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THE RISE OF NATIONAL INTELLIGENCE: EVIDENCE FROM BRITAIN, JAPAN AND THE U.S.A.

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Summary—It is estimated that national mean intelligence has been rising in Britain by 1.71 IQ points per decade since 1932. In Japan the mean national IQ has been increasing by 7.70 IQ points per decade since 1950, but the rate of gain in Japan has been decelerating. These figures can be compared with a rate of gain of 3.0 IQ points per decade in the U.S.A. since 1932. In both Britain and the U.S.A. the IQ gains have been greater for non-verbal than for verbal intelligence but there is conflicting evidence on this point for Japan. In Britain IQ gains have been greatest at the lower end of the intelligence distribution, indicating a contraction in the range of intelligence among the contemporary population.

INTRODUCTION

During the 1930s and 1940s there was some concern both in Britain and the U.S.A. that the mean population intelligence in economically advanced nations might be declining (e.g. Cattell, 1937; Burt, 1946; Conrad and Jones, 1932). The reason for this concern was the well-established finding of a negative association between intelligence and family size. It was inferred that the less intelligent must have a higher average rate of reproduction and that this would inevitably lead to a decline in the intelligence of the population.

From 1949 onwards this concern was to a considerable degree dispelled. In this year the Scottish Council for Research in Education (SCRE, 1949) published its investigation in which the intelligence of all Scottish 11-yr olds had been tested in 1932 and 1947. The results showed an increase of 2.28 IQ points over the 15-yr period. A year later Emmett (1950) reported results showing that the mean IQ in England had been stable over the years 1938–1947; and the next year Cattell (1951) showed that the mean IQ in the city of Leicester had risen by 1.28 IQ points from 1936 to 1949. These three results evidently disconfirmed the expectation that national intelligence in Britain was declining and showed that on the contrary it was rising or at least stable.

Nevertheless, there remained an uncomfortable discordance between these empirical results and the theoretical prediction of a decline derived from the negative association between IQ and family size. This discordance appeared to be resolved in the early 1960s with the publication of two American studies showing that fertility of adults is virtually uncorrelated with intelligence (Higgins, Reed and Reed, 1962; Bajema, 1963). The previous studies had been based on children and had found negative associations between children's IQ and family size. It was pointed out that these studies failed to sample the infertile. Furthermore, the new evidence showed that the infertile were concentrated disproportionately among the less intelligent and that this counterbalanced dysgenic trends among the fertile.

Thus by 1962–1963 the theory that national intelligence levels are likely to be in decline had been undermined both theoretically and empirically. More recently it has been shown by Vining (1982) that dysgenic trends have in fact been present in the U.S.A. in recent decades and that the results of Higgins *et al.* and Bajema were exceptional, so that the theoretical case for expecting a decline in national intelligence has been revived. In spite of this, a review of the secular trend of intelligence in the U.S.A. by Flynn (1984a) has shown that the mean American IQ has been rising by approx. 3.0 IQ points per decade over the period 1932–1978. This is a massive increase amounting to 15 IQ points, or 1 SD, over half a century and is substantially greater than any of the three British studies of the 1930s and 1940s summarized above. In view of this dramatic claim we think it worth analysing whether increases of similar magnitude have taken place in Britain and Japan and this is the purpose of the present paper.

GREAT BRITAIN

It has proved possible to find 11 studies for Britain from which gains or losses in mean IQ over time can be calculated. There are two methods by which these gains or losses can be measured. The first is to take an intelligence test which has been administered to representative samples in two different years. We have found 10 British studies of this kind. The second method is to administer two tests, standardized at different times, to a sample and compare their scores. If the score is lower on the second test, a rise in mean IQ is inferred. We have only found one study of this kind in Britain, namely that by Pilliner, Sutherland and Taylor (1960). The second method was relied on by Flynn (1984a) in his analysis of the American data. There seems no reason to suppose that the two methods are not equally valid.

The results of the 11 British studies are summarized in Table 1. In four cases the studies were explicitly carried out to determine whether there had been a gain or loss in mean IQ (namely, SCRE, 1949; Emmett, 1950; Cattell, 1951; Pilliner *et al.*, 1960). The remaining studies are restandardizations of various tests from which the secular trend in mean IQ has been calculated. In these cases our procedure has been to calculate the mean IQs of the first standardization sample and of the restandardization sample and give the difference between the two. All differences have been calculated on the base of a mean of 100 and a standard deviation of 15. Table 1 gives the dates of the first and second tests, the ages of the *S*s, the increase or decrease in mean IQ of the second sample, the increase per decade, the test used and the reference. The following points in the table are of interest.

