National IQ Means Transformed from Programme for International Student Assessment (PISA) Scores, and their Underlying Gene Frequencies

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National IQ Means Transformed from Programme for International Student Assessment (PISA) Scores, and their Underlying Gene Frequencies*

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Any general statement as to whether the secular trend of a society is eugenic or dysgenic depends upon a reliable calibration of the measurement of general intelligence. Richard Lynn set the mean IQ of the United Kingdom at 100 with a standard deviation of 15, and he calculated the mean IQs of other countries in relation to this "Greenwich IQ". But because the UK test scores are declining, the present paper recalibrates the mean IQ 100 to the average of seven countries having a historical mean IQ of 100. By comparing Lynn-Vanhanen-IQ with PISA scores and educational attainment of native and foreign born populations transformed into IQ, we confirmed brain gain and brain drain in a number of nations during recent decades. Furthermore, the growth of gross domestic product *per capita* can be derived as a linear function of the percentage of people with an IQ above 105 and its underlying frequency of a hypothetical major gene of intelligence.

Key Words: General intelligence; PISA; GDP; Dysgenics; Smart fraction theory; Immigration.

The Calibration of National IQ Means

Most intelligence tests, such as those used by Lynn and Vanhanen (2002, 2006) in their compilations, have been constructed in Britain and the United States and have subsequently been administered to samples of the populations in other countries throughout the world. In order to make comparisons possible, Lynn set the mean IQ of Britain at 100 with a standard deviation of 15, and he calculated the mean IQs of other countries in relation to this "Greenwich IQ".

As the standard of living during the phase of early industrialization deteriorated, the height of Saxony's soldiers decreased within a time span of 60 years (birth years 1775-1835) by about 6 cm (Cinnirella, 2008).

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Analogous secular trends up and down have been reported for all industrialized countries, and in the past century the acceleration of bodily growth has been accompanied by a similar secular rise of cognitive test scores, usually called the Flynn Effect (Fernandez-Ballesteros and Juan-Espinosa, 2001).

In the case of the Standard Progressive Matrices test, for example, which has been administered in many countries and which Lynn and Vanhanen (2002) used extensively for the calculation of national IQs, the British mean IQ increased at a rate of approximately 2 IQ points per decade from 1938, when the test was constructed, up to 1979. Where this and other tests have been used, adjustments for the secular rise of IQs have been made by Lynn. In some cases such an adjustment involved a bit of guesswork, but in retrospect and comparing it with other data sets available now (see Tables 1 and 3), an excellent and innovative job has been done.

Table 1

PISA scores (500; 100) of mathematical literacy and the respective means of differences from the mean of seven countries (whose Lynn-Vanhanen mean IQ is 100), these differences transformed into PISA IQ (100; 15) values, Lynn-Vanhanen estimates of IQ 2002 and 2006, and Rindermann estimates of IQ (from which 1 point is already subtracted in the lower part of the table)

Country	PISA 2000[(1)]	PISA 2003[(2)]	PISA 2006[(3)]	mean diff.	**PISA IQ**	L/V IQ 2002[(4)]	L/V IQ 2006[(5)]	Rind IQ 2007[(6)]
Belgium	520	529	520	+2	100	100	99	100-1
Canada	533	532	527	+8	**101**	97	99	102-1
Netherlands	(535)*	538	531	+15	**102**	102	100	102-1
New Zealand	537	523	522	+3	**100**	100	99	101-1
Sweden	510	509	502	-15	**98**	101	99	101-1
Switzerland	529	527	530	+6	**102**	101	101	101-1
United Kingdom	529	(512)*	495	-10	**99**	100	100	102-1
mean of these 7 countries	528	524	518	1.3	**100.29**	100.14	99.57	101.29 -1
corrected mean	527	523	517		**100**	100		100.29
Argentina	388		381	-138	**79**	96	93	88

Country	PISA 2000[1]	PISA 2003[2]	PISA 2006[3]	mean diff.	**PISA IQ**	L/V IQ 2002[4]	L/V IQ 2006[5]	Rind IQ 2007[6]
Australia	533	524	520	+3	**100**	98	98	100
Austria	515	506	505	-14	**98**	102	100	100
Brazil	334	356	370	-169	**75**	87	87	83
Bulgaria	430		413	-101	**85**	93	93	95
Chile	384		411	-125	**81**	93	90	88
Czech Republic	498	516	510	-14	**98**	97	98	99
Denmark	514	514	513	-9	**99**	98	98	98
Finland	536	544	548	+20	**103**	97	99	102
France	517	511	496	-14	**98**	98	98	99
Germany	490	503	504	-23	**97**	102	99	98
Greece	447	445	459	-73	**89**	92	92	96
Hong Kong	560	550	547	+30	**104**	107	108	105
Hungary	488	490	491	-33	**95**	99	98	100
Iceland	514	515	506	-11	**98**	98	101	100
Indonesia	367	360	391	-150	**78**	89	87	85
Ireland	503	503	501	-15	**98**	93	92	97
Israel	433		447	-82	**88**	94	95	95
Italy	457	466	462	-61	**91**	102	102	100
Japan	557	534	523	+16	**102**	105	105	104
Korea (South)	547	542	547	+23	**103**	106	106	105
Latvia	463	483	486	-45	**93**	97	98	97
Luxembourg	446	493	490	-46	**93**	101	100	98
Mexico	387	385	406	-130	**81**	87	88	84
Norway	499	495	490	-27	**96**	98	100	99
Poland	470	490	495	-37	**94**	99	99	98
Portugal	454	466	466	-60	**91**	95	95	94
Russia	478	468	476	-45	**93**	96	97	98
Slovakia	-	498	492	-25	**96**	96	96	98
Spain	476	485	480	-42	**94**	97	98	97
Thailand	432	417	417	-103	**85**	91	91	90
Tunisia	-	359	365	-158	**76**	84	83	84
Turkey	-	423	424	-97	**85**	90	90	87
United States	493	493	474	-39	**94**	98	98	99
Uruguay	-	422	427	-96	**86**	96	96	91

