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A Strong Flynn Effect in South Korea during the Second Half of the Twentieth Century

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Results from the standardization of the Wechsler Adult Intelligence Scale-4 (WAIS-IV) in South Korea show that when using British norms, average IQs are higher in Korea than in Britain among younger age groups, decline with age, and are lower than those in Britain among older age groups. These age differences are attributed to a strong Flynn effect in South Korea with IQs increasing at a rate of approximately 8.4 IQ points a decade from early 1940s to late 1980s birth cohorts. The increases were smallest for the Verbal Comprehension IQ and largest for the Processing Speed IQ.

Key Words: WAIS-IV; Intelligence, Flynn effect, South Korea, UK.

Increases in intelligence during the twentieth century and up to the present have been reported in numerous studies and in countries reviewed in Lynn (2013), Trahan et al. (2014), and Pietschnig & Voracek (2012). The rate of these increases in the United States has been approximately 3 IQ points a decade for general intelligence measured by the Wechsler Full Scale IQ (Flynn, 2012, p. 37). Several studies have reported that the rate of these increases has been greater for non-verbal IQ than for verbal IQ. In the United States the increase has been approximately 2.5 points a decade for the verbal IQ and 3.5 points a decade for non-verbal IQ on the Wechsler tests (Flynn, 1984a). Similar results have been reported for Britain where gains in verbal tests have been smaller than those in the non-verbal Progressive Matrices (Lynn & Hampson, 1986) and gains in verbal tests have been smaller than those in tests of reasoning, spatial ability and perceptual speed (Lynn, 1990).

Two methods have been used for identifying the increases in intelligence. The first is by administering a test to a sample and administering it to a comparable sample many years later. These studies have shown that the later sample obtained a higher IQ. This method was used by Tuddenham (1948) in a report showing that American soldiers in World War II obtained a higher IQ than those in World War I. The second method is to administer two tests to a sample, of which one test has been standardized at an earlier date than the other. If the sample obtains a higher IQ on the earlier test, this shows that the IQ has increased between the two standardizations assuming both standardization samples were representative of the population. This method was used by Flynn (1984b) to show increases in intelligence in the United States. In this paper we illustrate a third method for showing increases in intelligence by comparing data from the British and South Korean standardization samples of the Wechsler Adult Intelligence Scale-Fourth Edition (WAIS-IV). Hitherto there have been two studies of the increase in intelligence in South Korea for 6-16 year olds on the WISC (Wechsler Intelligence Scale for Children). One has been reported by Flynn (2012, p. 37) for 89 subjects tested on the WISC 1986-1999 and consists of a gain per decade of 7.23 IQ points on the Full Scale IQ, 3.15 IQ points on the Verbal IQ and 10.46 IQ points on the Performance IQ. The second was reported by te Nijenhuis et al. (2012), where the authors found gains of 7.7 IQ points per decade on the Full Scale, 1.6 points on the Verbal Scale, and 16.0 points on the Performance Scale for persons born between 1970 and 1990. These gains are approximately twice as great as those found in the United States.

Method

The WAIS-IV was standardized in the United States in 2007 on a nationally representative sample of 2200 aged 16 to 90 years (Wechsler, 2008a), and in Britain in 2008-9 on a sample of the same age (Wechsler, 2008b). The American and British standardization samples had closely similar scores, with the British sample obtaining a Full Scale IQ 0.78 points higher than the American standardization sample (Wechsler, 2008b, p.271). The WAIS-IV was standardized in South Korea in 2011 on a sample of 1229 aged 16 to 69 (Hwang et al., 2012). The sample was matched to the population given in the 2010 South Korean Census in terms of educational level and geographic region.

The tests in the Korean WAIS-IV are the same as those in the American and British WAIS-IV. There are 15 tests: Block Design, Similarities, Digit Span, Matrix Reasoning, Vocabulary, Arithmetic, Symbol Search, Visual Puzzles, Information, Coding, Letter-Number Sequencing, Figure Weights, Comprehension, Cancellation and Picture Completion. The first ten of the 15 tests are used to calculate the Full Scale IQ and four index IQs: the Verbal Comprehension Index (VCI) based on the three verbal tests (Similarities, Vocabulary and Information), the Perceptual Reasoning Index (PRI) based on the three perceptual reasoning tests (Block Design, Matrix Reasoning and Visual Puzzles), the Working Memory Index (WMI) based on the two working memory tests (Digit Span and Arithmetic), and the Processing Speed Index (PSI) based on the two processing speed tests (Symbol Search and Coding). The remaining five subtests are not used in the calculation of the Full Scale and Index IQs.

