# Intelligence and Family Size in Libya

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The Standard Progressive Matrices (SPM) was administered to a sample of 720 school students aged 13 to 18 years (mean age 15.5 years) in Libya. The results show (1) males obtained higher scores than females in all age groups although none of these is statistically significant; (2) the sample obtained a British-scaled IQ of 82.3; (3) there was a negative correlation between SPM scores and number of siblings of -.421. This may indicate less favorable conditions for intellectual development in larger families, or differential reproduction favoring less intelligent parents. Assuming differential reproduction by intelligence is the mechanism, the decline of genotypic intelligence can be estimated as approximately 2.75 IQ points a generation.
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The possible genetic deterioration of the populations of the Western nations began to be discussed in the middle decades of the nineteenth century. In France, the physician Benedict Morel (1857) noted that infant and child mortality were declining, largely as a result of improvements in public health. He argued that a consequence of this was that many infants and children who would previously have died were now surviving to adulthood and having children. These survivors, he argued, were predominantly those with poorer *physique* (health), *intellectuelle* (intelligence) and *morale* (moral character). Morel believed that these characteristics are transmitted in families from parents to children, through both genetic and environmental processes. Thus, he argued, the increased survival rate of those with poorer *physique*, *intellectuelle* and *morale* must entail a deterioration of the population's genetic quality for these three characteristics.

In the next decade, Francis Galton (1865, 1869) identified the same problem in Britain, although he did not cite Morel's work and was presumably not aware of it. Galton had read his half-cousin Charles Darwin's (1859) *Origin of Species* and noted that natural selection normally operates against those with poor health, low intelligence and weak moral character. He adopted the same argument as Morel that the decline of infant and child mortality entailed a relaxation of natural selection against those with poor health, low intelligence, and weak moral character. In his book *Hereditary Genius* (1869), Galton went further than Morel in arguing that the positive association between desirable qualities and fertility that had been present in previous times had turned negative. He wrote that in the early stages of civilization what he called "the more able and enterprising men" were the most likely to have children, but in older civilizations, like that of Britain, various factors operated to reduce the number of children of these and to increase the number of children of the less able and enterprising. He wrote that the effect of this was that "there is a steady check in an old civilisation upon the fertility of the abler classes: the improvident and unambitious are those who chiefly keep up the breed. So the race gradually deteriorates, becoming in each successive generation less fit for a high civilisation" (Galton, 1869, p. 414). He thought this was a serious problem and some years later, he proposed the term *eugenics* to denote measures designed to counteract genetic deterioration, such as providing financial incentives for those with desirable characteristics to have more children (Galton, 1873). The term *dysgenics* to denote the genetic deterioration that Morel and Galton argued was taking place was proposed in World War One by the British physician Caleb Williams Saleeby (1915), who argued that those who were being killed in the war were predominantly more healthy and intelligent than non-combatants, and hence that the genetic quality of the population was being impaired.

In the early decades of the twentieth century increasing numbers of biological and social scientists accepted Galton's thesis that dysgenic processes were at work in contemporary Western societies. Most of the concern was focussed on intelligence, and with the development of intelligence tests, studies began to be carried out to examine whether there was an inverse relation between intelligence and fertility, and hence whether a decline of intelligence was taking place. These studies were of two kinds. The first kind examined the relationship between IQ and number of siblings. These studies were carried out mainly on schoolchildren, first in the United States by Lentz (1927), then Britain by Cattell (1937), Thomson (1946) and Burt (1952), and subsequently in New Zealand (Giles-Bernardelli,1950) and Greece (Papavassiliou, 1954). Seventeen of these studies have been summarized in Lynn (2011) and showed that the correlation between IQ and number of siblings was invariably negative, i.e. the higher a child's IQ, the fewer the number of his or her siblings.

