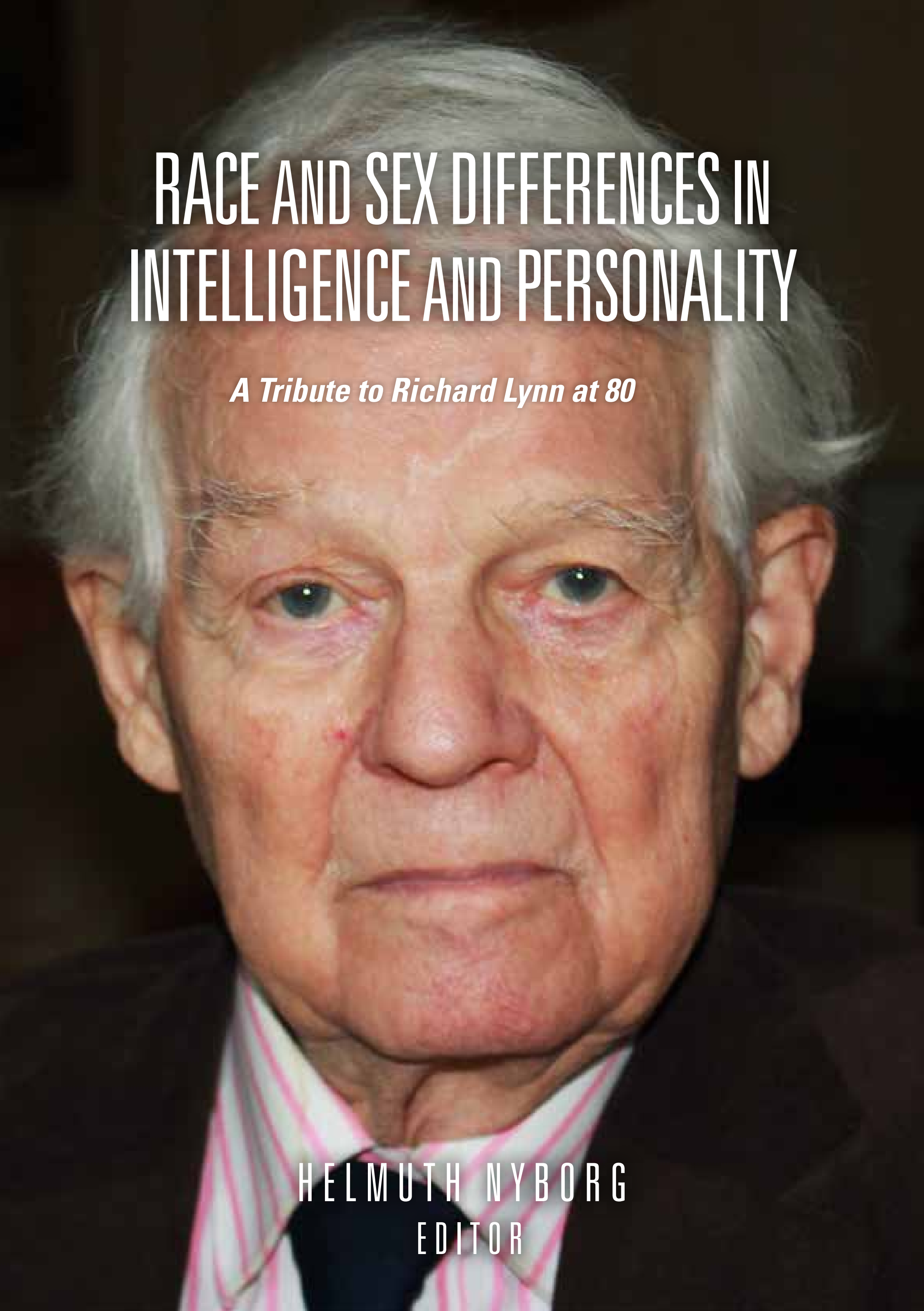


RACE AND SEX DIFFERENCES IN INTELLIGENCE AND PERSONALITY

A Tribute to Richard Lynn at 80

HELMUTH NYBORG
EDITOR

RACE AND SEX DIFFERENCES IN INTELLIGENCE AND PERSONALITY

A Tribute to Richard Lynn at 80

Helmuth Nyborg (Editor)

UI

Ulster Institute for Social Research

Published 2013 by
Ulster Institute for Social Research
London NW10 5TH UK

ISBN 9780957391345

The articles contained in this book were first published in *Personality and Individual Differences, Volume 53, Issue 2, pages 75-162 (July 2012)* and are re-published here with the full permission of Elsevier BV

Printed in Great Britain

Contents

Sex differences

Intelligence and dysgenic fertility

The Lynn-Flynn effect

Epilog

Preface

Helmuth Nyborg

These papers have been written to honour the work of Richard Lynn on the occasion of his eightieth birthday. They were initially published in the journal *Personality and Individual Differences* and are republished here to ensure the wider dissemination they deserve. Richard Lynn has carried out research on intelligence and personality over a period of sixty years. He published his first paper in 1953 and he has already produced four papers in 2014 (Lynn, 1953; Dutton & Lynn, 2014; Liu & Lynn, 2014; Lynn. & Čvorović, 2014a, 2014b). Much of his work has been on race and sex differences and the evolution of these. Most readers will know that research in these areas generates controversy, so a few brief introductory comments may help the reader to appreciate why this is so, and to illustrate the value of a robust personality and strategic judgement in order to get the scientific message on these through troubled waters.

During the past 60 years there have been three disturbing facts about the scientific study of individual and groups differences in intelligence and personality. First, there are many academics and lay people, who demonstrate a remarkable scientific indifference to the massive documentation for the importance of evolution and inheritance for our understanding of the unfolding of vitally important individual and social matters. I call this a “calculated scientifically harmful ignorance”. Then, some colleagues seem to suffer from a kind of strategically motivated fear, which reduce their knowledge of the field. They read and appreciate perfectly well the scope and potential societal importance of evolutionary and differential psychology but at the same time they fear the likely personal consequences of discussing these matters openly. They have a kind of latent self-censorship, readily admitted in private conversation but never public. Third, what they fear in particular are the highly vocal opponents who react to research in these areas with open hostility and call for sanctions against those who dare work in these fields. Richard Lynn is one of the multiple examples of those who have been intimidated by these threats, and some of them have been described in detail by Jensen (1972), Nyborg (1997), Segerstråle (2000) and Gottfredson (2013).

The effect of this has been that research in these controversial areas takes an extraordinarily robust personality. The only scientists able to do it are those capable of withstanding – over extended periods of time – the risk of being ousted from the "good scientific community" or even dismissed, and at the same time, being capable of amassing sufficient energy and nerve to continue collecting, analysing, and publishing even more "incorrect" data and theories. Richard Lynn has proved in spades that he possesses this type of courageous personality.

This provokes a natural question: How did the academic situation get so far out of control? I see a number of historical events, which from the 1930s acted to regard essential aspects of evolutionary theory, differential psychology and behaviour genetics as taboo and by some highly vocal critics as heretical. The most significant is undoubtedly the Nazi atrocities committed in the name of eugenics during the Second World War. The United Nations Committee on Human Rights felt compelled to react strongly against this in 1954, when it issued a statement which (even if it had to be revised shortly after serious critique for one-sidedness) in effect banned most research on the biology of race-differences in intelligence and personality. From then on socio-biologists, differential psychologists and behavioural geneticists became legitimate targets for ideologically based critiques, irrespective of the scientific relevance and quality of their research (Gross & Levitt, 1994/1998; Segerstråle, 2000).

A second factor was the rise of the Boasian school of cultural relativism led by Franz Boas at Columbia University, where his students Margaret Mead, Ruth Benedict and others produced ideologically based works promoting the notion that culture subjugates biology. A third factor was the influence of Frankfurt School and the Soviet proclamation of the possible and preferential political creation of the ideal Soviet Citizen, which also promoted acceptance of the tabula rasa models of man, again at the expense of biological aspects of human nature. A fourth factor was the influence of the late Steven Jay Gould from Harvard University whose prize-winning book *The Mismeasure of Man* (1981/1996) became widely cited for its condemnation of research on individual and group differences in intelligence, even though it was demonstrably based on faulty brain size data and analyses shown by Lewis et al. (2011) and on deliberate fraud in misrepresenting psychometrics that I showed in Nyborg (1997, pp. 491-496). In addition to these, various equal right groups, the feminist ideology movements, and the "all-children-are-equal" propaganda became prominent, despite being supported more by optimism than by solid evidence and rarely challenged by existing contra-evidence.

The lasting result of all this was that research on individual and group differences in intelligence and personality came to be regarded as evil, meant to downplay human, political, moral or cultural values as shown by Gottfredson (2013). These movements succeeded in effectively silencing the early eugenics societies that were closed down, and journal names and contents changed. Students of race and sex difference in intelligence were particularly hard hit by increasing political correctness, and not a few researchers fell into disrepute or were sacked.

This is the sombre background upon which this book honours Richard Lynn, as a prolific writer of numerous scientific papers and books on the study of evolution and behaviour genetics of individual, race, national and sex differences in intelligence and personality. The work he has undertaken demands remarkable personal stamina.

Let me illustrate how he not only demonstrated this, but also how he had to think strategically from time to time. In my chapter *A conversation with Richard Lynn* I bring out that when he was at the Economic and Social Research Institute in Dublin between 1967 and 1972 he realized that the economic backwardness of Ireland was attributable largely to the low average national IQ, and further that the treatment for this would be a eugenic program designed to raise the national intelligence. He knew that if he published this analysis, his critics would condemn him as a Nazi. So he decided the time was not right to publish and confined himself to writing a couple of minor papers about his reflections, and even that he had to do in a circumscribed way. Gradually, as more and more data appeared on national and race differences in intelligence, Richard took a leap in 1980. That year he proposed that the exodus of early humans from Africa into cold northern regions could explain the considerable national and race differences he had found in intelligence. Over the next two decades more data were published until in 2002 he felt that time was ripe to publish a worldwide catalogue of national IQs in his book *IQ and the Wealth of Nations,* co-authored with the Finnish political scientist, Tutu Vanhanen from the University of Tampere. Their astounding conclusion was that about half the explanation for the tremendous differences in wealth between economically developed and third-world countries is the national differences in IQs. They attributed the other fifty percent of the explanation to the strength of market economies and the possession of natural resources.

This analysis was first greeted with criticism. As Jyri Allik has observed "By analogy with many previous controversial discoveries, it is predictable that the first most typical reaction would be denial. Many critics are not able to tolerate the idea that the mean level of intelligence could systematically vary across countries and world regions. Neither are they ready to accept that from the distribution of mental resources it is possible to predict the wealth of nations. The next predictable phase is acceptance of the facts but denying their interpretation. The simplest strategy is to interpret the results as measurement error. A useful strategy is to discover a few small mistakes declaring that all the results are equally suspicious" (2007, p. 707).

Among the critics, Earl Hunt and Robert Sternberg (2006) initally described the national IQs as "technically inadequate… and meaningless". Two years later, however, Hunt conceded that "in spite of the weaknesses in several of their data points, Lynn and Vanhanen's empirical conclusion was correct" (Hunt and Wittmann, 2008).

Richard has not been deterred by the initially hostile criticisms. Whether storm or still, he sails through academia, demonstrating all the time the value of a galvanized mind, which allows him not to be distracted by the sometimes rather hostile headwinds. Like a true scientist, he has steadily concentrated on collecting relevant data, analysing them properly, developing theories to explain complex phenomena, and then testing them rigorously. His sharp intellect and notoriously insatiable curiosity have allowed him - alone or co-authoring with others – to publish a series of works on such apparently different matters as pigmentocracy (i.e. societies, where wealth and social status are related to skin color and IQ); globally and nationally declining IQs; dysgenics and genetic deterioration; the new eugenics of modern biotechnology; race differences in psychopathy; and the extraordinarily high IQ and impressive achievements of the Jews over centuries.

The present book illustrates and discusses only a few of Richard Lynn's major achievements over time. Some will no doubt take a critical stance on some of the chapters on the evolution of race, national, and sex differences in intelligence, personality and wealth, but this is how it should be. Science is basically a self-correcting, critical, and hopefully, fair process.

Allow me to finish this introduction on a personal note. When the dust has settled, I believe that, among all his pioneering work over the years, Richard Lynn's and Tatu Vanhanen's successful challenge of current economic and sociological theories of why and how national differences in the global economy unfold will stand out as a major advance in social science. It promotes a scientifically satisfactory explanation in proposing differences in national average IQs for the considerable and consistent North-South differences in wealth. Add to this Lynn's well-reasoned worry about the ongoing dysgenic genotypic deterioration of intelligence (Lynn, 2011), and arguments for a positive bio-technological eugenic rescue (Lynn, (2001), and we have the stuff Nobel prizes are made of.

References

Allik, J. (2007). Geographical distribution of mental abilities and its moral consequence. *European Journal of Personality*, 21, 707-708.

Dutton, E. & Lynn, R. (2014). Regional differences in intelligence and their social and economic correlates in Finland. *Mankind Quarterly* (to appear).

Gottfredson, L. (1994). Egalitarian fiction and collective fraud. *Society, 31*(3), Whole No. 209.

Gottfredson, L. (2000). "Equal potential: a collective fraud". *Society, 37*(5), vii/viii.

Gottfredson, L. (2013). Resolute ignorance on race and Rushton. *Personality and Individual Differences, 55*(3), 218-223.

Gould, S.J. (1981/1996). *The Mismeasure of Man*. New York: W.W. Norton/Hammondsworth. U.K.: Penguin Books.

Gross, P.R. & Levitt, N. L. (1994/1998). *Higher superstition: The academic left and its quarrels with science.* Baltimore: Johns Hopkins University Press.

Hunt, E. & Sternberg, R.J. (2006). Sorry, wrong numbers an analysis of a study of a correlation between skin color and IQ. *Intelligence*, 34, 131-139.

Hunt, E. & Wittmann, W. (2008). National intelligence and national prosperity. *Intelligence*, 36, 1-9.

Jensen, A. R. (1972). *Genetics and Education*. London: Methuen.

Lewis, J.E., DeGusta D., Meyer, M.R., Monge, J.M., Mann, A.E., et al. (2011) The Mismeasure of Science: Stephen Jay Gould versus Samuel George Morton on Skulls and Bias. *PloSBiol 9*(6). doi:10.1371/journal.pbio.1001071.

Liu, J. & Lynn, R. (2014). Sex differences on the WISC-R in China and the United States. *Intelligence*, (to appear).

Lynn, R. (1955). Personality factors in reading achievement. *Proceedings of the Royal Society of Medicine*, 48, 996-998.

Lynn, R. (2001). *Eugenics: A reassessment*. Westport, Ct.: Praeger.

Lynn, R. (2011). *Dysgenics*: *Genetic deterioration in modern populations* (Second revised edition). London: Ulster Institute for Social Research.

Lynn, R. & Čvorović, J. (2014a). Sex differences in intelligence: some new data from Serbia. *Mankind Quarterly* (to appear).

Lynn, R. & Čvorović, J. (2014b). The intelligence of Ashkenazi and Sephardi Jews in Serbia. *Mankind Quarterly* (to appear).

Nyborg, H. (1997). The sociology of psychometric and bio-behavioral sciences: A case study of destructive social reductionism and collective fraud in 20th century academia. Chapter 20 in H. Nyborg (Ed.). *The scientific study of general intelligence: Tribute to Arthur R. Jensen*. (pp.441-502). Oxford: Elsevier Science.

Segerstråle, U. (2000). *Defenders of the truth: The battle for science in the sociobiology debate and beyond*. Oxford, I.K.: Oxford University Press.

Chapter 1

A conversation with Richard Lynn

HELMUTH NYBORG
Prof. emer., dr. phil.
University of Aarhus (1968-2007), Denmark
+45 87680456, mobil +45 24241655
helmuthnyborg@msn.com

HN: Let us begin with your roots. Where are they?

RL: They are all from the east of England. My father's family are Viking stock from North Yorkshire and were small trade people until my father obtained a scholarship to King's College, London. My mother's family are from the southeast and are Saxon stock from the North plain of Germany.

HN: And your childhood: it is often said that our early years are the formative period of our lives. Were yours particularly favourable for future achievement?

RL: Not at all. I was born to a single mother of quite average intelligence, and it has typically been found that children born and brought up in these circumstances are disadvantaged. However, I do not subscribe to this conventional view. I believe the genes we inherit are much more important determinants of our life than our early years.

HN: So were your genes particularly favourable?

RL: They were certainly better than my environment. My father was Sydney Cross Harland and was one of the leading plant geneticists of the 1920s - 1940s. His specialism was cotton, on which he wrote the standard text *The Genetics of Cotton*, and for which he was elected a Fellow of the Royal Society. He was a friend of most of the big names in genetics of his day, including Ronald Fisher, J.B.S. Haldane, and Julian Huxley. He died in 1981. His obituary appeared in *The Times* on November 18 of that year, and concluded “his distinguished career as an applied botanist was marked by a remarkable blend of the agricultural and the academic; for although he made outstanding contributions to the improvement of tropical crops, most notably cotton, his work also had a profound influence on evolutionary theory and the understanding of gene complexes”.

HN: In addition to transmitting half his genes, did your father have a significant environmental influence on you during your childhood and adolescence?

RL: No. My parents split up when I was quite young. I did not see anything of my father during my childhood and adolescence because in my early childhood he was working in Trinidad as Director of the Imperial Cotton Research Institute. He was sacked from this position in 1937. My father had an aptitude for annoying people in authority, which I seem to have inherited. Fortunately, he had a marketable skill as a plant breeder and secured a position in Peru as Director of the Institute of Genetics, with the task of reviving cotton which had been attacked by a virus. I did not meet my father until 1949, when he returned to Britain as Professor of Genetics at the University of Manchester.

HN: Did you see much of him and did he influence you from this time onwards?

RL: We met about once a year. I have certainly been influenced by my father’s ideas, especially his conviction that our lives are much influenced by our genes, and also the importance he attached to eugenics. He was one of the signatories of *The Geneticists’ Manifesto*, drawn up in 1939 by Hermann Muller (1939), which posed the question “How could the world’s population be improved genetically?" My father has also served as a role model and has given me the confidence to advance theories that have sometimes been controversial.

HN: But you only received half your genes from your father. You received the other half from your mother and you said that she had quite average intelligence.

RL: Yes, but her father graduated in Botany as the top student of his year at Imperial College and entered the agricultural service of the British Colonial Office, whose task was to breed improved crops in the extensive British colonies. He ended up as Director of Agriculture in Trinidad, and it was in the small British community of botanical scientists in Port of Spain that my mother and father met in the late 1920s. However, unlike my father who was a workaholic and spent his evenings poring over his data on cross-bred strains and writing them up for journals, my grandfather was quite lazy and preferred to play bridge in his club. I seem to have inherited the workaholic gene from my father.

HN: Tell me now about your childhood and adolescence.

RL: I was born in February 1930 and brought up in Bristol. I went to the Bristol Grammar School, but although my family had all been scientists, I did not find school science interesting. The subject I liked best was history. At the end of my school career I won a scholarship to the University of Cambridge, but I did not go up straight away. At this time all 18 year olds were conscripted into the armed services and in July, 1949, I received my call up papers requiring me to report for military service. It was not a future to which I particularly looked forward. Remarkably, the army decided I would make a good officer and I was duly commissioned second lieutenant. I was put in charge of the training of new conscripts. One of the things I had to do was to teach them how to use a rifle. I had never found any difficulty in this, but I was surprised to find that the new conscripts found this very hard. Generally they failed to hit the target at all. I used to give them a demonstration of how it was done, and the sergeant would bring the target and show it to them with five neat little holes in the bull's eye. They would gather round with exclamations of "Cor, blimey, look at the officer's"! I realised later that this apparently simple task must be *g* loaded.

HN: So then you went up to Cambridge. How did you like Psychology there?

RL: Not much. When I started, the Professor was Sir Frederic Bartlett. He was already renowned for his books *Psychology and Primitive Culture* (1923) and *Remembering* (1932). I dutifully read these books and could not find anything much of interest in either of them. Apart from Bartlett, information theory was the dominant research paradigm. The theory was taken from communication engineers who used it to analyse the transmission of information, as for instance along a telephone line. The Cambridge people applied this model to explain the transmission of information through the nervous system. The two leaders of this group were William Hick, who published his famous paper *On the rate of gain of information* in 1953, and Donald Broadbent. I came to know Broadbent quite well and we remained on friendly terms up to his death. However, we did not have much of a meeting of minds. His caste of mind was for developing micro-theories phenomena, whereas I have always preferred broad brush macro-theories.

HN: I think Bartlett must have been quite elderly when you were a student, so you did not have to endure him for that long?

RL: Yes, in 1952 Oliver Zangwill was appointed to the professorship. I looked forward to this new broom and eagerly read his book *An Introduction to Modern Psychology* that had been published in 1950. I was not impressed by this slim volume. It ran to only 220 pages and about 60,000 words and the very idea that it was possible to provide an adequate account of psychology in such a short book seemed absurd. What was the point, I wondered, of writing such a book? I found to my dismay that Zangwill had an uncritical acceptance of psychoanalysis and even wrote that "as a result of Freud's researches, psychology today differs from psychology of fifty years ago in a manner so fundamental as to justify the comparison with biology before and after Darwin". I thought that regarding Freud as comparable in stature and achievement to Darwin was preposterous.

My chief interest became the work on intelligence done at University College, London, developed by Charles Spearman, Cyril Burt and Raymond Cattell, and extended to personality by Cattell and Hans Eysenck. I thought this was much more interesting than the experimental psychology that was being done at Cambridge.

I took the final exams in 1953 and did my best to conceal the antipathy I had developed for Cambridge experimental psychology. Apparently I succeeded as I was awarded the Passingham Prize, which is given annually for the best psychology student of the year. On the basis of this I was awarded a three year research studentship to work for a Ph.D.

I decided to examine the relation between anxiety, intelligence and educational attainment in school children. I completed my Ph.D in the spring of 1956 and was disconcerted to be told by Zangwill that he had appointed Sir Cyril Burt as my external examiner and himself as the internal. I was a bit alarmed at having Burt as my external examiner because he had recently failed two Ph.D. students from Cambridge. However, the viva went well and he passed my thesis.

HN: So then you needed a job.

RL: Yes, and I obtained a lectureship at the University of Exeter. I was now to enter the wilderness years and did not succeed in doing anything that I considered significant for the next twelve years. In 1959 I published a paper *Environmental conditions affecting intelligence*, in which I said that it was now established that genetic factors are the major determinant of intelligence, but that environmental factors are also involved. I proposed that these consisted of the quality and quantity of cognitive stimulation from others in the family. I suggested that this explained the tendency for only children to have the highest IQs, and for IQs to decline with increasing family size, and also that eldest and youngest children have higher average IQs than those in the middle of the family. I sent the paper to Sir Cyril Burt, who replied with a friendly letter saying that he agreed with me. After this, I corresponded with Sir Cyril from time to time and I always found him very friendly and helpful.

HN: Your theory of the quality and quantity of cognitive stimulation from others in the family as the environmental determinant of intelligence sounds like the so-called Zajonc *effect.*

RL: Yes, Zajonc later formulated a very similar theory and managed to get his name attached to it. However, I do not find this annoying because I now think that Joseph Rogers (2001) has disproved the theory.

HN: What did you do next?

RL: I fell under the spell of Hans Eysenck's theory that he published in 1957 in his book *The Dynamics of Anxiety and*

Hysteria. In this he extended Hull's theory to individual differences. He proposed that extraverts generate Hull's concept of reactive inhibition more rapidly than introverts. From this assumption he derived a lot of deductions, for which he provided evidence in his book. One of the most important of these was that introverts would form conditioned Pavlovian anxiety reactions more rapidly than extraverts, and one of his researchers named Cyril Franks demonstrated that this was so. On the basis of this result, Eysenck proposed that children become socialised by developing anticipatory anxiety reactions to disapproval and punishment, and that this process would occur more rapidly in introverts.

HN: This theory of Eysenck's was obviously very ambitious.

RL: Indeed. But I love big theories, and this was huge. It embraced Pavlovian neurophysiological concepts, Hull's behaviour system, the introversion-extraversion personality dimension, the social concepts of tough-mindedness and tender-mindedness, and political attitudes. I was enthralled by the theory and began testing some of the deductions that could be made from it.

HN: And how did this go?

RL: Some of them worked but others didn't. In 1959 I wrote up a paper on one of those that worked, and sent it to Hans Eysenck. He replied very warmly and said he would lend me some apparatus if I wanted to do some more work. He invited me to London to collect this and stay the night with him and Sybil, which I readily accepted. Talking with Hans was a real meeting of minds and unlike anything I had experienced before. I did some more work and published several papers on Eysenck's theory. I extended it to the deterioration of performance with age and proposed that this could be explained by an increase in reactive inhibition. Remarkably, in 1960 it was published in *Nature.*

During the 1960s, I worked on a variety of topics, including teaching two year olds to read and Russian psychology, but none of them led anywhere, and I became quite depressed with my failure to make any significant progress in my academic career.

HN: This brings us to 1967, when you quit the University of Exeter and took up a position in Ireland.

RL: Yes, I was appointed research professor at the Economic and Social Research Institute (ESRI) in Dublin, where I worked until 1972. The brief was to carry out research on the economic and social problems of the country. So I settled down to investigate the economic and social problems of Ireland and think about what contribution I could make to finding public policies that would help solve them. The major problem was the economic backwardness, and when I researched the literature it was not long before I discovered that the Irish had a low average IQ. So I formulated the theory that the low IQ was likely a significant reason for the economic backwardness. The solution for this problem was obvious. What was needed was a set of eugenic policies that would raise the Irish IQ.

HN: This sounds a bit scary!

RL: Indeed. I reflected on the likely headlines I would get if I wrote one of the monographs that the ESRI produced analysing the problem and its solution. Headlines like *Professor advocates sterilising the mentally retarded and incentives for graduates to have more children*! I didn't see these going down well. Ireland is a deeply conservative and Catholic country and the Catholics had been the only group that opposed eugenic programs in the first half of the twentieth century, when everyone else thought these were sensible. Virtually no-one supported eugenic programs any more and anyone who proposed doing so would be accused of being a Nazi.

HN: And how did you deal with this problem?

RL: I chickened out! I did not think I could go public on this, so I sat on it for 35 years. It was not until 2002 when I published *IQ and the Wealth of Nations* with Tatu Vanhanen that I set out the theory. Nevertheless, I did write something on the issue in a circumspect way. In 1968 I published *The Irish Brain Drain*. It reported research showing that there was a high rate of emigration of graduates from Ireland, and warned that this would reduce the average IQ of the remaining population.

I looked next at some of the demographic and epidemiological characteristics of Ireland to see if I could find any problems I could tackle. The first thing I noticed was that the Irish have an exceptionally high rate of psychosis. I knew that chronic hospitalised psychotics, consisting mainly of those with simple schizophrenia and retarded depression, have a low level of anxiety. I wondered whether a low level anxiety in the population might explain the high rate of psychosis and looked at other data that might corroborate the theory. I took the 18 economically developed nations for which there were reliable statistics and examined calorie consumption, coronary heart disease, caffeine and cigarette consumption as indices of low anxiety, and suicide rates, alcohol consumption, and road accident death rates as indices of high anxiety. I factor analysed the inter-correlations and found a general factor that accounting for about 50% of the variance and identified this as anxiety. The final step was to treat the nations as if they were individuals and use the data to score the nations on the anxiety factor. The result was that Ireland emerged as the nation with the lowest level of anxiety.

HN: How about the other nations? Could you find any pattern there?

RL: Yes, the northern Europe nations also had low anxiety, while the southern European nations and Japan came out as the high anxiety nations. It seemed likely that there are genetic differences in anxiety among the northern and southern sub-races of Europe, and between Japan and Europeans. This was my first excursion into the thorny field of racial differences.

HN: This was quite a sophisticated study. I wonder how many people understood it and how it was received.

RL: There were certainly a lot of people who did not understand it. However, it was received quite well by the more sophisticated. Sir Cyril Burt wrote a generous introduction – "what I should like chiefly to commend are the methods he has adopted". I believe this was the last thing that Sir Cyril wrote. Hans Eysenck was enthusiastic and it was this that inspired Hans and Sybil to begin collecting questionnaire data for neuroticism and extraversion, and later for psychoticism, from numerous countries that was to occupy them for the next thirty years or so.

HN: And how has your theory survived these last forty years?

RL: The theory has survived quite well among researchers on cross-cultural differences in personality. In 1985 Phil Rushton extended the theory in his book *Race, Evolution and Behavior* in which he reported that North East Asians obtain higher scores on anxiety than Europeans, confirming my conclusion that the Japanese have a high level of anxiety. David Lester (2000) expanded the theory further and found that it held up in a data set of 32 nations. Geert Hofstede and Robert McCrae (2004,p. 59) have written that "A breakthrough in the study of national cultures was Richard Lynn's book *Personality and National Character*" and have confirmed the same national differences in anxiety.

HN: We have come to the year 1972 and you were soon to leave Dublin.

RL: Yes, I had completed my work on national differences in anxiety and was keen to develop my ideas on national and racial differences in intelligence. But because I had discovered the low IQ in Ireland, I did not think it possible to do this while I was in Dublin. So I had to look for a new base. Then in the fall of 1971 the University of Ulster advertised for a professor to set up a psychology department. I thought this would suit me, so I sent in an application, was offered the job, and accepted.

So in 1972 I moved to Ulster and began my work on national and racial differences in intelligence. I began publishing papers on this in 1977 when I estimated the mean IQ in Japan at 106.6 (in relation to an American mean of 100), and the mean IQ of the Chinese in Singapore at 110. The next year I published a review of national and racial IQs. I continued to collect IQs for countries all over the world. I concluded that with the IQ of Europeans set at 100, the North East Asians have an IQ of 106, the South East Asians have an IQ of 90, the Native American Indians have an IQ of 89, and the IQ of sub-Saharan Africans have an IQ around 70.

In 1980 I published my theory that these race differences evolved when early humans migrated out of Africa into temperate and then into cold environments. These were more cognitively demanding, and so the peoples who settled in North Africa and South Asia, and even more the Europeans and the North East Asians, had to evolve higher IQs to survive.

HN: Then in 2002, you used these national and racial IQs in your book IQ and the Wealth of Nations*, which you wrote in collaboration with Tatu Vanhanen.*

RL: Yes, Tatu Vanhanen is a political scientist in Finland and has a good knowledge of economics. We got in touch in 2000, met in London and talked about using my national IQs to explain the huge differences in living standards between the economically developed countries and the third world. We found that the correlation between national IQs and per capita income was r = 0.68, so national IQs explained about half the variance in per capita income. The other half can be largely explained by the degree to which nations have free market economies and natural resources.

HN: How was the book received?

RL: It had the usual reaction to which I have become accustomed. Some hated it, some loved it. Among those who hated it was Earl Hunt, who described the national IQs as “meaningless”, while Susan Barnett and Wendy Williams, said they were “virtually meaningless”.

Others saw my national IQs as opening up a new field in which national differences in intelligence have explanatory power for a wide range of social and economic phenomena. In 2009, Heiner Rindermann and Steve Ceci described the calculation of national IQs as “... a new development in the study of cognitive ability: Following a century of conceptual and psychometric development in which individual and group (socioeconomic, age, and ethnic) differences were examined, researchers have turned their attention to national and international differences in cognitive competence to predict a variety of outcomes: societal development, rate of democratization, population health, productivity, gross domestic product (GDP), crime, health and longevity, infant mortality, and wage inequality". From 2005, numerous papers have been published on a variety of correlates of national IQs.

In 2010, in collaboration with Gerhard Meisenberg, I integrated all the international studies of scores in reading comprehension, math and science understanding. We put this on a common metric for 108 nations and showed that they are perfectly correlated (r = 1.0) with national IQs. I doubt whether there is anyone who now disputes that my national IQs are valid.

HN: In 2005, you wrote another book on race differences in intelligence, The Global Bell Curve*?*

RL: This took as its starting point *The Bell Curve*, in which Richard Herrnstein and Charles Murray in 1994 showed in that in the United States there is a racial hierarchy in which Europeans have the highest IQ and perform best for earnings, socio-economic status and a range of social phenomena, Hispanics come next, while Blacks do least well. In *The Global Bell Curve* I examined whether similar racial intelligence and socio-economic hierarchies are present in other parts of the world and documented that they are. They are found in Europe, Africa, Latin America, the Caribbean, Southeast Asia, Australia and New Zealand. It is invariably the Europeans and North East Asians who are at the top of these racial hierarchies. These are followed by the brown skinned peoples who occupy intermediate positions, e.g. the Coloureds and Indians from the sub-continent in Africa, the

Mulattos and Mestizos in Latin America, Indians in Europe, and light skinned Blacks in the United States, who come in the middle of the IQ and socio-economic hierarchies, while the dark skinned African Blacks and Native American Indians invariably come at the bottom of the hierarchies.

In Australia and New Zealand, it is the lighter skinned Europeans and Chinese who are at the top of the IQ and socio-economic hierarchies, while the darker skinned Aborigines and Maoris are at the bottom. In South-East Asia in Singapore, Indonesia, the Philippines, Malaysia, and Thailand, it is invariably the Chinese who have higher IQs than the indigenous peoples and outperform them in education, earnings, wealth and socio-economic status.

These colour-related social hierarchies are so inescapable that sociologists and anthropologists have coined the term *pigmentocracy* to describe them. A pigmentocracy is a society in which wealth and social status are related to skin colour. I argued that intelligence differences provide the best explanation for the racial hierarchies that are consistently present in all multiracial societies.

HN: I would like to turn now to your work on the increases in intelligence that occurred during the twentieth century.

RL: My first work on this appeared in 1982, when I published a paper showing that the IQ in Japan had increased by 7 IQ points from those born in 1910 to those born in 1969. I have published several more papers on the increase of IQs. My last one in 2009 showed that in Britain it has recently come to an end among children aged 13 years and older, although it is still present in younger children. I have also considered the problem of why IQs have increased and published a paper in 1990 arguing that improvements in nutrition have been the main factor responsible for the IQ rise.

HN: You have also worked on sex differences in intelligence. How did this come about?

RL: In all fields of scholarship we have to take a lot on trust. If all previous scholars are agreed on something, we take it for granted that they must be right. All the experts from at least World War 1 had stated that there is no sex difference in intelligence. In the following years numerous scholars whom I respected repeated this assertion. For instance, Herrnstein and Murray wrote in *The Bell Curve* that "The consistent story has been that men and women have nearly identical IQs".

I had no reason to doubt this consensus, but in 1992 I was shaken when Dave Ankney and Phil Rushton independently published papers showing that men have larger brains than women, even when these are controlled for body size and weight. It was evident that these results presented a problem. It is well established that brain size is positively related to intelligence at a correlation of about 0.4. As men have larger brains than women, men should have a higher average IQ than women. Yet all the experts were agreed that males and females have the same intelligence.

I grappled with this problem for about six months. I went though dozens of studies and the experts seemed to be right that males and females have the same intelligence. Then at last I found the solution. When I looked at the studies in relation to the age of the samples being tested, I found that males and females do have the same intelligence up to the age of 15 years, as everyone had said. But I found that from the age of 16 years onwards, males begin to show higher IQs than females and that by adulthood, the male advantage reaches about 5 IQ points, entirely consistent with their larger average brain size. I published this solution to what I called the Ankney-Rushton anomaly in 1994.

HN: And how was your solution received?

RL: Most people ignored it, including Art Jensen in his 1998 book *The g Factor*. He concluded that “the sex difference in psychometric *g* is either totally nonexistent or is of uncertain direction and of inconsequential magnitude”.

I continued to publish papers showing that up to the age of 15 years males and females have approximately the same IQ except for a small male advantage on the visualization abilities, but from the age of 16 years males begin to show greater intelligence, but most people continued to assert that men and women have equal intelligence. In 2006, Stephen Ceci and Wendy Williams published an edited book *Why aren’t more women in Science*? They brought together fifteen 15 experts to discuss this question. They began by saying “We have chosen to include all points of view”, but remarkably none of the contributors presented the case that men have higher intelligence than women, and that high intelligence is required to make a successful career in science. Several of the contributors asserted that there are no sex differences in intelligence.

The only person who attacked my theory was Nick Mackintosh. In 1996 he contended that the Progressive Matrices is an excellent measure of intelligence and of Spearman’s *g,* that it is known that there is no sex difference on the Progressive Matrices, and therefore that my claim is refuted. He made no mention of my maturation theory that it is only from the age of 16 years that males begin to show higher IQs than females.

In response to Mackintosh’s criticism I collaborated with Paul Irwing in carrying out meta-analyses of sex differences on the Progressive Matrices in general population samples and in university students. We found that in general population samples there is no sex difference up to the age of 15 years, but among adults, men have a higher IQ than women by 5 IQ points. Among university students, we found the male IQ advantage is 4.6 IQ points.

HN: Still, you did have some supporters for your theory that men have a higher average IQ than women. I myself came out in support of your theory.

RL: You did, and in the next few years several people published data supporting my theory, including Juri Allik, Doug Jackson and Phil Rushton, Roberto Colom, and Gerhard Meisenberg. By 2010, numerous studies had shown that men have a higher IQ than women. I believe this is now accepted by all serious scholars. But, of course, there are plenty of unserious scholars who have never bothered to read the literature on this issue.

HN: Let us move on to your work on eugenics.

RL: I became interested in eugenics when I was a student in the 1950s. I read the papers of several psychologists in the United States, and of Sir Cyril Burt, Sir Godfrey Thompson and Ray Cattell in Britain, showing that the average IQ of the population was declining because people with low IQs were having more children than those with high IQs. I thought this must be an enormously serious problem. But it was not until the early 1990s that I began to work on eugenics.

I have published several papers showing that dysgenic fertility for intelligence in the United States and Britain, and one showing that there is also dysgenic fertility for moral character. In 1996 I published *Dysgenics: Genetic Deterioration in Modern Populations,* which set out the evidence that modern populations have been deteriorating genetically from around 1880 in respect of health, intelligence and moral character.

In 2001, I published a sequel *Eugenics: A Reassessment*. This begins with a historical introduction giving an account of the ideas of Francis Galton and the rise and fall of eugenics in the 20th century. I then discuss the objectives of eugenics and identify these as the elimination of genetic diseases, and the improvement of intelligence and moral character. This is followed by a consideration of how eugenic objectives can be achieved using the methods of selective reproduction and concludes that there is not much scope for these. Finally, I discuss the how eugenic objectives could be achieved by the "New Eugenics" of biotechnology using embryo selection and how these are likely to be developed in the twenty-first century. I conclude by predicting the inevitability of a future eugenic world in which couples will select genetically desirable embryos for implantation and there will be huge improvements in the genetic quality of the populations of economically developed countries where these technologies are adopted.

I have continued to publish papers on genetic deterioration. I extended this in a study with John Harvey to an estimate of the decline of the world's IQ caused by the high fertility in third world low IQ countries. We estimated that the world's IQ deteriorated genetically by 0.86 IQ points in the years 1950-2000.

HN: You have also published work on racial and ethnic differences in personality.

RL: Yes, in 2002 I took up the problem that Dick Herrnstein and Charles Murray noted in *The Bell Curve* that while racial and ethnic differences in intelligence can explain a number of the differences in educational attainment, crime, welfare dependency, rates of marriage, etc., they cannot explain the totality of these differences. They concluded that there must be some additional factor that also contributes these. I proposed that some of the residual disparities are attributable to differences in psychopathic personality. I showed that psychopathic personality is highest among Blacks and Native Americans, next highest in Hispanics, lower in Whites and lowest in East Asians.

HN: Your most recent book is on the intelligence of the Jews. How did you get interested in this?

RL: Some years ago I read that about a third of the Nobel Prizes won by Germany in the years 1901-1939 had been awarded to Jews. I checked out the numbers of Jews in Germany and found they were about 0.85 per cent of the population. I reflected that Jews must have had a high IQ to achieve this astonishing over-representation. I had a look at the research on the intelligence of the Jews and found that a number of studies had been published reporting that Jews do indeed have high IQs. These were all quite old. Comparative studies of the IQs of different peoples have become increasingly taboo in recent decades. I investigated the Jewish IQ and estimated the Ashkenazi IQ at approximately 110, and the IQ of Oriental Jews at 91. I also wondered whether the Jews might have some personality characteristic, such as a strong work ethic, which might contribute to their high achievements, but could not find any evidence for this in a paper published in 2008 with Satoshi Kanazawa.

I then read a number of papers in economics and sociology journals on the educational attainments, earnings and socio-economic status of Jews in the United States, and found numerous studies going back to the first half of the twentieth century reporting that these are all higher in Jews than in gentile whites. But the strange thing is that none of these mentioned that the explanation for the remarkable achievements of the Jews could be that they are more intelligent than white gentiles.

The more of these papers I read, the more it became apparent that a job needed to be done investigating whether Jews have a high IQ and commensurate educational attainments, earnings and socio-economic status in all countries in which Jews are, or have been, present. I have documented that this has been so in my book *The Chosen People: Jewish Intelligence and Achievements*.

.

HN: I have one final question. How would you like to be remembered?

RL: I hope my obituarists will write something like “Some loved him, some hated him, but everyone accepted that he kept the faith and told the truth as he saw it”.

References

Allik, J., Must, O and Lynn, R. (1999). Sex differences in general intelligence among high school graduates: Some results from Estonia. *Personality and Individual Differences*, 26, 1137-1141.

Ankney, C.D. (1992) Sex differences in relative brain size: the mismeasure of women, too? *Intelligence*, 16, 329-336.

Barnett, S.M., & Williams, W. (2004). National intelligence and the emperor's new clothes: A review of *IQ and the Wealth of Nations*. *Contemporary Psychology, 49,* 389−396.

Ceci, S.J., & Williams, W. (Eds.) (2006) *Why aren't more women in Science*? *Top researchers debate the evidence.* Washington, D.C.: American Psychological Association.

Colom, R. & Lynn, R (2004). Testing the developmental theory of sex differences in intelligence on 12-18 year olds. *Personality and Individual Differences*, *36*, 75-82.

Eysenck, H.J. (1957). The *dynamics of anxiety and hysteria*. London: Routledge & Kegan Paul.

Flynn, J.R. (1984). The mean IQ of Americans: massive gains 1932 to 1978. *Psychological Bulletin*, *95*, 29-51.

Herrnstein, R. & Murray, C. (1994). *The Bell Curve: Intelligence and Class Structure in American Life*. New York: The Free Press.

Hofstede, G. & McCrae, R.R. (2004). Personality and culture revisited: Linking traits and dimensions of culture. *Cross-Cultural Research*, 38; 52-88

Hunt, E., & Sternberg, R. J. (2006). Sorry, wrong numbers: An analysis of a study of a correlation between skin color and IQ. *Intelligence, 34*, 121−139.

Irwing, P. & Lynn, R (2005). Sex differences in means and variability on the Progressive Matrices in university students: A meta-analysis. *British Journal of Psychology, 96,* 505–524.

Jackson, D.N. & Rushton, J.P. (2006). Males have greater g: Sex differences in general mental ability from 100,000 17-18 year olds on the Scholastic Assessment Test. *Intelligence, 34*, 479-486.

Jensen, A. R. (1998). The g factor: The science of mental ability. Westport, CT: Praeger Publishers.

Lester, D. (2000). National differences in neuroticism and extraversion. *Personality and Individual Differences, 28*(1), 35-39.

Lynn, R. (1977a). The intelligence of the Japanese. *Bulletin of the British Psychological Society, 30,* 69-72.

Lynn, R. (1977b). The intelligence of the Chinese and Malays in Singapore. *Mankind Quarterly, 18,*125-128**.**

Lynn, R (1982). IQ in Japan and the United States shows a growing disparity. *Nature*, 297, 222-223.

Lynn, R. (1990). The role of nutrition in secular increases of intelligence. *Personality and Individual Differences*, *11*, 273–285.

Lynn, R. (1994). Sex differences in intelligence and brain size: A paradox resolved. *Personality and Individual Differences*, *17*, 257-271.

Lynn, R. (1996). *Dysgenics: Genetic deterioration in Modern Populations*. Westport, CT., Praeger.

Lynn, R. (2001). *Eugenics: A Reassessment*. Westport, CT: Praeger.

Lynn, R. (2002). Racial and ethnic differences in psychopathic personality. *Personality and Individual Differences*, *32,* 273-316.

Lynn, R. & Irwing, P. (2004). Sex differences on the Progressive Matrices: A meta-analysis. *Intelligence*, *32*, 481-498.

Lynn, R. & Harvey, J. (2008). The decline of the world's IQ. *Intelligence*, *36*, 112-120.

Lynn, R. & Kanazawa, S. (2008). How to explain high Jewish achievement: The role of intelligence and values. *Personality and Individual Differences*, *44*, 801-808.

Lynn, R. & Meisenberg, G. (2010). National IQs validated for 108 nations. *Intelligence* (in press).

Mackintosh, N.J. (1996). Sex differences and IQ. *Journal of Biosocial Science*, *28,* 559-572.

Meisenberg, G. (2009). Intellectual growth during late adolescence: Effects of sex and race. *Mankind Quarterly, 50*, 138-155.

Muller, H. (1939). The geneticists' manifesto. *Eugenical News, 24*, 63-64.

Nyborg, H. (2005). Sex-related differences in general intelligence: *g,* brain size and social status. *Personality and Individual Differences*, *39*, 497-510.

Rindermann, H., & Ceci, S. J. (2009). Educational policy and country outcomes in international cognitive competence studies. *Perspectives in Psychological Science, 4,* 551-577.

Rogers, J.L. (1991). Impact of the Minnesota parental notification law on abortion and birth. *American Journal of Public Health, 81*, 294-300.

Rushton, J.P. (1992) Cranial capacity related to sex, rank and race in a stratified sample of 6,325 military personnel. *Intelligence, 16*, 401-413.

The Evolution of Differences in Intelligence and Personality

Chapter 2

Life History Theory and Race Differences: An Essay on Richard Lynn's Contributions to Science

J. PHILIPPE RUSHTON
1943-2012
Formerly *University of Western Ontario*

ABSTRACT

This essay describes six important findings by Richard Lynn that substantially influenced my research on the application of life history theory to human differences. To the best of my knowledge, he was the first to observe that: East Asians average *higher* on IQ *tests* than Europeans while sub-Saharan Africans average *lower.* Further, reaction time measures of intelligence show this same worldwide pattern. Third, average Black-White IQ differences in sub-Saharan Africa are more pronounced on those subtests with the highest *g* loadings just as they are in the US. Next, there are national differences in average IQ in the ten population groups identified by Cavalli-Sforza, Menzoni, & Piazza (1994). Finally, cold winters theory can parsimoniously explain why East Asians and Europeans evolved larger brains and higher IQs than their more southerly counterparts.

1. Personal Context

I began to research race differences in January 1981 during a term's leave of absence spent at the Institute of Human Development in the University of California, Berkeley. I had taken a leave of absence from my home university after completing a book, *Altruism, Socialization, and Society* (1980), which examined the influence of the family, the educational system, and the mass media. While writing the book, I'd read E. O. Wilson's (1975) *Sociobiology: The New Synthesis* and decided to search for a central organizing principle beyond the social learning paradigm in which I had been working since graduate school (1970-1973). I now aspired to integrate individual differences, behavioral genetics, and evolutionary biology with my previous social learning approach.

Although many researchers at the Institute had earned international reputations for documenting the early emergence of personality traits and their power to predict social adjustment, few were interested in exploring the underlying causes in behavioral genetics. The reason why was not hard to find. In 1981, at Berkeley, any discussion of behavioral genetics was but a nervous hop, skip, and a jump from Arthur Jensen's controversial findings on race differences. Since Jensen occupied an office in the School of Education, one floor up from my office in the Psychology Department, I decided to pay him a visit.

Jensen and I hit it off. I had been interested in his work on race and intelligence ever since graduate school, although had remained agnostic as to any genetic basis. Jensen was highly informative, sketching out his views and providing detailed answers to my questions along with copies of his reprints. However, the tentativeness with which he held so many of his conclusions surprised me. While Jensen obviously agreed that twin and adoption studies showed intelligence was heritable *within* a race, and therefore likely to be heritable *between* races, he questioned whether a "real proof" of the genetic hypothesis was completely possible. Jensen's skepticism bothered me. If such a scientifically important topic as IQ differences between the races could not be resolved, then what problem in psychology *could* be?

Despite his sometimes great caution in drawing conclusions, Jensen provided me with enormous amounts of data and theory which greatly increased the plausibility of a gene-based evolutionary account. In both his 1969 *Harvard Educational Review* paper, and his 1973 book *Educability and Group Differences*, Jensen cited studies documenting that while Black babies are born an average of a week earlier than White babies, they are more mature as measured by amniotic fluid, bone development, muscular strength, and motor co-ordination. When two-week old African babies are placed in a sitting position they are better able to keep their heads up and backs straight. White babies often need six to eight weeks to do these things. Black babies can reach for objects better. Black children sit, crawl, walk, and put on their clothes earlier than Whites or East Asians. East Asian infants, on the other hand, mature more slowly than do Europeans. East Asian children often do not walk until 13 months, whereas walking starts at 12 months for White children, and 11 months for Black children.

Paralleling this behavioral precocity, Jensen also reported evidence of faster bone development in Black infants (established using X-rays), the earlier eruption of the permanent teeth (by an average of one year), and the greater maturity of brain wave patterns (measured using EEGs). Based on these converging lines of evidence Jensen suggested that, "the three racial groups lie on a developmental continuum on which the Caucasian group is more or less intermediate." Jensen (1973) went on to point out race differences in production of two-egg twins, which is most common among African Americans and least common among East Asians, with Europeans again more or less intermediate. This, he conjectured, "may be a reflection of evolutionary age." In a long footnote (pp. 289-290), he wrote:

> [T]here is an inverse relationship throughout the phylogenic hierarchy between the tendency for

> multiple births and the prolongation of immaturity . . . "single young is a pre-adaptation for progressively increased maturation time, and in this respect man shows a clear continuity with the pongids" (the phylogenically closest group having the most recent common ancestor with hominids).

Jensen's footnote struck a responsive chord in me for it reminded me of another cross-species progression that had caused me to think about race differences. In *Sociobiology*, Wilson (1975) had described the origin of altruism as being one of parental care, which had increased in complexity over evolutionary time. I wondered if the well-documented racial differences in family structure might have such a gene-based evolutionary origin.

Wilson (1975) described two ends of a reproductive continuum. At one end, a "fast" life history (the *r*-strategy), eggs and sperm are produced and simply discharged into the water (for example, in frogs). At the opposite end, a "slow" life history (the *K-strategy*), an egg is not only laid in the ground but pollen and honey provided for future needs (as with wasps). Other steps in the *K* direction would include bringing food to the hatched larvae, and ministering to the continuing needs of the offspring. In mammals, the physiological burden of gestation, the ordeal of delivery, the production of milk, and the activities of protecting and physically caring for the young are required.

K-strategists give their offspring a lot of care. They work together in getting food and shelter, help their kin, and have complex social systems. That is why *K*-strategists need more complex nervous systems and bigger brains but produce fewer eggs and sperm. The bigger an animal's brain, the longer it takes to reach sexual maturity and the fewer offspring it produces. Number of offspring, time between births, parental care, infant mortality, speed of maturity, life span, even social organization and altruism, all work together like pieces of a puzzle.

As I came more and more to believe that studying race differences and human origins would complete the Darwinian revolution, I began to review the international literature on East Asians, Europeans, and Africans, looking not only at IQ scores, but also at traits such as speed of physical maturation and longevity, personality and temperament, family structure and crime, sexual behavior and fertility, and later brain size as well. What I found is that, on average, for all these traits, East Asians fall at one end of the spectrum, Africans fall at the other end, and Europeans fall in the middle often close to East Asians. Table 1 summarizes these findings. Only a gene-based evolutionary theory, I concluded, could explain the totality of this pattern.

Table 1. Average Differences among East Asians, Europeans and Africans

Trait	**East Asians**	**Whites**	**Blacks**
Brain size (cm3)	1,364	1,347	1,267
Cortical neurons (billions)	13,767	13,665	13,185
Intelligence			
IQ scores	105	100	70-85
Decision times	Faster	Intermediate	Slower
Cultural achievements	Higher	Higher	Lower
Maturation rate			

Trait	East Asians	Whites	Blacks
Gestation time	Longer	Longer	Shorter
Skeletal development	Later	Intermediate	Earlier
Motor development	Later	Intermediate	Earlier
Dental development	Later	Intermediate	Earlier
Age of first intercourse	Later	Intermediate	Earlier
Age of first pregnancy	Later	Intermediate	Earlier
Life-span	Longest	Intermediate	Shortest
Personality			
Activity level	Lower	Intermediate	Higher
Aggressiveness	Lower	Intermediate	Higher
Cautiousness	Higher	Intermediate	Lower
Dominance	Lower	Intermediate	Higher
Impulsivity	Lower	Intermediate	Higher
Self-esteem	Lower	Intermediate	Higher
Sociability	Lower	Intermediate	Higher
Social Organization			

Trait	East Asians	Whites	Blacks
Marital stability	Higher	Intermediate	Lower
Law abidingness	Higher	Intermediate	Lower
Mental health	Higher	Intermediate	Lower
Reproductive Effort			
Two-egg twinning (per 1000 births)	4	8	16
Hormone levels	Lower	Intermediate	Higher
Size of genitalia	Smaller	Intermediate	Larger
Secondary sex characteristics	Smaller	Intermediate	Higher
Intercourse frequencies	Lower	Intermediate	Higher
Permissive attitudes	Lower	Intermediate	Higher
Sexually transmitted diseases	Lower	Intermediate	Higher

One amazing discovery I made during my reading of the literature was just how substantial the race differences were in average brain size. Like most researchers, I had been under the (false) impression that no relationship existed between brain size and intelligence, let alone between brain size and race. Hadn't Stephen Jay Gould (1981, 1996) "debunked" all those "19th

century" studies long ago? Yet, here I was reading good research papers showing that race differences in brain size were to be observed even before birth. For example, Schultz (1923) found that from the 9th week of intrauterine life, 165 Black fetuses averaged a smaller brain case (but larger face) than 455 White fetuses.

I reviewed the world literature on brain size from the 1840s to the 1990s using all three methods of assessment (autopsies, endocranial volume, and head size measures), as well as head size measurements corrected for body size. I also analyzed several new data sets from military and industrial databases, one of them being a stratified random sample of 6,325 U.S. military personnel being fitted for helmet size. The overall mean cranial capacity (in cm^3) was: for East Asians, 1,364; Whites, 1,347; and Blacks, 1,267 (Rushton, 1995; Rushton & Ankney, 2009). The overall mean for East Asians was 17 cm^3 more than for Whites and 97 cm^3 more than for Blacks. Within-race differences due to differences in method of estimation averaged 31 cm^3. Since one cubic inch of brain matter contains millions of brain cells and hundreds of millions of synapses or neural connections, I argued that the race differences in average brain size likely explain their differences in average IQ.

2. The High IQ of East Asians

My interest in race differences really came alive when in 1981 I re-read Lynn's (1977) study which found that East Asians averaged a higher IQ than Whites. Lynn reported that when the Wechsler intelligence tests were standardized on 3,352 Japanese adults and children, their mean IQ was 107, which at the time was the highest IQ ever recorded for any nation (i.e., over a third of a standard deviation higher than Whites in Britain or the US). This result clearly posed a problem for "culture-only" explanations of Black-White difference being a result of "White racism," "culturally biased tests," or a disadvantaged upbringing. During the childhood years of the oldest cohorts tested, Japan was well behind the US in per capita income and other social indicators. Yet they too tested higher than White Americans.

Lynn (1978) followed up with other studies which reported that the Chinese in Hong Kong and Taiwan also averaged a higher IQ score than Whites. Subsequently, Lynn (1982) reported that the Japanese-American disparity in IQ had increased to 11 points based on the standardization in Japan of the Wechsler Intelligence Scale for Children (WISC-R). Lynn's results were also confirmed by Philip E. Vernon (1982) who recovered the school records for the children of the Chinese laborers who helped build the Canadian and US railways during the late 19th/early 20th centuries.

3. Sub-Saharan African IQ

Although my academic colleagues took little notice of Lynn's discovery that the average IQ score for East Asians was higher than for Europeans, many greeted with outrage his (1991a) conclusion in the *Mankind Quarterly* that the mean IQ for sub-Saharan Africans was 70. He reviewed 11 studies from East, West, Central, and Southern Africa showing that Africans averaged 15 points lower than the mean IQ of 85 typically found for African Americans (and 30 points lower than the 100 found for Whites). To some researchers this just proved the entire concept of IQ was misleading since it would imply that by Western standards 50% of Black Africans were "mentally retarded." Even earlier, Lynn (1978) had summarized seven African studies, mainly on pupils using the Raven's Matrices, and found average IQ equivalents ranging from 75 to 88 with a mean of 82. Lynn noted the difficulties of obtaining representative samples as well as accurate information on ages, both necessities for valid group comparisons. Despite inadequacies in many samples, Lynn found the results were consistent.

Subsequent studies (some with quite large Ns) have corroborated the low mean test scores of Africans. In Ghana, a 1992 World Bank study tested a representative sample of 1,736 individuals ranging in age from 11 to 20 years old. All had completed primary school; half were attending middle school. The mean score on the Raven's Colored Matrices was 19 out of 36, equivalent to an IQ of less than 70. In South Africa, Owen (1992) gave the SPMs without time limits to 1,093 African, 778 Colored, 1,063 Indian, and 1,056 White 14-year-olds. Studies of Black university students also reported low scores. One study, of 63 undergraduates at the then all-Black universities of Fort Hare, Zululand, the North, and the Medical University of South Africa, yielded a mean full scale IQ of 77 on the Wechsler Adult Intelligence Scale—Revised (WAIS-R). In a study at the University of Venda in South Africa's Northern Province, 30 students in 4th-year law and commerce averaged a score of 37 out of 60 on the Standard Matrices, equivalent to a 78 IQ test score on U.S. norms.

Given the heated controversy generated by these results, it seemed important that I engage in some original research of my own that might confirm or qualify Lynn's results. Even colleagues who agreed with much of my own research were concerned about the quality of some of the data from Africa. So, in 1998, I flew to Johannesburg, South Africa, to begin a series of studies with Mervyn Skuy, Chair of the Division of Specialized Education at the University of the Witwatersrand to collect new IQ data. We gave the students there the untimed Standard Progressive Matrices (SPM) under optimal testing conditions. The Raven's consists of 60 diagrammatic puzzles, each with a missing part that the test taker attempts to identify from several options. It is acknowledged as the best-known, most researched, and least culturally bound test of general mental ability.

The first study (Rushton & Skuy, 2000) was on 309 16- to 23-year-old psychology students at the University of the Witwatersrand. The 173 African students solved an average of 44 of the 60 problems, while the 136 White students solved 54, yielding IQ equivalents of 84 and 104, respectively. The second study (Skuy, Gewer, Osrin,, Khunou, Fridjhon, & Rushton, 2002) gave the SPM to 98 psychology students aged 17- to 29- years old. The 70 Africans averaged an IQ equivalent of 83, and the 28 non-Africans 99 (including 20 Whites, 6 South Asians, and 2 Coloreds). These latter results were from a training study; after receiving coaching on how to solve Matrices-type items, the African mean IQ rose to 96 and the non-African mean to 110.

