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THE GROWTH OF IQ AMONG ESTONIAN SCHOOLCHILDREN FROM AGES 7 TO 19

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Summary. The Standard Progressive Matrices test was standardized in Estonia on a representative sample of 4874 schoolchildren aged from 7 to 19 years. When the IQ of Estonian children was expressed in relation to British and Icelandic norms, both demonstrated a similar sigmoid relationship. The youngest Estonian group scored higher than the British and Icelandic norms: after first grade, the score fell below 100 and remained lower until age 12, and after that age it increased above the mean level of these two comparison countries. The difference between the junior school children and the secondary school children may be due to schooling, sampling error or different trajectories of intellectual maturation in different populations. Systematic differences in the growth pattern suggest that the development of intellectual capacities proceeds at different rates and the maturation process can take longer in some populations than in others.

Introduction

Data have recently been published for a standardization of the Standard Progressive Matrices test in Estonia for adolescents aged 12–19 years, and the mean IQ of this sample has been estimated to be 100·2 in relation to a British mean of 100 (Lynn *et al.*, 2002). In the current study the Progressive Matrices test was administered to a sample of Estonian schoolchildren aged 7–11 years, and it was found that on average their IQ was slightly below the British norm, provided that 1979 British norms were corrected for expected secular increase. In order to explain this discrepancy, this study scrutinizes the development trajectory of the IQ of Estonian schoolchildren through the whole age range, from 7 to 19 years.

One of the main components of Piaget's (1963) theory of intellectual development is that children learn certain things at certain times and it is impossible to skip particular stages of development. Most textbooks seem to accept, implicitly at least, that the process of intellectual maturation is uniform across different cultures and follows the same relatively fixed course through the stages of intellectual development.

This uniformity of intellectual development is assumed, not experimentally demonstrated. There is considerable evidence that mean intelligence levels vary substantially across regions and populations (Lynn & Vanhanen, 2002). It is also possible that children in two countries may reach an approximately identical ultimate level of intelligence through different trajectories of growth. For instance, it is likely that the periods of most rapid growth are not exactly synchronized and can happen at slightly different moments of chronological age. In this study evidence is provided that the speed of intellectual development may indeed be different in different populations.

Methods

In 2000–2001 the Standard Progressive Matrices test was standardized in Estonia on a sample of 4874 schoolchildren aged from 7 to 19 years. Data for 12-year-olds and older were reported in Lynn *et al*. (2002), except those for 313 adolescents, which were collected later. The sample was drawn from 45 geographically representative schools from all of the fifteen Estonian counties (*maakond*), including the capital city of Tallinn, smaller cities (e.g. Tartu), small towns and rural areas and constitutes 8·3% of all Estonian schools. The sample contained approximately equal numbers of boys ($n=2349$) and girls ($n=2525$). The children tested were in the first four grades, the 6th and the 8th grades of basic school (*põhikool*) and in the 10th and 12th grades of the secondary school or gymnasium. Most students continue in secondary schools or gymnasiums, and only 12% attend vocational schools. In each grade approximately 3% of all Estonian children who were born in that particular year were tested. Children in Estonia who attain 7 years of age by 1 October of the current year are obliged to start school. Normally the duration of studies in basic school is nine years. However, this may be prolonged if a student is obliged to repeat some grades. Thus, an individual curriculum may be shorter or longer than the norm. As a result, the age of students in one grade may differ by 2–3 years. For more details of the test administration see Raven (1981).

Estonian data are compared with British and Icelandic norms. A description of the test and British norms for children aged $6\frac{1}{2}$ to $15\frac{1}{2}$ years ($n=3256$) is given by Raven (1981, 2000). Icelandic norms for $6\frac{1}{2}$ to 16-year-olds ($n=550$) are given by Pind *et al.* (2003).

Results

The results are presented in Table 1. Columns 1–4 give the ages of the children, the mean scores, the standard deviations on the test for each of 25 age groups from 7 to 19 years, and the numbers of children in each age group. Column 5 gives the 1979 British 50 percentile norms given by Raven (1981, 2000), and column 6 gives the 2000 Icelandic means given by Pind *et al.* (2003).