(xxx) Mean of the two other PISA values of this country*
- *no data*

SOURCES:

- (1) OECD (2003). *Literacy skills for the world of tomorrow – further results from PISA 2000*, p. 100.
- (2) OECD (2004). *A profile of student performance in mathematics*, p. 92.
- (3) OECD (2007a). *Executive Summary.* PISA 2006, p. 53.
- (4) Lynn, R. & Vanhanen, T. (2002). *IQ and the wealth of nations.* Westport, CT: Praeger, p. 73ff.
- (5) Lynn, R. & Vanhanen, T. (2006). *IQ and global inequality*. Augusta, GA: Washington Summit Publ., p. 55ff.
- (6) Rindermann, H. (2007). The g-factor of international cognitive ability comparisons: the homogeneity of results in PISA, TIMSS, PIRLS and IQ-tests. *European Journal of Personality, 21,* 667-706, here p. 700ff.

In 2002, after the publication of "IQ and the Wealth of Nations" (Lynn and Vanhanen, 2002) and the preliminary reports of PISA 2000, Weiss became aware that PISA tests can be understood as IQ tests (Weiss, 2002) and that the transformation of PISA scores into IQ results in very similar numbers (Weiss, 2005, 2006). PISA scores, mean 500, standard deviation 100, can easily be transformed into IQ values, mean 100, standard deviation 15, by adding or subtracting the deviation from the mean in the relationship 100 : 15 = 6.67, that a mean of PISA 433 corresponds to IQ 90, PISA 567 to IQ 110, if PISA 500 is set to be IQ 100.

But can a PISA score of 500 be set to be IQ 100? The mean of 500 is the mean of all participating countries of the OECD, not the mean of the United Kingdom. In the 2003 PISA study, because of the inclusion for the first time of Turkey in the sample of reference to calculate the mean of 500, the average of Germany and other countries has risen 3 (non-transformed) PISA points (corresponding to 0.45 IQ) in comparison to 2000, without their contributing anything to such an effect.

In 2000 the PISA score of the United Kingdom was 529, but in 2006 only 495. This would mean a PISA IQ of 104 in 2000 and 99 in 2006, but we had to set this 104 and 99 to be the "Greenwich IQ" of 100. As it seems, it could be that the average IQ of the United Kingdom was or is actually declining (compare Flynn, 2009), and it is not reasonable to calibrate the IQ of the world to the waterline of a single leaking ship. In order to avoid this methodological pitfall, we set the arithmetic means of the PISA scores in 2000, 2003, and 2006 of seven countries of which the mean IQ was estimated by Lynn and Vanhanen (2002) to be 100 as IQ 100 (see Table 1). Seen as a whole, rise and decline of IQ within these seven countries seem to be in relative equilibrium.

As shown by Rindermann (2007), combining the scores of the mathematics, readings and science subtests of PISA makes no essential difference from using the mathematical subtest alone, because all subtests of PISA are heavily loaded with general cognitive ability. For example, in 2006 the transformed PISA mean of Germany on the reading scale is IQ 98, on the science scale IQ 99, on the mathematical scale IQ 98. Essentially, all three scales of PISA measure general intelligence (Lehrl, 2005).

Unifying the results of international educational research (not only of PISA but also the analogous inclusion of TIMSS and PIRLS) and differential psychology (Lynn and Vanhanen, 2006) into a plausible estimate (also the intention of Hanushek and Woessmann, 2007) of respective national IQs is the merit of Rindermann's contribution (2007). However, he did miss the problem of calibration entirely. As can be seen in Table 1, the IQ values estimated by him are on average 1 point too high. In their publications, today's educational psychologists prefer to avoid the terms "intelligence" and "IQ" completely (Brand, 1995; Brand, Constales and Kane, 2003; Weiss, 2002).

The Effects of Selective Migration and Differential Fertility on IQ Means

Before the author had calculated Table 2, he was as convinced as anybody else that educational attainments are difficult to compare across nations. However, most recently published data, in which the educational attainments of natives and migrants are separately published, were the incentive to estimate the effects of migration on IQ means.

> Educational attainments were transformed into IQ in the following way: The OECD average of native-borns with less than upper secondary education is 41%, which corresponds to a median percentile of 20.5 and IQ 89. The average of people with upper secondary and post-secondary education is 40%, which corresponds to a median percentile of 41 + 20

= 61 and IQ 104. The average of adult people with tertiary education is 18%, which corresponds to a median percentile of 41 + 40 + 9 = 91 and hence IQ 120. However, because the calibrated OECD average is not IQ 100 but IQ 96 (see Table 1), we have to correct IQ 89 to IQ 85, IQ 104 to IQ 100 and IQ 120 to IQ 116.