Skuy and I then searched for African students who might have higher IQs, eventually settling on those in the academically highly-select Faculty of Engineering. At the very best American universities, engineering students score at the 98th percentile on tests such as the Scholastic Aptitude Test and the Graduate Record Examination. Psychology students, by comparison, typically average at the 84th percentile, which is still high given the overall average (by definition) of the 50th percentile.

Thus, in our third study (Rushton, Skuy, & Fridjhon, 2002) we gave the SPM to 342 17- to 23-year-old engineering students (198 Africans, 58 South Asians, and 86 Whites). Out of 60 problems, the Africans solved an average of 50; the South Asians, 53; and the Whites, 56, yielding IQ equivalents of 97, 102, and 110, respectively. Although the average IQ for African engineering students was higher than that for first-year psychology students (85), it nonetheless still only yields an overall IQ of 70 for the general population if one makes the reasonable assumption that the African engineering students are 2 SDs above the general average (as would be the case in the US). Thus, these results too were consistent with Lynn's initial estimate.

Altogether, we published seven studies that yielded a median IQ of 84 for the African students (range 77 to 103). Assuming that they, like student groups around the world, are 1 standard deviation (15 IQ points) above the mean of their population, a median IQ of 84 is consistent with a general population mean of 70. The White university students averaged IQs of from 105 to 117; East Indian students were intermediate with average IQs of from 102 to 106.

We also examined the internal and external validity of the Standard Progressive Matrices (SPM) and the Advanced Progressive Matrices (APM). In regard to *internal* validity, the African students answered most of the questions correctly (e.g., 44 out of 60 in the first study) so they could obviously perform the required operations. Further, the items found difficult by Africans were also the ones found difficult by the Whites and by East Indians (mean r = .90; p < 0.001). There was no unique set of items that posed a special problem for Africans but not for non-Africans. In regard to *external* validity, we found the Raven's scores predicted school grades and job performance equally well for the Africans as for the non-Africans (i.e., .20 to .50). For example, the APM scores correlated with those on the SPM measured 3 months earlier—.60 for Africans and .70 for non-Africans—and with end-of-year exam marks measured 3 months later—.34 for Africans and .28 for non-Africans. Other reviewers have also concluded that IQ scores are demonstrably valid for Africa. For example, Kendall et al. (1988) showed that test scores predicted school grades and job performance equally well for Africans as for non-Africans (i.e., 0.20 to 0.50).

4. Spearman's *g* and Jensen Effects

In 1904, Charles Spearman introduced the term *g* to represent the general factor of intelligence, that is, the underlying process common to all mental tests. He conjectured that Black-White differences would be "most marked in just those [tests] which are known to be saturated with *g*" (p. 379). Jensen dubbed this "Spearman's hypothesis" (p. 535).

Jensen (1998) documented that *g* is the "active ingredient" of IQ scores, and is embedded to a greater or lesser extent in every question on an intelligence test. He showed that a test's *g* loading is the best predictor, not just of that test's correlation with scholastic and work-place performance, but of *biological* measures such as heritability coefficients determined from twin studies, inbreeding depression scores calculated in children of cousin marriages, brain evoked potentials, brain pH levels, brain glucose metabolism, as well as nerve conduction velocity and reaction time measures. These correlations argue strongly for the heritable and biological, as opposed to the mere statistical reality of *g*.

If the Black–White differences are greater on the more heritable and more *g*-loaded subtests, it implies they have a genetic origin (Jensen, 1973, 1998). Strong inference is possible: (1) Genetic theory predicts a positive association between heritability and group differences; (2) culture theory predicts a positive association between environmentality and group differences; (3) nature + nurture models predict both genetic and environmental contributions to group differences; while (4) culture-only theories predict a zero relationship between heritability and group differences.

Jensen (1998) developed the method of correlated vectors (MCV) to determine whether there is an association between a column of quantified elements (such as a test's *g* loading or heritability) and any parallel column of independently derived scores (such as mean differences between groups). Using that method, Jensen (1998, pp. 369–379) summarized 17 independent data sets of nearly 45,000 Blacks and 245,000 Whites derived from 149 psychometric tests and found the *g* loadings consistently predicted the magnitude of the mean Black–White differences (r = .63, P < .001). The term "Jensen Effect" has subsequently been used to designate significant correlations between *g* loadings and other variables.

Jensen's (1998) method of correlated vectors has also been used to demonstrate a relation between the heritability of an item's score and the differences in pass rates on the same items by Blacks and Whites. Most of these studies were carried out in the US and the results implied a strong genetic component for the group differences (Jensen, 1998; Rushton, 1995; Rushton & Jensen, 2005). If not, there would be a *zero* relation between the heritability scores and the magnitude of the group differences.

Lynn and Owen (1994) were the first to test Spearman's hypothesis in sub-Saharan Africa. After they administered the Junior Aptitude Test to thousands of White, Indian, and Black high-school students, they not only found the usual 30 point difference in mean IQ test scores between Africans and Whites, but also that the magnitude of the differences on each subtest correlated .62 ($P < .05$) with the *g* factor extracted from the African sample and .23 with the *g* factor extracted from the White sample.

Subsequently, Rushton and Skuy confirmed Spearman's hypothesis in sub-Saharan Africa in several of the studies carried out at the University of the Witwatersrand (described above). Since the total score on the Raven's is a good measure of *g*, the item-total correlation provides a reasonable estimate of each item's *g* loading. We found the African-White differences were consistently more pronounced on the more *g* loaded items (e.g., *r*s = .34-.41, whether using the African or White item-total correlations (Rushton & Skuy, 2000). In another of the studies, we carried out a multi-group confirmatory factor analysis (MGCFA) of the test items and confirmed the African-White differences were on *g* (Rushton et al., 2004). Thus, finding a "Jensen Effect" is not dependent on using Jensen's method of correlated vectors. The results also address a related criticism sometimes made, that the Raven's tests have not been shown to have a high *g* loading among Africans.

The most direct psychometric evidence to date for a genetic contribution to the African-White differences comes from the finding that the magnitude of the pass rate differences on each item are most pronounced on those with the highest heritability (Rushton, Bons, Vernon, & Cvorovic, 2007). We calculated the heritability for each of the 58 items of the SPM from the 152 pairs of twins in the Minnesota Study of Twins Reared Apart (Bouchard & McGue 2003). Most of the twins were separated early in life, reared in adoptive families and then reunited only in adulthood. The pass rate differences between Africans and Whites correlated .40 ($P < .05$) with the heritabilities calculated from the Minnesota twin pairs. We also found the results were highly generalizable, for the same heritabilities predicted the pass rate differences in South Africa, Serbia, Canada, and the US between Whites, Africans, South Asians, and Coloreds, and the Roma (Gypsies) in Serbia (Rushton et al., 2007). Furthermore, the results were corroborated after organizing the 58 items into six more reliable *parcels* of items, each containing nine or more items. As the heritability of the parcels increased, so did the mean group differences (mean $r = .74$; $P < .01$). It is difficult to interpret results such as these as other than supporting the genetic hypothesis of group differences.

5. Reaction Time Measures

Reaction time is one of the simplest culture free measures. Many RT tasks are so easy that 9- to 12-yearold children can perform them in less than one second. Yet even on these very simple tests, children with higher IQ scores perform faster than do children with lower scores, and in the US, East Asian 9- to 12-year-olds have faster RTs than Whites who have faster RTs than Blacks. Moreover, in the US, the differences between Blacks, Whites, and East Asians in RTs are largely on the *g* factor, with the correlations between the *g* loadings and the mean group differences ranging from .70 to .81 (Jensen, 1998). Since school children are not trained to perform well on reaction time tasks, as they are on certain paper-and-pencil tests, the advantage of those with higher IQ scores on RT tasks is unlikely to arise from practice, familiarity, education, or training. Moreover, although the East Asians averaged faster *decision* times than the Whites or the Blacks, the Blacks averaged faster *movement* times than the Whites or the East Asians, thereby eliminating the hypothesis that the differences on these tests reflect a difference in motivation.

Lynn (1991; Lynn & Vanhanen, 2002, pp. 66-67) found the same pattern of RT scores internationally with over 1,000 9-year-old East Asian children in Japan and Hong Kong, White children in Britain and Ireland, and Black children in South Africa. The Progressive Matrices were given as a non-verbal test of intelligence, along with the "simple," "choice," and "odd-man-out" reaction time tasks. The correlations between IQ and reaction times for the five countries showed the East Asian children obtained the highest IQs, followed by the White children, and then the Black children. The median speed for the three reaction time tasks followed the same order, as did their SDs.

6. National IQ Scores

The landscape of the race-IQ debate shifted dramatically when Lynn's (1978, 1991a) reviews of the IQ literature morphed into a collation of over 620 studies from 129 countries (Lynn, 2006, Lynn & Vanhanen, 2002, 2006). One arresting fact emerged is that the average national IQ of the world is only 90. Less than one in five countries has a mean IQ score equal or near the British average of 100. Almost half have mean national IQs of 90 or less. This poses a serious problem if the book's conclusion that a mean IQ of 90 is the threshold for maintaining a technological economy is correct. Further, mean national IQs have high predictive validity. In *IQ and Global Inequality*, Lynn and Vanhanen (2006) found that across 192 countries, national IQs correlated with national income (.68), adult literacy (.64), enrollment in higher education (.75), life expectancy (.77), level of democratization (.57), as well as several Quality of Life Indicators from the World Health Organization.

Construct validity studies have demonstrated that these average national IQ scores are reliable and valid. Rindermann (2007) found a positive manifold across the national IQ scores and tests of educational achievement. Subsequently, Lynn and Meisenberg (2010) found the corrected correlation between national IQs and the best of the achievement tests was 1.00. Gelade (2008a) and Morse (2008) found the national IQs correlated with scientific productivity measured by articles and technological patents. Gelade (2008b) used spatial statistics to show that geographic neighbors had more similar average IQs than nations further apart.

Lynn and Vanhanen's (2006) predictions based on the average national IQs have also been well corroborated. Templer (2008) found a super-factor accounted for 75% of the variance across 129 national differences in IQ, life expectancy, birth rate, infant mortality, HIV/AIDS rate, skin color, and GDP (median r = .68). Rushton and Templer (2009) extended these results to show that average national IQs also predicted rates of violent crime such as murder, rape, and serious assault, albeit at lower values (rs = .25, .29, and .21, respectively; Ns = 113; Ps < .05). Wicherts, Borsboom, and Dolan (2010) showed that even after excluding low scoring countries in sub-Saharan Africa, 60 national IQs correlated with latitude (.50), fertility (.75), child mortality (.61), education (.60), calories per day (.44), and urbanization (.52). They also found one dominant principal component that explained 65% of the variance across 18 variables.

7. Cold Winters Theory

Lynn's (2006) global perspective went well beyond the three-macro races that I (and others) had studied to date. He reviewed more than 500 published IQ studies from around the globe, from the beginning of the twentieth century up to the present, devoting a chapter to each of the ten "genetic clusters" or population groups identified by Luigi Cavalli-Sforza and his colleagues in their mammoth (1994) book, *The History and Geography of Human Genes*. Lynn (2006) regards these genetic clusters as "races." He found that the East Asians - Chinese, Japanese and Koreans - show the highest mean IQ at 105. Europeans followed with a mean IQ of 100. Next in order were the Inuit or Eskimos (mean IQ 91), South East Asians (87), Native American Indians (87), Pacific Islanders (85), and South Asians and North Africans (IQ 84). Lower means were found for sub-Saharan Africans (67), and the Australian Aborigines (62).

Addressing the fundamental question of the causes of the national differences in mean intelligence test scores, Lynn and Vanhanen (2006) concluded that they reflected the racial composition of the populations. There was remarkable consistency in the mean IQs of countries when these were classified into racial clusters. To explain why East Asians achieve higher average IQs, Lynn (1991b; 2006) proposed cold winters theory. During the last ice age, which lasted approximately from 28,000 years ago to 12,000 years ago, higher intelligence resulted from the natural selection of larger brained, higher IQ individuals who were better able to build shelters, store food, make clothes, and hunt large animals sufficiently to keep their offspring alive during Siberian-level cold. He suggested that the worldwide distribution of these IQ differences implied they had a genetic basis. Support of the cold winters theory comes from the .62 correlation found between average cranial capacity and distance from the equator in a study of 20,000 crania (Beals, Smith, & Dodd, 1984).

Lynn (1991b) thereby brought back to the fore some of the ideas of the early biogeographers who had begun to examine the effects of climate on human racial origins (as they routinely do when studying non-human species). For example, in *Civilization and Climate* (1915), Ellsworth Huntington (1876-1947), a professor of geography at Yale University, argued that hot climates were enervating for Northern Europeans. In *The Passing of the Great Race* (1916), Madison Grant (1865-1937) wrote a racial history of Europe in which he viewed Nordics as having evolved in a climate which "must have been such as to impose a rigid elimination of defectives through the bed agency of hard winters and the necessity of industry and foresight in providing the year's food, clothing, and shelter during the short summer."

Lynn's (1991b) cold winters theory also dovetailed with Rushton's (1995) "Out-of-Africa" life history theory of racial group differences. Subsequent support for Lynn's cold winters theory came from Templer and Arikawa (2006) who found a correlation of -.92 between skin color and IQ across 129 countries The skin color data were taken from an anthropological world map compiled by Biasutti (1967; the darker the skin, the lower the IQ). Templer and Arikawa (2006) conceptualized skin color as a multigenerational adaptation to the climate in which one's ancestors had lived in for thousands of years. They also found that average national IQ correlated -.76 with mean high winter temperature and -.66 with mean low winter temperature. The negative correlation between IQ and skin color remained even when calculated separately within each of three continents: Africa, -.86; Asia, -.55; and Europe, -.63.

Wicherts et al. (2010) has forcefully critiqued evolutionary explanations of regional differences in IQ by pointing to the many confounds among the measures and the poor quality of some of the data. They argued that since any empirical tests of long ago events is virtually impossible, an evolutionary basis for national and regional IQs should only be inferred if ''very strong prior knowledge of the processes that created the dependencies" existed, and such knowledge is ''all but lacking" (p. 95). Wicherts et al. (2010) proposed what they deemed was a more plausible, proximal, explanation for the co-variation among the variables, a country's ''developmental status."

In a counter to the Wicherts et al.'s (2010) critique, Rushton (2010) proposed heritable "brain power," mediated by brain size, as the primary cause of the correlates of average national IQ scores (Wicherts et al.'s "developmental status" among them). Brain size breaks the chain of circular reasoning and allows testable predictions for both within- and between-species differences. For example, across 234 mammalian (non-human) species, brain weight correlated with longevity (r = .70), gestation time (.72), birth weight (.44), litter size (.43), age at first mating (.63), duration of lactation (.62), body weight (.44), and body length (.54). Even after controlling for body weight and body length, brain size predicted the other variables (.59). Among a narrower range of 21 primate species, brain size still correlated

.80–.90 with life span, length of gestation, age of weaning, age of eruption of first molar, age at complete dentition, age at sexual maturity, inter-birth interval, and body weight (see Rushton & Ankney, 2009, for details on brain size variables).

Rushton (2010) also found a strong correlation between brain size and national average IQ in the specific data Wicherts et al. (2010) cited in their critique. For example, Rushton calculated a .91 ($P < .01$) correlation between IQ scores across the ten major population groups given in Lynn (2006) with the cranial capacity data provided by Beals et al. (1984, p. 304, Figure. 3). Rushton (2010) calculated a further correlation of .83 between cranial capacity and IQ from 10 different sets of data provided by Lynn (2006, p. 212, Table 16.2). Brain size is central to a suite of life-history variables which arise through natural selection. Traits need to be harmonized, rather than working independently or at odds with each other. Any theory such as natural selection leading to larger brains that explains differences at the individual, national, and cross-national level deserves to be taken very seriously.

References

Beals, K. L., Smith, C. L. & Dodd, S. M. (1984). Brain size, cranial morphology, climate, and time machines. *Current Anthropology*, *25*, 301-330.

Biasutti, R. (1967). *Le razze e i popoli della terra*. Torino, Italy: Unione tipografico-Editrice Torinese.

Cavalli-Sforza, L. L., Menzoni, P., & Piazza, A. (1994). *The history and geography of human genes*. Princeton: Princeton University Press.

Gelade, G. A. (2008a). IQ, cultural values, and the technological achievement of nations. *Intelligence*, *36*, 711-718.

Gelade, G. A. (2008b). The geography of IQ. *Intelligence*, *36*, 495-501.

Gould, S. J. (1981). *The mismeasure of man*. New York, NY: Norton.

Gould, S. J. (1996). *The mismeasure of man* (2nd edition). New York, NY: Norton.

Grant, M. (1916). *The passing of the great race, or the racial basis of European history.* New York: Charles Scribner's Sons.

Huntington, E. (1915). *Civilization and climate*. New Haven: Yale University Press.

Jensen, A. R. (1969). How much can we boost IQ and scholastic achievement? *Harvard Educational Review*, *39*, 1-123.

Jensen, A. R. (1973). *Educability and group differences*. London: Methuen.

Jensen, A. R. (1998). *The g factor*. Westport, CT: Praeger.

Kendall, I. M., Verster, M. A., & von Mollendorf, J. W. (1988). Test performance of blacks in Southern Africa. In S. H. Irvine & J. W. Berry (Eds.), *Human abilities in cultural context* (pp. 299-339). Cambridge, UK: Cambridge University Press.

Lynn, R. (1977). The intelligence of the Japanese. *Bulletin of the British Psychological Society, 30,* 69-72.

Lynn, R. (1978). Ethnic and racial differences in intelligence: International comparisons. In R. T. Osborne, C. E. Noble, & N. Weyl (Eds.), *Human variation: The biopsychology of age, race, and sex* (pp. 261-286). New York: Academic Press.

Lynn, R. (1982). IQ in Japan and the United States shows a growing disparity. *Nature*, *297*, 222-223.

Lynn, R. (1991a). Race differences in intelligence: A global perspective. *Mankind Quarterly*, *31*, 255-296.

Lynn, R. (1991b). The evolution of racial differences in intelligence. *Mankind Quarterly*, *32*, 99-121.

Lynn, R., (2006) *Race differences in intelligence: An evolutionary analysis*. Augusta, GA: Washington Summit Books.

Lynn, R., & Owen, K. (1994). Spearman's hypothesis and test score differences between Whites, Indians, and Blacks in South Africa. *Journal of General Psychology, 121*, 27-36.

Lynn, R., & Vanhanen, T. (2002). *IQ and the wealth of nations.* Westport, CT: Praeger.

Lynn, R., & Vanhanen, T. (2006). *IQ and global inequality.* Augusta, GA: Washington Summit.

Morse, S. (2008). The geography of tyranny and despair: Developmental indicators and the hypothesis of genetic inevitability of national inquiry. *The Geographical Journal*, *174*, 195-206.

Rindermann, H. (2007). The *g*-factor of international cognitive ability comparisons: The homogeneity of results in PISA, TIMSS, PIRLS, and IQ-tests across nations. *European Journal of Personality*, *21*, 667-706.

Rushton, J. P. (1980). *Altruism, socialization, and society*. Englewood Cliffs, NJ: Prentice Hall.

Rushton, J. P. (1995). *Race, evolution, and behavior: A life history perspective.* New Brunswick, NJ: Transaction.

Rushton, J. P. (2010). Brain size as an explanation of national differences in IQ, longevity, and other life-history variables. *Personality and Individual Differences*, *48*, 97-99.

Rushton, J. P., & Ankney, C. D. (2009). Whole-brain size and general mental ability: A review. *International Journal of Neuroscience*, *119*, 691-731.

Rushton, J. P., Bons, T. A., Vernon, P. A., & Cvorovic, J. (2007). Genetic and environmental contributions to population group differences on the Raven's Progressive Matrices estimated from twins reared together and apart. *Proceedings of the Royal Society of London*. *Series B. Biological Sciences*, *274*, 1773-1777.

Rushton, J. P., & Jensen, A. R. (2005). Thirty years of research on group differences in cognitive ability. *Psychology, Public Policy, and the Law*, *11*, 235-294.

Rushton, J. P., & Jensen, A. R. (2010). The rise and fall of the Flynn Effect as a reason to expect a narrowing of the Black-White IQ gap. *Intelligence*, *38*, 213-219.

Rushton, J. P., & Skuy, M. (2000). Performance on Raven's Matrices by African and White university students in South Africa. *Intelligence, 28,* 251-265.

Rushton, J. P., Skuy, M., & Fridjohn, P. (2002). Jensen Effects among African, Indian, and White engineering students in South Africa on Raven's Standard Progressive Matrices. *Intelligence, 30,* 409-423.

Rushton, J. P., Skuy, M., & Bons, T. A. (2004). Construct validity of Raven's Advanced Progressive Matrices for African and non-African engineering students in South Africa. *International Journal of Selection and Assessment, 12,* 220-229.

Rushton, J. P., & Templer, D. I. (2009). National differences in intelligence, crime, income, and skin color. *Intelligence, 37*, 341-46.

Templer, D. I. (2008). Correlational and factor analytic support for Rushton's differential *K* life-history theory. *Personality and Individual Differences, 45*, 440-444.

Templer, D. I., & Arikawa, H. (2006). Temperature, skin color, per capita income, and IQ: An international perspective. *Intelligence, 34*, 121-139.

Schultz, A. H. (1923). Comparison of White and Negro fetuses. In C. B. Davenport, H. F. Osborn, C. Wissler, & H. H. Laughlin (Eds.), *Scientific Papers of the Second International Congress of Eugenics: Vol. 2, Eugenics in Race and State* (Plates 11 and 12). Baltimore, MD: Williams & Wilkins.

Skuy, M., Gewer, A., Osrin, Y., Khunou, D., Fridjhon, P., & Rushton, J. P. (2002). Effects of mediated learning experience on Raven's matrices scores of African and non-African university students in South Africa. *Intelligence*, *30*, 221–232.

Vernon, P. E. (1982). *The abilities and achievements of Orientals in North America*. New York: Academic Press.

Wicherts, J. M., Borsboom, D., & Dolan, C. V. (2010). Why national IQs do not support evolutionary theories of intelligence. *Personality and Individual Differences*, *48*, 91–96.

Wilson, E. O. (1975). *Sociobiology: The new synthesis*. Cambridge, MA: Harvard University Press.

Chapter 3

The Evolution of General Intelligence

Satoshi Kanazawa
Department of Management
London School of Economics and Political Science
Managerial Economics and Strategy Group, Department of Management, London School of Economics and Political Science, Houghton Street, London WC2A 2AE, United Kingdom.
Email: S.Kanazawa@lse.ac.uk.

Abstract

Among Richard Lynn's numerous significant contributions to science is his cold winters theory of the evolution of general intelligence. The cold winters of Eurasia presented novel adaptive problems for our ancestors to solve, such as obtaining food by hunting large animals and keeping warm by building clothing, shelter and fire, and they functioned as strong selection pressures for higher intelligence. Empirical analyses support both Lynn's cold winters theory and my evolutionary novelty theory of the evolution of general intelligence. Mean annual temperature and the degree of evolutionary novelty in the environment independently predict the average intelligence of the population. Both theories can also account for the observed race difference in intelligence.

Introduction

How did human intelligence evolve? Why did humans attain such high levels of general intelligence? And why are there notable differences in average intelligence in different populations and races in different geographical locations?

The evolution of general intelligence is one of numerous areas in which Richard Lynn has made significant scientific contributions. In particular, along with J. Philippe Rushton (1995), Lynn has formulated and advanced the *temperature theory* (or *cold winters theory*)[1] of the evolution of general intelligence.

1. Cold Winters Theory

Lynn (1991) builds on Jerison's (1973) notion of *encephalization* throughout the evolution of life in the last 225 million years, and applies it specifically to the evolution of general intelligence among humans in the last 200,000 years. Jerison argues that, whenever a species migrates to a new ecological niche, novel adaptive problems confront the species and function as a selective force for greater intelligence. Those individuals of the species in the new ecological niche who cannot solve the novel adaptive problems die, and those who can, with their greater intelligence, live to reproduce more offspring who carry the genes for larger brains and greater intelligence. As species continue to migrate to new ecological niches and confront novel adaptive problems, the size of their brain relative to their body (encephalization quotient = EQ), and thus intelligence, increase in the course of evolution. The average living mammals are defined to have EQ of 1.0. On this scale, average living fish

---

[1]Neither Lynn nor Rushton gave an explicit name to their theory. In my 2008 article (Kanazawa, 2008), I called it *temperature theory.* However, in his contribution to this volume, Rushton (2011) calls it *cold winters theory.* I happen to like Rushton's name better than my own, so I will stick to *cold winters theory* throughout this paper.

and reptiles have EQ of .05, average living birds have EQ = 1.0, gorillas EQ = 2.0, Orangutans EQ = 2.4, Chimpanzees EQ = 2.6, and *Homo sapiens* EQ = 7.5.

Jerison's (1973) original theory was strictly for explaining different degrees of encephalization *between* species, but Lynn (1991) has applied it to the evolution of general intelligence *within* a species. Lynn argues that, as human ancestors migrated out of the tropical and subtropical climates of sub-Saharan African savanna, and spread to the rest of the world, they encountered new adaptive problems in the new ecological niches of the temperate, subarctic, and arctic climates of Eurasia. The novel adaptive problems that human ancestors encountered out of Africa fall into two categories: Obtaining food, and keeping warm.

1.1. Obtaining food

Our ancestors in Africa mostly subsisted on plant food, not hunted animals. Contemporary hunter-gatherers obtain a vast majority of their daily calories from gathered plant food. For example, the Gadio people in New Guinea obtain 96% of their calories from plants and only 4% from meat (Dornstreich, 1973). In the tropic and subtropic climate of Africa, plant food is abundant, and food procurement is therefore not difficult at all. Lee (1968) notes that women of the !Kung bushman tribe gather plant foods one day in three, and their men go on hunting expeditions for one week in three. The adaptive problem of obtaining food in the evolutionary environment of the sub-Saharan Africa does not therefore present a strong selection pressure for higher intelligence.

All of this changed when our ancestors left their ancestral home of Africa and migrated to Eurasia about 80,000 years ago (Oppenheimer, 2003). In the temperate, subarctic, and arctic climate of Eurasia, plant foods were seasonal and available only during the summer and the fall. Our ancestors who had migrated to Eurasia thus became increasingly dependent on hunting animals for food. Lee (1968) shows that, among the contemporary hunter-gatherers, there is a positive association between latitude and their reliance on animal meat for food; the higher the latitude (and thus the colder the climate), the greater the proportion of animal meat in their diet. Lynn (1991) also notes that hunting in the grasslands of Eurasia is more difficult than hunting in the woodlands of Africa because the former does not provide cover for the hunters. The prey animals can spot approaching hunters in the grasslands from miles away, whereas hunters can hide in the trees and other natural covers in the woodlands. Thus chimpanzees in Africa are known to hunt successfully (Goodall, 1986).

Effective hunting thus presents a whole host of new adaptive problems for our ancestors in Eurasia to solve, including the coordination of different hunters for a single goal and the manufacture and use of hunting weapons. These problems were largely unencountered by their counterparts left behind in sub-Saharan Africa. These novel adaptive problems exerted strong selection pressures for higher intelligence.

1.2. Keeping warm

The temperate, subarctic, and arctic climates of Eurasia presented another set of problems for our ancestors: Keeping warm during cold winters. These problems necessitated our ancestors in Eurasia to manufacture shelter and clothing to keep warm during cold winters. Effective clothing and shelter were all but unnecessary to survive in the tropic and subtropic climates of sub-Saharan Africa.

The cold temperatures of Eurasia also presented our ancestors with the problem of *building* fire and keeping it burning. Lynn (1991) notes that it must have been easier to acquire fire in Africa than in Eurasia. In Africa, there would have been spontaneous brush fires, from which our ancestors could take ignited branches, carry them back to camp, and get a domestic fire started. In Eurasia, there would have been few (if any) spontaneous brush fires, so our ancestors would have had to make fire by friction of two pieces of wood or percussion of flint stones. Those who could not figure out how to start and build a fire presumably died out in the cold winters of Eurasia, thus selecting for higher intelligence.

Lynn's (1991) and Rushton's (1995) cold winters theory therefore avers that cold winter temperature of Eurasia, which presented our ancestors with novel adaptive problems of obtaining food and keeping warm, among others, selected for greater intelligence. Their theory can explain how general intelligence evolved in the course of human evolution and why Europeans and East Asians have higher average intelligence than Africans.

2. Evolutionary Novelty Theory

I have approached the problem of the evolution of general intelligence from my perspective as an evolutionary psychologist, and offered a slightly different explanation for it. The concept of general intelligence poses a problem for evolutionary psychology (Chiappe & MacDonald, 2005; Cosmides & Tooby, 2002; Miller, 2000a). Evolutionary psychologists contend that the human brain consists of domain-specific evolved psychological mechanisms, which evolved to solve specific adaptive problems of survival and reproduction in narrow specific domains. If the contents of the human brain are domain-specific, how can evolutionary psychology explain general intelligence, which is seemingly domain-general?

In contrast to views expressed by Miller (2000b), Cosmides and Tooby (2002), and Chiappe and MacDonald (2005), I (Kanazawa, 2004) propose that what is now known as general intelligence may have originally evolved as a domain-specific adaptation to deal with evolutionarily novel, nonrecurrent problems. The human brain consists of a large number of domain-specific evolved psychological mechanisms to solve recurrent adaptive problems. In this sense, our ancestors did not really have to *think* in order to solve such recurrent adaptive problems. Evolution has already done all the thinking, so to speak, and equipped the human brain with the appropriate psychological mechanisms, which engender preferences, desires, cognitions, and emotions, and motivate adaptive behavior in the context of the ancestral environment. For example, our ancestors never had to think what was good to eat. All they had to do was to eat and keep eating what tasted good to them (sweet and fatty foods that contained high calories), and they lived long and remained healthy.

Even in the extreme continuity and constancy of the ancestral environment, however, there were likely occasional problems that were evolutionarily novel and nonrecurrent, which required our ancestors to think and reason in order to solve. These novel adaptive problems likely *included, but were not limited to,* the problems of obtaining food and keeping warm in the northern latitudes of Eurasia that are underscored by Lynn's (1991) and Rushton's (1995) cold winters theory.

To the extent that these evolutionarily novel, nonrecurrent problems happened frequently enough in the ancestral environment (a different problem each time) and had serious enough consequences for survival and reproduction, then any genetic mutation that allowed its carriers to think and reason would have been selected for, and what we now call "general intelligence" could have evolved as a domain-specific adaptation for the (originally narrow) domain of evolutionarily novel, nonrecurrent problems, which did not exist in the ancestral environment and therefore for which there are no dedicated modules in the form of domain-specific evolved psychological mechanisms.

From this perspective, general intelligence may have become universally more important in modern life (Gottfredson, 1997; Herrnstein & Murray, 1994; Jensen, 1998) only because our current environment is almost entirely evolutionarily novel. My theory suggests, and available empirical data confirm, that more intelligent individuals are better than less intelligent individuals at solving problems *only if* they are evolutionarily novel. More intelligent individuals are *not better* than less intelligent individuals at solving evolutionarily familiar problems, such as those in the domains of mating, parenting, interpersonal relationships, and wayfinding (Kanazawa 2004, 2007), *unless* the solution involves evolutionarily novel entities. For example, more intelligent individuals are no better than less intelligent individuals in finding and keeping mates, but they may be better at using computer dating services.

3. Empirically Adjudicating between the Cold Winters Theory and the Evolutionary Novelty Theory

A couple of recent studies (Ash & Gallup, 2007; Bailey & Geary, 2009), employing varied methods, have demonstrated that the average intelligence of a population appears to be a strong function of both average temperature and evolutionary novelty. However, given that cold winter temperature (the key explanatory factor in the cold winters theory) is part of the evolutionary novelty emphasized in my evolutionary novelty theory, and given that latitudes simultaneously increases both the coldness of the winter temperature and evolutionary novelty of the environment, it is difficult to adjudicate between these theories. It would require statistically controlling for both explanatory factors simultaneously in predicting the average intelligence of populations.

In my 2008 article (Kanazawa, 2008), I attempt to adjudicate between the cold winters theory and the evolutionary novelty theory of the evolution of general intelligence. For this purpose, I use another one of Richard Lynn's significant scientific contributions – the national IQ data (Lynn & Vanhanen, 2002, 2006; Lynn & Meisenberg, 2010). I use annual mean temperature as a measure of the coldness of the winter, and latitude, longitude and distance from the ancestral environment as proxies for evolutionary novelty of the environment. While these are far from perfect indicators of evolutionary novelty, which is the extent to which the environment differs from the evolutionary environment in sub-Saharan Africa, they do capture important aspects of it. For example, fauna and flora must physically travel from one location to another in order to migrate to a new environment (as our ancestors did). Thus the farther away two locations are, the less likely it is that the fauna and flora of the two locations share many species in common.

It is difficult to pinpoint the exact location of the ancestral environment, mostly because it was not just one place. So I use three alternative locations in sub-Saharan Africa, three vertices of the inverse triangle that is the African continent: the coordinate (0N, 0E), where the equator and the prime meridian intersects, which happens to be in the Atlantic Ocean just off the coast of Nigeria; the coordinate (30S, 30E), which is the southeast corner of South Africa; and the coordinate (10N, 40E), which is in the middle of Ethiopia. The latter two locations represent as far east and south one can go from the coordinate (0N, 0E) and still remain on the African continent.

As it turns out, however, all of my substantive conclusions are robust with respect to the chosen location of the ancestral environment. No matter which location one chooses as the site of the ancestral environment, both mean annual temperature and evolutionary novelty (measured by latitude, longitude, and distance) are significantly correlated with and independently predict the average intelligence of the population. Mean temperature has a significant and large effect on average intelligence net of evolutionary novelty, and evolutionary novelty has a significant and large effect on average intelligence net of mean temperature. Even though mean annual temperature and latitude are significantly correlated with each other, they both independently predict the average intelligence. Even when the mean temperature is statistically controlled, both the longitude and the distance from sub-Saharan Africa independently predict the mean intelligence of the population.

Mean temperature and evolutionary novelty together account for half to two-thirds of the variance in national IQ. The results appear to suggest that both Lynn's (1991) and Rushton's (1995) cold winters theory and my evolutionary novelty theory (Kanazawa, 2004) are both partially correct and explains the evolution of general intelligence among humans.

4. Implications for Race Differences in Behavior

Richard Lynn's another significant contribution to science is in the area of race differences in intelligence (Lynn, 2006, 2008). Both his and Rushton's cold winters theory and my evolutionary novelty theory can explain the systematic differences in general intelligence between the races.

Because the mean winter temperature of the temperate, subarctic, and arctic Eurasia are systematically and significantly lower than that in the tropic and subtropic Africa, the cold winters theory would predict that mean intelligence to be higher in Eurasia than in Africa, which is indeed the case (Lynn & Vanhanen, 2002, 2006; Lynn & Meisenberg, 2010). Because the ancestral environment for humans was in sub-Saharan Africa, locales outside of sub-Saharan Africa are by definition more evolutionarily novel than those in sub-Saharan Africa. My evolutionary novelty theory would therefore predict that the mean intelligence of the population outside of Africa to be higher than that inside. And, indeed, as I note above, even when the mean temperature is controlled, the farther away the population is from sub-Saharan Africa, the higher their mean intelligence.

In this context, it is instructive to note that *the geographical differences in national IQs are not entirely explainable by the difference between the races.* Largely black nations outside of sub-Saharan Africa, mostly in the Caribbean and the South Pacific, have significantly higher national IQs than those in sub-Saharan Africa (63.8 vs. 80.5; $t(68) = 10.12$, $p < .001$). The difference is therefore at least partly geographic, not entirely racial. Because the Caribbean and the South Pacific represent evolutionarily novel environment, this is perfectly consistent with my evolutionary novelty theory of the evolution of general intelligence.

5. Conclusion

In his long and brilliant career, Richard Lynn has made significant scientific contributions to many areas of intelligence research and differential psychology. Among them are the evolution of general intelligence (Lynn, 1991), the compilation of highly reliable and valid data on national IQ (Lynn & Vanhanen, 2002, 2006; Lynn & Meisenberg, 2010), and the race differences in intelligence (Lynn, 2006 2008). This brief note has shown how the three areas of Lynn's contribution converge. His national IQ data allow for the empirical test of and provide support for his cold winters theory of the evolution of general intelligence (as well as my evolutionary novelty theory), which explains the race differences in average intelligence. However, more empirical research is necessary to test and adjudicate between his cold winters theory and my evolutionary novelty theory of the evolution of general intelligence among humans. In particular, any data that show that the average intelligence of a population is uncorrelated with its geographical location would cast doubt on both the cold winters theory and evolutionary novelty theory of the evolution of general intelligence.

References

Ash, J., & Gallup, Jr., G. G. (2007). Paleoclimatic variation and brain expansion during human evolution. *Human Nature, 18,* 109-124.

Bailey, D. H., & Geary, D. C. (2009). Hominid brain evolution: Testing climatic, ecological, and social competition models. *Human Nature, 20,* 67-79.

Chiappe, D., & MacDonald, K. (2005). The evolution of domain-general mechanisms in intelligence and learning. *Journal of General Psychology, 132,* 5-40.

Cosmides, L., & Tooby, J. (2002). Unraveling the enigma of human intelligence: Evolutionary psychology and the multimodular mind. In Sternberg, R. J., & Kaufman, J. C., (eds.), *The evolution of intelligence* (pp. 145-198). Mahwah: Lawrence Erlbaum.

Dornstreich, M. D. (1973). Food habits of early man balance between hunting and gathering. *Science, 179,* 306.

Goodall, J. (1986). *The chimpanzees of Gombe: Patterns of behavior.* Cambridge: Harvard University Press.

Gottfredson, L. S. (1997). Why *g* matters: The complexity of everyday life. *Intelligence, 24,* 79-132.

Herrnstein, R. J., & Murray, C. (1994). *The Bell Curve: Intelligence and class structure in American life.* New York: Free Press.

Jensen, A. R. (1998). *The* g *factor: The science of mental ability.* Westport: Praeger.

Jerison, H. (1973). The evolution of the brain and intelligence. New York: Academic Press.

Kanazawa, S. (2004). General intelligence as a domain-specific adaptation. *Psychological Review, 111,* 512-523.

Kanazawa, S. (2007). Mating intelligence and general intelligence as independent constructs. In Geher, G., & Miller, G. (eds.), *Mating intelligence: Sex, relationships, and the mind's reproductive system* (pp. 283-309). Mahwah: Lawrence Erlbaum.

Kanazawa, S. (2008). Temperature and evolutionary novelty as forces behind the evolution of general intelligence. *Intelligence, 36,* 99-108.

Lee, R. B. (1968). What hunters do for a living, or how to make out on scarce resources. In Lee, R. B., & DeVore, I. (eds.), *Man the Hunter* (pp. 30-48). Chicago: Aldine.

Lynn, R. (1991). The evolution of race differences in intelligence. *Mankind Quarterly, 32,* 99−173.

Lynn, R. (2006). *Race differences in intelligence: An evolutionary analysis.* Augusta: Washington Summit Publishers.

Lynn, R. (2008). *The global bell curve: Race, IQ, and inequality worldwide.* Augusta: Washington Summit Publishers.

Lynn, R., & Meisenberg, G. (2010). National IQs calculated and validated for 108 nations. *Intelligence, 38,* 353-360.

Lynn, R., & Vanhanen, T. (2002). *IQ and the wealth of nations.* Westport: Praeger.

Lynn, R., & Vanhanen, T. (2006). *IQ and global inequality.* Augusta: Washington Summit Publishers.

Miller, G. F. (2000a). How to keep our metatheories adaptive: Beyond Cosmides, Tooby, and Lakatos. *Psychological Inquiry, 11,* 42-46.

Miller, G. F. (2000b). Sexual selection for indicators of intelligence. In Bock, G. R., Goode, J. A., & Webb, K., (eds.), *The nature of intelligence* (pp. 260-275). New York: John Wiley.

Oppenheimer, S. (2003). *Out of Eden: The peopling of the world.* London: Constable.

Rushton, J. P. (1995). *Race, evolution, and behavior: A life history perspective.* New Brunswick: Transaction.

Rushton, J. P. (2011). Life history theory and race differences: An essay on Richard Lynn's contributions to science. *Personality and Individual Differences, 53, (2),* 85-89.

Chapter 4.

The Scientific Style of Richard Lynn

DONALD I. TEMPLER
Alliant International University (Retired)
Fresno, California, USA
257 W. Los Altos
Fresno, CA 93704
Phone/fax: +1-559-431-1886
donaldtempler@sbcglobal.net

ABSTRACT

The scientific style of Lynn is described and includes his tenacity combined with his creativity, his research intuition, and his ability to politely correct the scientifically incorrect. His empirical and theoretical contributions to conscientiousness as a function of intelligence, race, and psychopathic personality in an evolutionary context are described and discussed. This is related to his work on pigmentocracy and to recent research showing more aggression in dark animals and humans. Suggestions for measurement of psychopathic personalities are offered.

Introduction

Richard Lynn's work, the best known of which is on ethnic/national differences in intelligence, reflects seemingly incongruous characteristics. He is on one hand a methodical and tenacious assembler of facts and figures. At the same time, he is a highly analytical, creative, and insightful conceptualizer. He tantalizes his readers with vast information, his organization of which is more than the sum of its parts. He is to intellectual group differences as Charles Darwin is to biology.

Clinical psychologists talk about "clinical intuition." I believe there is also a "research intuition" that Lynn possesses in conjunction with his being both bold and pioneering. He was the first to assemble IQ's for almost all of the countries of the world, thus making both a scientific and methodological contribution (Lynn & Vanhanen, 2002). Over half of the IQ's were estimated on the basis of neighboring countries. It seemed predictable at the time that some persons would question the legitimacy of such estimation (Hunt & Sternberg, 2006). Lynn and Vanhanen (2006) subsequently correlated estimated IQ and later measured IQ in 25 countries and found a remarkably high correlation of .91. I would not have predicted that such estimation would provide such a great approximation of measured IQ. Lynn's researcher's intuition is uncanny.

Lynn writes with patience and calmness while presenting evidence in defending the truth against the well-intentioned but scientifically incorrect. To use an example in the realm of antisocial behavior, Lynn (2009) first stated the position of an American Psychological Association Task Force that African American students do not engage in higher rates of disruptive behavior than Whites but are punished more because of lack of teacher training, classroom management, racial stereotyping, and lack of training in culturally competent practices. Lynn pointed out that there are grossly disproportionate Blacks in a variety of criminal and delinquent and other antisocial behavior. The descending order of suspension and exclusion rates of Blacks, Native-Americans, Hispanics, Whites, and East Asians has existed for many years. The grossly disproportionate crime rate of Blacks is found in a number of different countries. In spite of being a minority, East Asians consistently demonstrate a low rate of disruptive behavior both in school and the community.

Conscientiousness: The Personality Variable

Although personality and almost all human variables are conceptualized by researchers as continua ranging from very high to very low, when many lay persons use the word "conscientiousness" they usually are thinking of above-average levels and of situations of a school or work nature, e.g., Mary is a conscientious student in that she comes to school on time, does neat work, and keeps her desk clean. Conscientiousness in this chapter is conceptualized as extending from a high of giving to others, contributing to society, working hard, and being highly responsible to a low end of being dishonest, exploitative, parasitic, and violent. Conscientiousness is one of the widely cited "Big Five" dimensions of personality (Costa & McCrae, 1992a) and measured by the NEO-PI-R (Costa & McCrae, 1992b). The five dimensions are Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness. In a study by Decuyper, DeFruyt, and Buschman (2008) using the NEO-PI-R, conscientiousness correlated most highly with two measures of psychopathic personality, one of which is based on the Diagnostic and Statistical Manual of the American Psychiatric Association (APA, 1994).

Race, IQ, and Antisocial Behavior

Lynn's (2002) most comprehensive work on conscientiousness is his article "Racial and ethnic differences in psychopathic personality" which presented numerous studies on undesirable behavior in a number of different countries, especially the United States. He provided information on conduct disorder, school suspensions and exclusions, attention deficit hyperactivity disorder, moral understanding, aggression, homicide, robbery, rape, spousal assault, not honoring financial obligations, inability to maintain long-term monogamous relationships, extramarital sex, multiple sex partners, inability to delay gratification, unemployment, reckless driving, recklessness in sex, unplanned pregnancies, precocious sexual activity, and irresponsible parenting. All over the world Blacks are the highest, East Asians the lowest, and Whites in between. In the studies in the United States, the ranking in descending order is Black, Native-American, Hispanic, White, East Asian. The fact that Hispanics and Native-Americans score in a similar fashion should not be surprising. Most U.S. Hispanics are Mexican and Mexicans have Native-American sanguinity. In Lynn's (2008) book "The Global Bell Curve: Race, IQ, and Inequality Worldwide," it is stated that 9% of Mexicans are European, 60 to 80% Mestizos, and 10-30% Native-American Indian (Flores-Crespo, 2007). It is entirely possible that Mexicans in the United States have even greater Native-American sanguinity than what exists in Mexico. It is sometimes said that the Mexicans who come to the U.S. to work as farm laborers are those who are "not making it" in Mexico. Lynn pointed out that, not only in Mexico but throughout most of Latin America, those persons who are more European and have lighter skin color have higher IQ's and are better economically and politically situated. Lynn emphasized "pigmentocracy," social stratification on the basis of skin color.

Lynn (2002) is in agreement with Rushton (1995) that evolution accounts for the higher IQ's, larger brains, more stable family life, better cooperation, greater altruism, and better social organization in East Asians and Europeans. Both scholars agree that those characteristics are needed in colder environments where obtaining food and protection from the elements is more challenging. In support of this theory, research assessing skin color by two different methods converges to show very high correlation between IQ and skin color. Meisenberg (2004) used the 127 countries of Africa, Asia, and Europe that Lynn and

Vanhanen (2002) had mean IQ's for. He used skin reflectance measured by Jablonski and Chaplin (2000) at 685 nanometers for 37 countries and extrapolated skin reflectance for the other 95 countries. The correlation between skin reflectance and IQ was .89. Templer and Arikawa (2006) also used Lynn and Vanhanen (2002) IQ's for 129 countries and used the skin color (from 1 = very light to 8 = very dark) from an international map in a physical anthropology book by Biasutti (1967). Because national boundaries were not delineated, three graduate students independently specified the predominant skin color in each country. The inter-rater reliabilities were .93, .95, and .95. The correlation coefficient between IQ and skin color was -.92. Jensen (2006) suggested that the high correlation could reflect pleiotropy, that is, a single gene having two or more phenotypically quite different effects.

Hunt and Sternberg (2006) criticized the "subjectivity" of the map ratings in the Templer and Arikawa (2006) study. Therefore, Templer (2010b) determined the correlation between Meisenberg (2004) skin reflectance-based skin color and Templer and Arikawa (2006) anthropological map-based skin color. The Templer and Arikawa measure and the Meisenberg measure correlated .96 with the 37 countries with measured skin reflectance, .96 with the 95 countries with extrapolated reflectance, and .96 with all 127 countries. It is now apparent that any methodological problems in the measurement of skin color must be minor. Two different methods independently conducted provide almost identical findings.

Digression to Rushton's *K* Differential Theory

This is a digression that is not really a digression. It unites some of Rushton's *r-K* characteristics with Lynn's psychopathic personality dimensions. Rushton (1985a, 1985b, 1987a, 1987b, 1995) applied MacArthur and Wilson's (1967) *r* vs. *K* characteristics in animals to humans. The *r*-life history strategist has a smaller brain, lower intelligence, more offspring, more rapid maturation, earlier sexual reproduction, little parental care, shorter life expectancy, lower social organization, lower altruism, more aggression, and more impulsivity. The *K* strategist has the converse of this behavior and life history and social organization pattern. Rushton maintained that in such conceptualization East Asians are the prototype of the *K* strategist and Blacks the prototype of the *r* strategist. Whites are at an intermediate level on almost all *r-K* continuum characteristics. Blacks tend to be high and East Asians low in activity level, aggressiveness, dominance, excitability, impulsivity, and sociability. It is apparent that Lynn's psychopathic personality characteristics are similar to Rushton's *K* Differential Theory behavioral and personality features (Templer, 1993).

Psychopathic Personality

It is remarkable that the comprehensive review of Lynn (2002) showed that on a number of different antisocial/irresponsible behaviors the order Black, Native-American, Hispanic, White, and Asian consistently emerges. Also remarkable is the fact that the mean IQ's consistently rank in the same order. Lynn acknowledges that the material he covers and his inferences are very similar to those of Herrnstein and Murray (1994) and Rushton (1995). All four authors emphasize the great importance of IQ and the great importance of race. The differences between races can be largely accounted for by IQ. All four authors, however, recognize that IQ does not explain all the racial differences in disruptive behavior. Lynn goes further than the other racial realists in that he ascribes this difference to "psychopathic personality," otherwise known as antisocial personality.

Lynn (2002) gave some examples of racial differences in disruptive behavior remaining when IQ is controlled for, specifically for Whites, Hispanics, and Blacks, respectively. The crime differences are 13, 6, and 3, but with IQ controlled for are 5, 3, and 2. As another example, the respective race differences were 49, 30, and 13 for welfare but with IQ controlled were 30, 13, and 12.

Theoretical and Empirical Comprehensiveness

The works of Lynn, Rushton, and Herrnstein and Murray on intelligence, ethnic differences, and maladaptive behavior provides a solid racial realism perspective. Lynn's addition of psychopathic personality extends the conceptualization to an almost miniature theory of personality. It incorporates anthropology, history, race, criminology, sexual behavior, age, parenting, social psychology, personality theory, and education.

The Evolution of Conscientiousness

The same conditions conducive to the evolution of greater intelligence would appear to be conducive to greater conscientiousness. Cold climate is stressed by Lynn and by Rushton but it is unlikely that it is the only evolutionary soil conscientiousness grows from. I have previously said:

> *Neither Rushton nor Lynn has ever claimed that climate is the only variable in the evolution of intelligence. Both acknowledge that the high intelligence of Ashkenazi Jews could be a function of selection of those surviving maltreatment across centuries. If I had to use one word to describe the impetus for evolutionary increase in intelligence, it would be "challenge," because that word implies both adversity and opportunity. (Templer 2010b, p. l03).*

I will now give a couple of examples of how conscientiousness may evolve in situations not highly related to cold temperature.

The disruptive behavior of East Indians being comparable to Whites cannot be explained on the basis of IQ. The IQ of Indians is 81 for India, 87 for those living in Africa, and 89 for those living in Britain (Lynn, 2006). In a study using eight regions of the world, India with a mean IQ of 81 had an age-adjusted homicide rate of 7.2, which is similar to 7.5 in formerly Communist Europe with an IQ of 95 and to 7.5 in "Other Asian Nations" with an IQ of 92. The Latin American/Caribbean region had a comparable IQ of 84 but an age-adjusted homicide rate of 22.4. Just as adversity (cold climate) probably contributed to an evolutionary increase in intelligence in Europe and East Asia, it could be argued in Rushton-Lynn-type reasoning that adversity increased social organization and impulse control in India. The adversity is that a sixth of the world's population is packed into a geographically disproportionately smaller area with limited natural resources and excess and deficits in precipitation. The Hindu religion may have evolved because of the need to control impulses and biological drives and to increase social harmony. A caste system in which some persons are relegated to extremely low status probably goes against the grain of most readers of PAID. Nevertheless, this social stratification may have contributed to social stability and violence control.

It is widely recognized that Jews have a low rate of crime and delinquency (Lunde, 1986). One study determined the differences between 13 Jewish inmates and the 1497 non-Jewish inmates in a prison (Templer & Jackson, 1992). A not-surprising finding is that Jews scored significantly higher on the Raven's Standard Progressive Matrices. It was also found that the Jewish inmates endorsed traditional middle-class values and a high need for achievement. They did not have a family history of criminality. The high IQ and Jewish culture probably protect against criminality. However, the high conscientiousness of Jews may also be viewed in an evolutionary fashion just as their high IQ can be explained by only the brightest surviving hundreds of years of persecution. The Jewish religion is not a proselytizing one. It was not spread by the sword as were Islam and Christianity hundreds of years ago. There are not Jewish missionaries throughout the world. Since Jews do not actively encourage conversion, they could not rapidly replace the losses if Jews were frequently killing each other. Also, since Jews are a small minority, their chances of survival would be reduced by antisocial behavior.

Very relevant to the evolution of conscientiousness is the general factor of personality (GFP) which is to personality as g is to intelligence. Persons high on GFP are more agreeable and altruistic and conscientious (Figueredo & Rushton, 2009; Rushton et al., 2009; Rushton & Irving, 2008; Rushton, Bons, & Hur, 2008). It is apparent that the high GFP characteristics are similar to the *K* characteristics of the Rushton *K* differential theory. Also relevant is the work of Hrdy (2009), who contended that "cooperative breeding" helped foster extended life spans, prolonged childhood, altruism, and larger brains. Larger brains are probably associated both with the evolution of greater intelligence and with greater conscientiousness. Greater brain size is found not only in species with higher intelligence but also in ethnic groups with higher IQ's (Rushton, 2010). Furthermore brain degenerative disorders are associated not only with cognitive deficits but with personality changes such as impulsivity, emotional lability, irritability, impaired judgment, and deterioration of personal hygiene.

It is unlikely that climate will again be a major factor in the evolution of intelligence. People no longer freeze to death and starve to death in larger numbers because of extreme cold. Lynn wrote of dysgenic fertility in the United States and the world in which the less intelligent are having more offspring than the more intelligent (Lynn, 1999; Lynn & Harvey, 2008; Lynn and van Court, 2004; also see Nyborg, this issue). Since intelligence is positively related to conscientiousness, such a fertility pattern is not one that generates optimism. The incarceration and sterilization and execution of criminals at least theoretically increase conscientiousness. The death penalty is higher in the United States than in most other industrial societies. Nevertheless, a very small percentage of murderers are executed.

China has the highest execution rate in the world. Common sense dictates that incarceration makes reproduction more difficult. Conjugal privileges lessen this effect.

Dark Coloration and Aggressiveness Dimension

Where does the dark vs. light human and animal dimension fit into the race/IQ/psychopathic personality determination of disruptive behavior? Is it only a part of one or more of the above three or does it deserve a place of its own?

The article of Ducrest, Keller and Roulin (2010) is too recent to know the magnitude of importance it will eventually be accorded, but it can unquestionably be viewed as having provocative implications. These authors did research on wild vertebrate species including fish, reptiles, birds, and mammals. Darker individuals are more aggressive, sexually active, more active in general, and have larger body size. Pigmentation of the skin, hair, cuticle, feather, and eye were related to adaptive function of melanin-based coloration. Greater melanin was associated with enhanced fertility and male sexual initiation and performance mediated through higher production of sexual steroids, including testosterone.

Templer (2008) determined the correlation between skin color (as reported by Templer & Arikawa (2006) and violent crime in 57 countries. Skin color (darker) correlated .30 ($p < .05$) with murder, .27 with assault, and .39 ($p < .01$) with rape. Rushton and Templer (2009) with 113 countries found that skin color (a biological variable) correlated more highly with homicide, rape, and serious assault than with per capita income. Rushton and Templer (2010) found that within the 50 U.S. states, total violent crime correlated .54 with skin color (a more biologically influenced variable) and -.17 with per capita income (a more culturally influenced variable). Rushton and Templer discussed the finding in an evolutionary perspective. They also related the finding to pigmentocracy-racial hierarchies as a function of intelligence and social status and skin color. Lynn

(2008) strongly stressed pigmentocracy, especially in Latin America and Southeast Asia. Just as Meisenberg and Templer and Arikawa are recognized as major contributors to the relationship between skin color and intelligence on an international level, Lynn is arguably the number one authority in the world on the relationship between skin color and intelligence within individual countries.

Skin color and violence research with more than one race is recommended. It is also recommended that such research be carried out with only White people using skin color and hair color and eye color. Archival data such as possessed by the U. S. Federal Bureau of Investigation may be useful. Some countries, especially the Scandinavian countries, have exhaustive birth-to-death information that may include both eye color and criminal history. Skin color (both within Hispanic and within White) can be determined by high school yearbooks. This can be related to criminal activity a few years later.

Research Implications and Suggestions

The MMPI (Minnesota Multiphasic Personality Inventory) is the most widely used clinical personality inventory on an international basis. Millions of MMPI's have been administered and there certainly must be hundreds of thousands available in files of psychiatric hospitals, mental health centers, college counseling centers, prisons and other forensic facilities in the military and in the Veterans Affairs system. When the MMPI was constructed in the 1940's, projective techniques such as the Rorschach dominated psychological testing in the United States (but not so much in Britain). American clinical psychologists assumed that it was necessary to probe beneath the surface so that unconscious processes could be tapped and defense mechanisms could be overcome. Therefore, some of the MMPI scales contain what Templer and Arikawa (2002) call "junk items." This is not to say that the MMPI Psychopathic Deviate scale is not good and should not be used. (The MMPI-TRI described below consists of all items that could be regarded as directly pertaining to the entity being assessed.) An elevation in the Psychopathic Deviate Scale could be caused by a number of different factors. Templer and Arikawa (2002) said:

> *The Psychopathic Deviate Scale probably does not have the best possible name because it is not necessary to have the classical psychopathic personality features to have a high score. And it is common for a person to have a high Pd Scale without a history of crime or delinquency. The Pd Scale can be elevated by alienation, general dissatisfaction, general maladjustment, aggression, unconventional life style, an unhappy childhood, independent thinking, unconventional values, and paranoid tendencies. (p. 36).*

The MMPI-TRI is the most exhaustively constructed and validated of any of the content scales or abbreviated scales of the MMPI (Swanson et al., 1995). It has three scales consisting of items of very high content validity. It has a 20-item Psychosis Scale, a 20-item Subjective Distress Scale, and a 20-item Acting-Out Scale that is of present interest. Table 1 contains the Acting-Out Scale items. It is apparent that all of the items pertain rather directly to disruptive behavior. The clinician or researcher merely has to count the number of items endorsed.

It is recommended that race, IQ, and a measure of psychopathic personality (preferably the MMPI-TRI Acting-Out Scale) be employed with disruptive/conscientiousness dependent variables. Both basic research and selection-oriented research are recommended. It is not recommended that race be used in final selection decisions, e.g., suitability for parole. If, however, cognitive and/or personality measures resulted in racial disproportion, this would not necessarily constitute racism. Among the many ways that nature is cruel and that nature is unfair is that nature is racist. Lynn is best known as a creative and comprehensive researcher rather than one who constructs psychometric instruments. Nevertheless, he uses the optimal tools and methods of measuring the variables he is studying. His ultimate passion is the relentless and tenacious pursuit of truth.

References

APA (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Biasutti, R. (1967). *La Razze e I Popoli Della Terra*. Torino, Italy: Unione pipografiza-Editrice Torinese.

Costa, P. T., & McCrae, R. R. (1992a). The 5-factor model of personality and its relevance to personality-disorders. *Journal of Personality Disorders, 6(4)*, 343-359.

Costa, P. T., & McCrae, R. R. (1992b). *Professional Manual: Revised NEO Personality Inventory (NEO-PI-R) and NEO Five-Factor-Inventory (NEO-FFI).* Odessa, FL: Psychological Assessment Resources.

