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Innate IQ (Raven's) and Its Implications for High School Education and National Cognitive Capital

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Abstract

IQ, particularly natural innate IQ, has long been ignored by educational psychologists and educational officials in western countries as a cause of school achievement, with the prevailing view being that socioeconomic background and school quality are the main determinants. The present study strongly contradicts this view, finding that the national performance of 15-year-olds on the internationally recognized PISA test of ninth-grade high school achievement is almost perfectly predicted by innate IQ as measured by the nonverbal and culture-free Raven's Progressive Matrices test. The findings further suggest that the child's innate IQ interacts with school learning such that above-average IQs facilitate learning whereas below-average IQs inhibit learning, and that this two-way effect becomes stronger as the level of learning becomes more difficult. This in turn supports a national education policy of separate high schools or separate teaching in high schools whereby high ability students are given an advanced curriculum that allows them to reach their full academic potential while the curriculum for lower ability students concentrates more on basic numeracy and literacy. The paper concludes with a discussion of the important role of innate IQ in determining national cognitive capital.

Keywords

Innate IQ, Learned IQ, Positive and Negative Multiplier Effect, Raven's Progressive Matrices Test, PISA Testing, National Education Policy, Cognitive Capital

1. Introduction

It is evident to parents soon after their child has begun primary school that some

children are brighter than others while some will never catch up, and it is evident to any secondary school principal that the same children each year tend to stay at the top of the class while others perennially lag at the bottom. This suggests that natural differences in intelligence or IQ play a large role. Yet modern education academics and government officials responsible for setting school policy continue to deny these inborn differences, preferring instead to believe that all children are equally educable and that differences in academic achievement are merely a matter of the child's socioeconomic background and the quality of schooling received. Thus we have the Office of Economic Co-operation and Development, originators of the international PISA ninth-grade testing program—about which more later—arguing that the causes of PISA performance are socioeconomic background, money spent on schools, teaching quality, and school attention to student well-being and safety (OECD, 2023c). Modern education academics, for their part, seem to believe that the traditional active teaching method does not work and that "inquiry-based" teaching, whereby students are expected to discover the principles of numeracy and literacy for themselves, should replace it (e.g., Collie, Martin, Flesken, & McCourt, 2023; Greene, Yu, & Copeland, 2014). Neither the OECD's PISA report nor recent academic articles on education mention the role of intelligence or IQ.

This neglect can in large part be blamed on the introductory psychology textbooks used in teacher training courses, which these days provide poor coverage of intelligence. For example, a survey of the 29 most popular introductory psychology textbooks in the U.S. (Warne, Astle, & Hill, 2018) revealed that just 11 had a full chapter on intelligence and that the psychologists who pioneered and developed the science of intelligence were rarely mentioned. Sir Francis Galton, the acknowledged father of intelligence testing, was mentioned in less than a third of the textbooks, and the early work of Charles Spearman, who invented the theory of general intelligence or "g," a theory discussed further shortly, was hardly covered at all. Indeed, it has become politically incorrect to cite the work of IQ theorists such as Eysenck, Jensen, Herrnstein, Rushton, Flynn, Deary, or more recently Linda Gottfredson (1977), an American education academic, who in a landmark 1997 article summarized the critical importance of IQ differences for society.

Those few education researchers still doing research on IQ have almost all followed Spearman's early theory of intelligence (1904) in which he posited a primary general intelligence ability that he called *g*. Spearman inferred the existence of g by correlating the subject grades of high school students attending, in his words (Spearman, 1904: p. 291), a "high-class preparatory school for boys" in a wealthier area of England. He found that their grades in various school subjects, which included Classical Latin and Greek literature, Mathematics, English, French, and Music, were all highly correlated, suggesting a single underlying cause. Most IQ measures such as the Wechsler child and adult intelligence tests are based on g-theory, but the problem in relating g-measured IQ to school achievement is that both the IQ measure and the achievement measure strongly

reflect the influence of education, and so any predictive correlation found would be spurious. To avoid this problem, what is needed is a measure of IQ that is not influenced by education.

