottesville, Virginia.

Talhelm, T., & Dong, X. (2024). People quasi-randomly assigned to farm rice are more collectivistic than people assigned to farm wheat. Nature Communications, 15(1), 1782.

Talhelm, T., & English, A. S. (2020). Historically rice-farming societies have tighter social norms in China and worldwide. Proceedings of the National Academy of Sciences, 117(33), 19816-19824.

Talhelm, T., & Oishi, S. (2018). How rice farming shaped culture in Southern China. In A. K. Uskul & S. Oishi (Eds.), Socioeconomic environment and human psychology (pp. 53-76). Oxford University Press.

Talhelm, T., & Oishi, S. (2019). Culture and Ecology. In D. Cohen & S. Kitayama (Eds.), Handbook of Cultural Psychology (pp. 119-143). Guilford Press.

Talhelm, T., Zhang, X., Oishi, S., Shimin, C., Duan, D., Lan, X., & Kitayama, S. (2014). Large-scale psychological differences within China explained by rice versus wheat agriculture. Science, 344(6184), 603-608.

Wang, Y. (2021). The political legacy of violence during China's Cultural Revolution. British Journal of Political Science, 51(2), 463-487.

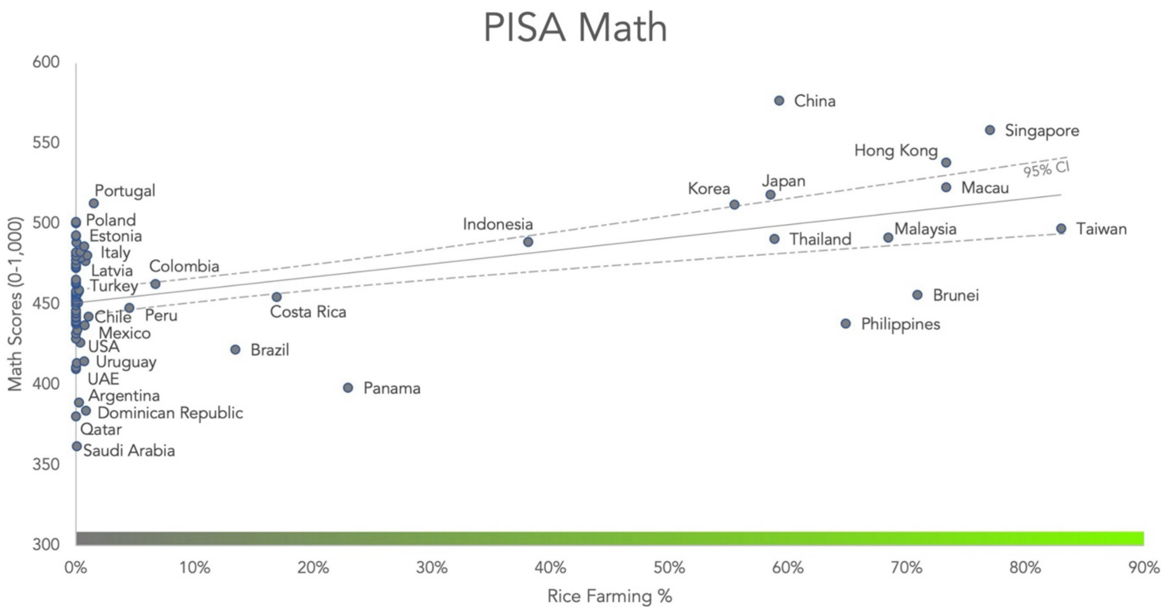
Wu, K., & Talhelm, T. (2024). Hide a Dagger Behind a Smile: A Review of How Collectivistic Cultures Compete More Than Individualistic Cultures. In S. Garcia & A. Tor (Eds.), Oxford Handbook on Psychology of Competition (pp. 611-642). Oxford University Press.

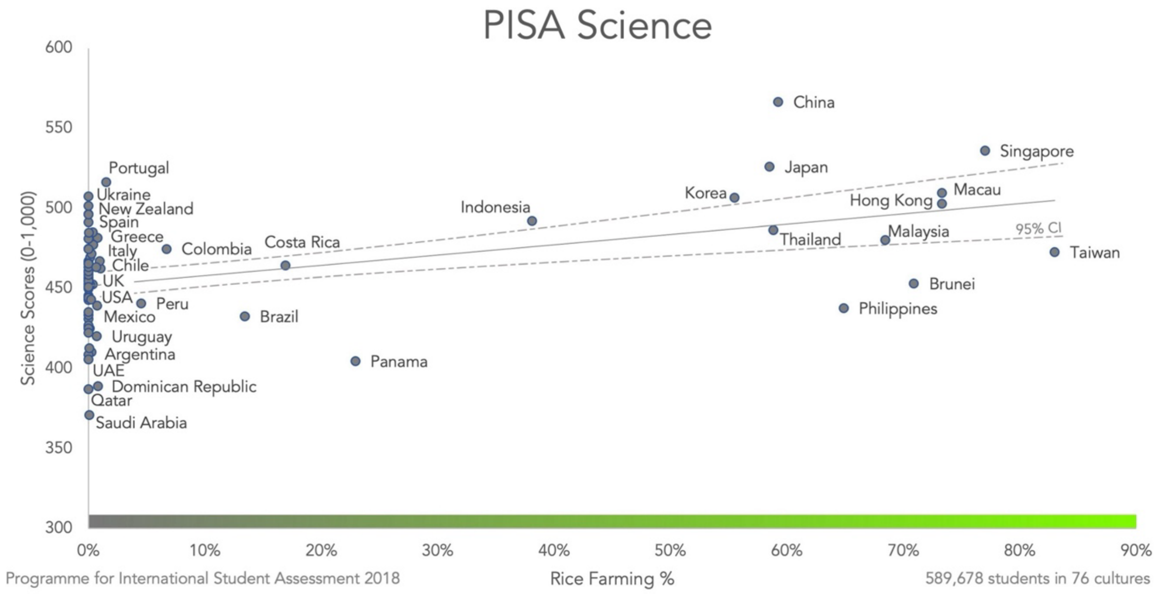
Zamarro, G., Hitt, C., & Mendez, I. (2019). When students don’t care: Reexamining international differences in achievement and student effort. Journal of Human Capital, 13(4), 519-552.

Zhu, J., Ang, J. B., & Fredriksson, P. G. (2019). The agricultural roots of Chinese innovation performance. European Economic Review, 118, 126-147.

Figure 1

Rice-Farming Cultures Score Higher on the PISA Test

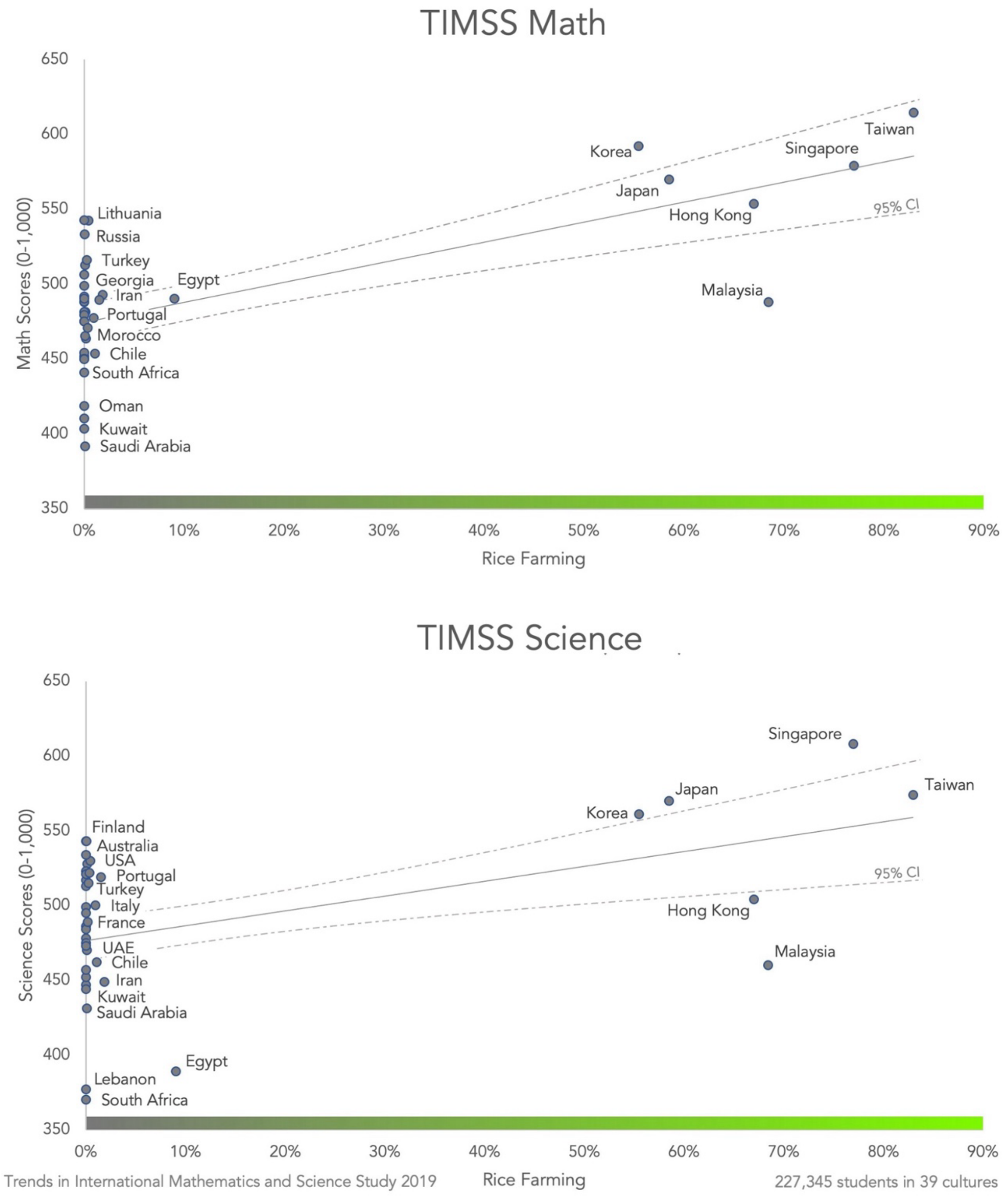




Note: The scatter plots illustrate the relationship between historical rice farming (measured by the percentage of farmland devoted to rice farming at the country level in 1961) and country average math and science test scores from PISA 2018. The scores account for the country characteristics listed in Table 2A, with the exception of freshwater availability to maximize country coverage. The graph sample includes 589,678 students from 76 cultures, larger than the sample in Table 2A, because the graph uses averages for demographics like family wealth whereas the regression sample excludes respondents with any missing data. Unlike TIMSS, PISA also tested reading, and the corresponding scatter plot is provided in Figure S1.

Figure 2

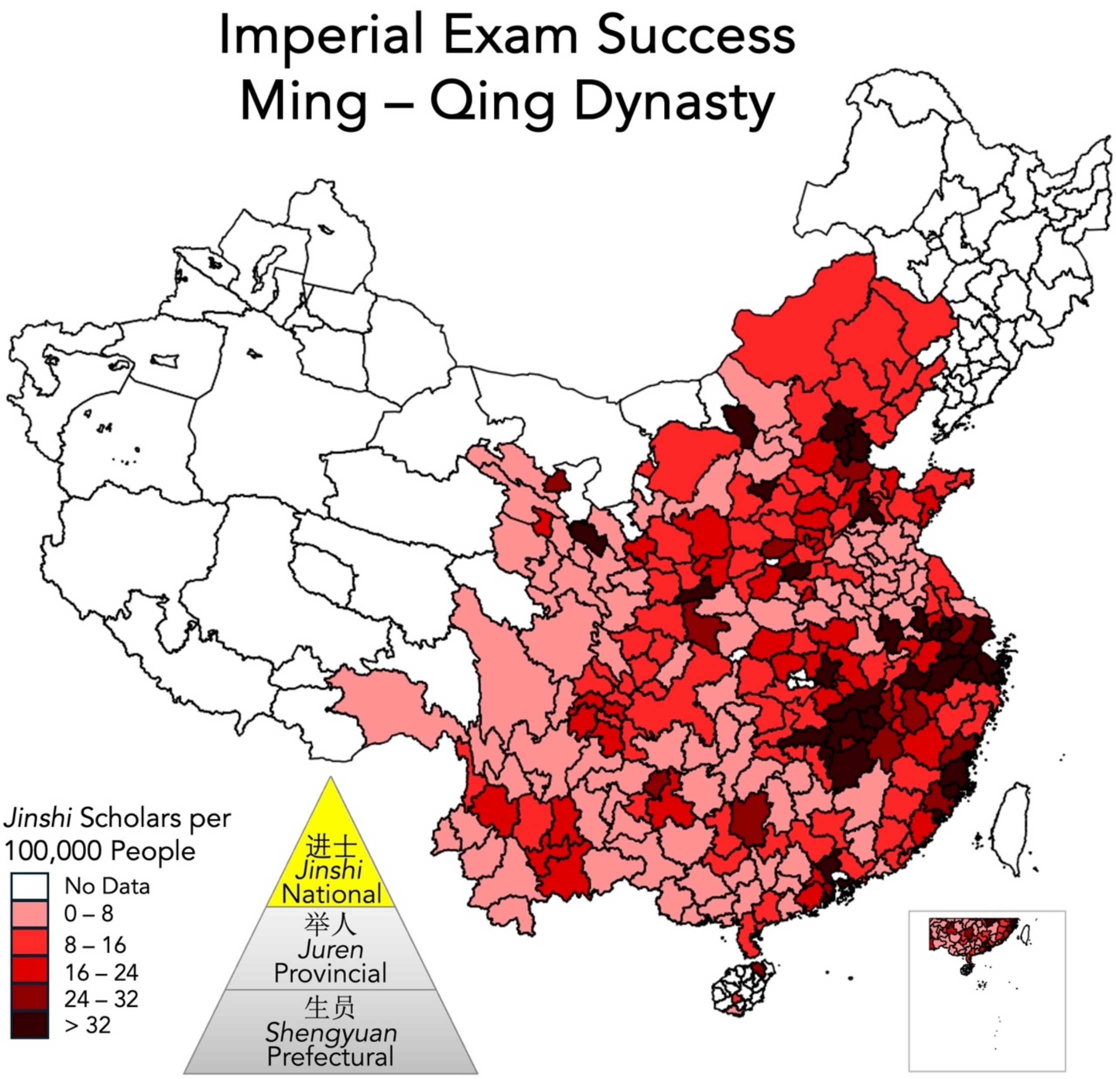
Rice-Farming Cultures Score Higher on the TIMSS Test



Note: The scatter plots illustrate the relationship between historical rice farming (measured by the percentage of farmland devoted to rice farming at the country level in 1961) and country average math and science test scores from TIMSS 2019. The scores account for the country characteristics listed in Table 2B, with the exception of freshwater availability to maximize country coverage. The graph sample includes 227,345 students from 39 cultures, larger than the sample in Table 2B, because the graph uses averages for demographics whereas the regression sample excludes respondents with any missing data.