(1) All the investigations except Emmett's (1950) show an increase in mean IQ over time rather than a loss

The increases are statistically significant at least at the 0.05 level as calculated by *t*-tests, except for the two smallest, i.e. Emmett's and Mill Hill Vocabulary-written. The overall average of the nine investigations is an increase of 1.71 IQ points per decade. This is a litttle over half the average gain in the U.S.A. studies of 3.0 IQ points per decade calculated by Flynn (1984a). The range of readings in the British data is considerably less than in the American data. The British results run from −0.03 to +4.71 IQ points gain per decade. The range of results in the American data is over twice as great, namely from −1.85 to +11.3 IQ points per decade. These differences from one study to another are probably to be explained in terms of sampling variations, differences in test content (some cognitive abilities may be improving more rapidly than others) and possibly in the dates of the two test administrations (the increases may have been greater at some periods than at others). The difference between the British and American gains is undoubtedly statistically significant. A difference of 1 IQ point is statistically significant at the 0.05 level on approx. 2000 *S*s, and there are many times this number in the present case.

The difference between the British rate of gain of 1.71 IQ points per decade and the American rate of gain of 3.0 points may not seem of much consequence for a single decade. However, multiplied up over the five decades covered by the various studies it would appear that the Americans have pulled ahead by appox. 6.7 IQ points and this is clearly appreciable. We can find no plausible explanation for this difference.

Table 1. Increases in mean IQ in Britain (all increases are statistically significant except the second and third in the list)

Time period	Age (yr)	Increase	Increase per decade	Test	Number	Reference
1932–1947	11	2.21	2.01	Verbal	158,303	SCRE (1949)
1938–1947	11	0.03	−0.03	Moray House	60,233	Emmett (1950)
1943–1979	11–15	0.67	0.18	Mill Hill written	4919	Raven *et al.* (1983)
1943–1979	11–15	2.70	0.75	Mill Hill oral	4323	Raven *et al.* (1983)
1945–1957	11	6.12	4.71	Moray House	3212	Pilliner *et al.* (1960)
1959–1977	9–11.5	3.43	1.90	Verbal CD	14,766	NFER
1936–1949	9–11	0.87	0.67	NV Scale 1	6705	Cattell (1951)
1938–1979	8–14	7.63	1.86	S. progressive matrices	4659	Raven *et al.* (1983)
1949–1982	5–11	8.79	2.66	C. progressive matrices	1225	Raven *et al.* (1983)
1954–1977	7–8	8.47	3.68	Picture Test A	8374	NFER
1955–1974	11–12	0.94	0.41	NV Test DH	13,200	NFER

(2) Time differences

It is possible that the rate of IQ gain may have differed at different periods. The most striking result here is that the largest IQ gain is that found by Pilliner *et al.* (1960) for the period 1945–1957. It seems likely that the 1945 figure was depressed by various negative effects of World War II such as disrupted family life and education. Hence there was an unusually large recovery from 1945 to 1957. The same factor may account for the only finding of an IQ loss, namely Emmett's study comparing 1938 with 1947.

Apart from some indication of a depression of IQ scores in the immediate post-war years followed by recovery, the data suggest that the IQ gains have been at least roughly constant over the entire period. There are no signs of a diminishing returns effect in the more recent decades. In this respect the British data resemble the American data, where the IQ gain has also been constant over time. There is however a lack of British studies where the first test was given from 1960 onwards and it would be useful to determine whether the rate of IQ gain has been maintained in more recent times.

(3) Verbal:non-verbal test differences

The test results in Table 1 have been arranged with the six verbal tests given first and the five non-verbal tests given second. From this it can be seen that the IQ gains on the verbal tests have in general been somewhat smaller than on the non-verbal. The average gain of the six verbal tests is 1.50 IQ points per decade, while that of the non-verbal tests is 1.86 points per decade. Moreover, the verbal IQ gains are inflated by the exceptionally large gain for 1945–1957 on a verbal test found in the Pilliner *et al.* study. If this is removed, the average gain on the remaining five verbal tests falls to 0.86, less than half the gain in non-verbal IQ.