In order to compare growth rates of intelligence in different countries Estonian mean scores need to be expressed in relation to British and Icelandic norms. However, before comparing Estonian and British data, an adjustment needs to be made for the secular increase in IQ. The British norms were collected in 1979, more than 20 years earlier than in Estonia. The mean British IQ assessed by the Progressive Matrices

Table 1. Data for the Estonian standardization of the Standard Progressive Matrices

Age	Mean	SD	*n*	British 1979[a]	Icelandic 2000[b]
6·5	—	—	—	16	22·6
7·0	25·84	8·76	43	19	22·7
7·5	25·81	9·02	48	22	30·6
8·0	26·12	9·74	248	25	29·3
8·5	28·12	9·54	189	31	35·2
9·0	32·23	10·07	267	33	36·2
9·5	32·96	8·44	203	36	39·3
10·0	36·67	8·15	243	38	40·5
10·5	36·52	8·38	201	39	37·9
11·0	39·11	8·63	206	40	41·4
11·5	39·62	9·04	211	41	42·7
12·0	42·46	8·88	71	41	43·9
12·5	46·36	6·78	300	42	45·4
13·0	46·45	6·42	325	43	45·6
13·5	45·07	8·33	97	44	45·0
14·0	47·93	7·86	126	45	46·1
14·5	49·24	6·42	286	46	46·7
15·0	49·78	6·84	295	47	47·8
15·5	49·01	6·39	125	47	48·8
16·0	52·06	5·78	223	—	48·8
16·5	52·62	5·18	357	—	—
17·0	52·24	4·73	193	—	—
17·5	52·78	4·55	86	—	—
18·0	52·97	4·63	245	—	—
18·5	52·90	5·92	210	—	—
19·0	53·17	4·02	76	—	—

[a]British 1979: 50th percentile British 1979 norms (Raven, 1981, 2000).
[b]Icelandic 2000: the mean score for Icelandic children (Pind *et al.*, 2003).

increased by approximately 2 IQ points a decade over the period 1938 to 1989 (Lynn & Hampson, 1986). The rate of increase of IQs appears to have declined during the last two decades of the twentieth century. In the United States the rate of increase of the Wechsler IQ was 3·3 IQ points per decade over the period 1932–1978 (Flynn, 1984), but it fell to 1·71 over the years 1978–1995 (Flynn, 1998). In Denmark the rate of secular increase of a non-verbal reasoning test similar to the Progressive Matrices test over the years 1988–98 was 1·35 IQ points (Teasdale & Owen, 2000). The authors consider that the most reasonable assumption is that the same rate of increase has taken place for the Progressive Matrices in Britain, and therefore that the British IQ increased by 3·0 IQ points over the period 1979–2000. To adjust Estonian and Icelandic results to a British IQ of 100 expected in 2001, it is therefore necessary to add 3·0 IQ points to the British IQ. Thus, the whole curve was shifted uniformly 3 IQ points down. Because Estonian data were collected approximately at the same

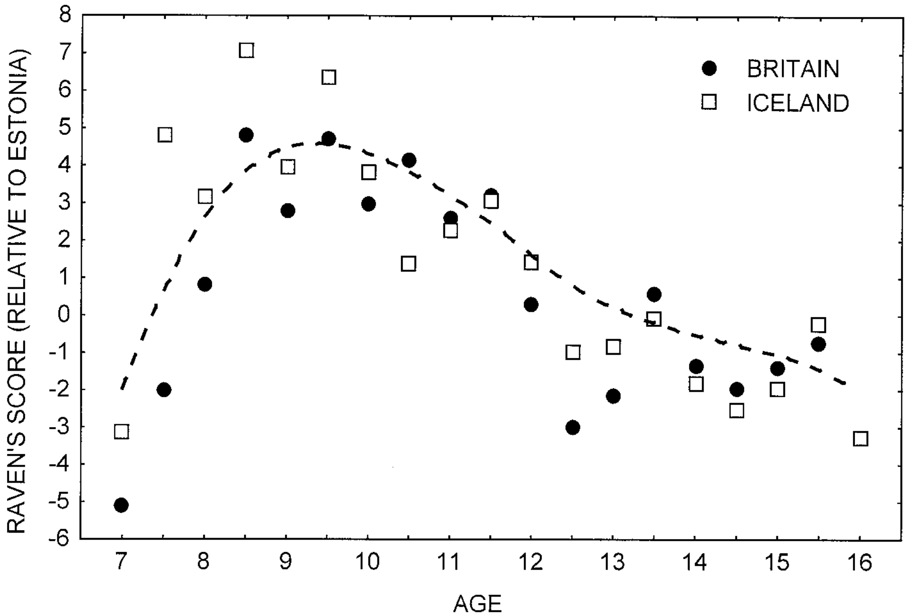

Fig. 1. The Raven's scores of Estonian age groups in relation to British and Icelandic means. British 1979 norms were shifted 3 IQ points up to adjust for the secular increase.