DeCuyper, M., De Fruyt, F., & Buschman, J. (2008). A five-factor model perspective on psychopathy and comorbid Axis-II disorders in a forensic-psychiatric sample. *International Journal of Law and Psychiatry, 31*, 394-406.

Ducrest, A., Keller, L., & Roulin, A. (2010). Pleiotropy in the melanocortin system, coloration and behavioural syndromes. *Trends in Ecology and Evolution, 29*, 502-510.

Ellis, L., & Nyborg, H. (1992). Racial/ethnic variations in male testosterone levels: A probable contributor to group differences in health. *Steroids, 57*, 72-75.

Figueredo, A. J., & Rushton, J. P. (2009). Evidence for shared genetic dominance between the general factor of personality, mental and physical health, and life history traits. *Twin Research and Human Genetic*s, *12*, 555-563.

Flores-Crespo, P. (2007). Ethnicity, identity and educational achievement in Mexico. *International Journal of Educational Development, 17*, 331-339.

Herrnstein, R. J., & Murray, C. (1994). *The bell curve: Intelligence and class structure in American life.* New York: The Free Press.

Hrdy, S. B. (2009). *Mothers and others. The evolutionary origins of mutual understanding.* Cambridge, MA: Harvard.

Hunt, E., & Sternberg, R. J. (2006). Sorry, wrong numbers: An analysis of a study of the correlation between skin color and IQ. *Intelligence, 34*, 131-137.

Jablonski, N. G., & Chaplin, G. (2000). The evolution of human skin coloration. *Journal of Human Evolution, 39*, 57-106.

Jensen, A. R. (2006). Comments on correlation of IQ with skin color and geographical-demographic variables. *Intelligence, 34*, 128-131.

Lunde, V. T. (1986). Murder and madness: Suggestions for homicide prevention. *American Journal of Forensic Psychiatry, 7*, 40-47.

Lynn, R. (1999). New evidence for dysgenic fertility for intelligence in the United States. *Social Biology, 46*, 146-153.

Lynn, R. (2002). Racial and ethnic differences in psychopathic personality. *Personality and Individual Differences, 32*, 273-316.

Lynn, R. (2006). *Race differences in intelligence and evolutionary analysis.* Augusta, GA: Washington Summit Publishers.

Lynn, R. (2008). *The global bell curve: Race, IQ, and inequality worldwide.* Augusta, GA: Washington Summit Publishers.

Lynn, R. (2009). Race differences in school exclusions and anti-social behavior. *Mankind Quarterly, L (1&2)*, 95-105.

Lynn, R., & Harvey, J. (2008). The decline of the world's IQ. *Intelligence, 36*, 112-120.

Lynn, R., & van Court, M. (2004). New evidence of dysgenic fertility for intelligence in the United States. *Intelligence, 32,* 193-201.

Lynn, R., & Vanhanen, T. (2002). *IQ and the wealth of nations.* Westport, CT: Praeger.

Lynn, R., & Vanhanen, T. (2006). *IQ and global inequality.* Augusta, GA: Washington Summit Publishers.

MacArthur, R. H., & Wilson, R. G. (1967). *The Theory of Island Biogeography.* Princeton, NJ: Princeton University Press.

Meisenberg, G. (2004). Talent, character and the dimensions of national culture. *Mankind Quarterly, 45*, 123-168.

Rushton, J. P. (1985a). Differential K theory: The sociobiology of individual and group differences. *Personality and Individual Differences, 6*, 441-452.

Rushton, J. P. (1985b). Differential K theory and race differences in E and N. *Personality and Individual Differences, 6*, 769-770.

Rushton, J. P. 1987a). An evolutionary theory of health, longevity, and personality. Sociology and r/K reproductive strategies. *Psychological Reports, 60*, 539-549.

Rushton, J. P. (1987b). An evolutionary theory of human multiple birthing. Sociobiology and r/K reproductive strategies. *Acta Geneticae Medicae et Gemellologiae, 36*, 289-296.

Rushton, J. P. (1995). *Race, evolution and behavior: A life history perspective.* New Brunswick, NJ: Transaction.

Rushton, J. P. (2010). Brain size as an explanation of national differences in IQ, longevity, and other life-history variables. *Personality and Individual Differences, 48*, 97-99.

Rushton, J. P., Bons, T. A., Endo, J., Hur, H.M., Irwing, P., Vernon, P. A., Petrides, K. V., & Barbaranelli, C. (2009). A general factor of personality from multi-trait-multimethod data and cross-national twins. *Twin Research and Human Genetics, 12*, 356-365.

Rushton, J. P., Bons, T. A., & Hur, H. M. (2008). The genetics and evolution of a general factor of personality. *Journal of Research and Personality, 42*, 1173-1185.

Rushton, J. P., & Irwing, P. (2008). General factor of personality (GFP) from Two Metaanalyses of the Big Five: Digman (1997) and Mount, Barrick, Scullen, and Rounds (2005). *Personality and Individual Differences, 45*, 679-683.

Rushton, J. P., & Templer, D. I. (2009). National differences in intelligence, crime, income, and skin color. *Intelligence, 37*, 341-346.

Rushton, J. P., & Templer, D. I. (December, 2010). IQ Pigmentocracy, crime, and income in 50 U.S. states. Presented at the Conference on Individual Society of Intelligence Research, Arlington, VA.

Swanson, S. C., Templer, D. I., Thomas-Dodson, S., Cannon, W. G., Steiner, D. L., Reynolds, R.M., & Miller, H. R. (1995). Development of a three-scale MMPI: The MMPI-TRI. *Journal of Clinical Psychology, 51*, 361-372.

Templer, D. I. (December, 2008). Violent crime and the r-K continuum. Presented at the International Society for Intelligence Research, Decatur, GA.

Templer, D. I. (2010a). Can't see the forest because of the trees. *Personality and Individual Differences, 48*, 102-103.

Templer, D. I. (2010b). The Old World reexamined and the New World. *Mankind Quarterly, 51*, 3-25.

Templer, D. I., & Arikawa, H. (2002). *Common sense in psychodiagnostics.* Fresno, CA: Image Cascade Publishing Company.

Templer, D. I., & Arikawa, H. (2006). Temperature, skin color, per capita income, and IQ: An international perspective. *Intelligence, 34*, 121-128.

Templer, D. I., Connelly, H. J., Lester, D., Arikawa, H., & Mancuso, L. (2007). Relationship of IQ to suicide and homicide rate: An international perspective. *Psychological Reports, 100*, 108-112.

Templer, D. I., & Jackson, P. A. (1992). Jewish inmates: An atypical prison group. *Psychological Reports, 71*, 513-514.

Templer, D. I., Spencer, D. A., & Hartlage, L. C. (1993). *Biosocial psychopathology: Epidemiological perspectives.* New York: Springer.

National Differences

Chapter 5

National IQs and their demographic correlates

TATU VANHANEN
Department of Political and Economic Studies, Faculty of Social Sciences, P.O. Box 54 (Unioninkatu 37), 00014 University of Helsinki, Finland

Suopolku 4 D, 01800 Klaukkala, Finland. Tel.: +358 9 8796771. E-mail address: tatu4@saunalahti.fi

ABSTRACT

National IQs calculated by Richard Lynn on the basis of intelligence tests carried out in many countries of the world measure differences in average mental abilities of nations. His cold winters theory provides a reasonable theoretical explanation for the emergence of these differences. Lynn's database on national IQs is unique. Many researchers have already started to use national IQs in their studies exploring to what extent differences in average mental abilities of nations could explain national differences in various social phenomena. The purpose of this paper is to tell about the evolution and expansion of data on national IQs in the connection of the author's and Richard Lynn's joint efforts to explore to what extent differences in the wealth of nations and in other social conditions are related to differences in national IQs.

Keywords: National IQ, Intelligence, Racial differences, Human diversity, Economic development, Human conditions, Inequalities

Introduction

My cooperation with Richard Lynn started in February 1999 when I contacted him and asked whether he could give me more information about his studies on racial differences in intelligence. I had assumed in my book On the Evolutionary Roots of Politics (1992), on the basis of some previous literature, that genetic diversity of individuals is behind the omnipresent inequalities in human societies (Vanhanen, 1992: 61-63). However, at this stage I was not yet aware of national and racial differences in intelligence. Later in the 1990s I became interested in national differences in intelligence when I wrote a review article ("The Consequences of Variable Intelligence") on Seymour W. Itzkoff's three books for The Mankind Quarterly (Vanhanen, 1994). I agreed with Itzkoff that social consequences of intellectual variability may be enormous and that they can be seen in all areas of human life. I noted: "The origin of social inequalities is in the fact that humans are not similar in their intelligence and other capabilities" (Vanhanen, 1994: 135). So I got an idea to explore to what extent the variation in socioeconomic development is correlated with the racial and geographical variation in intelligence, but a great problem was to find appropriate empirical evidence on national variation in intelligence.

Richard Lynn had studied national and racial differences in intelligence since the 1970s, but I became aware of his studies only in the late 1990s through his two articles published in The Mankind Quarterly (Lynn, 1991a, 1991b). Those articles inspired me. They included information that I had been looking for, but I wanted to get data on average national intelligence from so many single countries as possible. Therefore I contacted Richard Lynn and asked whether he had more statistical information on racial and national differences in intelligence. In March 1999 he sent me his article "Geographical variation in intelligence" (Lynn, 1997). I noted that it includes exactly the type of data I had been looking for, although not data on all countries of the world.

I was impressed by Richard Lynn's theoretical explanation for the evolution of race differences in intelligence. He had argued that the "genetically based racial differences in intelligence must have arisen because the races evolved in different geographical locations, some of which exerted stronger selection pressures for an increase of intelligence than others" (Lynn, 1997: 274). The most important selection pressures were caused by cold winters outside Africa. The survival problems in the conditions of cold winters were cognitively demanding, particularly during the ice ages. People had to develop the skills required for hunting large animals and to learn how to build shelters, fabricate clothing, and make fires (Lynn, 1997: 275). His cold winters theory stresses that "the Caucasoid and Mongoloid peoples who evolved in Eurasia came to occupy a new niche which exerted selection pressure for improved intelligence to deal with the problems of survival in the cold northern latitudes" (Lynn, 1991b: 102).

Lynn's tables and estimations provided me material to estimate mean national IQs for 183 contemporary countries and to compare the relationship between the estimated national IQs and per capita income. In June 1999 I sent the list of my estimated mean national IQ values to Richard Lynn and informed him that correlations between national IQs and data on per capita income are moderate. He accepted my rough estimations as approximately correct, which encouraged me to write a paper for the 2000 IPSA world congress in Quebec. In December 1999 I sent the first version of this paper to him (Vanhanen, 2000). I also told him that I hoped to be able to extend this paper to a small book on the same subject. He supported the idea and suggested that we could cooperate in the book project. I accepted his proposal with great pleasure.

IQ and the Wealth of Nations

We started to collect material for our planned book, and in June 2000 Richard Lynn had already calculated national IQs for more than 50 countries on the basis of intelligence tests. My task was to seek data on dependent variables and to make statistical analyses. I also gathered data on racial divisions in 183 contemporary countries. They were intended to help us to estimate mean IQs for some countries from which Richard had not found results of IQ studies. Our central idea was to test the hypothesis that differences in the wealth and poverty of nations are causally related to the differences in national IQs.

I presented my IPSA paper "The Wealth and Poverty of Nations Related to IQ" in Quebec in August 2000 (Vanhanen, 2000). The correlations between the mean national IQs and some measures of per capita income varied from .381 to .689 over the period 1946-1997. My major conclusion was that the average general intelligence of the population provides the most powerful explanation for the differences in the wealth and poverty of nations and that it also offers a solid ground to evaluate prospects of economic growth in single countries.

The first results of our joint study were published in a co-authored article "National IQ and Economic Development: A Study of Eighty-One Nations" (Lynn and Vanhanen, 2001a). We tested the hypothesis that the intelligence of the population is a major factor determining national differences in economic development. This article covered 81 nations for which Richard had calculated national IQs on the basis of intelligence tests. The validity of the calculated national IQs was tested by correlating them with the attainment of adolescents for 30 of these nations in math and science obtained in the 1999 study of achievements. The correlation between national IQ and attainment in math was .904 and between national IQ and attainment in science .878. These high correlations were interpreted to show that national IQs are measuring cognitive capacity as expressed also in the ability to master math and science. Real GDP per capita 1998 in US dollars was used to indicate national differences in economic development. The Pearson product moment correlation between national IQ and real GDP was .733 in this group of 81 nations. It indicates a strong positive relationship between national IQ and per capita income, although many countries deviated significantly from the average relationship. Regression analysis was used to disclose which countries deviate most from the regression line and contradict the hypothesis. It was found that most of the countries with the largest negative residuals were socialist or former socialist countries, whereas most of the countries with the largest positive residuals were free market economies. The relationship between national IQ and per capita income is assumed to be causal for the reason that differences in average national intelligence have most probably evolved long before the emergence of contemporary differences in per capita income and economic development.

Another co-authored paper (Lynn and Vanhanen, 2001b) was based on national IQs in the total group of 185 countries. National IQs were estimated for 104 countries for which Richard had not been able to find IQ data. Dependent variables included data on GDP per capita, per capita GDP growth 1820-1992, real GDP per capita (PPP=purchasing power parity), real GDP per capita growth 1987-98, GNP per capita, per capita GNP growth 1976-98, and GNP per capita measured at PPP 1999. Correlations were calculated separately for the group of 81 countries with measured national IQs and for the total group of 185 countries. In the group of 81 countries, the correlations between national IQ and the measures of per capita income vary from .535 to .759, and in the group of 185 countries from .463 to .730. The correlation between national IQ and per capita growth 1987- 98 was not significant, but in the cases of longer growth periods correlations are moderately strong (from .451 to .728). Thus the results of correlation analysis supported the hypothesis.

In our first book IQ and the Wealth of Nations (Lynn and Vanhanen, 2002), we explored the relationship between national IQ and the wealth of nations in greater detail. Richard explained the calculation of national IQs for 81 countries on the basis of one or more intelligence tests as well as the method used in the estimations of national IQs for 104 other countries on the basis of

IQs of neighboring or other comparable countries. This method to estimate national IQs has been criticized, but we found out in our 2006 book by comparing estimated and measured IQs that the estimated IQs are close to the measured IQs. This comparison concerned 25 countries with measured IQs for which national IQs were estimated in our 2002 book. The correlation between the two data sets was .913 (Lynn and Vanhanen, 2006: 54-55). The calculated and estimated national IQs of 185 countries are listed in Table 6.5 in our 2002 book. The calculated national IQs of 81 nations are documented in Appendix 1 (Lynn and Vanhanen, 2002). The fact that two or more measures of the IQ were available from 45 countries made it possible to test the reliability of national IQs by correlating the two or the two extreme values with each other. The extremely high correlation .939 implies that the measure of national IQ has high reliability. The validity of national IQs was tested, as in the 2001a article, by comparing national IQs and educational attainments in math and science. The correlation between national IQs and mathematics achievement scores in 1999 is .881 (N=38) and between national IQs and science achievement scores .868 (N=38). These high correlations support the validity of the measures of national IQs.

The list of dependent variables measuring per capita income includes 1. GDP per capita (1820-1992) compiled by A. Maddison (1995), 2. GNP per capita (1976-98), 3. GNP per capita measured in PPP (1995-98), 4. GDP per capita measured in PPP (1987-98), and 5. GDP per capita (1983-98). The correlations between national IQs and these measures of per capita income test the hypothesis. In the group of 81 countries, Maddison's historical per capita estimates correlate with national IQs from .257 to .728. The four other measures of per capita income correlate with national IQs from .502 to .775. In the total group of 185 countries, most correlations are slightly weaker. The results of correlation analysis support the hypothesis that the intelligence of the populations has been a major factor responsible for the national differences in economic growth and for the gap in per capita income between rich and poor nations, although many countries deviate from the average relationship. The causal interpretation of this relationship is based on the argument that differences in national IQs have most probably preceded later differences in per capita income by thousands of years. Regression analysis was used to disclose the most extremely deviating countries. They provided hints about various environmental factors affecting the level of per capita income independently from national IQ. For example, of the 25 extremely deviant countries on the basis of the regression of Real GDP per capita 1998 on national IQ, residuals are positive for 18 countries and negative for 7 countries. Fourteen of the large positive outliers are high technology market economies and the other four include three oil producing countries (Kuwait, Qatar, and the United Arab Emirates) and a tourist country (the Bahamas). The seven largest negative outliers are socialist or former socialist countries (Armenia, China, North Korea, Moldova, Mongolia, Ukraine, and Vietnam). These observations imply that the nature of a country's economic system and the availability of valuable natural resources may matter independently from national IQ (Lynn & Vanhanen, 2002: 135-147).

IQ and Global Inequality

The publication of our first book caused extensive discussion about the possibility to measure national differences in average intelligence satisfactorily and to explain differences in economic development by them (see, for example, Adler-Karlsson, 2002; Miller, 2002; Richards, 2002; Weede and Kampf, 2002; Ervik, 2003; Rushton, 2003; Volken, 2003). Several of the reviews were positive, but some of them were highly critical. We wanted to defend our arguments. First we intended to prepare an updated edition of the book, but quite soon we came to the conclusion that it was better to make a completely new book in which we extend our study to cover, in addition to per capita income, some other types of global disparities in human conditions.

We repeated and further developed our arguments in a conference paper "The Roots of Global Disparities in Human Diversity" (Lynn and Vanhanen, 2004). In this paper, six variables are used to measure global disparities: PPP gross national income per capita, income equality, adult literacy rate, tertiary gross enrollment ratio, life expectancy at birth, and the index of democratization (ID). They were combined into an index of the quality of human conditions (QHC). Data cover 170 contemporary countries. We hypothesized that the higher the level of national IQ, the higher the quality of human conditions as measured by the six dependent variables and their composite index QHC. The correlations between national IQ and the six measures of human conditions vary from .597 to .821. The correlation between national IQ and QHC is .858. It should be noted that although strong correlations support the hypothesized relationship between national IQ and various measures of human conditions, IQ does not impose a limit to equalize human conditions in all cases. Evidence shows that factors such as natural resources and income generating opportunities like tourism, when exploited, can increase human conditions in a country regardless of national IQ. In an article published in 2005 (Lynn and Vanhanen, 2005), we used national IQ to explain economic development in Asia and especially in East Asian countries. The crucial impact of national IQ was illustrated by comparing national IQs and data on per capita income in the group of 51 European, Asian, and African countries, from which group Latin American and Caribbean countries as well as former European socialist countries were excluded. The correlation between national IQ and PPP gross national income per capita 2001 was .831, which means that national IQ explains 69 percent of the variation in per capita income in this group of 51 countries. This analysis included only countries with measured IQs. Our new book IQ and Global Inequality was published in 2006. In this book, Richard explains again the measurement of the intelligence of nations, and all intelligence tests used in the calculation of national IQs are documented in Appendix 1. The reliability and validity of national IQs are tested by the same methods as in the 2002 book. The correlation between two extreme IQs in the group of 71 countries for which there are two or more scores was found to be .92, which indicates a high level of reliability. The correlations between national IQ and attainments in mathematics and science vary from .79 to .86, which support the validity of national IQ measurements (see also Lynn and Meisenberg, 2010).

In statistical analysis, some indicators of per capita income, literacy, higher education, life expectancy at birth, and democratization, which were combined into an index of the Quality of Human Conditions (QHC), are used to measure global inequalities from different perspectives. I refer only to some central results. In the total group of 192 countries, the correlations between national IQ and the five components of QHC vary from .529 (democratization) to .754 (life expectancy). In the group of 113 countries with measured IQs, these correlations are slightly higher. Looking at the 160 countries with a population of more than 500,000 inhabitants in 2000, these correlations are even stronger, from .584 to .822. We concluded that moderate and strong correlations between single measures of human conditions and national IQ support the research hypothesis strongly.

The composite index QHC is most strongly correlated with national IQ. In the group of 113 countries with measured IQs the correlation is .805, in the group of 79 countries with estimated IQs .725, and in the total group of 192 countries .791. In the smaller group of 160 countries, the correlation is .839. The explained part of variation in QHC is so high that we considered it justified to conclude that large global differences in the quality of human conditions are associated with differences in national IQ. The countries with higher national IQs have been shown to have better human conditions compared to countries with lower national IQs (Lynn and Vanhanen, 2006: 181-182).

The analysis was complemented by correlating national IQ with some other measures of global inequalities. However, in these analyses data were not available from all countries of our study. Let us see some of these results reported in Chapter 8 of our 2006 book. It was found that the correlation between national IQ and UNDP's (United Nations Development Program) Human Development Index (HDI-2002) is .776 (N=176); between national IQ and Gender-Related Human Development Index 2002 .849 (N=144); between national IQ and Economic Growth Rate in 1950-2001 .747 (N=132); between national IQ and the Gini Index of Inequality 2004 -.538 (N=146); between national IQ and poverty (below $2 a day) -.653 (N=93); between national IQ and undernourishment -.500 (N=124); between national IQ and maternal mortality ratio 2000 -.730 (N=149); between national IQ and infant mortality rate 2002 -.771 (N=149); and between national IQ and Corruption Perceptions Index 2003 .591 (N=132). These examples imply that no matter how global inequalities in human conditions are measured, national IQ is correlated moderately or strongly with variables. However, it should be noted that in most of these cases national IQ explains only slightly more than 50 percent on the variation in dependent variables and in some cases clearly less than 50 percent, which indicates that a significant part of national disparities depends on other explanatory factors. The evidence limited to one point of time does not show whether national inequalities have become reduced or increased over time.

National IQ and Human Conditions

We were satisfied with the results reported in our 2006 book, but our research project was not yet over. Richard continued to gather data on new intelligence tests carried out in various countries, which made it necessary to correct some of the earlier national IQs and calculate national IQs for several new countries. I had applied national IQs to the study of democratization and argued that persistent global differences in the level and quality of democratization can be partly traced to differences in national IQs. The correlation between national IQ and the Index of Democratization (ID) varied from .575 to .616 in the period 2002-06. Differences in average national intelligence seem to limit democratization, which means that all nations do not have equal chances to establish and maintain democratic systems (Vanhanen, 2009; see also Vanhanen, 2007).

We met in London October 2008 and discussed about possibilities to continue our research project. It was evident that many researchers still rejected our theory and findings and especially the calculations of national IQs, and mainstream publishers refused to publish anything on national differences in intelligence. We thought that ultimately empirical evidence will determine the destiny of theories. Therefore we should gather more evidence on national IQs and test its explanatory power to all kinds of disparities in human conditions. I suggested that we should make a new study in which national IQ is used to explain inequalities in many kinds of measurable human conditions. Richard accepted the idea and in 2012 we published a new book giving updated national IQs and their social and economic correlates (Lynn & Vanhanen, 2012).

Richard has gathered more data on intelligence tests and calculated national IQs for several new countries. Besides, the finding of new intelligence tests made it necessary to correct some previous national IQs. I have gathered new data on more than 20 variables measuring variation in different aspects of human conditions from per capita income to happiness and life satisfaction. All variables seem to be moderately or strongly correlated with national IQ, which supports our hypothesis on national IQ's significant impact on human conditions. The purpose is to combine seven of these variables into an Index of Human Conditions (IHC). According to the preliminary results, the correlation between national IQ and IHC is .792 in the total group of 192 countries and territories and .841 in the group of countries with more than one million inhabitants (N=153). The explained part of variation is 63 percent in the total group and rises to 71 percent in the group of bigger countries. Data on small countries may be less reliable than data on bigger countries, which may explain the fact that correlations in the total group of countries are slightly weaker than in the group of bigger countries.

Discussion

Richard Lynn has explored geographical and racial variation in intelligence since the 1970s and he has gathered more data on relevant intelligence tests carried out in the world than any other single researcher or research institution. On the basis of intelligence tests, he has calculated national IQs, which are intended to measure the average intelligence of nations and which are comparable from country to country. His database of national IQs has continually expanded since 2000. This database on national IQs is unique and the only one in the world. Consequently, many researchers have started to use national IQs in their own studies, and it is justified to predict that their use will increase in the future when social scientists realize that many kinds of social problems and global inequalities in human conditions are causally related to the evolved human diversity measured by national IQ. Researchers have not yet agreed on the causes of geographical and racial intelligence differences, and various explanations have been proposed (cf. Disease and intelligence, 2000; Eppig, Fincher, & Thornhill, 2010. Richard Lynn's cold winters theory provides one and I think the most convincing theoretical explanation for the evolution of geographical intelligence differences. Of course, there have been also other causes, but great climatic differences in the world may constitute the most dominant cause. This explains "the broad association between latitude or, more precisely, the coldness of winter temperatures and the intelligence of the races," as he notes (Lynn, 2006: 208). Social consequences of national intelligence differences reflected in human conditions are enormous. According to our comparative studies since 2001, nearly all kinds of measureable national differences in human conditions are moderately or strongly related to national IQs. It should be noted that this concerns principally human conditions which are more or less under conscious human control. According to our interpretation based on present evidence, national IQ constitutes the most important causal factor in these relationships because genetically based differences in national intelligence most probably evolved before the emergence of contemporary differences in social conditions. Our central argument is that because of evolved human diversity reflected in national IQs, there are many kinds of persistent inequalities in human conditions.

References

Adler-Karlsson, G. (2002). Ländernas framtid avgörs av medborgarnas IQ. Aftonbladed, September 2, 28.

Disease and intelligence: Mens sana in corpore sano. The Economist, July 3rd 2010, 70-71.

Eppig, C., Fincher, C. L. and Thornhill, R. (2010). *Parasite prevalence and the worldwide distribution of cognitive ability.* Proceedings of The Royal Society. Published online 30 June.

Ervik, A.O. (2003). IQ and the wealth of nations. *The Economic Journal, 113, No. 488*, 406-407.

Lynn, R. (1991a). Race differences in intelligence. A global perspective. *The Mankind Quarterly, 31,* 255-296.

Lynn, R. (1991b). The evolution of racial differences in intelligence. *The Mankind Quarterly, 32,* 99-121.

Lynn, R. (1997). Geographical variation in intelligence. In H. Nyborg (Ed.), *The scientific study of human nature* (pp. 259-281). Oxford: Pergamon.

Lynn, R. (2006). *Race differences in intelligence. An evolutionary analysis.* Augusta, Georgia: Washington Summit Publishers.

Lynn, R. and Meisenberg, G. (2010). National IQs calculated and validated for 108 nations. *Intelligence, 38,* 353-360.

Lynn, R. and Vanhanen, T. (2001a). National IQ and economic development: A study of eighty-one nations. *The Mankind Quarterly, 41,* 415-436.

Lynn, R. and Vanhanen, T. (2001b). IQ and the wealth and poverty of nations. Paper presented at the 2001 Annual Meeting of the American Political Science Association, San Francisco, August 29 - September 2.

Lynn, R. and Vanhanen, T. (2002). IQ *and the wealth of nations.* Westport, Connecticut: Praeger.

Lynn, R. and Vanhanen, T. (2004). The roots of global disparities in human diversity. Paper presented at the 2004 Annual Meeting of the American Political Science Association, Chicago, 2-5 September.

Lynn, R. and Vanhanen, T. (2005). The role of human capital and intelligence in the economic development of the Asian economies. In J.B. Kidd and Richter, F-J. (Eds.), *Infrastructure and Productivity in Asia: Political, financial, physical and intellectual underpinnings* (pp. 28-50). Houndmills, Basingstoke, Hampshire: Palgrave Macmillan.

Lynn, R. and Vanhanen, T. (2006). *IQ and global inequality.* Augusta, Georgia: Washington Summit Publishers.

Lynn, R. and Vanhanen, T. (2012). *Intelligence: A Unifying Construct for the Social Sciences.* London: Ulster Institute for Social Research.

Maddison, A. (1995). Monitoring the world economy 1820-1992. Paris: Development Centre of the Organization for Economic Co-operation and Development.

Miller, E. (2002). Differential intelligence and national income. A review of IQ and the wealth of nations. *Journal of Social, Political & Economic Studies, 27,* 413-424.

Richards, M. (2002). IQ and the wealth of nations. *Intelligence, 30,* 574-576.

Rushton, J.P. (2003). The bigger bell curve: Intelligence, national achievement, and the global economy. *Personality and Individual Differences, 34,* 367-372.

Vanhanen, T. (1992). *On the evolutionary roots of politics*. New Delhi: Sterling Publishers Private Limited.

Vanhanen, T. (1994). The consequences of variable intelligence. *The Mankind Quarterly, 35,* 123- 138.

Vanhanen, T. (2000). The wealth and poverty of nations related to IQ. Paper presented at the IPSA XVIII World Congress, Quebec, 1-5 August.

Vanhanen, T. (2007). Human diversity reflected in levels of purchasing power parity, democratization and the human condition. *The Mankind Quarterly, 48,* 141-155.

Vanhanen, T. (2009).*The limits of democratizaton: Climate, intelligence, and resource distribution.* Augusta, Ga: Washington Summit Publishers.

Volken, T. (2003). IQ and the wealth of nations. A critique of Richard Lynn and Tatu Vanhanen's recent book. *European Sociological Review, 19,* 411-412.

Weede, E. and Kampf, S. (2002). The impact of intelligence and institutional improvements on economic growth. *Kyklos, 55, Fasc. 3,* 361-380.

Chapter 6

National IQ and economic outcomes

GERHARD MEISENBERG
Ross University school of Medicine
Picard Estate
Dominica (Eastern Caribbean)

ABSTRACT

One of the most consequential parts of Richard Lynn's work is the establishment of a comprehensive data set of "national IQ" for nearly all countries in the world. The present contribution demonstrates the use of this database for the explanation of two economic outcomes: (1) economic growth and level of attained wealth at the country level; and (2) income distribution in countries as measured by the Gini index. The results show that high IQ is associated not only with high per-capita GDP and fast economic growth, but also with more equal income distribution. These outcomes are not mediated by educational exposure.

Keywords: IQ, school achievement, intelligence, education, human capital, economic growth, Gini index

Introduction

In today's world we find enormous differences between countries in wealth, social and political structures, and many "cultural" traits. Similar differences are observed between ethnic, racial, religious and other groups, even if they live in the same country. According to the "reductionist" approach, many of these differences result from differences in personality traits and cognitive abilities between human groups. Richard Lynn has been the most prominent protagonist of this approach in recent years (Lynn, 2008a).

Lynn's most outstanding contribution to this field is the compilation of a data base of "national IQ" for most countries of the world. Data for an initial set of 81 countries were published in 2001 and 2002 (Lynn & Vanhanen, 2001, 2002), followed by an expanded list of national IQs for 113 countries (Lynn & Vanhanen, 2006). The most recent update expands this set to a total of 136 countries (Lynn, 2010).

National IQs are based on studies with a wide variety of cognitive tests, with different versions of the non-verbal Raven's Progressive Matrices as the most widely used test (data from 95 countries). The computing of results from different cognitive tests into a single score is justified by the high correlations between alternative cognitive tests. All cognitive tests are thought to measure, to various extents, "general" cognitive ability or *g* (Jensen, 1998). 52 of the 136 national IQs are based on a single study. For all other countries the national IQ is calculated from multiple studies, numbering up to 22 for Japan. National IQs range from 60 (Malawi) to 108 (Hong Kong, Singapore). The average is 86.0 for the countries and 90.5 for the totality of individuals living in these countries. The discrepancy is caused by the higher average population size of high-IQ countries.

Lynn and his coworkers showed that national IQ is closely related with the results of international student assessments in mathematics, science, and other curricular subjects (Lynn et al., 2007; Lynn & Mikk, 2009; Lynn & Meisenberg, 2010). The reported correlations of averaged school achievement scores with IQ are as high as $r = 0.919$ (N = 67 countries, Lynn et al., 2007) and, with more recent data, $r = 0.917$ (N = 86 countries, Lynn & Meisenberg, 2010). These results suggest that IQ and school achievement are alternative indicators for the average intelligence in a country. In economic terms, both are measures of "human capital". School achievement results are currently available for 111 countries. 87 countries have data for both school achievement and IQ, and 160 countries have either IQ or school achievement or both.

Based on the well established relationship between IQ and earnings at the individual level (reviewed in Strenze, 2007), Lynn & Vanhanen (2002, 2006) proposed national IQ as a cause for differences in per-capita gross domestic product (GDP) and other country-level economic outcomes. The theory is that wealth-producing activities such as running a business, designing buildings, treating diseases and innovating are done more effectively by persons with higher general intelligence.

The most important implication of this postulated causal path is that economic conditions in today's less developed countries can be improved by increasing, within biological limits, the cognitive abilities of the population. Lynn has always been adamant in claiming that IQ is a cause rather than merely a consequence of prosperity, and that genetic race differences explain part but not all of the international IQ differences.

The Lynn/Vanhanen theory about the causal importance of country-level IQ differences for prosperity and other development indicators has been attacked on theoretical grounds (e.g., Morse, 2008). However, the few empiric studies conducted so far were mainly supportive. The relationship between IQ and national wealth has been confirmed in some studies (Hunt & Wittmann, 2008; Whetzel & McDaniel, 2006). Others found a relationship of IQ with economic growth (Jones & Schneider, 2006; Weede, 2004; Weede & Kämpf, 2002), although one study found no independent relationship between cognitive test results and economic growth, claiming that previously observed effects were due to the inclusion of the "Asian Tigers" (Chen & Luoh, 2010).

There are reasons to expect that high national IQ reduces income inequality in addition to raising the average income level. One reason is that through market forces, the skill premium is expected to be higher in low-IQ countries than in high-IQ countries. In low-IQ countries many low-IQ people compete for unskilled work, but few high-IQ people compete for cognitively demanding work in management, engineering and other professions. This results in high pay for individuals doing cognitively demanding work relative to the pay of unskilled labourers. Another reason to expect less income inequality in high-IQ countries is the existence in these countries of institutions for collective bargaining and for the redistribution of wealth from the rich to the poor. Cognitive sophistication is required to create and maintain such institutions. So far, an inverse relationship of national IQ with income inequality has been reported as an incidental finding in only two empiric studies (Meisenberg, 2007, 2008), with no follow-up and no contradictory findings in the literature.

Economic outcomes are expected to depend not only on intelligence, but also on geographic location, natural resources, political and economic institutions, and history. Studies about the effects of IQ on economic outcomes must take these additional factors into account. Failure to do so can lead to spurious results because many variables used by economists correlate highly with national IQ.

The present paper extends the previous studies on the possible causal effects of intelligence on economic growth and on income inequality, using the most recent data. Based on the near-equivalence of IQ and school achievement (Lynn & Meisenberg, 2010), the IQ data are augmented by school achievement data. This permits a far broader coverage of countries than in any previous study.

Methods

IQ is defined by the national IQs reported in Lynn & Vanhanen (2006), with the amendments and extensions reported in Lynn (2010). This data set includes 136 countries with measured IQ. 24 additional countries without measured IQ have results from international school achievement studies as reported in Lynn & Meisenberg (2010). These were extrapolated into the IQ data set, to yield 160 countries with measured "IQ". The correlation between the Lynn & Vanhanen IQs and school achievement is .92 for the 87 countries having both measures.

lgGDP is the logarithm of gross domestic product adjusted for purchasing power, averaged for the years 1975-2005. Data are from the Penn World Tables (Heston et al., 2009). Missing data were extrapolated into this data set from the World Development Indicators of the World Bank. The logarithmic transformation was used because of the highly skewed nature of GDP worldwide, which approximates to a normal distribution in the logarithmic form.

Education is calculated as the average of the Barro-Lee dataset for the average length of schooling for adults (1990-2000) and school life expectancy in 1999/2000 from the United Nations Statistics Division. Missing data were extrapolated from the combined primary, secondary and tertiary enrolment ratios in 2002, as reported in the 2005 Human Development Report of the United Nations.

Corruption is calculated from the reverse of Transparency International's Corruption Perception Index for the years 1999-2005 (http://www.transparency.org), combined with older data including the Business International corruption score from 1980-1983 (Treisman, 2000), and the "no corruption" domain of the Heritage Foundation's Economic Freedom Index of 1995 (http://www.heritage.org/research/).

Economic Freedom is calculated from the unrotated first factors of maximum-likelihood factor analyses of areas 2-5 of the Fraser Institute's Economic Freedom Index for the periods 1975-

2005 (Gwartney et al., 2009), and domains 1, 2, and 5-8 of the Heritage Foundation Index for 1995-2005 (http://www.heritage.org/research/). This measure indexes the extent of business regulation and red tape.

Big Government indexes the government's share of GDP. It is calculated from area 1 of the Fraser Institute's Economic Freedom Index for the periods 1975-2005 (size of government), and domains 3 and 4 of the Heritage Foundation Index for 1995-2005 (fiscal freedom and government spending). These measures are factorially and conceptually different from the other components of the Fraser Institute and Heritage Foundation indices for "economic freedom".

Gini index: The primary data source is the World Income Inequality Database (WIID2a) of the United Nations University, available at www.wider.unu.edu/wiid/wiid.htm, as described in Meisenberg, 2007. Missing data points were extrapolated from the World Bank's World Development Indicators of 2005, the Human Development Report 2005 of the United Nations, and the CIA's World Factbook of 2009.

Racial diversity is defined by the racial diversity index described in Meisenberg (2007). Racial distances were quantified as genetic distance according to Cavalli-Sforza and Feldman (2003).

Freedom/Democracy is the average of political freedom defined as the averaged scores of political rights + civil liberties from Freedom House at http://www.freedomhouse.org/research/freeworld, average 1975-2005; and democracy, defined as Vanhanen's democracy index (average 1975-2004), from the Finnish Social Science Data Archive at http://www.fsd.uta.fi/english/data/catalogue/FSD1289/. The correlation between these two measures is r = .847, N = 179 countries.

Results

Per capita GDP

Table 1 shows that IQ correlates not only with log-transformed GDP, but also with a number of other "development indicators" including exposure to formal schooling, economic freedom, low corruption, and the composite of political freedom and democracy. "Big government" is related only weakly both to IQ and to the other variables. These relationships are seen both in the complete sample of 134 countries with complete data (below the diagonal), and for the subsample of 107 countries that has not experienced a transition from communist rule in the recent past (above the diagonal). Correlations above 0.175 or 0.195 are significant at $p<.05$ for the complete sample and the non-communist countries, respectively. The subsample excluding the ex-communist countries was formed because the economic trajectories of the former communist countries of Eastern Europe and the former Soviet Union have been seriously disrupted by the end of communist rule.

Table 1. Correlations of IQ with log-transformed GDP and other country-level variables

	IQ	lgGDP	Educ.	Econ. fr.	Big govt.	Corruption	Freedom/ Dem.
IQ	1	.827	.817	.715	.118	-.686	.734
lgGDP	.733	1	.902	.822	.221	-.836	.750
Educ.	.774	.876	1	.786	.276	-.814	.768
Econ. fr.	.528	.780	.675	1	.195	-.863	.714
Big govt.	.215	.257	.310	.138	1	-.359	.253
Corruption	-.543	-.799	-.711	-.848	-.294	1	-.709
Freedom/Dem	.574	.747	.702	.727	.219	-.715	1

The correlations do not prove a causal effect of IQ on either lgGDP or any other variable in Table 1. It is equally plausible that IQ is a consequence of prosperity, schooling, or other environmental factors that prevail in highly developed countries. Indeed, the secular rise of IQ in many countries during the 20th century, which had been discovered independently by Richard Lynn and James Flynn (Flynn, 1984, 1987, Lynn & Hampson, 1986), suggests precisely this causal mechanism.

Economic growth

Present wealth is the outcome of past economic growth. If IQ causes differences in wealth between countries, we can predict that concurrently measured IQ correlates not only with attained wealth (measured as log-transformed GDP), but also with the rate of economic growth. Table 2 shows the relationship of economic growth from 1975 to 2005 with the usual predictors, plus some others that were hypothesized to affect economic growth. Oil exports were expected to promote economic growth, whereas communist history, overpopulation, and lack of access to the sea were postulated to impede economic growth.

*Table 2. Relationship of economic growth from 1975 to 2005 with plausible predictors. N=117 countries. Shown are the raw correlations (Pearson's r) and two regression models (standardized β-coefficients). For the correlations, lgGDP/capita refers to the average 1975-2005; for the regression models, it is lgGDP in1975. *p<.05; **p<.01; ***p<.001.*

	Correlation	**Model 1**	**Model 2**
IQ	.373***	.752***	.797***
lgGDP/capita	.089	-.714**	-.702**
Education	.183	.166	
Econ. freedom	.208*	.446*	.456**
Big government	.101	.143	.135
Corruption	-.137	.058	
Freedom/democ.	.047	-.377*	-.331*
Communism	.325**	.132	.150
lg pop. density	.253*	.134	.123
Oil export/capita	-.097	-.056	
Landlocked	-.026	.043	

	Correlation	Model 1	Model 2
N (countries)	90	90	91
R^2 (adj. R^2)		.410(.326)	.407(.357)

The first data column in Table 2 shows the raw correlations of economic growth between 1975 and 2005 with IQ and the other plausible predictors. Generally, countries with higher levels of economic freedom, education, and per-capita GDP (averaged over the entire period 1975-2005) tended to grow fast, but IQ stands out as the strongest correlate.

Model 1 in Table 2 is a regression model with the same predictor variables, except for the use of lgGDP in 1975, at the beginning of the trend period, rather than the averaged GDP over the entire 30-year period. Model 2 is derived from model 1 by eliminating non-predictors, in an attempt to reduce colinearity. In these models, IQ is the strongest and most significant predictor of economic growth. The models also show that everything else being equal, high GDP in 1975 is associated with slower growth. This "advantage of backwardness" (Weede & Kämpf, 2002) presumably results from the fact that poor countries can adopt the technologies and management practices of the wealthier countries, whereas wealthy countries depend on the slower method of innovation.

Economic freedom favors rapid growth, but democracy and political freedom have, if anything, the opposite effect. The measure of economic freedom used here describes mainly the extent of bureaucracy and red tape faced by businesspeople. Of the other suspects, corruption is ineffective, perhaps because economic freedom is a more accurate indicator for the business climate. A high share of the government in the GDP ("big government") does not impede economic growth, but excessive democracy does; and the economic setback at the end of communist rule is evident from the results as well. The ineffectiveness of population density in slowing economic growth contradicts ecological approaches, which predict flagging growth when the population approaches or exceeds the "carrying capacity" of the land. Education is only a weak predictor of economic growth as long as IQ is in the model. This is understandable because the measure of education describes exposure to formal schooling. The cognitive skills that children acquire in school are indexed by IQ rather than years in school.

Income inequality

The benefits of economic prosperity depend not only on per-capita GDP, but also on the income distribution. This is so because a fixed increment in income is expected to have a greater marginal benefit for a poor person than a rich person. In theory, equal income distribution leads to the greatest happiness of the greatest number. Table 3 shows the correlations of the Gini index with a number of predictors. The Gini index is a measure for society-wide income inequality, with values ranging from zero (perfect equality) to 1 (one person earns all).

Table 3. Correlations (Pearson's r) of the Gini index with predictor variables, separately for all countries and for countries without communist history only.

	All countries	**Non-communist**
Education	-.585***	-.565***
lgGDP	-.458***	-.448***
Economic freedom	-.434***	-.447***
Big government	-.287**	-.426***
Corruption	-.420***	-.327**
IQ	.380***	.484***
Freedom/democracy	-.389***	-.505***
Racial diversity	.405***	.356**
Oil exports/capita	-.061	-.090
lgPopulation density	-.366***	-.400***
Sq rt. Area	.116	.071
N countries	115	91

Population density and square root of the land surface area are included. Large countries are expected to be more unequal because of differences in wealth between regions of the country. Also racial diversity is included because high racial (but not ethnic and religious) diversity has previously been shown to be associated with more unequal income distributions (Meisenberg, 2007, 2008). We see negative correlations of the Gini index with all development indicators. Advanced societies are more equal than less advanced societies. We also see that IQ is more potent than education, GDP, and other development indicators in predicting an egalitarian income distribution. Unexpectedly, high population density is associated with a more egalitarian income distribution.

Table 4 elaborates on this observation with regression models in which IQ is pitted against other predictors.

Table 4. Relationship of the Gini index with predictor variables. Models 1-3 include all countries with complete data, and models 4-6 are for countries without communist history only.

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
IQ	-.454***	-.460***	-.502***	-.567***	-.561***	-.404***
Educ.	.107			.117		
lgGDP	.100			.320	.315	
Econ. fr.	.213	.186	.144	.178		
Big govt.	-.189*	-.207**	-.216**	-.168	-.204*	-.118
Corruption	.195			.274		
Fr./democ.	-.262*	-.209*		-.275	-.264	
Rac.div.	.282***	.294***	.219**	.289**	.268**	.202**
Comm.	-.098					
Oil exp./cap	.043					
lgPop. dens.	-.280***	-.283***	-.334***	-.321***	-.293***	-.374***
Sq. rt. area	.005			-.096		
IQ^2			.182**			
Big $govt.^2$						.118
Educ x lgGDP			-.291***			-.288**
Corr.x			.140*			.230**

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
fr/dem.						
N countries	115	117	115	91	92	91
R^2 (adj. R^2)	.615(.570)	.609(.588)	.699(.676)	.605(.549)	.589(.560)	.716(.689)

Model 1 includes the linear effects of all predictors. It shows that IQ, racial diversity and population density are the most significant predictors. Model 2 is derived from model 1 by removing the non-predictors, and model 3 includes quadratic and interaction terms. The significantly positive IQ^2 term, in addition to the main effect of IQ, means that the inequality-reducing effect of IQ is strong when low-IQ countries are compared with countries with IQs of 90 to 95, but IQs above 95 do not reduce the Gini index any further.

The interaction terms show that imbalances in development tend to raise income inequality. For example, countries in which the educational level of the population is far higher or far lower than expected from GDP tend to have a more unequal income distribution than countries in which these indicators are congruent. Also, countries that are both very democratic and very corrupt, or very dictatorial and non-corrupt, tend to have more income inequality than countries in which the level of corruption is more appropriate to the level of democracy.

Discussion

The hypothesis that IQ is a causal influence on prosperity and economic growth was derived from the observation that IQ predicts income at the individual level. Although country-level "ecological" correlations do not always replicate individual-level correlations (Hammond, 1973; Schwartz, 1994), in the case of national IQ and economic growth they apparently do. One caveat about the present findings, as in all country-level comparisons, is the likely presence of spatial and cultural autocorrelation. Autocorrelation refers to the relative non-independence of data points, caused by systematic similarities between neighboring countries or between countries with similar history or culture (Eff, 2004). Autocorrelation can inflate statistical significance levels and cause type 1 errors.

However, inclusion of individual world regions in the regression models, for example East Asia or sub-Saharan Africa, does not eliminate the IQ effect but leaves the significance level for IQ at $p \leq .001$ (data not shown). This contrasts with the observation of Chen & Luo (2010) that scholastic achievement has no major independent relationship with per-capita GDP once the dummy-coded East Asian countries are included in the model. The robustness of the present results for economic growth to the inclusion of world regions shows that the results are not caused by the chance coincidence of high (or low) IQ with high (or low) economic growth in one world region.

The results support the thesis of Richard Lynn and Tatu Vanhanen (2002, 2006) that the average IQ in the country is an important determinant of national prosperity. Countries with higher average IQ are not only wealthier, but there has been a trend – at least between 1975 and 2005 – for national wealth to become more congruent with IQ. The latter result is expected only if IQ is a cause for wealth differences between countries, rather than being only a consequence. Because the growth-promoting effect of IQ is stronger than that of education, IQ rather than exposure to formal education is the better measure of human capital. The IQ effect is of moderate magnitude. The correlation between IQ and economic growth in Table 2 suggests that approximately 23% of the between-country variation in economic growth can be attributed to IQ differences.

One task for future research is the extension of the "IQ world map" to countries for which cognitive test data are not yet available, and the generation of more accurate data for both IQ and school achievement. For large countries, we will need data at the regional level. In Pakistan, for example, the IQ difference between the most developed province (Sindh) and the least developed province (Northwest Frontier Province) is approximately 15 points on Raven's Standard Progressive Matrices (Ahmad et al., 2008); and in China, members of the Tibetan minority score about 12.6 points below the Han Chinese (Lynn, 2008b). An IQ map of the United States has already been used to correlate state IQ with several outcomes, including the fertility rate (Shatz, 2008).

International scholastic assessments will increasingly complement the IQ data and will help to provide an increasingly accurate picture of intelligence worldwide, both in cross-country comparisons and in the study of temporal trends. Traditionally, IQ has been considered an indicator of genetically inherited ability, whereas school achievement has been attributed to the effectiveness of the school system. The extremely close relationship between these two measures at the country level shows that this dichotomy is false. Another observation is that at the individual level, the heritability of scholastic achievement is between 35% and 75% depending on the kind of test and age at testing (Haworth et al., 2008; Walker et al., 2004; Wainwright et al., 2005). This is about as high as the heritability of IQ in children and adolescents (Haworth et al., 2010). Even length of schooling has been reported to have a heritability of 57% (Baker et al., 1996).

With his emphasis on the human factor, Richard Lynn has brought the study of country-level economic outcomes back to the psychological basics: the traits of the human actors who create and distribute material value by learning, teaching, working, managing and innovating. What the present results do not show are the mechanisms through which high intelligence promotes economic growth and reduces income inequality. Future studies will have to show whether the IQ effect on economic growth is mediated primarily by management skills, labour productivity, technological innovation, reduced birth rates, or other mechanisms. These mechanisms need not be the same in rich and poor countries. For the apparent effect of IQ on income distribution, future studies need to investigate whether this effect is due to greater income redistribution in high-IQ countries, or to market forces whereby a greater supply of cognitive skill reduces the skill premium in the labour market.

In addition to his work on national IQ, Richard Lynn has pioneered the study of differences in personality traits between nations (Lynn, 1971, 2007; Lynn & Hampson, 1975, 1977), but useful data sets on country-level differences in the Big Five (McCrae et al., 2005; Schmitt et al., 2007) and other personality dimensions (Hofstede, 2001; Schwartz & Rubel, 2005) have emerged only recently. It remains to be seen whether personality differences, in addition to IQ differences, are important predictors of economic development and other country-level outcomes. With his "national IQ" data set, Richard Lynn has created a paradigm for the study of country-level differences in personality as well as intelligence.

References

Ahmad, R., Khanum, S. J., Riaz, Z, & Lynn, R. (2008). Gender differences in means and variance on the Standard Progressive Matrices in Pakistan. *Mankind Quarterly, 49,* 50-57.

Baker, L. A., Treloar, S. A., Reynolds, C. A., Heath, A. C. & Martin, N. G. (1996). Genetics of educational attainment in Australian twins: sex differences and secular changes. *Behavior Genetics, 26,* 89-102.

Cavalli-Sforza, L. L. & Feldman, M. W. (2003). The application of molecular genetic approaches to the study of human evolution. *Nature Genetics Supplement, 33,* 266-275.

S.-S. Chen, S.-S. & M.-C. Luoh, M.-C. (2010). Are mathematics and science test scores good indicators of labor-force quality? *Social Indicators Research, 96,* 133-143.

Eff, E. A. (2004). Spatial and cultural autocorrelation in international datasets. *Department of Economics and Finance Working Paper Series*, Februar 2004. Retrieved 21 February 2006 from
http://www.mtsu.edu/~berc/working/spatial%20autocorrelation%20z.pdf.

Flynn, J. R. (1984). The mean IQ of Americans: massive gains 1932 to 1978. *Psychological Bulletin, 95,* 29-51.

Flynn, J. R. (1987). Massive IQ gains in 14 nations: what IQ tests really measure. *Psychological Bulletin, 101,* 171-191.

Gwartney, J., Lawson, R., Hall, J. C., Grubel, H., de Haan, J., Sturm, J.-E., & Zandberg, E. (2009). Economic freedom of the world: 2009 Annual Report. Economic Freedom Network, available at http://www.freetheworld.com/release.html

Hammond, J. L. (1973). Two sources of error in ecological correlations. *American Sociological Review, 38,* 764-777.

Haworth, C. M. A., Dale, P., & Plomin, R. (2008). A twin study into the genetic and environmental influences on academic performance in science in nine-year-old boys and girls. *International Journal of Science Education, 30,* 1003-1025.

Haworth, C. M. A., Wright, M. J., Luciano, M., Martin, N. G. & 20 others (2010). The heritability of general cognitive ability increases linearly from childhood to young adulthood. *Molecular Psychiatry, 15,* 1112-1120.

Heston, A., Summers, R., & Aten, B. (2009). *Penn World Table version 6.3*. Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, August 2009.

Hofstede, G. S. (2001). *Culture's consequences: comparing values, behaviors, institutions and organizations across countries*. Thousand Oaks (CA): Sage.

Hunt, E. & Wittmann, W. (2008). National intelligence and national prosperity. *Intelligence, 36,* 1-9.

Jensen, A. R. (1998). *The g Factor: the science of mental ability*. Westport (CT): Praeger.

Jones, G., & Schneider, W.J. (2006). Intelligence, human capital, and economic growth: a Bayesian averaging of classical estimates (BACE) approach. *Journal of Economic Growth, 11,* 71-93.

Lynn, R. (1971. *Personality and national character*. Oxford: Pergamon Press.

Lynn, R. (2006). *Race differences in intelligence. An evolutionary analysis*. Augusta (GA): Washington Summit.

Lynn, R. (2007). Race differences in intelligence, creativity and creative achievement. *Mankind Quarterly, 48,* 157-168.

Lynn, R. (2008a). *The global bell curve. Race, IQ, and inequality worldwide.* Augusta (GA): Washington Summit.

Lynn, R. (2008b). IQ and mathematics ability of Tibetans and Han Chinese. *Mankind Quarterly, 48,* 505-510.

Lynn, R, (2010). National IQs updated for 41 nations. *Mankind Quarterly, 50,* 275-296.

Lynn, R. & Hampson, S. L. (1975). National differences in extraversion and neuroticism. *British Journal of Social and Clinical Psychology, 14,* 223-240.

Lynn, R. & Hampson, S. L. (1977). Fluctuations in national levels of of neuroticism and extraversion. *British Journal of Social and Clinical Psychology, 16,* 131-137.

Lynn, R. & Hampson, S. (1986). The rise of national intelligence: evidence from Britain, Japan and the U.S.A. *Personality and Individual Differences, 7,* 23-32.

Lynn, R. & Meisenberg, G. (2010). National IQs calculated and validated for 108 nations. *Intelligence, 38,* 353-360.

Lynn, R., Meisenberg, G., Mikk, J., & Williams, A. (2007). National IQs predict differences in scholastic achievement in 67 countries. *Journal of Biosocial Science, 39,* 861-874.

Lynn, R, & Mikk, J. (2009). National IQs predict educational attainment in math, reading and science across 56 nations. *Intelligence, 37,* 305-310.

Lynn, R. & Vanhanen, T. (2001). National IQ and economic development: a study of eighty-one nations. *Mankind Quarterly, 41,* 415-435.

Lynn, R. & Vanhanen, T. (2002). *IQ and the wealth of nations*. Westport (CT): Praeger.

Lynn, R. & Vanhanen, T. (2006). *IQ and global inequality*. Augusta (GA): Washington Summit.

McCrae, R. R., Terracciano, A., & 79 others (2005). Personality profiles of cultures: aggregate personality traits. *Journal of Personality and Social Psychology*, 89, 407-425.

Meisenberg, G. (2007). Does multiculturalism promote income inequality? *Mankind Quarterly, 47,* 3-39.

Meisenberg, G. (2008). How does racial diversity raise income inequality? *Journal of Social, Political and Economic Studies, 33,* 3-26.

Morse, S. (2008). The geography of tyranny and despair: development indicators and the hypothesis of genetic inevitability of national inequality. *Geographical Journal, 174,* 195-206.

Schmitt, D. P., Allik, J., McCrae, R. R., & Benet-Martínez, V. (2007). The geographic distribution of big five personality traits.

Patterns and profiles of human self-description across 56 nations. *Journal of Cross-Cultural Psychology, 38,* 173-212.

Schwartz, S. (1994). The fallacy of the ecological fallacy: the potential misuse of a concept and the consequences. *American Journal of Public Health, 84,* 819-824.

Schwartz, S. H. & Rubel, T. (2005). Sex differences in value priorities: cross-cultural and multi-method studies. *Journal of Personality and Social Psychology, 89,* 1010-1028.

Shatz, S. M. (2008). State IQ and fertility in the United States. *Mankind Quarterly, 49,* 38-49.

Strenze, T. (2007). Intelligence and socioeconomic success: a meta-analytic review of longitudinal research. *Intelligence, 35,* 401-426.

Treisman, D. (2000). Causes of corruption. *Journal of Public Economics, 76,* 399-457.

Wainwright, M. A., Wright, M. J., Geffen, G. M., Luciano, M., & Martin, N. G. (2005). The genetic basis of academic achievement on the Queensland Core Skills Test and its shared genetic variance with IQ. *Behavior Genetics, 35,* 133-145.

Walker, S. O., Petrill, S. A., Spinath, F. M., & Plomin, R. (2004). Nature, nurture and academic achievement: a twin study of teacher assessments of 7-year-olds. *British Journal of Educational Psychology, 74,* 323-342.

Weede, E. (2004). Does human capital strongly affect growth rates? Yes, but only if assessed properly. *Comparative Sociology, 3,* 115-134.

Weede, E. & Kämpf, S. (2002). The impact of intelligence and institutional improvements on economic growth. *Kyklos, 55,* 361-380.

Whetzel, D. L. & McDaniel, M. A. (2006). Prediction of national wealth. *Intelligence, 34,* 449-458.

Chapter 7

Intellectual classes, technological progress and economic development: The rise of cognitive capitalism

PROF. DR. HEINER RINDERMANN
Department of Psychology, Chemnitz University of Technology
Wilhelm-Raabe-Str. 43, D-09107 Chemnitz, Germany
E-mail: heiner.rindermann@psychologie.tu-chemnitz.de
Tel. +49 371 531 38715
Fax +49 371 531 838715

ABSTRACT

Cognitive ability theory claims that peoples' competences are decisive for economic wealth. For a large number of countries Lynn and Vanhanen (2002) have published data on mean intelligence levels and compared them to wealth and productivity indicators. The correlation between intelligence and wealth was supported by studies done by different authors using different countries and controls. Based on their pioneering research two research questions were developed: Does intelligence lead to wealth or does wealth lead to intelligence or are other determinants involved? If a nation's intelligence increases wealth, how does intelligence achieve this? To answer them we need longitudinal studies and theoretical attempts, investigating cognitive ability effects at the levels of individuals, institutions and societies and examining factors which lie between intelligence and growth. Two studies, using a cross-lagged panel design or latent variables and measuring economic liberty, shares of intellectual classes and indicators of scientific-technological accomplishment, show that cognitive ability leads to higher wealth and that for this process the achievement of high ability groups is important, stimulating growth through scientific-technological progress and by influencing the quality of economic institutions. In modernity, wealth depends on cognitive resources enabling the evolution of cognitive capitalism.

1. Introduction: The wealth of nations

Since Adam Smith many scholars have tried to explain why some nations are richer than others. Two principal paradigms could be distinguished: In the first the causes are found *in a nation itself*, e. g. in the behavior of the people or the quality of institutions. In the second paradigm, factors *outside a nation* are decisive, like terms of trade or colonialism.

