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An Increase of Intelligence in Libya from 2006 to 2017

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Results are reported for intelligence of 6 to 11 year olds in Libya on the Coloured Progressive Matrices assessed in 2006 and 2017. Increases of CPM mean raw scores translate into a gain of 2.8 IQ points over the 11 years, or 0.25 points a year. Gains were seen mainly at the older ages, suggesting that they are caused by improvements in the educational system rather than by factors acting on preschool children. There was no difference between the IQs of girls and boys.
Key Words: Intelligence; Coloured Progressive Matrices; Libya; Sex differences; Flynn effect

Secular increases in intelligence, known as the Flynn effect, have been reported since the early years of the twentieth century in numerous studies from many countries. The studies have been reviewed in Flynn (1984, 1987, 2012) and Lynn (2013). A meta-analysis of 285 studies reported a mean increase of 2.31 IQ points per decade (Trahan et al., 2014), and a similar meta-analysis of 271 independent samples found average gains of 4.1, 3.0, 2.8 and 2.1 points per decade on tests of fluid, spatial, full-scale and crystallized intelligence, respectively (Pietschnig & Voracek, 2015). Most of these gains have been reported for economically developed countries but there have been two studies in the Middle East. The first of these reported an increase of 11.7 IQ points for 8-15 year olds in Saudi Arabia assessed by the Standard Progressive Matrices from 1977 to 2010. This represents a gain of 3.55 IQ points a decade over the 33-year

period (Batterjee et al., 2013). The second reported intelligence gains of 4.3 IQ points from 1999 to 2013 in a sample of 10-11 year old deaf boys assessed with the Coloured Progressive Matrices in Saudi Arabia, representing a gain of 3.1 points a decade (Bakhiet, Barakat & Lynn, 2014). In the present paper we report data showing a recent increase of intelligence in Libya.

Method and sample

The study used the Coloured Progressive Matrices (CPM) test (Raven, 2008), which assesses visual comprehension and non-verbal reasoning ability. The test was administered in January and February, 2006, to a sample of 600 children consisting of 100 pupils in each of first to sixth grades (ages 6 years through 11 years). The results have been reported by Lynn, Abdalla and Al-Shahomee (2008). The sample was randomly selected from seven elementary schools in the large city of El-Beida, four elementary schools in the small city of Shahat, and 9 villages, selecting one school in each village. Children in Libya begin school at the age of 6 years and boys and girls are educated together. This ensures that the boys and girls are matched for educational experience and family background. The sampling procedure comprised a multi-stage random sampling method (cluster sampling).

In the present study the CPM was administered in January and February 2017 to a representative sample of 903 children (466 boys and 437 girls) in each of first to sixth grades (ages 6 years through 11 years) who were randomly selected from cities and villages in three Libyan regions: west, east and south. All of them were Libyan citizens. The sampling procedure comprised a multi-stage random sampling method (cluster sampling). In cluster sampling, intact groups, not individuals are randomly selected. All members of selected groups had similar characteristics. Cluster sampling is more convenient when the population is large or spread out over a wide geographic area and is defined by Denscombe (1998) as a sampling method that involves selecting samples from samples, each sample being drawn from within the previously selected sample.

The procedure for conducting the multi-stage stratified sampling method involved sampling from all higher level units called the preparatory sampling units (western, eastern and southern Libyan regions) and then sampling of secondary sampling units from within these higher-level units (cities and villages). This was followed by classifying the cities into two homogeneous urban area clusters using the criterion of administrative boundaries as the third sampling level, i.e. main and secondary cities. The researcher selected one city from each category. In addition, villages were classified into three different categories (third clustering sampling level): coastal, desert and mountain villages. Three villages were

selected from each category with different weights or ratios as the fourth sampling level.

The CPM was modified as follows. Instructions were given in the colloquial Libyan Arabic language; English letters (A, B, and C) in the three sets were changed into Arabic letters; page orders in the test booklet were changed from left to right, to suit the Arabic way of writing and reading; a new answer sheet was designed with Arabic letters and with right to left answers.

