RUNNING HEAD: FLYNN EFFECT

An estimate of the Flynn effect: Evolution of the IQ of 10-year-old French children between 1965 and 1988

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Summary

The significant increase in IQ in the industrialised countries during recent decades, known as the *Flynn Effect*, tends to be given two types of explanation (Neisser, 1998). The first is based on environmental and cultural changes such as progress in schooling, urbanisation and technology. The second, which does not imply a refutation of the first, postulates an acceleration in evolution in general, quantifiable by an increase in the size and weight of the brain, partly linked to improvements in diet and health. One way of studying the problem consists of verifying in which sub-domains the evolution in IQ takes place. Using the comparison between the standardisation undertaken using 120,000 French children for an intelligence test (ECNI) in 1965 and the results of 8,640 children for the same test in 1988, this paper confirms the Flynn effect and discusses Greenfield's (1998) hypothesis that the media have induced an improvement in spatial and visual capacities to the detriment of capacities relating to vocabulary.

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Flynn (1984, 1987; cf. 1994 for a summary) synthesised a group of studies which show, over the last few decades, a spectacular increase in mental abilities assessed by classic intelligence tests. An analysis of the Weschler Test (e.g. WISC, Weschler Intelligence Scale for Children; cf. Weschler, 1991) shows an increase of 9 IQ points per generation (30 years) since 1941. It might be thought that this progression is simply due to the increasing quality of teaching and the resulting increase in general knowledge. However, since 1950, the populations of the Netherlands, Belgium, Israel and Argentina have shown an even bigger increase of 18 IQ points per generation on Raven's Progressive Matrices (cf. Raven, 1981). Flynn (1998) obtained the same result, in a regular fashion over the decades, by grouping samples from several countries having undergone the same test since 1952. This test is considered to represent a measure of abstract cognitive capacity, partly independent of the content of the school curriculum or of language (*culture-fair*), and gives a very good estimate of the intelligence factor *g*, which certain authors consider to be genetically determined, based either on studies of twinship (Burt, 1972, Wilson, 1979) or on intercultural studies whose methodologies and results are more questionable (Jensen, 1998).

If *g* is genetically determined, measuring it by intelligence tests is flawed. As Flynn often argues, according to these results, 70% of those born at the end of the 19th century would have an IQ of less than 75, which would have prevented them from correctly learning the rules of their favourite sport. It is thus very unlikely that the increase in IQ is related to a genuine intellectual advance and it is more reasonable to attribute to our near ancestors an intelligence comparable to our own. The idea that a gain in IQ points corresponds to an increase in factor *g*, non-modifiable by experience and of which the differences between

individuals is genetically determined, would appear to have little justification (Flynn, 1993). How can one, therefore, identify the precise cause of this specific capacity to do better in intelligence tests?

Sociological explanations of this effect would seem to be the most promising when the patterns of results of sub-tests are investigated in more detail (Flynn, 1998, 2003). Studies generally confirm an absence of progress for those tests whose content is purely scholastic (and even, according to Flynn, a decline for SATs, Scholastic Aptitude Tests, in the USA) and a very weak increase for verbal tests (a maximum of 10 points per generation). Between 1948 and 1989, American children gained 20 IQ points for the *Similarities* test of the WISC, a test which has little relationship to school subjects. During the same period, the tests *Information, Vocabulary, Comprehension* and *Arithmetic* showed only a slight increase (the smallest increase being for *Arithmetic*), these tests being much more closely sensitive to the school curriculum. If it was possible at the beginning of the century to invoke an improvement in schooling to explain the increase in mean IQ, it would seem that this explanation is no longer sufficient.

Explanations related to diet would also seem to be limited in scope when one takes into account the fluctuations in this factor over the last 50 years and its impact on different social categories (Neisser, 1998; Flynn, 2003). The hypothesis of an increase in the general availability of the tests or in the sophistication of the way in which professionals administer them is also inconsistent with the historical and experimental analysis of the tests. The analysis of the results seems to bring out, among a conjunction of favourable factors, an appreciable progress in visual and spatial analysis which should be attributable to the frequent and intensive stimuli provided by computers, video games and the media in general (Greenfield, 1998; cf. Subrahmanyam & Greenfield, 1994 for a review of the influence of video games on cognitive development and Subrahmanyam, Kraut, Greenfield & Gross,

2000, for the influence of computer use). Greenfield cites numerous studies which support this hypothesis, showing a positive correlation between exposure time to video games and an increase in the skills necessary to obtain a good score on the non-verbal tasks in IQ tests (e.g. Okagaki & Frensch, 1994). Greenfield (1998) emphasises the fact that improvement in intellectual level is based on training in visual tasks. Greenfield's hypothesis also fits in with the fact that verbal capacities appear to diminish at the same time. Reading, which involves more complex grammatical structures and a richer vocabulary, would appear to have been neglected in favour of media which involve a language of a mediocre level.