Another way of looking at verbal vs non-verbal gains is to take the two longest and comparable time periods for two verbal tests (Mill Hill Vocabulary, oral and written) and for two non-verbal tests (progressive matrices, coloured and standard). The vocabulary tests increased by 0.18 and 0.75 IQ points per decade (1943–1979), while the progressive matrices increased by 2.66 and 1.86 IQ points per decade (1949–1982 and 1938–1979). Thus there appear to have been greater increases in the non-verbal means of the order of around 1.5 IQ points per decade.

It is interesting to note that the same difference between verbal and non-verbal gains has been present in the U.S.A. Here the verbal gains have been increasing at approx. 2.5 IQ points per decade and non-verbal gains at approx. 3.5 IQ points per decade (Flynn, 1984b). Thus in both Britain and the U.S.A. non-verbal IQs have apparently been increasing faster than verbal IQs. We have to admit some surprise at this result. We assume that the IQ gains are principally due to a variety of environmental improvements and it is widely believed that verbal tests are more sensitive to environmental conditions than non-verbal. In Cattell's terms, non-verbal tests are more culture fair and better measures of fluid ability, while verbal tests are more culture bound and closer measures of crystallized ability. We should have expected that the verbal tests of crystallized ability would have shown the greater increases over time but apparently the reverse is the case. It may be that some words in vocabulary and other verbal tests become less frequently used over periods of 40 years or so and hence relatively harder for later generations of children. This would mean in effect that vocabulary tests are more culture bound over time than non-verbal tests.

(4) Distribution differences

We consider now the question of whether the secular increases in mean IQ have been present to an equal extent at different points of the distribution. A useful starting point for this question is Cattell's (1951) study of 10- to 11-year olds in the city of Leicester tested in 1936 and 1949. In analysing the changes in IQ Cattell divided the children into two groups, those below and above the mean. The results showed that all the increase in intelligence had taken place in the children below the mean. There was no increase in those above the mean and in the top quartile there was actually a fall in mean IQ.

To examine this question on a wider set of data we have calculated the changes in mean IQ at 1 SD above and below the mean (for the progressive matrices and Mill Hill Vocabulary the data are given for the 90th and 10th percentiles, corresponding to IQs of 119 and 81). These calculations

Table 2. IQ gains at the mean and at 1 SD above and below the mean

Time period	Age (yr)	Low IQ	Mean IQ	High IQ	Test
1932–1947	11	1.40	2.21	2.69	Scottish Council verbal
1943–1979	6–11	−5.91	2.70	10.87	Mill Hill Vocabulary oral
1943–1979	11–15	5.14	0.67	−6.29	Mill Hill Vocabulary written
1959–1977	9–11	4.40	3.43	3.29	NFER verbal CD
1936–1949	9–11	1.76	0.87	−0.02	Cattell non-verbal
1938–1979	8–14	10.55	7.63	5.78	Standard progressive matrices
1949–1982	5–11	1.23	8.79	10.37	Coloured progressive matrices
1954–1977	7–8	6.21	8.47	10.93	NFER Picture Test A
1955–1974	11–12	1.06	0.94	2.11	NFER non-verbal DH

have been made for 9 of the 11 studies (the remaining two do not give data from which these calculations can be made). The results are shown in Table 2. Examination of the table suggests that there is no consistent pattern. In some studies the more intelligent have made greater gains (viz. in the coloured progressive matrices, the NFER Picture Test A and the Mill Hill Vocabulary oral test) while in other studies the less intelligent have made the greater gains (viz. in the standard progressive matrices and the Mill Hill Vocabulary written test). It may however be observed that greater gains among the more intelligent seem to have been present among the younger children, while among the older children the greater gains have occurred among the less intelligent. We therefore examined this tendency in more detail.

(5) Age differences

The starting point for this problem is a small set of American data analysed by Thorndike (1977) for differences in IQ gains for children of different ages. Thorndike concluded that the gains were greatest for young children aged 2–6; from age 7 the gains declined and had virtually vanished to zero among 11-yr olds. From 11 yr onwards there were modest gains to the ages 17–18. He suggested that in more recent decades young children have benefitted from a kind of mass headstart effect, possibly due to TV and so forth, and this has faded by the age of 11. However, more extensive American data on this question have been analysed by Flynn (1984b) who has concluded that there are no such age effects in the U.S.A.