Now, in order to calculate the mean IQ of the native-born population of Australia (see Table 2), we had to multiply 46 x 85 = 3910, 15 x 100 = 1500, and 39 x 116 = 4524. By adding 3910 + 1500 + 4524 = 9934, divided by 100, we get a mean "educational IQ" of 99. In the analogous way we calculate for the foreign-born population of Australia a mean IQ of 101. Because the percentage of immigrants into Australia amounts to 25%, the mean educational IQ of its total population is 100.

Table 2

Educational attainment of the native- and foreign-born populations of OECD countries, percentage of immigrants, and Educational IQ (100; 15) of the total populations

Country	Native/foreign: less than upper seconday[(1)] % - Mean IQ 85	Native/ foreign: tertiary[(1)] % - Mean IQ 116	Immi-grants [(2)] %	**Educational IQ of total population**[(3)]	Difference of Educ. IQ foreign/ native borns[(4)]
Australia	46 / 38	39 / 43	25	**100**	+ 2
Austria	33 / 49	11 /11	12	**98**	- 3
Belgium	47 / 54	23 / 22	11	**97**	- 2
Canada	32 / 30	32 / 38	18	**100**	+ 2
Czech Republic	23 / 38	10 / 13	6	**99**	- 2
Denmark	41 / 49	19 / 19	4	**98**	- 2
Finland	40 / 53	23 / 19	3	**100**	- 3
France	46 / 55	17 / 18	9	**97**	- 1
Germany	24 / 44	19 / 15	7	**101**	- 3
Greece	54 /45	13 / 15	1	**95**	+ 1
Hungary	45 / 41	11 / 20	4	**96**	+ 1
Ireland	48 / 30	23 / 41	11	**97**	+ 6
Italy	64 / 54	8 / 12	2	**92**	+ 2
Japan	25 / 26	27 / 30	1	**102**	- 2
Luxembour g	29 / 37	13 / 22	27	**97**	0
Mexico	72 / 37	11 / 38	1	**90**	+ 11
Netherlands	41 / 53	19 / 18	11	**98**	- 2
New	30 / 19	27 / 31	20	**100**	+ 2

Country	Native/foreign: less than upper seconday[1] % - Mean IQ 85	Native/ foreign: tertiary[1] % - Mean IQ 116	Immi-grants [2] %	**Educational IQ of total population**[3]	Difference of Educ. IQ foreign/ native borns[4]
Zealand					
Norway	21 / 18	23 / 31	6	**102**	0
Poland	31 / 48	10 / 12	3	**95**	0
Portugal	80 / 55	8 / 19	3	**90**	+ 5
Spain	64 / 55	19 / 22	5	**94**	+ 1
Sweden	25 / 30	23 / 24	12	**101**	- 2
Switzerland	18 / 42	26 / 24	25	**102**	- 3
Turkey	79 /49	5 / 17	2	**90**	+ 5
United Kingdom	29 / 41	20 / 35	12	**99**	0
United States	22 / 40	27 / 26	7	**101**	- 3
OECD average	41 / 41	18 / 23	7	**96**	+ 2

SOURCES:

- (1) OECD (2007b). *OECD factbook 2007. Economic, Environmental and Social Statistics. Migration – Education - Educational attainment of immigrants.* Table: The educational attainment of the native- and foreign born populations as a percentage of the population aged 15 and above, within each group, circa 2000. – The upper secondary and post-secondary educational attainment (mean IQ 100) is the difference between 100 and the sum of the percentages of the less than the upper secondary plus tertiary.
- (2) Docquier, F. and A. Marfouk (2006). International migration by education attainment, 1990 - 2000. In: Özden, C. and M. Schiff (eds.): *International Migration, Remittances and the Brain Drain* (pp. 151-191). Washington, D. C.: The World Bank. - Table 5.6.A Net Brain Gain in OECD countries in 2000, pp. 182-183.
- (3) Means, calculated on the basis of source (1) and two analogous data sets: List, J. and C. Schnabel (2004). *Bildungsstagnation bei abnehmender Erwerbsbevölkerung. Bildungspolitische Herausforderungen durch Geringqualifizierte.* Lehrstuhl für Volkswirtschaftslehre, Friedrich-Alexander-Universität Erlangen Nürnberg, Discussion Paper No. 26. – Table 1, p. 8: Ausbildungsstand der 25- bis 64-jährigen Bevölkerung im internationalen Vergleich, 1992 and 2001. – The sources of List and Schnabel are OECD data (1995, 2003) and calculations of their own. In 1992 the OECD means of the 45% with less upper secondary were IQ 87, of the 36% with upper secondary IQ 101, and of the 11% with tertiary education IQ 120.
- (4) These differences are only based on source (1).

The general correpondence of means of educational IQ, PISA IQ and Lynn-Vanhanen IQ should not be a complete surprise. Rindermann (2007) had already found a correlation of .78 across countries between mean IQ and educational level of young adults, operationalized by an index composed of three measures: 1. adult literacy rate 1991; 2. percentage of persons between 12 and 19 years old 1960 – 1985, having graduated from secondary school; and 3. the mean of years of schooling of persons 25 years or older for 1990, 1995 and 2000.