Results

The reliability of the CPM test scores was investigated and showed that the split-half reliability was 0.899 (0.897 for girls and 0.907 for boys). The Pearson product-moment correlation coefficient was used to calculate the construct validity assessed as the internal consistency given by the correlation coefficients between CPM test total score and the three CPM test sets (Anastasi & Urbina, 1997). The results showed that there were strong and statistically significant positive correlation coefficients of each of the three sets (A, B and C) with total scores, ranging from 0.738 to 0.892.

Table 1. *Coloured Progressive Matrices scores for Libya in 2006 and 2017: sample size (N), mean raw score ± standard deviation, British-scaled IQ, raw score gain scaled as standard deviation units (d), and IQ gain.*

Age	Sex	CPM 2006			CPM 2017			d	IQ gain
		N	Mean ± SD	IQ	N	Mean ± SD	IQ		
6	Boys	50	20.9 ± 5.54	98	56	21.6 ± 6.53	100	0.12	1.8
	Girls	50	20.8 ± 4.61	98	48	20.3 ± 5.92	96	-0.08	-1.3
7	Boys	50	21.8 ± 6.16	88	65	21.0 ± 5.63	86	-0.14	-2.2
	Girls	50	22.0 ± 5.81	89	58	21.4 ± 4.79	87	-0.10	-1.6
8	Boys	50	22.0 ± 5.97	79	74	22.2 ± 5.42	80	0.03	0.5
	Girls	50	21.4 ± 6.02	77	60	22.2 ± 5.67	80	0.14	2.2
9	Boys	50	22.2 ± 5.92	80	90	23.9 ± 5.41	84	0.28	1.3
	Girls	50	22.8 ± 6.58	80	83	24.3 ± 5.77	85	0.25	3.8
10	Boys	50	22.8 ± 6.23	75	95	27.7 ± 5.40	88	0.80	12.0
	Girls	50	24.3 ± 7.12	80	98	26.3 ± 5.74	85	0.33	4.9
11	Boys	50	24.9 ± 6.55	71	86	27.2 ± 5.57	77	0.39	5.8
	Girls	50	25.8 ± 6.58	73	90	27.0 ± 5.21	76	0.20	3.3
All	Boys	300	22.43 ± 6.01	81.8	466	23.93 ± 6.18	85.8	0.25	3.8
	Girls	300	22.85 ± 6.34	82.8	437	23.58 ± 6.01	84.8	0.12	1.8
	Total	600	22.64 ± 6.18	82.3	903	23.76 ± 6.10	85.3	0.18	2.8

The results are summarized in Table 1. This gives for the 2006 and the 2017 samples for each age and sex the numbers, mean CPM scores and standard deviation, IQ according to British 2007 norms (Raven, 2008), standardized raw score differences (*d*), and differences in IQ points calculated from the *d* values. The right hand column gives the change in the British-scaled IQs between the two sets of data.

Discussion

The results show five interesting features. First, the CPM mean scores are 22.64 for the 2006 sample and 23.76 for the 2017 sample showing an increase of 2.8 IQ points over the 11 years and therefore an increase of 0.255 IQ points a year. This increase is comparable to the mean gain of 0.231 IQ points a year reported in the meta-analysis by Trahan et al. (2014). As has been proposed for Flynn effects in Western countries (Flynn, 2007), these IQ gains are likely attributable, at least in part, to improvements in education. In 2008, the Libyan Ministry of Education decided to change the curriculum used in pre-university levels of education, and Singapore's curriculum was adopted. This curriculum is considered to be one of the most powerful approaches to develop reasoning skills and promote problem solving abilities in students (Deng, Gopinathan & Lee, 2013), and it may explain the increases of IQ in Libya from 2006 to 2017. However, while this change has occurred, other aspects in the field of education have not shown positive developments. There still are obvious deficiencies in teaching skills among teachers. Class size averages 30 or more students per teacher. Many school buildings and facilities were deemed outdated and inappropriate for carrying out the teaching process. This reached a maximum of about 70% of schools in some places. Up-to-date computer programs are not available in 89% of the schools (Al-Shahomee, 2010).