In the important *libertarian approach* going back to Smith (1994/1776) and the Austrian school (Hayek, 1994/1944) economic freedom – an internal attribute – is the essential prerequisite for growth. Economic freedom should allow a nearly optimal allocation of labor and capital and result in a system of peaceful trade (instead of suppression and violence). Empirical-statistical research is supportive: Economically free countries are richer (r=.76, N=88 nations; Rindermann, 2008a) and economic freedom increases wealth: Moving from a closed to an open economy adds about 1.5% to annual growth rates (Jamison, Jamison & Hanushek, 2007). But the success of East Asian countries with large governmental influences on the economy contradicts the libertarian theory.

A second approach assumes that behind economic liberty, but also behind working patterns and the quality of institutions lie *cultural orientations* supporting hard and systematic work, education towards useful knowledge and thinking, meritoric principles, and efficiency. Such orientations are stressed in religious traditions (Protestantism, Confucianism, Judaism), in enlightenment and in a burgher culture (Weber, 2001/1905; Mokyr, 2010). Nevertheless, cultural theories have rarely been tested with adequate statistical models.

Dependency theories – belonging to the second paradigm of factors outside a nation – try to explain wealth differences as a result of asymmetric power structures. This theory with roots in the works of Marx (1992/1867) has a descriptive value, but cannot explain large differences in economic development within (formerly) developing countries, like between Southern Korea and Ghana. Some countries after the end of colonialism even suffered a decline in development in the form of a decay in infrastructure (Landes, 1998). Second, advantages of backwardness are not considered, meaning the possibility of faster growth for poorer countries by adopting and copying advanced technological countries.

Geographic theories which stress the relevance of mineral resources or of other advantages (like having access to overseas trade; the possibility of cross-continental exchange of goods and ideas along similar latitudes; few infectious diseases; good climate; domesticable animals; Diamond, 1997) also emphasize external factors. Of course, mineral resources (and the exploitation of people) can increase wealth, but they have not lead to sustainable development, even worse, they have lead to a decline in development and after the rush of exploitation countries can be even poorer than before (Landes, 1969, p. 36). Other disadvantages like tropical climates, no access to oceans, mountainous geography or earthquakes could be overcome by *intelligent* leadership and organization (e.g. Singapore, Switzerland, Taiwan, New Zealand).

2. Intelligence and wealth

Lynn and Vanhanen (2002) were the first to develop a theory of "*intelligent wealth*": They propose that cognitive ability is a major causal component of national wealth. Studies at the level of individuals within countries show an important impact of intelligence on income, which is more important than parents' socioeconomic-status (intelligence vs. SES metaanalysis: r_{Int}=.23 vs. r_{SES}=.15, Strenze, 2007; sibling comparison within families: one IQ point higher as a child is equivalent to around 810 US $ higher yearly income around age 35, Murray, 2002). At the level of countries the correlations are much higher between cognitive competence (including knowledge) and Gross Domestic Product (per capita; purchasing power parity/ppp: transformed across countries and currencies in comparable monetary units). GDP measures productivity not income, but it is highly correlated with national income per capita (r>.95) and a good indicator of the standard of living. Lynn and Vanhanen (2002) reported for 185 countries a correlation of r=.62 between intelligence test results and GDP 1998, Lynn and Vanhanen (2006) similarly for Gross National Income (2002, r=.60, N=192). Other researchers have studied international data sets using different variables and came to similar conclusions (Hanushek & Woessmann, 2008; Ramirez, Luo, Schofer & Meyer, 2006; Weede, 2004).

3. Criticisms

3.1. *Data quality*

The most frequent criticism was *data quality* (e.g. Barnett & Williams, 2004; Hunt, 2010). Indeed, there were serious problems in the intelligence data: For many countries data do not exist, so IQs have to be estimated. Data measurements were taken at different times, IQs have to be Flynn-corrected. Samples are not always large and representative, further data are needed. In many samples there are problems of representativity, not all test results can be used. Equatorial Guinea's results were based on an incorrect sample. In different countries different tests were used, results have to be made comparable. Tests include culturally loaded crystallized measures, results are not free of school effects.

But studies using other data produced similar results for wealth (including student assessment studies: Hanushek & Woessmann, 2008, r=.63 with GDP, N=72; Rindermann, 2008a, r=.63 with GDP, N=185). There are high correlations of IQ data with student assessment data (Rindermann, 2007) and Richard Lynn has presented updated data, corrected for detected errors and containing new samples, correlating highly with older and estimated measures (Lynn, 2010; Lynn & Meisenberg, 2010). Using these new combined data sets also results in higher correlations with GDP (1998, logged): r=.77, N=96 (only measured IQs), r=.68, N=185 (including estimated IQs).

3.2. *Causes of cross-country differences in intelligence*

Lynn and Vanhanen (2002, 2006; also Lynn, 2008) proposed a genetic theory of cross-country differences in intelligence. Their assumption is based on an *evolutionary theory* *of intelligence* and development of human subgroups (races/subspecies/ancestries) depending on different environmental challenges (see also Hart, 2007, Rushton, 2004). There is a strong, somewhat political debate on this assumption with many regrettable side effects in relation to science (Nyborg, 2003), but also scientific criticisms have been raised (e.g. Wicherts, Borsboom & Dolan, 2010). Extremely high correlations of skin-color (precisely: skin brightness as a rough indicator of evolutionary history) with intelligence across nations seem to support an evolutionary theory (Templer & Arikawa, 2006: r=.92; Meisenberg, 2009: r=.90), but the biologically more convincing correlations at the individual level are much lower (r=.20; Jensen, 2006, p. 130).

However, up to now no genes for intelligence have been found (Johnson, 2010). So the assumed causal path from genotype to intelligence, through brain size (Rushton, 2004), neurological efficiency (Haier et al., 1988), mental speed (Jensen, 2006; Rindermann & Neubauer, 2000) or through shaping of environment and learning finally leading to fluid and crystallized intelligence, at the level of individuals or nations, is not testable. And of course, if a more or less strong impact of identified genes is eventually found further causes are not excluded, like culture stimulating diligence, learning and thinking (Rindermann, 2009; Steppan, 2010). The same is true for reciprocal effects (e.g. from culture and intelligence to genes by inbreeding; Woodley, 2009).

Most important, we do not need to know the causes of cognitive ability differences between countries to know that these differences influence wealth, democracy or even health (Rindermann & Meisenberg, 2009). But maybe the effect is converse?

3.3. The direction: Does intelligence lead to wealth or wealth to intelligence? Longitudinal analyses

Hunt and Wittmann (2008) using different samples and measures support the existence of a correlation between ability and wealth as found by Lynn and Vanhanen, but they *question the* *direction of causality*. Cross-sectional studies can never answer this. Leaving aside unworkable country-wide experiments, it would be best to use a cross-lagged panel design with data for many countries investigating reciprocal effects (from former intelligence to wealth, controlled for former wealth and the most important further determinant of growth, economic freedom). Unfortunately we have no data sets with cognitive ability levels from say 1950 or 1960 for many countries; but there are results from some student assessment studies around and before 1970. Additionally, there are large data sets for educational level, and education is the best proxy for cognitive competence (see Figure 1). For *N*=88 nations economic development was longitudinally analyzed for its dependency on education (years at school), economic freedom and former wealth (data and procedure are similar to Figure 4 in Rindermann, 2008a, except for using log GDP and for 2000). A detailed data and method description can be found in the *supplementary data file*.

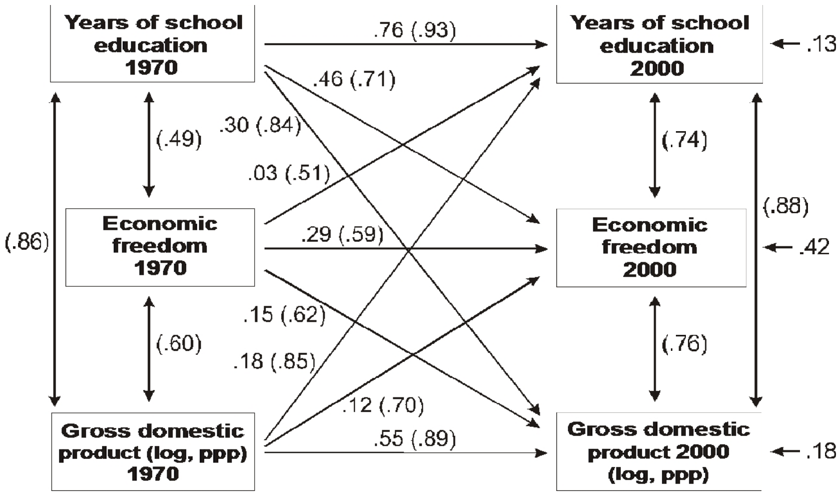


Figure 1. Longitudinal effects. Standardized path coefficients (and correlations in parentheses) between average schooling years in the population over 25, economic freedom and GDP (error terms as unexplained variables on the right; SRMR =.03, CFI=.96). N=88 nations.

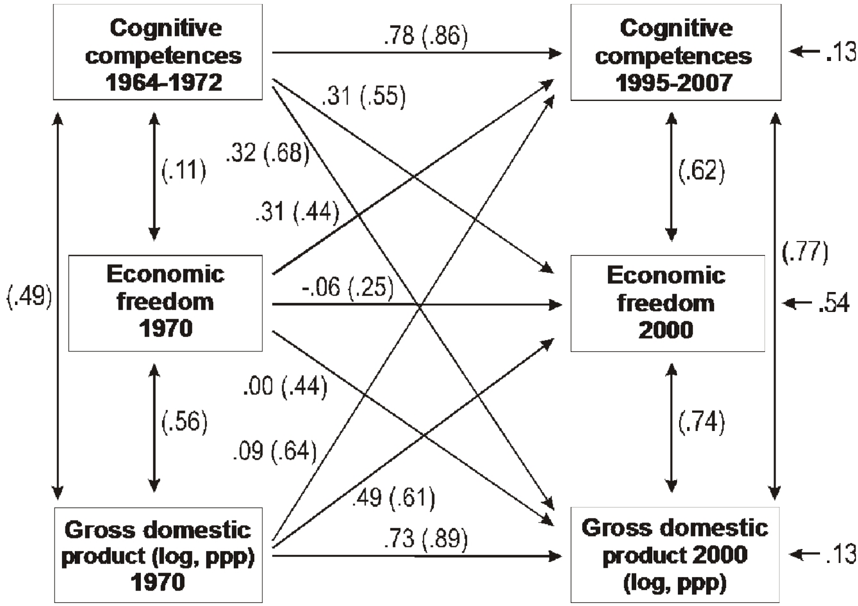


Figure 2. Longitudinal effects. Standardized path coefficients between cognitive abilities (students' assessment studies from 1964 to 1972 and 1995 to 2007), economic freedom and GDP (SRMR=.03, CFI=.98), N=17 nations.

In concrete numbers (not logged), one added year of school education raises GDP three decades later by US $1,614. In the poorer half of the world, a $1,000 higher GDP 1970 has increased school attendance in 2000 by about one and half years, in the richer half by eight months. A similar result could be found using cognitive competence measures (see Figure 2; data and procedure are the same as for Figure 5 in Rindermann, 2008a, except for using log GDP and GDP 2000, last from Penn World Table Version 6.3, and except for the second cognitive competence measure, taken updated from Rindermann, Sailer & Thompson, 2009). Each IQ point increase in the nineteen sixties has raised wealth in 2000 by US $279. Each $1,000 GDP increase in 1970 has increased cognitive competence in 2000 by 0.23 IQ-points.

The effect of one year of education on GDP was larger than the effect of one IQ point. This is not astonishing, as one year at school corresponds internationally to two IQ points in 1970 or 3.5 IQ points in 2000, an amount similar to results at the individual data level (pure school year effect: 3 IQ points; Winship & Korenman, 1997; 60-80% of the average age increase of 5.6 IQ points, Rindermann, 2011). The 88 nations sample for educational effects also comprises nations at a lower wealth level (mean GDP 2000 US $11,289) than the 17 nations for cognitive competence effects (mean GDP in 2000 US $21,024).

Taken together the results of these analyses and of the older ones (Rindermann, 2008a) show that cognitive competence (measured by tests or education as a proxy) is more important for wealth (mean of 4 coefficients: β=.33) than vice versa (β=.11), cognitive competence is more important for wealth development (β=.33) than economic freedom (β=.12), and cognitive competence even has a positive effect on the development of economic freedom (β=.39 vs. wealth on freedom: β=.33, vs. freedom on competence: β=.15). There are reciprocal effects between intelligence and GDP (β=.33 and β=.11), but the effect of intelligence is stronger. But how could intelligence achieve this? A *theory* is necessary, dealing with behavior of individuals and with performance at the level of institutions, societies and cultures, and backed by results of empirical studies.

4. Development of a theory: Cognitive capitalism

At the *individual data level*, many studies show that intelligence predicts job performance (Schmidt & Hunter, 2004: k=425 studies, majority from the US, not corrected r=.28, corrected ρ=.53) and in Europe the findings are similar (Salgado et al., 2003: k=69 studies, r=.25, ρ=.56). Especially in complex jobs, cognitive ability predicts performance (Schmidt & Hunter, 2004, complex vs. less: ρ=.58 vs. .23; Salgado et al., 2003: ρ=.64 vs. .51). This is due to a necessary minimum cognitive level for success in highly complex jobs – smart people can be found in cognitively easier jobs, but hardly unintelligent people are found in complex ones. Some argue that this relationship is due to the filter and signal function of the educational system, allowing only persons with good grades (indirectly high intelligence) to enter universities and the job market for professional jobs. This could be one reason, but more important is the cognitive load in complex jobs and in work more generally (Gottfredson, 2003): More intelligent persons can better cope with difficult cognitive demands, they make fewer errors, they are more innovative and generally more productive. Such an assumption is backed by research: For instance, immigrants are more successful as entrepreneurs and workers in their new country depending on their home country's mean intelligence (Jones & Schneider, 2010; Vinogradov & Kolvereid, 2010). Discipline and conscientiousness are also important in being successful (e. g. Heckman, 2000), and this holds at the level of societies (Rindermann & Ceci, 2009), but cognitive ability is the most important single factor explaining success in complex jobs, which are increasingly part of the global job market.

Such job performance aggregated at the country level is not irrelevant for wealth differences between nations, but genuine national level effects are even more important:

First, *cognitive ability of the political class* is crucial to *governmental competence*. According to Simonton (2006) cognitive ability has an important influence on the performance of US presidents (r=.33-.56). Rindermann et al. (2009) showed that cognitively more competent politicians lead longitudinally to increases in the intelligence of nations (β=.21).

Second, *institutions* benefit from the cognitive ability of their founding fathers and their members working in them, both maintaining and developing institutional quality and functionality. Institutions include government and administration, attorneys and courts, companies and trade, police and military, especially schools and universities. In cross-country-analyses, government effectiveness (Singapore in the lead) correlates with cognitive ability (r=.61).

Third, as cognitive development benefits from the intelligence level of one's social environment (Rindermann & Heller, 2005), *intelligence of others* is important for nurturing individuals' intelligence. During youth the intelligence of parents, teachers and class-mates is important, in adulthood that of colleagues and neighbors, at the level of society the competence of politicians, entrepreneurs, scientists, and intellectuals.

Fourth, intelligence has an impact on citizens' *political orientations and behavior* (Deary, Batty, & Gale, 2008). Intelligence contributes to a general pattern of *cognitive rationality* including the formation of more reasonable worldviews (Meisenberg, 2004). Thus intelligence of a society has a positive impact on development of *democracy, political liberty and rule of law*, which all again have a positive impact on a nations' wealth (mean of seven cross-lagged path analyses on GDP: β=.20; Rindermann, 2008b).

Fifth, intelligence and knowledge are important for shaping *culture*: Intelligence interacting with education furthers *rational and autonomous thinking* (Piaget, 1947; Oesterdiekhoff & Rindermann, 2007).

However, cognitive ability is not the single determinant of all these outcomes. There are additional factors behind and beneath ability, and between ability and the positive outcomes. And of course, intelligence has no deterministic effect, in the sense that intelligence always leads to the aforementioned results. Intelligence only increases the probability of these outcomes.

One decisive aspect has been ignored up to now: The *cognitive ability level of intellectual classes*. This could be defined by the intelligence level of the brightest 5%, 1% or 1‰ of a country ("level of an intellectual class"; Rindermann & Thompson, 2011) or by the size of a stratum operating above a certain threshold, e.g. from IQ 106, 115, 130 or 145 on (La Griffe, 2002; Hanushek & Woessmann, 2008). In the past, writers and philosophers have assumed that *technological development* and more generally the *development of a society* benefits from a cognitive elite (e.g. Rand, 1992/1957). Highly able intellectual classes are necessary to *manage growing complexity* in technology, economy and everyday life. Especially in modern times wealth depends mainly on technological progress (Reich, 1991) and this depends on cognitive ability – in particular of the smartest members within a society. Hanushek and Woessmann (2008, table 4) found that the level of "rocket scientists" is more important for growth than the mean level of a society or the percentage of people above a low threshold (around IQ 85). But "rocket scientists" as category would be too narrow because for a functioning society not only exceptional scientists and engineers are necessary, but also "normal" scientists and engineers maintaining daily business, also officials, politicians, teachers, and – as Schumpeter (1939) mentioned – entrepreneurs and their primarily cognitively based abilities of economic process innovations and economically successful use of inventions shifting the conventional ways of production, trade and consumption.

Here it is less the individual's cognitive competence which is relevant, but more the cognitive competence of social networks, institutions and societies in their interplay (engineers and entrepreneurs, scientists and engineers, politicians and officials, consumers and producers, scientists and editors, universities and companies; e.g. studied as "absorptive capacity"; Cohen & Levinthal, 1990). Cognitive competence increases with use, and becomes the main capital in the modern production process – this position is also held even by traditionally left wing thinkers in the Marxist tradition (Virno, 2001).

The theory, that cognitive ability is crucial – especially the cognitive ability level of an intellectual class – through innovation leading to wealth has been empirically tested several times (Gelade, 2008; Hanushek & Woessmann, 2008; Rindermann et al., 2009), but always with some methodological weaknesses, such as no assessment of cognitive ability of an high ability group or its size (Gelade), no use of mediating variables (Hanushek) or selective and overly small country samples (Hanushek, Rindermann).

Thus we have done a reanalysis using the Hanushek and Woessmann data (student assessment studies from 1964 to 2003, percentage of students with student assessment scores SAS=400 or higher, equivalent to IQ≥85, vs. percentage of students with SAS=600 or higher, equivalent to IQ≥115) for 77 nations using FIML (full-information-maximum-likelihood, no listwise deletion in the case of missing data). It is assumed that cognitive ability influences scientific-technological excellence (STEM) as indicated by rates in patents, Nobel Prizes, scientists and high tech exports and that it influences economic liberty as indicated by two economic freedom measures and both together increase wealth, indicated by two GDP measures (from 1998 and 2003, per capita, ppp, logged). A detailed data and method description for the intellectual class effect analysis could be found in the *supplementary data file*.

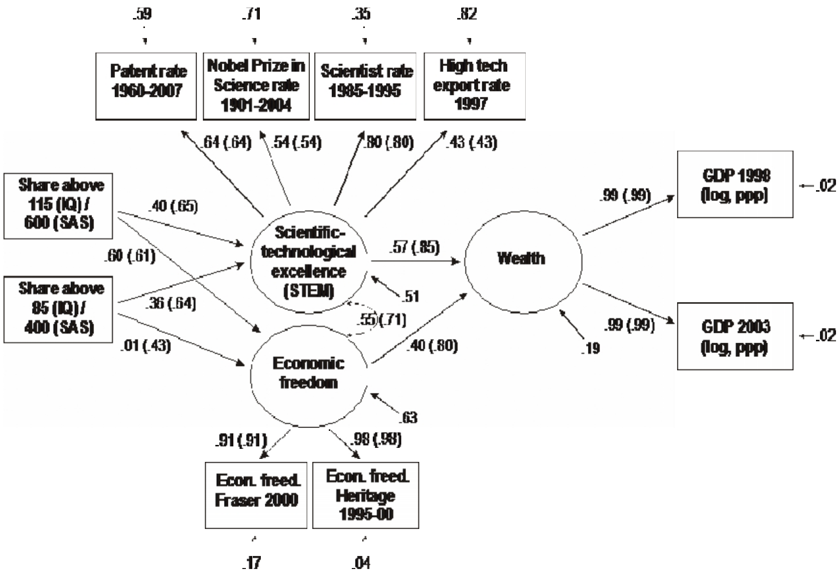


Figure 3. Intellectual class effect analysis. Effect of different large ability fractions through STEM and economic freedom on wealth (Hanushek and Woessmann data; FIML, CFI=.97, SRMR=.06), N=77 nations.

In a former analysis with other data and fewer countries (Rindermann et al., 2009, p. 17) the cognitive ability level of an upper ability group was more important for scientific-technological excellence. Here (Figure 3) the share of an upper ability group (SAS=600/IQ=115 or higher) is more relevant than the share of the population above a rather low level (SAS=400/IQ=85 or higher), mean of both: $\beta_{U/95}$=.42 vs. $\beta_{L/50}$=.34. The effect difference for economic freedom is even larger: β_U=.60 vs. β_L=.01. Wealth depends more on scientific-technological excellence (β=.57) than on economic freedom (β=.40). The message is double: Scientific-technological excellence and economic freedom depend more on the size of a smart fraction. Wealth depends more on scientific-technological excellence than on economic freedom. Both results are backed by former studies, by the relevance of the cognitive level of a high ability group for scientific-technological excellence (Rindermann et al., 2009) and by the stronger impact of cognitive ability than of economic freedom on wealth (see Figures 1 and 2). Economic freedom, the rules and institutions enabling a free economy, depends also on an intellectual class. It seems that not only wealth, but even capitalism depends on the size and cognitive level of a high ability group within society. Capitalism in modernity is a cognitive one!

Cognitive capitalism has a fourfold meaning: The cognitive demands of jobs, and more generally of economics and every day life in modernity are growing – *physical work changes to cognitive work*. The modern economy is built up on the cognitive resources of its labor force from all workers to some developers – *wealth is cognitive wealth*. The functionality of capitalist institutions and their development depend on cognitive ability – *institutions are built on intelligence and knowledge*. Wealth in modernity depends largely on technological progress and this progress depends on the ability level of the intellectual class – *wealth becomes high ability wealth*.

5. Future work

Further studies should take a more detailed look at the process of *how cognitive ability works*. It could be shown to have a positive impact through accomplishment in science, technology, engineering and math. It is immediately reasonable that high intelligence, extensive knowledge and the intelligent use of this knowledge are not only necessary, but a prerequisite for high achievement in these cognitive demanding tasks. But how does cognitive ability create economic freedom and even lower the government spending ratio (Rindermann, 2008b)? How does it improve quality and outcomes in institutions? To understand how ability works it is also necessary to have a closer look at its historical development within countries. Cross-sectional designs cannot study backward effects of wealth and economic freedom on ability and STEM. Longitudinal approaches are necessary.

The *double effect of demographic change on innovation* has not been analyzed: An aging society means that in future a smaller fraction of a society will be in its innovative age range. A society in which the well educated and intelligent have few children will have in future (without noteworthy further progress in cognitive-development-furthering environmental conditions) a smaller intellectual class and at a lower cognitive level – independent of genetic or environmental theories of cognitive ability.

Further variables like *government effectiveness*, *quality and speed of bureaucracy*, and *meritoric principles* should be acknowledged in modeling of cognitive ability effects on wealth. On the one hand the top 5% level (equivalent to IQ≥125) seem to be too low to capture the real “rocket scientists” or pioneering engineers. Thus a *higher threshold* (top 1%, top 1‰, IQ≥130, 140, 150) would be useful. On the other hand “rocket scientists” and pioneering engineers need colleagues, editors, and contributors. Intellectual classes alone are not sustainable and empirical research (see Figure 3) has shown the *positive impact of average smart groups* and the mean competence levels on societies' success. All this knowledge could lead into *governmental consulting* to improve the future of nations.

References

Barnett, S. M., & Williams, W. (2004). National intelligence and the emperor's new clothes. *Contemporary Psychology, 49*, 389-396.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly, 35*, 128-152.

Deary, I. J., Batty, G. D., & Gale, C. R. (2008). Bright children become enlightened adults. *Psychological Science*, *19*, 1-6.

Diamond, J. (1997). *Guns, germs, and steel*. New York: Norton.

Gelade, G. A. (2008). IQ, cultural values, and the technological achievement of nations. *Intelligence*, *36*, 711-718.

Gottfredson, L. S. (2003). *g*, jobs and life. In H. Nyborg (Ed.), *The scientific study of general intelligence* (pp. 293-342). Oxford: Pergamon.

Haier, R. J., Siegel, B. V., Nuechterlein, K. H., Hazlett, E., Wu, J. C., Paek, J., Browning, H. L., & Buchsbaum, M. S. (1988). Cortical glucose metabolic rate correlates of abstract reasoning and attention studied with positron emission tomography. *Intelligence, 12*, 199-217.

Hanushek, E. A., & Woessmann, L. (2008). The role of cognitive skills in economic development. *Journal of Economic Literature*, *46*, 607-668.

Hart, M. (2007). *Understanding human history*. Athens: Washington Summit.

Hayek, F. A. v. (1994/1944). *The road to serfdom*. Chicago: University of Chicago Press.

Heckman, J. J. (2000). Policies to foster human capital. *Research in Economics*, *54*, 3-56.

Hunt, E. (2010). The rights and responsibilities implied by academic freedom. *Personality and Individual Differences*, *49*, 264-271.

Hunt, E., & Wittmann, W. (2008). National intelligence and national prosperity. *Intelligence*, *36*, 1-9.

Jamison, E. A., Jamison, D. T., & Hanushek, E. A. (2007). The effects of education quality on income growth and mortality decline. *Economics of Education Review*, *26*, 772-789.

Jensen, A. R. (2006). Comments on correlations of IQ with skin color and geographic-demographic variables. *Intelligence*, *34*, 128-131.

Johnson, W. (2010). Understanding the genetics of intelligence: Can height help? Can corn oil? *Current Directions in Psychological Science*, *19*, 177-182.

Jones, G., & Schneider, W. J. (2010). IQ in the production function. *Economic Inquiry*, *48*, 743-755.

La Griffe du Lion (2002). *The smart fraction theory of IQ and the wealth of nations. 4*(1). Retrieved July 13, 2009 from www.lagriffedulion.f2s.com/sft.htm.

Landes, D. S. (1969). *The unbound Prometheus.* Cambridge: Cambridge University Press.

Landes, D. S. (1998). *The wealth and poverty of nations.* New York: Norton.

Lynn, R. (2008). *The global bell curve.* Augusta: Washington Summit.

Lynn, R. (2010). National IQs updated for 41 Nations. *Mankind Quarterly*, *L*(4), 275-296.

Lynn, R., & Meisenberg, G. (2010). National IQs calculated and validated for 108 nations. *Intelligence*, *38*, 353-360.

Lynn, R., & Vanhanen, T. (2002). *IQ and the wealth of nations*. Westport: Praeger.

Lynn, R., & Vanhanen, T. (2006). *IQ and global inequality.* Athens: Washington Summit.

Marx, K. (1992/1867). *The capital*. London: Penguin.

Meisenberg, G. (2004). Talent, character, and the dimensions of national culture. *Mankind Quarterly*, *45*, 123-168.

Meisenberg, G. (2009). Wealth, intelligence, politics and global fertility differentials. *Journal of Biosocial Science*, *41*, 519-535.

Mokyr, J. (2010). *The enlightened economy*. New Haven: Yale University Press.

Murray, Ch. (2002). IQ and income inequality in a sample of sibling pairs from advantaged family backgrounds. *American Economic Review*, *92*, 339-343.

Nyborg, H. (2003). The sociology of psychometric and bio-behavioral sciences. In H. Nyborg (Ed.), *The scientific study of general intelligence* (pp. 441-502). Oxford: Pergamon.

Oesterdiekhoff, G. W., & Rindermann, H. (2007). The spread of AIDS in developing countries. *Journal of Social, Political and Economic Studies, 32*, 201-222.

Piaget, J. (1947). *La psychologie de l'intelligence.* Paris: Colin.

Ramirez, F. O., Luo, X., Schofer, E., & Meyer, J. W. (2006). Student achievement and national economic growth. *American Journal of Education*, *113*, 1-29.

Rand, A. (1992/1957). *Atlas shrugged*. New York: Signet.

Reich, R. B. (1991). *The work of nations*. New York: Knopf.

Rindermann, H. (2007). The big *G*-factor of national cognitive ability. *European Journal of Personality, 21,* 767-787.

Rindermann, H. (2008a). Relevance of education and intelligence at the national level for the economic welfare of people. *Intelligence*, *36*, 127-142.

Rindermann, H. (2008b). Relevance of education and intelligence for the political development of nations. *Intelligence, 36*, 306-322.

Rindermann, H. (2009). Intelligence as bourgeois phenomenon. *Merkur*, *63*(8/723), 666-676.

Rindermann, H. (2011). Intelligenzwachstum in Kindheit und Jugend. [Increase of intelligence in childhood and youth.] *Psychologie in Erziehung und Unterricht, 58*(3), 210-224.

Rindermann, H., & Ceci, S. J. (2009). Educational policy and country outcomes in international cognitive competence studies. *Perspectives on Psychological Science, 4*, 551-577.

Rindermann, H., & Heller, K. A. (2005). The benefit of gifted classes and talent schools for developing students' competences and enhancing academic self-concept. *Zeitschrift für Pädagogische Psychologie, 19*, 133-136.

Rindermann, H., & Meisenberg, G. (2009). Relevance of education and intelligence at the national level for health: The case of HIV and AIDS. *Intelligence, 37*, 383-395.

Rindermann, H., & Neubauer, A. (2000). Speed of information processing and success at school: Do basal measures of intelligence have predictive validity? *Diagnostica, 46*, 8-17.

Rindermann, H., Sailer, M., & Thompson, J. (2009). The impact of smart fractions, cognitive ability of politicians and average competence of peoples on social development. *Talent Development and Excellence, 1*, 3-25.

Rindermann, H., & Thompson, J. (2011). Cognitive capitalism: The effect of cognitive ability on wealth, as mediated through scientific achievement and economic freedom. *Psychological Science, 22*, 754-763.

Rushton, J. Ph. (2004). Placing intelligence into an evolutionary framework. *Intelligence*, *32*, 321-328.

Salgado, J. F., Anderson, N., Moscoso, S., Bertua, C., De Fruyt, F., & Rolland, J. P. (2003). A meta-analytic study of general mental ability validity for different occupations in the European Community. *Journal of Applied Psychology*, *88*, 1068-1081.

Schmidt, F. L., & Hunter, J. E. (2004). General mental ability in the world of work. *Journal of Personality and Social Psychology*, *86*, 162-173.

Schumpeter, J. A. (1939). *Business cycles.* New York: McGraw-Hill.

Simonton, D. K. (2006). Presidential IQ, openness, intellectual brilliance, and leadership. *Political Psychology*, *27*, 511-526.

Smith, A. (1994/1776). *An inquiry into the nature and causes of the wealth of nations.* New York: Modern Library.

Steppan, M. (2010). Protestantism and intelligence. *The International Journal of Educational and Psychological Assessment*, *5*, 134-154.

Strenze, T. (2007). Intelligence and socioeconomic success. *Intelligence, 35*, 401-426.

Templer, D. I., & Arikawa, H. (2006). Temperature, skin color, per capita income, and IQ. *Intelligence, 34*, 121-128.

Vinogradov, E., & Kolvereid, L. (2010). Home country national intelligence and self-employment rates among immigrants in Norway. *Intelligence*, *38*, 151-159.

Virno, P. (2001). *On general intellect*. Retrieved May 4, 2010 from www.generation-online.org/p/fpvirno10.htm.

Weber, M. (2001/1905). *The Protestant ethic and the spirit of capitalism*. London: Routledge.

Weede, E. (2004). Does human capital strongly affect economic growth rates? *Comparative Sociology*, *3*, 115-134.

Wicherts, J. M., Borsboom, D., & Dolan, C. V. (2010). Why national IQs do not support evolutionary theories of intelligence. *Personality and Individual Differences*, *48*, 91-96.

Winship, Ch., & Korenman, S. (1997). Does staying in school make you smarter? In B. Devlin, S. E. Fienberg, D. P. Resnick, & K. Roeder (Eds.), *Intelligence, genes and success* (pp. 215-234). New York: Springer.

Woodley, M. A. (2009). Inbreeding depression and IQ in a study of 72 countries. *Intelligence*, *37*, 268-276.

See also the *supplementary data file*.

Supplementary material Method

1. Analyses in *Figure 1 and 2* (longitudinal studies)

1.1 Education

For the analysis reported in *Figure 1* the amount of education was used as a proxy for cognitive competence. The data pool collected by Barro and Lee (2000) gives data as *years at school* ("average schooling years in the total population over age 25"). For 1970 *N*=101 countries, for 2000 *N*=104 countries, in the repeated measurement at both measurement points *N*=88 countries.

1.2 Cognitive competence

Mean results from student assessment tests were used in the second analysis (*Figure 2*). For the first measurement point *1964-1972* old student assessment studies collected by Lee and Barro (1997) were used. From 1964: IEA-Mathematics tested in 13-year old pupils, eighth grade; IEA-Mathematics at the end of secondary school. From 1972: Science tested in 10-year old pupils; science in 14-year old pupils; science at the end of secondary school; reading in 13-year old pupils. The mean correlation between the results of the studies with weighted N (number of countries) and after Fishers-Z-transformation is *r*=.62. The complete sample for old student assessment studies includes 19 nations: Australia, Belgium, Chile, Finland, France, Germany, Great Britain, Hungary, India, Iran, Israel, Italy, Japan, Malawi, Netherlands, New Zealand, Sweden, Thailand, USA. For IQ standardized analyses the results were transformed to the IQ scale (*M*=100, *SD*=15) according to the distribution in the newer student assessment results 1995-2007.

For the second measurement point *1995-2007* recent student assessment studies were used. Sources were TIMSS 1995, 4th and 8th grade, math and science, TIMSS 1999, 8th grade, math and science, TIMSS 2003, 4th and 8th grade, math and science, TIMSS 2007, 4th and 8th grade, math and science; PISA (always students of around 15 year of age) 2000, 2003 and 2006, verbal, math and science literacy, 2003 also problem solving, PIRLS verbal literacy in 4th grade 2001 and 2006. All results were originally presented in student assessment scales (SAS M=500, SD=100).

With references: Sources were *TIMSS 1995* (in the order of the grades and scales: Beaton, Mullis, Martin, Gonzalez, Kelly & Smith, 1996; Beaton, Martin, Mullis, Gonzalez, Smith & Kelly, 1996; Mullis, Martin, Beaton, Gonzalez, Kelly & Smith, 1997; Martin, Mullis, Beaton, Gonzalez, Smith & Kelly, 1997), *TIMSS 1999* (Mullis, Martin, Gonzalez, Gregory, Garden, O'Connor, Chrostowski & Smith, 2000; Martin, Mullis, Gonzalez, Gregory, Smith, Chrostowski, Garden & O'Connor, 2000), *TIMSS 2003* (Mullis, Martin, Gonzalez & Chrostowski, 2004; Martin, Mullis, Gonzalez & Chrostowski, 2004), *TIMSS 2007* (Mullis, Martin & Foy, 2008; Martin, Mullis & Foy, 2008), *PISA 2000* (OECD, 2003), *PISA 2003* (OECD, 2004a, b), *PISA 2006* (OECD, 2007a, 2007b), *PIRLS 2001* (Mullis, Martin, Gonzales & Kennedy, 2003) and *PIRLS 2006* (Mullis, Martin, Kennedy & Foy, 2007).

A sum value of different scales, grades/age groups, studies and study approaches (grade vs. age level studies; studies trying to measure abilities defined by curriculum like TIMSS vs. studies trying to measure abilities defined by cognitive demands in modernity like PISA) is more convincing, that is, more representative, reliable and valid. High correlations between scales within and across studies, and similarities in cognitive demands and processes necessary to solve the tasks, allowed us to sum up scales to a single sum value (all factor loadings on an international G-factor were λ>.90; Rindermann, 2007a, 2007b).

To form a common score the results were at first averaged within one grade, year and study between different scales (e.g. within TIMSS 1995, 4th grade, across math and science), secondly within one year and study between different grades (e.g. within TIMSS 1995, across 4th and 8th grade), thirdly within one study between different years (e.g. within TIMSS, across 1995, 1999, 2003 and 2007), fourthly within different grade vs. age study approaches across TIMSS and PIRLS (TIMSS and PIRLS are studies done in grades, PISA is a study done in a single age group), fifthly and finally between different study approaches (across grade and age approach studies: TIMSS-PIRLS-mean and PISA-mean). All averaging was done using *z*-transformations, calculating means and standard deviations in countries which participated in all samples used for averaging (so *z*-formula are based on the same countries and over- or underestimation are avoided). Subsequently the *z*-results were re-normed using means and standard deviations obtained by simple arithmetical averaging of all three study results (SAS-scale with M=500 and SD=100). At the end the values were transformed to the more usual IQ-scale, using Great Britain as the reference country, SAS-*SD* were simply transformed to an IQ-scale ("Greenwich-IQ", M=100, SD=15). Results are provided for N=90 countries. Means in SAS-scale are 453, 304 and 596, in UK-IQ-scale 90, 68 and 111. A table of country means could be found in Rindermann, Sailer and Thompson (2009; see: www.iratde.org/issues/1-2009/tde_issue_1-2009_03_rindermann_et_al.pdf).

The results are not identical with the formally published cognitive ability values of Rindermann (2007a), because a) psychometric intelligence test results were not used here (because stemming from different decades), b) older student assessment studies like IEA-Reading and IAEP were not used (too old for the second measurement point in longitudinal analyses), c) newer studies were included (PISA 2006, PIRLS 2006, TIMSS 2007), and d) the results were not corrected for age and grade or sample quality. Nevertheless the correlations are very high (with former corrected cognitive ability sum r=.92, with uncorrected r=.95, N=88).

"Normed" values of all variables at international data level are somewhat arbitrary, e.g. the student assessment scale with M=500 and SD=100. The norms are estimated by the authors of the student assessment studies with reference to results in OECD-countries (and sometimes in accordance with older results). OECD-membership, however, is no scientific criterion. IQ-norms depend on the secular rise of intelligence and intelligence test results ("Flynn-effect"). Student assessment results are biased because only those in school participated, in several countries participating pupils had been too old (especially in older studies and in developing countries students had been older than defined by the study guidelines), not all regions participated (especially in older studies and in developing countries) etc. (see Rindermann, 2007a; Wuttke, 2007). But also for other variables the norms are arbitrary, e.g. for GDP (inflation, Dollar or Euro).

The competence levels are obtained through student assessment studies. But students do not work and nor do they win Nobel Prizes. We assume that the results of students could be generalized to adults, an assumption that is backed by high correlations with IQ measures (r=.87, N=86, Lynn & Vanhanen, 2006; often gained in adult samples), with an adult literacy study (r=.68, N=20; OECD, 2000) and the educational level of societies (r=.67, N=84, r=.75, N=85; measures see below). And, of course, the past youth is today's workforce. OECD is doing an adult literacy study for a larger country sample (PIAAC, Programme for the International Assessment of Adult Competencies, in 2011), by using their data it would be possible to prove if our assumptions are correct.

In the repeated measurement at both measurement points N=17 countries.

1.3 Economic freedom

Economic freedom ratings for 1970 (or the first available measurement point in the 1970s) and 2000 (122 countries each) were obtained from the Fraser Institute (Gwartney & Lawson, 2003). (More information on the construct see below). In the analyses N=88/17 countries.

1.4 Wealth

Gross Domestic Product (GDP, ppp) was taken from Barro and Lee (1993) for 1970 (122 countries), and from Penn World Table Version 6.3 for 2000 (187 countries; Heston, Summers & Aten, 2009). GDP considers only goods and services produced within a country, not income received from abroad. GDP is an indicator for produced wealth. GDP was logged. Using not logged GDP would mean that the difference between e.g. 20.000 and 25.000 US $ would have the same meaning as between 5.000 and 10.000 US $. Instead, by using log GDP wealth increases at lower levels would mean a larger and more relevant gain in wealth than at higher levels. "PPP" means "purchasing power parity": GDP transformed across countries and currencies in comparable monetary units. In the analyses N=88/17 countries.

1.5 Longitudinal statistical analyses

Longitudinal effects were calculated by the use of cross-lagged path coefficients in a cross-lagged panel design (see Shadish, Cook & Campbell, 2002; for causal interpretation: Pearl, 2009). This method provides a test of reciprocal causal relations between two or more variables. The standardized path coefficients (β) between time-lagged variables are reported, along with correlations in parentheses. Additional correlations help to estimate the influence of other variables in the model (by inspection of the difference between the correlation coefficient and the path coefficient), they allow a check of the model (1-error=$R^2=\Sigma r\beta$) and to calculate the proportion of explained variance through each factor ($R^2=\Sigma r\beta$). According to Rogosa (1980), unlike the path coefficients the cross-lagged correlations are not useful for estimating causal effects because of their stronger dependence on the stability and variance of the variables. An even more important reason is that cross-lagged path coefficients represent the incremental part of the other variables in the model, the part that is not explained by self-prediction. Even highly stable variables, such as GDP, can be explained by other variables in a model. The cross-lagged path analyses were done with LISREL 8.80.

For evaluating the fit of path-models Hu and Bentler (1998, 1999) recommended a 2-index-strategy. Indices assess the fit between the theoretical model and empirical data. In accordance with Hu and Bentler, we chose the SRMR (Standardized Root Mean Square Residual) and the CFI (Comparative Fit Index). The SRMR is sensitive to model misspecifications (especially wrong factor covariances) and it is robust against violations of distributional assumptions and sample size. The CFI is sensitive to incorrectly specified factor loadings and does not penalize model complexity (Marsh, Hau & Wen, 2004). The SRMR-results should be small, the CFI-results high. Commonly accepted criteria for a good fit are: SRMR≤.08 (Hu & Bentler, 1999) or SRMR≤.05 (Schermelleh-Engel, Moosbrugger & Müller, 2003) and CFI≥.95 (Hu & Bentler, 1999) or CFI≥.97 (Schermelleh-Engel et al., 2003).

2. Analysis in *Figure 3* (intellectual class effect analysis)

2.1 Cognitive competence (shares above ability thresholds)

Hanushek and Woessmann (2009, p. 25f., A2ff., A13ff.) calculated for 77 countries, from older and newer student assessment studies (1964-2003, FIMS, FISS, FIRS, SIMS, SISS, SIRS, TIMSS, PISA, PIRLS), the percentage of students in math and science above SAS=400 or 600 (≅ IQ≥85 or 115) using US NAEP-results and an OECD (Organisation for Economic Co-operation and Development) standardization sample. The US NAEP-results (yearly tests in an intertemporally comparable way since 1969) were used to find a common comparison scale to combine data from different studies: The United States has been the only country which participated in all by Hanushek and Woessmann used 12 student assessment studies and their NAEP-results could be compared across time. The 13 country OECD-sample (economically advanced countries with stable education systems and without major changes in overall enrollment) was used for standardization of the variance for finding the "400" and "600" thresholds.

A threshold of 400 points ("basic skill") is used as the lowest bound for a basic level of competence in reading, math and science literacy. This corresponds to the middle of the level 1 range, which denotes that students can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. A score of 600 points ("topperforming”) is near the threshold of the highest level 5, which means that students can develop models for complex situations; they can reflect on their answers and can communicate their interpretations and reasoning.

A total of 77 countries have participated in at least one of the student assessment studies, but Hanushek and Woessmann used only the data for 50 countries (excluding former communist countries, countries for which oil production is the dominant industry, small countries, newly created countries, lacking early output data, strong outliers). Here data for *N*=77 countries were used.

2.2 Indicators of scientific-technological excellence (STEM)

STEM is measured independently from our indicators of cognitive ability by rates in patents, Nobel Prizes, scientists, and high-technology exports. All measures are adjusted for population size.

Patent rate: Number of patents of a nation (sum of residents and nonresidents) related to population size, average annual patents per 1 million people 1960-2007 (*N*=67 countries). Source is the World Intellectual Property Organization (WIPO, 2009), an agency of the United Nations.

Nobel Prizes: Nobel Prizes in science 1901-2004 related to population size (Nobel-Prize-Committee, 2005). Science sums up Nobel Prizes in physics, chemistry, medicine and economics. Mean correlations between those are around r=.90 (α=.97, here for *N*=76 countries).

Scientist rate: Scientists and engineers in research and development per million people, 1985-1995 (source: Kurian, 2001, p. 388, here for *N*=50 countries).

High-technology exports: High-technology exports as percentage of manufacturing exports, 1997 (source: Kurian, 2001, p. 389-390, here for *N*=58 countries).

All indicators were related to population size, in this sample the sum *N*=76 (Cronbach-α=.68).

2.3 Economic freedom

Economic freedom covers property rights, rule of law, low customs, taxes, government spending ratio, and trade restrictions (within our analyzed sample: N=67 and 72; Cronbach-α=.88) from Fraser Institute for 2000 (Gwartney & Lawson, 2003) and from Heritage Foundation for 1995-2000 (O'Driscoll, Holmes & O'Grady, 2002). The *Fraser Institute* uses 42 measures to construct a summary index measuring the degree of economic freedom in five categories: (1) Size of government (negative): expenditures, taxes, and enterprises; (2) legal structure and security of property rights (positive); (3) access to sound money (positive); (4) freedom to trade internationally (positive); and (5) regulation of credit, labor and business (negative). The raw data consist of objective (numerical) measures and subjective assessments on a rating scale which were weighted and combined to a sum score. *Heritage Foundation* uses 50 independent economic variables in 10 areas: (1) Trade policy, (2) fiscal burden of government, (3) government intervention in the economy, (4) monetary policy, (5) capital flows and foreign investment, (6) banking and finance, (7) wages and prices, (8) property rights, (9) regulation, and (10) black market activity. The raw data consist of objective (numerical) measures and subjective assessments, both rated on a 5 point scale. Finally the 10 factors were equally combined to one sum score.

2.4 Wealth

Gross domestic product 2003 (GDP per capita, purchasing power parity/ppp, logarithm; Human Development Report/HDR, 2005, here for N=72 countries). GDP 1998 (ppp, logarithm) per capita from Lynn and Vanhanen (2002), here for N=74 countries.

2.5 Structural equation modeling analysis

Structural equation modeling analysis using Mplus (5.21) and FIML (full-information-maximum-likelihood, no listwise deletion in the case of missing data) were calculated at the latent level (manifest variables in boxes as indicators of latent ones in circles which are assumed to be error-free measures of constructs).

Good values for fit indices are SRMR≤.08 (Hu & Bentler, 1999) or SRMR≤.05 (Schermelleh-Engel, Moosbrugger & Müller, 2003) and CFI≥.95 (Hu & Bentler, 1999) or CFI≥.97 (Schermelleh-Engel et al., 2003).

Significance tests were not used for interpretation (for an in-depth justification e.g. Cohen, 1994; Falk & Greenbaum, 1995; Gigerenzer, 2004; Hunter, 1997). Especially at the macro-social level they are not appropriate for scientific reasoning. More instructive for inductive generalization – which is not possible with significance tests – is the demonstration of the stability of relationships across different country samples, different variables, different measurement points and various studies by different authors.

References

Barro, R. J., & Lee, J.-W. (1993). *Barro-Lee data set. International measures of schooling years and schooling quality. Distributed by the World Bank Group.* Washington, Version 1994. Retrieved July 14, 2004 from www.worldbank.org.research/growth/ddbarle2.htm.

Barro, R. J., & Lee, J.-W. (2000). *Barro-Lee data set. International data on educational attainment: updates and implications.* Boston: Harvard University. Retrieved November 18, 2004 from www2.cid.harvard.edu/ciddata/barrolee/readme.htm.

Beaton, A. E., Mullis, I. V. S., Martin, M. O., Gonzalez, E. J., Kelly, D. L., & Smith, T. (1996). *Mathematics achievement in the middle school years.* Chestnut Hill: TIMSS Study Center.

Beaton, A. E., Martin, M. O., Mullis, I. V. S., Gonzalez, E. J., Smith, T., & Kelly, D. L. (1996). *Science achievement in the middle school years.* Chestnut Hill: TIMSS Study Center.

Cohen, J. (1994). The earth is round (p<.05). *American Psychologist*, *49*, 997-1003.

Falk, R., & Greenbaum, Ch. W. (1995). Significance tests die hard. The amazing persistence of a probabilistic misconception. *Theory & Psychology*, *5*, 75-98.

Gigerenzer, G. (2004). Mindless statistics. *Journal of Socio-Economics, 33*, 587-606.

Gwartney, J., & Lawson, R. (2003). *Economic freedom of the world. 2003 annual report.* Vancouver: Fraser Institute.

Hanushek, E. A., & Woessmann, L. (2009). *Do better schools lead to more growth? Cognitive skills, economic outcomes, and causation.* Bonn: IZA DP No. 4575.

Heston, A., Summers, R., & Aten, B. (2009). *Penn World Table Version 6.3*. Retrieved January 15, 2010 from http://pwt.econ.upenn.edu/php_site/pwt_index.php.

Hu, L., & Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods, 3*, 424-453.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1-55.

Human Development Report of the United Nations (HDR) (2005). *Human Development Report 2005.* New York. Retrieved May 25, 2007 from http://hdr.undp.org/reports/global/2005/pdf/hdr05_HDI.pdf.

Hunter, J. E. (1997). Needed: A ban on the significance test. *Psychological Science, 8*, 3-7.

Kurian, G. Th. (2001). *The illustrated book of world rankings.* Armonk: Sharpe.

Lee, J.-W., & Barro, R. J. (1997). *Schooling quality in a cross-section of countries.* New York. Retrieved November 18, 2004 from www.nber.org/papers/W6198.

Lynn, R., & Vanhanen, T. (2002). *IQ and the wealth of nations*. Westport: Praeger.

Lynn, R., & Vanhanen, T. (2006). *IQ and global inequality.* Athens: Washington Summit.

Marsh, H. W., Hau, K.-T., & Wen, Z. (2004). In search of golden rules: Comment on hypothesis testing approaches to setting cutoff values for fit indexes and dangers in overgeneralising Hu & Bentler's (1999) findings. *Structural Equation Modeling*, *11*, 320-341.

Martin, M. O., Mullis, I. V. S., Beaton, A. E., Gonzalez, E. J., Smith, T., & Kelly, D. L. (1997). *Science achievement in the primary school years.* Chestnut Hill: TIMSS Study Center.

Martin, M. O., Mullis, I. V. S., & Foy, P. (2008). *TIMSS 2007 international science report*. Chestnut Hill: TIMSS & PIRLS Study Center.

Martin, M. O., Mullis, I. V. S., Gonzalez, E. J., & Chrostowski, S. J. (2004). *TIMSS 2003 international science report.* Chestnut Hill: TIMSS & PIRLS International Study Center.

Martin, M. O., Mullis, I. V. S., Gonzalez, E. J., Gregory, K. D., Smith, T. A., Chrostowski, S. J., Garden, R. A., & O'Connor, K. M. (2000). *TIMSS 1999 international science report.* Chestnut Hill: TIMSS Study Center.

Mullis, I. V. S., Martin, M. O., Beaton, A. E., Gonzalez, E. J., Kelly, D. L., & Smith, T. (1997). *Mathematics achievement in the primary school years*. Chestnut Hill: TIMSS Study Center.

Mullis, I. V. S., Martin, M. O., & Foy, P. (2008). *TIMSS 2007 international mathematics report*. Chestnut Hill: TIMSS & PIRLS Study Center.

Mullis, I. V. S., Martin, M. O., Gonzalez, E. J., Gregory, K. D., Garden, R. A., O'Connor, K. M., Chrostowski, S. J., & Smith, T. A. (2000). *TIMSS 1999 international mathematics report.* Chestnut Hill: TIMSS Study Center.

Mullis, I. V. S., Martin, M. O., Gonzalez, E. J., & Chrostowski, S. J. (2004). *TIMSS 2003 international mathematics report.* Chestnut Hill: TIMSS & PIRLS International Study Center.

Mullis, I., Martin, M. O., Gonzales, E. J., & Kennedy, A. M. (2003). *PIRLS 2001 international report.* Chestnut Hill: IEA.

Mullis, I., Martin, M. O., Kennedy, A. M., & Foy, P. (2007). *PIRLS 2006 international report*. Chestnut Hill: IEA/TIMSS & PIRLS International Study Center.

Nobel-Prize-Committee (2005). *Nobel prizes 1901-2004 in physics, chemistry, medicine and economics*. Retrieved May 23, 2005 from http://nobelprize.org/nobel_prizes/lists/all.

O‘Driscoll, G. P., Holmes, K. R., & O‘Grady, M. A. (2002). *2002 index of economic freedom.* Washington: Heritage Foundation & Wall Street Journal.

OECD (2000). *Literacy in the information age. Final report of the International Adult Literacy Survey*. Paris: OECD.

OECD (2003). *Literacy skills for the world of tomorrow. Further results from PISA 2000.* Paris: OECD.

OECD (2004a). *Learning for tomorrow‘s world. First results from PISA 2003.* Paris: OECD.

OECD (2004b). *Problem solving for tomorrow‘s world.* Paris: OECD.

OECD (2007a). *PISA 2006. Science competencies for tomorrow‘s world. Volume 1: Analysis*. Paris: OECD.

OECD (2007b). *PISA 2006. Volume 2: Data/Données*. Paris: OECD.

Pearl, J. (2009). *Causality. Models, reasoning, and inference*. Cambridge: Cambridge University Press.

Rindermann, H. (2007a). The *g*-factor of international cognitive ability comparisons: The homogeneity of results in PISA, TIMSS, PIRLS and IQ-tests across nations. *European Journal of Personality, 21,* 667-706.

Rindermann, H. (2007b). The big *G*-factor of national cognitive ability. *European Journal of Personality, 21,* 767-787.

Rindermann, H., Sailer, M., & Thompson, J. (2009). The impact of smart fractions, cognitive ability of politicians and average competence of peoples on social development. *Talent Development and Excellence, 1*, 3-25.

Rogosa, D. (1980). A critique of cross-lagged correlation. *Psychological Bulletin, 88*, 245-258.

Shadish, W. R., Cook, Th. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference.* Boston: Houghton Mifflin.

Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Test of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research – online, 8*, 23-74.

WIPO (World Intellectual Property Organization) (2009). *Patent applications by patent office (1883-2007), by resident and non-resident*. Geneva. Retrieved June 22, 2009 from www.wipo.int/ipstats/en/statistics/patents.

Wuttke, J. (2007). Uncertainties and bias in PISA. In S. Th. Hopmann, G. Brinek & M. Retzl (Eds.), *PISA zufolge PISA - PISA according to PISA* (pp. 241-263). Wien: LIT.

Chapter 8.

National Differences in Personality

JÜRI ALLIK
Department of Psychology, University of Tartu
The Estonian Center of Behavioral and Health Sciences
Tiigi 78, Tartu 50410, Estonia
E-mail: juri.allik@ut.ee

ABSTRACT

Besides establishing national IQ levels, Richard Lynn also started and inspired studies attempting to find out regularities behind the national differences in personality. Recent large-scale collaborative projects involving hundreds of psychologists from about fifty countries allowed for determination of the aggregate national scores of personality for the most popular personality models, including the Big Five. These studies have already revealed several universal and geographically regular patterns in the global personality trait distributions. The area of the study of national differences in personality has arguably matured to a level where it can start to help solving fundamental problems such as the relationship between genes, culture, and personality.

1. Richard Lynn on National Differences in Personality

Richard Lynn's illustrious scientific career has taught, especially those who are ready to learn, several lessons including a methodological one. Francis Crick described how Lawrence Bragg defeated him in his first scientific race to find out the structure of haemoglobin: "Whereas I had gotten bogged down, he made rapid progress. He boldly assumed that one could approximate the shape by an ellipsoid—a particularly simple type of distorted sphere… Moreover, he was not disturbed if the data did not exactly fit his model, since it was unlikely that molecule was exactly an ellipsoid. In other words he made bold, simplifying assumptions; looked at as wide range of data as possible; and was critical but not pernickety, as I had been, about the fit between his model and experimental facts… it was an revelation to me as to how to do scientific research and, more important, how not to do it" (Crick, 1990, p. 47).

This description applies equally well to how Richard Lynn has advanced in his research: he always looked for the big picture, never hesitated to make unorthodox assumptions, and was not particularly concerned if experimental facts did not fit exactly, initially at least, with the theoretical predictions. In the result we have some of the boldest explanations ever advanced about individual or group differences.

Richard Lynn is so tightly associated with IQ research that his equally seminal works on personality have been seriously underestimated. For example, his pioneering *Personality and National Character* (1971) has not received the attention it certainly deserves. Even according to the relatively liberal *Google Scholar* this book has been cited only 96 times by the end of September 2010. His more recent paper "National differences for thirty-seven nations in extraversion, neuroticism, psychoticism and economic, demographic and other correlates" (Lynn & Martin, 1995) has been slightly more lucky, being cited 51 times by journals indexed in the *Web of Science.* His previous paper on a similar subject (Lynn, 1981) has been less popular (cited 34 times) than it really deserves.

Personality and National Character (1971) is a remarkable achievement, only partly built on the preceding tradition of what was known as moral statistics (Bayatrizi, 2009). This book continues a tradition which was started by André-Michel Guerry, Adolphe Quetelet, Alexander von Oettingen and, of course, Émile Durkheim who looked at the statistics of suicide, divorce, mental health, and abortion as something that could tell us about the moral health of the society. The main idea advanced by this book is that among the advanced nations there are differences in the level of anxiety in the population. The anxiety level manifests itself in various ways, such as the incidence of suicide, mental illness and tobacco consumption. What makes Lynn's approach different from his predecessors is the assumption that largely inherited personality traits, not cultural institutions or acquired social practices, are responsible for the instances of social maladies such as suicide, alcoholism, accidents, hypertension, and smoking. However, all these statistics were indirect indicators of anxiety, not direct measures of personality traits. Only in his later papers the mean scores on extraversion, neuroticism and psychoticism became available for a sufficient number of countries (Lynn & Martin, 1995).

Two observations made by Richard Lynn are turning out to be particularly penetrating. First, he (1981) noticed that nations like Australia, Canada, and the United States, whose populations are predominantly made up of immigrants, tend to have higher Extraversion scores than the European countries from which the emigrants largely came. This intrepid generalization was recently confirmed by elegant studies of immigrants from small islands demonstrating that genetic drift is responsible for a higher level of Extraversion and Openness among emigrant populations (Camperio Ciani & Capiluppi, 2011; Camperio Ciani, Capiluppi, Veronese, & Sartori, 2007).

Another observation made by Lynn and Martin (1995) concerned women obtaining higher mean scores than men on Neuroticism scales in all 37 nations where the results of the Eysenck Personality Questionnaire (EPQ) were available. In addition, men scored higher than women on Extraversion in 30 countries and on Psychoticism in 34 countries. As it turned out, these sex differences in the level of personality traits are not only universal but they seem to increase with higher levels of human development including long and healthy life, equal access to knowledge and education, and economic wealth (Costa, Terracciano, & McCrae, 2001; Schmitt, Realo, Voracek, & Allik, 2008).