Figure 3

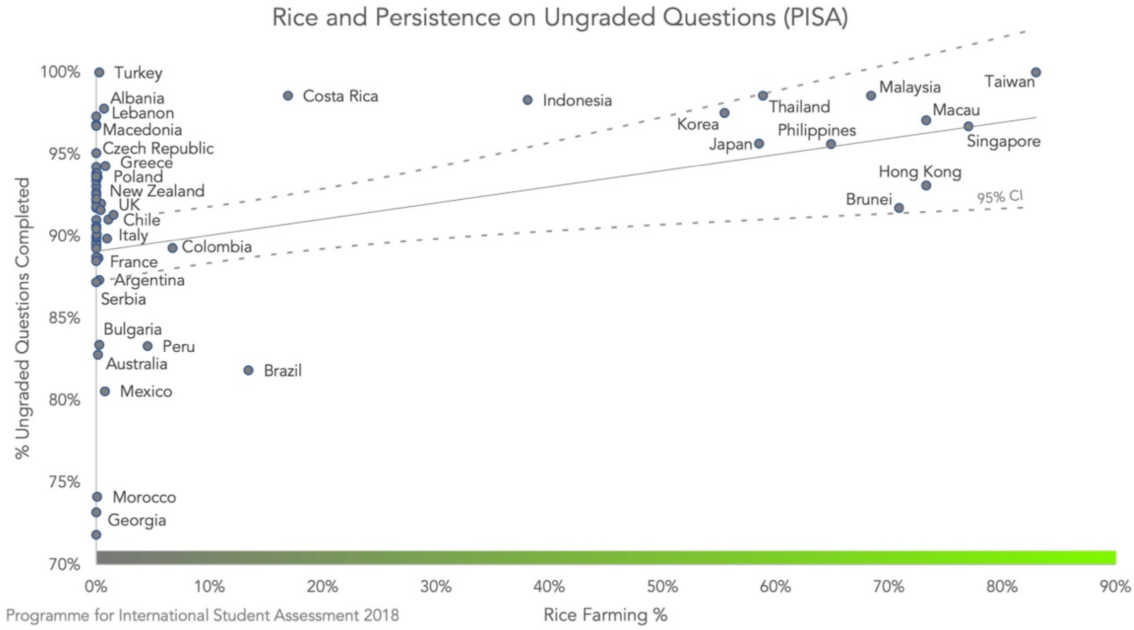
Success in the Imperial Exam During the Ming and Qing Dynasties Across Prefectures

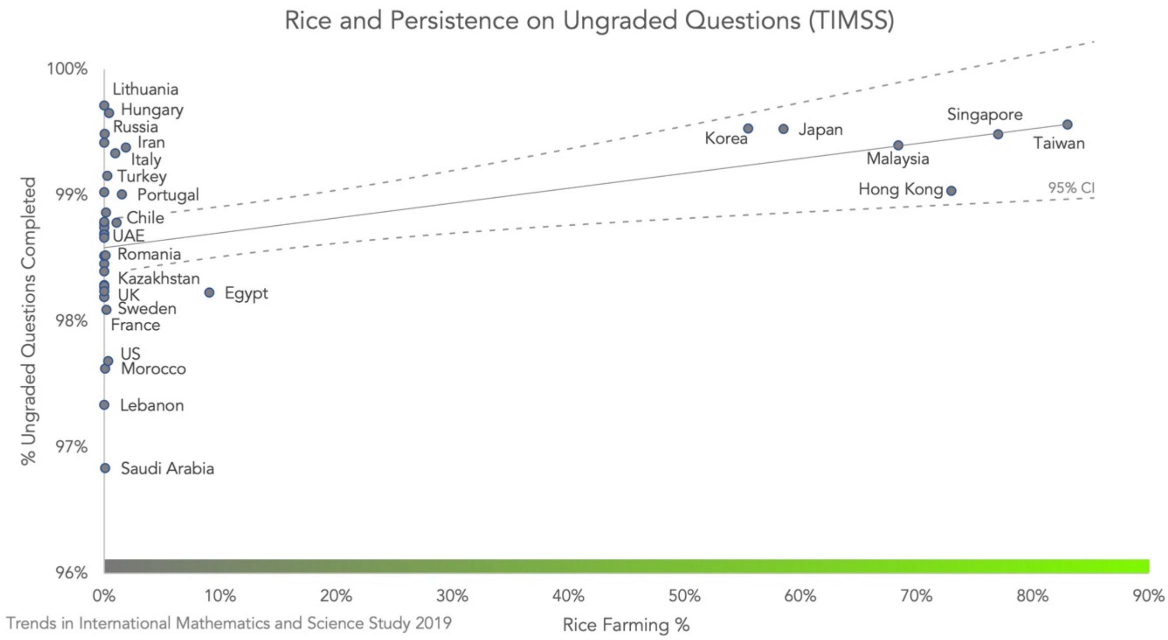


Note: This map shows the number of people per 100,000 who passed the national level of the imperial exam from different prefectures during the Ming and Qing dynasties (1368-1905 CE; Chen et al., 2020). Passing the national exam led to desirable government jobs, but competition was fierce. Even the most successful prefectures had rates of less than one in a thousand people passing the exam from the population. Figures S2 and S3 map success on the province (*juren*) and prefecture (*shengyuan*) exams.

Figure 4

Rice and Perseverance: Students in Cultures with a History of Rice Farming Complete More Ungraded Survey Questions on Standardized Tests

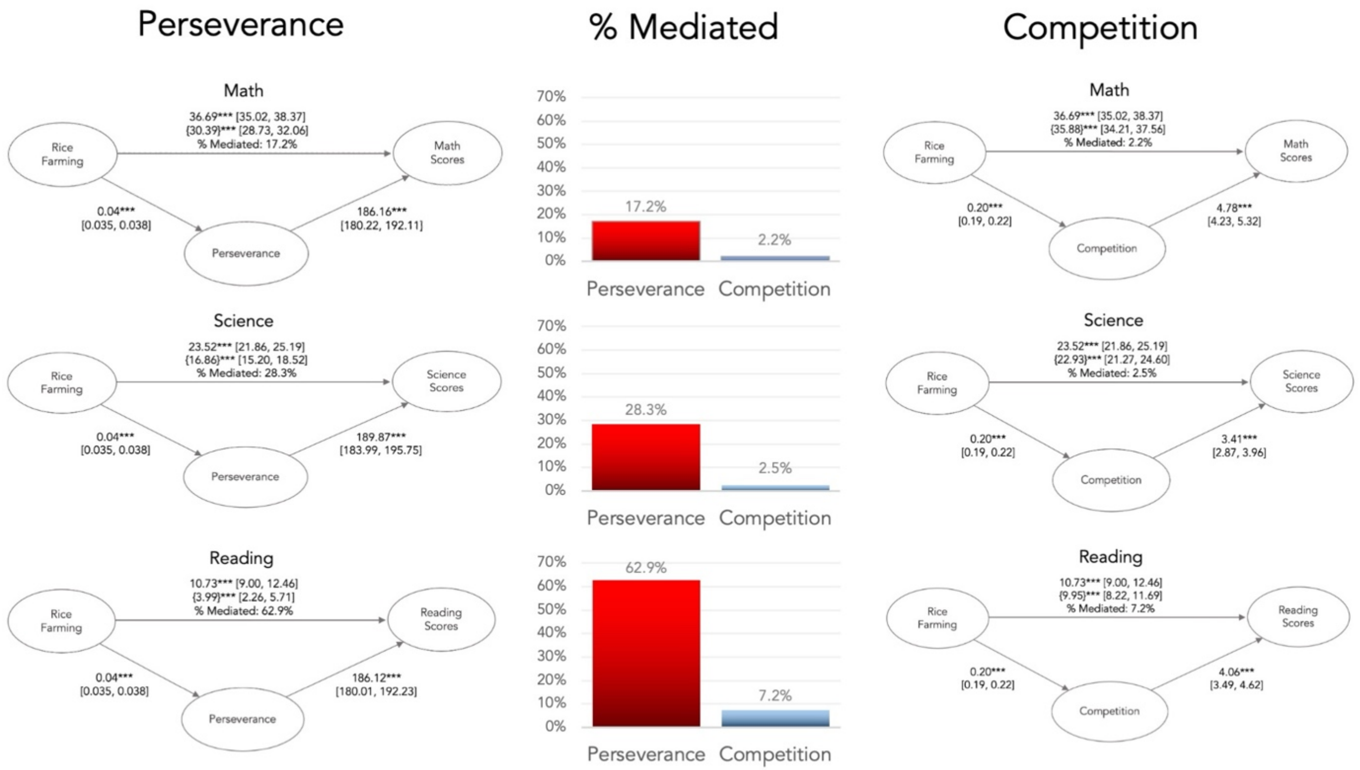




Note: These figures plot the relationship between rice farming and the percentage of demographic and attitude questions that students complete. These questions come after the main test and do not affect students' grades. A previous study used this as a measure of perseverance (Boe et al., 2002). Scores on the Y axis take into account potential confounds between sites listed in Table 2, such as parental education, family wealth, and private versus public schools.

Figure 5

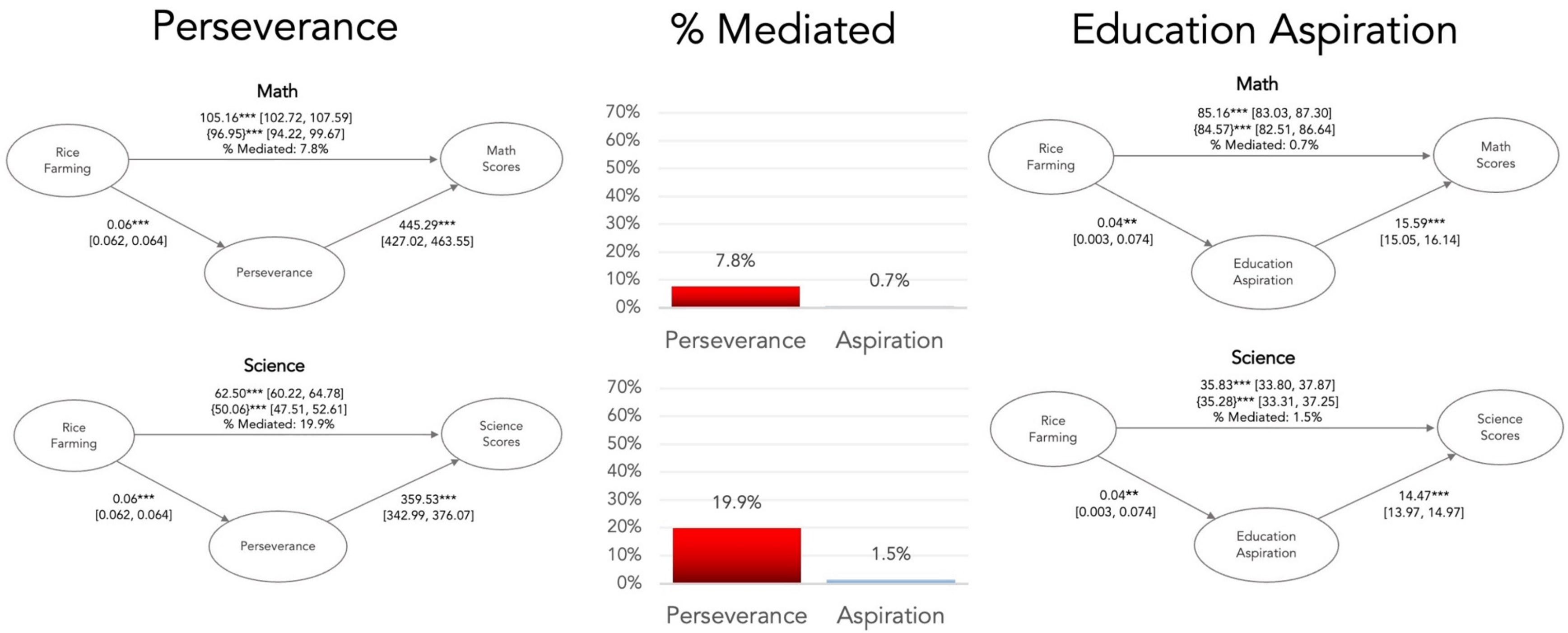
Mediation Test: Perseverance Is a Stronger Mediator of the Relationship Between Rice Farming and Scores Than Competition (PISA Test)