Lentz (1927), Cattell (1937), Thomson (1946) and Burt (1952), who collected these data from the 1920s onwards, argued that children's IQs are on average the same as those of their parents. Hence, they argued that the negative correlation between children's IQs and their number of siblings implied that there is also a negative correlation between adults' IQs and their number of children, i.e. couples with low IQs must be having larger numbers of children, entailing the negative correlation found among children between their IQs and their number of siblings. They argued this implies that the intelligence of the population must be declining and they calculated that the rate of decline was approximately 2 IQ points a generation. It has sometimes been objected that a plausible explanation for the observed correlation is that the environmental conditions are worse in large than in small families. Evidence against this theory has been presented by Rodgers (2001), who argues that a more probable explanation is that low-IQ couples use contraception less efficiently and consequently have more children, with the effect that larger sibship size is statistically associated with lower intelligence of the children. However, the issue remains contentious, and others (e.g., Michalski & Shackelford, 2001; Zajonc, 2001) continue to insist on the importance of family environment.

This problem is avoided in a more straightforward method for determining whether intelligence is declining which is to examine the relationship between the intelligence of adults and their number of children. The decade of the 1960s saw the appearance of the first adequately sampled American studies on this issue. The first of these was carried out by Higgins et al. (1962) on a sample in Minnesota born between 1910 and 1928. The initial sample consisted of approximately 2,032 mothers and fathers, and 2,039 of their children, for all of whom there were intelligence test results. The correlations between intelligence and number of children were negative for both fathers (-.08) and mothers (-.11), indicating that more intelligent adults had fewer children. Both correlations are statistically significant, indicating significant dysgenic fertility for both males and females. Subsequent studies in the United States produced conflicting results. Bajema (1963, 1968) and Waller (1971) found positive associations between intelligence and number of children but these were on un-representative samples. Studies by Osborne (1975), Vining (1982, 1995), van Court & Bean (1985), Retherford & Sewell (1988), Lynn & van Court (2004) and Meisenberg (2010) all reported negative relations between intelligence and number of children in the United States.

Studies of this issue in Europe have also found a negative association between intelligence and number of children. A study by Maxwell (1969) reported results for a sample of 517 adults in Scotland. For the men there was a negative association between intelligence and number of children, but this trend was not present among the women. Nystrom et al. (1991) reported a positive relationship between intelligence and fertility among men and a negative relationship among women in Sweden. A recent review of 17 studies, the majority from the United States, has shown that the correlation between IQ and number of children is -.197 for women and -.077 for men (Reeve, Heeney & Woodley of Menie, 2018). These results confirm most previous studies in showing that dysgenic fertility is greater for women than for men in modern societies. The negative correlations obtained in these studies typically are smaller, and sometimes much smaller, than the correlations that are usually observed between children's IQ and the number of their siblings.

There have been three studies of the relationship between intelligence and fertility in economically developing countries. The first was by Meisenberg et al. (2005). It reported data from the Caribbean island of Dominica and found that the correlation between the IQ of adults and the number of their children was slightly positive ($r = .06$) for men, while for women it was negative ($r = -.163$). Thus on this island at this time in history, fertility was slightly eugenic for men but more strongly dysgenic for women. The second is a study in Kuwait reporting a correlation of -.05 between intelligence tested with the Standard Progressive Matrices and family size in a sample of 4,643 8-15 year olds (Abdel-Khalek & Lynn, 2008). This very low correlation indicates that there was no or not much dysgenic fertility for intelligence in Kuwait, and/or that large family size did not adversely affect children's intelligence in this country. The third is a study of a sample of 592 16-year-old school students in Libya reporting a correlation of -.14 between Standard Progressive Matrices scores and number of siblings, also indicating only marginal dysgenic fertility and/or little effect of family size on the development of children's intelligence (Al-Shahomee, Lynn & Abdalla, 2013). We report here a further study of the relation between intelligence and family size in Libya.

## Method

The study used the Standard Progressive Matrices (SPM) (Raven, 1981) for the measurement of intelligence. The test was administered in January and February 2017 to a representative sample of 720 school students (360 boys and

360 girls) in seventh to twelfth grades (ages 13 years through 18 years; mean age 15.5) who were randomly selected from cities and villages in the east Libyan region. 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 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 (eastern Libyan regions) and then sampling of secondary 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 Standard Progressive Matrices (SPM) test was modified to make it suitable for the Libyan sample. The modifications were (1) instructions were given in the Arabic language; (2) English letters (A, B, C, D and E) in the five sets were changed into Arabic letters; (3) page order (direction) of the test booklet was changed from left to right, as in the Arabic way of writing and reading; (4) a new answer sheet was designed with Arabic letters, and right to left direction for answering and writing.