Such a measure is the Raven's Progressive Matrices test, conceptualized and designed in the 1930s by J.C. Raven, one of Spearman's doctoral students at University College London (see especially Penrose & Raven, 1936; Raven, 1940). Raven's, as it is often called, is a pictorial, nonverbal intelligence test that it is independent of school learning and is entirely culture-free. It requires only the individual's inborn ability to correctly perceive an object's attributes, and then to detect relationships between objects in terms of those attributes. In Raven's, this means correctly noticing the elements in each of a set of patterns arranged in the form of a pictorial matrix, a matrix with the bottom right-hand pattern missing, and then detecting the elemental relationships between the patterns to identify the missing pattern, which is to be chosen from a set of alternatives given below the matrix. **Figure 1** shows a simple Raven's type of item. In this example, from an IQ test designed by Eysenck (1990), the item shows eight patterns in a 3 × 3 matrix, with the bottom right-hand pattern missing. Below it, six answer alternatives are shown of which only one is correct. There are three main forms of Raven's, ranging from very easy with the items consisting of 2 × 2 matrices and four answer alternatives, to very difficult with items consisting of 6 × 6 matrices and eight answer alternatives (Wikipedia, 2024a). These are the Colored Progressive Matrices test, a manually completed jigsaw-like test intended for use with 5 to 11-year-olds and for older children and adults with very low literacy; the Standard Progressive Matrices test, intended for use with older children and adults expected to be within the normal range of intelligence; and the Advanced Progressive Matrices test, intended for those likely to be of well above-average intelligence. People are quite poor at estimating their own natural intelligence (see Freund & Kasten, 2012) and it needs to be objectively measured, preferably by one of the Raven's tests. There are imitations of Raven's available on the Internet but researchers, school psychologists, or employment psychologists should purchase one of the authorized versions owned by the publisher Pearson, Inc., because only these versions have been properly pretested for increasing within-test item difficulty and normed, just like other established IQ tests, to give innate IQ scores with a mean of 100 and standard deviation of 15.

Innate IQ represents the natural inborn ability to learn and is hypothesized to increase the effectiveness of formal education, thereby resulting in a higher learned IQ as measured by conventional school achievement tests. This innate IQ multiplier idea was first put forward by the eminent Canadian neuropsychologist, Donald Hebb (1942). Hebb proposed that there are two types of intelligence, Intelligence A which is the innate brain-based form, and Intelligence B which is the applied form, and that the former acts to increase the latter. Researchers should note that Hebb's theory preceded and is conceptually superior to Cattell's (1943) distinction between so-called fluid intelligence and crystallized intelligence, a

distinction he "borrowed" from a discussion with Hebb at the 1941 American Psychological Association conference (Brown, 2016). In this article I will importantly extend Hebb's theory by proposing that innate intelligence, which I will call g_i in honor of Spearman, multiplies the input of education to form learned intelligence, or g_l, which is the form of intelligence needed to do well academically, in *two ways*—positively for higher innate IQ individuals and negatively for lower innate IQ individuals. The causal mechanism that I am proposing here is that innate perceptual ability allows the individual to better take in and remember learnable knowledge, most importantly in the form of mathematical rules and enumeration, grammatical rules and vocabulary, and the main facts in areas of science. The higher the innate IQ the more this intake is facilitated, whereas the lower the innate IQ the more this intake is inhibited.