Note: This figure reports mediation tests asking whether perseverance (left side) and attitudes toward competition (right side) can explain why cultures with a history of rice farming score higher on the standardized international PISA tests. Perseverance: We used the percentage of ungraded survey questions each student completed (Boe et al., 2002). Competition: We used a question on the PISA test that asked students how much they agree with the statement, "It is important for me to perform better than other people on a task" from 1 (*strongly disagree*) to 4 (*strongly agree*). Because the sample size is large, it is fairly easy to get a significant result. Therefore, we think it is more valuable to look at the percent mediated. The models account for students' year in school, gender, college and high school education of both father and mother, family wealth, the percentage of female students at the school, whether the school is private, whether the school is in an urban area, GDP per capita, distance to the coast, absolute latitude, elevation, and freshwater resources. The tests use the "mediate" package in the program R with bootstrapping and 500 simulations. Values are regression coefficients [with bootstrapped 95% confidence intervals]. ***$P < 0.01$

Figure 6

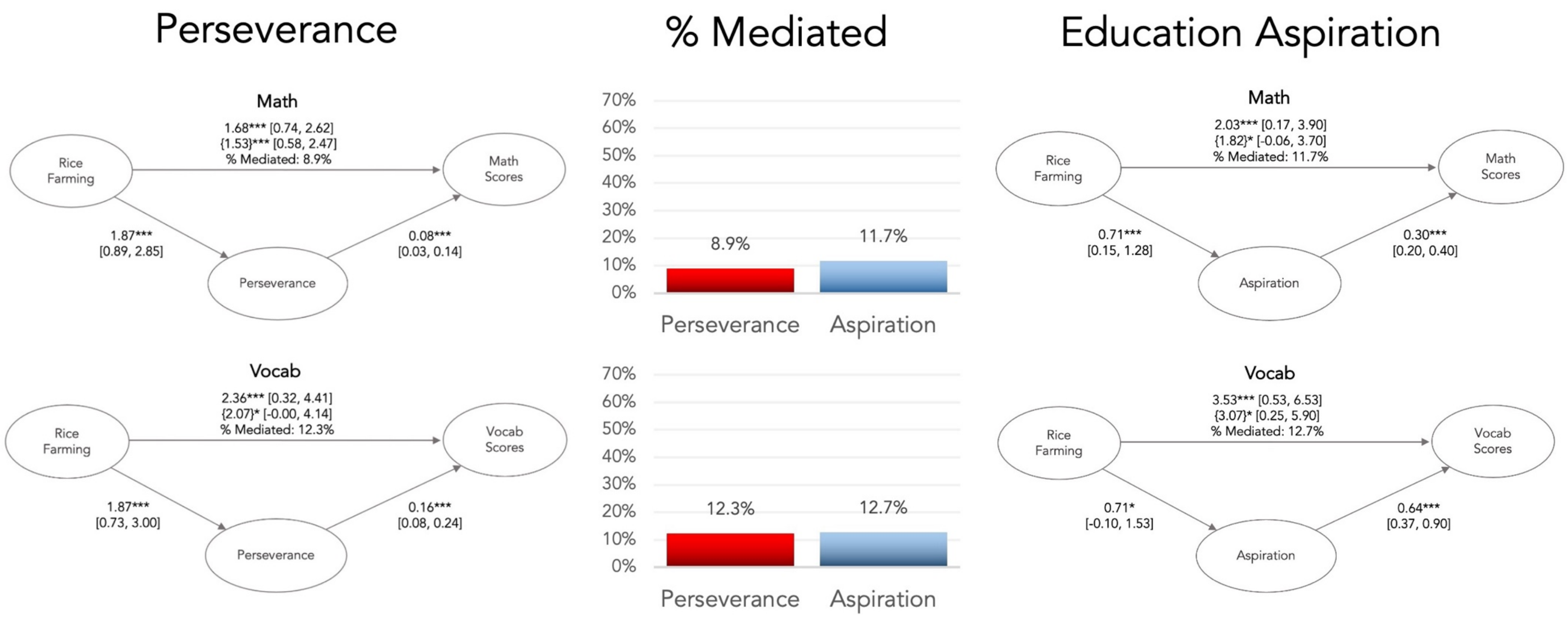
Mediation Test: Perseverance Is a Stronger Mediator of the Relationship Between Rice Farming and Scores Than Students' Educational Aspirations (TIMSS)



Note: This figure reports mediation tests asking whether perseverance (left) and parents' aspirations for their kids' education (right) can explain why cultures with a history of rice farming score high on the standardized international TIMSS test. **Perseverance:** The percent of ungraded survey questions each student completed. **Aspiration:** The TIMSS asks students their aspirations for their education from 1 (*lower secondary*) to 6 (*postgraduate*). Aspirations explained less than 2% of the relationship between rice and test scores. **Percent Mediated:** Because the sample size is large, it is fairly easy to get significant results. Therefore, we think it is more valuable to look at the percent mediated. **Control Variables:** The models account for age, gender, parental education, the percent of affluent students at the school, whether the school is in an urban area, GDP per capita, absolute latitude, elevation, water scarcity, and distance to the coast/navigable river with sea access. The tests use the "mediate" package in R with bootstrapping and 500 simulations. Values are regression coefficients [with bootstrapped 95% confidence intervals]. *$P < 0.10$, **$P < 0.05$, ***$P < 0.01$. The asterisks follow the convention in economics of marking $P < 0.10$ with an asterisk (Brodeur et al., 2016).

Figure 7

Testing Perseverance and Education Aspiration as Mechanisms of the Relationship Between Rice Farming and Test Scores (CFPS)



Note: This figure reports mediation tests asking whether perseverance (left) and parents' aspirations for their kids' education (right) can explain why cultures with a history of rice farming score high on the test questions in the China Family Panel Study. **Perseverance:** We estimated perseverance using the number of hours per day students reported studying. **Aspiration:** Parents reported their aspirations for their children from 0 (*none*) to 7 (*doctoral*). **Control Variables:** The models account for age, gender, college and high school education of both father and mother, the percentage of affluent students at the school, whether the school is in an urban area, GDP per capita, absolute latitude, elevation, water scarcity, and distance to the coast/navigable river with sea access. Because the "mediate" package in R had trouble with the China Family Panel Study data, we used the "gsem" command in the program STATA with bootstrapping and 500 simulations. Values are regression coefficients [with bootstrapped 95% confidence intervals]. $*P < 0.10$, $**P < 0.05$, $***P < 0.01$

Table 1: *Correlation Between Rice Farming and Test Scores*

	PISA 2018				TIMSS 2019		
	Rice	Math	Science	Reading	Rice	Math	Science
Math	0.29^{**}	1			0.62^{***}	1	
Science	0.25^{**}	0.97^{***}	1		0.41^{**}	0.88^{***}	1
Reading	0.20^{*}	0.94^{***}	0.98^{***}	1	--	--	--

Note: The left panel uses data from PISA 2018, and the right panel uses data from TIMSS 2019. The TIMSS did not include reading scores. Rice is the percentage of farmland devoted to rice farming in 1961. ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$. The asterisks follow the convention in economics of marking $P < 0.10$ with an asterisk (Brodeur et al., 2016).

Table 2A: *Test Scores and Rice Farming (PISA 2018)*

Variables	Math	Science	Reading	Math	Science	Reading	Math	Science	Reading
	Dependent variable: Test scores								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Controls:	Individual Students and Family			Schools			Countries and Regions		
Rice	47.710***	33.413***	14.366***	44.060***	28.259***	6.746***	75.371***	47.723***	22.989***
	(0.755)	(0.721)	(0.778)	(0.759)	(0.725)	(0.771)	(0.904)	(0.907)	(0.939)
Grade	32.462***	29.314***	32.082***	32.519***	29.394***	32.175***	29.421***	27.310***	30.178***
	(0.280)	(0.276)	(0.289)	(0.279)	(0.274)	(0.286)	(0.266)	(0.265)	(0.276)
Female	-10.120***	-3.109***	22.163***	-12.757***	-6.495***	18.048***	-12.463***	-6.260***	18.310***
	(0.327)	(0.328)	(0.344)	(0.344)	(0.345)	(0.360)	(0.332)	(0.338)	(0.352)
Father High School Grad.	7.089***	7.624***	7.039***	7.128***	7.688***	7.124***	7.371***	7.349***	7.036***
	(0.491)	(0.489)	(0.513)	(0.490)	(0.487)	(0.510)	(0.477)	(0.482)	(0.503)
Father Univ. Grad.	12.195***	13.359***	12.467***	11.630***	12.566***	11.330***	12.340***	12.893***	11.891***
	(0.517)	(0.519)	(0.543)	(0.517)	(0.518)	(0.540)	(0.502)	(0.511)	(0.533)
Mother High School Grad.	4.248***	3.875***	4.925***	4.308***	3.955***	5.074***	4.926***	4.428***	5.770***
	(0.510)	(0.506)	(0.531)	(0.509)	(0.504)	(0.527)	(0.494)	(0.495)	(0.516)
Mother Univ. Grad.	9.781***	10.949***	11.143***	9.457***	10.486***	10.522***	9.126***	10.380***	10.686***
	(0.542)	(0.542)	(0.566)	(0.541)	(0.541)	(0.562)	(0.526)	(0.533)	(0.554)
Father Employed	8.494***	7.189***	8.177***	8.200***	6.790***	7.701***	13.087***	10.541***	11.111***
	(1.129)	(1.132)	(1.175)	(1.124)	(1.123)	(1.162)	(1.094)	(1.111)	(1.146)
Mother Employed	24.576***	22.554***	25.118***	24.859***	22.956***	25.666***	16.550***	16.065***	17.742***
	(0.453)	(0.443)	(0.465)	(0.452)	(0.441)	(0.462)	(0.443)	(0.438)	(0.456)
Household Wealth	33.781***	29.399***	30.544***	33.385***	28.827***	29.781***	22.742***	20.978***	21.377***
	(0.179)	(0.175)	(0.185)	(0.180)	(0.176)	(0.185)	(0.193)	(0.192)	(0.201)
School % Female				24.378***	31.318***	38.235***	29.895***	35.295***	42.354***
				(1.050)	(1.044)	(1.089)	(1.019)	(1.028)	(1.065)
Private School				2.381***	3.794***	4.116***	6.281***	6.714***	6.820***
				(0.409)	(0.407)	(0.431)	(0.400)	(0.406)	(0.428)
Urban Area				10.897***	15.262***	23.452***	14.079***	16.017***	23.088***
				(0.470)	(0.467)	(0.491)	(0.463)	(0.468)	(0.490)
GDP per Capita							18.476***	14.399***	17.470***
							(0.246)	(0.248)	(0.259)
Distance to Sea							0.004***	-0.000	0.000
							(0.001)	(0.001)	(0.001)
Latitude (Absolute)[a]							0.841***	0.539***	0.436***
							(0.016)	(0.017)	(0.018)
Elevation[b]							11.675***	17.088***	19.446***
							(0.688)	(0.687)	(0.712)
Terrain Ruggedness[c]							-20.091***	-57.810***	-74.832***
							(1.621)	(1.639)	(1.734)
Freshwater Availability[d]							-4.614***	-2.641***	-1.829***
							(0.124)	(0.129)	(0.137)
Students	279,071	279,071	279,071	279,071	279,071	279,071	279,071	279,071	279,071
R Squared	0.294	0.248	0.260	0.296	0.253	0.270	0.343	0.283	0.302

Note: This table reports the effect of rice farming on student's test scores in math, science, and reading using data from PISA 2018. Table S1 gives more detail on the variables. Rice is measured as the percentage of farmland devoted to rice farming at the country level in 1961. Robust standard errors are in parentheses. [a]Latitude is absolute, meaning it reflects distance from the equator. [b]Elevation is the average over each country. [c]Terrain ruggedness measures the difference in elevation across points in each country. Scores are lowest in flat countries like the Netherlands (0.04) and highest in mountainous countries like Nepal (5.04). Rugged terrain is a long-run ecological condition that influences whether farming is possible and tends to harm economic development (Nunn and Puga, 2012). [d]Freshwater availability measures the cubic meters of freshwater per person. A previous study found that people in cultures with water scarcity tend to endorse perseverance and long-term orientation more than people in cultures with plentiful water (Harati and Talhelm, 2023). ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$. The asterisks follow the convention in economics of marking $P < 0.10$ with an asterisk (Brodeur et al., 2016).