For the British data there are four studies which give long age runs from which this question can be analysed. These are the progressive matrices (coloured and standard) and the Mill Hill Vocabulary test (oral and written). The results for the progressive matrices broken down for each age from 5- to 14-yr olds are shown in Table 3. In the bottom row are given the product–moment correlations of the IQ gains with age. It will be seen that for the population mean there is no significant tendency for the IQ gains to vary systematically with age. However, at the 10th percentile the IQ gains have been much greater among older children (the correlation of gains with age is 0.90 and is statistically highly significant). Conversely, at the 90th percentile the IQ gains have been greatest among the younger children.

Table 3. IQ gains for coloured progressive matrices (ages 5–11 yr) and standard progressive matrices (ages 8–14 yr) shown for the mean and the 10th and 90th percentiles.

Age (yr)	Low IQ	Mean IQ	High IQ
5.00	—	3.50	12.50
6.00	−2.50	5.00	5.75
7.00	0.00	10.00	8.00
8.00	4.25	10.00	12.50
9.00	2.25	10.00	10.75
10.00	2.00	11.00	16.50
11.00	3.50	10.00	5.00
8.00	—	11.75	8.75
9.00	9.50	8.85	8.75
10.00	13.00	11.25	6.25
11.00	13.75	11.25	6.25
12.00	8.75	4.50	1.00
13.00	6.50	1.85	5.75
14.00	12.00	5.00	6.00
Correlations	0.90**	−0.21	−0.56*

*Statistically significant at the 5% level.
**Statistically significant at the 1% level.

Table 4. IQ gains for the Mill Hill Vocabulary scales (oral test for ages 6–11 yr, written for ages 11–15 yr) shown for the mean and the 10th and 90th percentiles

Age	Low IQ	Mean IQ	High IQ
6.00	−6.00	−1.00	10.70
7.00	−11.25	−2.80	9.20
8.00	−9.30	2.55	8.20
9.00	−6.25	4.55	10.75
10.00	−2.50	5.20	15.25
11.00	5.50	9.00	11.00
11.00	12.00	2.60	−2.00
12.00	1.50	0.10	−6.75
13.00	2.00	−1.50	−9.50
14.00	7.50	3.00	−5.50
15.00	9.50	2.00	−4.00
Correlations	0.87**	0.21	−0.80**

**Statistically significant at the 1% level.

Similar data are displayed for the Mill Hill Vocabulary test in Table 4. The pattern of results is similar to the progressive matrices. There are no age trends for the IQ gains at the mean. At the 10th percentile the mean children's Vocabulary scores have deteriorated between the ages of 6–10 and improved at 11–15 yr. At the 90th percentile the reverse has taken place, namely improvement over the age range 6–11 and deterioration from 11 to 15 yr.

It is a striking result that this pattern should be so similar in the verbal and non-verbal tests. A possible interpretation is as follows. The environmental improvements responsible for the rise in IQ have accelerated the cognitive development of the more intelligent among the younger children. But these are 'headstart' gains which have faded in later years and the less intelligent catch up. By the ages of 12 and 14 both data sets show greater gains among the less intelligent. By the ages of 14–15 the secular increase in IQ has been greatest among the less intelligent and least among the more intelligent. There has therefore been a reduction in the variation in intelligence among older children in more recent times.

(6) Sex differences

Little attention has been given to the possibility of sex differences in the IQ gains. Neither Thorndike nor Flynn examine the American data for sex differences. Most of the British data do not give results for the sexes separately so there is not much scope for examining this variable in Britain either. Nevertheless, both the early studies of the Scottish Council (SCRE, 1949) and Emmett (1950) did give sex differences and both showed greater IQ gains among girls than among boys. The differences obtained in these two studies are shown below. In both studies the greater gains made by girls are statistically highly significant.

IQ gains	SCRE	Emmett
Boys	1.38	−0.09
Girls	2.31	0.09

The sex differences were discussed by Emmett. He proposed that the various disruptions of the war—many fathers away from home, evacuation, interrupted schooling and so forth—probably had greater damaging effects on boys than on girls. The suggestion seems plausible. It is a pity that there are apparently no data available to examine sex differences in rates of gain of IQ in more recent decades. This is a question which could usefully be investigated in future inquiries.