The analysis was carried out in the following manner: (1) Kolmogorov–Smirnov, Shapiro–Wilk test and normal probability plots were used to determine the normality of the data; (2) reliability of SPM test scores was investigated using Alpha (KR-20) method; (3) validity (internal consistency) of SPM test scores was calculated using the Pearson product-moment correlation coefficient; (4) partial correlations (controlled for age) were used to examine continuous variable correlational relationships between SPM test scores and family size; (5) two-way analysis of variance was used to compute differences between SPM test means in regard to family size and gender variables.

## Results

The data were first examined for normality using the Kolmogorov–Smirnov and Shapiro–Wilk tests. The p values were .320 and .234, respectively. Both values were above .05, indicating that the data were normally distributed. This allowed the use of parametric tests to investigate and evaluate the presence of statistically significant differences in the data. The reliability of the SPM test scores was investigated and showed that alpha reliabilities (KR-20) for the SPM ranged from .87 (males aged 15) to .94 (males aged 17). The Pearson product-moment correlation coefficient was used to calculate the construct validity assessed as the internal consistency given by the correlation coefficients between SPM test total score and the five SPM test sets (Anastasi & Urbina, 1997). The results showed that there were strong and statistically significant positive correlation coefficients between the five sets (A, B, C, D and E) and total scores, ranging from .53 to .84 ($p<.01$) for males and .71 to .85 ($p<.01$) for females.

The family size differences were examined by two-way ANOVA. Participants were divided into male and female groups. There was a statistically significant main effect for family size, $F(8, 702) = 36.7$, $p = .000$. The interaction effect between family size and gender is not statistically significant, $F(8, 702) = 1.389$, $p = .189$. The magnitude of the effect size is medium (partial eta squared = .325), with the exception of higher mean scores for smaller family size. Levene's equality test is not significant indicating that the group variances can be considered to be equal.

Table 1 gives the scores for males and females on the Standard Progressive Matrices followed by the sex difference (*d*, the differences in standard deviation units), the t values and British-scaled IQs of the sample. None of the differences between the scores of the males and females in the six age groups is statistically significant but the higher score obtained by males is statistically significant in the total sample. The British-scaled IQs have been calculated by converting the SPM scores to SPM Plus scores using Table SPM3 in Raven, Raven and Court (2000) and entering the British IQs in the 2008 standardization given in Table A1 in Raven (2008).

Table 2 gives the SPM mean scores for family size from 1 to 9+. The results show that children in one-child families had the highest mean score and that the scores declined in successive family sizes. The partial correlation with age controlled between SPM score and family size is -0.421 and is statistically significant at $p<.001$.

**Table 1.** *Descriptive statistics of Standard Progressive Matrices scores: sample size (N), mean raw score ± standard deviation, sex difference d as standard deviation units, t statistic for sex differences, and British-scaled IQ.*

| Age | Male | | Female | | *d* | t | British IQ |
|---|---|---|---|---|---|---|---|
| | N | Mean ± SD | N | Mean ± SD | | | |
| 13 | 60 | 38.7 ± 4.8 | 60 | 37.1 ± 4.9 | 0.33 | 1.75 | 79 |
| 14 | 60 | 39.8 ± 4.6 | 60 | 39.3 ± 3.1 | 0.13 | 0.85 | 84 |
| 15 | 60 | 40.5 ± 4.6 | 60 | 40.0 ± 3.9 | 0.12 | 0.66 | 84 |
| 16 | 60 | 40.2 ± 4.6 | 60 | 40.0 ± 4.7 | 0.04 | 0.14 | 84 |
| 17 | 60 | 40.8 ± 3.1 | 60 | 40.3 ± 7.5 | 0.09 | 0.71 | 80 |
| 18 | 60 | 43.0 ± 5.1 | 60 | 41.8 ± 5.8 | 0.22 | 1.24 | 83 |
| Total | 360 | 40.50 ± 4.7 | 360 | 39.75 ± 5.7 | 0.14 | 2.58 | 82.3 |