Table 2B: *Test Scores and Rice Farming (TIMSS 2019)*

Variables	Dependent variable: Test scores					
	Math (1)	Science (2)	Math (3)	Science (4)	Math (5)	Science (6)
Rice	141.805***	90.007***	146.478***	94.362***	178.160***	111.177***
	(1.177)	(1.115)	(1.169)	(1.109)	(1.517)	(1.405)
Age	-17.441***	-23.695***	-15.761***	-21.991***	-15.211***	-23.503***
	(0.390)	(0.457)	(0.369)	(0.436)	(0.354)	(0.422)
Female	-0.567	2.156***	-0.466	2.277***	0.087	2.611***
	(0.612)	(0.637)	(0.590)	(0.617)	(0.549)	(0.576)
Father Graduated High School	25.330***	28.654***	21.208***	24.620***	13.094***	14.826***
	(0.939)	(1.017)	(0.914)	(0.994)	(0.857)	(0.937)
Father Graduated University	67.122***	70.070***	54.712***	57.850***	38.499***	39.497***
	(1.060)	(1.135)	(1.038)	(1.117)	(0.978)	(1.058)
Mother Graduated High School	25.374***	24.517***	21.545***	20.773***	15.516***	13.486***
	(0.924)	(1.000)	(0.899)	(0.976)	(0.838)	(0.912)
Mother Graduated University	49.197***	45.235***	39.169***	35.299***	34.498***	29.977***
	(1.065)	(1.143)	(1.033)	(1.115)	(0.958)	(1.036)
Proportion of Affluent Students			21.794***	21.374***	13.115***	13.107***
			(0.265)	(0.274)	(0.269)	(0.278)
Urban Area			3.005***	4.295***	11.263***	12.306***
			(0.647)	(0.659)	(0.619)	(0.641)
GDP per Capita					25.536***	24.762***
					(0.408)	(0.416)
Distance to Sea					0.015***	0.008***
					(0.001)	(0.001)
Latitude (Absolute)[a]					1.572***	1.247***
					(0.030)	(0.029)
Elevation[b]					3.123***	4.165***
					(1.100)	(1.065)
Terrain Ruggedness[c]					25.328***	-43.717***
					(2.758)	(3.155)
Freshwater Availability[d]					-0.829***	3.115***
					(0.188)	(0.192)
Students	91,119	91,119	91,119	91,119	91,119	91,119
R Squared	0.305	0.241	0.354	0.289	0.442	0.380

Note: This table reports the effect of rice farming on student's test scores in math and science using data from TIMSS 2019. Table S2 gives more detail on the variables. Rice is measured as the percentage of farmland devoted to rice farming at the country level in 1961. Robust standard errors are in parentheses. [a]Latitude is absolute, meaning it reflects distance from the equator. [b]Elevation is the average over each country. [c]Terrain ruggedness measures the difference in elevation across points in each country. Scores are lowest in flat countries like the Netherlands (0.04) and highest in mountainous countries like Nepal (5.04). Rugged terrain is a long-run ecological condition that influences whether farming is possible and tends to harm economic development (Nunn and Puga, 2012). [d]Freshwater availability measures the cubic meters of freshwater per person. A previous study found that people in cultures with water scarcity tend to endorse perseverance and long-term orientation more than people in cultures with plentiful water (Harati and Talhelm, 2023). ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

Table 3: *The Rice-Farming Heritage of Second-Generation Immigrants' Parents Predicts Standardized Test Scores (PISA 2018)*

	Dependent Variable: Test Scores											
	Either Parent			**Mother**			**Father**			**Both**		
	Math	Science	Reading	Math	Science	Reading	Math	Science	Reading	Math	Science	Reading
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Rice	78.286***	52.350***	49.911***	79.172***	55.629***	50.100***	82.838***	51.670***	52.931***	78.224***	50.496***	47.678***
	(13.085)	(12.252)	(13.301)	(14.882)	(13.729)	(14.810)	(14.215)	(15.011)	(15.850)	(18.928)	(18.288)	(19.880)
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ancestral Country Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Host Country Fixed Effects[a]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Students	8,669	8,669	8,669	6,386	6,386	6,386	6,272	6,272	6,272	3,989	3,989	3,989
R Squared	0.345	0.275	0.295	0.356	0.285	0.308	0.354	0.293	0.316	0.379	0.319	0.353

Note: This table reports the effect of rice farming on student's test scores in math, science, and reading using the sample of second-generation immigrants from PISA 2018. Rice is measured as the percentage of farmland devoted to rice farming for their parents' country in 1961. Table S1 lists the control variables. Standard errors in parentheses are clustered by people's country of ancestry. [a]Host-country fixed effects remove differences between the countries students are living in, such as wealth and national education policies. ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$.

Table 4: *Instrumental Variable Estimates of the Effect of Rice Farming on Test Scores*

Panel A: Dependent Variable: Actual Rice Farming[a] (First-Stage Estimates)

	PISA (Full Sample)	TIMSS (Full Sample)	PISA (2^{nd}-Gen. Immigrants)	CFPS
Environmental Suitability for Rice	0.015***	0.008***	0.014***	0.011***
	(0.000)	(0.000)	(0.000)	(0.001)

Panel B: Dependent Variable: Test Scores (2SLS Estimates)

	PISA (Full Sample)			TIMSS		PISA (2^{nd}-Gen. Immigrants)			CFPS	
	Math	Science	Reading	Math	Science	Math	Science	Reading	Math	Vocabulary
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Rice	43.817***	40.419***	29.489***	211.981***	150.180***	80.121***	50.782***	59.559***	2.120***	4.644*
	(1.671)	(1.325)	(1.796)	(2.023)	(1.922)	(15.892)	(15.054)	(11.769)	(0.601)	(2.816)
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Controls	Yes	Yes	Yes	Yes	Yes					
Ancestral Country Controls						Yes	Yes	Yes		
Host Country Fixed Effects						Yes	Yes	Yes		
Current Province Fixed Effects									Yes	Yes
Birth Province Fixed Effects									Yes	Yes
Students	279,071	279,071	279,071	91,119	91,119	8,669	8,669	8,669	2,772	2,772
R Squared	0.333	0.273	0.292	0.436	0.392	0.345	0.275	0.294	0.598	0.373

Note: This table reports the instrumental variable estimates for the effect of rice farming on students' test scores. Control variables are listed in Table S1 for the PISA data, Table S2 for the TIMSS data, and Table S3 for the CFPS. Standard errors are robust, clustered at the level of students' country in Columns 1-5, at the level of students' country of ancestry in Columns 6-8, and at the level of students' birth county in Columns 9-10. [a]The first stage tests whether environmental suitability for rice (instrumental variable) predicts actual rice farming. There are different estimates because the number of countries and counties depends on the sample of participants. ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

Table 5: *Rice Farming in Children's Home County Predicts Test Performance (CFPS 2010)*

Variables	Math (1)	Vocabulary (2)
Rice	1.251**	2.331**
	(0.552)	(1.094)
Education	1.207***	1.731***
	(0.136)	(0.235)
Age	1.268***	1.387***
	(0.045)	(0.084)
Income	0.269***	0.514***
	(0.096)	(0.156)
Other Individual Controls	Yes	Yes
School Controls	Yes	Yes
Current Province Fixed Effects	Yes	Yes
Birth Province Fixed Effects	Yes	Yes
Observations	2,772	2,772
R Squared	0.559	0.377

Note: This table reports the effect of rice farming on children's performance on math and vocabulary using the CFPS 2010 data. Rice is measured as the percentage of farmland devoted to rice farming in 1957 in people's county of birth. All regressions include individual controls and school controls, which are listed in Table S3. Models also include fixed effects for current province and birth province. Standard errors in parentheses are clustered at the level of children's birth county.****P* < 0.01, ***P* < 0.05, **P* < 0.10

Table 6: *The Prevalence of* Jinshi *Scholars and Rice Farming*

Variables	First Stage: Farmed Rice in Han Dynasty (1)	First Stage: Farmed Rice in Sui Dynasty (2)	Second Stage: *Jinshi* Scholar Density (Log) All (3)	All (4)	Excluding Movers (5)	Excluding Movers (6)
Rice Suitability	0.0183***	0.0145***				
	(0.002)	(0.002)				
Han Dynasty Rice			1.051***		0.773***	
			(0.375)		(0.263)	
Sui Dynasty Rice				1.324***		0.974**
				(0.426)		(0.382)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Prefectures	272	272	272	272	272	272
R Squared	0.876	0.872	0.428	0.377	0.303	0.183

Note: Jinshi (进士) scholars are people who passed the imperial exam at the highest level (the national level). These analyses use the prevalence of *jinshi* across 272 prefectures in 27 provinces. The estimates of rice farming in the Han Dynasty (202 BCE-220 CE) and the Sui Dynasty (581-618 CE) come from an earlier study (Lu, 2014). These are binary estimates of whether rice farming is the predominant subsistence style in each prefecture, based on historical texts. The rice suitability variable is an estimate of the environmental suitability for wetland rice farming using UNFAO modeling of conditions such as temperature, rainfall, and soil quality. The first two columns test whether environmental suitability for rice farming predicts actual rice farming in history. Columns 3 and 4 test whether rice farming predicts a higher prevalence of people passing the imperial exam. The last two columns repeat the analyses after excluding scholars who moved between regions. Control variables are listed in Table S4. ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

Table 7: Jinshi *Scholars per Capita and Rice-Farming Regions: Sensitivity to Additional Controls*

	Dependent Variable: *Jinshi* per Capita (Log)							
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Han Rice Region	0.679**		0.887**		1.049***		0.525*	
	(0.281)		(0.331)		(0.368)		(0.264)	
Sui Rice Region		0.870**		1.089***		1.322***		0.653*
		(0.419)		(0.362)		(0.422)		(0.363)
River Distance to Pine/Bamboo[a]	-0.085***	-0.082***					-0.085***	-0.084***
	(0.012)	(0.013)					(0.011)	(0.011)
Distance to Provincial Capital[b]			-0.141	-0.160			-0.129	-0.142
			(0.096)	(0.116)			(0.077)	(0.091)
Clans[c]					0.048	0.031	-0.004	-0.012
					(0.038)	(0.036)	(0.015)	(0.018)
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	272	272	272	272	272	272	272	272
R Squared	0.622	0.590	0.449	0.419	0.430	0.378	0.638	0.620

Notes: Results are 2SLS regression estimates using rice suitability as the instrumental variable. Other control variables are agricultural suitability, population density, urbanization rates, and *shengyuan* quotas as listed in Table S4. The government set quotas for different counties based on their population size, taxes, and success in past exams. If rice continues to predict success on the imperial exam after taking quotas into account, it suggests that the effect of rice is not due to quotas or the factors that went into calculating the quotas, like population size. The parentheses report robust standard errors adjusted for clustering at the province level. Rice farming in the Han Dynasty (202 BCE-220 CE) and the Sui Dynasty (581-618 CE) are binomial variables from an earlier study (Lu, 2014). [a]The distance to sources of pine and bamboo represent the fact that these were important materials used in reading and writing. [b]The distance to the capital of the province represents remoteness, which is a proxy for access to resources. [c]We estimated clan activity using data on the number of genealogies published per prefecture during the Ming and Qing dynasties (Chen et al., 2020). ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

Table 8: *People in Rice-Farming Cultures or With Parents from Rice Cultures Endorse Hard Work More*

	World Values Survey						General Social Survey	
	Full Sample			Second-Gen. Immigrants			Ancestry[a]	Second Gen.
	Hard Work Brings Success	Hard Work Important for Child	Perseverance Important for Child	Hard Work Brings Success	Hard Work Important for Child	Perseverance Important for Child	Hard Work Important for Child	Hard Work Important for Child
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rice	1.782***	0.968***	0.362***	2.931**	0.508**	0.404**	0.474***	0.596***
	(0.671)	(0.121)	(0.023)	(1.339)	(0.241)	(0.205)	(0.134)	(0.207)
Individual Controls	YES	YES	YES	YES	YES		YES	YES
Country Controls	YES	YES	YES					
Ancestral Country Controls				YES	YES	YES	YES	YES
Host Country Fixed Effects				YES	YES	YES		
Host Region Fixed Effects							YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
R Squared	0.022	0.025	0.063	0.074	0.073	0.073	0.041	0.127
Respondents	54,889	54,889	54,889	3,389	3,389	3,389	14,102	1,611

Note: This table reports regressions estimating the effect of rice farming on respondents' attitudes towards perseverance and hard work (2SLS second-stage results). For the World Values Survey, perseverance is whether respondents chose “determination, perseverance” as an important quality to teach children. Control variables are listed in Table S5 for the World Values Survey and in Table S6 for the General Social Survey. The instrumental variable is the agro-ecological suitability index for wetland rice. Analyses that use the full sample report robust standard errors in parentheses. Analyses of second-generation immigrants report standard errors clustered at the level of people’s country of ancestry. [a]The General Social Survey asked participants about their country of ancestry, regardless of how many generations back it went. This contrasts with Column 8, which defines ancestry as second-generation immigrants, which are people whose parents were born in another country. ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

Table 9: *People from Rice-Farming Cultures Show More Evidence of Perseverance on Tests and Studying*

	PISA 2018		**TIMSS**	**China Family Panel Study**
	Full Sample	**2nd-Gen. Immigrants**	**Full Sample**	**Full Sample**
	% Ungraded Survey Questions Completed			Study Hours
Variables	(1)	(2)	(3)	(4)
Rice	0.139***	0.052**	0.062***	1.74***
	(0.003)	(0.023)	(0.000)	(0.205)
Individual Controls	YES	YES	YES	YES
School Controls	YES	YES	YES	YES
Country Controls	YES		YES	YES
Ancestral Country Controls		YES		
Host Country Fixed Effects		YES		
Current Province Fixed Effects				YES
Birth Province Fixed Effects				YES
R Squared	0.053	0.162	0.577	0.255
Respondents[a]	133,532	4,339	48,279	2,125

Note: This table reports the second-stage results of 2SLS regressions estimating the effect of rice farming on perseverance. We estimated perseverance on the PISA and TIMSS tests using the percentage of survey questions (such as about attitudes and demographics) that students completed. These questions come after the exam and do not affect students' test scores. The instrumental variable is the ecological suitability index for wetland rice. Rice is measured as the percentage of farmland devoted to rice at the country level in 1961. The China Family Panel Study analysis uses the percentage of farmland devoted to rice per county in 1957. For the full samples, rice is measured for students' home countries. For the second-generation immigrants, rice is measured from their parents' country of ancestry. Control variables are listed for the PISA in Table S1, for the TIMSS in Table S2, and Table S3 for the China Family Panel. Columns 1 and 3 report robust standard errors in parentheses. Standard errors are clustered in people's country of ancestry in Column 2 and in people's birth county in Column 4. [a]The sample sizes for the ungraded questions are smaller than the samples in Table 2 because the PISA and TIMSS datasets have less data for this metric. ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

Supplementary Materials

1. More Details on Rice Statistics

Figure 1 includes data from Mainland China in the PISA data. However, the statistical analyses for the PISA data do not include Mainland China (Table 2) because the codebook explains that the student background data for China is not disclosed in the public dataset. Thus, we were missing critical demographic questions that serve as control variables.

In addition, the PISA China data only included four sites within China: Jiangsu, Shanghai, Zhejiang, and Beijing. Three of these are high rice-farming provinces. Therefore, it makes more sense to estimate China rice for the PISA not from all of China, but from these four provinces. To do that, we calculated the average percent rice farming across these four provinces based on previous data (Talhelm et al., 2014).

We also followed previous research by using settlement patterns of cultural heritage to estimate rice farming for the urban regions of Macau and Hong Kong. Traditionally, these areas have been largely Cantonese-speaking, including many settlers from the majority-rice-farming province of Guangdong. Macau and Hong Kong have little farmland area, so it makes little sense to try to estimate their subsistence style heritage using their current statistics. Instead, we followed previous research and used Guangdong's rice value (73.3%) to represent Macau and Hong Kong.