JAPAN

It has been possible to find five studies providing evidence on the secular trend of intelligence in Japan for the post World War II period. The results are summarized and discussed in chronological order.

(1) Ushijima's study (1961)

Here the Ushijima intelligence test was administered to 1365 children in 1953 and to a comparable sample of 1370 children in 1960 with the objective of determining any change in the mean over this relatively short period. The children were aged 9–15 yr. The test consists of eight subtests covering the major primary abilities of verbal ability, number, reasoning, spatial ability, perceptual ability and memory. The results are set out in detail as standard deviation increases in Table 5. This table gives the standard deviation increases for each test at each age. The principal points of interest are as follows:

(i) All age groups show a rise in scores for all abilities. The overall mean increase was 0.66 standard deviations, the equivalent of 9.9 IQ points, and representing an IQ gain of 14.1 IQ points per decade. This is of course a very considerable increase and much greater than anything found in either Britain or the U.S.A.

(ii) The IQ increases are in general greater among the younger age groups than among the older. This trend is clearly evident in the right-hand column of the table where the means of all the subtests are given for each age. Here it will be seen that the IQ gains of the 13- to 15-yr olds are about two thirds of those of the 9- to 12-yr olds. The same trend is apparent in most of the subtests.

Table 5. Gain in intelligence in Japan 1953–1960 expressed as standard deviation increases (from Ushijima, 1961)

Age (yr)	Memory	Memory	Number	Verbal	Verbal	Spatial	Perceptual	Reasoning	Mean
9	0.90	0.34	0.74	1.24	1.10	0.11	0.83	0.71	0.76
10	0.77	0.38	1.12	1.17	0.82	0.53	0.88	0.94	0.83
11	0.80	0.40	1.15	1.26	0.82	0.51	1.18	0.74	0.86
12	0.58	0.45	0.93	1.37	0.73	0.49	0.67	0.68	0.74
13	0.61	0.51	0.36	1.12	0.27	0.10	0.52	0.34	0.48
14	0.57	0.11	0.31	1.02	0.38	0.39	0.46	0.40	0.46
15	0.42	0.29	0.69	1.46	0.24	0.22	0.45	0.20	0.50
Mean	0.67	0.35	0.76	1.23	0.62	0.34	0.71	0.59	0.66

(iii) The gains for each of the eight subtests are shown in the last row, averaged for all age groups. There are evidently quite substantial differences between some of the subtests in the magnitude of the gains. The smallest gain occurred in the spatial ability test and the largest in the number test. But there does not appear to be any consistent tendency for verbal tests to improve more than non-verbal or vice versa. It will be noted that the perceptual ability test, which involved the matching of patterns (as in the American Matching Familiar Figures test except that the Japanese test involved abstract patterns instead of objects), showed a greater gain (0.71) than the average of all the tests (0.66). It looks as if there were different rates of gain for quite narrow skills, e.g. the two verbal tests (consisting of antonym problems and verbal reasoning) showed markedly different gains.

In a discussion of the reasons for the considerable rise in mean IQ in Japan over the years 1953–1960 Ushijima suggests the crucial factor was probably the recovery of Japanese society and education from the disruption of World War II and the early post-war years.

(2) Kaneko's study (1970)

This investigation used the Kyoto NX 9–15 intelligence test. This test was first constructed and standardized in Japan in 1954. It is a group test suitable for the 9- to 15-yr age range. It consists of 12 subtests measuring verbal, numerical and spatial abilities. The test is broadly similar in form to group tests widely known and used in the West such as Primary Mental Abilities and the Differential Aptitude Test.

Kaneko's investigation of a possible rise in the scores on this test was carried out in 1963. His 1963 sample consisted of 50 boys and 50 girls aged 10 and 11 randomly selected from three schools in the city of Kyoto. The three schools had been used in the original 1954 standardization sample and were chosen because their catchment areas were representative of the city and because there had been little change in the catchment populations and environment over the 9-yr period. The 1954 children from these three schools obtained a mean IQ of 102.52. Thus they scored slightly higher than the national mean of 100. This is almost certainly because they were an urban sample and urban children obtain slightly higher means than rural children in Japan, as has generally been found elsewhere. The mean IQ of the 1963 sample was 112.90. Hence the mean IQ in these schools had risen 10.38 IQ points over the 9-yr period (the difference between the two mean IQs is statistically significant: $t = 5.66$, $P < 0.01$), representing an IQ gain of 11.4 IQ points per decade. This figure is evidently broadly similar to the rise of 14.1 IQ points per decade for 1953–1960 found by Ushijima and confirms a very considerable rate of IQ gain in Japan in these early post World War II years.