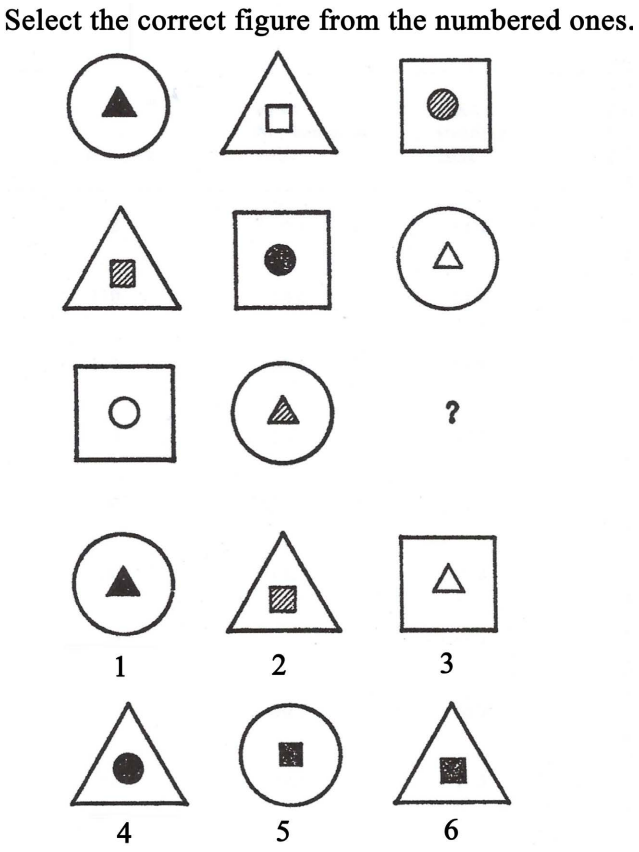

Figure 1. A simple Raven's type of item. Source: Eysenck (1990).

2. The Present Study

The present study examines the relationship, across different nations, of innate IQ as measured by Raven's, and performance on the international ninth-grade academic achievement test, the Programme for International Student Assessment, known as PISA, national average scores on which have emerged as the main measure of the success of the nation's high school education. Designed by researchers at the international Office of Economic Co-operation and Development,

OECD, the PISA test program began in 1998 and is conducted every three years, apart from the scheduled 2021 test which was postponed to 2022 due to the Covid pandemic. PISA tests 15-year-olds, or more specifically ninth-graders between the ages of 14 and 16, in Mathematics, Reading (verbal comprehension), and Science, and delivers national average scores normed to an overall mean of 500 with a standard deviation of 100. These scores can be more readily interpreted, as in the present study, in percentage terms by dividing them by 10 so that the mean score is 50%, with a standard deviation of 10%. Thus, allowing for two standard deviations above and below the mean, we could expect the national *average* scores to range from a low of 30%, or 300 in raw-score terms, to a high of 70%, or 700.

The PISA performance data for the present study come from the 2022 PISA test results for 12 OECD member nations selected by the OECD to illustrate the typical range of performance worldwide (OECD, 2023b). The present analysis relates them to the Raven's IQ scores achieved earlier by school-aged children in those nations (see Lynn & Vanhanen, 2006). The data are shown in **Table 1**, and are arranged in descending order of national average Raven's IQ as shown in the first column. The subsequent three columns list national average percentage scores on the PISA Mathematics test, the PISA Reading test, and the PISA Science test.

Table 1. Raven's innate IQ average scores (from Lynn & Vanhanen, 2006) matched with PISA 2022 average scores (in percent) by country. Base = the 12 countries selected by the OECD to be representative of worldwide 15-year-olds' range of performance (OECD, 2023b).

Country (Raven's test year)	Raven's IQ score	PISA Mathematics 2022	PISA Reading 2022	PISA Science 2022
Singapore (1994)	114	57.5	54.3	56.1
Japan (1991)	110	53.6	51.6	54.7
Korea (1994)	109	52.7	51.5	52.8
Switzerland (1993)	104	50.8	48.3	50.3
Estonia (2002)	100	51.0	51.1	52.6
Australia (1974)	100	48.7	49.8	50.7
U.S.A. (1996)	98	46.5	50.4	49.9
Canada (1998)	97	49.7	50.7	51.5
Mexico (2005)	88	39.5	41.5	41.0
Brazil (ca. 2000)	87	37.9	41.0	40.3
Indonesia (1998)	87	36.6	35.9	38.3
Philippines (1972)	86	35.5	34.7	35.6

Because of the small sample size of countries, the Spearman rank-order correlation coefficient, r_s, was used to relate Raven's IQ scores to PISA scores. The

correlation between national average Raven's IQ and national average PISA Mathematics performance is r_s = .96; for Reading performance r_s = .89; and for Science performance, which presumably requires both mathematics ability and language ability, r_s = .92. Rank-order correlation can often "lose information" by using ranks rather than actual scores and therefore, as a check on possible informational loss, the Pearson product-moment correlation, r_p, was computed. The Pearson correlation for PISA Mathematics was found to be r_p = .97, almost identical to the Spearman correlation of r_s = .96, a result that suggests that using rank orders in this case does *not* lose information.