In the standardization of the Korean WAIS-IV, the American items were translated into Korean through translation and back-translation procedures by bilinguals and a panel of clinical psychologists. Most American items were retained in the Korean WAIS-IV but some American items in Similarities, Vocabulary, Information and Arithmetic were modified or replaced with new items as the translated items had substantially different levels of difficulty compared to the original items or were unfamiliar to most Koreans. The new items were carefully selected so that they were comparable to the original American items in terms of level of difficulty and familiarity of content. The comparability of the changed items was approved by the developers of the American WAIS-IV.

We selected the seven adult groups from 20-24 years to 65-69 years from the Korean WAIS-IV standardization sample, and obtained the mean scores for the 10 tests for these age groups from the WAIS-IV manual of the British standardization. We then calculated the IQs of the seven age groups of the Korean sample on the British standardization norms. We chose the 20-24 year

olds as the youngest adult group because performance on most tests reaches a peak around this age.

Table 1. *Mean scores of South Koreans on the WAIS IV and equivalent British-scaled scores for age 20-24 years and age 65-69 years.*

Tests/IQs	Age 20-24 S. Korean raw score (mean)	Age 20-24 British-scaled score	Age 65-69 S. Korean raw score (mean)	Age 65-69 British-scaled score
Block Design	53.87	12	28.93	9
Similarities	18.63	7	11.46	5
Digit Span	32.59	12	18.38	7
Matrix Reasoning	19.91	11	8.68	7
Vocabulary	34.64	10	18.23	6
Arithmetic	15.92	11	10.44	8
Symbol Search	44.10	14	18.05	7
Visual Puzzles	17.87	10	8.19	7
Information	14.97	11	8.99	8
Coding	95.56	14	36.43	7
Verbal Comprehension	-	96	-	80
Perceptual Reasoning	-	105	-	86
Working Memory	-	108	-	86
Processing Speed	-	122	-	84
Full Scale IQ	-	108	-	80

Results

Table 1 gives the mean scores obtained by the Korean 20-24 year olds and 65-69 year olds on the 10 subtests, the 4 index IQs, and the Full Scale IQ. Column 2 gives the mean raw scores of the Korean 20-24 year olds and column 3 gives the British standardization scaled scores for these. The mean of each of the British scaled scores is 10 and the standard deviation is 3. The Full Scale IQ is calculated from the sum of the subtest scaled scores. Thus, a sample that obtained a scaled score of 100 obtains a British IQ of 100. The sum of the British standardization scaled scores of the Korean 20-24 year old sample is 112, and this gives a British IQ of 108. This figure needs adjustment because the British standardization sample over-sampled participants with above average education, inflating the IQ by 2.5 points (Wechsler, 2008b, p.270). This has to be added to the IQ of the Korean 20-24 year olds giving them a British IQ of 110.5. The same data for the Korean 65-69 year olds are given in columns 4 and 5. Column 4 gives the Korean mean scores and column 5 gives the British standardization scaled scores for these. The sum of the scaled scores of the Korean sample is 71 and

this gives it a British IQ of 80. As with the 20-24 year olds, 2.5 IQ points need to be added to the IQ of the Korean 65-69 year olds, giving them a British IQ of 82.5. We have carried out the same calculations for the other age groups aged 25-29, 30-34, 35-44, 45-54 and 55-64. The results are summarized in Table 2.

Table 2. *British Full Scale and Index IQs of South Koreans on the WAIS-IV for seven age groups.*

Birth years	1986-1990	1981-1985	1976-1980	1966-1975	1956-1965	1946-1955	1941-1945	Difference
Age at time of testing	20-24	25-29	30-34	35-44	45-54	55-64	65-69	
British Full Scale IQ	110.5	110.5	105.5	102.5	94.5	84.5	82.5	28
British Verbal Comprehension Index	98.5	98.5	76.5	76.5	87.5	85.5	82.5	16
British Perceptual Reasoning Index	107.5	106.5	104.5	100.5	96.5	86.5	88.5	19
British Working Memory Index	110.5	110.5	107.5	102.5	97.5	91.5	88.5	22
British Processing Speed Index	124.5	126.5	119.5	116.5	107.5	91.5	86.5	38

Note. Difference = Magnitude of IQ difference between the 65-69 year olds and the 20-24 year olds.