2. Large-Scale Cross-Cultural Studies

Collection of personality data from many cultures is very expensive. There are only two principal ways to collect data from a sufficient number of countries. The first is to put together a popular inventory which will be translated into a large number of languages by enthusiastic colleagues. The Eysencks' EPQ and Costa and McCrae's NEO PI-R are good examples of this relatively slow method of collecting data (Lynn & Martin, 1995; McCrae, 2002; van Hemert, van de Vijver, Poortinga, & Georgas, 2002). Another way is to form an international research consortium, which is held together by the promise that the first two or three papers are co-authored by all those who participate in the consortium, and collect the data. For instance, David Schmitt, who following his mentor David Buss reintroduced this method to a cross-cultural research, was able to collect personality data from 56 countries or territories (Schmitt, Allik, McCrae, & Benet-Martinez, 2007). Exploiting the same research scheme, McCrae and Terracciano were later able to collect observer-reported personality data and national character ratings from 50 cultures (McCrae, Terracciano, & 78 Members of the Personality Profiles of Cultures Project, 2005; McCrae, Terracciano, & 79 Members of the Personality Profiles of Cultures Project, 2005).

Another important development in research technology is, of course, the widespread use of Internet which allows the collection of huge samples during a relatively short period of time. Perhaps one of the best examples is the BBC Internet study of sexual differences which allows one to observe sex differences in three personality traits—extraversion, agreeableness, and neuroticism—for over 200,000 participants from 53 nations (Lippa, 2010). Although appealing, the self-recruited Internet data seems biased (more educated people are more likely recruited) compared to random sampling (Pullmann, Allik, & Realo, 2009) which may constrain their value (however compare Gosling, Vazire, Srivastava, & John, 2004).

Richard Lynn was among the firsts who noticed regularities in the geographical distribution of intelligence (Lynn, 1997). There are reasons to suspect that personality traits also demonstrate a systematic geographic pattern of distribution. However, it was much more complicated to find a systematic pattern in the geographic distribution of personality traits. Unlike IQ data, personality traits showed a clear contrast between European and American cultures and Asian and African cultures. The former were higher in extraversion and openness to experience and lower in agreeableness (Allik & McCrae, 2004; Schmitt et al., 2007). Although this pattern of geographic distribution of personality traits is fairly replicable, there are only speculations about their genetic or cultural origin.

In contrast to cross-cultural differences in intelligence (Lynn & Meisenberg, 2010) the mean differences in personality across different countries are rather modest. It seems to be a replicable pattern that country means have standard deviations equal to about one-third of the magnitude of individual differences within culture (Allik, 2005). This means that variance produced by cross-cultural differences is approximately nine times smaller than what is produced by interindividual variance within each country. One obvious consequence of this observation is that expected convergence between different cross-cultural studies using different personality instruments cannot be very high (Schmitt et al., 2007). What is, however, truly remarkable is that some personality differences are much more reliable than the mean scores themselves. It is not only, as was noticed above, that women in most countries are higher in several traits related to neuroticism, agreeableness, warmth, and openness to feelings, whereas men score higher on scales measuring assertiveness and openness to ideas, but the differences increase systematically with human development—including long and healthy life, equal access to knowledge and education, and economic wealth (Costa et al., 2001; Schmitt et al., 2008). There also seems to be a pervasive difference in how personality of younger and older targets is perceived (the same applies to self-other reports): younger people are thought to be considerably more extraverted and open than older people, and older people are perceived to be more agreeable and conscientious than younger people (Allik, Realo et al., 2009; McCrae, Terracciano, & 78 Members of the Personality Profiles of Cultures Project, 2005). Somewhat surprisingly, there is also a cross-culturally replicable pattern of differences between internal and external perspectives for the Big Five personality traits. People everywhere see themselves as more neurotic and open to experience compared to how they are seen by other people. External observers, on the other hand, generally hold a higher opinion of an individual's conscientiousness than he or she does about him or herself (Allik, et al., in press).

3. National Stereotypes

In everyday life people are not only judging their own or other people's personality. They also have strong opinions about groups of people, most frequently defined by their ethnic or national origin. There are many jokes about ethnic stereotypes. Finns, for instance, are often depicted by their neighbours as having no sense of humour as well as being quiet, taciturn, and slow. "How do you tell a Finnish extravert from a Finnish introvert? The extravert will look at your shoes when he's talking to you - the introvert will look at his own...." What is surprising, these jokes indeed sound very funny because quite often, people have strong opinions about the typical representative of their own or a neighbouring nation.

Most of the previous studies of national stereotypes remained inconclusive since the researchers had no clear idea about how to measure the adequacy of national stereotypes. A real breakthrough came when Antonio Terracciano, Robert R. McCrae and their colleagues decided to measure the correspondence between national stereotypes with the mean ratings of personality across 49 nations (Terracciano et al., 2005). It turned out that the widely held belief that national stereotypes contain a "kernel of truth" (Allport, 1978/1954) is wrong because, with a single exception, the ratings of the national character do not resemble aggregated personality trait ratings in at least 49 countries or territories (Terracciano et al., 2005).

Although using exactly the same instrument for measuring both stereotypes and personality dispositions could improve resemblance between these two types of ratings (Allik, Mõttus, & Realo, 2010; Realo et al., 2009), it is clear that opinions about national character are rarely if ever based on statistical averaging of judgements concerning really existing personality dispositions. One of the mechanisms of the stereotype formation is mirroring a dominant national stereotype in the culture. For example, it seems that Canadians formed their ideas about their national character based almost entirely on the stereotypes of a typical American by a simple inversion (Terracciano et al., 2005). Similarly, there was not much specifically to say about Northern Italians except that they are direct opposites in everything to what is typically believed about Southern Italians (McCrae, Terracciano, Realo, & Allik, 2007a). Needless to say that there were no differences between South and North Italians in their self-ratings. Continuing the examples of the mirror-stereotypes, Estonians, Latvians and Finns appear to form their aggregated self-portraits by mainly making negative images of their culturally and politically dominating neighbour—the Russians (Realo et al., 2009). All these recently collected evidences indicate that the primary role of national stereotypes is not to summarize really existing personality dispositions. The stereotypes rather reflect values and social norms that are shared by the members of a nation, and they may serve the function of maintaining a national identity by constructing stereotypes that reflect beliefs, either true or wrong, about some other nations, or beliefs about socially desirable personality traits (Allik et al., 2010; Allik, Mõttus et al., 2009).

4. Validity of the Country-Level Mean Scores of Personality

After Richard Lynn and Tatu Vanhanen published their *IQ and the wealth of nations* (2002), one of the most serious criticisms was that the mean scores of IQ reported in the book cannot be trusted (for answers to the critique, see Lynn & Vanhanen, 2006). To be true, some of the mean scores required later correction (Lynn & Meisenberg, 2010) but the general validity was not questioned because the scores strongly converged with various studies of educational attainment (Lynn & Mikk, 2009; Rindermann, 2007). The agreement between the Lynn-Vanhanen IQ estimates and educational studies such as PISA and TIMSS is remarkable since their authors usually openly distance from IQ studies. Richard Lynn has always assumed that the mean personality scores collected either with the Eysencks' EPQ or Costa-McCrae's NEO PI-R are at least in the first approximation reliable. Later studies have generally confirmed this assumption (Schmitt et al., 2007).

Since personality questionnaires measure opinions rather than individuals' performance, it gives even more reason to question the validity of the nation-level mean personality scores. Some of the scepticism is based on theoretical arguments (Ashton, 2007; Perugini & Richetin, 2007) accompanied by empirical evidences showing that at least in one personality domain (i.e., Conscientiousness) national mean scores of personality strongly disagree with expected criterion variables (Heine, Buchtel, &

Norenzayan, 2008). Heine and colleagues (2008) reanalyzed published data showing that aggregate national scores of self-reported Conscientiousness were, contrary to the authors' expectations, negatively correlated with various country-level behavioural and demographic indicators of Conscientiousness, such as postal workers' speed, accuracy of clocks in public banks, accumulated economic wealth, and life expectancy at birth. Oishi and Roth (2009) expanded the list of contradictory findings by demonstrating that nations with high self-reported Conscientiousness were not less but more corrupt.

A part of the validity criticism can be dismissed on the basis of some simple considerations. For example, proponents who assume that the mean scores are distorted by some kind of social comparison process usually ignore that they demand unrealistic abilities to estimate the average level of personality traits of some reference groups or the whole nations (McCrae, Terracciano, Realo, & Allik, 2007b). Differences between nations may be too small to be noticed even by the collective wisdom of thousands of everyday raters. Another problem is that the social comparison process may decrease, not increase the predictive validity of personality measures. Although it is rather easy to persuade respondents to think relative to a salient comparison group, this leads to substantial reductions in criterion-related validities such as academic performance, self-reported counterproductive behaviours, and self-reported health outcomes (Credé, Bashshur, & Niehorster, 2010).

When the external criterion variable is based on the behaviour of a small group of people, who form only a small fraction of the total population, the relationship between personality variables could be easily inverted (Mõttus, Allik, & Realo, 2010). For example, the crime rate in the 50 US states is positively related to the mean level of Conscientiousness which is typically characterized as an ability to resist impulses and temptations and a tendency to be organized, strong-willed, and determined (Rentfrow, Gosling, & Potter, 2008). It would be difficult to think that self-discipline and strong character inclines people to commit crimes. It is more likely that very few people living among highly conscientious people find it difficult to meet high standards and more easily lose control over their impulses. Similarly, nobody doubts that people commit suicide mainly because they feel desperately unhappy. However, in countries where more people are generally happy and satisfied with their lives, the suicide rate is higher than in those countries where people tend to feel more miserable (Inglehart, 1990). An explanation for this paradox is that the very small number of people who commit suicide may be mainly those who are not able to cope with the social demand for being happy brought about by the relatively high average level of happiness (Inglehart, 1990).

Finally, it is possible that the personality traits used in predictive validity studies are sometimes too broad and only some of their aspects are related to the expected criterion variable. For example, the relationship to potential criterion variables differed largely across facets of the broad Conscientiousness domain. For several facets, the pattern of relationships to external criteria were consistent with clearly formulated predictions, but only few facets were related to few criteria in an unexpected manner (Mõttus et al., 2010).

Thus, it is premature to claim that the national mean scores of personality are invalid after discovering that some correlations with the criterion variables contradict the common sense or vaguely formulated theoretical expectations. It is more urgent to elaborate on reasonable tactics about how to react to the increasing number of findings that personality instruments used in cross-cultural studies demonstrate, in the best case, structural invariance, but very rarely the full metric invariance (Nye, Roberts, Saucier, & Zhou, 2008; Rossier, Dahourou, & McCrae, 2005).

5. Conclusions

Cross-cultural studies of personality traits involving a large number of countries were launched only recently. Many of these studies were inspired by Richard Lynn's pioneering research and by the sometimes uncomfortable questions he had the courage to ask. The study of national differences in personality has lagged behind similar studies of intelligence, but when influenced by Lynn's prevailing ideas, they have nevertheless reached a satisfying level of sophistication. There are now several replicable regularities, emerging from the truly collaborative efforts of numerous researchers from many countries. This indicates that the study of national differences in personality may soon be ready to answer some of the most fundamental questions of social sciences, such as the relations among genes, culture, and personality. Is culture shaped by the aggregate personality traits of its members? Can selective migration cause genetic drift which changes the mean level of personality traits in the population? Can acculturation change personality traits?

References

Allik, J. (2005). Personality dimensions across cultures. *Journal of Personality Disorders, 19*, 212-232.

Allik, J., & McCrae, R. R. (2004). Toward a geography of personality traits - Patterns of profiles across 36 cultures. *Journal of Cross-Cultural Psychology, 35*, 13-28.

Allik, J., Mõttus, R., & Realo, A. (2010). Does national character reflect mean personality traits when both are measured by the same instrument? *Journal of Research in Personality, 44*, 62-69.

Allik, J., Mõttus, R., Realo, A., Pullmann, H., Trifonova, A., McCrae, R. R., et al. (2009). How national character is constructed: personality traits attributed to the typical Russian. . *Psychological Journal of International University of Nature, Society and Human "Dubna", 2*, 1-23.

Allik, J., Realo, A., Mõttus, R., Borkenau, P., Kuppens, P., & Hřebíčková, M. (2010). How People See Others is Different from How People See Themselves: A Replicable Pattern across Cultures. *Journal of Personality and Social Psychology*, 99, 870-882.

Allik, J., Realo, A., Mõttus, R., Pullmann, H., Trifonova, A., McCrae, R. R., et al. (2009). Personality traits of Russians from the observer's perspective. *European Journal of Personality, 23*, 567-588.

Allport, G. W. (1978/1954). *The nature of prejudice* (25th Anniversary ed.). New York: Basic Books.

Ashton, M. C. (2007). Self-reports and stereotypes: A comment on McCrae et al. *European Journal of Personality, 21*, 983-986.

Bayatrizi, Z. (2009). Counting the dead and regulating the living: early modern statistics and the formation of the sociological imagination (1662-1897). *British Journal of Sociology, 60*, 603-621.

Camperio Ciani, A. S., & Capiluppi, C. (2011). Gene flow by selective emigration as a possible cause for personality differences between small islands and mainland populations. *European Journal of Personality, 25*, 53-64.

Camperio Ciani, A. S., Capiluppi, C., Veronese, A., & Sartori, G. (2007). The adaptive value of personality differences revealed by small island population dynamics. *European Journal of Personality, 21*, 3-22.

Costa, P. T., Terracciano, A., & McCrae, R. R. (2001). Gender differences in personality traits across cultures: robust and surprising findings. *Journal of Personality and Social Psychology, 81*, 322-331.

Credé, M., Bashshur, M., & Niehorster, S. (2010). Reference Group Effects in the Measurement of Personality and Attitudes. *Journal of Personality Assessment, 92*, 390-399.

Crick, F. (1990). *What mad pursuit. A personal view of scientific discovery*. London: Penguin.

Gosling, S. D., Vazire, S., Srivastava, S., & John, O. P. (2004). Should we trust web-based studies? A comparative analysis of six preconceptions about Internet questionnaires. *American Psychologist, 59*, 93-104.

Heine, S. J., Buchtel, E. E., & Norenzayan, A. (2008). What do cross-national comparisons of personality traits tell us? The case of conscientiousness. *Psychological Science, 19*, 309-313.

Inglehart, R. (1990). *Culture shift in advanced industrial society*. Princeton, NJ: Princeton University Press.

Lippa, R. A. (2010). Sex Differences in Personality Traits and Gender-Related Occupational Preferences across 53 Nations: Testing Evolutionary and Social-Environmental Theories. *Archives of Sexual Behavior, 39*(3), 619-636.

Lynn, R. (1971). *Personality and national character*. Oxford: Pergamon Press.

Lynn, R. (1981). Cross-cultural differences in neuroticism, extraversion and psychoticism In R. Lynn (Ed.), *Dimensions of personality. Papers in honour of H. J. Eysenck* (pp. 263-286). Oxford: Pergamon Press.

Lynn, R. (1997). Geographical variation in intelligence. In H. Nyborg (Ed.), *The scientific study of human nature: Tribute to Hans J. Eysenck at eighty* (pp. 259-281). Oxford: Pergamon.

Lynn, R., & Martin, T. (1995). National differences for thirty-seven nations in extraversion, neuroticism, psychoticism and economic, demographic and other correlates. *Personality and Individual Differences, 19*, 403-406.

Lynn, R., & Meisenberg, G. (2010). National IQs calculated and validated for 108 nations. *Intelligence, 38*, 353-360.

Lynn, R., & Mikk, J. (2009). National IQs predict educational attainment in math, reading and science across 56 nations. *Intelligence, 37*, 305-310.

Lynn, R., & Vanhanen, T. (2002). *IQ and the wealth of nations*. Westport, Conn.: Praeger.

Lynn, R., & Vanhanen, T. (2006). *IQ and global inequality*. Augusta, Georgia: Washington Summit Publishers.

McCrae, R. R. (2002). NEO-PI-R data from 36 cultures: further intercultural comparisons. In R. R. McCrae & J. Allik (Eds.), *The Five-Factor Model of personality across cultures* (pp. 105-125). New York: Kluwer Academic/Plenum Publishers.

McCrae, R. R., Terracciano, A., & 78 Members of the Personality Profiles of Cultures Project. (2005). Universal features of personality traits from the observer's perspective: Data from 50 cultures. *Journal of Personality and Social Psychology, 88*, 547-561.

McCrae, R. R., Terracciano, A., & 79 Members of the Personality Profiles of Cultures Project. (2005). Personality Profiles of Cultures: Aggregate Personality Traits. *Journal of Personality and Social Psychology, 89*(3), 407-425.

McCrae, R. R., Terracciano, A., Realo, A., & Allik, J. (2007a). Climatic warmth and national wealth: Some culture-level determinants of national character stereotypes. *European Journal of Personality, 21*, 953-976.

McCrae, R. R., Terracciano, A., Realo, A., & Allik, J. (2007b). On the validity of culture-level personality and stereotype scores. *European Journal of Personality, 21*, 987-991.

Mõttus, R., Allik, J., & Realo, A. (2010). An attempt to validate national mean scores of conscientiousness: No necessarily paradoxical findings. *Journal of Research in Personality, 44*, 630-640.

Nye, C. D., Roberts, B. W., Saucier, G., & Zhou, X. Y. (2008). Testing the measurement equivalence of personality adjective items across cultures. *Journal of Research in Personality, 42*, 1524-1536.

Oishi, S., & Roth, D. P. (2009). The role of self-reports in culture and personality research: It is too early to give up on self-reports. *Journal of Research in Personality, 43*, 107-109.

Perugini, M., & Richetin, J. (2007). In the land of the blind, the one-eyed man is king. *European Journal of Personality, 21*, 977-981.

Pullmann, H., Allik, J., & Realo, A. (2009). Global self-esteem across the life span: A cross-sectional comparison between representative and self-selected Internet samples. *Experimental Aging Research 35*, 20-44.

Realo, A., Allik, J., Verkasalo, M., Lönnqvist, J. E., Kwiatkowska, A., Kööts, L., et al. (2009). Mechanisms of the national character stereotype: How people in six neighboring countries of Russia describe themselves and the typical Russian. *European Journal of Personality, 23*, 229-249.

Rentfrow, P. J., Gosling, S. D., & Potter, J. (2008). A Theory of the Emergence, Persistence, and Expression of Geographic Variation in Psychological Characteristics. *Perspectives on Psychological Science, 3*, 339-369.

Rindermann, H. (2007). The g-factor of international cognitive ability comparisons: The homogeneity of results in PISA, TIMSS, PIRLS and IQ-tests across nations. *European Journal of Personality, 21*, 667-706.

Rossier, J., Dahourou, D., & McCrae, R. R. (2005). Structural and mean-level analyses of the five-factor model and locus of control - Further evidence from Africa. *Journal of Cross-Cultural Psychology, 36*, 227-246.

Schmitt, D. P., Allik, J., McCrae, R. R., Benet-Martinez, V., Alcalay, L., Ault, L. et al. (2007). The geographic distribution of big five personality traits - Patterns and profiles of human self-description across 56 nations. *Journal of Cross-Cultural Psychology, 38*, 173-212.

Schmitt, D. P., Realo, A., Voracek, M., & Allik, J. (2008). Why can't a man be more like a woman? Sex differences in big five personality traits across 55 cultures. *Journal of Personality and Social Psychology, 94*, 168-182.

Terracciano, A., Abdel-Khalek, A. M., Adam, N., Adamovova, L., Ahn, C., Ahn, H. N., et al. (2005). National character does not reflect mean personality trait levels in 49 cultures. *Science, 310*, 96-100.

van Hemert, D. A., van de Vijver, F. J. R., Poortinga, Y. H., & Georgas, J. (2002). Structural and functional equivalence of the Eysenck Personality Questionnaire within and between countries. *Personality and Individual Differences, 33*, 1229-1249.

Chapter 9

The Decay of Western Civilization: Double relaxed Darwinian selection

HELMUTH NYBORG
University of Århus, Denmark (1968-2007)
helmuthnyborg@hotmail.com

ABSTRACT

This article briefly describes Lynn's view on what makes modern populations rise and fall. It then provides a demographic analysis of what happens to modern sub-fertile high-IQ Western populations when Internal Relaxation of Darwinian Selection (IRDS) combines with External Relaxation (ERDS, in the form of super-fertile low-IQ non-Western immigration) into Double Relaxation of Darwinian Selection (DRDS). The genotypic IQ decline will ruin the economic and social infrastructure needed for quality education, welfare, democracy and civilization. DRDS is currently unopposed politically, so existing fertility differentials may eventually lead to Western submission or civil resistance.

1. Introduction

Science and civilization owe much to Richard Lynn for his decade-long attempts to identify major factors behind the rise and fall of modern populations. In *Race differences in intelligence: An evolutionary analysis* (2006) Lynn mapped geographic variations in intelligence, and explained related race differences by Cold Winters theory, according to which people from Africa migrated up North, and met still more harsh climatic challenges, so they had to develop new ways of preserving food, heat-efficient cloth and sheltering, complex traps, and later agricultural, industrial and urban ways of life. As they migrated further North, they became increasingly exposed to unforgiving Darwinian selection for superior intelligence, health, and character.

In two other books, *IQ and the Wealth of Nations* (2002) and *IQ & global inequality* (2006) Lynn and Vanhanen proved the existence of a geographic gradient for intelligence by establishing average IQ estimates for all countries in the world with populations larger than 40,000, and showed that they rank themselves according to a North-South gradient correlating 0.82 with Gross National Product (GNP).

In *Dysgenics: Genetic Deterioration in Modern Populations* (1996) Lynn re-introduced the classic eugenic idea that modern societies erode if Darwinian selection is relaxed. Western civilization began to decay when the once predominant preindustrial Darwinian natural selection process broke down in modern societies during the nineteenth and twentieth century. The implication is that modern populations deteriorate genetically in health, intelligence, and character to a point where their civilization is no longer sustainable. Lynn regrets that the forewarnings of the early eugenic whistleblowers were forgotten. He deserves much credit for bringing up again their important agenda in spite of a hostile academic and political climate.

In a sequel book *Eugenics: A reassessment* Lynn (2000) first reiterated the early objectives of classical eugenics, and then outlined a *New Eugenics* program, based more on recent advances in human biotechnology than on classical principles.

Lynn raises the most serious and morally challenging problem facing advanced populations: The noble, ethically motivated, preservation of the weak inevitably leads to self-destruction through a progressive reduction in the quality of the genetic material for superior intelligence, health, fertility and personality - traits essential for the rise and sustainability of advanced civilizations.

2. The anatomy of Western decay

The genetic decay may take one of two routes or work in tandem. I suggest the following terminology for this: An Internal Relaxation (or Reversal) of Darwinian Selection (IRDS), and an External Relaxation (or Reversal) of Darwinian Selection (ERDS). This study estimates the effects of both in terms of Double Relaxation (or reversal) of Darwinian Selection (DRDS).

2.1 IRDS

Natural selection previously worked through the elimination of the old and via social-class differentials in the number of children surviving to adulthood. The greater reproductive fitness of the upper and middle classes indicates the presence of positive natural selection for intelligence, as does negative selection in the lower classes with higher mortality, more infanticides and abortions, undernourishment associated lower fertility, bad health and higher mortality rate among illegitimate children, and strong social controls preventing marriage for the unfit, thereby typically reducing their procreation.

Lynn (1996, p. 18 ff) noted that natural selection due to high mortality broke down around year 1800, whereas low fertility of the less fit changed around 1850, thanks to improved hygiene and disease reduction. This reduced mortality in general – but more so for the poor. This first demographic transition was more or less complete towards the middle of the twentieth century. IRDS is reflected primarily in the low fertility among the intelligent and by a population profile biased towards the old. IRDS currently characterizes Europe and most other modern societies. The reason why the professional and middle classes reduced their fertility more than the working class is still debated, but more efficient use of contraception by the educated classes and rising educational aspiration of modern women might play a role. IRDS also works when selective pressures against elimination of harmful mutant genes are lifted. Lynn (1996, p. 31) averaged the results of several early studies, and found that intelligence had declined 2 points per generation.

A decline in genotypic intelligence can be estimated from phenotypic intelligence by multiplying the heritability for intelligence with the phenotypic decline. Using the calculated average heritability for intelligence of 0.82, Lynn (1996, p. 36) found that the adjusted genotypic decline of British IQs was 1.64 points per generation between 1920 and 1940, and 0.66 points per generation for the second half of the 20th. century. Averaging declines over several studies covering a 90 year period, Lynn noted a phenotypic decline of 6.2, or 0.069 IQ point per year.

Denmark (DK) has a homogenous population of 5+ million citizens with negligible immigration for more than a thousand years, which makes it appear technically more like a tribe than a nation (Rasmussen, 2008). Today, the population is alarmingly sub-fertile and ageing, and excellent social and health care systems increasingly preserve the weak and old. Applying Lynn's British estimate, Danish phenotypic and genotypic IQ have declined 0.069*161 years and 0.056*161 years, or 11.11 and 9.11 IQ points, respectively, since 1850 due to IRDSD.

2.2 ERDS

IRDS recently combined with ERDS into *Double Relaxation (or Reversal) of Darwinian Selection* (DRDS) when super-fertile non-Western low-IQ immigrants began to replace ethnic Danes. The present study evaluates what this means for population dynamics and phenotypic pre-immigration IQ.

3. Method and analysis

StatistikBanken (SB: http://www.statistik-banken.dk/) publishes yearly statistics for: 1) Total DK Population, 2) Number of foreign citizens/citizens of foreign origin distributed by citizenship, including children born abroad, 3) Number of naturalizations of the year including the children born before the naturalization. Children born to foreign citizens/citizens of foreign origin in DK are counted as Danish citizens and so are the children born to naturalized citizens after naturalization. SB also has a category for so-called immigrants and their descendants. It, finally, publishes total common birth and total common mortality rates each year.

The place-of-birth type of classification makes it increasingly more difficult to tell apart ethnic Danes from Danish citizens of foreign origin, and to reliably identify citizens and their children by Country-of-Origin (COO). This artificially raises the estimate of ethnic Danish fertility and lowers that for citizens of foreign origin, thus preventing an objective analysis of the effect of ERDS, which demands accurate information on citizens by COO.

The present study uses the official counts from SB, but in a way that partly circumvents the ethnic mix-up problem. A download January 1st. 1979 gave the number of citizens and people of foreign origin with an address in DK and registered in the Central Person Register. Changes in status for 1979 were then checked January 1st. 1980 and again each January 1$^{st.}$ the following years until January 1st. 2010 with respect to 1) number of foreign citizens the year, 2) *estimated* number of children born to all foreign citizens in DK, 3) number of naturalized individuals, and 4) *estimated* number of children born to all naturalized individuals the year (based on the total birth rates provided by United Nations (UN: http://un.org/esa/) for each of 235 COO), and to the total common mortality rates for DK. The difference between the total population counts and the partly estimated number of citizens of foreign origin is the *estimated* residual number of ethnic Danes.

On January 1st. 1980, the birth rates for the 235 COOs and the total common mortality rate in DK constituted the "interest rates" of increases for the status in January 1st. 1979. Foreign citizens and naturalized citizens 1979 were then added. This was repeated the following year (1981) based on status per January 1st. 1980, and for each ensuing year.

The analysis thus retro-corrected the official population counts 1979-2010 for each of the 235 COOs in a year-by-year fashion, by balancing the ratios of official UN birth rates (*b*) against the total common mortality rate for DK (*d*) for the year immediately before, and adding increases in the number of citizens of foreign origin (i_{fo}) and naturalized people (i_{np}) in accordance with the annuity model:

Status count 1979 x $(1+(b\text{-}d)/1.000) + i_{fo} + i_{np}$

The retro-estimated numbers for 1979-2010 were then used for projections of population growth 2011 to 2072, based on the following assumptions: 1) An average of ethnic Danish net emigration of 2.700 per year for the period of 1997-2007, 2) The UN-recommended birth rates for all developed countries of 9.6, reduced by 1/10 of a point from 2032 and again every seventh year forward (even though we had estimated it to be 9.3 at January 1st. 2010 by a weighted average based on the UN-recommended foreign birth rates, 3) The SB registration of population count and the total common birth- and mortality rates in DK (where the total mortality rate was the arithmetic average of the rates 2007-2009), 4) The net number of new immigrants per year for each the 235 COOs (where the average was calculated from the numbers for the latest seven years).

When the annuity approach was used for projection, the last two parts of the formula (i_{fo} + i_{np}) were substituted by the number of net immigration per year, that is, 17.037.

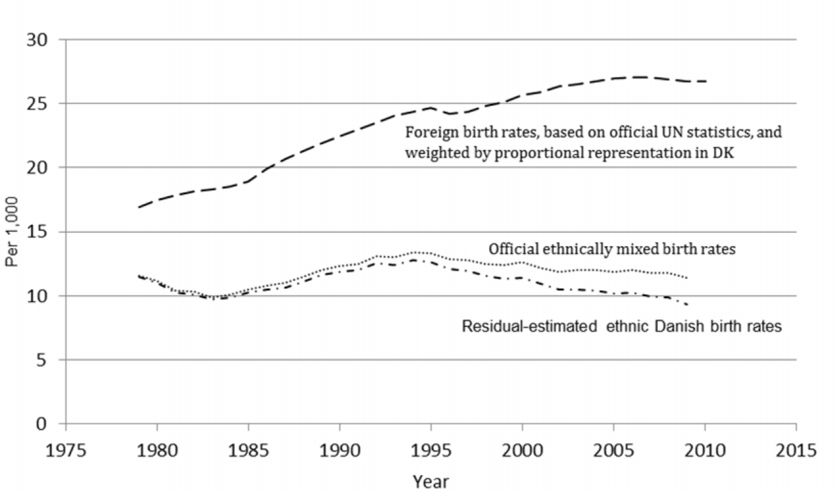
National average IQs were taken from Lynn and Vanhanen (2006), weighted separately for each country each year according to its proportional numerical presence in DK, and then the retro-estimated IQs were categorized into 5 IQ bands. A large meta-analysis of IQ scores of immigrants to the Netherlands is also available (te Nijenhuis, de Jong, Evers, & van der Flier, 2004).

4. Results

4.1 Measures 1979-2010

The upper curve in figure 1 shows the yearly summed average number of live children born per 1.000 per year for citizens of foreign origin 1979 to 2010, weighted by their relative representation among immigrants and their descendants.

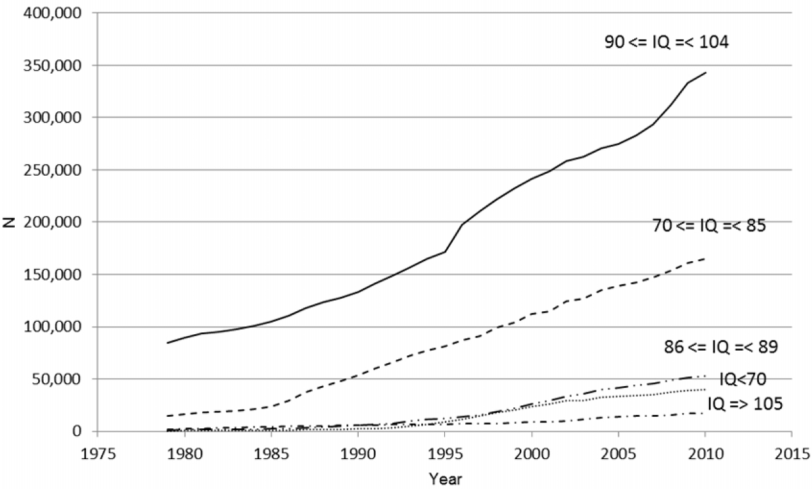
Figure 1. Average birth rates for the period 1979-2009



The middle curve reflects the official uncorrected ethnically mixed count of total birth rates in DK. The bottom curve is the summed averages of retro-estimated number of live children born per 1.000 residual-estimated (by weighted averages) ethnic Danes. The ethnic Danish birth rate was 9.31 in 2009, and the ethnically mixed curve declined from 1995 onwards, reaching 11.4 in 2009. From about 1990, the shares of individual births by foreign origin have had a still leveraged weight of the former ethnic curve to a higher total common curve. The ethnic Danish birth rate reached a local minimum of 9.68 in 1983 and an even lower rate of 9.31 in 2009. Several alternative birth rate model simulations suggested that even the official UN-recommended birth rates used here do not reflect true rates.

Figure 2 maps year-by-year changes in national average IQs when categorized into 5 IQ bands and weighted in accordance with their proportional numerical representation 1979-2010.

Figure 2. Retro-estimated number of immigrants and their descendents 1979-2010, categorized into 5 IQ band.

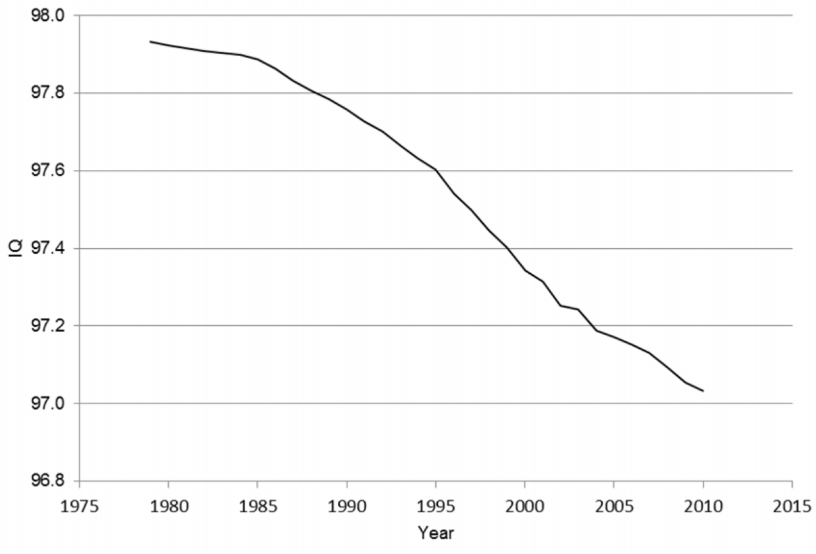


Mostly non-Western immigrants with average IQs above 105 (predominantly East Asians), and those with IQs between 86 and 89 (mostly Latin American, Caribbean, Central Asian and Southeast Asians) were few in 1979, and their relative proportions did not increase much up unto 2010. Neither did the mainly sub-Saharan representations with IQs below 70, nor the Middle Eastern, North African, and several Latin American and

Caribbean representations with IQs between 80 and 85. In contrast, the group with IQs between 90 and 104 rose four-fold in number. This group includes immigrants with IQs 90-94 (mainly from the Balkans via Turkey to Central Asia or European inhabited Latin American Countries, plus immigrants with IQs between 95 and 99 (from European or European offshoot countries, except Israel), plus immigrants with IQs 100 to104 (all, except Taiwan and Singapore, from countries situated in temperate or cold climatic zones). The less gifted share of immigration to DK with IQs below 90 was thus modest 1979-2010, compared to the relatively gifted share of immigrants with IQs above 90. The classification of immigrant IQs by area of origin was modeled after Vanhanen (2009).

As the total number of immigrants with IQs lower than 90 did not increase much, there was little reason to expect that the Western IQ differences in birth rates would affect overall Danish IQ. Figure 3 confirms this.

Figure 3. Overall average DK IQ decline 1979-2010.



The phenotypic decline amounts to just 0.9 IQ point.

4.2 Projections 2011-2072

Table 1 outlines selected key numbers to facilitate understanding of the ensuing projections.

Table 1. Projected population growth, proportional birth rates by IQ band, similarity to DK IQ, and ethnic origin. Finally, total percentages of births by Western/non-Western origin.

	1979	**2009/2010**	**2072**
Population growth due to immigration or number of births (%)			
Immigration		72.0	23.0
Births		28.0	77.0
Birth rates by IQ band			
IQ<70	40.4	39.0	40.0
70-85	28.4	32.8	40.8
86-89	22.0	22.6	23.8
90-104	11.7	12.7	12.3
IQ>105	9.6	13.2	14.7
Birth rates by similarity to DK IQ (=98)			
>	9.6	10.1	10.6
EQ	12.0	11.3	11.0
<	21.0	24.9	32.8
Birth rates by ethnic origin			
Danish[1]	9.3	9.3	9.3
Western[2]	9.9	9.9	9.9
All foreign	14.3	20.6	28.2
Non-Western	23.7	27.6	34.8
Total percent births/year by foreign origin			
	3.1	21.4	67.4

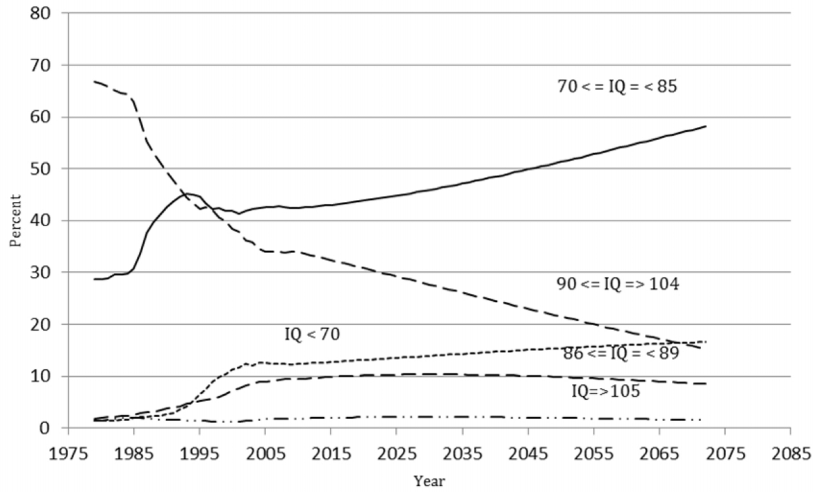
	1979	2009/2010	2072
Total percent of population of foreign origin			
	2.0	10.9	40.6
Percentage of births/year			
Danish	96.9	78.6	32.6
Western	1.5	4.1	6.3
Non-Western	1.6	17.2	61.1

[1] UN recommends a birth rate of 9.6 for all developed nations. Given this, data from SB led to 9.3 for residual ethnic Danes in 2009.
[2] When Europe to Ural and Caucasus, Israel, New Zealand and Australia are included in the group of Western origin, the weighted average is 9.9.

Section 1 forewarns major changes in future population growth due to ERDS. Whereas 72% of the growth in 2010 was due to new immigration, by 2072 more than three quarter of further growth will be driven by the higher fertility of non-Western immigrants. The next section shows that retro-estimated birth rates were inversely related to IQ in 1979 and 2009, as immigrants with lower IQs are 2-4 times more fertile than high IQ immigrants, and this inverse relationship is assumed to generalize over time. Section 3 shows that retro-estimated birth rates for citizens with IQs similar or higher to that of ethnic Danish IQ (= 98) are only about half that of citizens with lower IQs. Section 4 shows that estimated and projected birth rates increase when going from ethnic Danes, over Western immigrants, to all foreign citizens, to non-Western citizens. The higher birth rate of Non-Westerns can be expected to more than triple by 2072. Section 5 suggests that foreign citizens can be expected to account for 67.4 of all birth in DK in 2072, close to 22 times their rate of births in 1979. Section 6 suggests that the proportional representation of immigrants increases about 20 times between 1979 and 2072. The final section suggests that residual ethnic Danes recede from almost total birth dominance (97% in 1979), to account for only 32.6% of all live births in 2072, when citizens of non-Western origin answers for more than 60% of all births. This six-fold increase is driven by higher fertility rates, as immigration was set to constant in the projection.

Figure 4 reflects retro-estimated and projected changes in the proportional percentage share of total population fertility.

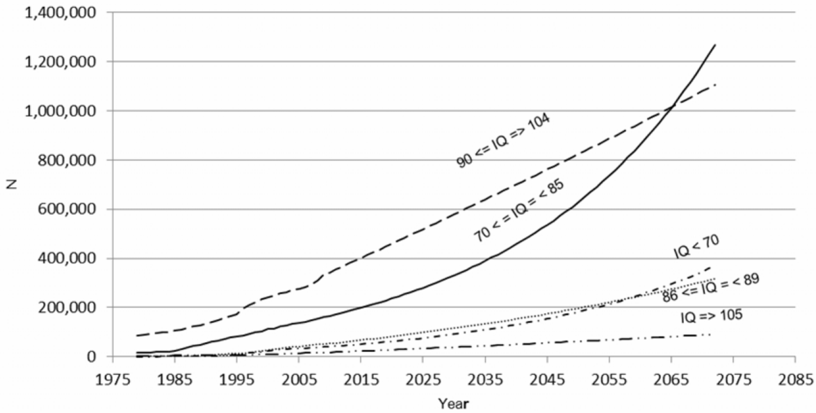
Figure 4. Retro-corrected (1979-2009) and projected (2010-2072) IQ group shares of foreign births by IQ band.



Very high IQ immigrants (=>105) and low IQ immigrants (86 to 89) maintain less than 10% of their share of foreign births, whereas the sub-Saharan share (IQ<70) increases slightly. The share of births by the predominantly Western group (90 and 104) dropped three-fold 1979-2010 from a relatively high level in 1979, leading to projection of a further two-fold drop to about 15% by 2072. The low IQ (70 to 85) immigrant share increased during the 1980s, with an initial burst in the 1990s, and is projected to grow steadily to close to 60% of the share of all births by 2072. The smoothness of curves after 2011 reflects that net immigration per year was kept constant (based on past immigration from the 235 COOs).

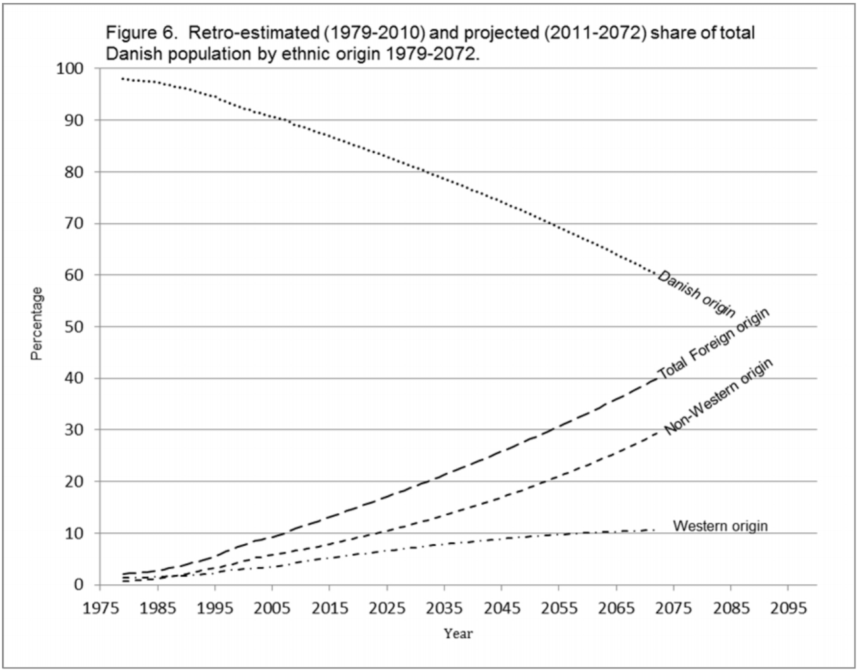
Figure 5 estimates (1979-2010) and projects (2011-2072) expected number citizens by IQ band.

Figure 5. Estimated (1979-2010) and projected (2011-2072) number of citizens, categorized by 5 IQ bands.



The fertility differentials in figure 4 largely explain the estimated and expected population growth seen in figure 5. Growth of groups with IQs above 105 and between 86 to89 thus remains modest. The slight acceleration for citizens with IQs below 70 means a moderate linear increase in number. Accelerating fertility for citizens with IQ 70-85 converts into a rapidly rising share, whereas the considerable drop in proportions of births by citizens with IQ 90-104 implies that they will eventually be outnumbered by citizens with IQ 70-85.

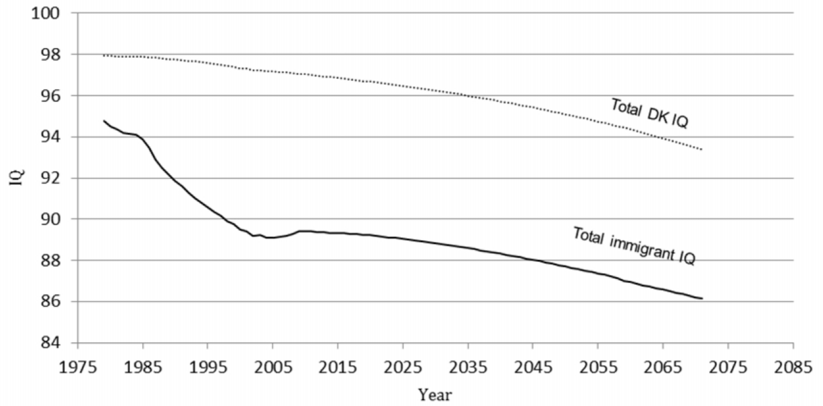
Figure 6 summarizes the retro-estimated and projected percentage proportional representation of 1) Ethnic Danes, 2) All foreign citizens, 3) Non-Western citizens, and 5) Western citizens, respectively.



By 2072 the total population in DK may consist of 60 % ethnic Danes and 40 % people of foreign origin. Thirty percent of the latter will be of non-Western origin. Further projection suggests that ethnic Danes become a minority around 2085.

The upper curve in figure 7 reflects the decline in total average Danish IQ as a function of declining immigrant IQ.

Figure 7. Retro-estimated (1979-2010) and projected (2011-2072) average phenotypic IQ declines for the total population and for the total group of citizens of foreign origin.



The decline was briefly interrupted around 1983, reflecting changes in official immigration policy, and again in the 2000s when a burst of relatively high IQ immigration from Eastern Europe at first raised total immigrant IQ. However, the effect was short-lived because Eastern Europeans are about as sub-fertile as most other Western immigrants. The gradual decline in average immigrant IQ drives down the upper curve for overall Danish phenotypic IQ from 98 in 1979 to IQ 93 in 2072, or 5.1 IQ points.

4.3 The Western decay model

Assuming largely similar demographic transitions all over Europe, we may now begin to quantify the associated long-term common phenotypic IQ declines, convert them to genotypic declines, and thus estimate the overall genetic damage done to Western civilization as IRDS combines with ERDS into DRDS, as illustrated in table 2.

Table 2. The model for decaying Western civilization.

IQ loss due to	1850-1978	1979-2010	2011-2072	Total phenotypic decline
IRDS[1]	8.90	2.21	4.28	15.39
ERDS		0.90	5.10	6.0
DRDS (total)	8.90	3.11	9.38	21.39

[1] Decays due to increasing mutation rates and consanguinity are disregarded here.

Multiplying Lynn's summed average estimate for phenotypic British IQ decline over 90 years due to IRDS (i.e. 0.069 per year) with 223 years (1850-1978, 1979-2010, 2011-2072), we obtain a total phenotypic decline of 15.39 IQ points and a genotypic damage of 15.39*0.82 or 12.62 IQ points from IRDS alone. Phenotypic decline due to ERDS adds further 6 IQ points (0.9 + 5.1), or a 4.92 points drop in genotypic IQ (6*0.82) or. Together phenotypic or genotypic DRDS declined 21.39 or 17.54 IQ points, respectively.

5. Discussion

The study illustrated nine points of interest.

First, official Danish birth statistics is demographically misleading. It suggests that immigrant birth rates are low and declining since 1995, whereas retro-correction shows it to be on the rise since 1980 and more than double the ethnic Danish birth rate in 2009. Moreover, instead of rising, Danish birth rates declined since 1995 and reached a new low of 9.31 in 2009. The message is clear: The Danish tribe is threatened by IRDS, and the excellent social and health care systems worsen this by preserving still more weak, poor and old. Other modern countries also present demographically misleading statistics.

Second, fertility differentials exerted little impact on average national IQs 1979 to 2010. The share of immigrants with IQs between 90 and 104, mostly of Western origin, grew faster than that of other groups.

Third, overall phenotypic DK IQ declined by only 0.9 IQ point between 1979 and 2010. However, Teasdale and Owen (2008) found that half a century of IQ increases were in 1997 replaced in by a drop, dragging overall DK IQ down by 1.5 points over a few years. The reverse Lynn-Flynn effect has also been observed in Norway (Sundet, Barlaug, & Torjussen, 2004), but continue elsewhere in- and outside Europe. Still worse, the large birth differentials (Table 1) will over time drive the future population expansion, and low-IQ immigrants (IQs=< 90) consistently display higher birth rates than better endowed immigrants (IQ> 90). Average population IQ is sure to decline.

Fourth, ethnic Danes can be expected to recede from representing 97% of the population in 1979 to 33 percent in 2072, whereas the non-Western representation rises from 12 percent in 1979 to 60+ percent in 2072. The actual transition is probably larger, because the UN Western-Non-Western fertility rates surely under-predict. Still worse, long-term fertility based ERDS processes are largely irreversible, even in the politically highly unlikely case of total stop for non-Western immigration. Gifted immigrant women may lower their fertility when engaged in higher education, but their relatively low number will not affect the overall picture.

Fifth, projection of group shares of foreign births by IQ bands suggests that the numerical share of the IQ 90-104 group drops to below 20%, quite like the high IQ group (105+), the group with IQs below 70, and the group with IQs between 86 and 89. In contrast, the IQ 70-85 group rapidly increases its share to 50+% around 2050. This means that low IQ children from sub-Saharan, Middle Eastern, North African, Latin American and Caribbean countries come to dominate the classrooms in Danish primary schools around 2050.

Sixth, in terms of total population growth, mainly non-Western citizens with IQ 70-85 can be expected to numerically surpass the mainly Western group with IQs 90-104 at about 2065.

Seventh, citizens of foreign origin will numerically outnumber ethnic Danes around 2085.

Eight, the escalation of the mainly non-Western share of low IQ populations translates into a circa 9 points decline in average immigrant IQ.

Ninth, overall DK IQ accordingly declines from 98 in 1979 to 93 in 2072.

The results suggest that entirely unanticipated major changes are in store for the Danish tribe, described as demographic transitions by Coleman (2010). The first is the reduction in mortality and fertility in Europe and North America in the 19th century and the early and middle decades of the 20th century (here called IRDS). The second is the breakdown of the traditional family and changes in lifetime cohabitation without marriage, increased frequency of divorce, and of single parenthood (here changes in infrastructure due to IRDS). The third is the consequences of mass immigration of non-European peoples into Western Europe during the second half of the 20th century (ERDS).

Why were early dysgenic warnings neglected and the messengers demonized? Because too many leading scientists, politicians and intellectuals (Nyborg, 2003; 2011) ignored Darwinian principles and started a historically hitherto unheard of voluntary, humanistic, democratic and financed replacement policy, whereby dwindling genetically weakened sub-fertile Western European populations will rapidly be replaced by more fertile low-IQ non-European immigrants. They allowed IRDS to combine with ERDS into DRDS, as they embarked on IRDS from 1850 and they let ERDS accelerate during second half of the 20th century, and finally allowed DRDS to persist into the 21th century. The result is that Western European peoples become minorities in their own ancestral homelands before the end of the 21th century, and other modern societies undergo similar demographic transitions (see also Coleman, 2006; 2010).

The generality and pervasiveness of these dynamic phenomena makes it tempting to let the simple DRDS decay model explain the downfall also of previous civilizations. The infrastructure of all civilized societies depends on respectable mean IQs and replacement fertility, and genotypic damage to them leads into an anti-Darwinian death spiral that dooms democracy, civilization and, in modern times, welfare.

Genotypic damage is reflected in changes in vital parameters. Vanhanen (2009) thus observed that "... the quality of democracy rises systematically from the lowest to the highest level of national IQ ..." (p. 169). Almost all of the 48 countries studied with IQs above 90 were democracies in 2006, whereas for countries with IQs below 90, less than 20 percent had always been democratic. Societal values are also vulnerable. Meisenberg (2004) demonstrated that IQ is a powerful predictor of modern, non-traditional values, and Deary, Batty, and Gale (2008) found that bright ten year olds tend to develop into enlightened adults. The flip side is that less bright youngsters do not, and they come to dominate classrooms in the West around 2050. National wealth is also sensitive to genotypic damage. Meisenberg (2010) found reciprocal effects between IQ and GDP (β= 0.33 and β = 0.11, respectively), but the effect of intelligence was stronger. A drop of 5 IQ points predicts a 35% decline of Danish GDP (Meisenberg, personal communication December 2010)

The damage implies that even if fertile low-IQ non-Western immigrants are the ultimate winners in the third DRDS demographic transition, they will conquer a lesser country. Danish average IQ will, for example, then have approached 90, or perhaps even be close to the projected mean immigrant of IQ 86. An intellectual corrosion this size will have undermined the economic and educational infra-structure of DK, and ultimately made its democracy unsustainable. Another factor is the increased frequency of partly heritable antidemocratic attitudes, authoritarian culture, and dogmatic religious preferences, traits often seen in low-IQ countries (e.g. Lynn, Harvey & Nyborg, 2009; Nyborg, 2009; Vanhanen, 2009).

All this would seriously challenge the characteristic social coherence and solidarity of the Danish tribe. Tragically, the third demographic transition may also simultaneously damage the countries of origin, due to brain drain. In short, DRDS may increasingly doom modern countries, harm developing countries, and has nothing to do with racism or nationalism.

6. Limitations

Projections are only as good as their premises. Coleman (2010) thus dryly remarks: “In population projections, the only certainty is that the exact projected outcome will not become reality”. He adds “Unless the assumptions here are hopelessly wrong, however, major change is in the offing” (p. 473). His projections for UK and other European countries are as gloomy as the one for DK.

Not all of foreign origin could be identified in the official SB register. The true number might be a fourth to a third higher.

The official legal mixing of ethnicities with different fertilities leads to demographically confusing results, and the true number of children born to foreign citizen and naturalized could not be counted directly. It had to be estimated. The fertility estimates were based on individual birth rates for each of the 235 COOs given in the United Nations official birth statistics, and balanced against common yearly total Danish birth- and mortality rates. However, two alternative national fertility estimates produced largely similar outcomes. Nevertheless, the UN birth rates used appear unrealistically low for DK for several reasons. First, immigrants giving birth in DK have a younger age profile and therefore higher birth rates, as immigrants are young and younger than those procreating in their COOs (where the estimate depends on the local age distribution). Second, the birth rate of immigrants, (which depends on the age distribution of the country to which they immigrate), will be higher by constant fertility, as it numerically represents relatively more young and younger immigrants giving birth than would be the case in the COOs, from where the fertility measures were taken. Third, the use of a common total mortality for DK results in an overestimation of the mortality of the immigrants, because most immigrant age distributions are skewed towards young and younger age groups.

Such limitations mean that the depressing perspectives presented in the present study are to be found on the conservative side of reality. Then again, fertility rates depend on partly unforeseeable cultural, educational, and other events, and politically administered restrictions, however unlikely, may also fundamentally alter migration patterns – and thereby the basis for projection.

References

Coleman, D. (2006). Immigration and ethnic change in low-fertility countries: A third demographic transition. *Population and Developmental Review, 32(3),* 401-446.

Coleman, D. (2010). Projections of the Ethnic Minority Populations of the United Kingdom 2006-2056. *Population and Development Review, 36(3),* 441-486.

Deary, I. J., Batty, G.D., & Gale, C.R. (2008). Bright children become enlightened adults. *Psychological Science, 19*(1), 1-6.

http://www.un.org/esa/population/publications/worldfertility2007/Fertility_2007_table.pdf

http://www.statistikbanken.dk/statbank5a/default.asp?w=1280

Lynn, R. (1996). *Dysgenics: Genetic deterioration in Modern Populations.* Westport, CT., Praeger

Lynn, R. (2000). *Eugenics: A reassessment.* Westport, CT., Praeger.

Lynn, R. (2006). *Race differences in intelligence: An evolutionary analysis.* Augusta, GA: Washington Summit Publishers.

Lynn, R., Harvey, J., & Nyborg, H. (2009). Average intelligence predicts atheism rates across 137 nations. *Intelligence, 37,* 11-15.

Lynn, R. & Vanhanen, T. (2002). *IQ and the Wealth of Nations.* Westport, CT., Praeger

Lynn & Vanhanen (2006). *IQ & Global Inequality. A sequel to IQ and the Wealth of Nations.* Augusta, Georgia: Washington Summit Publishers.

Meisenberg, G. (2004). Talent, character, and the dimensions of national culture. *Mankind Quarterly, 45*, 123-168.

Meisenberg, G. (2010). The reproduction of intelligence. *Intelligence, 38,* 220-230.

Meisenberg, G. (2010). Personal email communication (December).

Morel, B.A. (1857). *Traité des dégénerescenses physiques, intellectuelles et morales de l'espèce humaine*. Paris: Larouse.

Nyborg H. (2003). The sociology of psychometric and biobehavioral sciences: A case study of destructive social reductionism and collective fraud in 20th. century academia. In Nyborg H. (Ed.).*The scientific study of general intelligence: Tribute to Arthur R. Jensen* (pp. 441-501). Amsterdam: Pergamon.

Nyborg, H. (2009). The intelligence-religiosity nexus: A representative study of white adolescent Americans. *Intelligence, 37,* 81-93.

Nyborg, H. (2011). The greatest collective scientific fraud of the 20th century: The demolition of differential psychology and eugenics. *Mankind Quarterly,* Spring Issue (in press).

Rasmussen, H.K. (2008). *Den Danske Stamme: En befolkningshistorie.* (The Danish Tribe: A story about a People). København: JP/Politikens Forlagshus.

Sundet, J. M., Barlaug, D. G., & Torjussen, T. M. (2004). The end of the Flynn Effect? A study of secular trends in mean intelligence test scores of Norwegian conscripts during half a century. *Intelligence, 32,* 349-362.

Teasdale, T.W. & Owen, D.R. (2008). Secular declines in cognitive test scores: A reversal of the Flynn effect. *Intelligence, 36,* 121-126.

te Nijenhuis, J., de Jong, M.-J., Evers, A., & van der Flier, H. (2004). Are cognitive differences between immigrant and majority groups diminishing? *European Journal of Personality, 18,* 405-434.

Vanhanen, T. (2009). *The limits of democratization: Climate, intelligence, and resource distribution*. Augusta, Georgia: Washington Summit Publishers.

Sex Differences

Chapter 10

Sex Differences in g: An analysis of the US standardization sample of the WAIS-III

PAUL IRWING
Manchester Business School East, The University of Manchester, Booth Street West, Manchester, M15 6PB, UK.
Email: paul.irwing@mbs.ac.uk

ABSTRACT

This study employed both hierarchical and Bi-factor multi-group confirmatory factor analysis with mean structures (MGCFA) to investigate the question of whether sex differences are present in the US standardization sample of the WAIS-III. The data consisted of age scaled scores from 2,450 individuals aged from 16 to 89 years. The findings were more or less uniform across both analyses, showing a sex difference favoring men in *g* (0.19 - 0.22*d*), Information (0.40*d*), Arithmetic (0.37 – 0.39*d*) and Symbol Search (0.40 – 0.30*d*), and a sex difference favoring women in Processing Speed (0.72 – 1.30*d*).