That the relationship between innate IQ and PISA performance is not just predictive but causal is indicated by several considerations. One is the time-order requirement, which is met in the present data because, as shown in the first column of the table, the Raven's data were collected well before the PISA data. It should also be noted that national Raven's IQ scores are very stable over time in the absence of any large change in the ethnic composition of the population, and no major ethnic shifts occurred in the countries in the sample leading up to the Raven's test dates. A further causal requirement is that there be no "third variable" that could account for the extremely high Raven's IQ-PISA performance correlation, and this is surely the case here because Raven's IQ is stable from a very early age and independent of possible third variables such as home environment and years of schooling.

A final possibility can be ruled out, which is the possibility that the 12 countries selected by the OECD were chosen to fit the innate IQ hypothesis. The OECD, however, would have had no knowledge of the Raven's IQ figures, and in its report (OECD, 2023a) it gave no indication that the countries were chosen in any manner other than to represent a wide range of PISA scores. Note that the correlations would probably be even higher if very low IQ countries were included but school attendance is very low in these countries and most do not participate in PISA.

The present data also provide tentative support for the hypothesized positive and negative multiplier effect. **Table 2** shows my estimates of the multiplier effect as derived by plotting the relationship between the Raven's scores and the PISA Mathematics scores from the first two data columns of **Table 1** earlier. The estimates in **Table 2** suggest that for every 5 points of innate IQ above 100, the mathematics achievement score *increases*, albeit in a moderately accelerating manner; whereas for every 5 points of innate IQ below 100, it *decreases*, and in a rapidly accelerating manner. For example, students with an innate IQ of 115, one standard deviation above average, could be expected to score 59% on the PISA Mathematics test (as the Singapore students did) whereas students with an innate IQ of 85, one standard deviation below average, could be expected to score just 34% (very close to what the Philippines students scored). Nearly identical results would be found for the other two PISA tests because Mathematics test scores in the present data are correlated with Science test scores at r_s = .98, and with Reading test scores at r_s = .95.

Table 2. Estimated increases and decreases in 2022 PISA Mathematics scores above and below the 500 raw score mean and 50% percentage score mean as a function of Raven's IQs above and below 100.

	Change in PISA Mathematics score	
Raven's IQ score	Raw score	Percentage score
115	+90	+9
110	+40	+4
105	+10	+1
100	0	0
95	−30	−3
90	−90	−9
85	−160	−16

3. Policy Implications

The finding that national average innate IQ, as measured by the Raven's test, is by far the major predictor of national PISA test performance has broad policy implications, at the national level for high school education, and at the international level for what has been called national cognitive capital.

National high school education policy should be based on two key facts. The first is that innate IQ is fundamentally unchangeable by education, and the other, as revealed in the present study, is that the innate IQ two-way multiplier effect applies. One general level of teaching will not be the best educational policy because the content at each grade level tends to be too difficult for lower IQ students and too limiting for higher IQ students. This implies that some form of educational separation at the start of high school will be the optimal policy. It is clear to teachers and school principals by the end of primary school which students are academically above average and which students are academically below. There will always of course be borderline students entering high school and it seems safer to place these students in the lower group because they can always move up during high school if a misclassification was made, whereas failure in the higher group might undermine the student's self-confidence and result in further failure.