Generally, the differences between Lynn-Vanhanen IQ, PISA IQ and Educational IQ do not exceed plus or minus two points. Whereas Lynn-Vanhanen IQ is based on IQ-tested samples (in some countries even on a single, small and local sample), and PISA IQ is based on large and representative samples of schoolchildren, Educational IQ is based on data of the total adult population. Data on educational attainment, scaled as Educational IQ, and PISA results do confirm, in most cases within the limits of measurement error, the results of a century of IQ testing, summarized by Lynn and Vanhanen (2002, 2006). Whoever active in the field of educational economy had ever imagined such a possibility?

However, educational attainments are not well calibrated in all countries to allow international comparisons. Obviously, the Educational IQ of the United States does not fit to its Lynn-Vanhanen IQ and PISA IQ. Because of the decline in value of a US college education arising from increases over time in the number of persons graduating from college, there is a stronger deflation of educational degrees in the United States than in other OECD countries. Also, Scandinavian degrees seem be more deflated than degrees in the Netherlands.

There is a theory of college-going decision-making (Arai, 1998) that is quite different from human capital theory (Wößmann, 2002; Hanushek and Woesmann, 2007). This alternative theory is based on the idea that the role of higher education is not to certify the knowledge and skills acquired in college, but simply to convey information to society about the degree holder's innate productivity. According to this theory, those who have high productive capabilities acquire higher education so that firms can identify degree holders as more productive and pay them more. This role of education has been called signaling, screening, filtering or sorting by different authors

(Arrow, 1973; Burdett, 1978; Spence, 2002). The holding of a degree is also seen as a signal of whether an applicant is from a rich and educated family. This information is used to guess their productivity because those from rich and educated families are more productive either on average or with certainty (Bowles and Gintis, 2002; Mulligan, 1999). Signaling (filtering) theory assumes that higher education does not improve a student's talents, because it does not change his genotype. An employer uses a job applicant's educational rank or years of education (this means, in our context, his Educational IQ) to infer his position in the distribution of abilities. The education system of most countries consists of primary, secondary and tertiary education. Suppose that only primary education was initially compulsory and that compulsory education has been extended to the secondary level. Because of this change, the genotype of individuals whom the signaling theory considers to be of low ability and who used to receive only primary education will now receive secondary education. Then, the average productivity and accordingly wages of workers with secondary education will be lower than before and will be deflated. This is because the extended years of compulsory education will neither enhance the productivity of students nor their IQ.

Already in the last quarter of the nineteenth century in England the decrease of birth rates in the upper stratum led to the assumption of a threat of an accompanying decrease of average giftedness. But contrary to all such expectations, cognitive test scores rose over many decades (Fernandez-Ballesteros and Juan-Espinosa, 2001). For a geneticist (Weiss, 1992) it seems clear that – in analogy to the already mentioned acceleration of body height – such a rise could only be a rise in phenotypic values and not in genotypic ones. Under the impression of the Flynn effect, the argument that a dysgenic development was imminent seemed to be ridiculous to the wider public (Lynn, 1996).

In a comparative study of national fertility surveys taken around 1970, Finland was the only country where a positive correlation with fertility became more accentuated as a husband's education increased (Jones, 1982). In view of the development in other Scandinavian countries (Teasdale and Owen, 2008), it can be doubted that such a trend has lasted up to today.

A study (UN, 1995) that analyzed nationally representative surveys of 26 countries (including 10 countries in sub-Saharan Africa, but also Egypt, Indonesia, Thailand, Brazil, Mexico, and Peru) found in all countries a strong negative correlation between women's years of education and their mean number of living children. This was confirmed by Meisenberg (2008) with data from the 1990, 1995 and 2000 waves of World Value Survey covering 78 countries. Because this correlation has held for both industrialized and developing countries for more than half a century (Lam, 1997), economists are beginning to discuss the possible consequences (Bishop, 1989; Goujon and Lutz, 2004). Exceptions (as Finland temporarily was) are very few, and the elite of managers and professionals with sometimes a relatively high number of surviving children, (causing a U-shaped distribution of differential fertility in some countries) is numerically too small to have a trend-changing demographic effect.

However, as it seems, within one generation or even within a few years the impact of dysgenic fertility on IQ means of countries is much smaller than the impact of selective migration.

Table 3

OECD countries with at least 7 percent immigrants, Lynn-Vanhanen estimates of IQ (2002), Educational IQ, PISA IQ, difference of Educational IQ between foreign and native born and the percentage of immigrants among the adult population, and difference of PISA IQ between children with and without migrational background

Country	L/V IQ 2002 (see Table 1) Mean year of birth about 1955	Educational IQ (see Table 2) Mean year of birth about 1960	PISA IQ (see Table 1) Mean year of birth 1988	**Difference. of Educ. IQ foreign/native born and percentage of immigrants** (see Table 2)	Difference of PISA IQ between children with and without migrational background[1]
Ireland	93	97	98	**+ 6 – 11%**	0
Australia	98	100	100	**+ 2 – 25%**	+1
Canada	97	100	101	**+ 2 – 18%**	0
New Zealand	100	100	100	**+ 2 – 20%**	- 1
United Kingdom	100	99	99	**0 – 12%**	no data
France	98	97	98	**- 1 - 9%**	- 8
Belgium	100	97	100	**- 2 – 11%**	- 13
Netherlands	102	97	102	**- 2 – 11%**	- 10