(3) Sano's study (1974)

This investigation was a further follow-up of the last study by Kaneko. It was carried out in 1972, 9 yr after Kaneko's second study, and the same test and age group (10- to 11-yr olds) were used. The children were drawn from eight schools, five of which were in Kyoto city and three in the 'prefectural' area, i.e. small towns in the region around Kyoto. All the schools had been used in the original 1954 standardization for which records were available for comparison and two of the schools had been used in Kaneko's (1970) 1964 study. The results are set out in Table 6. The Kyoto test is normed on a mean of 50 and standard deviation of 10. The data are given in this form and also converted to IQs based on a mean of 100 and standard deviation of 15.

Table 6. IQ gains in Kyoto, 1954–1972 (Sano, 1974)

	1954, 10-yr olds		1972, 10-yr olds	
	City	Prefecture	City	Prefecture
Number	196	219	185	164
Mean	52.70	50.14	65.20	59.85
SD	7.49	7.51	7.36	8.03
Mean IQ	104.05	100.21	122.80	114.78
	1954, 11-yr olds		1972, 11-yr olds	
	City	Prefecture	City	Prefecture
Number	218	275	189	173
Mean	53.31	49.49	65.01	59.87
SD	7.05	7.56	7.21	8.39
Mean IQ	104.97	99.24	122.52	114.81

It will be seen that in all samples there were considerable increases in mean IQ from 1954 to 1972. The increases appear to be a little greater among the city children than among those from the prefecture. When the results for 10- and 11-yr olds are combined, city children gained 18.04 IQ points and prefecture children 15.07 IQ points. The average of the two gains is 16.56 IQ points, representing a gain of approx. 9.15 IQ points per decade for the entire sample.

Sano also considered the question of whether the IQ gains in Japan have been increasing at a constant rate. For this he used Kaneko's 1964 data which were available for two of the schools. He calculated that the increase in mean IQ was 10.47 points for 1954–1963 and 3.42 for 1963–1972. (The total of these two figures is a little lower than the 16.56-point gain given above because this is a reduced sample; the difference between the two rates of gain is statistically significant: it will also be noted that the gain of 10.47 IQ points for 1954–1963 is closely similar to Kaneko's figure of 10.38 for the same period.)

It is apparent therefore that there was a considerable deceleration in the rate of increase in intelligence over the period 1954–1972. Sano suggests that the disruptions and deprivations of the war and early post-war years may have depressed the intelligence of the first cohort tested in 1954 and the rapid improvement in social conditions during 1954–1963 can account for the considerable rise in mean IQ during this period. For the second period there has probably been a diminishing returns effect with further environmental improvements. During the second 9-yr period (1963–1972) the increase in mean IQ in Japan of 3.42 IQ points is quite close to the 3.0 points per decade in the U.S.A. calculated by Flynn (1984a). Flynn does not find any deceleration in the rate of gain in the U.S.A., but then the U.S.A. did not experience the degree of environmental deprivation suffered by Japan in the years of World War II and the immediate post-war period.

A further question considered by Sano is whether the increase in mean intelligence has been of equal magnitude for all the 12 subtests providing various measures of verbal, spatial and numerical ability. The results are set out in detail in Table 7. The figures in this table are the standard deviation increases based on the standard deviation of 10 of the Kyoto subtests. The data are broken down

Table 7. IQ gains for verbal, spatial and numerical subtests expressed as standard deviation increases based on a standard deviation of 10 (Sano, 1974)