Educational separation can be, and has been, implemented in different ways. One way, which is arguably the best way for nations that historically have had an average innate IQ of 100 or thereabouts (see Table 3) is to have three separate high school types—advanced academic high schools (to grade 12), normal academic high schools (to grade 10 with an option for the proven brightest students to transfer to an advanced academic high school), and vocational or what are more acceptably called technical high schools (to grade 9, allowing students to leave school after that and pursue a trade or service job). Three-level school separation is the system used in Singapore (Wikipedia, 2024b), which is regarded as having the best education system in the world, and it has long been the system in Germany (Wikipedia, 2024c). Both countries are known for pursuing intensive

teacher-delivered instruction at all levels rather than switching to student centered instruction, which has been proven not to work either for basic *or* for advanced students (see especially Kirschner, Sweller, & Clark, 2006). A second separation method is known as "streaming," which involves separating students from grade 7, the first year of high school, into an advanced A class and a more basic B class, with an opportunity for a B student to be moved to the A class if his or her early academic results are high. This within class-year streaming is the most common system in Australia, New Zealand, and in England, and it has the advantage of keeping all students together for sports and other activities (Evidence for Learning, 2024). The third method, sometimes called "setting," or in the U.S. called "tracking," is subject-level separation (Wikipedia, 2024d). In this system, students can elect to take either advanced or more basic courses in mathematics, literature, and science. Countries with a very low average innate IQ—notably all African countries, whose average innate IQs on the Raven's test are below 80 (again see **Table 3**)—do not have a large enough number of students with high IQs to practice subject-level separation or within-class streaming. These poorer academic nations would be best served by having a small number of selective schools for the bright students, and general technical schools for the rest.

Table 3. National average innate IQs of school-age children (Raven's test estimates from Lynn and Vanhanen, 2006). Main countries only for which Raven's test data were available. Higher versus lower division is at average Raven's IQ of 95. An asterisk (*) denotes that this nation is likely to be facing a decline in national IQ due to an increase in legal and illegal immigration (Pew Research Center, 2019).

Higher Raven's IQ		Lower Raven's IQ	
Country/Region	**Average Raven's IQ**	**Country**	**Average Raven's IQ**
Singapore	114	Ireland, Vietnam	94
Hong Kong SAR, Japan, Taiwan Region	110	Poland	92
South Korea	109	Turkey	90
Switzerland	104	Mexico	88
Italy*	103	Indonesia, Iraq	87
Chinese Mainland (major urban areas)	101	Kuwait	86
Australia*, Netherlands*, Norway, U.K.*	100	India, Iran, Puerto Rico	84
Germany*, New Zealand, Spain, Sweden*	99	Zambia	77
		Kenya	75
Finland, U.S.A.*	98	South Africa	72
		Zimbabwe	70

Continued

Canada, Denmark, France*, Russia	97	Nigeria	69
Israel	95	Ghana	62

I will now move on to the very serious long-run implications of international innate IQ. According to the present study, innate IQ largely determines academic achievement and this in turn largely determines what is known as national cognitive capital (Rindermann & Thompson, 2011). National cognitive capital, in plain terms, is the nation's internal resource or stockpile of human intelligence. More specifically, what counts is the *upper portion*, or "smart fraction" of the population (La Griffe du Lion, 2002). The smart fraction has been defined in the literature at various levels of high IQ, but the most predictive of major achievements seems to be the proportion of the population with an IQ of 125 or higher. As demonstrated in Rindermann and Thompson's article, this IQ level identifies those likely to be high achievers in the science, technology, engineering, and mathematics (STEM) fields, with STEM achievement in turn being highly correlated with the population's per capita wealth and standard of living. Here it is helpful again to refer to **Table 3**. At the top end are the clearly advantaged countries or regions with a national average Raven's IQ of 105 or higher—Singapore, Hong Kong SAR, Taiwan Region, South Korea, and Japan—where according to the normal distribution the size of the smart fraction would be about 4.5%, which is very sizable in relative terms. In the middle are those western countries with a national average Raven's IQ of close to 100 (see left-hand column, where I have chosen an innate IQ of 95 as the cutoff level for the higher IQ group) which are likely have a smart fraction of about 2%. Lower down are the disadvantaged countries—those with average innate IQs in the 80s and 90s—which would be likely to have only about 1% with IQs at the 125-plus level. At the very bottom are the predominantly black-populated countries in Africa with average IQs in the 70s or lower which likely would have only a small number of individuals at that level.