2. Econometric Methods

Details on the descriptive statistics and explanations for the measures are in Table S1 for the PISA data, Table S2 for the TIMSS data, Table S3 for the China Family Panel Study, Table S4 for the *Keju* data, Table S5 for the World Values Survey, and Table S6 for the General Social Survey.

To estimate the impact of rice farming on test scores across countries, we start with the following baseline specification:

$$Y_{isj} = \beta_0 + \beta_1 RICE_j + \beta_2 X_{isj} + \beta_3 M_{sj} + \beta_4 G_j + \varepsilon_{isj}, \qquad (1)$$

where the outcome variable Y_{isj} is the test score for student i in school s of country j. $RICE_j$ is the percentage of farmland devoted to rice farming in country j in 1961. The vectors X_{isj} and M_{sj} include individual and school characteristics, while G_j measures economic and geographical characteristics of country j. ε_{isj} is the error term. The coefficient of interest is β_1 which measures the role of historical rice farming in explaining test scores. We estimate the model using data from PISA 2018 and TIMSS 2019. Summary statistics for the samples and details of the control variables are available in Table S1 and Table S2.

Although statistically controlling for cross-country differences is useful, it has important limitations. Some cultural and institutional characteristics may remain unmeasured, and these could be correlated with both rice farming and test scores. To address these concerns, we leverage a unique feature of the PISA data: information on students' parental origins. This allows us to identify second-generation immigrants, students born in a host country with at least one parent born abroad, and to compare the influence of rice-farming heritage while holding constant the institutional environment of the host country.

For the second-generation immigrant sample, we estimate the following model:

$$Y_{isjk} = \alpha_0 + \alpha_1 RICE_k + \alpha_2 G_k + \alpha_3 X_{isjk} + \alpha_4 M_{sj} + \alpha_5 Z_j + \varepsilon_{isjk}, \quad (2)$$

where Y_{isjk} is the test score for student i of school s living in host country j, with parental country of ancestry k. $RICE_k$ is the percentage of farmland devoted to rice farming in the country of ancestry k in 1961*;* G_k measures the economic and geographical characteristics of country *k;* X_{isjk} and M_{sj} are vectors of individual and school characteristics; Z_j is a full set of host country fixed effects; and ε_{isjk} is the error term. Standard errors are clustered at the country of ancestry level.

One potential concern in analyzing rice farming data is reverse causality. It is possible that rice farming does not shape attitudes toward hard work; rather, pre-existing cultural values about hard work might influence whether communities chose to cultivate rice. To address this possibility, we employ an instrumental variable (IV) strategy. Our instrument is the agro-ecological suitability index for wetland (paddy) rice, which is largely determined by natural conditions rather than human choice. This measure captures the ecological *potential* for rice cultivation, independent of cultural preferences.

In our estimations, we implement a two-stage least squares (2SLS) strategy. In the first stage, we use the agro-ecological suitability index to predict a region's actual rice farming. In the second stage, we estimate the effects of the predicted rice farming on test performance by replacing actual rice farming in Equations (1) and (2) by the predicted rice farming. If variation in rice farming generated by ecological suitability continues to predict academic performance, the likelihood of reverse causality is reduced.

A key limitation of cross-country analyses is that most rice-dominant countries are in East Asia, raising the concern that some other regional factor, rather than rice farming itself, may be driving the observed effect. One way to address this concern is to compare regions within the same country. Therefore, we conduct a within-country analysis using data from China as individuals from the same country are exposed to similar national institutions. The empirical model is similar to Equation (1):

$$Y_{icjk} = r_0 + r_1 RICE_c + r_2 G_j + r_3 X_{icjk} + r_4 Z_k + v_{icjk}, \quad (3)$$

where Y_{icjk} is the test scores on math and vocabulary from the CFPS 2010 for student *i* that was born in county *c* of province *j* and currently living in province *k*. $RICE_c$ is the percentage of farmland devoted to rice farming in birth county *c* in 1957. G_j and Z_k are full sets of province fixed effects. X_{icjk} is a set of individual and school characteristics as listed in Table S3. v_{icjk} is the error term. We use rice suitability index to instrument county-level actual rice farming.

To test if rice-farming areas had more educational success earlier in history, we estimate the following model using historical data:

$$Y_{pj} = \rho_0 + \rho_1 RICE_p + \rho_2 G_{pj} + \rho_3 Z_j + \omega_{pj}, \quad (4)$$

where Y_{pj} is the log of *jinshi* scholar density in prefecture *p* of province *j*. $RICE_p$ is the estimates of rice farming in the Han Dynasty (202 BCE-220CE) and the Sui Dynasty (581-618 CE) from an earlier study (Lu, 2014). These are binary estimates of the predominant subsistence style in each prefecture, based on historical texts. G_{pj} is a vector of prefecture characteristics listed in Table S4 and Z_j is a full set of province fixed effects. ω_{pj} is the error term. Again, we use rice suitability index to instrument historical rice farming at prefecture level.

Finally, to examine if rice farming fostered values of hard work and behavioral markers of perseverance, we replace the outcome variables in Equations (1)-(3) by variables on hard work and perseverance. Whenever possible, we implement an IV strategy to minimize reverse causality.

3. Accounting for the Number of Survey Questions

We estimated perseverance using the percentage of ungraded survey questions students answered on the PISA and TIMSS. However, one downside of the surveys (for our purposes) is that some students saw more questions than other students. For example, some countries administered shorter versions of questions about financial literacy.

We tested whether people in rice-farming cultures still completed more ungraded survey questions after accounting the number of questions each participant saw (Table S13). We repeated the regression analysis in the main text after adding a variable representing the number of questions each participant saw into the model.

In line with what most people would expect, students who saw more questions completed a lower percentage of the questions, PISA: $r = -0.06$, $P < 0.001$, TIMSS: $r = -0.36$, $P < 0.001$. After accounting for differences between countries and other variables, those relationships became positive (Table S13). One possible explanation is that the survey administrators had good hunches about which schools or countries would complete more survey questions, so they gave more survey questions to students in places where they correctly guessed that students would answer more of them.

After accounting for the number of survey questions, rice farming continued to significantly predict perseverance (Table S13). This was true across countries in the PISA, between second-generation immigrants in the PISA, and across countries in the TIMSS. (We do not have a second-generation analysis for the TIMSS sample because the TIMSS did not have data on second-generation immigrants.) In sum, cultures with a history of rice farming completed more ungraded questions, even after controlling for the number of questions students saw.

4. Estimating Effect Sizes for Perseverance on Ungraded Survey Questions

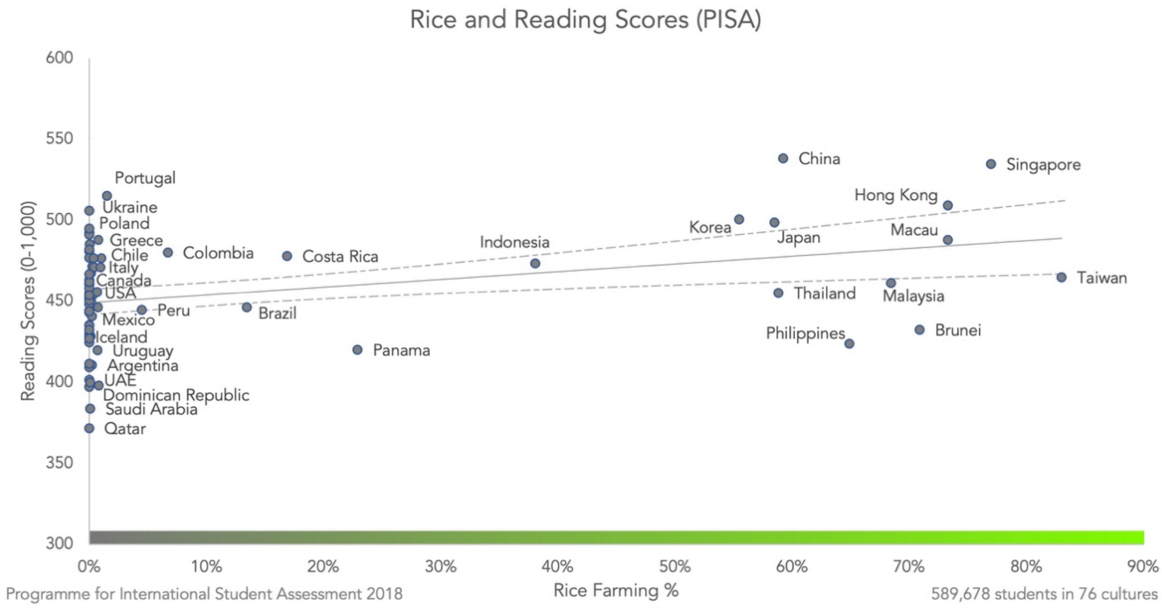
Table 9 reports estimates for the percentage of ungraded survey questions that students completed on the PISA exam. The ungraded questions include questions of demographics (such as students' gender) and attitudes (such as how students feel about competition). These questions do not count toward students' exam scores, but researchers have found that students who complete the ungraded questions tend to score higher on the exams (Boe et al., 2002). The table controls for a series of potential confounds. Here, we compare the raw effect sizes with the effect sizes after controlling for confounding variables.

In terms of raw percentages, cultures with essentially no rice farming (< 1%) completed an average of 94% of the ungraded questions. In majority-rice cultures, students completed an average of 98% of the ungraded questions. That is a difference of 4%. The regression estimate for rice in Table 9 is 13.9 (Column 1). That implies that cultures with 50% of farmland devoted to rice farming completed 6.95% more questions on average (50% x 13.9%). That estimate is higher than the raw difference.

The difference could be because of how the model adjusts for potential confounds. In a simple regression using rice to predict the percentage of ungraded questions completed, the coefficient for rice is 5.8 ($P < 0.001$). After adding the controls from Table 9 (Column 1) into the model, the coefficient is 9.1 ($P < 0.001$). Then, replacing actual rice farming with rice farming predicted from environmental suitability for rice (which is what Table 9 uses), the coefficient is 13.9. Thus, the regression method produces larger effect size estimates than the raw differences. We chose to report the more conservative raw estimates in the main text.

Figure S1

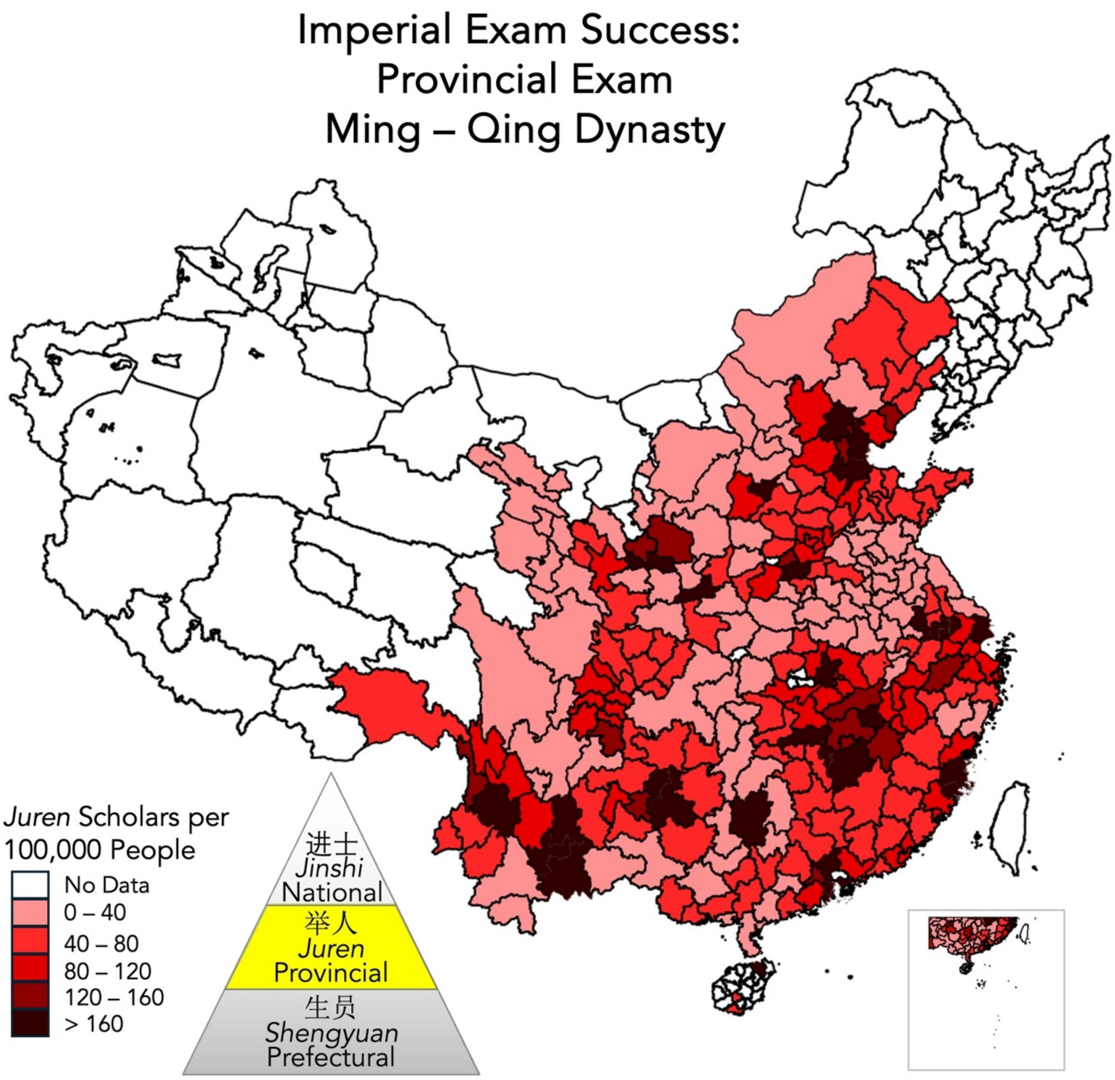
Rice Farming and PISA Reading Scores



Note: This graph plots the relationship between historical rice farming (measured by the percentage of farmland devoted to rice farming at the country level in 1961) and country average reading test scores from PISA 2018. The scores account for the country characteristics listed in Table 2A, with the exception of freshwater availability to maximize country coverage. The graph sample includes 589,678 students from 76 cultures, larger than the sample in Table 2A, because the graph uses averages for demographics like family wealth whereas the regression sample excludes respondents with any missing data.