Table 3 presents mean scores of South Koreans on the WAIS-IV for age 65-69 years and the scaled scores of these means scored using the norms of the age 20-24 year group. When scored using the norms of the 20-24 year old Koreans, the 65-69 year old Koreans obtained a full-scale IQ of 54. The decrease of 42 IQ points of Korean-scaled IQ (96-54) is much larger than the 28 IQ points of British-scaled IQ we found in Table 2. This is because the 42 IQ points are likely to include cohort effects as well as age-related decline in cognitive abilities among South Koreans. Table 4 gives the Korean scores on the WAIS IV subtests and British scaled scores and IQs for all age groups.

Table 3. *Mean scores of South Koreans on the K-WAIS IV for age 20-24 years and age 65-69 years and the scaled scores of age 65-69 years scored based on the K-WAIS IV norms of the age 20-24 year group.*

Tests/IQs	Age 20-24 S.Korean raw score (mean)	Scaled scores based on the norms of the age 20-24 year group	Age 65-69 S. Korean raw score (mean)	Scaled scores based on the K-WAIS norms of the age 20-24 year group
Block Design	53.87	9	28.93	4
Similarities	18.63	10	11.46	4
Digit Span	32.59	10	18.38	1
Matrix Reasoning	19.91	9	8.68	4
Vocabulary	34.64	10	18.23	4
Arithmetic	15.92	9	10.44	5
Symbol Search	44.10	9	18.05	1
Visual Puzzles	17.87	9	8.19	4
Information	14.97	10	8.99	8
Coding	95.56	9	36.43	1
Verbal Comprehension	-	100	-	74
Perceptual Reasoning	-	94	-	62
Working Memory	-	98	-	58
Processing Speed	-	97	-	50
Full Scale IQ	-	96	-	54

Discussion

There are six points of interest in the results. First, the data in Table 2 show that the British-scaled IQs of the Koreans declined steadily with increasing age. This shows that the Koreans had a strong Flynn effect over the half century between the births of the oldest and youngest age groups. The increase of the Korean IQ is 28 IQ points, defined by the difference between the 20-24 year olds and the 65-69 year olds (110.5 – 82.5 = 28). The 20-24 year olds were born in 1986-1990 and the 65-69 year olds were born in 1941-1945. There are therefore approximately 45 years between the two age groups, so the British-scaled IQ of the Koreans increased by 6.2 IQ points a decade over these years. To estimate the absolute increase of the Korean IQ we have to add the increase of the British IQ over this period. This is given as 2.3 IQ points a decade on the Standard and Coloured Progressive Matrices 1938-82 (Lynn and Hampson, 1986) and as 2.2 IQ points a decade on the Standard Progressive Matrices 1980-2008 (Flynn, 2012, p. 37).

Table 4. *Korean raw scores on the WAIS IV subtests and the corresponding scaled subtest scores and IQs according to British 2007 norms.*

Age	Group	Tests/IQ														
		BD	SI	DS	MR	VC	AR	SS	VP	IN	CD	VCI	PRI	WMI	PSI	FSIQ
25-	Korean	50.21	19.04	32.11	19.61	35.10	16.08	44.38	16.52	14.76	96.91					
29	British	11	7	12	11	10	11	14	10	11	15	96	104	108	124	108
30-	Korean	49.49	18.47	30.91	18.29	33.78	15.52	41.57	16.62	15.50	89.72					
34	British	11	6	11	10	9	11	13	10	11	13	74	102	105	117	103
35-	Korean	45.58	17.06	28.70	15.82	34.01	14.37	38.15	14.25	15.64	83.39					
44	British	11	6	10	9	9	10	12	9	11	13	74	98	100	114	100
45-	Korean	37.42	15.39	25.06	12.39	29.44	13.09	32.06	11.36	12.83	68.31					
54	British	10	5	9	8	8	9	11	9	9	11	85	94	95	105	92
55-	Korean	32.80	14.35	23.28	10.69	25.45	12.28	26.20	10.13	11.76	54.64					
64	British	8	5	8	7	7	8	8	7	9	8	83	84	89	89	82

Note: Korean = South Korean raw scores (mean), British = British scaled score. BD = Block Design, SI = Similarities, DS = Digit Span, MR = Matrix Reasoning, VC = Vocabulary, AR = Arithmetic, SS = Symbol Search, VP = Visual Puzzles, IN = Information, CD = Coding, VCI = Verbal Comprehension Index, PRI = Perceptual Reasoning Index, WMI = Working Memory Index, PSI = Processing Speed Index, FSIQ = Full Scale IQ.