Introduction

The question of whether there is a sex difference in general cognitive ability is a matter of considerable controversy. Richard Lynn has made three important contributions to debate on this issue. Firstly, he has proposed that there is a male advantage on g in adults of about 3 to 5 IQ points (Lynn, 1994, 1999), secondly that there is a developmental trend whereby, while among children up to the age of 16 years the sex difference in overall intelligence is negligible, the male advantage begins to appear at the age of 16 and increases into early adulthood. For convenience, we will dub this the developmental theory of sex differences in cognitive ability. Thirdly, he has questioned the overwhelming consensus that there is greater male variability (Irwing & Lynn, 2005; Johnson, Carothers & Deary, 2008). This paper will test all three of these propositions in the US standardization sample of the WAIS-III.

From discussions of the issue you might think that the evidence is overwhelmingly against the developmental theory of sex differences (e.g. Ceci, Williams, & Barnett, 2009). In fact, a simple examination of empirical findings shows that by far the majority of the evidence favours a mean male advantage in adulthood and that its emergence follows a developmental trend (e.g. Irwing & Lynn, 2005; Jackson and Rushton, 2006; Johnson & Bouchard, 2007; Lynn, 1994, 1999; Lynn & Irwing, 2004). There are studies which apparently support a null sex difference, or even a female advantage amongst adults, though most of these studies have used multi-group confirmatory factor analysis (MGCFA) (e.g. Dolan, Colom, Abad, Wicherts, Hessen & van der Sluis, 2006; Keith, Reynolds, Patel, & Ridley, 2008; van der Sluis, Posthuma, Dolan, de Geus, Colom & Boomsma, 2006).

The confused state of debate on this issue is perhaps attributable to a number of methodological problems, which any study of sex differences needs to address. Firstly, there is a problem of selection biases which may mean that any given sample is not equally representative of males and females (Madyastha, Hunt, Deary, Gale, & Dykiert, 2009). Secondly, findings are method dependent, and there are strong arguments favouring MGCFA as the preferred form of analysis (Dolan et. al., 2006). In particular, a number of criticisms of the method of correlated vectors have been made (e.g. Lubke, Dolan and Kelderman, 2001; Ashton and Lee, 2005), such that conclusions depending on this method must be regarded as suspect. Thirdly, there is the issue of the quality of tests and exactly what they measure. Fourthly, the establishment of measurement invariance and lack of bias represent prerequisites for the unequivocal demonstration of sex differences (Meredith, 1993). Fifthly, there is strong evidence that g is not normally distributed (Johnson et al, 2008). Unfortunately, no study, including the current one is immune from all these difficulties.

It was probably Gustafsson who first suggested that that MGCFA should be the preferred method of analyzing group differences in intelligence. Which method is appropriate is dependent on which model of intelligence is veridical. Certainly MGCFA is compatible with the consensus hierarchical factor models of human cognitive abilities. Apart from compatibility, MGCFA has many other advantages over alternatives such as the method of correlated vectors or exploratory factor analysis (Bollen, 1989). It may, therefore, seem damaging that studies using MGCFA have uniformly failed to support a mean male advantage in *g*. However, there are a number of complications in conducting such analyses. It has been shown by Molenaar, Dolan, and Wicherts (2009). that large samples are required to attain sufficient power in order to detect a mean difference in MGCFA models. Here, we have such a large sample, and in order ensure sufficient power we carry out the analysis in the entire sample aged 23 years and older. A more profound difficulty is that most analyses have failed to separate out measurement issues from structural analyses. In doing so, authors have simply followed recommended practice (Chen, Sousa, & West, 2005). The problem is that for cross group comparisons to be valid scalar invariance must hold (Widaman & Reise, 1997). To establish scalar invariance multiple congeneric measures at the first order factor level are required (Widaman, & Reise, 1997), but to date, no study including the current one, has had access to multiple measures. However, we adopt a somewhat novel solution by simply recognizing that testing of metric invariance is the most that we can achieve with only one measure for each construct.

Probably the most serious problem in validly testing for mean differences in MGCFA models is that factors are correlated, and therefore order of testing influences the conclusion. The problem is closely analogous to that presented by post hoc testing in multivariate analysis of variance. Here, in order to achieve an unambiguous conclusion, we present two solutions to this problem. The first followed the practice in stepdown analysis of prioritizing the order of testing according to a mixture of theoretical and practical criteria. We then used a Bonferroni correction in order to control for type 1 error. In the second, we used a Bi-factor model which removes the problem of correlated factors by orthogonalizing them.

In short we use one of the best samples, the doyen of psychometric tests of general cognitive ability, and a novel testing procedure in order to examine Lynn's developmental theory.

2. Method

2.1 Sample

The sample analysed in this study is the American standardization sample of the WAIS-III[1]. This consists of 2,450 individuals aged from 16 to 89 years. The data consist of sex differences in age scaled scores provided by the Psychological Corporation. The standardization sample was designed to be representative of the US population according to the 1995 census, with regard to age, sex, ethnicity, educational level and geographic region (U. S. Bureau of the Census, 1995). Three categories of adults were excluded from the sample: individuals with sensory or motor deficits that might compromise the validity of test scores; individuals fitting criteria for drug or alcohol dependency or who were on medication; and individuals with known or possible neuropsychological disorders. These exclusions would not seem to impair the suitability of the sample for the analysis of sex differences.

2.2 Measures

The WAIS-III contains 13 subtests and a Full Scale IQ, a Verbal IQ and a Performance IQ, like its predecessors. It also provides measures of four factors: Verbal Comprehension (Vocabulary, Similarities, Information, Comprehension), Perceptual Organization (Picture Completion, Block Design, Matrix Reasoning, Picture Arrangement), Working Memory (Arithmetic, Digit Span, Letter-Number Sequencing), and Processing Speed (Digit Symbol – Coding, Symbol Search). Object Assembly is an optional test, but the current analysis placed it on the Perceptual Organization factor, in common with some other analyses (Dolan et al., 2006). Average split-half reliability coefficients across the 13 age groups were .98 for Full Scale IQ, .97 for Verbal IQ and .94 for Performance IQ. The average reliabilities for the individual subtests ranged from .93 (Vocabulary) to .70 (Object Assembly).

Table 1. Univariate means, standard deviations and Cohen's d

Scale/subtest	M			F			*d*	F
	N	M	SD	N	M	SD		
Full scale IQ	603	134.4	25.83	696	129.4	27.92	.185	<.001
		1			2			
Verbal comprehension	1147	41.44	10.59	1303	38.96	10.65	.233	<.001
Vocabulary	1147	10.08	2.98	1303	9.96	3.04	.038	.230
Similarities	1147	10.19	3.00	1303	9.91	3.00	.095	.055
Information	1147	10.67	3.04	1303	9.40	2.82	.433	<.001
Comprehension	1147	10.50	2.91	1303	9.69	2.98	.276	<.001
Perceptual organization	1147	41.26	9.71	1303	39.19	9.25	.219	<.001

Scale/subtest	M			F			*d*	F
	N	M	SD	N	M	SD		
Picture completion	1147	10.15	3.05	1303	9.92	2.97	.076	.077
Block design	1147	10.51	3.10	1303	9.70	2.87	.274	<.001
Matrix reasoning	1147	10.23	2.95	1303	9.85	2.95	.130	.003
Picture arrangement	1147	10.38	3.13	1303	9.72	2.94	.217	<.001
Working memory	603	31.27	7.44	696	29.51	7.41	.238	<.001
Arithmetic	1147	10.68	3.21	1303	9.45	2.96	.399	<.001
Digit span	1147	10.15	3.03	1303	9.95	3.04	.069	.095
Letter-number	696	10.18	3.14	1303	9.92	3.08	.083	.135
Processing speed	1147	19.15	5.21	1303	20.82	5.54	-.308	<.001
Digit symbol	1147	9.27	2.81	1303	10.60	3.04	-.456	<.001
Symbol seach	1147	9.89	2.94	1303	10.21	3.05	-.108	.006
Object assembly	1147	10.09	3.02	1303	9.96	3.05	.040	.391

The last column contains *p* values based on the multivariate F-test, *d* represents the males' minus the females' means scores divided by the within-groups standard deviation.

Descriptive statistics for sex differences in the American WAIS III data are given in Table 1, which shows the means, standard deviations, and sample sizes for male and female subtest and scale scores on the WAIS-III, together with Cohen's *d* (the male mean score minus the female mean score divided by the within-group standard deviation). Multivariate ANOVA's revealed main effects of sex for both the subtests ($F(14, 1284) = 30.38$, $p < .001$) and scale scores ($F(4,1294) = 46.70$, $p < .001$). Twelve of the 14 subtest difference scores are in favor of males (six significant at the .001 level), and two are in favor of females (both significant at the .01 level). Cohen's *d* for the Full-Scale IQ score is .185 in favor of males.

3. Results

We have analysed the data using two different models for reasons explained above. Because, in 1,151 cases, there were missing data for Letter-Number Series, we used Full Information Maximum Likelihood estimation for all analyses, which broadly conforms with best practice (Schafer & Graham, 2002). In all cases, we test for measurement invariance in the order: (1) configural invariance; and (2) metric invariance (for the reasons given above, we do not consider tests for scalar invariance to be logical as applied to this data set). As a third step, we constrained all mean and intercept differences across sex to zero and then, in subsequent models, allowed for mean differences based on both theory (Bollen, 1989) and modification indices (Joreskog & Sorbom, 2001). Finally, in the Bi-factor model we tested for sex differences in factor variances. The theory and logic of testing for measurement invariance is extensively detailed elsewhere (e.g. Meredith, 1993; Widaman & Reise, 1997) so we do not repeat this here.

There is no fully satisfactory answer to the question of model fit, particularly as this applies to testing for measurement invariance (Yuan, 2005). Moreover, with Full Information Maximum Likelihood, the only available fit indices are the likelihood ratio statistic and the root mean square error of approximation (RMSEA). We rely partly on the simulations of Hu and Bentler (1998, 1999), which suggest that in order to assess absolute fit, a cut-off point of about .06 is appropriate for the RMSEA. Decline in model fit at a given stage of the invariance analysis indicates that the assumptions of invariance do not hold in the constrained parameters (French & Finch, 2006). To assess possible decline in model fit, we rely on the conclusion of Cheung and Rensvold (2002). Their primary recommendation is that changes of equal to or less than -0.01 for CFI indicate that invariance holds. However, since this statistic is not available, we suggest a comparable cut-off value of 0.013 for the RMSEA, based on their findings. Though conventionally the χ^2 difference statistic has been proposed as a measure of decrease in fit between nested models, it too has been demonstrated to be sensitive to sample size (Kelloway, 1995), and therefore it has been argued to be inferior to other metrics for comparison of nested models (Cheung & Rensvold, 2002).

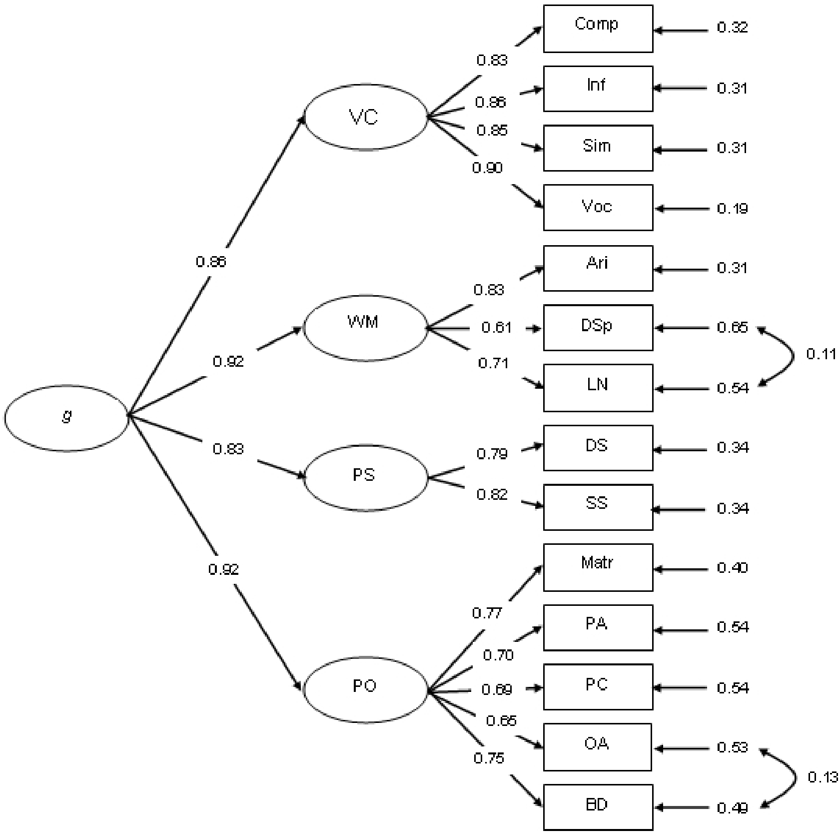


Figure 1. The WAIS second-order confirmatory factor model with mean structures (M_8*) – common metric completely standardized solution (VC = Verbal Comprehension, WM = Working Memory, PS = Processing Speed, PO = Perceptual Organization, Comp = Comprehension, Inf =Information, Sim = Similarities, Voc = Vocabulary, Ari = Arithmetic, DSp = Digital Span, LN = Letter-Number Sequencing, DS = Digit Symbol, SS = Symbol Search, Matr = Matrix Reasoning, PA = Picture Arrangement, PC = Picture Completion, OA = Object Assembly, BD = Block Design.*

3.1 Hierarchical MGCFA

First we consider results for the hierarchical MGCFA factor model shown in Figure 1. We analyzed this using the subsample aged 23 years or older (N_{male} = 902, N_{female} = 1053), since, according to data presented in Lynn and Irwing (2004), together with developmental studies of brain tissue, we surmise that this is the age at which sex differences probably attain their full adult value. All invariance analyses considered parameters in the first- and second-order factor models simultaneously. For the configurally invariant model (same factor pattern), the RMSEA was within the specified cut-off, clearly demonstrating that the model provides a good fit to the data (χ^2 = 569.1, *df* = 134; *P* < .001; RMSEA = .055). For the fully metrically invariant model the fit effectively improved as indicated by a reduction in the RMSEA (χ^2 = 597.2, *df* = 147; *P* < .001; RMSEA = .054, ΔRMSEA = -.001), so we conclude that metric invariance is convincingly demonstrated.

At the next step, we constrained all subtest means (intercepts) and factor means to equality in both males and females. This resulted in a dramatic decrement in fit (χ^2 = 1254.6, *df* = 171; *P* < .001; RMSEA = .081, Δ χ^2 = 657.4, *df* = 24, *P* < .001). This clearly establishes that there are mean differences in either factor or scale scores across sex.

There are well established sex differences in Processing Speed, Information and Arithmetic, while g is the focus of the investigation (e.g. Hedges & Nowell, 1995; Held, Alderton, Foley & Segal, 1993; Lynn, Irwing & Cammock, 2002; Majeres, 2007). Following the logic of stepdown analysis the means (intercepts) for each of these variables was released first. Next, an inspection of modification indices (MI) suggested that the intercept for Symbol Search (MI = 77.4) should be released. This model provided equivalent fit to that of the metrically invariant model in terms of the RMSEA index (χ^2 = 709.4, *df* = 166; *P* < .001; RMSEA = .058, ΔRMSEA = 0.004), so we accepted this model.

Next we released the intercepts for Verbal Comprehension, Working Memory and Perceptual Organization which lead to a non-significant change in the likelihood ratio ($\Delta\ \chi^2 = 2.09$, df = 3, $p > .05$), so we may conclude that g adequately explains the residual mean differences for these second-order factors.

The differences in the means expressed in *d* scores are 0.19 ($t = 3.88$, $p = 00005$), -0.72 ($t = 15.54$, $p < .00001$), 0.40($t = 7.66$, $p < .00001$), 0.37 ($t = 14.14$, $p < .00001$), and 0.40 ($t = 32.12$, $p < .00001$) for *g,* Processing Speed, Information, Arithmetic and Symbol Search, respectively (a negative score denotes a female advantage). The Bonferroni corrected probability is .002 in order to maintain the probability of a type 1 error at .01, so clearly all the d-score differences are significant.

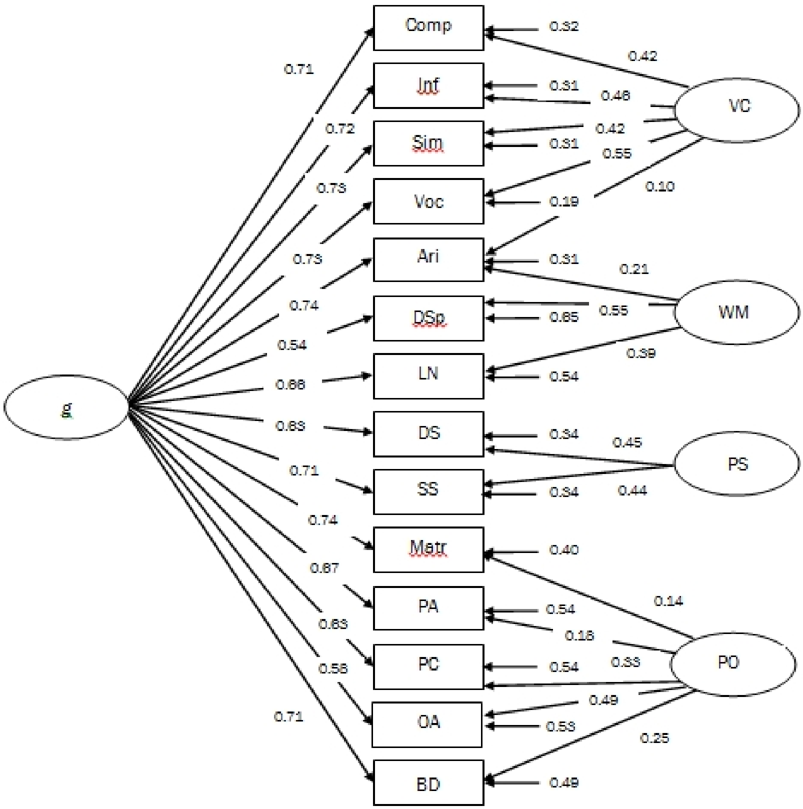


Figure 2. The WAIS-III Bi-factor model with mean structure (M_{16}) = common metric completely standardized solution (abbreviations as for Figure 1).

2.2 Bi-factor Models

Although the hierarchical factor model corresponds well to some conceptualizations of the structure of intelligence, it has some disadvantages. Because all the factors are correlated, this can lead to ambiguities in the interpretation of such models. In Bi-factor models, the factors are uncorrelated, which in principle greatly simplifies interpretation. For these reasons, Carroll (2003), for example, has favoured such models. Therefore, using the same strategy and logic of analysis as presented above, we examined Bi-factor models (see Figure 2). With regard to all tests of measurement invariance, the Bi-factor model supported identical conclusions to those derived from the hierarchical factor model. The mean score sex differences were highly similar at 0.22, .0.40, .0.39 and 0.30 for *g,* Information, Arithmetic and Symbol Search, respectively, but the estimated difference for Processing Speed, at 1.30, was substantially larger.

The Bi-factor model has another advantage in that it greatly simplifies testing for equality of factor variances. We applied equality constraints to variances and error variances in the metrically invariant model. All means and intercepts were also constrained except for those five which were significantly different (χ^2 = 629.3, *df* = 176; *P* < .001; RMSEA = .051, $\Delta\ \chi^2$ = 71.8, *df* = 25, *P* < .001). We then sequentially released constraints on each of the variances one at a time. The variance ratios and associated chi-square differences were: g (VR = 1.04, $\Delta\ \chi^2$ = 0.32, *df* = 1, *P* = 0.572), Verbal Comprehension (VR = 1.03, $\Delta\ \chi^2$ = 0.07, *df* = 1, *P* = 0.791), Working Memory (VR = 1.39, $\Delta\ \chi^2$ = 5.07, *df* = 1, *P* = 0.024), Processing Speed (VR = 0.65 ,$\Delta\ \chi^2$ = 9.07, *df* = 1, *P* = 0.003), and Perceptual Organization (VR = 1.14 ,$\Delta\ \chi^2$ = 0.45, *df* = 1, *P* = 0.502). We can thus conclude that there are no significant differences in variability between males and females on g, Verbal Comprehension, and Perceptual Organization, whilst there is significantly greater male variability on Working Memory at the .05 level, and significantly greater variability in females on Processing Speed at the .01 level.

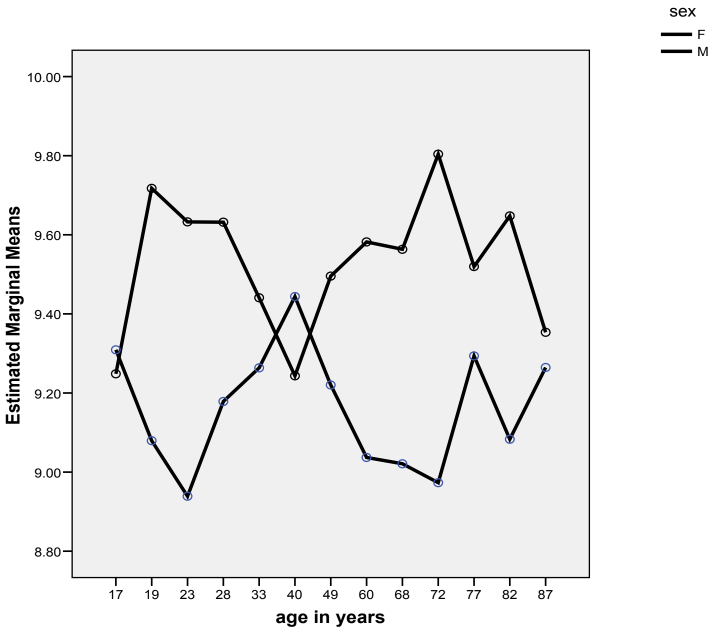


Figure 3. Age profile of g-scores by sex.

3.3 Sex differences across age in g

There is evidence that education has an effect on intelligence (Dolan et al. 2006; Johnson, Deary, & Iacono, 2009), so it could be argued that the observed sex difference in *g* favouring males may be attributable to the older age groups in the sample in which women would have been exposed to less education than males.

In order to test for sex differences in *g* across age, we first calculated a composite *g* score using factor score regression. This approach could be criticized in that it is known that composite measures of *g* are potentially contaminated with non-*g* variance. However, provided our results are not greatly discrepant from those obtained from the latent variable analyses, we can be confident that the parameter estimates observed with the composite score are in this instance closely equivalent. The sample was divided into 13 age bands with 200 participants in all age bands except the oldest two which comprised 150, and 100, respectively. We carried out an analysis of variance with the g composite score as the dependent variable, and sex and age group as the independent variables. There was a significant mean difference for sex (d = 0.177, F = 17.95, df = 1, p < 0.001), but neither the age nor the interaction term were significant. To provide a direct test of the effects of exposure to education we next controlled for length of education divided into five levels from ≤ 8 years to ≥ 16 years. The effect of sex remained significant (F = 14.41, df = 1, p = .001), and Cohen's *d* (0.154) reduced only marginally. Consequently, the argument that the sex difference in *g* is attributable to differential experience of education does not appear to hold.

Figure 3 shows a plot of the data which shows some interesting features of the profile of *g* across age. Firstly, although not significant, there is a trend whereby the sex difference in *g* increases across age from 17 - 23 years, as predicted by the developmental theory of sex differences. Secondly, across age from 23 - 60 years, male *g*-scores appear to follow a V shaped trend, while over the same period females *g*-scores follow an inverted V.

4. Discussion

The MGCFA and Bi-factor analyses both show the existence of a sex difference favoring men in *g,* Information, Arithmetic, and Symbol Search and a sex difference favoring women in Processing Speed. The sex difference effect sizes were highly similar except that the estimate for Processing Speed was substantially larger in the Bi-factor model.

Our results that the females have an advantage on Processing Speed, while males have an advantage on Information and Arithmetic replicate the findings of a number of other studies (e.g. Hedges & Nowell, 1995; Held et al.,1993; Lynn, et al. 2002; Majeres, 2007). The large female advantage of 0.72 – 1.30*d* on Processing Speed is particularly notable. The magnitude of this effect arises partially because *g* is not masking sex differences in this analysis (Johnson & Bouchard, 2007). Nevertheless, this finding does support the argument of Majeres (2007) that because the female brain is highly specialized for processing phonologically coded information, this provides a female advantage on a range of cognitive tasks including perceptual speed, digit-symbol substitution, numerical computation, spelling ability and word-level reading. Neuroimaging studies also show that during phonological processing women evidence greater right hemisphere activation (e. g. Pugh et al., 1997). If women devote more right hemisphere brain tissue to phonological processing, and men devote more to visual rotation, then this might explain the trade-off observed by Johnson and Bouchard (2007) on what they refer to as a rotation-verbal dimension.

Contrary to some previous findings (e.g. Johnson et al, 2008; Hedges & Nowell, 1995), we did not find greater variability in male scores on *g*, Verbal Comprehension, or Perceptual Organization, and while we did find greater male variability on Working Memory, there was even greater female variability on Processing Speed. Our results add to the numerous inconsistencies in findings on sex differences in variability. There are some possible reasons for these discrepancies. Firstly, no latent variable analysis of the issue has found greater male variability. This may be attributable to known difficulties with composite variables. For example, during development up to about 14 years of age, males score lower on Verbal ability, and higher on Visuo-Spatial ability than do females. This in itself would lead to greater apparent variability in males on a composite containing these factors. Equally, if there are greater differences in developmental lags amongst males, this would also produce greater male variability until they enter adulthood. Alternatively, the findings may be due to a lack of power.

Although the WAIS-III is a very highly regarded cognitive battery, nevertheless it does suffer some limitations for the estimation of sex differences. In particular, 3-D mental rotation, for which there is a large male advantage (e.g. Voyer, Voyer & Bryden, 1995), is not tested in the WAIS-III, and therefore the WAIS-III is likely to provide an underestimate of the sex difference in *g*. We also found that between the ages of 23 and 60 that the sex difference was strongly attenuated (see Figure 3). One interpretation would be that successful males in these age ranges are harder to contact than females, while intelligent females are more likely to volunteer. Despite rigorous attempts at random sampling it would not be surprising if the WAIS-III standardization sample was subject to such selection effects, which would lead to an underestimate of the sex difference in g.

The WAIS-III manual also documents that extensive procedures were used in the construction of the test in order to eliminate gender bias. The methods of expert opinion and differential item functioning (DIF) were both used for this purpose. It is impossible to know exactly how these procedures were employed. However, it is well established that expert opinion is not a good basis to establish bias in items (Smith & Smith, 2005). DIF analyses will also tend to remove unbiased items unless item pools are truly unidimensional and this is something that is hard to establish (Embretson & Reise, 2000). Taking all these considerations together, there are some grounds to think that the WAIS-III, despite its excellent psychometric properties, may underestimate sex differences in cognitive abilities.

In conclusion, our findings provide further support for Lynn's developmental theory of sex differences, and suggest that the consensus view that there is greater male variability in cognitive abilities requires further investigation.

References

Ashton, M. C., & Lee, K. (2005). Problems with the method of correlated vectors. *Intelligence*, *33*, 431-444.

Bollen, K.A. (1989). *Structural equations with latent variables*. New York: Wiley.

Carroll, J. B. (2003). The Higher-stratum structure of cognitive abilities: Current evidence supports *g* and about ten broad factors. In H. Nyborg (Ed) *The Scientific Study of General Intelligence.* Amsterdam: Elsevier.

Ceci, S. J., Williams, W. M., & Barnett, S. M. (2009). Women's Underrepresentation in Science: Sociocultural and Biological Considerations. *Psychological Bulletin*, 135, 218-261.

Chen, F. F., Sousa, K. H., & West, S. G. (2005). Testing measurement invariance of second-order factor models. *Structural Equation Modelling*, 12, 471-492.

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling*, 9, 235-255.

Dolan. C. V., Colom, R., Abad, F. J., Wicherts, J. M., Hessen, D. J., & van der Sluis, S. (in press). Multi-group covariance and mean structure modelling of the relationship between the WAIS-III common factors and sex and educational attainment in Spain. *Intelligence*, *34*, 193-210.

Embretson, S. E. & Reise, S. P. (2000). *Item response theory for psychologists*. Mahwah, NJ: Lawrence Erlbaum Associates.

French, B. F., & Finch, W. H. (2006). Confirmatory factor analytic procedures for the determination of measurement invariance. *Structural equation Modeling*, 13, 378-402.

Hedges, L. V., & Nowell, A. (1995). Sex differences in mental test scores, variability, and numbers of high-scoring individuals. *Science*, *269*, 41-45.

Held, J. D., Alderton, D. L., Foley, P. P., & Segal, D. O. (1993). Arithmetic reasoning gender differences: explanation found in the Armed Forces Vocational Aptitude Battery (ASVB). *Learning and Individual Differences*, *5*, 171-186.

Hu, L.-T., & Bentler, P. M. (1999). Cutoff criteria for fit indices in covariance structure modelling: conventional criteria versus new alternatives. *Structural Equation Modelling*, *6*, 1-55.

Hu, L.-T., & Bentler, P. M. (1999). Fit indices in covariance structural modelling: Sensitivity to underparametrized model misspecification. *Psychological Methods*, *3*, 424-453.

Irwing, P. Lynn, R. (2005). Sex differences in means and variability on the progressive matrices in university students: A meta-analysis. *British Journal of Psychology*, *96*, 505–524.

Jackson, D. N. & Rushton, J. P. (2006). Males have greater g: Sex differences in general mental ability from 100,000 17- to 18-year-olds on the Scholastic Assessment Test. *Intelligence*, *34*, 479-486.

Johnson, W., & Bouchard, T. J. Jr. (2007). Sex differences in mental abilities: *g* masks the dimensions on which they lie. *Intelligence*, *35*, 23-39.

Johnson, W., Carothers, A., &, Deary, I. J. (2008). Sex differences in variability in general intelligence: A new look at the old question. *Perspectives on Psychological Science*, *3*, 518-531.

Johnson, W., Deary, I., & Iacono, W. J. (2009). Genetic and environmental transactions underlying educational attainment. *Intelligence*, *37*, 466-478.

Jöreskog, K. G., & Sorbom, D. (2001). *LISREL 8: User's reference guide*. Lincolnwood, ILL: Scientific Software International Inc.

Keith, T. Z., Reynolds, M. R., Patel, P. G., & Ridley, K. P. (2008). Sex differences in latent cognitive abilities ages 6 to 59: Evidence from the Woodcock Johnson III tests of cognitive abilities. *Intelligence*, *36*, 502-525.

Kelloway, K.E. (1995). Structural Equation Modelling in Perspective. *Journal of Organizational Behavior, 16,* 215-224.

Lubke, G.H., Dolan, C.V., & Kelderman, H. (2001). Investigating group differences on cognitive tests using Spearman's hypothesis: An evaluation of Jensen's method. *Multivariate Behavioral Research, 36*, 299-324.

Lynn, R. (1994) Sex differences in brain size and intelligence: A paradox resolved. *Personality and Individual Differences*, *17*, 257-271.

Lynn, R. (1999) Sex differences in intelligence and brain size: A developmental theory. *Intelligence*, *27*, 1-12.

Lynn, R. & Irwing, P. (2004) Sex differences on the Progressive Matrices: a meta-analysis. *Intelligence*, *32*, 481-498.

Lynn, R., Irwing, P. & Cammock, T. (2002). Sex differences in general knowledge. *Intelligence, 30,* 27-39.

Madyastha, T. M., Hunt, E., Deary, I. J., Gale, C. R., Dykiert, D. (2009). Recruitment modeling applied to longitudinal studies of group differences in intelligence. *Intelligence*, *37*, 422-427.

Majeres, R. L. (2007). Sex differences in phonological coding: Alphabet transformation speed. *Intelligence, 35*, 335-346.

Meredith, W. (1993). Measurement invariance, factor analysis and factorial invariance. *Psychometrika*, *58*, 525-543.

Molenaar, D., Dolan, C. V., & Wicherts, J. M. (2009). The power to detect sex differences in IQ scores using Multi-Group Covariance and Means Structure Analysis. *Intelligence*, *37*, 396-404.

Pugh, K. R., Shaywitz, B. A., Shaywitz, S. E., Shankweiler, D. P. Katz, L., Fletcher, J., et al. (1997). Predicting reading performance from neuroimaging profiles: The cerebral basis of phonological effects in printed word identification. *Journal of Experimental Psychology: Human Perception and Performance*, *23*, 145-151.

Schafer, J. L., & Graham, J. W. (2002). Missing data: Our view of the state of the art. *Psychological Methods*, *7*, 147-177.

Smith, J M., & Smith, P. (2005) *Testing People at Work: competencies in psychometric testing.* London: Blackwell.

U. S. Bureau of Census (1995). *Current population survey*, March, 1995 (Machine readable data file). Washington, DC: U. S. Bureau of Census (Producer/Distributor).

Van der Sluis, S., Posthuma, D., Dolan, D. V., de Geus, E. J. C., Colom, R., & Boomsma, D. I. (2006). Sex differences on the Dutch WAIS-III. *Intelligence*, *34*, 273-290.

Vernon, P.E. (1950). *The Structure of Human Abilities*. London: Methuen.

Voyer, D., Voyer, S., & Bryden, M. P. (1995). Magnitude of sed differences in spatial abilities: A meta-analysis and consideration of critical variables. *Psychological Bulletin*, *117*, 250-270.

Widaman, K. F., & Reise, K. F. (1997). Exploring the measurement invariance of psychological instruments: Applications in the substance use domain. In K. J. Bryant, & M. Windle (Eds.).The science of prevention: Methodological advances from alcohol and substance abuse research (pp. 281-324). Washington, DC: American Psychological Association.

Yuan, K.-H. (2005). Fit indices versus test statistics. *Multivariate Behavioral Research*, *40*, 115-148.

---

[1]Standardization data from the *Wechsler Adult Intelligence Scales*® - *Third Edition.* Copyright © *1997* by Harcourt Assessment Inc. Used with permission. All rights reserved.

Chapter 11

Sex differences in educational attainment

JAAN MIKK, KARIN TÄHT, OLEV MUST
University of Tartu, Estonia

Jaan.Mikk@ut.ee
Phone +372 7424565
Mobile +372 53494864

ABSTRACT

At the end of the nineties, Lynn knew that men have higher abilities and SAT scores. However, why then did females have higher grades in college? Analysing national databases and relevant literature, he concluded that the reason is in higher work ethics of females. Lynn has analysed science achievement in large international studies. Males were better than females, especially 17-18 year olds, which corresponds to the higher abilities of males. However, the male advantage decreased over time and females performed as well as males by about 2008.

The next object of interest for Lynn was the variance in the test results for males and females. Seven international tests revealed that on average the variance for males was 12% larger than that for females. This is one explanation for the fact that there are more men in science than women.

Several lines of future research emerge from Lynn's studies. The decrease in the male advantage in science tests leads to the hypothesis that there should be different Flynn effects for boys and girls. While the causes of sex differences may be different at the individual and country level, multilevel analysis is a useful tool of further research.

1. Introduction

In the last twenty years, Richard Lynn and his followers have shown that males have higher intelligence than females (see paper by Irwing in this issue). For example, in Progressive Matrices, the male advantage is 5 IQ points (Lynn & Irwing, 2008, p. 233). The difference in intelligence appears after the age of 15 years, because girls develop faster and this enables girls to be as good as boys until the age of 15 years. The main reason for higher intelligence in males is seen in their greater brain size (Lynn 1994; Lynn, 1999; Lynn, Allik, & Must, 2000) and in some environmental factors that may be different for males and females.

Educational attainment is strongly related to intelligence. Sipe and Curlette (1997) have found in their meta-synthesis of educational research that on the individual level the effect of intelligence on educational attainment was .6 ($r = .5$). The effects of other variables (motivation, SES, teacher education, etc.) were smaller. The educational attainment of a person and his/her intelligence are interdependent: learning fosters intelligence and intelligence is an important factor of success in learning.

The relationship between international test results and the National IQ is even stronger at the country level. Lynn and Mikk (2007), Lynn, Meisenberg, Mikk and Williams (2007) have found correlations of .83–.92 between TIMSS and PISA test results and the National IQ. Rindermann (2007) has conducted a factor analysis of international test results and the National IQ and found that as indicators of the general cognitive ability of nations, international test results are as good as the National IQ tests.

Considering the relationship between IQ and educational attainment on the one hand, and sex differences in intelligence on the other, it is logical to conclude that there should be sex differences in educational attainment as well. We will reflect on Lynn's contribution to the studies of sex differences in educational attainment at the individual and national levels.

Lynn has also contributed to studies of sex differences in the variance of educational achievement that will be presented together with some research developments.

2. Sex differences at the individual level

Richard Lynn became interested in sex differences in educational attainment in the late nineties. At this time, it was known that males are better at spatial abilities and science and it was accepted that males are better at maths. The results from analysing verbal abilities have given mixed results; most of the studies have indicated female superiority; however, in some studies males achieved better results in verbal tests as well.

The starting point for the studies was the contradiction between the higher scores by males in the Scholastic Aptitude Test (SAT) and American College Test (ACT) on the one hand, and the higher grades for females in college on the other. Mau and Lynn (2000; 2001; Lynn & Mau, 2001) analysed the American National Educational Longitudinal Study (NELS) results for 20 612 tenth and twelfth grade students, SAT results for 3 930 students and ACT results for 3 553 students. In NELS, males obtained significantly higher mean scores in maths and science and females obtained significantly higher mean scores in reading and amount of homework. Males had higher scores in ACT and SAT including the verbal part of SAT, but females obtained a significantly higher Grade Point Average.

The higher results for males in most of the tests can be explained by their higher abilities. However, why did females have higher grades although their abilities were lower? Lynn and Mau explain this finding via the stronger work ethic of females that has been found in several studies. The existence of a stronger work ethic in females was also found in these studies in terms of the larger amount of homework done by females. Mau and Lynn (1999) have related the amount of homework to motivation in different groups of students.

There may be male-female differences in other correlates of educational achievement as well, and this may explain the differences in the educational achievement of boys and girls. For example, female teachers may pay more positive attention to girls and this may foster the achievement of girls in comparison with boys. Mau and Lynn (2000, p. 123) have hypothesised that greater amount of homework completed by females may be related to greater levels of socialisation (lower rates of aggression, conduct disorders, etc.).

3. Sex differences at the country level

Some years ago, Lynn and Mikk (2008) conducted a comparative analysis of nine international studies by the International Association for the Evaluation of Educational Achievement and the Organisation for Economic Co-operation and Development from 1970 to 2006. The studies were carried out in up to 57 countries with representative samples of students consisting of several hundred thousand students in the largest studies. The tasks for measuring educational attainment were carefully composed and translated into the languages of the participating countries.

The findings of the analysis are summarised in Table 1. The difference in the attainment of males and females is expressed in the standard deviation units, which are calculated by dividing the difference in score points by the pooled standard deviation of the scores for males and females.

Table 1. Sex differences in science.

Study	**Year**	**N countries**	**Difference in attainment (M-F)**		
			9-10 year olds	**13-15 year olds**	**17-18 year olds**
IEA	1970	19	.23	.46	.69
IEA	1983	17	.23	.34	.31
IEA	1991	8	.16	.26	

Study	Year	N countries	Difference in attainment (M-F)		
			9-10 year olds	13-15 year olds	17-18 year olds
TIMSS	1995	21/36*	.10	.19	
TIMSS	1999	38		.18	
PISA	2000	27		-.00	
TIMSS	2003	24/46*	-.01	.08	
PISA	2003	41		.04	
PISA	2006	57		-.07	

(* The first number of countries is for 9-10 year olds and the second number of countries is for 13-15 year olds.)

It can clearly be seen in the table that males outperformed females significantly in most of the studies. The largest difference is for 17–18 year olds and the smallest for 9–10 year olds.

Lynn & Mikk (2008) explain these findings by the differences in the abilities of boys and girls. The development of boys catches up with the development of girls by the age of 15 years and after this age the higher abilities of boys may cause their higher educational attainment. Before that age, there is no sex difference in abilities. Why then were 9–10 year old boys better than girls? Lynn and Mikk (2008, p. 120) say that this difference is because boys are more interested in science than girls.

Science can be divided into three kinds in the tests: physical systems, earth and space systems and living systems. The superiority of boys was the largest in the physical systems, but boys and girls had an almost equal level of knowledge in living systems. This finding may be related to the different interests of boys and girls.

In table 1, we see the decrease of sex differences in science attainment year by year. In 1970, the difference was .46 for 13–15 year olds and only -.07 in 2006. The decrease is regular and a regression analysis revealed a correlation of .94 between the size of the effect and the year (Figure 1). In figure 1 we can see the equality of male and female test results in 2006; afterwards females are predicted to achieve higher results in science tests. An analogous regression analysis for 9–10 year olds revealed a coefficient of multiple correlations of .90 and the equality of results for boys and girls in 2008.

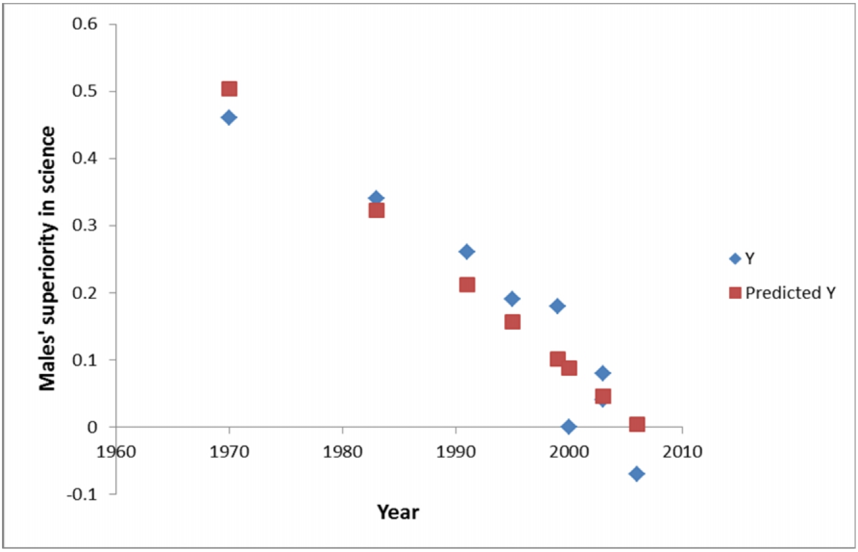


Figure 1. The decline of the superiority in science for 13-15 year old males.

Lynn and Mikk (2008, p. 119) explain the diminution of the boys' advantage in science in two ways: "First, the boys and girls may be becoming more similar in ability and/or interests. Second, the content of the problems in the tests may have changed." In PISA field trial, the items were analysed on different aspects including gender-by-item analysis and some items were removed from the main study (PISA 2006 Technical Report at: http://www.oecd.org/dataoecd/0/47/42025182.pdf. (p. 41). This may have diminished the gender difference in science test results.

Let us move on to sex differences in reading, which also have been the object of studies for a very long time. Hyde and Linn (1988) found in their meta-analysis that girls had an advantage of .23*d* in studies prior to 1973, while in studies after 1973 it had dropped to .10*d*. The meta-analysis of sex differences in reading achievement by Lietz (2006) revealed that girls in secondary school performed .19 standard deviation units above boys. Most of the studies revealed superiority among females in different tests on reading; however, in some studies men obtained higher results than women. The analyses were made according to countries, and first of all, data from the USA were used.

Lynn and Mikk (2009) analysed the gender effect in reading in the three PISA and two PIRLS studies. PISA studies were carried out by OECD and most of the participating countries were also from OECD. The number of PISA countries has increased in the years 2000 to 2006 from 27 to 57 including non OECD countries. There participated more than 250 000 students in the years 2000 and 2003 and more than 400 000 students in 2006. Nationally representative samples were tested in every country. The PIRLS studies have been carried out by IEA – International Association for the Evaluation of Educational Achievement. In the PIRLS studies countries from four continents (Europe, Asia, Africa, and America) were participating, however, European countries were prevailing. Representative samples of four-five thousand students were tested in every country. Summative gender effect sizes in reading in the studies are shown in Table 2.

In all five international studies, females significantly outperformed males in reading. The difference was .23 for 10 year olds and .42 for 15 year olds (Table 2). The difference is larger than found in earlier studies.

Table 2. Sex differences in reading achievement

Study	Year	N countries	Difference in attainment (F-M)	
			10 year olds	15 year olds
PISA	2000	27		.49
PISA	2003	40		.36
PISA	2006	57		.41
PIRLS	2001	35	.25	
PIRLS	2006	40	.21	

The female advantage in reading was larger than the male advantage in science if we consider the three PISA tests (Tables 1 and 2). In science, the superiority of boys was diminishing, but we do not have enough data to speak about the time trends for the superiority in reading among females because the time trend was statistically non-significant.

The higher scores that females received in reading tests have been explained by their higher verbal abilities. Lynn and Mikk (2009) have looked for additional explanations using PISA 2006 data. They found that boys more often had DVR or VCR players that took time away from reading. Girls had more classical literature and poetry in their homes and more girls were from homes without a computer. Girls also had more regular lessons in language and they were confident that they are doing well in language.

4. Variance in the results of tests of males and females

The President of Harvard, Lawrence Summers, declared in 2005 that there are more men in science than women, not because of less average innate aptitudes of women but because of a larger dispersion of scores among men. This provoked a storm of protest to such an extent that he resigned his post. In 2007, Ceci and Williams edited the book “Why aren’t more Women in Science?” in which they concluded that on average females are as good as males in science and maths.

Above we saw Lynn's studies about the advantage of males in international science studies that correlate with males' higher abilities in science. However, Lynn has proposed another explanation for the multiplicity of men in science. The variance in males' test results is higher than in females test results, and therefore, there are relatively more men in both ends of the distribution.

Lynn and Mikk (2008; 2009) have calculated the average ratios of males' variance to females' variance relying on data from the TIMSS, PIRLS and PISA studies. We can see in Table 3 that males' variance in test results is 1.12 times larger than the variance in females' test results. The variance ratio is larger for 13–15 year olds, which means that boys and girls are more different at 13–15 years than they are at 10 years of age.

Table 3. The ratio of males' variance to females'

Study	**Year**	**Subject**	**Variance ratio M/F**	
			10 year olds	**13-15 year olds**
TIMSS	1995	Science	1.12	1.10
TIMSS	1999	Science		1.14
PIRLS	2001	Reading	1.08	
TIMSS	2003	Science	1.10	1.10
PISA	2003	Science		1.15
PISA	2003	Reading		1.20
PIRLS	2006	Reading	1.08	

The authors explained the greater variability in males' test results by the greater variability in their abilities. Convincing data presented by many authors support the position that general intelligence has higher variability in males than in females (Ang, Rodgers, & Wänström, 2010; Deary, Irwing, Der, & Bates, 2007; Deary, Whalley, & Starr, 2009; Johnson, Carothers, & Deary, 2008). Sex differences in variance of intelligence emerge before preschool (Arden, & Plomin, 2006) and so they are not determined by educational influences but they may cause differences in variance of educational attainment. The greater interest in science among males and their higher competitiveness may lead to excellent attainment test results for some of them. Lynn & Mikk (2009, p. 12) hypothesize that “women have greater responsibility in bringing up the next generation and the fulfilment of this important task may be in danger in the case of a big variability which sometimes is a disadvantage in life”.

The larger variability in male test results explains why there are more men among the top achievers as well as bottom achievers in schools. Females do not vary so much and they prevail in the middle of the distribution of achievement and abilities test results.

5. Further developments in the research

The causes for sex differences in educational attainment have been explored by looking at the correlates of attainment. If a correlate has different values for males and females then it is reasonable to conclude that the correlate causes differences in the test results of males and females. For example, spatial ability is correlated with science test results and males have higher values in that ability, so we can conclude that differences in spatial ability cause differences in science test results, at least to some degree.

There is another way we can search for the correlates for sex differences in attainment. One can find correlations between the differences and characteristics of schooling, students, economic situation etc. Correlations with sex differences in educational attainment show directly which characteristics may cause the differences in achievement for boys and girls.

Let us use an example. The aim of the following calculations was to find some possible causes of the sex differences in the PISA 2006 results. The data for the calculations were taken mostly from the PISA databases (OECD, 2007). Index of democracy was taken from Kekic (2009), National Intelligence from Lynn & Vanhanen (2006), and Gross National Income per capita from Worldbank database at: http://siteresources.worldbank.org/DATASTATISTICS/Resources/GNIPC.pdf. A confirmatory factor analysis was used and the hypothetical model was fitted to the data from 50 PISA 2006 countries (Figure 2). The model fits the data adequately: $\chi2(48) = 57.15$ ($p = .17$), RMSEA = .062, CFI = .99.

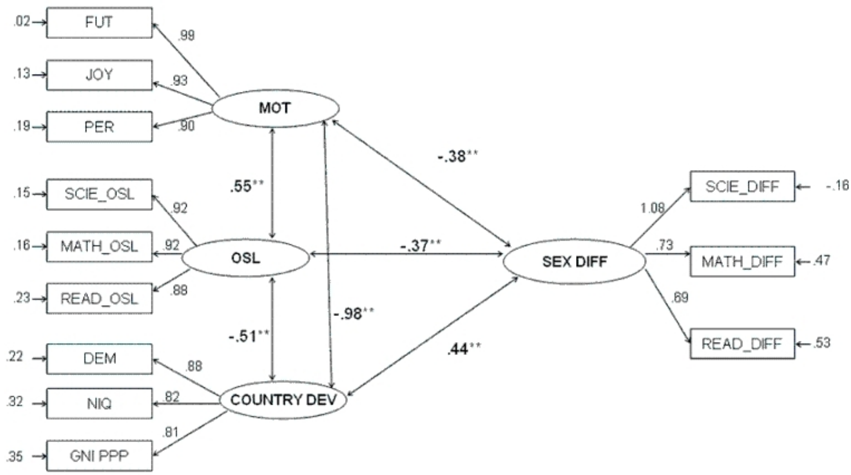


Figure 2. The model of correlates of sex differences in educational attainment.

Note:

FUT – future oriented motivation to science;

JOY – enjoyment of science;

PER – personal value of science;

SCIE_OSL – Science out of school lessons >4 in a week;

MATH_OSL – Maths out of school lessons >4 in a week;

READ_OSL – Reading out of school lessons >4 in a week;

DEM – Index of democracy;

NIQ – National Intelligence;

GNI PPP – Gross National Income per capita adjusted by purchasing power parity;

SCIE_DIFF – gender differences in student performance on science scores;

MATH_DIFF – gender differences in student performance on mathematics scores;

READ_DIFF – gender differences in student performance on reading scores;

OSL – out of school lessons;

COUNTRY DEV – country development;

SEX DIFF – sex differences in educational attainment.

We can see in the figure that sex differences in PISA test results were larger in countries with higher development measured using the Index of Democracy, National Intelligence and Gross National Income. We can hypothesize that in developed countries everyone has the freedom to develop his/her abilities and that there can be "a restriction of range in scores among poorly developed countries" (anonymous reviewer). The second correlate of sex differences in attainment was motivation. In countries with more motivated students, the sex differences in PISA scores are smaller. High motivation may lead to the achievement of educational standards by most of the students. The third group of correlates was out of school lessons. The more students in a country had four or more out of school lessons in the subject in a week the smaller the differences between boys and girls in PISA scores. It may be that the boys or girls who feel weak in a subject take out-of-school lessons and this diminishes the sex differences in attainment.

The second methodological remark concerns sampling sizes that should be equal for males and females. If, for example, females prevail in the representative sample of college students, then their average result will be lower than the average for males because a smaller top in normal distribution has a higher average than a larger top. This regularity has been noted in the meta-analysis of gender differences in mathematics performance by Hyde, Fennema and Lamon (1990, p. 139), who concluded that "Gender differences were smallest and actually favoured females in samples of the general population, grew larger with increasingly selective samples, and were the largest for highly selected samples...". Dykiert, Gale, & Deary (2009) have also concluded that "A proportion of the apparent male advantage in general cognitive ability that has been reported by some researchers might be attributable to the combination of greater male variance in general cognitive ability and sample restriction …".

There are some other interesting perspectives in the research. Richard Lynn has found that male superiority in science has decreased over time (Table 1). It is logical to conclude from that fact that the Flynn effect in science attainment is different for males and females. Ang et al. (2010) have recently studied the Flynn effect within different subgroups in the US relying on NLSYC data and found no gender effect. Nevertheless, the question of different Flynn effects for males and females deserves to be studied on the basis of other data samples.

Above we have analysed sex differences in complex areas of reading and science. General statements about gender differences in such complex areas may be misleading if we consider some specific aspect of the area. One example of the phenomena is given above regarding science test results (Lynn & Mikk, 2008) and another comes from the studies by Lindberg, Hyde, Petersen, & Linn (2010). The authors found in their meta-analysis that boys were better in short answer problems and girls in multiply choice problems. Earlier Hyde (2005) has raised the Gender Similarities Hypothesis according to which males and females are similar on most psychological features. She has reviewed 46 meta-analyses on psychological gender differences and found that gender effect favours males on some variables and it favours females on other variables. Looking for gender differences in specific areas of educational attainment is an important aspect of future research.

Richard Lynn explained the relatively good results of girls in tests of educational attainment in terms of their stronger work ethic and motivation. This was true for the individual level, but this explanation cannot be accepted for the country level. We see here the manifestation of ecological fallacy: the correlation between motivation and educational attainment is about .5 at the individual level, but the correlation between interest in science and international test results is -.7 at the country level (Mikk & Täht, 2010). Some correlates of educational achievement at the individual and country level are different (Täht, Must, Peets, & Kattel, submitted), and therefore, multilevel analysis of correlates of sex differences in attainment is an important task for future studies.

6. Limitations

International tests of educational attainment carried out on representative samples in many countries were the sole basis for the analysis of sex differences. This approach was used in the research by Lynn and his co-workers and the approach is used in our survey. However, sex differences in educational attainment should be studied from other aspects as well; for example, the learning strategies used by male and female students.

It became clear from the PISA 2006 Technical Report that in the process of test composition, the test items were analysed for gender- by-item interactions and some items favouring one gender were excluded. It was impossible to calculate how much this exclusion diminished gender effect in PISA test results. There were excluded items favouring both boys and girls however, gender difference in test results exist, especially in reading. In spite of the pursuit to compose items not favouring boys or girls there exist gender differences in the summary results of the tests.

7. Concluding remarks

Lynn and Meisenberg (2010) have recently shown that the correlation between educational attainment and National IQ is .92 at the country level. Consequently, the relationships with National IQ can be transferred to educational attainment and vice versa. However, at the individual level, the correlation between IQ and educational achievement is about .5 and therefore many other factors may influence achievement and differences in achievement between males and females.

The analysis of international test results by Lynn and colleagues revealed that males outperformed females in science by 0.15*d* and females were better readers by 0.23*d* at the age of 10 years and by 0.42*d* at the age of 15 years. Richard Lynn's recent work has shown that boys' advantage in science tests is diminishing over time. The variance in males' test results is about 12% larger than the variance in females' test results. Causes of the differences can be seen in abilities, motivation and activities.

The difference between male and female average test achievement results may be up to one third of a standard deviation. This means that the distributions mostly overlap. Girls are better at reading than boys, but there are many males who read better than most of the females. Males achieve higher results in maths tests on average, but many females do maths tests better than most of males.

Richard Lynn has considerably advanced studies on sex differences. He has asked some simple but fundamental questions and given convincing answers relying on the research results of many studies. Richard Lynn has created a lively research community which discusses problems concerning many people.

References

Ang, S., Rodgers J. L, & Wänström L. (2010). The Flynn Effect within subgroups in the U.S. gender, race, income, education, and urbanization differences in the NLSY-Children data. *Intelligence, 38,* 367–384.

Arden, R., & Plomin, R. (2006). Sex differences in variance of intelligence across childhood. *Personality & Individual Differences, 41*(1), 39-48.

Deary, I. J., Irwing, P., Der, G., & Bates T. C. (2007). Brother-sister differences in the g factor in intelligence: analysis of full, opposite-sex siblings from the NLSY 1970. *Intelligence, 35,* 451 – 456.

Deary, I. J., Whalley, L. J., & Starr, J. M. (2009). *A lifetime of intelligence: Follow-up studies of the Scottish mental surveys of 1932 and 1947*. Washington, DC, US: American Psychological Association.

Dykiert, D., Gale, C. R., & Deary, I. J. (2009). Are apparent sex differences in mean IQ scores created in part by sample restriction and increased male variance? *Intelligence*, *37*(1), 42-47.

Hyde, J. S. (2005). The gender similarities hypothesis. *American Psychologist*, 60(6), 581-592.

Hyde, J. S., Fennema, E., & Lamon, S. J. (1990). Gender differences in mathematics performance: a meta-analysis. *Psychological Bulletin, 107,* 139-153.

Hyde, J. S., & Linn M. C. (1988). Gender differences in verbal ability: A meta-analysis. *Psychological Bulletin 104,* 53–69.

Johnson, W., Carothers, A., & Deary, I. J. (2008). Sex differences in variability in general intelligence: A new look at the old question. *Perspectives on Psychological Science, 3*(6), 518–531.

Kekic, L. (2009). The Economist Intelligence Unit's Index of Democracy. *Economist* At http://www.economist.com/media/pdf/Democracy_Index_2007_v3.pdf.

Lietz, P. (2006). A meta-analysis of gender differences in reading achievement at the secondary school level. *Studies in Educational Evaluation 32*(4), 317–344.

Lindberg, S. M., Hyde, J. S., Petersen, J. L., Linn, M. C. (2010). New trends in gender and mathematics performance: A meta-analysis. *Psychological Bulletin, 136*(6), 1123-1135.

Lynn R. (1994). Sex differences in brain size and intelligence: A paradox resolved. *Personality and Individual differences, 17*, 257 – 271.

Lynn R. (1999). Sex differences in intelligence and brain size. *Intelligence, 27,* 1 – 12.

Lynn, R., Allik, J., & Must, O. (2000). Sex differences in brain size, stature and intelligence in children and adolescents: some evidence from Estonia. *Personality and Individual Differences, 29,* 555-560.

Lynn R., & Irwing P. (2008). Sex differences in mental arithmetic, digit span, and g defined as working memory capacity. *Intelligence, 36*, 226-235.

Lynn, R., & Mau, W.C. (2001). Ethnic and sex differences in the predictive validity of the scholastic achievement test for college grades. *Psychological Reports, 88*, 1099-1104.

Lynn, R., & Meisenberg G. (2010). National IQs calculated and validated for 108 nations. *Intelligence, 38*, 353–360.

Lynn, R., Meisenberg, G., Mikk, J., & Williams, A. (2007). National IQs predict differences in scholastic achievement in 67 countries. *Journal of Biosocial Science, 39*, 861 –874.

Lynn, R., & Mikk, J. (2007). National differences in intelligence and educational attainment. *Intelligence, 35*, 115 - 121.

Lynn R., & Mikk J. (2008). Science: Sex differences in attainment. *The Journal of Social, Political and Economic Studies, 33*, 101 – 124.

Lynn, R., & Mikk, J. (2009). Sex differences in reading achievement. *TRAMES: Journal of the Humanities and Social Science*s, *13,* 3–13.

Lynn, R., & Vanhanen, T. (2006). *IQ and global inequality.* Augusta, GA: Washington Summit Books.

Mau, W.-C. & Lynn, R. (1999). Racial and ethnic differences in motivation for educational achievement in the United States. *Personality and Individual Differences, 27,* 1091 – 1096.