	10-yr olds		11-yr olds		
	City	Prefecture	City	Prefecture	Mean
Verbal					
2. Sentence completion	15.10	11.83	14.15	13.63	13.68
4. Jumbled sentence	3.09	2.51	4.06	3.55	3.30
6. Verbal memory	13.13	10.88	12.83	9.41	11.56
10. Verbal correlates	9.84	7.45	5.82	7.58	7.67
11. Antonyms	14.18	10.14	11.51	8.79	11.16
12. Vocabulary	12.49	7.46	13.42	6.96	10.08
Spatial					
1. Paper folding	12.07	9.36	12.32	11.38	11.28
3. Shape analysis	7.91	6.52	5.91	8.00	7.08
7. Visualization	10.46	8.84	10.03	9.93	9.81
8. Spatial orientation	8.62	3.13	4.24	4.86	5.21
Numerical					
5. Arithmetic (a)	13.11	12.82	16.64	15.09	14.42
9. Arithmetic (b)	7.67	6.80	7.83	4.95	6.81

for 10- and 11-yr olds and for city and prefecture samples and the means for all four groups are given in the right-hand column. When the means for the verbal, numerical and spatial tests are summed, we find that the greatest increase has been in verbal ability (11.49) followed by numerical ability (10.62), while the smallest increase has been in spatial ability (8.34). However, there was clearly a wide range of variation in the rate of increase for the various subtests within each factor. Thus the smallest increase is in one of the verbal tests, namely test 4. This test consists of jumbled words which have first to be put in the correct order to form an intelligible sentence. This sentence is a question, and the question must then be answered. For example, the first item is "rise does the sun which direction in the morning" and the alternatives provided from which the *S* must select the answer are west, below, south, east, north. It is curious that of the 12 subtests this should be the one that has shown the least improvement over time.

(4) *Wechsler studies*

The investigations by Lynn (1977, 1982) on the Japanese standardizations of the Wechsler tests provide further data on IQ gains in Japan. It is considered that the most reliable data come from the Japanese standardizations of the WISC (Wechsler Intelligence Scale for Children) in 1951 and WISC-R (the revised test) in 1975. The performance scale of the WISC was retained virtually unaltered in the Japanese standardizations of the tests. The Japanese obtained a mean performance IQ of 103.1 on the original WISC in 1951 (Lynn, 1977). This figure needs to be adjusted for the 4-yr interval between the American and Japanese standardizations (1947–1951). To make this adjustment we use Flynn's calculation that the mean IQ in the U.S.A. has been rising at 3.0 IQ points per decade, and therefore subtract 1.2 points from the Japanese mean of 103.1, giving a Japanese mean of 101.9 in relation to an American mean of 100 for the year 1951.

The WISC-R was standardized in the U.S.A. in 1972 and in Japan in 1975. On this test the Japanese children obtained a mean performance IQ of 110.7 (Lynn, 1982). This figure requires two adjustments. First, the 3-yr interval between the American and Japanese standardizations requires the subtraction of 0.9 IQ points from the Japanese mean. Secondly, the American WISC-R was standardized on a representative sample of the total American population, blacks and whites, whereas the first WISC was standardized on whites only. On the WISC-R the mean IQ of whites was 102.25 (Jensen and Reynolds, 1982). Hence a further 2.25 IQ points needs to be subtracted from the Japanese mean to give a Japanese figure in relation to a white American mean of 100. Making the two adjustments, we arrive at a Japanese mean IQ of 107.45 in relation to a white American mean of 100 for the year 1975.

Thus after making these adjustments we have Japanese mean IQs of 101.9 for 1951 and 107.4 for 1975. Hence over this 24-yr period (1951–1975) the Japanese mean IQ increased by 5.5 IQ points relative to the American IQ. However, the American performance IQ rose by 8.3 points over this period, as Flynn (1984b) has shown. To obtain the absolute rise in the Japanese IQ, the relative rise (5.5. points) must be added to the American rise (8.3 points), giving an absolute Japanese rise of 13.8 IQ points. This represents a Japanese IQ gain of 5.75 IQ points per decade. This rate of increase for the period 1951–1975 is somewhat less than Sano's result of a 9.15 IQ point per decade increase over approximately the same period (1954–1972).

A second Japanese study using the WISC and WISC-R is also available (Anon, 1981). In this investigation the method was used of administering the Japanese WISC and Japanese WISC-R to groups of *S*s and calculating the discrepancy between the scores. The WISC was standardized in Japan in 1951 and the WISC-R in 1975. If *S*s find the WISC-R harder than the WISC, the disparity in scores indicates the magnitude of the increase in mean IQ in Japan over the 24-yr period.

There were 112 *S*s in this investigation with an age range of 6–15 yr and average age of 10. In all cases there was an interval of at least 2 months between the two test administrations. Approximately half the *S*s took the WISC first and half the WISC-R first. For the full-scale IQ, the *S*s obtained a WISC IQ of 114.53 and a WISC-R IQ of 94.50. This gives a rise of 20.03 IQ points over the 24-yr period, making 8.34 IQ points per decade.