**Table 2.** *SPM scores in relation to family size in Libya.*

| Family size | Children | Age mean | Mean score ± SD |
|---|---|---|---|
| 1 | 29 | 15.40 | 54.00 ± 3.23 |
| 2 | 36 | 15.67 | 44.89 ± 4.25 |
| 3 | 88 | 15.55 | 42.99 ± 4.34 |
| 4 | 124 | 15.60 | 41.51 ± 3.97 |
| 5 | 130 | 15.76 | 40.70 ± 3.84 |
| 6 | 106 | 15.53 | 38.79 ± 3.65 |
| 7 | 71 | 14.97 | 37.70 ± 3.83 |
| 8 | 84 | 15.40 | 37.37 ± 4.00 |
| 9+ | 52 | 14.90 | 35.10 ± 4.23 |

The magnitude of the generational decline can be calculated from these results by the method of Lentz (1927), Cattell (1937), Burt (1946) and Thomson (1946) summarized in the introduction. The mean score of the sample is 40.495. This is assumed to be the mean score of the parental generation. The mean score of the children's generation is calculated as the score of each child plus the same score assigned to the child's siblings. The average of the siblings is assumed to be the same as the score of the tested child. The mean IQs of all these untested siblings is calculated by weighting each child's IQ by the number of children in the family and the number of families of this family size. This gives a mean score of 39.094. The difference between the two scores is 1.401. With an average standard deviation of about 3.8, the difference is about 5.5 IQ points.

The rate of decline of genotypic intelligence can be estimated as the product of the rate of decline and the narrow heritability of intelligence in Libya. The narrow heritability of intelligence in Libya is not known but Bouchard (1981) gives a correlation for the IQs of siblings of approximately 0.25 indicating a narrow (additive) heritability of 0.5 (50%). On the basis of this assumption, the decline of genotypic intelligence in Libya can be estimated at approximately 2.75 IQ points a generation (5.5 x 0.5 = 2.75). This is an upper-bound estimate that assumes no differences in the quality of environmental conditions between children in large and small families. The genotypic decline is smaller than calculated if environmental conditions for cognitive development are better in small than in large families.

## Discussion

There are four points of interest in this study. First, the SPM scores given in Table 1 show that in all six age groups males obtained higher scores than females although none of these is statistically significant. The higher scores obtained by males than females in the 16 to 18 year olds is compatible with the results of a meta-analysis of sex differences on the Standard Progressive Matrices by Lynn and Irwing (2004). Second, the mean British-scaled IQ of the six age groups given in Table 1 is 82.3. This is broadly comparable to the IQ of 84.6 for Libya given by Lynn & Vanhanen (2012) in their compilation of national IQs.

Third, the results confirm the previous study of 16-year-old school students showing a negative correlation of -.14 between intelligence and number of siblings in Libya reported by Al-Shahomee, Lynn and Abdalla (2013). However, the present study found a substantially higher negative correlation of -.421. This suggests increasing dysgenic fertility during the 9 years between the two studies carried out in 2008 and 2017. One possible reason is that there was rapid adoption of contraceptive use among more intelligent couples in Libya in recent years, and that this resulted in a steeper fertility gradient. Table 2 implies a high fertility rate in our sample. For example, only 65 of the 720 children were from one-child and two-child families. Dysgenic fertility typically increases during the early stages of the transition from natural fertility to controlled fertility (e.g., Skirbekk, 2008), and this is likely taking place in eastern Libya today.

Fourth, the present study confirms the three previous studies in showing the presence of dysgenic fertility for intelligence in economically developing countries. Earlier research had shown that a negative correlation between education and fertility is near-universal worldwide, including in developing countries (Meisenberg, 2008). The present result, together with results from other countries, suggests that also the relationship between cognitive skills and fertility is usually negative in developing countries.

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