Country	L/V IQ 2002(see Table 1) Mean year of birth about 1955	Educational IQ(see Table 2) Mean year of birth about 1960	PISA IQ (see Table 1) Mean year of birth 1988	**Difference. of Educ. IQ foreign/native born and percentage of immigrants**(see Table 2)	Difference of PISA IQ between children with and without migrational background[1]
Sweden	101	101	98	**- 2 – 12%**	- 10
Austria	102	98	98	**- 3 – 12%**	- 9
Germany	102	101	97	**- 3 – 7%**	- 12
Switzerland	101	102	102	**- 3 – 25%**	- 12
United States	98	101	94	**- 3 - 7%**	- 4

SOURCES:

- (1) Means, calculated on the basis of three data sets: Zimmermann, K. F. (2005), *Herausforderungen des demografischen Wandels für den Standort Deutschland,* Berlin: DIW; p. 16, Mathematikleistungen im PISA-Test. – Levels, M., and Dronkers, J. (2008). Educational performance of native and immigrant children from various countries of origin. *Ethnic and Racial Studies, 32* 1404-1425; p. 1414, Table3; OECD PISA 2003, n = 67,865. – de Heus, and Dronkers, J. (2008). Can educational systems compensate for societal features? *International Conference on Survey Methods in Multinational, Multiregional, and Multicultural Contexts*, Berlin; Table 2; n = 9414 immigrant pupils, OECD PISA 2006.

At an average, schoolchildren tested by PISA are born about one generation later than the subjects of IQ test samples summarized by Lynn and Vanhanen (2002). By comparying Lynn-Vanhanen IQ means with PISA IQ means, we see clearly that in Ireland, Canada, Australia and New Zealand (Winkelmann, 2000), where the Educational IQ of immigrants is higher than of natives, the IQ of the total population is rising; and in Germany and Austria where the Educational IQ of immigrants is lower than of natives the IQ is declining. A rise of 5 IQ points in Ireland is contrasted with a 5 point decline in Germany. Background data from many sources (List and Schnabel, 2004; Zimmermann, 2005; Belot and Hatton, 2008; Brücker and Ringer, 2008; de Heun and Dronkers, 2008; Levels and Dronkers, 2008; Levels et al., 2008) corroborate that this rise and fall is a real one.

The figure of 7% of immigrants in Germany (see Table 3) is clearly an underestimate (immigrants from the former Soviet Union obtain in most cases German citizenship and are not counted as foreigners in governmental statistics). Other sources (OECD, 2004) speak of more than 20% of schoolchildren with at least one foreign-born parent (the microcensus of 2007 has counted 27% of such families; Brücker and Ringer, 2008.) In Germany the IQ mean of pupils with Turkish background, comprising about half of all immigrants (Levels et al., 2008), is 18 points lower than the IQ of natives (de Heus and Dronkers, 2008), and in the second migrant generation even 3 points lower than in the first (Levels and Dronkers, 2008).

Taking OECD countries as a whole, the mean IQ of immigrants is 2 points higher than of native-borns (OECD, 2007b), overriding in such a way the effects of dysgenic fertility in many industrialized countries. The brain gain (Mueller-Jentsch, 2008), especially of English-speaking countries, is contrasted with a brain drain from third-world and East European countries (Docquier, 2006; Docquier and Marfuk, 2006; Von der Oelsnitz et al. 2007; Belot and Hatton, 2008). There, the combination of brain drain with dysgenic fertility is leading to a fast decline of mean IQ, especially in South Africa and some countries of Latin America (Weiss, 2007; Lynn, 2008). For example, Children of immigrants from China, India and Vietnam to OECD countries have a mean PISA IQ of 106 (Levels et al., 2008), and furthermore also emigrants from Germany, South Africa, the United Kingdom, and the United States to Australia and New Zealand a mean IQ above 100 (see for very detailed tables: Heus and Dronkers, 2008).

Clearly, within one generation the effect of selective migration on IQ means is in many countries much higher than by differential fertility. The data show that Finland seems to be the only country in the world where the IQ mean has risen by eugenic fertility during the last half century.

Table 4
Highly gifted men and the percentage of their highly gifted male relatives (classified by occupation and achievement in the studies by Galton, Terman, Brimhall, and Weiss)

	Galton %	**Terman** %	**Brimhall** %	**Weiss** %	*n* (Weiss), mean year of birth
Probands	100	84^{+}	100	97^{+}	1972: *1329,* 1994: *357,* born 1947
Fathers	26	41	29	40	*346,* b. 1917
Brothers	47	-	49	49	*220,* b. 1947

	Galton %	**Terman** %	**Brimhall** %	**Weiss** %	*n* (Weiss), mean year of birth
Sons	60	64*	-	55	*77,* b. 1972
Grandfathers	14	-	9	9	*681,* b. 1887
Uncles	16	-	13	14	*615,* b. 1917
Nephews	23	-	-	22	*76,* b. 1970
Grandsons	14	-	-	-	-
Great-grandfathers	0	-	-	4	*1290,* b. 1857
Uncles of the parents	5	-	-	5	*1996,* b. 1887
Cousins	16	-	9#	18	*570,* b. 1942
Great-grandsons	7	-	-	-	-
Cousins of parents	-	-	-	11	*2250,* b. 1917