In this study results were also given separately for the Wechsler Verbal and Performance scales. On the Verbal scale, the *S*s obtained a WISC IQ of 109.27 and a WISC-R IQ of 93.25, indicating an increase of 16.02 IQ points or 6.67 IQ points per decade. On the Performance scale, the *S*s obtained a WISC IQ of 115.31 and a WISC-R IQ of 97.95, indicating an increase of 17.36 IQ points

or 7.23 per decade. Thus the non-verbal performance IQ apparently increased slightly more than the verbal IQ, as in the British and American studies, but in contradistinction to Sano's study in Japan summarized above.

The conclusion of the Japanese studies is as follows. Two studies of the early post World War II period show substantial IQ gains of 9.9 and 11.4 IQ points per decade (Ushijima, 1961; Kaneko, 1970). Three studies of a longer period from approx. 1950–1975 show lower IQ gains of 9.1, 8.3 and 5.7 IQ points per decade, giving an average gain of 7.7 IQ points per decade. 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 approx. 5 IQ points per decade.

CONCLUSIONS

The results set out in this paper speak largely for themselves but we highlight the following points in conclusion. First, the apprehension of a number of psychologists of the 1930s and 1940s that the national intelligence in advanced Western nations might be declining is clearly not borne out by the evidence in Britain, Japan and the U.S.A. On the contrary there have been increases in intelligence over the last half century. The quantification of these at 3.0 IQ point gains per decade calculated by Flynn for the U.S.A. for 1932–1978 is broadly substantiated in Britain and Japan. The British gains have been somewhat less, namely 1.71 IQ gains per decade. But the Japanese gains for the post World War II period have been even greater than the American, namely 7.70 IQ points per decade. However, this figure includes exceptionally rapid gains in the immediate post World War II period, which were followed by a reduction in the rate of gain.

It is not particularly surprising that the Japanese gains should have been the greatest of the three countries. Japan was a relatively undeveloped country in the 1930s with a per capita income about one eighth of that of the U.S.A. Furthermore, the Japanese suffered considerable disruption and deprivation in and immediately after World War II. The initial measurements of Japanese IQ about 1950 therefore start from a relatively low base and display rapid gains to around 1960. Thereafter they show a diminishing returns effect.

Although Flynn could find no evidence for any deceleration of the rate of IQ gain in the U.S.A. over the period 1932–1978, if we go back earlier we find that IQ in the U.S.A. rose 13 points between the two World Wars, as measured by Tuddenham (1948) on conscripted servicemen in the two wars. This represents a gain of approx. 5 IQ points per decade, significantly greater than the 3 IQ points per decade calculated by Flynn for the later period. Thus if Tuddenham's figures are accepted there is evidence of a diminishing returns effect in the U.S.A. as well as in Japan. The same effect appears also to have been present in Britain, where the large IQ gains in the period 1945–1957 were followed by a lower rate of gain.

Turning now to the causes of these increases in intelligence, we consider that these are probably largely due to environmental factors of various kinds such as improvements in health and nutrition, greater environmental stimulation arising from TV, educational toys and games, books, increased leisure among parents and reductions in family size. The IQ gains seem too large for genetic factors to have played a major role. Nevertheless, genetic factors should not necessarily be ruled out as contributory influences on the differential rates of IQ gain between Britain, Japan and the U.S.A. Birth rates may be eugenic or dysgenic to varying degrees in different countries, and there is evidence here that Japanese birth rates may have been less dysgenic than in the U.S.A. in the post World War II period (Vining, 1983). This may have contributed to the fast rate of IQ gain in Japan. We do not attempt to quantify this effect here and leave this as a problem for further inquiry.

There are several other questions raised by the present survey of the rise of national intelligence which deserve additional study. We particularly draw attention to the following. First, what is the rate of gain for different abilities? We have presented evidence that non-verbal intelligence has been increasing faster than verbal in Britain and the U.S.A., while in Japan the evidence is contradictory. Secondly, the British results indicate that the IQ rise has been greater at the lower end of the distribution among older children, thereby producing a narrowing of the range of intelligence among the contemporary population as compared with previous generations. Both these questions merit further research and analysis.

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