Second, the IQs obtained for Libya in both samples are closely similar to the median IQ of 83.8 for 26 studies that have been done in North African countries given in the compilations of national IQs worldwide in Lynn and Vanhanen (2012) and Lynn (2015).

Third, relative to British norms, in both the 2006 and the 2017 samples the youngest children aged 6 years performed best with IQs close to 100, and IQs declined to less than 80 among 11-year-olds. This decline with age has been reported in other Middle East countries including Syria and the United Arab Emirates (Khaleefa & Lynn, 2008a,b). One possible explanation for this decline is that it has been shown by Lynn, Allik and Irwing (2004) that the initial items in the CPM and the SPM tests measure visualization ability, while the later items measure abstract reasoning ability. The 6- and 7-year-olds are scored mainly on

the initial visualization items because the abstract reasoning items are too difficult for them. The older children aged 10 and 11 are scored mainly on the abstract reasoning ability items because the visualization items are so easy that they mostly get them all right, so the visualization items are largely a constant that is added to their scores on the abstract reasoning ability items. A second possible explanation for the decline is that education in the Middle East does not develop abstract reasoning ability as effectively as does education in Britain. Teachers may be less well trained, and children have less experience tackling reasoning tasks in school and taking intelligence tests. It may be that the solution to this problem would be for teachers in Libya to devote more attention to teaching reasoning skills.

Fourth, gains between 2006 and 2017 were not evident in children aged 6 and 7 years, but were more substantial in the older age groups. For ages 9, 10 and 11 combined, the gains averaged 5.7 IQ points or 5.2 points per decade. It is therefore evident that the environmental improvements that have caused rising Raven scores in Libya during this time are unlikely to be found in the preschool environment to which children are exposed in the family and community. Improvements in nutrition and health, which have been proposed as causes for Flynn effects (Lynn, 1990, 2009), would produce gains at younger as well as older ages and are therefore unlikely causes. The observed pattern points to environmental effects acting *after* children have entered school. Because schooling is already known to be a major determinant of cognitive ability (Ritchie & Tucker-Drob, 2017), improved schooling is the most likely cause of the observed gains.

Fifth, there are no consistent differences in the IQs of the boys and girls. This result confirms studies from Western countries given in a meta-analysis by Lynn and Irwing (2004) and for children in Syria (Khaleefa & Lynn, 2008a), although in the United Arab Emirates girls scored slightly higher than boys (Khaleefa & Lynn, 2008b). These are interesting results because it is sometimes suggested that there is discrimination against girls in traditional societies and this impairs their intellectual development, and that as females have become more emancipated and gained greater equality in economically developed Western nations, their cognitive abilities relative to males have improved. For example, Mackintosh (2011, pp. 378-80) has stated that in successive American standardizations of the DAT (Differential Aptitude Test) "there has been a consistent and substantial decline in male superiority on the two spatial tests, and the complete disappearance (or even reversal) of the earlier male superiority on tests of abstract, verbal and numerical reasoning." He concluded his discussion of this issue stating that "at least some cognitive differences have diminished in the past

50 years or more" and attributed this to "substantial changes in society's attitude to women since the 1960s". Flynn (2012, p. 184) has also contended that the former higher average abilities of males have disappeared in recent decades: "There is strong evidence that females match males on Raven's Progressive Matrices even at maturity, unless their societies have not undergone modernity, as in developing nations, or women have been shielded from the effects of modernity (like Orthodox women in Israel)." This theory receives no support from the present results showing that girls and boys perform equally well on non-verbal reasoning ability in Libya.

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