Figure S2

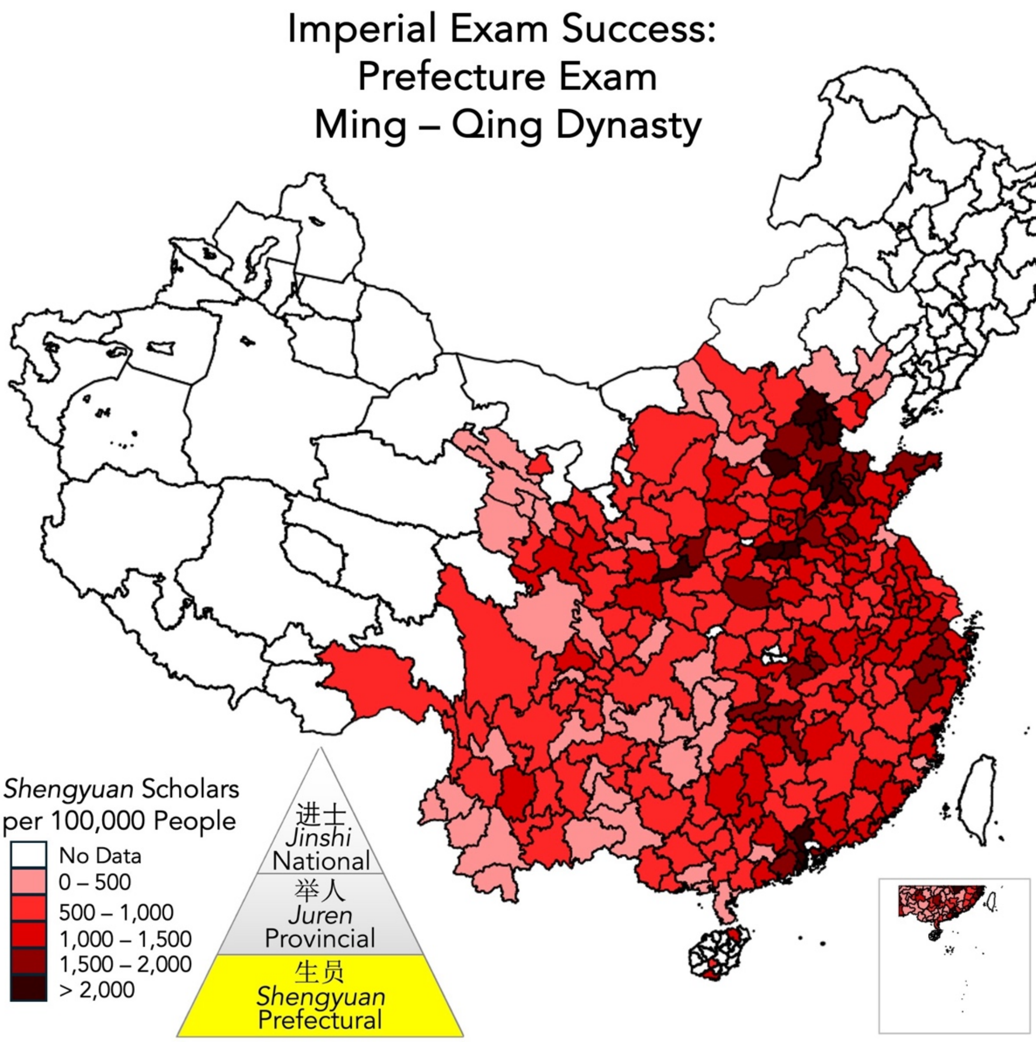
Success in the Province-Level Imperial Exam During the Ming and Qing Dynasties



Note: This map shows the number of people per 100,000 who passed the province level of the imperial exam from different prefectures during the Ming and Qing dynasties (1368-1905 CE; Chen et al., 2020). Passing the province exam gave people the title "*juren*" (literally "recommended person") and special privileges, such as exemption from some forms of labor service and laws. Some received government jobs. Passing the province exam qualified people to take the national exam. Figure S3 maps success on the prefecture (*shengyuan*) exams.

Figure S3

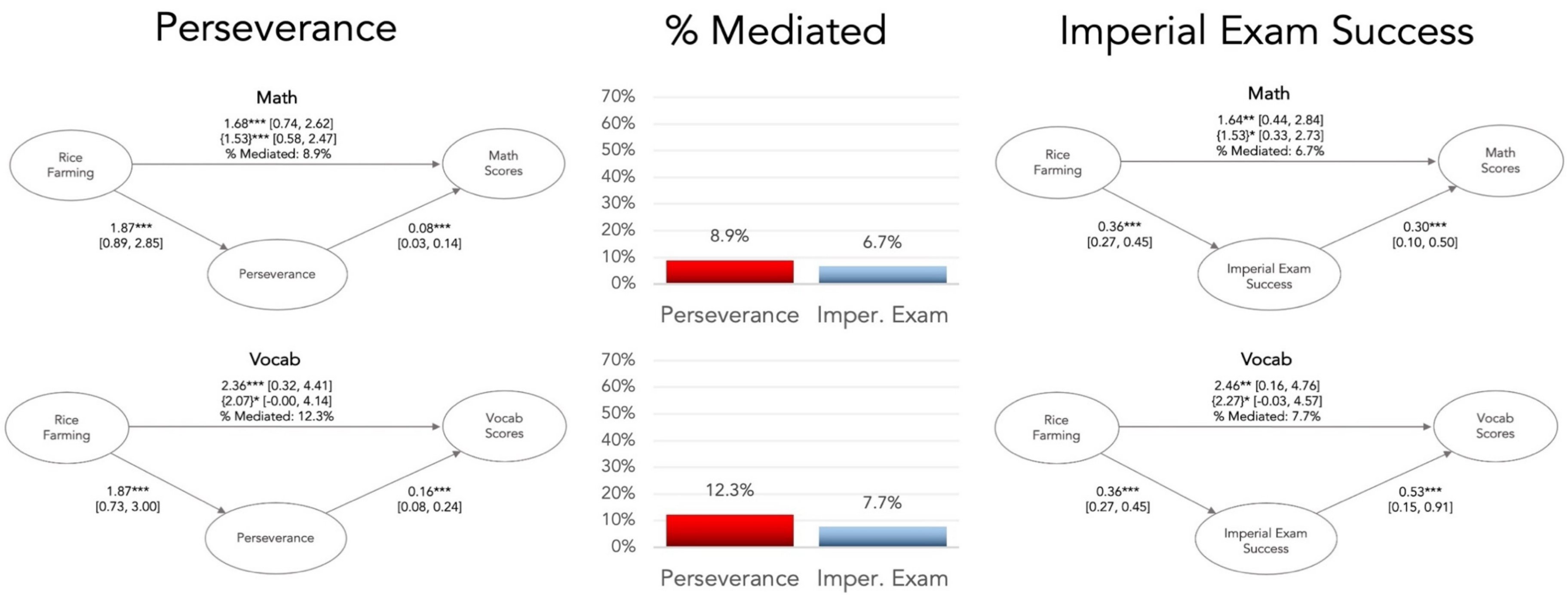
Success in the Prefecture-Level Imperial Exam During the Ming and Qing Dynasties



Note: This map shows the number of people per 100,000 who passed the prefecture level of the imperial exam from different prefectures during the Ming and Qing dynasties (1368-1905 CE; Chen et al., 2020). The prefecture exam was the entry-level portion of the imperial exam system. That meant far more people passed this level than the upper levels. However, passing the exam was still a distinction. People who passed were called "*shengyuan*" (literally "student members") and received benefits, such as exemption from forced labor, corporal punishment, and some taxes. Passing the prefecture test also qualified people to take the province test. Figure S2 maps success on the province (*juren*) exams.

Figure S4

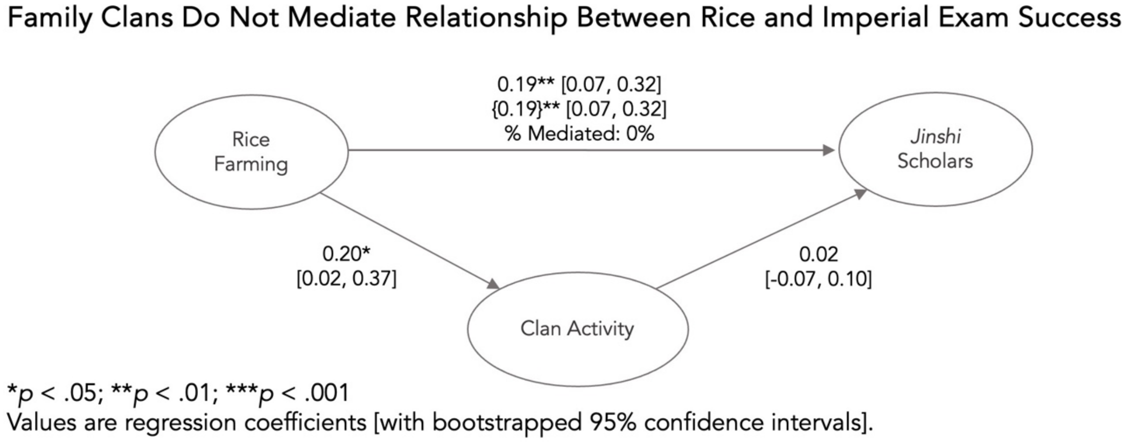
Testing Perseverance and Regional Success on the Imperial Exam as Mechanisms of the Relationship between Rice Farming and Test Scores (CFPS)



Note: This figure reports mediation tests asking whether perseverance (left) and historical success on the imperial exam across regions (right) can explain why students from regions with a history of rice farming score higher on the test questions in the China Family Panel Study. **Perseverance:** We estimated perseverance using the number of hours per day students reported studying. **Imperial Exam Success:** We used data on the number of people passing the top level of the imperial exam (*jinshi* scholars) per capita across regions. **Control Variables:** The models account for age, gender, education levels and employment status of both father and mother, education investment, health, yearly family income, ethnicity, whether the school is a private school, and whether the school is a boarding school. Current province fixed effects and birth province fixed effects are also included. Because the "mediate" package in R had trouble with the China Family Panel Study data, we used the "gsem" command in the program STATA with bootstrapping and 500 simulations. Values are regression coefficients [with bootstrapped 95% confidence intervals]. $^{*}P < 0.10$, $^{**}P < 0.05$, $^{***}P < 0.01$

Figure S5

Mediation Test: Family Clans Do Not Mediate Relationship Between Rice Farming and Success on the Imperial Exam



Note: This figure reports a mediation test asking whether the prevalence of family clans can explain the relationship between rice farming and success on the imperial exam. The results did not support the idea that the effect of rice operates through family clans. Family clan activity during the Ming and Qing dynasties (as indexed by published genealogies) was more common in areas that farmed rice earlier in history (the Sui Dynasty). However, prefectures with more family clan activity did not have more success on the imperial exam. This result fits with the results of Table 7. In the mediation analysis, the prevalence of *jinshi* scholars controls for population density, urbanization, *shengyuan* quotas, distance to the provincial capital, distance to pine and bamboo resources. This analysis uses Sui Dynasty rice farming because it is closer in time to the Ming Dynasty, but the mediation was also non-significant using Han Dynasty rice farming.

Table S1: *Summary Statistics for the PISA 2018 Data*

Variables	Definition	Full Sample Mean	Full Sample SD	Immigrants Mean	Immigrants SD
Rice Cultivation					
Rice	The percentage of farmland devoted to rice cultivation in 1961	0.23	0.28	0.08	0.12
Test Scores					
Math	PISA 2018 math test scores	472.67	101.91	493.90	99.01
Science	PISA 2018 science test scores	474.20	99.12	487.33	96.36
Reading	PISA 2018 reading test scores	469.74	104.81	488.96	104.02
Effort					
Perseverance	The percent ungraded questions answered out of the total number of questions asked in the Student Questionnaire	0.94	0.05	0.96	0.04
Individual Controls					
Grade	Respondent's grade minus modal grade for kids of the same age in the host country	-0.14	0.61	0.00	0.61
Female	Dummy where 1 = respondent is female, 0 = not	0.51	0.50	0.52	0.50
Father High School Grad.	Dummy where 1 = respondent's father has upper secondary education, 0 = not[a]	0.33	0.47	0.32	0.47
Father Uni. Grad.	Dummy where 1 = respondent's father has tertiary education, 0 = not[a]	0.45	0.50	0.43	0.50
Mother High School Grad.	Dummy where 1 = respondent's mother has upper secondary education, 0 = not[a]	0.33	0.47	0.32	0.47
Mother Uni. Grad.	Dummy where 1 = respondent's mother has tertiary education, 0 = not[a]	0.47	0.50	0.43	0.50
Fat. Emp.	Dummy where 1 = respondent's father is employed, 0 = not	0.98	0.15	0.98	0.15
Mot. Emp.	Dummy where 1 = respondent's mother is employed, 0 = not	0.82	0.38	0.86	0.35
Household Wealth	An index of household possessions as a proxy for family wealth. Zero is the average for OECD countries.	-0.41	1.18	-0.08	0.99
School Controls					
School % Female	The proportion of girls enrolled in each school	0.50	0.17	0.50	0.18
Private School	Dummy where 1 = private school, 0 = not private	0.22	0.41	0.30	0.46
Urban area	Dummy where 1 = school is located in a large city, 0 = not	0.16	0.36	0.22	0.41
Country Controls					
GDP per Capita	The real GDP per capita (in dollars) in 2018 (log)	9.77	0.92	9.65	1.12
Distance to Sea	The distance, in 1,000 km, from a GIS grid cell to the nearest ice-free coastline or river that is navigable to the sea, averaged across the grid cells of a country	153.54	331.25	113.68	111.44
Latitude	Absolute latitude of a country's approximate geodesic centroid	37.05	16.70	40.07	15.81
Elevation	The mean elevation of a country in km above sea level	0.41	0.31	0.36	0.32
Terrain Ruggedness	Ruggedness measures the difference in elevation across points in each country (Nunn and Puga, 2012)	0.19	0.13	0.14	0.12
Freshwater Availability	Internal freshwater resources m^3 per capita in 1962 (log; Harati and Talhelm, 2023)	8.71	1.67	8.60	1.79
Instrumental Variable					
Rice Suitability	The ecological suitability index for wetland rice (0 to 100)	9.92	15.43	9.54	7.89
Respondents		279,071		8,669	
Host Countries		52		34	
Countries of Ancestry		--		51	

Note: The "full sample" columns include 12,885 schools. We based our country control variables on a study by Galor and Ozak (2016). [a]The PISA education categories were: (0) none; (1) primary education; (2) lower secondary; (3) vocational/pre-vocational upper-secondary; (4) upper-secondary and/or non-tertiary post-secondary; (5) vocational tertiary; and (6) theoretically oriented tertiary and post-graduate. We defined (3) and (4) as "high school" and (5) and (6) as "university."