time as the Icelandic survey there was no need for adjustment. Figure 1 shows the Raven's scores of Estonian age groups in relation to British and Icelandic means. It is remarkable that the two data sets look very similar. Indeed, the correlation between these two sets of IQ values is highly significant ($r=0{\cdot}79$, $p<0{\cdot}001$), indicating that the growth trajectories of intelligence in these two countries are very similar. The continuous curve shows the least-square approximation to the averaged British and Icelandic data. This curve demonstrates that the youngest Estonian age group scored above both British and Icelandic means. In the age range from 8 to 12, both British and Icelandic children scored above their counterparts in Estonia. However, after age 12·5 Estonian students again reached the mean level of British and Icelandic IQ and even surpassed the mean level. Across all age groups the average Estonian IQ score was 99·4 and 98·4 in relation to British and Icelandic norms of 100, respectively.

Discussion

The mean IQ of Estonian 8–11-year-olds in relation to British and Icelandic children of the same chronological age was remarkably low compared with that of Estonian adolescents aged 12–16. For example, 8–11-year-old Estonians scored approximately 5–11 IQ points below their counterparts in Britain and Iceland. At the same time, 12–16-year-old Estonians scored systematically above the British and Icelandic mean level. Thus, the speed of growth of IQ is slower in Estonia than in two comparison countries that have remarkably similar growth trajectories. There are several possible explanations for the difference between the junior school children and the secondary school children in Estonia.

First, the difference between the junior and the secondary school children may be due to schooling. Studies in which children who differ in both chronological age and schooling are compared, have shown that schooling is the major factor underlying the increase of intelligence test scores (Cahan & Cohen, 1989). The schooling effect on IQ, however, seems to 'fade out' after a few years (Ceci, 1991). Estonian primary school children start school at age 7, whereas in Britain and Iceland children start school at 5 and 6 respectively. This relatively late start might be the reason why Estonian 7-year-olds are intellectually slightly behind British and Icelandic children of the same age. In fact the situation is exactly reversed: the Estonian first-graders are slightly ahead of their counterparts but lag behind after the first year of schooling.

Second, the discrepancy between different age groups may be due to sampling errors. It is possible that some grades contained more gifted or highly motivated students and some other grades less gifted and less motivated students. Although possible, this type of sampling error is unlikely due to the large number of schools and parallel grades from different schools. The regular S-shape shown in Fig. 1 also indicates that deviations from the 100 IQ level are systematic, and not due to some random sampling error.

Finally, it is likely that the discrepancy between IQ estimates among Estonian primary and secondary school children may result from different intellectual maturation trajectories. It seems that junior school children in Estonia initially lag behind in their intellectual development but catch up with their counterparts in Britain and Iceland when they reach adolescence. Like physical maturation (Eveleth & Tanner, 1990), the growth of intellectual capacities may be uneven and the maturation process can take a longer time in some populations than in others. This different growth rate may be caused by biological factors, schooling or both. Although none of these factors can be automatically excluded, some of the simplest explanations can be empirically tested. For example, it is unlikely that the approximately 7–10 points lower score of Estonian 9-year-old children is caused by their slower physical development compared with their British counterparts. On the contrary, Estonian 9-year-old boys and girls seem to be physically more developed than British children of the same age. The mean height of Estonian 9-year-old boys and girls is 135·4 and 134·0 cm respectively (Veldre, 1997), whereas that of British 9-year-old boys and girls was 131·7 and 131·8 respectively (Eveleth & Tanner, 1990, pp. 227–229).

Although it is unclear what exactly causes the different intellectual growth rate, this study provides evidence that there are different trajectories of intellectual maturation.

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