"+": classified by occupation; 100%, if classified by test
"*": Classified only by IQ; classification by occupation gives about 55%; n = 820.
"#": some cousins were still too young and did not have full opportunity to become distinguished
"-": no data

SOURCES:

- Galton, F. (1869). *Hereditary Genius.* London: Macmillan, p. 195.
  100 famous men (n = 43) of science and the percentage of their famous male relatives.
- Oden, M H. (1968). The fulfillment of promise: 40-year follow-up of the Terman group.
  Genetical Psychology Monographs, 77, 3-93.
  The mean IQ (transformed to 100;15) of the sample of probands was 146 (n = 724); the cut-off score IQ 137.
- Brimhall, D. R. (1922/23). Family resemblances among American men of science.
  The American Naturalist, 56, 504-547, *57,* 74-88, 137-152, and 326-344.
  In 1915 questionnaires were filled in by 956 distinguished American men of science and their relatives.
- Weiss, V. (1994). Mathematical giftedness and family relationship.
  European Journal for High Ability, 5, 58-67.
  Highly gifted males (mean IQ 135 +/- 9) and their relatives in professions and occupational positions, typically associated with an IQ above 123.

The Law of the Vital Few

Another possibility for measuring differences between countries would be in terms of allele frequencies of genes underlying the IQ distribution. Until now, attempts to discover effects of hypothetical major genes underlying this distribution (for all arguments in favor and against such a hypothesis, see Weiss, 1992, 2000) have been fruitless (Payton, 2006). In the present state of knowledge, this neither proves nor disproves the existence or non-existence of such genes. In most countries, funding of such research and even the hypothesis of such genes is politically incorrect (Weiss, 2007).

Francis Galton was the first to replace mere speculation on the inheritance of talent with statistical data (Galton, 1869). There is an obvious parallelism between the data collected by Weiss (2000; p. 80) in 1970/71 and his follow-up in 1993 (see Weiss, 1992; 1994) and the data of Galton, Terman and co-workers (Oden, 1968), and Brimhall (1922/23).

In the first column of Table 4 (Galton, 1869), we see famous scientists of past centuries and their famous relatives belonging to the upper stratum of society; in the last column, schoolchildren of a so-called socialist state (Weiss, 1992, 1994), selected by nation-wide mathematical competitions, and their relatives scattered over the whole spectrum of jobs and occupations. In addition, we see the Californian top performers of Terman's Stanford-Binet IQ testing in 1916 (Oden, 1968), and Brimhall's sample (1922/23) of famous American men of science. Such a parallel can only arise if Galton's and Brimhall's criteria of fame; Weiss' criterion of giftedness for mathematics, science and high accomplishments in other fields; and Terman's definition of high IQ have something substantial in common. Unconsciously (or perhaps better: very consciously), Galton, Terman, Brimhall, and Weiss must have shared the same intuitive understanding of a qualitative threshold beyond which we can speak of well-above-average cognitive ability. Any contribution to the genetics of general cognitive ability has to try to find an explanation for the regularity of this table.

By applying the method of stochastic Mendelian matrices (Li and Sacks, 1954) as early as 1971, Weiss (see Weiss, 1992, 2000) put forward the hypothesis that a major gene, M1, could explain the frequency of fame and high giftedness among the consanguine kin of the highly gifted. In a population with a mean IQ of about 100, the frequency q of this allele M1 was estimated to be about 0.20. From this, and from the segregation of IQ within families (Weiss, 1992, 1994), it follows that individuals with an IQ above 123 are homozygote M1M1, and those above 104 are heterozygote M1M2 (where M2 could stand for an unknown series of alleles).

According to Jensen (1980, p. 115.): "The socially and personally most important threshold regions on the IQ scale are those that differentiate with high probability between persons who because of their level of general mental ability ... can or cannot succeed in the academic or college preparatory curriculum through high school (about 105)." Independently, an author who is publishing on the world wide web under the pseudonym "La Griffe du Lion" [The Paw of the Lion] put forward his "smart fraction theory" (2004), stating: "In market economies, *per capita* GDP is directly proportional to the population fraction with IQ greater than 105. …According to the *1992 Wonderlic Personnel Test and Scholastic Level Exam Users Manual*, at an IQ level of 106 we might expect to find bookkeepers, credit clerks, laboratory technicians, salesmen and secretaries. At slightly higher IQs we find registered nurses, sales account executives, administrative assistants and store managers. These people are not rocket scientists. They are, however, vital to a flourishing economy. Any nation … needs a cognitive core to carry its water." While Lynn and Vanhanen (2002) found a *non*linear relationship between GDP and IQ, La Griffe du Lion asserts that *per capita* GDP is related linearly to the percentage of smart fraction. We can go a step further and extend his argument.

From the Hardy-Weinberg-law of population genetics, it follows that the frequency q of the hypothetical major gene M1 is $(1\text{-}q)^2 + 2q(1\text{-}q) + q^2 = 1$. From $q = 0.20$ follows that $2q(1\text{-}q) + q^2 = 0.36$. This frequency of 0.36 and its percentile rank not only correspond to an IQ of 105 (in a population with a mean IQ of 100), but are also identical with the smart fraction suggested by La Griffe du Lion. By extracting the root from the non-smart fraction $(1\text{-}q)^2$, we get the allele frequency q of M1 (see Table 5) in different countries.