Adding Flynn's estimate of 2.2 to the Korean increase of 6.2 IQ points relative to the British IQ gives a Korean increase of 8.4 IQ points a decade from early 1940s to late 1980s birth cohorts. This result is reasonably close to the increase of 7.7 IQ points a decade for South Koreans estimated by te Nijenhuis et al. (2012) and 7.23 IQ points a decade by Flynn (2012, p. 37).

Second, of the four Index IQs and the Full Scale IQ, the Verbal Comprehension Index (VCI) shows the smallest increase (16 points) from the 65-69 year olds to the 20-24 year olds, representing a gain of 3.56 points per decade. These results confirm Flynn's (2012, p. 37) report of a gain of 3.12 IQ points per decade on the Verbal IQ on the WISC in South Korea and many studies that have reported smaller increases in verbal than in non-verbal abilities documented in Lynn and Hampson (1986) and Lynn (1990, 2013). The increases of 19 IQ points in the Perceptual Reasoning Index (PRI) and of 22 IQ points in the Working Memory Index (WMI) are smaller than the increase of 28 IQ points in the Full Scale IQ. The increase of 38 IQ points in the Processing Speed Index (PSI) is the largest of the four Index IQs, yielding a gain of 8.4 points per decade. To the best of our knowledge, this is the first study to report this very large amount of increase in Processing Speed ability.

Third, this use of the data of the British and South Korean standardization samples of the WAIS IV demonstrates a novel way of estimating the Flynn effect. Our results are consistent with those found in previous studies based on the two traditional methods. It may be wondered whether the modification of the original items during the standardization procedure may have resulted in differences in the scores between Britons and South Koreans. To examine the possibility, we note that in the WMI, some items of the Arithmetic subtest were modified but none of the items of the Digit Span subtest were changed. This enables us to compare the outcomes of the modification. We found that of the seven age groups of South Koreans, four age groups (30-34 yrs, 35-44 yrs, 45-54 yrs and 55-64 yrs) obtained exactly the same British scaled scores in Arithmetic and Digit Span, and each of the remaining three age groups (20-24 yrs, 25-29 yrs, & 65-69 yrs) showed only one point difference in the British scaled scores between Digit Span and Arithmetic. These results suggest that the modification of items in the Korean WAIS-IV made little impact on the Flynn effect.

Fourth, the British Full Scale IQs of South Koreans were lower than those of the British among the three older age groups aged 45-54, 55-64 and 65-69 at 94.5, 84.5 and 82.5, respectively, while in the four younger age groups aged 20-24, 25-29, 30-34, and 35-44, the British IQs of the Koreans were higher than those of the British at 110.5, 110.5, 105.5, and 102.5, respectively. These results

show a larger increase of IQ in South Korea than in Britain over the period of approximately 45 years.

Fifth, four British IQs for South Korea are given by Lynn & Vanhanen (2012, pp. 24, 405) as 113, 109, 103 and 100 averaging 106 based on samples of children, and an IQ of 103.8 based on PISA data for 15 year olds for language, math and science. The present results for the four age groups of 20 to 44 year olds obtained a British IQ of 104.75 and therefore confirm the results given by Lynn & Vanhanen (2012). The present results also show that the higher IQs for South Koreans found by Lynn & Vanhanen are largely attributable to these being based on relatively recent data for children and that the IQs of middle-aged and older South Koreans are lower than those of the British.

Sixth, the large increase of intelligence in South Korea is likely attributable to the recent rapid economic development. During the 1940s and 1950s, per capita incomes in South Korea were very low and modern western education was extremely limited due to Japanese colonial rule and the Korean War. During these years, the IQ gain was only about 2 Full Scale IQ points as shown between the 55-64 and 65-69 year-old groups. The large rise of IQ began in the late 1950s and continued until the 1980s during which time there was rapid economic growth and improved education. The IQ of South Korean children started to exceed the British IQ around the late 1960s. The large increases of IQ in South Korea resemble those reported more than 30 years ago in Japan in a study showing that Wechsler IQs had increased more rapidly in Japan than in the United States (Lynn, 1982). In both countries large increases in IQ have been accompanied by large increases in years of education, economic growth, higher living standards and improvements in the quality of education, nutrition and health. More generally, the present results show that national IQs are subject to variation according to the year in which they were obtained and the age of the sample.

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