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# SEX DIFFERENCES ON THE PROGRESSIVE MATRICES: SOME DATA FROM HONG KONG

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**Summary.** There has been a debate between N. J. Mackintosh and the first author of this paper on whether the sex difference on the Progressive Matrices is zero or, at most, 1–2 IQ points in favour of either sex, as maintained by Mackintosh, or whether from the age of 15 years onwards males obtain higher average scores than females by more than 2 IQ points, as maintained by Lynn. New data relevant to this controversy are presented from Hong Kong consisting of sex differences on the standardization sample of the Advanced Progressive Matrices on 15- to 18-year-olds. The results are that males obtained a higher mean score than females of 1·6 raw score points, equivalent to an advantage of 3·2 or 4·1 IQ points, according to two alternative methods of calculation. The results provide further confirmation that in later adolescence and among adults, males obtain significantly higher mean IQs on the Progressive Matrices than females.

## Introduction

This paper presents further data bearing on the debate between N. J. Mackintosh (Mackintosh, 1996, 1998) and the first author (Lynn, 1994, 1998, 1999) on sex differences on Raven's Progressive Matrices. The interest of this debate is that the Progressive Matrices is a particularly and perhaps a uniquely important kind of intelligence test. It is widely accepted as the best test, or one of the best tests, of abstract or non-verbal reasoning ability, which is itself the essence of 'fluid intelligence'. Mackintosh (1996, p. 564) considers that abstract reasoning ability and 'fluid intelligence' (Gf) can be equated with 'general intelligence' and that the Progressive Matrices is 'the paradigm test of non-verbal, abstract reasoning ability'. Thus the issue of sex differences on the Progressive Matrices becomes crucial to the more general issue of whether there is a sex difference in 'general intelligence'.

For many decades the consensus view has been that there is no sex difference, or at any rate only a negligible sex difference, on either general intelligence or on the Progressive Matrices. This view was advanced in the first decade of the twentieth century by Terman (1916, pp. 69–70) on the basis of his American standardization

sample of the Stanford–Binet test on approximately 1000 4- to 16-year-olds. In this sample girls obtained a slightly higher average IQ than boys but 'the superiority of girls over boys is so slight . . . that for practical purposes it would seem negligible'. A few years later Spearman (1923) concluded that there is no sex difference in *g*, the general factor of all cognitive tests and equatable with 'general intelligence'.

This conclusion that there is no sex difference in abstract reasoning ability, fluid intelligence, general intelligence and Spearman's *g* has been re-stated down the decades. For example: 'men and women average pretty much the same IQ' (Eysenck, 1981, p. 42); 'gender differences in general intelligence are small and virtually non-existent' (Brody, 1992, p. 323); 'no evidence was found for sex differences in the mean level of *g*' (Jensen, 1998, p. 531); and 'there is no sex difference in general intelligence worth speaking of' (Mackintosh, 1996, p. 567).

A major constituent of the conclusion that there is no sex difference in fluid intelligence, general intelligence and Spearman's *g* is the claim that there is no sex difference on the Progressive Matrices, which is widely regarded as an operational measure of these constructs. It has been virtually universally concluded that there is no sex difference on the Progressive Matrices. For instance, Eysenck (1981, p. 41) wrote that the tests 'give equal scores to boys and girls, men and women'. Court (1983) reviewed 118 studies on sex differences on the Progressive Matrices and found that some showed higher mean scores by males, others found higher mean scores by females, and yet others showed no difference in mean scores. From this he concluded that 'the accumulated evidence at all ability levels indicates that a biological sex difference cannot be demonstrated for performance on the Raven's Progressive Matrices' (p. 68). This conclusion has been endorsed by Mackintosh (1996) who summarizes Court's review as showing that 'large scale studies of Raven's tests have yielded all possible outcomes, male superiority, female superiority and no difference' (1996, p. 564), from which he concludes that the overall verdict is that there is no sex difference on the Progressive Matrices or, in a slight modification of his position, that he was possibly 'over-confident in my assertion that there was *no* sex difference,' but that 'the sex difference in general intelligence among young adults today in the USA, Britain or Israel is trivially small, surely no more than 1–2 points either way' (Mackintosh, 1998, p. 538). The use of the term 'either way' apparently means that either males or females may have a slight advantage on the Progressive Matrices.