To our knowledge, three studies relating to advances in intellectual level in France have been published (only in French, however, which has limited their dissemination). The first, included in Flynn's (1987) analysis, is based on two samples of soldiers aged 18 to 22, carried out in 1949 and 1974 (Girod & Allaume, 1976). Unfortunately, estimation of the Flynn effect lacks precision due to a bias in the 1949 sample (Flynn, 1987). The other two published studies, involving samples of children of 8 and 7 respectively, showed an increase of 24 points in 40 years on the *Mosaïque* Test (Flieller, Saintigny & Schaeffer, 1986) and of 5 points in 19 years on the *Echelle Collective de Niveau Intellectuel* (Flieller, Manciaux & Kop, 1995).

We propose to verify Greenfield's hypothesis by checking the sub-domains in which the improvement in IQ has taken place. The sensitivity of the subjects to the media should correspond with an improvement in the sub-tests which require spatio-visual competence and a lesser improvement in tasks involving vocabulary and language.

Method

This paper will report on one of the pieces of data that allows the evolution of the IQ to be appreciated within one French department, the Oise[1] (750,000 inhabitants). In 1965, the ECNI (*Echelle Collective de Niveau Intellectuel* – Collective Test of Intellectual Level, comparable to the WISC) was given to 120,000 French schoolgirls and boys, under the aegis of the regional careers guidance inspectors. The population to be studied was chosen by means of a careful sampling programme carried out by the National Institute for Demographic Studies (*Insitut National des Etudes Démographiques*, INED) and the National Institute for the Study of Work and Careers Guidance (*Insitut National du Travail et d'Orientation Professionnelle, INETOP)*. This population thus forms a very reliable basis for standardisation (the results of the study are published in INED & INETOP, 1969). In 1988, a study of 8,640 children aged 10 (born in 1978), that is approximately 90% of the ten-year-olds in the department of the Oise, was carried out by the academic authorities (with the help of a team of 60 people, educational psychologists, counsellors and secretaries of commissions for special needs teaching), using section III of the ECNI adapted to that population. The ECNI consists of four verbal and four non-verbal sub-tests. The 60 high-school catchments of the department were represented as well as nearly all the primary schools that feed them. The test used was the same as that given to the 120,000 French children studied in 1965.

The objective of this article is to analyse both the overall increase in mean IQ, and the specific evolution within the eight sub-tests of the ECNI. The comparison is based on the standardisation carried out for the sector which groups together the Picardy and Champagne Regions, of which the Oise is part, since the number of schools from the Oise visited in the 1965 study was insufficient to carry out a standardisation.

Results

Comparison in relation to the Picardy-Champagne sector in 1965

In the ECNI, the IQ is obtained by the transformation of a raw score which is itself the sum of two sub-totals corresponding to the verbal and non-verbal tests. Mean IQ was fixed at 100 during standardisation and the standard deviation at 15. The 1965 study had sociological rather than psychological aims and, despite the substantial resources deployed and the voluminous analysis of the results, the only information available for the Picardy-Champagne sector relates to total IQ (mean = 96.5; standard deviation = 14.1). It is known that the verbal and non-verbal tests contribute to this figure in equal measure, and that the sub-tests contribute equally to the total for each of these two tests, this being guaranteed by the construction of the test.

The mean results for the verbal and non-verbal tests and the global IQ obtained by the children from the Oise in 1988 are given in Table 1, together with the global reference IQ for children from the Picardy-Champagne sector from 1965. The increases are very significant for the two tests for both girls and boys. Taking girls and boys together, the pupils from the Oise in 1988 have a mean IQ of 102.5. The difference is spectacular in comparison to the mean IQ of 96.5 in 1965. In 23 years, 6 IQ points have been gained, which corresponds approximately to the estimate for the Flynn effect of 3 points per decade for the WISC, according to the data cited in the introduction to this paper.

Insert Table 1 about here

Comparison of verbal and non-verbal tests and analysis of sub-tests

In Table 1, it may be noted that girls are globally superior to boys for the two tests. As shown in Table 2, there is a frequency bias due to the greater number of boys who show backwardness at school[2], which explains the superiority of the girls. It appears that keeping a child in a class of younger children leads to under-stimulation which leads in turn to a deterioration in IQ[3].

In accordance with the findings of Flynn (1998), the improvement is much more spectacular for non-verbal IQ than for verbal IQ. The first gains 7.5 points and the second 4.5 points. Table 3 shows the results for each sub-test on the verbal and non-verbal tests. According to the standardisation carried out in 1965, the reference score for each of the sub-tests is 5. The sub-test showing the biggest improvement is that involving matrices, which reinforces Greenfield's (1998) hypothesis that the improvement is essentially related to an increase in spatio-visual capacities, also implicated in the Raven matrices. Again in agreement with Greenfield (1998), an impoverishment is observed in vocabulary, where scores actually fall, and a very weak improvement in verbal comprehension.