It is the western nations that are at most risk of loss of cognitive capital. The IQ of younger people coming through western populations is slowly but steadily falling (Lynn & Harvey, 2008). This is happening despite high rates of school and university attendance and is thought to be due mainly to later age of marriage and very low below-replacement birth rates among higher-IQ parents, coupled with high birth rates among lower-IQ parents. The so-called replacement or population maintenance birth rate is 2.1 children per couple, slightly above 2.0 to allow for some loss due to childhood deaths (Wikipedia, 2024e). The world average birth rate is currently 2.3 but has fallen to 1.7 in the U.S., 1.6 in the U.K., and 1.6 in Australia, and is likely to fall further with increased and mostly illegal migration from lower IQ countries, especially from African countries, where the overall birth rate is 4.5 and is as high as 6.0 in the poorest ones. By way of warning, I have marked with an asterisk in the table those countries that appear to be at greatest risk from immigration (Pew Research Center, 2019). The birth rate is even lower

in high-IQ countries or regions, at 1.3 for Japan, 1.2 for Chinese Mainland, 1.0 for Singapore, 0.9 for South Korea, and 0.8 for Hong Kong SAR, but they have largely avoided the threat to their national IQ by severely restricting immigration.

The only available internal solution to the falling IQ problem in western countries would be to implement a policy of selective breeding, as proposed centuries ago by the philosopher Plato in his famous treatise, *The Republic.* This could be achieved by incentivizing high-IQ citizens, such as university medical and science graduates, to marry and produce more children. Interestingly, this form of selective breeding was proposed for Singapore in 1983 by then-Premier Lee Kwan Yew (see Wikipedia, 2024f) and in the following year he even went as far as to offer a $10,000 payment to low-IQ mothers to undergo sterilization and promised that they would receive free schooling for their present children. Lee's ideas were overwhelmingly rejected by Singapore's voters in 1985, even by university graduates, and any such selective breeding program, although it would make scientific sense, surely would be rejected by today's western governments.

No discussion of national cognitive capital would be complete without considering the threat to national cognitive capital posed by the growth of *artificial* intelligence, AI. Here I am talking about so-called generative AI based on what is known as a "large language model," as distinct from rule-following robotic "machine learning-based" AI and its many useful engineering and medical applications. Generative AI programs such as ChatGPT and Copilot are now available to almost everyone on their phone or computer and their ready availability is almost certain to move the population intellectually backwards. Generative AI will do nothing for innate intelligence, which is fixed, but over time it will counteract the positive effects of education and thereby decrease *learned* intelligence. This is because, as we are already seeing, schoolchildren and adults are finding less need to do mental calculations, or thoughtfully formulate their written communications, or gather and evaluate information before making decisions. The implications of AI for national cognitive capital are clearly negative.

4. Conclusion

Government policymakers and educators in western countries seem to be totally swept up in the wave of "equity, diversity, and inclusion," a wave based on the naive egalitarian idea that differences in intelligence do not exist or are minor and that all children are equally able to benefit from school education. The present study contradicts this notion by showing that an internal factor—innate IQ as measured by the Raven's test—is by far the main determinant of academic achievement as measured by the international ninth-grade PISA test of mathematics, reading and science. The predictive correlation between national average innate IQ and the nation's average PISA scores is to the order of r = .9, which means that approximately 80% of the variance in PISA test performance is determined by the innate IQ of the test-taking students. This leaves about 20% of the variation controllable by high-school education, and the positive and negative

multiplier effect identified in the present study, whereby above-average innate IQs increase the effect of education and below-average innate IQs decrease it, suggests that the optimal policy is either to have separate academic and technical high schools, or to teach students in separate advanced and basic classes.

The long-run implications of innate IQ for national cognitive capital are dire. For countries with an average innate IQ of 80 or lower, which includes all African countries, the outlook is seemingly unchangeably grim. For countries with a middle-range average innate IQ of around 100, which is most western nations, the future is in the balance because many are under threat from uncontrolled immigration from low-IQ, high birth-rate countries. Only the East Asian countries with higher innate IQ and a highly restrictive immigration policy are protected.

So far as I know, I am the first researcher to expose the importance of *innate* IQ and to point out its implications for educational policy and national intellectual capital.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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