Table S2: *Summary Statistics for the TIMSS 2019 Data*

Variable	Definition	Mean	SD
Rice Cultivation			
Rice	The percentage of farmland devoted to rice cultivation in 1961	0.13	0.28
Test scores and Mechanism			
Math	TIMSS 2019 math test scores ranging from 0-1,000	494.57	109.73
Science	TIMSS 2019 science test scores ranging from 0-1,000	495.60	109.90
Perseverance	The percent of ungraded questions answered in the Student Questionnaire, which comes after the test, asking about attitudes and demographics	0.95	0.05
Individual Controls			
Age	The respondent's age in years	14.38	0.78
Female	Dummy where 1 = respondent is female, 0 = not	0.52	0.50
Father Graduated High School	Dummy where 1 = respondent's father graduated high school, 0 = not[a]	0.35	0.48
Father Graduated University	Dummy where 1 = respondent's father graduated university, 0 = not[a]	0.44	0.50
Mother Graduated High School	Dummy where 1 = respondent's mother graduated high school, 0 = not[a]	0.37	0.48
Mother Graduated University	Dummy where 1 = respondent's mother has tertiary education, 0 = not[a]	0.41	0.49
% Affluent Students	School principals' response to a question asking about their school population. Response categories were: 1 = 0 - 10% of students come from affluent homes; 2 = 11 - 25%; 3 = 26 - 50%; 4 = 51 - 100%.	2.18	1.18
Urban Area	Dummy where 1 = school is located in an urban area, 0 = not, as defined by the country reporting statistics to the TIMSS.	0.31	0.46
Country Controls			
GDP per Capita	Real GDP per capita (in USD) in 2018 (log)	9.82	0.93
Distance to Sea	The distance (1,000 km) from a GIS grid cell to the nearest ice-free coastline or river that is navigable to the sea, averaged across the grid cells of a country	9.92	0.95
Latitude	The absolute latitude of a country's approximate geodesic centroid	225.22	429.40
Elevation	The mean elevation of a country in km above sea level	38.31	15.43
Terrain Ruggedness	The degree of terrain roughness of a country	0.47	0.33
Freshwater Availability	Internal freshwater resources m^3 per capita in 1962 (log; Harati and Talhelm, 2023)	0.19	0.13
Instrument			
Rice Suitability	The ecological suitability index for wetland rice from 0 to 100 from the United Nations Food and Agriculture Organization	8.12	13.04
Students		91,119	
Countries		31	

Note: The sample includes 91,119 students from 31 different countries. We based our country control variables on a study by Galor and Ozak (2016). [a]In the TIMSS, the parental education categories were: (0) none or primary education; (1) lower secondary; (2) upper-secondary; (3) post-secondary and/or non-tertiary post-secondary; (4) vocational tertiary; and (5) bachelor's or equivalent level; (6) post graduate degree. We define (3) and (4) as "high school", and (5) and (6) as "university."

Table S3: *Summary Statistics for China Family Panel Study 2010*

Variable	Definition	Mean	SD
Rice Cultivation			
Rice	The percentage of sown land devoted to paddy rice cultivation in children's birth county (*xian*/县) in 1957.	0.29	0.31
Test Scores and Effort			
Math	The rank of the most difficult math question that the respondent answered correctly. Higher is better. Perfect = 24 questions correct.	11.18	4.44
Vocabulary	The rank of the most difficult vocabulary question that the respondent answered correctly. Higher is better.	21.63	7.15
Hard Work	"The most important factor affecting one's future success is his/her effort" with responses of "strongly disagree" (1), "disagree" (2), "neither agree nor disagree" (3), "agree" (4), and "strongly agree" (5).	3.94	0.62
Study Hours	Children's self-reported average study hours per day in the most recent academic month (excluding holidays), including time in school, outside school (such as homework), and on extra classes (such as a class not at the student's formal school).	7.76	3.08
Controls			
Age	The respondent's age in years	12.53	1.71
Female	Dummy where 1 = respondent is female, 0 = not	0.50	0.50
Years of Education	The respondent's years of education	6.07	2.04
Father Education[a]	The respondent's father's education ranging from 0 (*none*) to 7 (*doctoral*)	1.56	1.10
Mother Education[a]	The respondent's mother's education ranging from 0 (*none*) to 7 (*doctoral*)	1.19	1.15
Father Employed	Dummy where 1 = respondent's father is employed, 0 = not	0.99	0.10
Mother Employed	Dummy where 1 = respondent's mother is employed, 0 = not	0.95	0.21
Education Investment	An index measuring how much the parents invest in the child's education assessed by the interviewer based on the home environment ranging from 1 to 5.	3.36	0.73
Health	The child's self-reported[b] health from 0 (*very unhealthy*) to 4 (*healthy*)	3.70	0.59
Income	Yearly family income in Yuan (log)	9.82	0.93
Ethnicity	Dummy where 1 = the respondent belongs to the Han ethnic group, 0 = not	0.90	0.30
Private sch.	Dummy where 1 = private school, 0 = not	0.03	0.18
Boarding sch.	Dummy where 1 = boarding school, 0 = not	0.23	0.42
Instrument			
Rice Suit.	Ecological suitability index for wetland rice from 0 to 100 from the United Nations Food and Agriculture Organization	13.59	15.39
Children		2,772	

Note: The sample includes children who were born in 156 different counties (*xian*) in 32 different provinces. [a]Parental education included seven categories: (0) none; (1) primary education; (2) lower secondary; (3) upper-secondary; (4) vocational tertiary; (5) undergraduate; (6) master's; and (7) doctoral. [b]In the China Family Panel Study, children answer a set of questions on their own, although family members can be around to help.

Table S4: *Summary Statistics for the Imperial Exam Analysis*

Variables	Definition	Mean	SD
Rice Regions			
Han Rice Region	Dummy where 1 = the prefecture farmed rice in the Han dynasty, 0 = not.	0.60	0.49
Sui Rice Region	Dummy where 1 = the prefecture farmed rice in the Sui dynasty, 0 = not.	0.56	0.50
Dependent Variable			
Jinshi Density	Log(1+number of *jinshi*/10,000 prefecture population). *Jinshi* were people who passed the national imperial exam.	0.92	0.70
Controls			
Agricultural Suitability	Suitability for farming in general, calculated as the potential caloric output of farmed crops (not animals) such as beans, wheat, and rye to estimate potential for land to produce calories, regardless of whether people are actually farming there (Galor and Ozak, 2016)	3.01	0.72
Population Density	Average population density between 1391 and 1910[a] (Log)	4.50	0.99
Urbanization	Average percent of the population living in an urban area between 1391 and 1910[a]	0.05	0.04
Shengyuan Quota	*Shengyuan* quota per exam/10,000 in population	4.37	0.84
River Distance to Pine/Bamboo	The average of the shortest river distances to pine and bamboo habitats (km, log)	9.97	5.57
Distance to Prov. Capital	Shortest distance to provincial capital (km, log)	12.08	0.69
Clans	The number of genealogies compiled per prefecture in the Ming and Qing dynasties (log; Chen et al., 2020)	0.05	0.73
Instrumental Variable			
Rice Suitability	Pre-1500[b] caloric ecological suitability for wetland rice (Galor and Ozak, 2016)	11.48	10.83
Prefectures		272	

Note: Estimates of rice farming during the Han and Sui dynasties come from a study by Lu (2014). The sample covers 272 different prefectures in 27 provinces. We chose country control variables based on a study by Chen and colleagues (2020). All control variables (listed under "Controls" in this table) are sourced from that study. [a]The data has estimates from 1391, 1580, 1776, 1820, 1851, 1880, and 1910. [b]We used an earlier estimate of ecological suitability for rice in the imperial exam analysis so that we could have an ecological estimate that pre-dates the imperial exam data. However, from a big-picture perspective, the regions that could farm rice in the historical data were mostly the same regions that could farm rice in the modern data.

Table S5: *Summary Statistics for the 2017 World Values Survey*

Variables	Definition	Full Sample Mean	Full Sample SD	Immigrants Mean	Immigrants SD
Rice Cultivation					
Rice	% national/region[a] farmland devoted to rice cultivation in 1961	0.22	0.32	0.13	0.28
Attitudes					
Hard Work Better Life	Responses from 1 ("Hard work doesn't generally bring success – it's more a matter of luck and connections) to 10 ("In the long run, hard work usually brings a better life")	6.57	2.86	6.40	2.74
Hard Work Quality	1 = the respondent chose "hard work" as an important quality, 0 = did not choose	0.51	0.50	0.53	0.50
Perseverance	1 = respondent chose "determination, perseverance" as an important quality in children, 0 = did not choose	0.34	0.47	0.41	0.49
Individual Controls					
Age	The respondent's age in years	43.71	16.28	46.19	17.39
Female	1 = female, 0 = not	0.48	0.50	0.48	0.50
Num. Kids	The number of children the respondent has	1.73	1.67	1.39	1.59
Married	1 = respondent is married, 0 = not	0.58	0.49	2.99	2.25
High School or Above	1 = respondent's education is "high school or above," 0 = not	0.42	0.49	0.58	0.49
Income	Income scale on which 1 indicates the lowest income group and 10 the highest income group in the respondent's country	4.77	2.05	5.01	1.88
Religion	1 = respondent belongs to a religion, 0 = not	0.74	0.44	0.63	0.48
Country Controls					
GDP	Real GDP per capita (in dollars) in 2017 (log)	9.26	1.08	9.54	1.14
Distance to Sea	Distance (1,000 km) from a GIS grid cell to the nearest ice-free coastline or river that is navigable to the sea, averaged across the grid cells of a country	266.73	448.35	196.28	336.87
Latitude	Absolute latitude of a country's approximate geodesic centroid	27.43	15.57	35.54	16.61
Elevation	Mean elevation of a country above sea level (km)	0.51	0.39	0.44	0.34
Terrain Ruggedness	Ruggedness measures the difference in elevation across points in each country (Nunn and Puga, 2012)	0.20	0.12	0.18	0.12
Freshwater Availability	Internal freshwater resources m^3/capita 1962 (log)	9.00	1.88	8.66	1.63
Instrumental Variable					
Rice Suitability	Ecological suitability index for wetland rice (0-100)	16.23	18.34	11.42	16.93
Respondents		54,889		3,389	

Note: The "full sample" columns include 54,889 individuals from 37 different host cultures. The "immigrants" columns focus on second-generation immigrants only, including 3,389 individuals from 70 different countries of ancestry. We chose country controls based on a study by Galor and Ozak (2016). [a]We use the term "region" to account for places that the PISA reports scores for that are not technically countries, such as Macau.

Table S6: *Summary Statistics for the US General Social Survey*

Variables	Definition	Mean	SD
Rice Cultivation			
Rice	% of national/region[a] farmland devoted to rice cultivation in 1961	0.05	0.248
Attitudes			
Hard Work Important	"Do you think to work hard is the most important thing on the list for a child to learn to prepare him or her for life?" Responses ranged from 0 (*least important*) to 4 (*hard work is the most important*).	2.59	0.98
Individual Controls			
Age	The respondent's age in years	46.24	17.59
Number of Kids	Number of children	1.90	1.74
Female	1 = respondent is female, 0 = not	0.55	0.50
Education	Years of education	13.02	3.15
Foreign	1 = the respondent was living in a foreign country at age 16, 0 = not	0.09	0.28
Income	Family income on a scale from 0 (lowest income group) to 11 (highest income group)	9.22	2.70
Religion	1 = respondent belongs to a religious group, 0 = not	0.88	0.32
Country Controls			
GDP per Capita	Real GDP per capita 2018 USD (log)	10.18	0.87
GDP Growth[b]	GDP per capita growth between 1986-2021	0.62	0.61
Distance to Sea	The distance (1,000 km) from a GIS grid cell to the nearest ice-free coastline or river that is navigable to the sea, averaged across the grid cells of a country	315.08	539.41
Latitude	The absolute latitude of a country's approximate geodesic centroid	44.48	12.87
Elevation	The mean elevation of a country in km above sea level	0.46	0.36
Terrain Roughness	The degree of terrain roughness of a country	0.17	0.12
Freshwater Availability	Internal freshwater resources m^3 per capita in 1962 (log)	8.63	1.40
Instrumental Variable			
Rice Suitability	Ecological suitability index for wetland rice from 0 to 100	8.31	14.40
Sample		14,102	

Note: Rice is measured based on US immigrants' country of ancestry. The sample covers 36 different countries of ancestry. We chose country control variables based on a study by Galor and Ozak (2016). [a]We use the term "region" to account for places that the PISA reports scores for that are not technically countries, such as Macau. We use "country" as a shorthand for "country/region" throughout the paper. [b]The models in Table 8 use GDP per capita. However, results were similar when we ran models replacing GDP with GDP growth. Growth is worth testing for the General Social Survey data because it spans over 30 years.