Insert Table 2 about here

Insert Table 3 about here

Discussion

The Flynn effect is generally described by a phrase such as: "the level rises". Our results show that this description is only approximate and that in fact, "the level changes", and this only in part. The increase in IQ between 1965 and 1988 for a sample of 8,640 French ten-year-old children conforms with the expectation of an increase of approximately 3 points per decade for an industrialised country and for an intelligence test (ECNI) comparable with that of Weschler. This study shows the unquestionable improvement in spatio-visual analysis: the most noticeable improvement concerns the non-verbal sub-test *Matrices* (the sub-test *Analogies* also shows significant improvement and also has a significant spatio-visual component). This fact tends to confirm Greenfield's theory of an increase in intellectual level essentially related to an improvement in spatio-visual performance. This phenomenon is accompanied by a regression for the vocabulary test, also compatible with Greenfield's theory of an impoverishment of capacities relating to vocabulary due to the mediocre level conveyed by the visual media and the strong representation of these media compared to reading. This result also parallels the decline shown by Flynn in the results of SATs, because SATs put a particular emphasis on the level of vocabulary of subjects.

It is, however, regrettable that this research does not allow an item-by-item analysis using item response theory (Baker, 1985), due to the fact that it is impossible to completely recuperate the data from 1965. These models should be used in the future in order to find out whether an improvement in performance observed for certain sub-tests also conceals an improvement in a given competence. In fact, in this study it is impossible to separate the measure of competence (representing the factor *g*) and that of performance, performance depending on competence but also on additional factors which can be favoured for a given cohort of subjects. Item response models would have made it clear whether the improvement in performance in the Matrices sub-test is related to an increased facility for the sub-test for

the 1988 cohort, given children of equal competence. If the structure of the items in the Matrices sub-test was of equivalent difficulty for equivalent competence, the improvement in performance on Matrices would be related to an increase in factor *g*.

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Footnotes

[1] A complementary source of information may be obtained from the study reported by Lynn (1988) carried out on the population of military conscripts in the 1950's, which shows that the Oise is completely representative of the situation in France (the author gives data for all the French departments). The Oise obtains a weighted score of 10.1 against a national mean of 10.5. We therefore draw the hypothesis that the representativeness of the department had not changed much in two decades and that it is legitimate to compare the results of children from the Oise in 1988 with the standardisation of the ECNI established for the whole of France during the 1965 study.

[2] Backwardness at school results from a policy of making children repeat years that is specific to a certain number of countries, including France. This practice, which is tending to become rarer given its limited effect, is now only observed at the end of each of the three primary school cycles.

[3] This phenomenon is similar to that observed in relation to a child's position in his family (whether he is the oldest of several children) and his IQ (Zajonc, 1976). Zajonc showed that intelligence can be affected by position in the family: first-born children have an advantage over the others because they spend more time in the company of mature people (i.e. their parents) than with their brothers and sisters, who are less intellectually stimulating because of their age. Here, children who repeat a year at school spend the majority of their time with children and class activities which give them insufficient stimulation. If this bias is neutralised by removing from the sample boys who have repeated one or more years, the apparent inferiority of the boys disappears.

Table 1

Verbal and non-verbal IQ on the Collective Scale of Intellectual Level (ECNI) of 8640 ten-year-old children in the department of the Oise, France, in 1988, compared with the mean IQ of children from the corresponding Picardy-Champagne region in 1965.

	IQ-NV	IQ-V	Total IQ
Girls 1988	**109**	**102,5**	**104**
	(57)	(27)	(34)
Boys 1988	**106**	**100,5**	**101**
	(45)	(2)	(2)
Girls and Boys 1988	-	-	**102,5**
			(40)
Girls and Boys 1965	**-**	**-**	**96,5**

Legend : IQ-NV, non-verbal IQ; IQ-V, Verbal IQ; In brackets is the number of standard errors in relation to the 1965 standardisation. For a sample of 8,640 subjects, the standard error in relation to the mean of the reference population (M = 96.5; s = 14.1) is $14.1/\sqrt{8640} \approx 0.15$. It is $14.1/\sqrt{4192} \approx 0.22$ for the girls and $14.1/\sqrt{4448} \approx 0.21$ for the boys.

Table 2

Characteristics of backwardness and IQ for 8640 ten-year-old children from the department of the Oise, France, in 1988.

		School level				
		0-RET	*1-RET*	*2-RET*	*3-RET*	Total
Girls	*N*	3192	806	187	7	4192
		76.14%	19.23%	4.46%	0.17%	100%
	QI	**108**	**94**	**90**	**80**	
Boys	*N*	3111	1088	240	9	4448
		69.94%	24.47%	5.39%	0.2%	100%
	QI	**108**	**96**	**90**	**77**	

Legend. *0-RET* (the child has not repeated any years and is in the final year at primary school); *1-RET* (one year repeated); *2-RET* (two years repeated); *3-RET* (three years or more behind).

Table 3

Scores on the eight sub-tests of the Collective Scale of Intellectual Level (ECNI) for 8640 ten-year-old children from the department of the Oise, France, in 1988.

	Non-verbal test				Verbal test			
	DIF	INT	MAT	SER	APP	VOC	COM	ANA
Boys	5.49	6.82	7.86	4.92	6.63	4.72	5.39	6.71
Girls	5.44	6.81	8.13	4.68	6.86	4.77	5.42	7.14

Legend. DIF, Differences; INT, Odd-one-out; MAT, Matrices; SER, Series;

APP, Membership; VOC, Vocabulary ; COM, Comprehension ; ANA, Analogies.