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Sex differences on the advanced progressive matrices in college students

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Abstract

Sex differences on the Advanced Progressive Matrices are reported for a sample of 2222 American college students. Males obtained a significantly higher mean of 3.4 IQ points, contrary to the frequently made contention that there is no sex difference on the Progressive Matrices but confirming the position of Lynn (1994, 1999) that from the age of 16 years males obtain a higher mean on the Progressive Matrices than females. The standard deviation was a little but not significantly greater in females, contrary to the frequent assertion that the male variance for intelligence is greater than the female.

Keywords: Progressive matrices; Sex differences; Means; Variance

1. Introduction

Raven's Progressive Matrices is widely regarded as one of the best tests of abstract reasoning ability and of *g* (Court, 1983; Jensen, 1998; Mackintosh, 1996). It has frequently been asserted that there is no difference in the mean scores obtained by males and females on the Progressive Matrices and therefore that there is no difference between males and females in reasoning or in *g*. Thus Court (1983) in a review of 118 studies of sex differences on the Progressive Matrices concluded that "there is no consistent difference in favour of either sex over all populations tested... the most common finding is of no sex difference. Reports which suggest otherwise can be shown to have elements of bias in sampling" (p. 62). This conclusion has been accepted by

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Mackintosh (1996, p. 564): "large scale studies of Raven's tests have yielded all possible outcomes, male superiority, female superiority and no difference"; and by Jensen (1998, p. 541): "there is no consistent difference on the Raven's Standard Progressive Matrices (for adults) or on the Coloured Progressive Matrices (for children)".

The consensus that there are no sex differences on abstract (non-verbal) reasoning ability measured by the Progressive Matrices and by other tests has been challenged by Lynn (1994, 1998, 1999). His alternative theory states that girls mature more rapidly than boys in physical and mental development up to the age of 14–15 years but from the age of 16 the growth of girls slows while that of boys continues. The theory proposes that among adults males have an advantage in abstract reasoning ability of somewhere between 2.4 to 5.0 IQ points.

There have been around 200 studies of sex differences on the Progressive Matrices and we do not attempt to present a full summary of this literature here. The major reviews are available in Court (1983), Lynn (1999) and Mackintosh (1996, 1998). Because the existence of a male advantage among adults on this test is maintained by Lynn (1999), and denied by Mackintosh (1998) and Jensen (1998) our purpose here is to present further evidence on this issue.

2. Method

Participants: Data have been collected during the 1990s on the Advanced Progressive Matrices for 1807 men and 415 women students at the Texas A & M university by Winfred Arthur, who has made these available to us for this report. The students tested have been drawn from all academic disciplines. The mean age of both men and women is 20 years.

3. Results

Men obtained a mean of 25.48 (SD = 5.29) and women a mean of 24.22 (SD = 5.69). The standard deviation of the combined sample is 5.37. The difference between the means is statistically significant ($t(2220) = 5.36$, $p < 0.01$) but the difference in the standard deviations is not statistically significant ($F(414, 1806) = 1.05$, $p > 0.05$). The magnitude of the difference between men and women in SD units calculated as the difference between the means divided by the pooled standard deviation is 0.23. This is equivalent to 3.4 IQ points.

4. Discussion

The result provides further evidence in support of the theory that among adults men obtain a higher mean IQ on the Progressive Matrices than women. The male advantage of 3.4 IQ points found in this study is approximately in the middle of the range between 2.4 and 5.0 male advantage proposed by Lynn (1994, 1999). It is noteworthy that this result has been obtained on a sample of 2222. Despite the large number of studies on sex differences on the Progressive Matrices there are only three other data sets on subjects aged 16 years and above with sample sizes greater than 2000. These are for Hawaii ($n = 2353$) Wilson et al. (1975), Belgium ($n = 2164$) (Deltour,

1993), and Brazil ($n = 5703$) (Campos, 1999), in which there are male advantages of approximately 3.8, 6.0 and 4.6 IQ points, respectively. The principal reasons for the conclusion of Court, Mackintosh and Jensen that there is no sex difference on the Progressive Matrices are first that they have looked at a lot of studies of small samples of which the size is insufficient for a statistically significant difference and second because they have not distinguished adults from children and adolescents up to the age of 15 years. The three other studies with sample sizes greater than 2000 are all samples of the general population. The present study of college students is not a general population sample but nevertheless shows a comparable sex difference favouring males. Taking these four studies together with Colom and Garcia-Lopez's (2002) study of 604 college applicants among whom males had an advantage of 4.2 IQ points on the Advanced Progressive Matrices, we believe that a male advantage of around 3–6 IQ points among adults on the Progressive Matrices can no longer be questioned.