Table 5

Mean of Rindermann estimates of IQ (minus 1) and PISA IQ, smart fraction of the population (percentage above IQ 105.6), allele frequency of the hypothetical major gene M1 underlying iq, 0.93 theoretical GDP per capita (1998), and 0.57 real GDP per capita (2007)

Country	Mean of Rind IQ (-1) [1] and PISA IQ (See Table 1)	Smart Fraction[2] %	**Gene Frequency M1**[3]	0.93 X Theoretical GDP (1998) Per Cap $[2]	0.57 X Real GDP (2007) Per Cap $[4]

Country	Mean of Rind IQ (-1) [1] and PISA IQ (See Table 1)	Smart Fraction [2] %	**Gene Frequency M1** [3]	0.93 X Theoretical GDP (1998) Per Cap $ [2]	0.57 X Real GDP (2007) Per Cap $ [4]
Finland	103	43	**0.24**	24100	20200
Netherlands	102	41	**0.23**	22600	22000
Canada	101	38	**0.21**	21200	21800
Switzerland	101	38	**0.21**	21200	22700
United Kingdom	100	36	**0.20**	19800	20100
New Zealand	100	36	**0.20**	19800	15600
Australia	100	36	**0.20**	19800	21400
Belgium	100	36	**0.20**	19800	20800
Sweden	99	33	**0.18**	18400	21000
Austria	99	33	**0.18**	18400	22200
France	99	33	**0.18**	18400	19300
Denmark	99	33	**0.18**	18400	21300
Germany	98	31	**0.18**	17100	19600
Ireland	98	31	**0.18**	17100	26000
United States	97	28	**0.15**	15800	26200
Italy	96	26	**0.14**	14600	17700
Spain	96	26	**0.14**	14600	19200
Greece	93	20	**0.11**	11200	17400
Portugal	93	20	**0.11**	11200	12400
Israel	92	18	**0.09**	10200	16400
Uruguay	89	13	**0.07**	7500	6100
Thailand	88	12	**0.06**	6800	4600
Turkey	86	10	**0.05**	5400	5400
Chile	85	9	**0.05**	4700	8200
Argentina	84	8	**0.04**	4200	7400
Mexico	83	7	**0.03**	3700	7100
Indonesia	82	6	**0.03**	3300	1900
Tunisia	80	4	**0.02**	2400	4300
Brazil	79	4	**0.02**	2100	5500

SOURCES:

- (1) Rindermann, H. (2007). The g-factor of international cognitive ability comparisons: the homogeneity of results in PISA, TIMSS, PIRLS and IQ-tests.

European Journal of Personality, 21, 667-706, here p. 700ff.
- (2) La Griffe du Lion (2004). Smart fraction theory II. Vol. *6*, No. 2, p. 11ff.; http://www.lagriffedulion.f2s.com/sft2.htm , retrieved on 2005-05-07.
- (3) Weiss, V. (1992). Major genes of general intelligence. *Personality and individual Differences, 13,* 1115-1134. – Weiss, V. (1995). The advent of a molecular genetics of general intelligence. *Intelligence, 20,* 115-124.
- CIA (2008). *The world factbook.* Washington, D. C.: Potomac, retrieved on 2008-24-01.

Applying a rule of thumb, we see that this frequency multiplied by about 1000 gives the theoretical GDP in 1998 (La Griffe du Lion, 2004). Now, indeed, the relationship between GDP and the frequency of a major gene underlying above-average IQ is a linear one. Also Docquier (2006) found a linear correlation of .68 between GDP *per capita* (average 1995-2005) and the proportion of workers with tertiary education in the labor force. This proportion is not identical to the smart fraction, but about half of it.

The Pareto principle (also known as the 80-20 rule), the law of the vital few, states that for many events 80% of the effects come from 20% of the causes (Koch, 2000). The power of a nation does not depend of its mere number, but of the percentage of its cognitive elite, optimized by social evolution (Weiss, 2000). Highly intelligent people are networking, and the economic effect of networking is the square of the nodes of the network, i.e. in our case the square of the number of people involved (Koch, 2000).

> Advanced methods, applied very successfully in the low IQ range, for example, homozygosity mapping and comparative genomic hybridization within consangineous families have still never been used in order to detect high-IQ genes. Of course, the IQ is influenced by hundreds of minor genes and other effects, measurable under certain circumstances and in subpopulations, but this does not exclude the possibility of major gene effects.
>
> A rationale for the search of such genes could include the following knowledge and steps: 1. homozygosity mapping among the relatives of highly gifted, who have an IQ above 123 (for them their Educational IQ could be a good estimate); 2. nonsynomously coding SNPs and other genetic polymorphisms that are found to be homozygous among relatives should be checked whether their distribution of allele frequencies in the data bases does fit the expected racial distribution of socially representative samples: about 0.20 of the rare allele among Eurasian populations and approximating 0.00 in sub-Saharan Africa; 3 .if either 1 or 2. are given, the possible association between genotypes and IQ could

be checked by comparing with the genotypes of Craig Venter, James Watson and the highly intelligent volunteers of the Personal Genome Project, whose genomes can be accessed freely.