The only challenge to the position that men and women are equally intelligent has come from the first author, who has maintained that among adults males have higher average IQs than females by 3·8 IQ points, made up from an advantage of 2·1 IQ points for reasoning ability, 1·7 IQ points for verbal ability and 7·5 IQ points for spatial ability (Lynn, 1994, 1998, 1999). The sex difference in reasoning ability can be disaggregated to a male advantage of 1·8 IQ points for verbal reasoning and of 2·4 IQ points for abstract (non-verbal) reasoning ability. It is contended that the male advantage of 3·8 IQ points is consistent with, and is caused by, the larger male brain, which from the age of 15 years onwards is about 10% greater than the average female brain. This theory holds that girls mature faster than boys, particularly during the growth spurt during the ages of around 9–12 years. This gives girls a slight advantage on abstract reasoning ability between these ages, but this is replaced by an advantage for boys emerging in the fifteenth year and persisting into adulthood.

This theory is called 'the developmental theory of sex differences' because its central contention is that to make sense of the conflicting results on sex differences in intelligence the issue has to be analysed developmentally. The theory states that one of the main reasons that some studies have found that males obtain higher means on the Progressive Matrices and other tests of abstract reasoning ability, while other studies have found that females obtain higher means, lies in the differing rates of maturation of boys and girls. The other reason lies in deficiencies of the samples in respect of size and representativeness. These are the two principal explanations for the conflicting results in the 118 studies reviewed by Court (1983).

The present position regarding sex differences on the Progressive Matrices is that there are two alternative theories. The first is the theory of Eysenck (1981), Court (1983), Mackintosh (1996, 1998) and Jensen (1998): that there is no sex difference or, in Mackintosh's (1998) modified position, possibly a sex difference of 'no more than 1–2 IQ points either way'. The second is the theory advanced by Lynn (1994, 1998, 1999) that an advantage for males emerges among 15-year-olds and reaches about 2·4 IQ points among adults. Further evidence is required to differentiate between these two theories and it is to this that the discussion now turns.

## Methods

The Standard Progressive Matrices was constructed in the late 1930s as a test of non-verbal or abstract reasoning ability and of Spearman's *g*. The Advanced Progressive Matrices was constructed in 1947 as a more difficult version of the test suitable for those in the higher ability range. The format of the items in the Advanced Progressive Matrices is the same as that of the Standard Progressive Matrices. Raven, Raven & Court (1998) provide full details of the test, including norms for the 1992 British standardization and for samples in a number of countries, and for the reliability and validity of the test.

The Advanced Progressive Matrices was standardized in Hong Kong in 1985 for 15- to 18-year-old school students by Kitty Li Nim-yu (Li Nim-yu, 1986). The results of the standardization were presented in an MA thesis for the Chinese University of Hong Kong. No summary of them has ever been published. They have consequently remained unknown to the community of scholars interested in the issue of sex differences on the Progressive Matrices. A search by the authors for Kitty Li Nim-yu has proved unsuccessful. She is not listed in the Hong Kong telephone directory or among the members of the Hong Kong Psychological Society. The task of introducing her results into the published literature on sex differences on the Progressive Matrices has therefore been undertaken by the authors of this paper.

The objective of the standardization was to obtain a representative sample of around 1500 15-, 16-, 17- and 18-year-old school students. This represents about 2% of the senior high school students in Hong Kong. The method used to obtain the sample entailed: (1) the selection of a random sample of 23 schools from the 401 secondary schools in Hong Kong and (2) the selection of two classes from each school, one for students specializing in science and the other for students specializing

**Table 1.** Sex differences on the Advanced Progressive Matrices

| Age | Boys | Girls | Diff. | IQ Diff. | *t* |
|---|---|---|---|---|---|
| 15–18-year-olds | | | | | |
| *n* | 903 | 594 | | | |
| Mean score | 23·0 | 21·4 | 1·6 | 3·2 | 5·53*** |
| SD | 5·9 | 5·5 | | | |
| 15-year-olds | | | | | |
| *n* | 178 | 163 | | | |
| Mean score | 24·20 | 22·00 | 2·20 | 4·40 | 2·84** |
| SD | 5·48 | 4·97 | | | |
| 16-year-olds | | | | | |
| *n* | 316 | 235 | | | |
| Mean score | 23·52 | 21·43 | 2·09 | 4·18 | 4·15** |
| SD | 5·79 | 5·82 | | | |
| 17-year-olds | | | | | |
| *n* | 270 | 139 | | | |
| Mean score | 22·45 | 21·52 | 0·93 | 1·86 | 1·60 |
| SD | 5·98 | 5·45 | | | |
| 18-year-olds | | | | | |
| *n* | 139 | 57 | | | |
| Mean score | 21·88 | 19·49 | 2·39 | 4·78 | 2·58** |
| SD | 6·45 | 5·96 | | | |

SD, standard deviation.
**$p<0·001$; ***$p<0·01$.

in arts. This yielded a sample of 1497. It may be useful to note that in 1985 schooling was compulsory for 15-year-olds in Hong Kong, and these 15-year-olds can therefore be regarded as representative of all 15-year-olds. Schooling was not compulsory for 16- to 18-year-olds, so the sample of these is representative of those at school and not of the age groups as a whole. It will, however, be noted from the data set out in Table 1 that there is little difference in the magnitude and direction of the sex difference between the 15-year-olds and the other three age groups.