A point that needs to be considered is that the sample of this study consists of college students who are predominantly drawn from the top half of the intelligence distribution. It has frequently been contended that the range of intelligence is greater among males than among females. This theory was advanced at the beginning of the 20th century by Havelock Ellis (1904, p. 425): "In man, as in males generally, there is an organic variational tendency to diverge from the average; in women, as in females generally, an organic tendency to stability and conservatism, involving diminished individualism and variability". Similarly "the larger range of variation in males than in females for general intelligence is an outstanding phenomenon" (Penrose, 1963, p. 186); "the consistent story has been that men and women have nearly identical mean IQs but that men have a broader distribution (Herrnstein & Murray, 1994, p. 275); and "males are more variable than females" Lehrke (1997, p. 140). If this is so, males drawn predominantly from the top half of the distribution would have a higher mean than females, while males drawn predominantly from the lower half of the distribution would have a lower mean than females. Hence the result of the present study would not provide strong confirmation for the theory that males have a higher mean abstract reasoning IQ than females because it might be wholly due to the greater variation of males than of females producing a higher mean for males in the top half of the distribution from which college students are predominantly drawn. It should therefore be noted that in the present sample the variation among males as measured by the standard deviation is in fact smaller in males than among females. The difference is not statistically significant but nevertheless disconfirms the thesis that the variability of intelligence is greater among males. The present result is consistent with the study by Feingold (1992) that there is no sex difference in variability for abstract or verbal ability on the Differential Aptitude Test. We believe that although the theory is that males have greater variability for intelligence than females the weight of the evidence does not support this and that it cannot be advanced as an alternative explanation of the present result.

The present result providing further confirmation that among adults males have a higher mean abstract reasoning ability assessed by the Progressive Matrices than females has further implications. The Progressive Matrices is widely regarded as a measure of general intelligence and of Spearman's *g*. Mackintosh (1998, p. 538) asserts that the Progressive Matrices is an excellent measure of Gf (fluid intelligence) and that Gf can be identified with "general intelligence", so his reading of the research literature that there is no sex difference on the Progressive Matrices leads to the conclusion that there is no sex difference in either Gf or in general intelligence. A similar argument has been presented by Jensen (1998, p. 541): "the total variance of Raven scores in fact

comprises virtually nothing besides *g* and random measurement error'', so his interpretation of the evidence that there is no sex difference on the Progressive Matrices leads him to the conclusion that is no sex difference in Spearman's *g*. Now that the evidence is accumulating that among those aged 16 years and older males have higher mean scores on the Progressive Matrices than females, we are driven to the conclusion that males have higher general intelligence and *g*. This is predictable from the greater male brain size, whether or not adjusted for body size, reported by Ankney (1992) and Rushton (1992), because brain size and IQ are correlated at a magnitude of 0.40 according to the meta-analysis of Vernon, Wickett, Bazana, and Stelmack (2000). However, the contentions of Jensen (1998) and Mackintosh (1998) that the Progressive Matrices is an excellent measure of general intelligence has been questioned by Colom and Garcia-Lopez (2002) who propose that the Cattell Culture-Fair test provides a better measure because it contains a greater variety of problems.

Although the Progressive Matrices is widely regarded as a measure of abstract reasoning ability, it has sometimes been suggested that it also measures spatial ability. If this is so, the male advantage among adults on the Progressive Matrices could be due to higher spatial ability which has been found many times in males and is virtually universally acknowledged (e.g. Linn & Peterson, 1985). The question of whether the Progressive Matrices measures spatial ability in addition to reasoning ability has been examined by van der Ven and Ellis (2000). They analysed the results of the Standard Progressive Matrices administered to a sample of 905 Dutch 12–15 year olds for unidimensionality by Rasch analysis. Their analysis revealed the presence of two strong factors identified as (1) ''gestalt continuation'' present in Set A and items 1–6 in Set B for which ''the correct solution must be found according to some Gestalt continuation rule''; and (2) ''analogical reasoning'', present in items B 8–12 and in most of the later items the solution of which ''the subject should deduce, by means of analogical reasoning, that a certain change in the transition from the first element in a row to the next element in a row must be repeated in the following row''. We believe that this analysis is broadly correct and that the ''gestalt continuation'' factor can be regarded as a kind of spatial ability. However, the items measuring the ''gestalt continuation'' factor are easy and discriminate among young children but would not be expected to discriminate among adult college students, who would be expected to get all or virtually all the ''gestalt continuation'' items correct. We therefore doubt whether the higher means obtained by male college students reported here can be attributed to a possible tendency to perform better on the ''gestalt continuation'' factor and that it is attributable to greater ability on what van der Ven and Ellis (2000) call ''analogical reasoning''. We therefore agree with Mackintosh and Jensen that the Progressive Matrices is for adult college students a measure of reasoning ability and of *g*.

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