Mau W.-C., & Lynn R. (2000). Gender differences in homework and test scores in mathematics, reading and science at tenth and twelfth grade. *Psychology, Evolution and Gender, 2,* 119-125.

Mau, W.-C., & Lynn, R. (2001). Gender differences on the Scholastic Aptitude Test, the American College Test and college grades. *Educational Psychology, 21,* 133-136.

Mikk, J., & Täht, K. (2010). Factor structure of PISA 2006 correlates at national level. Paper presented at ECER conference in Helsinki. OECD (2007). *PISA 2006. Volume 2: Data.* Paris: OECD.

Rindermann, H. (2007). The g-factor of international cognitive ability comparisons: the homogeneity of results in PISA, TIMSS, PIRLS and IQ tests across nations. *European Journal of Personality, 21*, 667−706.

Sipe, T. A., & Curlette W. L. (1997). A meta-synthesis of factors related to educational achievement: A methodological approach to summarizing and synthesizing meta-analyses. *International Journal of Educational Research, 25*(7), 583-698.

Täht, K., Must, O., Peets, K., & Kattel, R. (submitted). Educational achievement and attitudes: the individual and contextual national level. *Personality and Individual Differences.*

Intelligence and Dysgenic Fertility

Chapter 12

A standardisation of the Standard Progressive Matrices for adults in Libya

ALSEDIG ABDALGADR AL-SHALOMEE
University of Omar Al–Mukhtar, El-Beida, Libya
e-mail: Shahomee@yahoo.com

ABSTRACT

Twenty one studies of intelligence in North Africa are summarised showing a median British IQ of 84. Data are reported for a standardisation of the Standard Progressive Matrices on a sample of 600 adults in Libya giving a median British IQ of 81. Results are reported for the urban-rural, gender and education levels in means and variance. Confirmatory factor analysis provided evidence of four first-order factors and one general factor accounting for 58.7% of the reliable variance.

1. Introduction

Lynn (2006) and Lynn & Vanhanen (2006) have summarised the results of intelligence tests worldwide and estimated the mean IQ in North Africa at approximately 81, in relation to a British IQ of 100 (sd=15). Subsequently, a number of further studies have been published. This paper begins with a summary of all the studies and presents new data for a standardisation of the Standard Progressive Matrices for adults in Libya.

The first study of intelligence in North Africa was published in the 1960s by Badri, 1965a, 1965b) who administered the Draw-a-Man test to a sample of 293 nine year olds in Sudan. In the subsequent years a further 20 studies have been published and data are now available for all the North African countries except for Algeria. The results of these studies are summarised in Table 1. The IQs in these studies are expressed in relation to a British IQ of 100 (SD-15). It will be seen that they lie in the range between 75 of (Ahmed, 1989) and 86 (Badri, 1965 and Lynn et al., 2008). Considering that these studies have been conducted over more than forty years and have used six different tests, the results are remarkably consistent. The median IQ of the studies is 84. These IQs have been validated by Lynn & Mikk (2009) who have reported that 15 year olds in Tunisia tested on mathematical ability have a “Mathematical Quotient” of 81 in relation to British Quotient of 100 (SD-15).

Table 1. Studies of the IQ in North Africa

Country	Age	N	Test	IQ	Reference
Egypt	6-10	206	DAM	84	Dennis, 1957
Egypt	12-15	111	CCF	81	Sadek, 1972
Egypt	6-12	129	SPM	83	Abdel-Khalek, 1988
Egypt	8-15	-	MSR	84	Rindermann, 2007
Libya	6-11	600	CPM	86	Lynn et al., 2008
Libya	8-17	1600	SPM	78	Al-Shahomee &

Country	Age	N	Test	IQ	Reference
					Lynn, 2010
Libya	6-16	870	WISC-R	85	Lynn et al., 2009
Morocco	8-15	-	MSR	79	Rindermann, 2007
Morocco	adults	202	SPM	84	Sellami et al., 2010
Sudan	9	293	DAM	86	Badri, 1965a, 1965b
Sudan	8-12	148	SPM	75	Ahmed, 1989
Sudan	adults	77	ETMT	76	Stanczak et al., 2001
Sudan	6-9	1683	CPM	81	Khatib et al., 2006
Sudan	4-10	1345	DAM	83	Khaleefa et al., 2008a
Sudan	9-25	6202	SPM	79	Khaleefa et al., 2008b
Sudan	7-11	3185	SPM	79	Irwing et al., 2008
Sudan	50	801	WAIS-R	86	Khaleefa et al., 2009
Sudan	50	801	WAIS-R	84	Khaleefa et al., 2009
Tunisia	20	509	SPM	84	Abdel-Khalek & Raven, 2006
Tunisia	8-15	-	MSR	84	Rindermann, 2007
North Africa	adults	90	SPM	84	Raveau et al., 1976

Note: full names of tests abbreviated in the table: DAM: Draw-a-Man test; CCF: Cattell's Culture Fair Test; CPM: Coloured Progressive Matrices; ETMT. Expanded Trail Making Test; MSR: Math, Science & Reading combined as a measure of IQ by Rindermann (2007): SPM: Standard Progressive Matrices; WAIS-R: Wechsler Adult Intelligence Scale-Revised; WISC-R: Wechsler Intelligence Scale for Children-Revised

2. Method

Sample

The Standard Progressive Matrices test (SPM, Raven, Raven & Court, 2000) was standardized in Libya during November and December 2010 on a representative sample of 600 adults (300 men and 300 women) aged between 23 and 37 years. All of them were Libyan citizens and employed in the government service. The sampling procedure comprised a multi-stage random sampling method (cluster sampling), to obtain an urban sample of 300 from two cities (Al-Beida and Shahat) and a rural sample of 300 from nine villages from the existing thirty. Villages were divided depending on location in coastal, mountain or desert villages (three villages from each category). Al-Beida is the main city in the eastern region of Libya. During the monarchy (1951-1969), Al-Beida was the second capital of Libya. It is considered as an educational, trade and health centre for neighbouring settlements and small cities (Kezeiri, 1995). Shahat city, previously known as Cyrene, was established by the Greeks in 631 B.C. It was the first city to be formed in Libya. The location of the city played a significant role in its growth and prosperity as did the availability of water from the Apollo springs and the abundance of rain. Its proximity to the port of Apollonia provided easy contact with all Mediterranean ports. The city is considered as an important political, religious, agricultural and industrial centre (Kezeiri, 1995).

In cluster sampling, intact groups, not individuals are randomly selected. All members of selected groups had similar characteristics. Cluster sampling is more convenient when the population is large or spread out over a wide geographic area. Cluster sampling can be carried out in stages, involving selection of clusters within clusters. This process is called multistage sampling (Gay, Geoffrey and Peter, 2006). When Raven (1981) standardized the Irish and British Standard Progressive Matrices test, he used this sampling method, which was defined by Denscombe (1998) as a sampling method that involves selecting samples from samples, each sample being drawn from within the previously selected sample. The procedure for conducting the multi-stage stratified sampling method involved sampling from one higher level unit called the preparatory sampling unit (Eastern Libyan Region) and then sampling of secondary sampling units from and within that higher level unit (cities and villages). This was followed by classifying the cities into two homogenous urban area clusters using the criterion of administrative boundaries as the third sampling level, i.e. main and secondary cities. The researcher selected one city from each category. In addition, villages were classified into three different categories (third clustering sampling level); coastal, dessert and mountain villages. Three villages were selected from each category with different weights or ratios as the fourth sampling level.

Measure

The Standard Progressive Matrices (SPM) test consists of 60 items given in 60 pages, and is divided into five sets lettered A, B, C, D and E. Each set consists of 12 items. Each page of the booklet contains a matrix with one missing part. Participants are asked to select the missing part from six or eight options given below each matrix, and to indicate its number on a separate answer sheet. Items are scored either right or wrong. A participant's score is the number of right answers. The maximum possible score is 60. The Raven's Standard Progressive Matrices (SPM) test was constructed to measure the educative component of *g* as defined in Spearman's theory of cognitive ability (Raven & Court, 1989). Kaplan & Saccuzzo (2008) and Jensen (1998) consider that research shows that the Raven Standard Progressive Matrices is a measure of fluid reasoning. The Progressive Matrices (Standard, Coloured, and Advanced) are the best known and most widely used tests as measures of individual differences in cognitive ability and as culture-reduced tests (Powers et al., 1986a; DeShon et al., 1995).

The following modifications were introduced to the SPM test, to make it more suitable for the Libyan sample:

1. Instructions were given in the colloquial Libyan Arabic language.

2. English letters (A, B, C, D and E) in the five sets were changed into Arabic letters.

3. Page order (direction) of the test booklet was changed from left to right, to suit the Arabic way of writing and reading.
4. A new answer sheet was designed with Arabic letters, and right to left direction for answering and writing.

Strategy of analysis
The analysis was carried out in the following manner:

- **First** Kolmogorov-Smirnov, Shapiro-Wilk test and normal probability plots were used to determine the normality of the data.
- **Second** To investigate the effect size of the SPM means by calculation of Cohen's *d,* which is equal to the difference between the means divided by the within group standard deviation (Cohen, 1988).
- **Third** Two-Way Analysis of Variance was used to compute differences between SPM test means in regard to regions and gender variables or education levels and gender variables or age groups and gender variables.
- **Fourth** To evaluate the gender differences in variability (variance ratios).
- **Fifth** Reliability of SPM test scores was investigated using Alpha (KR-20) and split-half methods.
- **Sixth** the construct validity of SPM test scores was investigated using exploratory and confirmatory factor analysis.

3. Results

The data were first examined for normality using the Kolmogrovo-Smirnov and Shapiro-Wilk tests. The *p* values were 0.200 and 0.308 respectively. Both values were above 0.05, indicating that the data were normally distributed. This allowed the use of parametric tests to investigate and evaluate the presence of statistically significant differences in the data. Descriptive statistics giving the mean scores, standard deviations, median and range obtained by the urban and rural samples are given in Table 2. The urban sample scored significantly higher than the rural sample (t= 2.265, p<.05). Cohen's *d* (the difference between the urban and rural samples means divided by the within group standard deviation) is 0.20.

Table 2. Urban-rural differences in the Standard Progreeive Matrices in Libya.

Region	(N)	Mean	SD	Median	Range
Urban	300	42.14	9.93	44.00	45
Rural	300	40.14	10.31	40.50	45
Total	600	40.80	10.22	41.50	46

Table 3 gives the gender differences in mean scores, standard deviations and variability on the SPM for the urban, rural and total samples. The Cohen's *d,* which is calculated as the difference between the means divided by the within group standard deviation. The variance ratios (VR), i.e. the variance of the males divided by the variance of the females; a VR greater than 1.0 indicates that males had greater variance than females, while a VR less than 1.0 indicates that females had greater variance than males). The VRs show that in the total sample females had greater variance than males. The results show that region is significantly associated with SPM scores, and the gender differences tested by F show that in each region males obtained significantly higher scores than females.

Table 3. Gender differences in mean scores, standard deviations and variability (VR) on the SPM in urban and rural regions.

Region	Gender	N	Mean	SD	*d*	Vr
Urban	Male	150	43.11	9.36	0.28	0.76
	Female	150	40.37	10.73		
	Total	300	42.14	9.93		
Rural	Male	150	42.35	10.21	0.38	1.02
	Female	150	38.48	10.09		

Region	**Gender**	**N**	**Mean**	**SD**	***d***	**Vr**
	Total	300	40.14	10.31		
Total	Male	300	42.68	9.85	0.37	0.92
	Female	300	38.92	10.25		
	Total	600	40.80	10.22		
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Part. Eta Sq'd
Corrected model	2343.28/*a*	3	781.096	7.739	.000	.037
Intercept	836903.920	1	836903.920	8292.058	.000	.933
Regions	217.579	1	217.579	5.145	.024	.004
Gender	1351.988	1	1351.988	13.396	.000	.022
Regions*Gender	39.461	1	39.461	.391	.532	.001
Error	60153.312	596	100.928			
Total	1061199.000	600				
Corrected total	62496.598	599				

a. R Squared = .037 (Adjusted R Squared = .033).

The sample was divided by regions and gender. The interaction effect between regions and gender was not statistically significant (F (1, 596) = .391, P = 0.532). There was a statistically significant main effect for regions, F (1, 596) = 5.145, P = 0.024; the magnitude of the effect size was small (partial eta squared = .037). The main effect for gender is statistically significant (F (1, 596) = 13.396 *P* = 0.000). Leven's equality test was not significant indicating that the group variance was equal.

Table 4 gives the differences in mean scores, standard deviations and variability on the SPM as a function of three education levels. Preparatory level consists of those at school until the age of 14, secondary level consists of those at school until the age of 17, and the university level consists of those who had completed university. The results show that education is significantly associated with SPM scores, and the gender differences tested by F show that at each educational level males obtained significantly higher scores than females. The interaction effect between gender and education levels was not statistically significant (F (2, 594) = .797, *P* = .451). There was a statistically significant main effect for gender (F (1, 594) = 14.282, *P* =.000); the magnitude of the effect size was small (partial eta squared = .060). Post-hoc comparisons using the Tukey HSD test showed that there were statistically significant differences between the different education levels. The main effect for education levels is statistically significant (F (2, 594) = 8.073 *P* = .000). Leven's equality test was not significant indicating that the group variance was equal.

Table 4. Gender differences in mean scores and variability on SPM as a function of education levels.

Education levels	**Gender**	**N**	**Mean**	**SD**	***d***	**Vr**
Preparatory	Male	40	40.18	8.71	0.95	1.16
	Female	38	31.38	8.07		
	Total	78	38.22	9.24		
Secondary	Male	91	40.98	9.71	0.34	0.84
	Female	80	37.52	10.59		
	Total	171	39.35	10.25		
University	Male	161	44.09	9.92	0.42	0.92
	Female	190	39.85	10.02		
	Total	351	41.79	10.18		
Source	Type III Sum of Squares	df	Mean square	F	Sig.	Part. Eta Sq'd
Corrected model	3724.977/*a*	5	744.995	7.530	.000	.060
Intercept	284536.663	1	284536.66	2875.79	.000	.829
Education level	1595.860	2	797.930	8.065	.000	.026
Gender	1412.841	1	1412.841	14.279	.000	.023
Education level*Gender	157.712	2	78.856	.797	.451	.003
Error	58771.621	594	98.942			
Total	1061199.00	600				
Corrected total	62496.598	599				

a. R Squared = .060 (Adjusted R Squared = .052).

Table 5 gives the differences in mean scores, standard deviations and variability on the SPM as a function of three age groups. The results show that the gender differences tested by F show that at each age group males obtained significantly higher scores than females.

Table 5. Gender differences in mean scores and variability on SPM as a function of age groups.

Age group	**Gender**	**N**	**Mean**	**SD**	***d***	**Vr**
23-27	Male	100	43.13	10.55	0.18	1.09
	Female	100	41.31	10.06		
	Total	200	42.22	10.32		
28-32	Male	100	42.85	9.65	0.46	0.90
	Female	100	38.08	10.18		
	Total	200	40.47	10.17		
33-37	Male	100	42.04	9.37	0.46	0.84
	Female	100	37.38	10.19		
	Total	200	39.71	10.04		
Source	Type III Sum of Squares	df	Mean square	F	Sig.	Partial Eta Squared
Corrected model	3052.388*a*	5	610.478	6.100	.000	.049
Intercept	998702.402	1	998702.402	9979.596	.000	.944
Age Group	663.343	2	331.672	3.314	.037	.011
Gender	2109.375	1	2109.375	21.078	.000	.034
Age group*Gender	279.670	2	139.835	1.397	.248	.005
Error	59444.210	594	100.074			
Total	1061199.000	600				
Corrected total	62496.598	599				

a. R Squared = .049 (Adjusted R Squared = .041).

Based on age groups and gender there was a statistically significant main effect for gender (F (2, 594) = 21.078 p = 0.000); the magnitude of the effect size was small (partial eta squared = .049). Post-hoc comparisons using Tukey HSD test showed that there were statistically significant differences between the age groups. The main effect for age groups was statistical significant (F (2, 594) = 3.314 P = 0.037). The interaction effect between age groups and gender was not statistically significant (F (2, 594) = .1.397, p = .248). Leven's equality test was not significant indicating that the group variance was equal.

The alpha reliability tested by α Cronbach (KR-20) for the SPM for the total sample was 0.92 and split-half reliability for the total sample was 0.88.

In order to explore the construct validity of the SPM the three-factor solution proposed by Lynn Allik and Irwing (2004) was tested using the WLSMV estimator within Mplus version 6.0. Muthen et al. (1997) developed WLSMV in order to provide appropriate estimates of model parameters for categorical data. This form of estimation has been shown to be robust in small sample sizes (Flora & Curran, 2004), given a stable weight matrix (Wirth & Edwards, 2007). The Lynn et al. solution showed only moderate fit to the current data (χ^2 = 2767.4, df = 1649, CFI = 0.91, TLI = 0.91, RMSEA = 0.034, SRMR = 0.113). We, therefore, adopted an exploratory approach in an attempt to identify a better solution.

In order to determine the correct number of factors to extract from the data we inspected the Scree plot, and conducted both a parallel analysis and Velicer's Minimum Average Partial. These methods have been shown in both simulation and review studies to be among the best methods for determining the number of factors present in a given data set (Zwick & Velicer, 1986; Velicer, Eaton & Fava, 2000; Hayton, Allen & Scarpello, 2004). According to a principal components analysis there were 16 factors with eigenvalues greater than unity, whereas both the scree test and Velicer's MAP pointed to four factors. Parallel analysis indicated seven factors, which appears over inclusive.

We tested a four factor solution, first with exploratory factor analysis using the WLSMV estimator and an Equamax rotation. The resulting solution was translated into a confirmatory factor model by freeing each factor loading of ≥0.30, from the exploratory solution. The fit of this model was good (χ^2 = 2228.6, df = 1636, CFI = 0.95, TLI = 0.95, RMSEA = 0.025, SRMR = 0.096), so it was accepted. We next tested a model in which each of the first-order factors was permitted to load on a single second-order factor. The fit of this model was highly similar (χ^2 = 2232.4, df = 1638, CFI = 0.95, TLI = 0.95, RMSEA = 0.025, SRMR = 0.097). This supports the contention that one general factor underlies the SPM, and this factor explained 58.7% of the reliable variance. We conclude that our analyses based on a simple sum score of the SPM items are justified.

Table 6. Correlations matrix between the five sets of the SPM.

Set	**Correlations**					**Factor 1**
	A	B	C	D	E	
A						0.57
B	0.50**					0.78
C	0.45**	0.62**				0.85
D	0.40**	0.56**	0.64**			0.87
E	0.33**	0.45**	0.58**	0.62**		0.78
Eigen value						2.183
% of variance						64.35
KMO and Bartlett's Test						
Kaiser-Meyer-Olkin Measure of Sampling Adequacy					.8350	
Bartlett's Test of Sphericity	Approx. Chi-Square				1107.7	
	df				10	
	Sig.				.0000	

4. Discussion

There are six principal points of interest in the results.

One, Table 2 shows that the urban sample obtained a significantly higher score on the SPM than the rural sample, although the difference was quite small at only 0.20*d*, equivalent to 3 IQ points.

Two, Table 3 shows that in the total sample and in the rural sample, but not in the urban sample, males scored significantly higher than females. In the total sample the difference was 0.32*d*, equivalent to 4.8 IQ points. This is virtually identical to the 5 IQ point male advantage among adults reported by Lynn & Irwing (2004) in their meta-analysis of gender differences on the SPM among adults in economically developed nations.

Three, Table 3 shows that the variance ratio for the total sample was 0.92, showing that females had greater variance than males. This result is contrary to numerous assertions that the variance of intelligence is greater in males than in females, e.g. "the general pattern suggests that there is greater variability in general intelligence within groups of boys and men than within groups of girls and women" (Jensen,1998, p.537). Despite this contention, the greater variance of men is not a universal phenomenon, as noted by Abdel-Khalek & Lynn (2009) and Meisenberg (2009).

Four, Table 4 shows that SPM scores were significantly associated with education levels. However, the differences were quite small: the difference between those with the least education and those with university education was only 0.37*d*, equivalent to 5.5 IQ points.

Five, the mean score of the total sample was 40.80. This is the 10^{th} percentile on the British 1992 standardisation on adults given in Raven, Raven & Court (2000) and is equivalent to a British IQ of 81. No Flynn effect correction is required because British means on the SPM for those aged over 13 years have remained stable between 1979 to 2008 (Lynn, 2009). This is closely similar to the three previous studies of IQs in Libya for children that gave British IQs of 78, 85 and 86, and the median

British IQ of 84 of the 21 studies in North Africa, given in Table 1.

Six, although exploratory and confirmatory factor analyses pointed to four first-order factors, they identified a general factor with a high degree of factor saturation. This is consistent with many other studies of the Progressive Matrices, indicating that it is a relatively pure measure of fluid reasoning, as stated by Jensen (1998). Some factor analytic studies, however, have found that while the Progressive Matrices is largely a measure of *g* it also contains a small visualization or spatial factor. These include Adcock (1948), Keir (1949), Banks (1949), Vernon (1950), Gabriel (1954) and Gustaffson (1984, 1988), who concluded that the SPM measures a reasoning factor and a further factor that he called "c*ognition of figural relations"*. Lynn, Allik & Irwing (2004) identified a general factor and three further factors that they reported as the gestalt continuation found by van der Ven & Ellis (2000), verbal-analytic reasoning and visuospatial ability. Further analysis of the three factors showed a higher order factor identifiable as *g*. Despite these reports, the present study is consistent with Jensen's (1998) conclusion that the SPM measures fluid reasoning and little else, and that the loadings occasionally found on other "perceptual" and "performance" type factors, independently of *g* are usually trivial and inconsistent from one analysis to another.

References

Abdel-Khalek, A. M. (1988). Egyptian results on the Standard Progressive Matrices. *Personality and Individual Differences*, 9, 193–195.

Abdel-Khalek, A.M. & Lynn, R. (2009). Norms for intelligence in Saudi Arabia assessed by the Standard Progressive Matrices. *Mankind Quarterly*, 50, 106-113.

Abdel-Khalek, A. & Raven, J. (2006). Normative data from the standardization of Raven's Progressive Matrices in Kuwait in an international context. *Social Behavior and Personality*, 34, 169-180.

Ahmed, R. A. (1989). The development of number, space, quantity and reasoning concepts in Sudanese schoolchildren. In L. L. Adler (Ed.). *Cross Cultural Research in Human Development*. Westport, CT: Praeger.

Adcock, C. (1948) A re-analysis of Slater's spatial judgment research. *Occupational Psychology*, 22, 213-216.

Al-Shahomee, A.A. & Lynn, R. (2010). Norms and sex differences for the Standard Progressive Matrices in Libya. *Mankind Quarterly*, 51, 97-107.

Badri, M. B. (1965a). The use of finger drawing in measuring the Goodenough quotient of culturally deprived Sudanese children. *Journal of Psychology*, 59, 333–334.

Badri, M. B. (1965b). Influence of modernization on Goodenough quotients of Sudenese children. *Perceptual and Motor Skills*, 20, 931–932.

Banks, C. (1949). Factor analysis of assessments for army recruits. *British Journal of Psychology*, Statistical Section, 2, 76-89.

Bartlett, M.S. (1954). A note on the multiplying factors for various chi square approximations, *Journal of the Royal Statistical Society*, 16 (Series B), 296-8.

Burke, H. (1958). "Raven's Progressive Matrices: A Review and Critical Evaluation." *The Journal of Genetic Psychology,* 93, 199-228.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Mahwah, NJ: Erlbaum.

Dennis, W. (1957). Performance of Near Eastern children on the Draw-a-Man test. *Child Development*, 28, 427–430.

Dennis, W., & Najarian, P. (1963). Development under environmental handicap. In W. Dennis (Ed.). *Readings in Child Psychology*. Englewood Cliffs: Prentice-Hall.

Denscombe, M. (1998). *The Good Research Guide: For Small-scale Social Research*. Buckingham: Open University Press.

Deshon, R. C. D. & Weissbein, D. (1995). Verbal overshadowing effect on Raven's APM: Evidence for multidimensional performance determinants. *Intelligence,* 21, 135-155.

Flora, D. B., & Curran, P. J. (2004). An empirical evaluation of alternative methods of estimation for confirmatory factor analysis with ordinal data. *Psychological Methods*, 4, 466-491.

Gabriel, K.R. (1954). The simplex structure of the progressive matrices test. *British Journal of Statistical Psychology*, 2, 3-16.

Gay, L. R., Geoffrey E.M, & Peter A. (2006). *Educational Research: Competencies for Analysis Applications*. 8th ed. New Jersey, Pearson.

Gustaffson, J. (1984). A unifying factor model for the structure of intellectual abilities. *Intelligence*, 8, 179-203.

Gustaffson, J. (1988). Hierarchical models of individual differences in cognitive abilities. In R.J.Sternberg (Ed) *Advances in the Psychology of Human Intelligence,* vol.4, pp. 35-72. New Jersey: Laurence Erlbaum.

Irwing, P., Hamza, A., Khaleefa, O. & Lynn, R. (2008). Effects of Abacus training on the intelligence of Sudanese children. *Personality and Individual Differences*, 45, 694-696.

Hayton, J. C., Allen, D. G., & Scarpello, V. (2004). Factor retention decisions in exploratory factor analysis: A tutorial on parallel analysis. *Organizational Research Methods*, 7, 191-205.

Jensen, A. (1980). *Bias in Mental Testing*. London, Methuen.

Jensen, A.R. (1998). *The g Factor*. Westport,CT: Praeger.

Kaiser, H.F. (1970). A second generation little jiffy. *Psychometrika*, 35, 401- 415.

Kaiser H.F (1974). An index of factorial simplicity. *Psychometrika*, 39, 31-36.

Kaplan, R.M., & Saccuzzo, D.P. (2008). *Psychological testing: Principles, applications, and issues.* (7th. ed.). Belmont, CA: Wadsworth/Thomson/Learning.

Keir, G. (1949) The Progressive Matrices as applied to school children. *British Journal of Psychology, Statistical Section*, 2, 140-150.

Khaleefa, O. Abdelwahid, S.B., Abdulradi, F. & Lynn, R. (2008a). The increase of intelligence in Sudan 1964-2006. *Personality and Individual Differences*, 44, 412-413.

Khaleefa, O., Khatib, M.A., Mutwakkil, M.M. & Lynn, R. (2008b). Norms and gender differences on the Progressive Matrices in Sudan. *Mankind Quarterly*, 49, 177-183.

Khaleefa, O., Sulman, A., & Lynn, R. (2009). An increase of WAIS-R IQ in Sudan, 1987-2007. Journal of Biosocial Science, 41, 279-283.

Khatib, M., & Mutwakkil, M. (2001). *Manual for Standard Progressive Matrices to the Sudanese environment* (in Arabic). Khartoum: Khartoum Press.

Khatib, M., Mutwakkil, M., Hussain, A. (2006). *Tagneen I'khtibar al-masfofat al-mutatabia' al-mulawwan litalameez al-halaqa al-o'la bimarhalat al-asas biwilayat al-khartoum (Standardization of the Coloured Progressive Matrices for children in Khartoum State)*. Khartoum: Sharikat Matabi' al-Sudan lil-Omlah al-Mahdodah.

Kezeiri, S. K. (1995). *Urbanisation*. In Bulugma, H. M. and Kezeire, S. K., Aljamahiriya: a geographical study. Sirt: Aljamahiriya Publishing House (Arabic text).

Lynn, R. (2006). *Race Differences in Intelligence: An Evolutionary Analysis*. Augusta, GA: Washington Summit Publishers.

Lynn, R. (2009) Fluid intelligence but not vocabulary has increased in Britain, 1979-2008. *Intelligence*, 37, 249-255.

Lynn, R., Abdalla, S. & Al-Shahomee, A.A. (2008). Norms for the Progressive Matrices for Libya and Tunisia. *Mankind Quarterly,* 49, 71-77.

Lynn, R., El-Ghmary Abdalla, S. & Al-Shahomee, A.A. (2009). Intelligence in Libya: Norms for the Verbal WISC-R. Mankind Quarterly, 49, 292-300.

Lynn, R., Allik, J. & Irwing, P. (2004). Sex differences on three factors identified in Raven´s Standard Progressive Matrices. *Intelligence*, 32, 411-424.

Lynn, R. & Irwing, P. (2004). Sex differences on the Progressive Matrices: a meta-analysis. *Intelligence*, 32, 481-498.

Lynn, R & Mikk, J. (2009). National IQs predict educational attainment in math, reading and science across 56 nations. *Intelligence,* 37, 305–310.

Lynn, R. & Vanhanen, T. (2006). *IQ and Global Inequality*. Augusta, GA: Washington Summit Publishers.

Meisenberg, G. (2009). Intellectual growth during late adolescence: Sex and race. Mankind Quarterly, 50, 138-155.

Muthen, B., du Toit, S.H. C., & Spisic, D. (1997). Robust inference using weighted least squares and quadratic estimating equations in latent variable modelling with categorical and continuous outcomes. Unpublished technical report: http://www.statmodel.com/wlscv.shtml

Powers, S.; Barkan, J. & Jones, P. (1986.a). Reliability of the (SPM) Test for Hispanic and Anglo-American Children. *Perceptual and Motor Skills*, 62, 348-350.

Raveau, F. H. M., Elster, E. & Lecoutre, J. P. (1976). Migration et acculturation différentiale. *International Review of Applied Psychology*, 25, 145–163.

Raven, J. (1981). Irish and British Standardisations. Oxford: Oxford Psychologists Press.

Raven, J. C., Court, J. H. & Raven, J. (1996). *Standard Progressive Matrices*. Oxford: Oxford Psychologists Press.

Raven, J. & Court, J. H. (1989). *Manual for Raven's Progressive Matrices and Vocabulary Scales*. London: Lewis.

Raven, J., Raven, J. C. & Court, J. H. (2000). *Standard Progressive Matrices*. Oxford: Oxford Psychologists Press.

Rindermann, H. (2007). The g-factor of international cognitive ability comparisons. *European Journal of Personality*, 21, 667-706.

Sadek,A. A. M. (1972). *A Factor Analytic Study of Musical Abilities of Egyptian Students Taking Music as a Special Subject*. Ph.D. dissertation, University of London.

Stanczak, D., Stanczak, E. & Awadalla, A. (2001). Development and initial validation of an Arabic version of Expanded Trail Making Test: Implications for cross-cultural assessment. *Archives of Clinical Neuropsychology*, 16, 141-149.

Tabachnick, B.C. & Fidell, L.S. (2007). *Using Multivariate statistics*. (2nd ed). New York, Harper-Collins.

van der Ven, A.H.G.S. & Ellis, J.L. (2000). A Rasch analysis of Raven's standard progressive matrices. *Personality and Individual Differences*, 29, 45-64.

Velicer, W. R., Eaton, C. A., & Fava, J. L. (2000). Construct explication through factor or component analysis: A review and evaluation of alternative procedures for determining the number of factors or components. In R. D. Goffin & E. Helmes (Eds.), *Problems and solutions in human assessment: Honoring Douglas N. Jackson at seventy*. Norwell, MA: Kluwer Academic.

Vernon, P.E. (1950). *The structure of human abilities*. London: Methuen.

Wirth, R. J., & Edwards, M. C. (2007). Item factor analysis: Current approaches and future directions. *Psychological Methods*, 12, 58-79.

Zwick, W.R. & Velicer, W.F. (1986). Comparison of five rules for determining the number of components to retain. *Psychological Bulletin*, 99, 432-442.

The Lynn-Flynn Effect

Chapter 13

The Flynn effect in Korea: Large gains

JAN te NIJENHUIS, SUN HEE CHO**,*
*RAEGAN MURPHY ***, KUN HO LEE *****
**Work and Organizational Psychology, University of Amsterdam, the Netherlands; **Global Institute For Talented Education, KAIST, Daejeon, Korea; ***Applied Psychology, University College Cork, Ireland; ****Department of Marine Life Science, Chosun University, Gwangju, Korea.*

This study was supported in part by a research grant from Chosun University, 2011.
Corresponding author: Kun Ho Lee, Department of Marine Life Science, Chosun University, Gwangju 501-759, Korea.
Email: Leekho@chosun.ac.kr.

ABSTRACT

Secular gains in IQ test scores have been reported for many Western countries. This is the first study of secular IQ gains in South Korea, using various datasets. The first question is what the size of the Flynn effect in South Korea is. The gains per decade are 7.7 points for persons born between 1970 and 1990. These gains on broad intelligence batteries are much larger than the gains in Western countries of about 3 IQ points per decade. The second question is whether the Korean IQ gains are comparable to the Japanese IQ gains with a lag of a few decades. The gains in Japan of 7.7 IQ points per decade for those born approximately 1940-1965 are identical to the gains per decade for Koreans born 1970-1990. The third question is whether the Korean gains in height and education lag a few decades behind the Japanese gains. The Koreans reach the educational levels the Japanese reached 25-30 years before, and the gains in height for Koreans born 1970-1990 are very similar to gains in height for Japanese born 1940-1960, so three decades earlier. These findings combined strongly support the hypothesis of similar developmental patterns in the two countries.

Introduction: The Secular Increase in Average IQ Test Scores

Western, industrialized countries showed average gains on standard broad-spectrum IQ tests of three IQ points per decade between 1930 and 1990. Verbal tests showed gains of 2 IQ points per decade, and non-verbal (Fluid and Visual) tests showed gains of 4 IQ points per decade. Gains on specific measures, such as the Raven's Progressive Matrices when used for the assessment of military recruits averaged about 7 IQ points per decade. Recently, however, studies from Denmark and Norway show the secular gains have stopped in Scandinavia and even suggest a decline of IQ scores (Teasdale & Owen, 2007; Shayer, Ginsburg, & Coe, 2007; Sundet, Barlaug, & Torjussen, 2004). However, an important part of the decline in IQ score is most likely due to the increase of low-*g* immigrants (see te Nijenhuis, de Jong, Evers, & van der Flier, 2004). In a recent paper Lynn has shown that fluid intelligence measured by the Progressive Matrices has increased in Britain over the years 1979- 2008 among 7 to 12 year olds, but not among 13 to 15 year olds, and that vocabulary has shown no increase in Britain over the years 1982- 2007 among 5 to 11 year olds (Lynn, 2009a). There is also recent evidence of IQ test scores continuing to rise in countries in the former communist Eastern Europe (e.g. in Estonia, see Must, te Nijenhuis, Must, & van Vianen, 2009), in less-developed parts of the world, for example in Sudan (Khaleefa, Abdewahid, Abdulradi, & Lynn, 2008), Kenya (Daley, Whaley, Sigman, Espinosa, & Neumann, 2003), and in the Caribbean (Meisenberg, Lawless, Lambert, & Ross, 2006).

Various causes have been hypothesized for the Flynn effect. Chief among them are improved nutrition and health care and education (see Lynn, 1990; see Jensen, 1998). Some theorists argue that the Flynn effect is a byproduct of outbreeding, testing artefacts, test sophistication, cultural changes, and decreasing family size.

Lynn's contribution to the area

The so-called Flynn effect was identified by Richard Lynn (1982) two years before Flynn (1984) identified the same phenomenon in the United States. Lynn's 1982 paper showed that intelligence had increased in Japan from the 1930s up to the 1970s. In 1987 he published a further paper documenting the increase in Britain during the half century 1936-1986 (Lynn, Hampson, & Mullineaux, 1987), which was followed by Flynn (1987) showing the same increase had taken place in a number of countries. Lynn and Pagliari (1994) documented gains in the US. However, although Lynn was certainly ahead of Flynn in identifying the increase of intelligence that occurred in many countries in the twentieth century, he was by no means the first to show this. The first major study to identify the Flynn effect was published some forty years earlier by Tuddenham (1948), who showed that the intelligence of American conscripts had increased by 4.4 IQ points a decade from 1917 to 1943. A year later an increase of intelligence was reported in Scotland over the years 1932-1949 (Scottish Council for Research in Education, 1949). In view of these early studies, the secular increase of intelligence arguably should properly have been called the "Tuddenham effect". Many studies on secular gains have developed from Lynn's pioneering work.

Lynn has published a number of further seminal papers on score gains. His principal contributions have been to document the effect and to argue that the principal factor responsible for the effect has been improvements in nutrition (Lynn,1990; 1998 2009b). In the last of these he showed that the FE of approximately 3 IQ points a decade has taken place in the developmental quotients of one and two year olds. He argues that this favors the nutrition theory and makes less plausible the alternative explanations of the Flynn effect that it is due to improvements in education, advanced by Flynn (2007). However, it could also be argued that this is explained by the trend towards turning infancy into a frantic learning experience.

Lynn and Hampson (1986) review five studies providing evidence on the secular trend of intelligence in Japan for the post World War II period. They conclude that two studies of the early post World War II period show substantial IQ gains of 9.9 and 11.4 IQ points per decade, giving an average of 10.7 IQ points per decade. Three studies of a longer period from approximately 1950-1975 – so for those approximately born 1940 – 1965 – show lower gains of 9.1, 8.3, and 5.7 IQ points per decade, giving an average gain of 7.7 IQ points per decade. This is the highest gain on a broad intelligence battery in the literature. Since the early part of this period was characterized by a greater rate of gain, it appears that since around 1960 the IQ gains in Japan have decelerated to approximately 5 IQ points per decade. However, there are, to this date, no studies of the Flynn effect in Korea. The present paper fills this important gap in the literature.

History of Korea

The Korean peninsula has a long integrated history with China and Japan. Korea was annexed by Japan in 1910 and subjugated economically, religiously, culturally, socially, and politically resulting in mass exodus. After independence in 1945, Russian forces and American forces entered Korea in an attempt to defeat Japan. The drawing up of what was originally a temporary demarcation line between North and South Korea would eventually lead to Korea’s most troubled period in history. In 1948 the South was declared a Republic with the North following suit shortly thereafter proclaiming a Democratic People’s Republic of Korea. South Korea’s growth and development stand in marked contrast to the North. In South Korea’s per capita GNI (2007) is $20,045 in comparison to North Korea for whom the figure is $1,108 (2006). (U.S. Department of State: Bureau of East Asian and Pacific Affairs, 2008).

The Republic of Korea’s education system follows a similar general pattern as to that found in typical western countries with compulsory elementary schooling with a 100%

enrollment figure (http://www.korea.net). Teacher-student ratios have declined since the 1960-1970s from high ratios to figures more in keeping with western countries. Table 1 details the education level of the population above the age of 25 from 1970-2005 and Table 2 details the enrolment figures from 1945-2002.

Table 1. South Korea: Education level of the population above the age of 25.

Year	Elementary school or below elementary school (%)	Middle school (%)	High school (%)	University or above university (%)	Total (%)
1970	73.4	11.5	10.2	4.9	100
1975	65.5	14.8	13.9	5.8	100
1980	55.3	18.1	18.9	7.7	100
1985	43.4	20.5	25.9	10.2	100
1990	33.4	19.0	33.5	14.1	100
1995	26.6	15.7	38.0	19.7	100
2000	23.0	13.3	39.4	24.3	100
2005	19.1	11.2	38.3	31.4	100

Table 2. Enrolment in higher education in South Korea and Japan 1945-2002.

Year	Korean students in higher education as a percentage of the total population	Japanese students in higher education as a percentage of the total population
1945	.034	-
1950	.056	1.23
1960	.404	2.9
1965	.486	4.43
1970	0.62	7.18
1975	0.98	8.29
1980	1.69	8.03
1985	3.55	7.99
1990	3.89	9.9
1995	5.19	12.79
2000	7.11	14.2
2002	7.5	14.55

The increase in the South Korean national educational level in just over 30 years is quite dramatic as the data shows that between 1970 and 2002 the number of students in higher education increased with a factor 18, another indication of the spectacular increase in education.

The height of a population is a good indicator of its health and the data show spectacular gains in height. Table 3 illustrates how 17-year-olds in 2005 measured 167.3 cm whereas in 1965 they measured 160.3 cm.

Taking an SD of 5 cm (Korean Educational Development Institute, 1966- 2006), this is almost a one-and-a-half SD increase in height in 40 years. Looking at 17-year-olds may not give the best impression, because boys stop growing around age 18, whereas girls stop growing around age 15 (Lynn, 1994). Again taking an SD of 5, 13-year-olds show a gain of 15.2 cm, which is the equivalent of 3 SDs, and 14-year-olds show a very similar gain of 15.1 cm. The greatest increases occurred for the 11-year-old age group with a gain of 18.1cm. A gain in height of 3 SD in just 40 years is spectacular.

Chief among the various hypothesized causes of the Flynn effect are improved nutrition and health care and education (Jensen, 1998). As there are such large gains in height and education it is expected there are also large gains in IQ scores.

Same Patterns of Development in Korea and Japan?

Lynn and Hampson (1986) report a 7.7 IQ point gain per decade for Japanese born approximately 1940-1965; this estimate is based on a number of studies and therefore quite reliable. Various studies show large gains in height and years of education for the Japanese; these gains happened at the same time as the gains in IQ.

Korea changed dramatically after the Korean war ended in 1953, just as Japan had shown a dramatic change several decades before. From poor countries they both quickly developed to rich countries. It may be that the development of Japan and Korea in

Table 3. South Korea: Year of birth and increase in height between ages 6 and 17 for males and females combined.

Age →	6 b.1959-1999	7 b.1958-1998	8 b.1957-1997	9 b.1956-1996	10 b.1955-1995	11 b.1954-1994	12 b.1953-1993	13 b.1952-1992	14 b.1951-1991	15 b.1950-1990	16 b.1949-1989	17 b.1948-1988
Year↓	**Height measured (cm.)**											
1965	111.5	114.9	119.3	124.7	127.8	131.6	142.0	145.3	148.8	156.4	159.0	160.3
1970	112.4	116.7	120.9	125.6	130.0	133.8	144.0	148.5	151.5	157.1	159.6	161.2
1975	111.8	118.1	121.4	127.6	132.4	137.2	144.3	149.6	153.7	158.3	160.4	161.8
1980	114.4	119.8	124.8	129.7	134.6	139.8	145.4	150.6	155.3	159.0	161.1	162.3
1985	116.0	121.5	126.4	131.5	136.7	142.3	148.6	153.6	157.9	160.8	162.3	163.4
1990	117.8	123.3	128.5	133.7	139.0	145.0	155.0	155.8	159.6	162.2	163.5	164.4
1991	117.9	123.5	128.8	134.0	139.4	145.2	155.2	156.1	159.9	162.3	163.6	164.5
1992	118.2	123.7	129.2	134.2	140.1	146.0	151.3	156.6	160.7	162.8	163.9	164.6
1993	118.5	124.1	129.5	134.9	140.3	146.3	152.0	157.1	160.9	163.4	164.4	165.0
1994	118.9	124.4	129.5	135.0	140.8	146.4	152.4	157.5	161.0	163.5	164.8	165.3
1995	118.9	124.6	130.0	135.3	141.0	147.1	152.9	157.9	161.8	163.9	164.9	165.7
1996	119.1	124.7	130.2	135.5	141.3	147.3	153.1	158.2	162.0	164.1	165.4	166.1
2000	119.5	125.4	130.7	136.3	142.1	148.7	154.7	159.6	163.1	165.0	166.2	166.8
2005	120.0	125.9	131.5	137.2	143.4	149.7	155.7	160.6	163.9	165.9	166.8	167.3

Table 4. Japan: Year of birth and increase in height between ages 5 and 17 for males and females combined

Age→	5 b.1945-2000	6 b.1944-1999	7 b.1943-1998	8 b.1942-1997	9 b.1941-1996	10 b.1940-1995	11 b.1939-1994	12 b.1938-1993	13 b.1937-1992	14 b.1936-1991	15 b.1935-1990	16 b.1934-1989	17 b.1933-1988
Year↓	Height measured (cm.)												
1950	104.45	108.2	113.2	118.0	122.5	126.85	131.4	136.65	141.85	146.95	152.5	155.55	157.2
1955	105.45	109.8	115.1	119.85	124.8	129.55	134.4	140.1	145.5	150.3	155.1	157.1	158.3
1960	106.8	111.15	116.45	121.5	126.55	131.8	137.15	142.95	148.1	152.9	156.95	158.45	159.3
1965	108.2	112.9	118.3	123.5	128.6	133.85	139.45	145.5	151.0	155.4	158.8	160.15	160.8
1970	109.05	114.05	119.75	125.05	130.25	135.75	141.7	147.75	153.05	157.35	159.7	161.0	161.7
1975	109.35	114.75	120.5	125.75	131.6	137.0	143.1	149.1	154.65	158.6	160.9	162.05	162.5
1980	109.85	115.35	121.0	126.55	131.95	137.8	143.9	150.2	155.45	159.8	161.8	162.9	163.3
1985	110.2	116.05	121.75	127.2	132.6	138.25	144.35	150.45	156.05	160.05	162.25	163.3	163.9
1990	110.5	116.4	122.15	127.75	133.15	139.05	145.35	151.45	156.75	160.45	162.55	163.55	164.1
1995	110.55	116.4	122.15	127.85	133.45	139.55	145.8	151.95	157.35	160.9	162.9	163.9	164.4
2000	110.3	116.25	122.1	127.8	133.55	139.7	146.2	152.5	157.55	161.15	162.95	163.9	164.4
2005	110.3	116.2	122.1	127.85	133.55	139.55	146.0	152.25	157.55	161.1	162.85	163.9	164.4

the 20th century shows the same patterns in gains in height, education, and IQ. It may be the case that Korea simply lags a few decades behind Japan.

Research Questions

The first question is what the size of the Flynn effect in South Korea is. The second question is whether the South Korean IQ gains are comparable to the Japanese IQ gains with a lag of a few decades. The third question is whether the Korean gains in height and education lag a few decades behind the Japanese gains.

Method

Tests

Test data were gathered on the well-known test batteries adapted and used in many countries, such as the various versions of the Wechsler scales. Table 5 lists the Korean tests and their US counterparts.

Table 5. Korean IQ tests and US originals.

Korean tests	US original	Year Korean norm sample	M/SD
Korean K-ABC (1997)	K-ABC (1983)	1996	100/15
K-WAIS (1992)	WAIS-R (1981)	1991	100/15
KEDI-WISC (1991)	WISC-R (1974)	1986	100/15
K-WISC III (2001)	WISC III 1991)	1999*	100/15
K-WPPSI (1996)	WPPSI-R (1989)	1995	100/15

Note. The year in which the Korean norm samples were tested was taken from the manual.
* = year estimated. When the date at which standardization was carried out is not given, it was assumed to have taken place two years before the date of publication. When the collection of the

standardization sample took several years, we took the year in the middle.

Collecting Data on Height and Education in Korea and Japan

Data were collected on height and education in Japan, so as to be able to make a comparison with the gains in height and education in South Korea as described in Introduction.

Statistical Analyses

Computing secular score gains.

The methods of computing secular gain scores used in this paper were also used in Flynn (1984). In studies where the same group took two different test batteries the resulting means were compared. These samples need not be representative. For instance, one group took both the K-WISC-III (2001) and the KEDI-WISC (1991). Comparing their scores on the older test and on the newer test with the scores of norm samples from the older test and with the scores of the norm sample of the newer test, and computing the difference, gives an estimate of the Flynn effect. For instance, if the same group of subjects took the KWIS – normed in 1961 – and the K-WAIS – normed in 1991 – they should score higher on the earlier test, the KWIS. The group's raw score on the KWIS should be compared to the norm scores of the KWIS from 1961, which might result in a score of 117. The group's raw score on the K-WAIS should be compared to the norm scores of the K-WAIS from 1991, which might result in a score of 101. The difference between their mean scores on the two tests serves as s measure of the magnitude of gains, that is, scoring 117 on the earlier test and 101 on the later test suggests a gain of 16 IQ points in 30 years. Table 6 delineates the combinations of batteries used to compute the effect in this manner.

Table 6. Samples used to determine Flynn Effect using the same groups on different tests.

Test	Norm dates
K-WISC- (2001) and K-WAIS (1992)	1999 and 1991
KEDI-WISC (1991) and K-ABC (1997)	1986 and 1996
K-WPPSI (1996) and K-WISC- (2001)	1995 and 1999
K-WISC- (2001) and KEDI-WISC (1991)	1999 and 1986

Note. Counterbalanced designs were used in all studies.

Samples were compared when there was at least four years between the groups being compared or between the norm samples of the two tests such that the scores of one group taking two tests were compared; in such a way sampling error will not overwhelm the trend.

Comparison of Korean and Japanese gains.

Statistics on height and education for Korea and Japan were compared to check how many decades the Koreans lagged behind the Japanese. How many decades passed before Koreans were at a specific educational level at a specific point in time in Japan? For a specific period in time, were gains in height in Japan similar to gains in height in Korea a few decades later?

Results

Descriptive Statistics

From the four data sets in Table 7 – the same group takes two different tests using a counterbalanced design – we computed the average gain per decade; the sample sizes are quite comparable, so we did not use sample size weighed means.

Table 7. Score gains for same group on two different tests.

Test	Norm dates	(Average of) year born for two groups	Age	N	Time gap (years)	Gain per decade		
						Verbal	Perf.	Full
K-ABC (1997) and KEDI-	1996 and	1977-1987	5 - 12	80	10			3.3

Test	Norm dates	(Average of) year born for two groups	Age	N	Time gap (years)	Gain per decade		
						Verbal	Perf.	Full
WISC (1991)	1986							
K-WISC- (2001) and KEDI-WISC (1991)	1999 and 1986	1975-1988	6 - 16	89	13	3.15	10.46	7.23
K-WISC- (2001) and K-WAIS (1992)	1999 and 1991	1975-1983	16	70	8	6.0	16.13	11.88
K-WISC- (2001) and K-WPPSI (1996)	1999 and 1995	1988-1992	6-7	68	4	-4.5	21.5	8.25

Note. Gain per decade is expressed in IQ points. An SD of 15 is assumed.

The gains for Verbal, Performance, and Full Scale were, respectively, 1.6 IQ points, 16.0 IQ points, and 7.7 IQ points. Excluding the comparison between the K-WISC III and the K-WPPSI with its decrement on Verbal IQ results in a mean gain per decade on Verbal of 4.6 IQ points based on two data sets. This gain per decade on the Full Score of 7.7 IQ points for people being born in the period of about 1970-1990 is the same as the value for Japan of 7.7 IQ points gain per decade for those born approximately 1940-1965 (Lynn & Hampson, 1986).

Comparison of Height and Education Data for Korea and Japan

The gains in IQ for Koreans born approximately 1970 – 1990 are identical to the gains for Japanese born approximately 1940-1965. So, we simply take three decades as an estimate of the developmental lag of Korea in comparison to Japan. When comparing the Japanese enrolment figures with those of South Korea, it can be seen that South Korea lags some 25 to 30 years behind Japan (see Table 2). The first example is that the number of students expressed as a percentage of the population enrolled in higher education in South Korea in 1975 is comparable to the numbers enrolled in Japan in 1950. The second example is that the enrolment figure in South Korea for 2002 and Japan 30 years earlier is highly similar, about 7%.

Table 3 shows that the gains in height in Korea are similar to the gains in height in Japan thirty years before. For instance, South Koreans born in 1968, measured in 1985 at age seventeen were 163.4 cm tall; Koreans born in 1988, measured in 2005 at age seventeen were 167.3 cm tall. This is a gain of 3.9 cm in twenty years. Thirty years earlier, Japanese born in 1938, measured in 1955 at age seventeen, were 158.3 cm tall; Japanese born in 1958, measured in 1975 at age seventeen were 162.6 cm tall. This is a gain of 4.3 cm. So, over a period of twenty years, the Koreans show highly comparable gains in education and height as the Japanese 30 years before.

Discussion

Secular score gains in IQ have been shown clearly for many Western countries, but there is a much smaller number of studies from Asia. In this study we tried to answer three questions concerning secular score gains in Korea. The first question is what the size of the Flynn effect in South Korea is. The results are clear: secular score gains in South Korea are large, based on findings from a substantial number of data sets. The gains per decade are 7.7 points for persons born between 1970 and 1990. The most recent gains are reliable as they are based on several high-quality datasets. These gains on broad intelligence batteries are much larger than the gains in Western countries of about 3 IQ points per decade.

The second question is whether the Korean IQ gains are comparable to the Japanese IQ gains with a lag of a few decades. Lynn and Hampson (1986) show gains in Japan of 7.7 IQ points per decade for those born approximately 1940-1965. These gains are identical to the gains per decade for Koreans born 1970-1990. Indeed, the Korean gains in IQ lag behind the Japanese gains by three decades.

The third question is whether the Korean gains in height and education lag a few decades behind the Japanese gains. The data on education clearly show that the Koreans reach the educational levels the Japanese reached 25-30 years before, which strongly supports the hypothesis of similar developmental patterns in the two countries. The data on height clearly show that gains in height for Koreans born 1970-1990 are very similar to gains in height for Japanese born 1940-1960, so three decades earlier. This is in line with the hypothesis of similar development. The combined findings on education and height strongly support the hypothesis of similar developmental patterns. These two gains may be responsible for part of the gains in IQ in both Japan and Korea, but of course gains in GDP, urbanization, family size, health care expenditure, the dissemination of television, and teacher-to-student ratios may have shown comparable trends in the same time period and may have also contributed to the gains.

Thoughts about the future of the area

Following the pioneering work of Lynn a lot of data have been collected on secular score gains. To separate the trends from the outliers various meta-analyses are badly needed. For instance, Flynn (2007) lists all the datasets on the question whether gains are dissimilar for persons of low, average, and high IQ, and a next step is to meta-analyze these data. Flynn also describes the comparative trends on Wechsler subtests and these should also be meta-analyzed. Secular gains in variables hypothesized to be causes of the Flynn effect have been documented and also need to be meta-analyzed to be combined with the meta-analyses on IQ gains.

Some claims rest on only a small number of studies, such as Lynn’s claim that IQ gains are already fully present at a young age. Some more studies on this topic are needed.

Comparison of countries which vary on variables hypothesized to be causes of the gains are also possible. For instance, communism influenced various variables, so a comparison between Estonia and Sweden would be interesting, or between former West Germany and East Germany. Theoretically, it would be very interesting to do a study of secular score gains in IQ in North Korea. It appears that height has not increased in North Korea since the end of the Korean war. However, it may be that the quality and number of years of education has improved. This experiment of nature could throw some light on the question to what degree nutrition/hygiene and education influence score gains. Following Lynn (2010) a comparison of the north and south of Italy would also be interesting.

Another fundamental question is when the secular gains have started. Some empirical studies go as far back as people born in the last part of the 19th century. The German sociologist Oesterdiekhoff (2006) has written extensively on the cognitive level of populations in earlier times, suggesting the cognitive level in 17th century France, Germany, England and the Netherlands was more than two *SD*s below the present level. He argues that the cognitive level of ancient Greeks and Romans was even lower. Oesterdiekhoff makes extensive use of the Piagetian developmental literature to back up his claims and this looks like a promising approach.

References

Daley, T., Whaley, S., Sigman, M., Espinosa, M., & Neumann, C. (2003). IQ on the rise: The Flynn effect in rural Kenyan children. *Psychological Science, 14*, 215 – 219.

Flynn, J. R. (1984). The mean of IQ of Americans: Massive gains 1932 to 1978. *Psychological Bulletin, 95*, 29-51.

Flynn, J. R. (1987). Massive IQ gains in 14 nations: What IQ tests really measure. *Psychological Bulletin, 101*, 171-191.

Flynn, J.R. (2007). *What is intelligence? Beyond the Flynn effect*. Cambridge University Press.

Jensen, A. R. (1998). *The g factor*. Westport, CT: Praeger.

Jun, Y. S., Seo, B. Y., & Lee, C. W. (1963). Korean Wechsler Intelligence Scale manual. Seoul: Choong Ang Education Research Center.

Khaleefa, O., Abdelwahid, S.B., Abdulradi, F. & Lynn, R. (2008). The increase of intelligence in Sudan 1964-2006. *Personality and Individual Differences*, 44, 412-413.

Korean Educational Development Institute. (1966-2006). *Statistical yearbook of education, 1966-2006.* Korea.

Kwak, K. J., Park, H. W., Kim, C. T. (2001). Korean-Wechsler Intelligence Scale for Children-III. Seoul: special education publishing Co.

Lynn, R (1982). IQ in Japan and the United States shows a growing disparity. *Nature*, 297, 222-223.

Lynn, R. (1990). The role of nutrition in secular increases in intelligence. *Personality and Individual Differences, 11*, 273 – 285.

Lynn, R. (1994). Sex differences in intelligence and brain size. A paradox resolved. *Personality and Individual Differences, 17*, 257-271.

Lynn, R. (1998). In support of the Nutrition Theory. In: Neisser, U. (Ed.) *The rising curve. Long-term gains in IQ related measures*. Washington: American Psychological Association.

Lynn, R., (2009a). Fluid intelligence but not vocabulary has increased in Britain, 1979-2008. *Intelligence*, 37, 249-255.

Lynn, R. (2009b). What has caused the Flynn effect? Secular increases in the Development Quotients of infants. *Intelligence*, 37, 16-24.

Lynn, R. (2010). In Italy, north-south differences in IQ predict differences in income, education, infant mortality, stature, and literacy. *Intelligence, 2010*, 93-100.

Lynn, R., & Hampson, S. (1986). The rise of national intelligence: Evidence from Britain, Japan and the U.S.A. *Personality and Individual Differences, 7*, 23-32.

Lynn, R., Hampson, S.L. & Mullineaux, J.C. (1987). A long term increase in the fluid intelligence of English children. *Nature*, 328, 797.

Lynn, R. & Pagliari, C. (1994) The intelligence of American children is still rising. *Journal of Biosocial Science*, 26, 65-68.

Meisenberg, G., Lawless, E., Lambert, E., & Newton, A. (2006). The social ecology of intelligence on a Caribbean Island. *Mankind Quarterly, 46*, 395 – 433.

Moon, S. B., & Byeon, C. J. (1997). Korean Kaufman Assessment Battery for Children. Seoul: HakJi publishing Co.

Must, O., te Nijenhuis, J., Must, A., & van Vianen, A. (2009). Comparability of IQ scores over time. *Intelligence*, *37*, 25-33.

Oesterdiekhoff, G.W. (2006). *Kulturelle Evolution des Geistes [Cultural evolution of the mind]*. Germany, Hamburg: Lit Verlag.

Park, H. W., Kwak, K. J., & Park, K. B. (1996). Korean-Wechsler Preschool and Primary Scale of Intelligence. Seoul: special education publishing Co.

Park, K. S., Yoon, J. Y., Park, H. J., Park, H. J., & Kwon, K. U. (1991). KEDI-Wechlser Intelligence Scale for Children manual. Seoul: KEDI.

Scottish Council for Research in Education (1949). *The Trend of Scottish Intelligence*. London: University of London Press.

Shayer, M., Ginsburg, D., & Coe, R. (2007) Thirty years on – a large anti-Flynn effect? The Piagetian test Volume & Heaviness norms 1975 – 2003. *British Journal of Educational Psychology, 77*, 25 -71.

Sundet, J.M., Barlaug, D., & Torjussen, T. (2004). The end of the Flynn effect? A study trends in mean intelligence test scores of Norweigian conscripts during half a century. *Intelligence, 32*, 349 – 362.

te Nijenhuis, J., de Jong, M.-J., Evers, A ,van der Flier, H. (2004). Are cognitive differences between immigrant and majority groups diminishing? *European Journal of Personality, 18*, 405-434.