Table S7: *Children in Rice-Farming Counties Report Studying More Hours per Week, Splitting out Weekdays and Weekends (China Family Panel Study)*

Variables	Study Hours (Weekdays) (1)	Study Hours (Weekends) (2)
Rice	3.113**	0.588***
	(0.276)	(0.154)
Individual Controls	YES	YES
School Controls	YES	YES
Current Province Fixed Effects[a]	YES	YES
Birth Province Fixed Effects[a]	YES	YES
R Squared	0.244	0.111
Children	2,125	2,125

Note: This table complements Table 9. Table 9 analyzes the total number of study hours. This table breaks out weekdays and weekends. This analysis reports the second-stage results of 2SLS regressions estimating the effect of rice farming on respondents' time spent on studying. Table S3 lists the control variables for this analysis. Rice is measured in the percentage of farmland devoted to rice per county in 1957 with an instrumental variable of the agro-ecological suitability index for wetland rice. Standard errors in parentheses are clustered at respondents' birth county. [a]For readers unfamiliar with fixed effects, these rule out any differences between provinces. Any differences between provinces are essentially removed from the comparisons. What is leftover is variation between at levels smaller than provinces, such as rice (which we measure here at the county level [*xian,* 县]) and individual demographics (such as gender). *P < 0.10, **P < 0.05, ***P < 0.01

Table S8: *Students in Rice-Farming Countries (or with Immigrant Parents from Rice-Farming Countries) Endorse Competition More*

	Full Sample (1)	Second-Generation Immigrants (2)
Rice	0.221**	0.134***
	(0.009)	(0.064)
Individual and School Controls	YES	YES
Current Country Controls	YES	
Ancestral Country Controls		YES
Host Country Fixed Effects		YES
Students	265,122	8,239
R Squared	0.196	0.053

Note: This table analyzes students' responses in the PISA survey to a question about competition. Students rated how much they agreed with the statement, "It is important for me to perform better than other people on a task" from 1 (*strongly disagree*) to 4 (*strongly agree*). Column 1 finds that students in countries with more historical rice farming tend to agree more with the competition question. Column 2 finds that students whose parents are from countries with more historical rice farming agree more than students with parents from countries that did not farm rice. Rice is estimated from the ecological suitability for rice (instrumental variable). Table S1 describes the control variables that the analyses take into account. ***$P < 0.001$

Table S9A: *Mediation Tests: Do Perseverance and Competition Explain the Relationship Between Rice and Test Scores on the PISA and TIMSS?*

	Percent Mediated	PISA Mediation Effect	*P*	95% Conf. Interval Lower	Upper
Rice -> Perseverance -> Math	17.2%	6.30	< 0.001	6.05	6.54
Rice -> Competition -> Math	2.2%	0.81	< 0.001	0.60	0.93
Rice -> Perseverance -> Science	28.3%	6.66	< 0.001	6.39	6.94
Rice -> Competition -> Science	2.5%	0.59	< 0.001	0.46	0.71
Rice -> Perseverance -> Reading	62.9%	6.75	< 0.001	6.46	7.00
Rice -> Competition -> Reading	7.2%	0.78	< 0.001	0.65	0.91

	Percent Mediated	TIMSS Mediation Effect	*P*	95% Conf. Interval Lower	Upper
Rice -> Perseverance -> Math	7.8%	8.21	< 0.001	7.23	9.25
Rice -> Aspiration -> Math	0.7%	0.59	0.024	0.08	1.06
Rice -> Perseverance -> Science	19.9%	12.44	< 0.001	11.29	13.56
Rice -> Aspiration -> Science	1.5%	0.55	0.024	0.07	1.00

Note: This table reports mediation tests asking whether perseverance, attitudes about competition, and educational aspirations can explain why cultures with a history of rice farming score high on the standardized international PISA and TIMSS tests. **Perseverance:** We estimated perseverance using the percentage of ungraded survey questions each student completed, following previous research (Boe et al., 2002). **Competition:** The PISA asked students how much they agreed with the statement, "It is important for me to perform better than other people on a task" from 1 (*strongly disagree*) to 4 (*strongly agree*). The TIMSS did not ask this question. **Aspiration:** The TIMSS asked students their aspirations for their education from 1 (*lower secondary*) to 6 (*postgraduate*). Aspirations explained less than 2% of the relationship between rice and test scores. **Percent Mediated:** Because the sample sizes are large, it is fairly easy to get a significant result. Therefore, we think it is more valuable to look at the percent mediated, rather than the significance. The PISA models account for students' year in school, gender, college and high school education of both father and mother, family wealth, the percentage of female students at the school, whether the school is private, whether the school is in an urban area, GDP per capita, distance to the coast or navigable river that has access to the sea, absolute latitude, elevation, and freshwater resources. The TIMSS models account for age, gender, college and high school education of both father and mother, the percentage of affluent students at the school, whether the school is in an urban area, GDP per capita, distance to the coast or navigable river that has access to the sea, absolute latitude, elevation, and freshwater resources. The mediation effect is the "average causal mediation effect" (ACME) from the "mediate" package in the program R. The models use bootstrapping and 500 simulations. The sample sizes for the mediation analyses are 126,492 for the PISA and 48,279 for the TIMSS perseverance and 49,387 for the TIMSS aspiration data. We tested the robustness of the findings to the differences in sample sizes on the TIMSS by limiting the sample to only participants with complete data and then re-running the analyses. Perseverance still explained a higher percentage of the relationship between rice and test scores. The samples are smaller than the samples in Table 2 because the PISA and TIMSS datasets have less data for perseverance and competition.

Table S9B: *Mediation Tests: Do Perseverance, Education Aspiration, and Success on the Imperial Exam Explain the Relationship Between Rice and Test Scores on the CFPS?*

	Percent Mediated	CFPS Mediation Effect	*P*	95% Conf. Interval Lower	Upper
Rice -> Perseverance -> Math	8.9%	0.15	0.006	0.04	0.26
Rice -> Aspiration -> Math	10.3%	0.21	0.018	0.04	0.39
Rice -> Imperial Exam -> Math	6.7%	0.11	0.006	0.03	0.18
Rice -> Perseverance -> Vocabulary	12.3%	0.29	0.017	0.05	0.54
Rice -> Aspiration -> Vocabulary	12.7%	0.45	0.087	-0.07	0.97
Rice -> Imperial Exam -> Vocabulary	7.7%	0.19	0.011	0.04	0.34

Note: This table reports mediation tests asking whether perseverance, educational aspirations, and historical success on the imperial exam across regions can explain why students from regions of China with a history of rice farming score higher on the test questions in the China Family Panel Study. **Perseverance:** We estimated perseverance using the number of hours per day students reported studying. **Aspiration:** The China Family Panel Study asked parents their aspirations for their kids' education from 0 (*none*) to 7 (*doctoral*). **Imperial Exam Success:** We used data on the number of people passing the top level of the imperial exam (*jinshi* scholars) per capita across regions. **Control Variables:** The models account for age, gender, college and high school education of both father and mother, the percentage of affluent students at the school, whether the school is in an urban area, GDP per capita, absolute latitude, elevation, water scarcity (measured by freshwater availability), and distance to the coast or the nearest navigable river that has access to the sea. Because the "mediate" package in R had trouble with the China Family Panel Study data, we used the "gsem" command in the program STATA with bootstrapping and 500 simulations. Values are regression coefficients [with bootstrapped 95% confidence intervals]. $*P < 0.10$, $**P < 0.05$, $***P < 0.01$

Table S10: *Regional Differences in Confucianism Do Not Explain Rates of Success on the Imperial Exam*

	***Jinshi* Scholars per Capita (Log)**					
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Han Dynasty Rice	1.099***		1.071**		1.068**	
	(0.385)		(0.411)		(0.420)	
Sui Dynasty Rice		1.382***		1.204***		1.202**
		(0.435)		(0.430)		(0.435)
Confucian Academies in Ming and Qing Dynasty	0.002	0.002				
	(0.001)	(0.001)				
Confucian Academies Modern[a]			0.005	0.005		
			(0.008)	(0.008)		
Confucian Temples Modern					0.002	0.003
					(0.017)	(0.017)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Prefectures	268	268	243	243	243	243
R Squared	0.428	0.371	0.428	0.386	0.425	0.384

Note: This table tests whether rice farming (estimated from ecological suitability) predicts regional differences in success on the imperial exam during the Ming and Qing Dynasty (second-stage 2SLS). This table tests for regional differences in the prevalence of Confucianism, estimated from the prevalence of Confucian academies and temples. The basic control variables for the regressions are agricultural suitability, population density, urbanization rates, and *shengyuan* quotas (listed in Table S4). *Jinshi* (进士) scholars are people who passed the imperial exam at the highest level (the national level). The parentheses report robust standard errors adjusted for clustering at the province level. Rice farming in the Han Dynasty (202 BCE-220 CE) and the Sui Dynasty (581-618 CE) are binomial variables from an earlier study (Lu, 2014). [a]This measure of Confucianism uses modern data on academies, which are later than the imperial exam data. However, we include this test based on the idea that (1) these regional differences in Confucianism may be long-lasting enough to tap into differences that stretch back to before the imperial exam data and (2) modern data is easier to collect and therefore may be more precise than historical data. ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

Table S11: *Rice Farming Continues to Predict Differences in Test Scores After Accounting for Regional Differences in the Prevalence of Confucianism*

	Math				Vocabulary			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rice	1.687***	1.706***	1.938***	1.704**	2.430**	2.748 **	2.348**	3.487**
	(0.589)	(0.568)	(0.575)	(0.772)	(1.115)	(1.073)	(1.145)	(1.662)
Confucian Academies in Ming and Qing Dynasty	0.000				0.013*			
	(0.004)				(0.008)			
Confucian Academies Modern		0.011				0.045*		
		(0.013)				(0.024)		
Confucian Temples Modern			-0.002				0.046	
			(0.030)				(0.057)	
Jinshi Scholar Density				0.788***				2.020**
				(0.295)				(0.775)
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Current Province Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Children	2,772	2,742	2,742	2,654	2,772	2,742	2,742	2,654
R Squared	0.535	0.535	0.535	0.533	0.351	0.353	0.352	0.358

Note: This analysis tests whether differences in test performance based on rice farming are independent from regions' history of Confucianism. Testing Confucianism is helpful because some researchers have suggested that East Asia's strong performance in education stems from the influence of Confucianism, which emphasized education. We tested three different estimates of the prevalence of Confucianism across regions in China. These measures of Confucianism were not significantly related to math scores and weakly related to vocabulary scores ($p < 0.100$). The fact that rice remained significant after accounting for regional differences in Confucianism suggests that the performance of rice-farming cultures is not due to Confucianism. This table uses estimates of rice farming (based on ecological suitability) per county (*xian*, 县) predicting children's performance on math and vocabulary test questions on the China Family Panel Study (second-stage 2SLS). Table S3 lists the control variables. Robust standard errors in parentheses are clustered at respondents' birth county. ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

Table S12: *Rice Farming Predicts Educational Aspirations*

	Aspiration	
Variables	TIMSS	CFPS
Rice	0.052***	0.722**
	(0.016)	(0.363)
Individual and School Controls	Yes	Yes
Current Province Fixed Effects		Yes
Birth Province Fixed Effects		Yes
Country Controls	Yes	
Students	90,169	1,363
R Squared	0.186	0.125

Note: This analysis tests the effect of rice farming on educational aspirations. Educational aspirations from TIMSS are measured by students' aspirations for their education from 1 (*lower secondary*) to 6 (*postgraduate*). Educational aspirations from CFPS are measured by parental aspiration for their kids from 0 (*none*) to 7 (*doctoral*). In the first column, the instrumental variable is the ecological suitability index for wetland rice. Rice is measured as the percentage of farmland devoted to rice at the country level in 1961. Table S2 lists the control variables. Robust standard errors are reported in parentheses. The second column uses estimates of rice farming (based on ecological suitability) per county (*xian*, 县) predicting parental aspirations for their kids. Table S3 lists the control variables. Robust standard errors in parentheses are clustered at respondents' birth county. ****P* < 0.01, ***P* < 0.05, **P* < 0.10

Table S13: *Rice Farming Continues to Predict Differences in Test Scores After Controlling for the Total Number of Survey Questions*

	PISA 2018		TIMSS
	Full Sample	**2nd-Gen. Immigrants**	**Full Sample**
	% Ungraded Survey Questions Completed		
Variables	(1)	(2)	(3)
Rice	0.152***	0.052**	0.061***
	(0.004)	(0.023)	(0.000)
Total Number of Survey Questions	0.017***	-0.022***	0.016***
	(0.001)	(0.004)	(0.001)
Individual Controls	Yes	Yes	Yes
School Controls	Yes	Yes	Yes
Country Controls	Yes		Yes
Ancestral Country Controls		Yes	
Host Country Fixed Effects		Yes	
R Squared	0.063	0.163	0.584
Respondents[a]	133,532	4,339	48,279

Note: This table reports the second-stage results of 2SLS regressions estimating the effect of rice farming on perseverance after controlling for the total number of questions. Rice is measured as the percentage of farmland devoted to rice at the country level in 1961. For the full samples, rice is measured for students' home countries. For the second-generation immigrants, rice is measured from their parents' country of ancestry. Control variables are listed for the PISA in Table S1, for the TIMSS in Table S2. Columns 1 and 3 report robust standard errors in parentheses. Standard errors are clustered in people's country of ancestry in Column 2. [a]The sample sizes for the ungraded questions are smaller than the samples in Table 2 because the PISA and TIMSS datasets have less data for this metric. ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$