The Advanced Progressive Matrices is a more difficult version of the Standard Progressive Matrices. It consists of Set 1, a practice test of twelve items, and Set 2, the test proper containing 36 items. The administration of Set 1 is optional and it was not given in the Hong Kong standardization.

The procedure for the administration of the test is described by the author as follows: 'The instruction given to the students was in accordance with the manual of the APM 1975 except that it was conveyed in Cantonese. Each class had to sit for one hour which included the time for giving instruction and distribution of the question papers. The time limit for completing the test was 40 minutes' (p. 27).

## Results

Table 1 shows, for boys and girls, the numbers, the mean scores, the standard deviations, the sex difference in raw scores, the sex difference in IQs obtained approximately by doubling the raw score differences and the statistical significance of the sex differences. Shown first are these results for the total sample followed by the results for each of the four years. The salient features of the results are as follows. First, in the total sample boys obtain a higher mean than girls by 1·6 raw score points, approximately equivalent to 3·2 conventional IQ points and a statistically highly significant advantage ($p<0·001$). An alternative method for calculating the sex difference in IQ points is to divide the raw score difference by the standard deviation of the total sample (5·84) to give the *d* statistic (0·274) and multiply this by 15 to give the sex difference of 4·1 in conventional IQ points.

The results are presented next for each of the four age groups. It can be seen that boys obtain higher means than girls in each age group. Among the 15-, 16- and 18-year-olds the sex differences are closely similar and statistically significant at $p<0·01$. Among the 17-year-olds the sex difference is smaller and not statistically significant. These differences between the age groups should probably be ascribed to chance.

## Discussion

The results provide two points of interest. First, they have been presented to test two rival hypotheses on sex differences on the Progressive Matrices among 15- to 18-year-olds. The first is the Eysenck–Court–Mackintosh–Jensen hypothesis that no differences exist or, if they do exist, they are 'no more than 1–2 IQ points either way' (Mackintosh, 1998, p. 538). The second is the Lynn hypothesis that a discernable and, with adequate sample size, statistically significant male advantage is present from the age of 15 years onwards. The Lynn hypothesis does not specify the magnitude of the male advantage in later adolescence but it states that it is around 2·4 IQ points among adults. It is evident that the result for the total sample – that males have an advantage of 3·2 or 4·1 IQ points, according to the two methods of calculation – supports the Lynn hypothesis and disconfirms the Eysenck–Court–Mackintosh–Jensen hypothesis. If anything, it suggests that the previous estimate of the male advantage in abstract reasoning ability of 2·4 IQ points among adults may have been too conservative.

Second, the results are consistent with the three studies of sex differences on the Progressive Matrices among adults obtained on general population samples. These are the Heron & Chown (1967) English sample of 600 adults covering the age range 20–80, among whom there was a male advantage of 2·8 raw score points (=5·6 IQ points); the Hawaii sample of 2363 18- to 55-year-olds of Wilson *et al.* (1975) on which males obtained a higher average score of 1·9 raw score points (=3·8 IQ points); and the Belgian sample of 2104 adults of Deltour (1993) on which males obtained a higher average score of 3·2 raw score points (=6·4 IQ points). These are reasonably impressive sample sizes and deserve to be taken seriously in a consideration of the issue of whether there is a sex difference among adults on the Progressive Matrices. The same cannot be said, the authors believe, for a number of the studies in Court's

(1983) review that found no statistically significant sex differences, such as those based on 60 Welsh 11- to 12-year-olds and 22 American 5-year-olds, which are among the studies upon which Mackintosh relies for his contention that there is no sex difference on the Progressive Matrices. The argument advanced by Mackintosh (1998) – that in adult samples the sex difference on the Progressive Matrices may be present among the older generation but not among the younger, and that this trend is present in the Hawaii sample of Wilson *et al.* (1975) – should, however, be acknowledged. If this argument can be substantiated, it may be that there is no single answer to the question of whether there is a sex difference on the Progressive Matrices, but that sex differences vary with generations and, no doubt, in different countries.

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