Teasdale, T., & Owen, D. (2007). Secular declines in cognitive test scores: A reversal of the Flynn Effect. *Intelligence, 36*, 121-126.

Tuddenham, R.D. (1948). Soldier intelligence in world wars 1 and 11. *American Psychologist*, 3, 54-56.

Yeom, T. H., Park, Y. S., Oh, K. J., Kim, J. K., & Lee, Y. H. (1992). Korean-Wechsler Adult Intelligence Scale. Seoul: Korea Guidance.

Web references

Republic of Korea. (2008). Retrieved 21 October 2008 from http://www.korea.net.

U.S. Department of State: Bureau of East Asian and Pacific Affairs. (2008). Background note North Korea. Retrieved 20 October 2008 from http://www.state.gov/p/eap/ci/kn/.

Chapter 14.

A life history model of the Lynn-Flynn effect

MICHAEL WOODLEY
University of London, School of Biological Science, Royal Holloway, Egham, Surrey TW20 0EX, United Kingdom
Michael.Woodley03@gmail.com

ABSTRACT

A new life history model of the Lynn-Flynn effect is presented based on the idea that life history speed is associated with a trade-off between positive manifold strength (fast life history) and differentiation with respect to abilities (slow life history) rather than individual differences in levels of *g* (which instead function as a fitness indicator and are associated with pleiotropic mutation load). Given that the Lynn-Flynn effect concerns only the non-*g* variance in test scores it is proposed that it is associated with ability differentiation resulting from recent population-level shifts towards slower life history speed as a consequence of the mitigation of sources of environmental unpredictability and harshness, such as pathogen stress and malnourishment. Smaller family sizes are also significant as not only do they result from slower life history speed, but they might also potentiate further life history slowing. Education is also significantly involved in the development of specialized patterns of cognitive abilities. This arrangement also accounts for the seemingly contradictory dysgenesis effect, as this occurs on *g*, which is unconnected to life history speed. Empirical predictions are made in the discussion, which if tested, could present definitive evidence either confirming of refuting the life history model.

1. Introduction

Richard Lynn was the first to bring the phenomenon of massive gains on standardized intelligence tests over time to widespread attention with a study published in *Nature* involving Japanese cohorts (Lynn, 1983). Subsequent research by Flynn (1984, 1987) expanded the scope of the search for these gains and found that they are occurring worldwide at a rate of approximately three points a decade. The effect has been christened the 'Flynn effect' (Herrnstein & Murray, 1994), however Rushton (1999) has argued that the effect should be termed the Lynn-Flynn effect, owing to the equally important contributions of both researchers to its elucidation. Congruent with Rushton's suggestion, the effect shall here be referred to as the Lynn-Flynn effect.

A number of studies have found that the effect manifests itself most strongly on measures of fluid intelligence such as verbal ability rather than on tests of crystallized intelligence (Colom, Andres-Pueyo, & Juan-Espinosa, 1998; Emanuelsson, Reuterberg, & Svensson, 1993; Emanuelsson & Svensson, 1990; Flynn, 1987, 1998; Lynn & Hampson, 1986, 1989; Teasdale & Owen, 2000), these 'differential gains' have in turn led to debate concerning whether or not the effect concerns *g* (Colom, Juan-Espinosa, & Garcia, 2001; Flynn, 1999a, 1999b, 2000a; Jensen, 1998; Must, Must, & Raudik, 2003; Rushton, 1999, 2000). A recent study by Rushton and Jensen (2010), has examined this issue in some detail. They found that *g*-loadings and inbreeding depression scores on the 11 subtests of the Wechsler Intelligence Scale for Children correlated either significantly negatively or not at all with secular gains due to the Lynn-Flynn effect, which reinforces the idea that the effect is not in any way *g*-loaded. This is compatible with the finding that the assumption of factorial invariance with respect to cohorts (a necessary criterion for the invocation of *g* in the Lynn-Flynn effect) is untenable (Wicherts et al., 2004).

The idea that the Lynn-Flynn effect is not *g*-loaded has raised another issue, namely to what extent might the effect simply be an artefact of some kind stemming from factors such as heightened test sophistication or even the tendency for tests to lose their *g*-loading as a consequence of training, retesting and general familiarity (Brand, 1987; 1990; Brand, Freshwater, & Dockrell, 1989; Flynn, 1990; Jensen, 1996; Rodgers, 1998; Rushton & Jensen, 2010)? Still, others maintain that the effect is associated with real world increases in intelligence (Howard, 1999, 2001)

In this study, after a brief review of the various major proposed causes of the Lynn-Flynn effect, the recently developed cognitive differentiation-integration effort hypothesis (Woodley, 2010a) will be used to propose a new model concerning the causes of the effect, namely that it results from the operation of environmental factors (such as the diminution of pathogen stress and improvements in nutrition) which have acted to slow the life history speeds of populations in such a way that favors the investment of effort into the development of specific cognitive abilities. The model will be used to a) account for why the effect appears to be associated exclusively with non-*g* variance, b) explain the contradiction between secular gains in IQ and losses due to dysgenesis, and c) address the issue of what the effect actually measures. In the final section the implications of this model will be discussed along with empirical predictions.

2. The causes of the Lynn-Flynn effect

Amongst those who maintain that the effect is associated with real gains in cognitive ability, a variety of theories have been proposed to account for it. Lynn (1989, 1990) has argued that the principle cause has been increases in nutrition, as malnourishment especially with respect to micronutrients is associated with inhibited brain development. General improvements in the quality of education (Husén & Tuijnman, 1991; Teasdale & Owen, 1989; Tuddenham, 1948) have also been proposed as a prospective source of the effect; as has the idea that smaller families permit greater resource consolidation into fewer offspring (Zajonc &

Mullally, 1997). Dickens and Flynn (2001) have proposed a social multiplier model, which is predicated upon the idea that the ambient cognitive 'background' of a society exerts an enhancing effect on IQ through feedback. Wide scale literacy, access to the internet and computer games would be examples of the sorts of social multipliers that once in widespread usage, might raise the mean IQ of a population in such a way that leads to greater demand for yet more cognitively demanding sources of stimulus.

Another theory is the idea that a tendency towards heterosis (outbreeding vigor) might be associated with gains in IQ (Mingroni, 2007). Recently pathogen stress has been found to be a significant predictor of cross-national variation in cognitive ability. An implication of this theory is that pathogens attenuate the development of full IQ through their capacity to commandeer bioenergetic resources ordinarily reserved for brain development into their own growth and fitness. Measures aimed at eradicating pathogens or mitigating their effects at cross-national scales might therefore be behind the Lynn-Flynn effect (Eppig, Fincher & Thornhill, in press).

Which of these theories are plausible? As the Lynn-Flynn effect does not concern *g*, heterosis can be ruled out as a significant contributor owing to the fact that inbreeding depression on test scores is highly *g*-loaded (Rushton, 1999, 2000; Rushton & Jensen, 2010). Furthermore, a study aiming to establish the degree to which consanguinity (cousin marriage) predicts cross-national variation in mean IQ found no contribution from this variable, despite the existence of significant differences between nations in terms of the intensity with which consanguineous marriage is practiced (Woodley, 2009). Given the fact that cross-national IQ scores are heavily conflated with the Lynn-Flynn effect (Wicherts, Borsboom & Dolan, 2010), this finding poses a problem for the idea that heterosis is a cause of the effect (Woodley, 2010b).

The social multiplier model suffers from a number of apparent shortcomings. The model seems to permit for large-scale changes in the historical variance of IQ despite the fact that there is no evidence for such changes (Rowe & Rodgers, 2002). Also there is no indication given by the model as to the time scales over which social multipliers might exert their effects, which in turn impacts the predictive power of the model. Do they operate across the life span of individuals for example or over larger population scales (Loehlin, 2002)?

Unlike the social multiplier model, the pathogen stress (health), nutrition, family structure and education (literacy) models do seem to be significantly involved in real world measures of the Lynn-Flynn effect (Daley, Whaley, Sigman, Espinosa & Neumann, 2003), thus presenting plausible reasons as to why cognitive abilities might have risen over time. In the subsequent sections, it will be shown how these are complimentary with respect to the novel hypothesis presented here.

3. The cognitive differentiation-integration effort hypothesis

Humans exhibit individual differences in life-history speed (the fundamental pattern of bioenergetic resource allocation and tradeoffs), measures of which combine to give rise to a latent factor termed *K* (Figueredo, Vásquez, Brumbach & Schneider, 2004). Rushton (1985) predicted that general intelligence forms part of the human life-history matrix, with those oriented towards slow (‘live long and prosper’ type) life history speeds possessing the highest *g* and those oriented towards fast (‘live fast, die young’ type) life history speeds possessing the lowest. Research at the individual differences level has failed to find support for this proposition however, with correlations between *K* and *g* typically being both very low magnitude and non-significant (Gladden, Figueredo & Jacobs, 2008; Sefcek & Figueredo, 2010).

The cognitive differentiation-integration effort (henceforth CD-IE) hypothesis is a life history informed model of cognitive development, which was conceived as a theoretical solution to the aforementioned problem. The CD-IE hypothesis is predicated upon the idea that there are two largely independent sources of genetic variance in general intelligence – one source corresponds to Miller's (2000a, b) theory that the basic positive manifold arises through the action of pleiotropic mutations, and that individual differences in levels of *g* therefore function as a fitness indicator in sexual selection. The other source is associated with a life history trade-off between positive manifold strength and the development of separate abilities and manifests its self in ability differentiation/integration effects such as Spearman's Law of Diminishing Returns (SLODR). This life history tradeoff concerns two hypothetical types of effort – cognitive integration effort (CIE), which would be associated with a strengthening of the manifold via the equal investment of bioenergetic resources (such as time and calories) into diverse abilities, and cognitive differentiation effort (CDE), which would be associated with a weakening of the manifold via the unequal investment of bioenergetic resources into individual abilities. Just to be absolutely clear, this tradeoff is independent of the genetic *g* detectable through the Jensen effect (correlated vectors), which appears to be largely impervious to differentiation/integration effects (Jensen, 2003). Variation in manifold strength in this model is purely statistical in that it results from either equal or unequal investments of resources into abilities. Genetic *g* is therefore at the root of individual differences in levels of *g* and is controlled through pleiotropic mutation load as opposed to life history tradeoffs

CIE is associated with fast life history speed and may constitute a form of mating effort as by strengthening the signal of genetic *g* it may serve to better advertise mental fitness to short term mates. CDE is associated with slow life history speed and may constitute a form of somatic effort, as by weakening the manifold it permits individuals to acquire diverse 'cognitive polymorphisms' and to become successful ecological specialists (Woodley, 2010a).

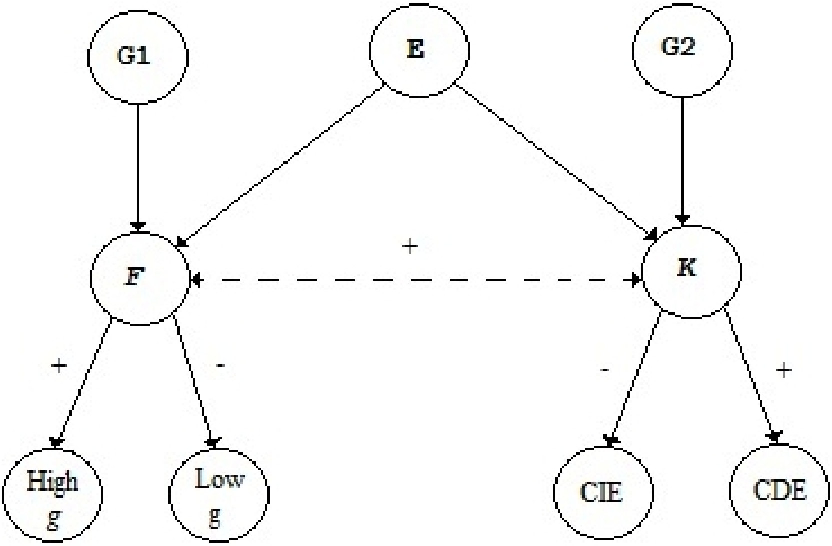


Figure 1. G1 and G2 represent sources of genetic variance in general intelligence unique to general fitness (F) and life history (K). E represents sources of environmental variance, which may be common to both pathways. F is associated with individual differences in levels of 'genetic g', whereas K is associated with the tradeoff between CIE and CDE (Woodley, 2010). + indicates a positive association between variables, whereas - indicates a negative association.

Figure 1 illustrates the CD-IE hypothesis. General fitness (*F*) and life history (*K*) are assumed to be modestly positively correlated (Sefcek & Figueredo, 2010), However there is much variance that is exclusive to each latent trait, indicating the operation of separate genetic pathways. It is also assumed that many environmental factors would simultaneously influence both the level and composition of general intelligence through their shared developmental effects on general fitness and life history. The degree to which an environmental factor could affect the level of *g* would theoretically be much less than the degree to which it could affect the CD-IE tradeoff, owing to the fact that genetic *g* has a much higher heritability than the non-*g* variance in specific cognitive abilities (Carroll, 1993; Jensen, 1998).

4. CD-IE and the Lynn-Flynn effect

As CD-IE tradeoffs are hypothesized to be associated with non-*g* variance, they could be a source of the Lynn-Flynn effect at cross-cultural and cross-temporal scales. If this is the case then the effect should be associated with a secular change in the strength of statistical *g* over time. Indeed, several studies have found evidence for this in a number of countries (Juan-Espinosa, Cuevas, Escorial & García, 2006; Lynn & Cooper, 1993, 1994; Kane, 2000; Kane & Oakland, 2000). As differentiation effects are associated with slower life-history speeds in the CD-IE hypothesis, this suggests that life history might have been slowing in the nations where the Lynn-Flynn effect has manifested its self. There is certainly evidence from the fertility data amongst Western nations of a slowing life history speed, as indicated by the shrinking size of Western families over the course of the last century (Zajonc & Mullally, 1997). Similarly there is evidence for a more recent global scale fertility decline in countries containing four fifths of the world's population (Caldwell, 2006). This is consistent with the observation that life history speed has a heritability of .68 (Figueredo, Vásquez, Brumbach & Schneider, 2004), which is lower than that of *g*, suggesting that there is more flexibility in life-history speed to environmental factors.

Significant environmental factors responsible for much of the life history speed change in the developing world might be pathogen stress and malnutrition. Pathogen outbreaks are both unpredictable (in terms of high variation in adult mortality) and harsh (in terms of absolute mortality), as are the effects of malnutrition (crop failures etc). Fast life history speed is favored under such conditions as it makes sense to try an overshoot the carrying capacity as a way of bet-hedging against contingency (Ellis, Figueredo, Brumbach & Schlomer, 2009).

Any factor therefore that reduces harshness (such as the eradication of disease, providing adequate nourishment etc) would encourage the development of slower life history speed, which in turn, with access to an appropriately cognitively stimulating environment (e.g. education), might permit the development of differentiated abilities and therefore the Lynn-Flynn effect. An important corollary of this may be the tendency towards smaller families, as not only are smaller families a consequence a slow life-history strategy, but they would further mitigate the effects of unpredictability and harshness by permitting consistent and higher volume resource allocation into smaller numbers of offspring (Ellis, Figueredo, Brumbach & Schlomer, 2009), which in turn might afford them the luxury of being able to develop patterns of cognitive specialization.

Whilst these factors may currently be operating in the contemporary developing world, they may have already finished exerting their effect on the developed world. Modern medicine and the mass production/availability of food coupled with other comforts of modernity have likely been a significant driving force behind the historical shrinking of Western families over the course of the last century. There is evidence from a handful of Western nations that the Lynn-Flynn effect has ceased and may even have gone into reverse in some instances (Teasdale & Owen, 2008; Shayer & Ginsburg, 2009; Sundet, Barlaug & Torjussen, 2004). Perhaps this latter trend is being driven by the recently observed tendency towards faster life history speeds (as evidenced by increased fertility) amongst developed nations (Myrskylä, Kohler & Billari, 2009). This sadly does not imply that the developing world will eventually ‘catch up’ to the West in terms of cognitive ability, as the Lynn-Flynn effect concerns non-*g* variance rather than *g*, which appears to be the principle dimension of cross-population differences (Rushton, 1999, 2000; Rushton & Jensen, 2010). It does however suggest that with slowing life-history speed, populations in developing nations may become increasingly cognitively diversified and specialized.

Another effect in need of mentioning is dysgenesis, which has been observed with respect to IQ in a number of Western countries (Lynn, 1996; Lynn & Van Court, 2004; Lynn & Harvey, 2009; Nyborg, this issue). Unlike the Lynn-Flynn effect, dysgenesis concerns *g* (Meisenberg, 2010) and is therefore unrelated to changes in life history speed. Looked at in this way, the two effects are not contradictory, as secular gains can occur on the non-*g* variance simultaneously with respect to selection against genetic *g*.

5. Discussion

The life history model of the Lynn-Flynn effect accounts for several observations. For example its association with the non-*g* variance in test scores makes sense in light of the idea that slower life history speed promotes effort allocation into the development of specific abilities. The theory is consistent with the pathogen stress, nutrition and family size models of the effect, as pathogen stress and infrequent access to adequate nutrition constitute forms of environmental unpredictability and harshness, which may (along with other factors) combine to favour the development of fast life history speed. In mitigating the effects of these factors, the development of slower life history speed is favoured, which is reflected in declining absolute fertility and shrinking family size. These factors combine through positive feedback to favour yet further decreases in life history speed. The combination of slow life history and access to appropriate cognitive stimulation permits individuals to develop specific abilities via allocations of CDE. The Lynn-Flynn effect and dysgenesis can co-occur as they concern two different sources of variance in tests of cognitive ability.

The life history model also suggests that the Lynn-Flynn effect actually measures something tangible rather than simply constituting a measurement artefact. Flynn (2000) has argued that IQ scores reflect individual differences in adaptation to modernity by which he means the tendency (especially since the Second

World War) to think abstractly rather than practically. Flynn may be correct where secular gains in non-*g* sources of variance on tests are concerned. The adaptation to modernity theory makes sense in light of the life history model presented here, as many aspects of modernity (such as adequate nutrition, medical care etc) may have slowed the life histories of populations. Furthermore education instils into individuals abstract models of how the world works, and through investments of time, permits those with the necessary predispositions (i.e. slow life history speed) to cultivate specific abilities as an example of experience producing drive (Bouchard Jr, 1997). Similarly, the process of modernization has been accompanied by increasing divisions of labour. The cognitive polymorphism amongst those with slow life histories may be a direct response to the increasing demand for division of labour. The Lynn-Flynn effect can therefore be accurately described as an adaptation to modernity, albeit one that has been mediated by slowing life history speed.

5.1 Predictions

Two major predictions arise from the life history model of the Lynn-Flynn effect:

i) At the individual differences scale it is predicted that samples of the same age, but sourced from different cohorts should exhibit not only SLODR with respect to abilities, but should possess slower life history speed also. The latter should account for the majority of the variance in the former.

ii) In countries where life history speed is accelerating or staying constant anti-Lynn-Flynn effects or no secular gains/losses will be detectable. The Lynn-Flynn effect is therefore predicted to be restricted to countries in which life history speed has been slowing. This can be investigated through a comparative analysis of secular gains or losses experienced by countries with cross-temporal variation in life history speed indicators, such as those that comprise Templer's (2008) K super-factor (total fertility rates, infant mortality etc).

5.2 Conclusion

Testing the above predictions would provide significant evidence either in favor of or against the life history model of the Lynn-Flynn effect. This model has the potential to make sense of a phenomenon that has been described as "officially mysterious" (Deary, 2001, p. 112), furthermore if life history speed is the primary factor associated with secular gains, and if these secular gains represent a form of adaptation to modernity, then it has the potential to not only better shape policies designed to enhance cognitive abilities via environmental treatments, but also to better inform on the limitations of such approaches.

References

Bouchard Jr, T. J. (1997). Experience producing drive theory: How genes drive experience and shape personality. *Acta Paediatrica, Supplement, 422*, 60-64.

Brand, C. R. (1987). Bryter still and Bryter? *Nature, 328*, 110.

Brand, C. R. (1990). A "gross" underestimate of a "massive" IQ rise? A rejoinder to Flynn. *Irish Journal of Psychology, 11*, 52–56.

Brand, C. R., Freshwater, S., & Dockrell, W. B. (1989). Has there been a massive rise in IQ levels in the West—Evidence from Scottish children. *Irish Journal of Psychology, 10*, 388–393.

Caldwell, J. C. (2006). The globalization of fertility behavior. *Demographic Transition Theory, Part II,* 249-271.

Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor-analytic studies*. Cambridge: Cambridge University Press.

Colom, R., Andres-Pueyo, A., & Juan-Espinosa, M. (1998). Generational IQ gains: Spanish data. *Personality & Individual Differences, 25*, 927–935.

Colom, R., Juan-Espinosa, M., & Garcia, L. F. (2001). The secular increase in test scores is a 'Jensen effect'. *Personality & Individual Differences, 30*, 553–559.

Daley, T. C., Whaley, S. E., Sigman, M. D., Espinosa, M. P., & Neumann, C. (2003). IQ on the rise: The Flynn effect in rural Kenyan children. *Psychological Science, 14*, 215-219.

Deary, I. J. (2001). *Intelligence: A very short introduction.* Oxford: Oxford University Press.

Dickens, W. T., & Flynn, J. R. (2001). Heritability estimates versus large environmental effects: The IQ paradox resolved. *Psychological Review, 108*, 346–369.

Ellis, B. J., Figueredo, A. J., Brumbach, B. H., & Schlomer, G. L. (2009). Fundamental dimensions of environmental risk: The impact of harsh versus unpredictable environments on the evolution and development of life history strategies. *Human Nature, 20,* 204-298.

Emanuelsson, I., Reuterberg, S. E., & Svensson, A. (1993). Changing differences in intelligence? Comparisons between groups of 13-year-olds tested from 1960 to 1990. Scandinavian *Journal of Educational Research, 37*, 259–277.

Emanuelsson, I., & Svensson, A. (1990). Changes in intelligence over a quarter of a century. *Scandinavian Journal of Educational Research, 34*, 171–187.

Eppig, C., Fincher, C. L., & Thornhill, R. (In Press). Parasite prevalence and the worldwide distribution of cognitive ability. *Proceedings of the Royal Society, Series B, Biological Sciences*. doi: 10.1098/rspb.2010.0973.

Figueredo, A.J., Vásquez, G., Brumbach, B.H., & Schneider, S.M.R. (2004). The heritability of life history strategy: The K-factor, covitality, and personality. *Social Biology, 51*, 121-143.

Flynn, J. R. (1984). The mean IQ of Americans: Massive gains 1932 to 1978. *Psychological Bulletin, 95*, 29–51.

Flynn, J. R. (1987). Massive IQ gains in 14 nations: What IQ tests really measure. *Psychological Bulletin, 101*, 171–191.

Flynn, J. R. (1990). Massive IQ gains on the Scottish WISC—Evidence against Brand et al's hypothesis. *Irish Journal of Psychology, 11*, 41–51.

Flynn, J. R. (1998). Israeli military IQ tests: Gender differences small; IQ gains large. *Journal of Biosocial Science, 30*, 541–553.

Flynn, J. R. (1999a). Evidence against Rushton: The genetic loading of WISC-R subtests and the causes of between-group IQ differences. *Personality and Individual Differences, 26*, 373–379.

Flynn, J. R. (1999b). Reply to Rushton: A gang of *g*s overpowers factor analysis. *Personality and Individual Differences, 26*, 391–393.

Flynn, J. R. (2000a). IQ gains and fluid *g*. *American Psychologist, 55*, 543.

Gladden, P. R., Figueredo, A. J., & Jacobs, W. J. (2008). Life history strategy, psychopathic attitudes, personality, and general intelligence. *Personality & Individual Differences, 46*, 270-275.

Herrnstein, R. J., & Murray, C. (1994). *The bell curve: Intelligence and class structure in American life.* New York: Free Press.

Howard, R. W. (1999). Preliminary real-world evidence that average human intelligence really is rising. *Intelligence, 27*, 235-250.

Howard, R. W. (2001). Searching the real world for signs of rising population intelligence. *Personality & Individual Differences, 30*, 1039-1058.

Husén, T., & Tuijnman, A. (1991). The contribution of formal schooling to the increase in intellectual capital. *Educational Researcher, 20*, 17–25.

Jensen, A. R. (1996). Secular trends in IQ: Additional hypothesis. In D. K. Detterman (Ed.), *The environment. Current Topics in Human Intelligence*, vol. 5 (pp. 147–150). Westport, CT: Ablex Publishing.

Jensen, A. R. (1998). *The g factor: The science of mental ability*. Westport: Praeger.

Jensen, A. R. (2003). Regularities in Spearman's law of diminishing returns. *Intelligence, 31*, 95-105.

Juan-Espinosa, M., Cuevas, L., Escorial, S., & García, L. F. (2006). The differentiation hypothesis and the Flynn effect. *Psicothema, 18*, 284-287.

Kane, H. D. (2000). A secular decline in Spearman's *g*: Evidence from the WAIS, WAIS-R and WAIS-III. *Personality & Individual Differences, 29*, 561-566.

Kane, H. D., & Oakland, T. D. (2000). Secular declines in Spearman's *g*: Some evidence from the United States. *The Journal of Genetic Psychology, 161*, 337-345.

Loehlin, J. C. (2002). The IQ paradox: Resolved? Still an open question. *Psychological Review, 109*, 754-758.

Lynn, R. (1983). IQ in Japan and the United States shows a growing disparity. *Nature, 306*, 291-292.

Lynn, R. (1989). A nutrition theory of the secular increases in intelligence—Positive correlations between height, head size and IQ. *British Journal of Educational Psychology, 59*, 372–377.

Lynn, R. (1990). The role of nutrition in secular increases in intelligence. *Personality & Individual Differences, 11*, 273–285.

Lynn, R. (1996). *Dysgenics: Genetic deterioration in modern populations*. Westport, CT: Praeger.

Lynn, R., & Cooper, C. (1993). A secular decline in Spearman's *g* in France. *Learning & Individual Differences, 5*, 43-48.

Lynn, R., & Cooper, C. (1994). A secular decline in the strength of Spearman's *g* in Japan. *Current Psychology, 13*, 3-9.

Lynn, R., & Hampson, S. (1986). The rise of national intelligence: Evidence from Britain, Japan and the USA. *Personality & Individual Differences, 7*, 23–32.

Lynn, R., & Hampson, S. (1989). Secular increases in reasoning and mathematical abilities in Britain, 1972–84. *School Psychology International, 10*, 301–304.

Lynn, R., & Harvey, J. (2008) The decline of the world's IQ. *Intelligence, 36*, 112-120.

Lynn, R., & Van Court, M. (2004). New evidence of dysgenic fertility for intelligence in the United States. *Intelligence, 32*, 193−201.

Meisenberg, G. (2010). The reproduction of intelligence. *Intelligence, 38*, 220−230.

Miller, G. F. (2000a). Sexual selection for indicators of intelligence. In G. R. Bock, J. A. Goode, & K. Webb (Eds.), *The nature of intelligence* (pp. 260–275). Chichester: John Wiley & Sons Ltd.

Miller, G. F. (2000b). Mental traits as fitness indicators: Expanding evolutionary psychology's adaptationism. *Annals of the New York Academy of Sciences, 907,* 62-74.

Mingroni, M. A. (2004). The secular rise in IQ: Giving heterosis a closer look. *Intelligence, 32*, 65–83.

Mingroni, M. A. (2007). Resolving the IQ paradox: Heterosis as a cause of the Flynn Effect and other trends. *Psychological Review, 114*, 806-829.

Must, O., Must, A., & Raudik, V. (2003). The secular rise in IQs: In Estonia the Flynn effect is not a Jensen effect. *Intelligence, 167*, 1–11.

Myrskylä, M., Kohler, H-P., & Billari, F. C. (2009). Advances in development reverse fertility declines. *Nature, 460*, 741-743.

Nyborg, H. (2011). The decay of Western civilization: Double relaxation of Darwinian Selection. In H. Nyborg (Ed.), Evolution of race and sex differences in intelligence and personality: Tribute to Richard Lynn at eighty. *Personality & Individual Differences (Special issue).*

Rodgers, J. L. (1998). A critique of the Flynn effect: Massive IQ gains, methodological artifacts or both? *Intelligence, 26*, 337–356.

Rowe, D. C., & Rodgers, J. L. (2002). Expanding variance and the case of historical changes in IQ means: A critique of Dickens and Flynn (2001). *Psychological Review, 109*, 759-763.

Rushton, J. P. (1985). Differential K theory: The sociobiology of individual and group differences. *Personality & Individual Differences, 6*, 441-452.

Rushton, J. P. (1999). Secular gains in IQ not related to the *g* factor and inbreeding depression—Unlike Black–White differences: A reply to Flynn. *Personality & Individual Differences, 26*, 381–389.

Rushton, J. P. (2000). Flynn effects not genetic and unrelated to race differences. *American Psychologist, 55*, 542–543.

Rushton, J. P., & Jensen, A. R. (2010). The rise and fall of the Flynn Effect as a reason to expect a narrowing of the Black-White IQ gap. *Intelligence, 38*, 213-219.

Sefcek, J. A., & Figueredo, A. J. (2010). A life-history model of human fitness indicators. *Biodemography & Social Biology, 56,* 42-66.

Shayer, M. D., & Ginsburg, D. (2009). Thirty years on – a large anti-Flynn effect? (II): 13- and 14-year olds. Piagetian tests of formal operations norms 1976-2006/7. *British Journal of Educational Psychology, 79*, 409-418.

Sundet, J. M., Barlaug, D. G., & Torjussen, T. M. (2004). The end of the Flynn effect? A study of secular trends in mean intelligence test scores of Norwegian conscripts during half a century. *Intelligence, 32*, 349-362.

Teasdale, T. W., & Owen, D. R. (1989). Continuing secular increases in intelligence and a stable prevalence of high intelligence levels. *Intelligence, 13*, 255–262.

Teasdale, T. W., & Owen, D. R. (2000). Forty-year secular trends in cognitive abilities. *Intelligence, 28*, 115–120.

Teasdale, T. W., & Owen, D. R. (2008). Secular declines in cognitive test scores: A reversal of the Flynn effect. *Intelligence, 36*, 121-126.

Templer, D. I. (2008). Correlational and factor analytic support for Rushton's differential K life history theory. *Personality & Individual Differences, 45*, 440–444.

Tuddenham, R. D. (1948). Soldier intelligence in World Wars I and II. *American Psychologist, 3*, 54–56.

Wicherts, J. M., Dolan, C. V., Hessen, D. J., Oosterveld, P., van Baal, G. C. M., Boomsma, D. I., & Span, M. M. (2004). Are intelligence tests measurement invariant over time? Investigating the nature of the Flynn effect. *Intelligence, 32*, 509-537.

Wicherts, J. M., Borsboom, D., & Dolan, C. V. (2010). Why national IQs do not support evolutionary theories of intelligence. *Personality & Individual Differences, 48*, 91-96.

Woodley, M. A. (2009). Inbreeding depression and IQ in a study of 72 countries. *Intelligence, 37*, 268-276.

Woodley, M. A. (2010a, December). Introducing the cognitive differentiation-integration effort hypothesis: A coherent evolutionary explanation for SLODR and related effects. Paper presented at the eleventh annual conference of the International Society for Intelligence Research. Alexandria, Virginia.

Woodley, M. A. (2010b, June). Assessing the impact of consanguinity on national IQs: A cultural feedback effects model. Paper presented at the twenty-second annual meeting of the Human Behavior and Evolution Society. Eugene, Oregon.

Zajonc, R. B., & Mullally, P. R. (1997). Birth order: Reconciling conflicting effects. *American Psychologist, 52*, 685–699.

Epilog

Chapter 15

Richard Lynn's contributions to personality and intelligence: A critical evaluation

JAMES THOMPSON
Department of Psychology, University College London,
26 Bedford Way, London WC1H 0AP, UK
James Thompson@ucl.ac.uk

ABSTRACT

An evaluation is presented of Lynn's work on national differences in personality, race differences in intelligence, national IQs & economic development, correlates of national IQs, the Flynn effect, sex differences, eugenics and dysgenics, race differences in psychopathic personality, and intelligence of the Jews.

Key words: national differences; personality; intelligence; race differences; Flynn effect; sex differences; eugenics; psychopathic personality

1. National Differences in Personality

Lynn's early work on Eysenck's personality theory showed that extraverts have greater tolerance of pain than introverts. He went on to measure national differences in demographic and epidemiological phenomena such as the prevalence rates of psychosis, suicide, alcoholism, crime, road accident deaths, etc. He factor analysed these and showed the presence of two factors of neuroticism and extraversion in the population (Lynn, 1971). This work was recognised as "a breakthrough in the study of national cultures" (Hofstede & McCrae 2004). Eysenck had an impact on Lynn's approach to psychology, providing a model of a fearless investigator, willing to propose large scale theories and to adopt unpopular positions if the data seemed to support them. In Lynn's view Eysenck remains the most influential British psychologist.

2. Race Differences in Intelligence

Lynn's major contribution to the issue of race differences in intelligence is the assembly of world wide data for the intelligence of ten races (Lynn, 2006). Hitherto, the work of Jensen (1998), Eysenck (1971) and others had been largely confined to the black-white difference in the United States. Many explanations have been advanced for this, including minority status, deprivation, discrimination and prejudice by the white majority. Eysenck (1971) speculated that the low average intelligence of American blacks could be attributed to the less intelligent being caught in Africa and transported as slaves, while the sub-Saharan Africans who remained in Africa would have had higher IQs. Lynn's compilation of studies showing that the IQ of blacks sub-Saharan Africans in Africa is significantly lower than that of blacks in the United States disconfirms this theory.

In 1977 Lynn published two papers on the intelligence of the North East Asians. He estimated Japanese IQ at 106.6 (Lynn, 1977a) and Chinese IQ in Singapore at 110 (Lynn, 1977b). These papers were significant because many people had claimed that the higher IQs obtained by Europeans were attributable to European ethnocentric prejudice and test bias. Lynn's results showed that these explanations did not hold.

Lynn published his first compilation of worldwide racial IQs in 1991 and concluded that North East Asians have an IQ of 106, Europeans 100, South East Asians 90, New Zealand Maoris 91, Native American Indians 89, South Asians 86, Australian Aborigines 80, and sub-Saharan Africans 70 (Lynn, 1991). In his most recent compilation of over 500 studies, these estimates remain about the same, except that he has revised the IQ of Australian Aborigines down to 62, and the IQ of sub-Saharan Africans down to 67, and added the Arctic peoples with an IQ of 91 and the Bushmen with an IQ of 54 (Lynn, 2006). Wicherts et al. (2010a) challenged the sub-Saharan African estimate, calculating it to be 78 in relation to a British mean of 100 on the Progressive Matrices tests and 81 on other tests. Lynn replied that unreasonable exclusion of low results and inappropriate selection of high results had led to inflated estimates (Lynn, 2010; Lynn & Meisenberg, 2010a). It is hard to adjudicate between these alternative interpretations. Lynn's most recent study estimates the IQ of sub-Saharan Africans in Darfur at 72.5 (Khaleefa et al. 2010), about midway between his previous estimate and that of Wicherts and his colleagues. Perhaps this is the best compromise figure to adopt, but the broad picture stated by Wicherts et al. (2010b, p.17) is that "there can be little doubt that Africans average lower IQs than do westerners". If the two estimates of Wicherts are averaged to 79.5, Lynn's position is not significantly affected. Sub-Saharan Africans remain in the same position in Lynn's ten race IQ hierarchy, and have an average IQ significantly lower than that of African Americans in the United States, as Lynn predicts from their admixture of European genes and environmental advantages.

Criticism of Lynn's compilation centred on the small sample sizes of many of the studies, and reservations about their representativeness. However, in those cases where larger, epidemiologically sound methodologies have been employed, the results have often been close to those obtained in the original smaller samples. The use of neighbouring countries as a proxy for those countries without suitable data also attracted criticism, yet the addition of further studies improved the picture, though many countries lack reliable data. A useful but less remarked aspect of Lynn's compilation of results are the intelligence test results of national groups tested when they have emigrated to other countries, revealing that they are little different from the results obtained in their countries of origin. In brief, Chinese, European and other emigrants seem to preserve their IQ's when they travel. The capacity of British people to retain their original level of intellect over three or four generations in the very different climates of Canada and Australia seems unremarkable, but this invariance requires as much explanation as the difference between different genetic groups. If there is any acclimatization of intellect, it is a slow process, as genetic theory would predict.

Lynn's second major contribution is his theory that race difference in intelligence evolved when early humans migrated out of Africa into temperate and then into cold environments. These new environments were more cognitively demanding, and so the peoples who settled in North Africa and South Asia, and even more the Europeans and the North East Asians, evolved higher IQs to survive. This is a standard Darwinian explanation of an adaptation for optimum survival in a new environment. This theory has become widely accepted by those working on this question and is supported by studies showing high correlations of 0.89 between skin colour and IQ across 58 nations reported by Meisenberg (2004) and replicated across 113 nations with a correlation of 0.92 using a different measure of skin colour by Rushton & Templer (2009). Light skin colour is another adaptation to temperate and cold environments because light skin allows the absorption of vitamin D from sunlight and reduces the risk of rickets. Light skin colour therefore provides a measure of the coldness of the climates inhabited by the ancestors of contemporary populations. Of course, we cannot directly test the cognitive demands of these ancient environments, but we can infer that new environments present a survival challenge, and harsh environments particularly so.

3. National IQs & Economic Development

In *IQ and the Wealth of Nations* (Lynn & Vanhanen, 2002) collected measured IQs for 81 nations and estimated IQs for 104 nations using the IQs of similar neighbouring countries. They reported that for the 81 nations the correlation between national IQs and per capita income (real GDP) in 1998 was 0.73, and for 185 nations 0.63. They concluded that national IQs explain 53 per cent of the variance in per capita income (.73 squared = 0.53). Thus, they argued that national IQs are the single most important variable in the determination of national per capita income, and that the remaining 47 per cent can be largely explained by the degree to which nations have free market economies and natural resources.

This book had a mixed reception. The national IQs were described as "meaningless" by Hunt & Sternberg (2006). However, Hunt changed his mind about the national IQs because he reported that the national IQs were highly correlated with scores in math and science, and concluded that "Lynn & Vanhanen's empirical conclusion was correct" (Hunt & Wittmann, 2008, p.1). Lynn & Meisenberg (2010b) integrated all the international studies of reading comprehension, math and science understanding and showed that they are perfectly correlated with national IQs. This strongly suggests that the national IQs are valid.

4. Correlates of National IQs

Numerous studies have validated national IQs by showing that they are correlated with and explain a wide range of social and economic phenomena, including the incidence of HIV (Rindermann & Meisenberg, 2009), fertility (Meisenberg, 2009), infant mortality (Kanazawa, 2006), crime (Rushton & Templer, 2009) and religious belief (Kanazawa, 2009). Rindermann & Ceci (2009) have described the calculation of national IQs as "a new development in the study of cognitive ability. The goal is to use cognitive differences to understand and predict national differences in a variety of outcomes: societal development, rate of democratization, population health, productivity, gross domestic product (GDP), and wage inequality". Economists have used national IQs to explain economic phenomena, e.g. Jones & Schneider (2010) have shown that a country's average IQ score is a predictor of the wages that immigrants from that country earn in the United States, and that national IQs are useful for predicting cross-country productivity differences, and cross-country growth rates.

5. The Global Bell Curve

Lynn's (2006) next book on race differences in intelligence was *The Global Bell Curve.* This examined race differences worldwide and showed that there are consistent racial hierarchies in which Europeans and North East Asians have the highest IQ, educational attainment, earnings and socio-economic status. In southeast Asia, i.e. in Singapore, Indonesia, the Philippines, Malaysia and Thailand, it is invariably the Chinese who have higher IQs than the indigenous peoples and outperform them in education, earnings, wealth and socio-economic status. Typically mixed race peoples such as Mulattos and Mestizos in Latin America and Hispanics in the United States come in the middle of these hierarchies, and indigenous peoples (Australian Aborigines, New Zealand Maoris and Native American Indians) and sub-Saharan Africans do least well.

Sociologists and anthropologists have coined the term *pigmentocracy* to describe these IQ and socio-economic hierarchies. A pigmentocracy is a society in which wealth and social status are determined by skin colour. Lynn's contribution has been to document that intelligence differences provide the best explanation for the racial hierarchies that are consistently present in all multiracial societies.

Lynn's book has been criticised by Johnson (2009) who writes that “Lynn's data “are essentially correct and do reflect the general state of the world”, but she warns “read this book if you want a glimpse into the intellectual process of rationalizing pre-existing ideas through data collection”. However, science always depends on data collection to confirm or disconfirm a hypothesis.

Taking Lynn’s work on national differences in IQ as a whole, two features stand out. First, the work attracted hostility from main stream establishment media. Major publishing houses would not be associated with it, and even when the books were eventually published many major journals would not review them. Second, notwithstanding this attempt to sideline Lynn’s findings, the work had considerable impact, and that impact continues to grow. The harsh treatment of Nobel Laureate James Watson in 2007, forced to retire from the Chancellorship of Cold Spring Harbour Laboratory after he quoted Lynn’s work, showed the extent to which ideological ostracism can distort the progress of science. If even the founding father of DNA research could not make a comment about genetic differences in intelligence, the threat to all other researchers was made very clear. In subsequent years, citations to Lynn’s work increased, such that his findings served as the basis for further modelling of national differences in wealth, sometimes in more popular texts that brought Lynn’s finding and theories to a much wider audience. Despite all attempts to ignore his findings, Lynn’s dogged accumulation of data made a considerable contribution to understanding human differences.

6. The Flynn Effect

The “the Flynn effect” was coined by Herrnstein & Murray (1994) to describe the increase of intelligence during the twentieth century that Flynn documented in the United States and in number of other countries in the eighties. However, Lynn had already published a paper in 1982 reporting that IQs had been increasing in Japan during recent decades. The "Lynn- Flynn effect" may be more accurate, but the increase of intelligence during the twentieth century had already been reported in numerous studies. Tuddenham (1948) reported that the IQs of American conscripts had increased by 11 points between 1917-1943. Lynn has published a number of papers on the Flynn effect documenting the phenomenon and arguing that improvements in nutrition have been the principal responsible factor, most notably that the Flynn effect is present in infants (Lynn, 2009) which appears to rule out the effects of education favoured by Flynn and a number of others.

In the eyes of popular commentators, the Flynn Effect is seen as invalidating the concept of intelligence as invariant and predictive. It suggests that IQ is a debased currency, subject to continual test inflation. Flynn himself has given different explanations of the phenomenon, often doubting whether there had been any real increase in intelligence, but at other times suggesting that the ready availability of well publicised heuristics has provided ways of actually boosting applied intelligence. Lynn's work on baby tests in infancy (Lynn, 2009) suggests this is not a major factor, since pre-school infants show the same proportional gains on very simple tasks. The widespread rise in test scores has also been seen as proof that racial intelligence differences will disappear, through an education-mediated convergence of intelligence scores. However, the trend lines have not converged, though they have oscillated somewhat, though not in easily explicable ways. Lynn's work suggests that there has been a real increase in intelligence as a consequence of rising living standards, though this effect has probably reached an asymptote, and little further increase can be expected. Lynn has always taken a pragmatic view, and has corrected his international data sets for the secular rise in intelligence scores, so as to make valid comparisons.

7. Sex Differences

Lynn has advanced several claims on sex differences, of which the most controversial is that males and females have the same intelligence up to the age of 15 years, but that from 16 years onwards, males begin to show higher IQs than females and that by adulthood, the male advantage reaches about 5 IQ points (Lynn, 1994). He formulated this theory to explain the Ankney-Rushton paradox that males have a larger average brain size than females are not higher in measured IQ. He explained the higher male average IQ at the age of sixteen as due to later maturation of males.

Lynn & Irwing (2004) published a meta-analysis of sex differences in which they showed that there is no difference among children aged 6–14 years, but that males obtain higher means from the age of 15 through to old age, and among adults, the male advantage is 5 IQ points. Irwing & Lynn (2005) published a meta-analysis of 22 studies of sex differences on the Progressive Matrices in university students and concluded that males have an advantage of 4.6 IQ points.

In more recent studies, Mackintosh & Bennett (2005) reported data for a sample of 17 year olds (n=97) on selected items from the Progressive Matrices in which males obtained a higher mean of 6.4 IQ points. They stated that "studies of older participants (over the age of 16) were more likely to yield a male than a female advantage" (p.670). Mackintosh (2007) reported data for a larger sample of 242 17 year old students on the Progressive Matrices in which males obtained a significantly higher score, essentially supporting Lynn's view that late adolescent and adult males obtain higher mean scores than females on the Progressive Matrices.

This conclusion has been confirmed for sex differences in general intelligence defined as the IQ obtained in tests like the Wechsler in a recent review by Ellis (2008, p.288). He lists 50 studies of adults. Males obtained statistically significantly higher IQs than females in 29 studies and there was no statistically significant difference in 20 studies. In evaluating the non-statistically significant studies, it should be born in mind that a sample size of around 500 is required to obtain a statistically significantly difference of 5 IQ points and a number of the studies fall short of this number. There was one study in which females obtained a higher IQs than males, but this was of a mentally subnormal sample and should be discounted because males are more impaired in mentally subnormal samples (Ellis, 2008, p.290). Thus, the preponderance of the evidence reviewed by Ellis (2008) indicates that Lynn is correct in contending that men have a higher average IQ than women. This late developing male advantage, coupled with a slightly higher standard deviation evident even at young ages has considerable consequences at the far ends of the ability spectrum. At exceptionally high levels of intellect, many more men will be found than women, and men will continue to reach those levels in any fair competition. The presumption that the greater representation of men is due to unfair influence can be rejected on objective grounds.

Lynn's second claim regarding sex differences is that males have more general knowledge than females. He reported that in 26 nations 15 year old boys have more general knowledge of history than do girls (Wilberg & Lynn,1999). In subsequent papers written in collaboration with Irwing, he has shown that there are nineteen domains of general knowledge and that males have more general knowledge than females in most of them, notably of science, sport, current affairs, finance, politics and history. The only domains in which females have more general knowledge than males are medicine and cooking (e.g. Lynn, Irwing & Cammock, 2002). Lynn argues that these differences can be understood in terms of evolutionary psychology on the grounds that the domains in which males have more general knowledge than females are concerned with inter-male conflict, while the domains in which females have more general knowledge than males are concerned with nurturing.

In further contributions on sex differences, Lynn has shown that males have greater working memory than females, are more competitive, and perform better in math and science, while females perform better in course work and foreign languages. In a further application of evolutionary psychology to sex differences, Lynn's proposed explanation for the superiority of females in foreign languages is that in the evolutionary environment, females typically moved into neighboring groups and this gave a selective advantage to females who could acquire a foreign language easily (Lynn & Piffer, 2010).

8. Eugenics and Dysgenics

Lynn has published two books, *Dysgenics* (1996) and *Eugenics* (2001), and several papers showing the presence of dysgenic fertility for intelligence and moral character. His book *Dysgenics* set out the evidence that modern populations have been deteriorating genetically from around 1880 in respect of health, intelligence and moral character. He attributed the genetic deterioration of health to the improvements in public health and medicine, which saved the lives of many who would formerly have died, and the genetic deterioration of intelligence and moral character to the invention in the1870s of the latex condom, which he argued was used more effectively to control unwanted fertility by the more intelligent and the more conscientious. The book was generally well received. Bouchard (1999, p. 273) described it as "a must read" and Serebriakov (1997, p. 19) wrote that "This might be the most important book published in the decade".

Lynn's (2001) *Eugenics: A Reassessment* opens with a historical introduction giving an account of the ideas of Francis Galton and the rise and fall of eugenics in the 20th century. He then discusses the objectives of eugenics and identifies these as the elimination of genetic diseases, the improvement of intelligence and moral character. He next discusses how eugenic objectives could be achieved by attempting to promote the greater reproduction of the more intelligent and a reduction of the reproduction of the less intelligent and concludes that this would be largely ineffective. Finally, he discusses the potential for the achievement of eugenic objectives by the use of genetic assessment of embryos and selection of the more desirable for implantation and concludes that this development is inevitable in the twenty-first century. He predicts that embryo selection is inevitable and in a future eugenic world there will be huge improvements in the genetic quality of the populations of economically developed countries where these technologies are adopted. This book was negatively reviewed by St.Clair (2002, p.571) who complained that "there is no mention of the effects of breastfeeding or of fetal iron deficiency on birth weight", although the relevance of these to eugenics is unclear. The book was more sympathetically reviewed by Rushton (2002).

Lynn's most recent paper concerns the decline of the world's IQ caused by the high fertility in third world low IQ countries. He estimated that the world's IQ deteriorated genetically by 0.86 IQ points in the years 1950-2000 (Lynn & Harvey, (2008). This analysis has been elaborated and shown to be an underestimate by Meisenberg (2009) who has estimated that at present rates of fertility and mortality and in the absence of changes within countries, the average IQ of the world population will decline by 1.34 points per decade. Typically for Lynn, he is not afraid to challenge the conventional wisdom that any study of eugenics must inevitably lead to totalitarian abuse, and is uncompromising in showing that populations can improve or regress in terms of their underlying quality. Although Gregory Clark's (2007) brief economic history of the world eschews any mention of eugenics or intelligence and probably reached a far wider audience thereby, he was able to show by means of the relatively higher fertility of the wealthier families in Britain that there was a de facto eugenics program for at least six centuries prior to 1870, which may well have set the intellectual foundations for the unique discontinuity of the industrial revolution. His thesis is that this was almost entirely a British phenomenon, with the Danish partly following the same practices. As such theses enter mainstream debate, Lynn's work on eugenics may eventually receive the recognition it deserves among economists.

9. Race Differences in Psychopathic Personality

Herrnstein and Murray (1994) noted in *The Bell Curve* that while racial and ethnic differences in intelligence can explain a number of the differences in educational attainment, crime, welfare dependency, etc., they cannot explain the totality of these differences, and concluded that there must be some additional factor that also contributes to these. Lynn (2002) proposed that this additional factor is ethnic and racial differences in psychopathic personality considered as a continuously distributed trait. The paper presented a review of evidence showing that psychopathic personality is highest among blacks and Native Americans, next highest in Hispanics, lower in whites and lowest in Orientals. Skeem, Edens, Sanford & Colwell (2003) and Zuckerman (2003) have criticised Lynn's theory and Lynn (2003) has replied to these criticisms. This controversy is appraised by Templer in this issue. Personality differences between racial groups is likely to be the next frontier of racial research, and both intelligence and personality assessments will be tested in statistical models to see how well they account for observed differences.

10. The Intelligence of the Jews

Lynn's most recent work has been on the intelligence of the Jews. He has published four papers on this and estimated the average Jewish IQ at approximately 110 in the United States and Britain. His book *The Chosen People* (2011) summarises studies worldwide showing that European Jews have higher IQs than gentiles and that this explains their higher educational attainments, earnings, socio-economic status and intellectual achievements such as the award of Nobel Prizes and the like. He estimates the

IQ of Oriental Jews in Israel at 91 and documents their lower attainments. He concludes by discussing the persecution, eugenic and other theories that have been advanced to explain the high IQ of European Jews. Again, Lynn does not shrink from analysing differences in genetic terms, and championing eugenic practices and not simply religious classifications as the determining factor in group differences in intelligence.

References

Barnet, S.M. & Williams, W. (2004). Review of IQ and the Wealth of Nations. *Contemporary Psychology, 49*, 389-396.

Bouchard, T. (1999*) Dysgenics. American Journal of Human Biology, 11,* 272-274.

Clark, G. (2007) A Farewell to Alms: A brief economic history of the world. Princeton: Princeton University Press.

Ellis, L. et al. (2008). *Sex Differences: Summarizing more than a century of scientific research*. New York: Psychology Press.

Eysenck, H.J. (1971). *Race, intelligence and education*. London: Maurice Temple Smith.

Herrnstein and Murray (1994) *The Bell Curve.* Free Press, New York.

Hofstede, G. & McCrae, R.R. (2004). Personality and culture revisited: Linking traits and dimensions of culture. *Cross-Cultural Research*, 38; 52-88.

Hunt, E. & Sternberg, R. J. (2006). Sorry, wrong numbers: An analysis of a study of a correlation between skin color and IQ. *Intelligence, 34*, 121−139.

Hunt, E. & Wittmann,W. (2008). National intelligence and national prosperity. *Intelligence*, 36, 1-9.

Irwing, P. & Lynn, R. (2005). Sex differences in means and variability on the Progressive Matrices in university students: A meta-analysis. *British Journal of Psychology*, 96, 505–524.

Irwing, P. & Lynn, R. (2006). The relation between childhood IQ and income in middle age. *Journal of Social, Political and Economic Studies, 31,* 191-196.

Jencks, S. (1972). *Inequality*. London: Penguin.

Jensen, A.R. (1998). *The g Factor: The Science of Mental Ability*. Westport CT: Praeger.

Johnson, W. (2009). Review of *The Global Bell Curve*. *Intelligence,* 37, 119-120.

Jones, G. & Schneider, W.J. (2010). IQ in the production function: evidence from immigrant earnings. *Economic Inquiry*, 48, 743-755.

Kanazawa, S. (2006). Mind the gap… in intelligence: re-examining the relationship between inequality and health. *British Journal of Health Psychology*, 11,623- 642.

Kanazawa, S, (2009). IQ and the values of nations. *Journal of Biosocial Science*, 41, 537-556.

Khaleefa, O., Lynn, R., Abulgasim, A., Dosa, M. & Abdulradi, F. (2010). Norms for the Standard Progressive Matrices for 9-18 year olds for in Darfur. *Mankind Quarterly* (in press).

Lynn, R. (1971) Personality and national character. Pergamon, London.

Lynn, R. (1977).The intelligence of the Japanese. *Bulletin of the British Psychological Society, 30,* 69-72.

Lynn, R. (1977b). The intelligence of the Chinese and Malays in Singapore. *Mankind Quarterly, 18,*125-128.

Lynn, R. (1991). Race differences in intelligence: a global perspective. *Mankind Quarterly, 31,* 254-296.

Lynn, R. (1994) Sex differences in intelligence and brain size: a paradox resolved. *Personality and Individual Differences*, 17, 257-271.

Lynn, R. (1996). *Dysgenics: Genetic Deterioration in Modern Populations.* Westport, CT: Praeger.

Lynn, R. (2001). *Eugenics: A Reassessment*. Westport, CT: Praeger.

Lynn, R. (2002). Racial and ethnic differences in psychopathic personality. *Personality & Individual Differences*, 32, 273-316.

Lynn, R. (2003). Race differences in psychopathic personality: a reply to Skeem and Zuckerman. *Personality & Individual Differences*, 35, 1471-1478.

Lynn, R. (2006). *Race Differences in Intelligence: An Evolutionary Analysis*. Augusta, GA: Washington Summit Publishers.

Lynn, R. (2009). What has caused the Flynn effect? Secular increases in the Development Quotients of infants. *Intelligence*, 37, 16-24.

Lynn, R. (2010). The average IQ of sub-Saharan Africans assessed by the Progressive Matrices: Some comments on Wicherts, Dolan, Carlson & van der Maas. *Learning & Individual Differences*, 20, 152-154.

Lynn, R. (2011). *The Chosen People: A Study of Jewish Intelligence and Achievements*. Augusta, GA: Washington Summit Publishers.

Lynn, R. & Eysenck, H.J. (1963). Some effects of carisaprodol on pain reactivity. In H. J. Eysenck (Ed.) *Experiments with Drugs*, Oxford: Pergamon Press.

Lynn, R. & Harvey, J. (2008). The decline of the world's IQ. *Intelligence*, 36, 112-120.

Lynn, R. & Irwing, P. (2004). Sex differences on the Progressive Matrices: a meta-analysis. *Intelligence*, 32, 481-498.

Lynn, R., Irwing, P. & Cammock, T. (2002). Sex differences in general knowledge. *Intelligence*, 30, 27-40.

Lynn, R. & Meisenberg, G. (2010a). The average IQ of sub-Saharan Africans: Comments on Wicherts, Dolan, & van der Maas. *Intelligence*, *38*, 21-29.

Lynn, R. & Meisenberg, G. (2010b). National IQs validated for 108 nations. *Intelligence, 38,* 353-360.

Lynn, R. & Piffer, D. (2010). Sex differences in foreign language ability: An evolutionary hypothesis. *Human Evolution* (in press).

Lynn, R. & Vanhanen, T. (2002). *IQ and the Wealth of Nations*. Westport, CT: Praeger.

Lynn, R. & Vanhanen, T. (2006) *IQ and Global Inequality.* Augusta, GA: Washington Summit Publishers.

Mackintosh, N.J. & Bennett, E.S. (2005). What do Raven's Matrices measure? An analysis in terms of sex differences. *Intelligence*, 33, 663-674.

Mackintosh, N.J. (2007) Reply to Colom and Abad (2006). *Intelligence*, 35, Issue 3, 301-302.

Meisenberg, G. (2004). Talent, character and the dimensions of national culture. *Mankind Quarterly,* 45, 123-169.

Meisenberg, G. (2009). Wealth, intelligence, politics and global fertility differentials. *Journal of Biosocial Science*, 41, 519-536.

Rindermann, H., & Ceci, S. J. (2009). Educational policy and country outcomes in international cognitive competence studies. *Perspectives in Psychological Science, 4,* 551-577.

Rindermann, H. & Meisenberg, G. (2009). Relevance of education, intelligence, and knowledge at the national level for non-economic welfare: The case of HIV and AIDS. *Intelligence*, 37, 383-395.

Rushton, J.P. (2002). Review of *Eugenics*. *Personality & Individual Differences*, 33,183-184.

Rushton, J.P. & Templer, D. I. (2009). National differences in intelligence, crime, income and skin color. *Intelligence*, 37, 341-346.

Serebriakov, V. (1997). Review of *Dysgenics*. *Right Now*, July.

Skeem, J.M. Edens, J.F., Sanford, G.M. & Colwell, L.H. (2003). Psychopathic personality and racial/ethnic differences reconsidered: a reply to Lynn (2002). *Personality & Individual Differences*, 35, 1439-1462.

St.Clair, D. (2002). Review of *Eugenics*. *Intelligence,* 30, 569-571.

Tuddenham, R.D. (1948). Soldier intelligence in world wars 1 and 11. *American Psychologist*, 3, 54-56.

Wicherts, J. M., Dolan, C. V., Carlson, J. S. & van der Maas, H. L. J. (2010a). Raven's test performance of sub-Saharan Africans; mean level, psychometric properties, and the Flynn Effect. *Learning & Individual Differences*, 20, 135-151.

Wicherts, J. M., Dolan, C. V., & Van der Maas, H. L. J. (2010b). A systematic literature review of the average IQ of sub-Saharan Africans. *Intelligence*, 38, 1-20.

Wilberg, S. and Lynn, R. (1999) Sex differences in historical knowledge and school grades: a 26 nation study. *Personality and Individual Difference,* 27, 1221-1229.

Zuckerman, M. (2003). Are there racial and ethnic differences in psychopathic personality? A critique of Lynn (2002). *Personality & Individual Differences*, 35, 1463-1470.

Index