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Sex differences in educational attainment

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ABSTRACT

At the end of the 90s, 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 20 years, 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 five 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, 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 (1996) 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 90s. 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

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(2000,2001) and Lynn and Mau (2001) analysed the American National Educational Longitudinal Study (NELS) results for 20,612 tenth and twelfth grade students, SAT results for 3930 students and ACT results for 3553 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.

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 and 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 (Fig. 1). In Fig. 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.

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 onto 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 2000–2006 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.

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.

Table 1
Sex differences in science.

Study	Year	No. of 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	
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	

Note: The first number of countries is for 9–10 year old students and the second number of countries is for 13–15 year olds.