In 1998, the GDP *per capita* of a country with a gene frequency of 0.20 for M1 was about ninefold higher than for a country with a frequency of 0.02; the absolute difference in GDP *per capita* was about $19,000. This gap between highly industrialized and underdeveloped countries has been widening since the beginning of the industrial revolution (Clark, 2007; Galor and Moav, 2002).

The expected decrease in the world's average IQ from 95 in 1950 to 87 in 2050 (Weiss, 2007; similar Lynn and Harvey, 2008) means a decrease of the gene frequency *q* of Ml from 0.12 to 0.05 and a decrease of the smart fraction (with an IQ above 105) from 22% to about 10%; that means a decrease of about 4% per generation.

It is common knowledge that non-market economies, in their increase in GDP, are not in step with market economies. While some former non-market countries with a high average IQ such as Estonia, the Czech Republic, Slovenia and especially China are narrowing the gap, those with a low average IQ seem to have no chance to catch up. On the one hand we have the impressive success story of Singapore (Lee, 2000); on the other hand are countries such as Haiti and Zimbabwe, which are not only backward, but suffer from mismanagement and brain drain. - In 1968, the Pacific island of Nauru possessed the highest GDP *per capita* in the world (cited from Wikipedia, 2008) due to its rich phosphate deposits. Today, after the exhaustion of these deposits, Nauru – faced with chaos amid political strife and the collapse of the economy caused by mismanagement and corruption – has a GDP more in accordance with the gene frequency of M1 in its population.

One of the criteria that differentiate science from speculation is the power of prediction. In 2007, oil-producing Equatorial Guinea, a country with an average IQ of 59 (Lynn and Vanhanen, 2002), one of the lowest in the world, had a GDP *per capita* of $44,100 (CIA, 2008), one of the highest in the world. We predict that after the exhaustion of the oil the GDP of this country will fall back into a range typical for a country with a gene frequency of M1 below 0.02. As long as the oil is flowing, a number of specialists and dealers of Lebanese, Chinese, Indian and other origins make money, but they will abandon such a country after the boom.

In Table 5 we included only countries with a long history of a market economy and with at least two sets of data from PISA studies. Therefore, the overall impression of this table is misleading, because three quarters of world population have a GDP *per capita* below Brazil. In 2007, in sub-Saharan Africa there are 12 countries with a GDP below $1,000, all with a gene frequency of M1 below 0.02. There has been no Flynn Effect in these countries. Therefore, a truncation of national IQs to a minimum of 80 would make sense, but would not make much difference in terms of gene frequencies.

Some countries (for example, Brazil, Israel, South Africa) with a socially and regionally segregated or highly stratified population (and a high Gini-index) have a much higher GDP than can be expected from their average IQ. In such countries, the variance of IQ within the overall population is higher than 15, and we should strive to replace the theoretical frequency of M1 by its real frequency. Most suitable would be measuring the percentage of subjects with an IQ above 105 directly.

Even within developed nations, the difference between prosperous and more backward regions amounts to 10 and more IQ points. For example, in Germany the IQ average of Bavaria is about 10 points higher than that of Bremen (Ebenrett, Hansen and Puzicha, 2003); in Italy the difference between Venice and Sicily is 13 points; in Spain the difference between Aragon and Andalusia 8 points (OECD, 2007a); and in the United States the difference between New Hampshire and Mississipi is 10 points. Such differences, aggravated by internal migration between the economic core and the backward regions (Ebenrett, Hansen and Puzicha, 2003) – but not always of such magnitude – will be found in any country. However, the average IQ of 102 for Italy (Lynn and Vanhanen, 2002) as a whole was never correct and can have been obtained only from testing in that country's northern regions.

When merging the 16 German states into one league table with the other 28 OECD countries that report PISA 2003 performance data, Bavaria (IQ 102) takes 5th place internationally, while the largest state of Germany, North Rhine-Westphalia (IQ 94) takes 35th place and the city state of Bremen 39th place (IQ 92) out of the 44 countries and states (Wößmann, 2007).

There should be doubt whether the average IQ of China is really as high as 105 (Lynn and Vanhanen, 2006) or even 106 (Rindermann, 2007; minus 1 already subtracted). This average may hold for the coastal regions, but perhaps not for the provinces in the interior (neighboring Kyrgyzystan, for example, has in 2006 a PISA IQ of only 69). In view of the fact that also within industrialized countries (see further below) the difference between the prosperous economically backward regions amounts to about 10 IQ points, why should the situation in China be different? Also, for decades in China, as in most countries all over the world, highly qualified women bear only half the number of children as unqualified women: in the China region with primary education 2.14 children, with tertiary 1.08 (Goujon and Lutz, 2004). It is simple naiveté to believe a one-child-policy has changed anything in this respect.

Within Brazil, the federal states of the south have an average IQ and GDP *per capita* similar to South Europe and four times higher than the states in the north-east of Brazil (CIA, 2007). Political turmoil and ethnic cleansing can eliminate or drive away the gifted of a country, and within a very short time harm the economy for decades to come (Weiss, 2000). Highly-skilled citizens from stagnating economies are unlikely merely to watch their standard of living decline, and they will vote with their feet. Their migration amplifies economic divergences within and between countries.

There are three types of men (Weiss and Weiss, 2003): Men (with IQ above 123) who invent machines, men (with IQ above 104), who repair machines, and men who use machines. In a country where there are not enough men to construct and to repair a bridge, sooner or later traffic by railroad will break down (Malloy, 2008).

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