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Sex differences on the WISC-R in Mauritius

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Abstract

Sex differences on the WISC-R (Wechsler Intelligence Scale for Children-Revised) are examined in a sample of 1258 11 year olds in Mauritius. Boys obtained a significantly higher Full Scale IQ by 5.8 IQ points. Boys obtained a higher Performance IQ by 6.5 IQ points and a higher Verbal IQ by 1.0 IQ points. On the subtests, girls obtained a significantly higher mean on Coding while boys obtained significantly higher means on Similarities, Picture Completion, Block Design, Object Assembly and Mazes. There was no significant sex difference on Digit Span. Two methods were adopted for determining whether boys had an advantage on Spearman's *g*. First, calculated from the first principal component of a principal components analysis, boys had an advantage on Spearman's *g* of 6.15 IQ points. Second, using the method of entering the sex difference on each of the subtests as point-biserial correlations, including these in the full matrix of subtest correlations for factor analysis and examining the factor loading of sex on *g* produced a correlation between sex and *g* of .224, the equivalent of a sex difference of 6.9 IQ points. Thus the sex difference on the Full Scale IQ was found to be a good approximate measure of the difference in *g*. The pattern of sex differences in Mauritius is compared with that in eight other countries and found to be generally similar, although the boys' advantage is greater in Mauritius than elsewhere. The variance in boys is slightly greater than in girls, but is only significant for Block Design.

Keywords: Sex differences; WISC-R; *g*; Intelligence; Mauritius

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1. Introduction

It has become well established that males obtain higher mean scores on some cognitive abilities while females obtain higher mean scores on others. There is a large research literature on this subject including books by Caplan, Crawford, Hyde, and Richardson (1997), Kimura (1999) and Halpern (2000) as well as numerous review papers and meta-analyses. Kimura (2002) lists five abilities on which males obtain higher means on average than females: spatial orientation, visualization, line orientation, mathematical reasoning, and throwing accuracy; and five abilities on which females obtain higher means on average than males: object location memory, perceptual speed, verbal memory, numerical calculation, and manual dexterity. To these should be added higher means obtained by females on spelling (Lynn, 1992) and foreign language ability (Lynn & Wilson, 1993), and higher means obtained by males on mechanical aptitude (Feingold, 1988; Lynn, 1992).

The Wechsler tests provide one of the most useful sources of data for the study of sex differences in cognitive abilities because they are highly respected, being the most used intelligence test in the United States (Watkins, Campbell, Nieberding, & Hallmark, 1995), are extensively used in many countries, are based on well drawn standardization samples, and provide measures of a good range of abilities including several verbal abilities (information, arithmetic, vocabulary, etc.), spatial and visualization abilities (picture completion, block design and object assembly), immediate or working memory (digit span), and perceptual speed (coding). Scores on these tests are aggregated to give a Full Scale IQ, which is widely regarded as an excellent measure of general intelligence and Spearman's *g* (e.g. Jensen, 1998).

The general pattern of sex differences on the Wechsler tests for 6–16 year olds (the Wechsler Intelligence Scale for Children: WISC) and the Wechsler Intelligence Scale for Children-Revised (WISC-R) are quite consistent in several samples in the United States (Jensen & Reynolds, 1983) and Europe including the Netherlands (Born & Lynn, 1994) and Scotland (Lynn & Mulhern, 1991). Typically, males obtain higher means on Information and the visual–spatial subtests (Block Design, Object Assembly and Mazes); females obtain a substantially higher mean on Coding, a measure of perceptual speed; and there are no or very small differences on the remaining subtests. Typically, males obtain a slightly higher mean on the Verbal and Full Scale IQ, but there is little or no difference on the Performance IQ because the small male advantage on the visual–spatial subtests is counterbalanced by the larger female advantage on Coding.

The existence of fairly consistent sex differences in the various abilities in different samples raises the question of whether these arise through differential socialization such that, for instance, boys are encouraged to be good at visual–spatial tasks and girls at perceptual speed tasks, or whether they have some substantial genetic basis (as argued by Kimura, 1999), or whether both nature and nurture are involved. One of the ways of bringing evidence to bear on the nature–nurture debate is to examine the cross-cultural consistency of the sex differences. If it is found that the pattern of sex differences in the United States and Europe is not present in other cultures, this is a strong argument that they are culturally determined. If on the other hand the pattern is present in a range of different cultures, the view that they are to some degree genetically determined is supported. To provide evidence on this issue we present data on sex differences in the abilities measured by the WISC-R in a sample in Mauritius and examine how far these are consistent with those present in western countries and elsewhere.

2. Method

The participants were obtained from two towns (Vacoas and Quatre Bornes) in Mauritius, chosen because they were representative of the ethnic mix of the island. All children born between 1969–1970 in the two towns were recruited into the study. The ethnic mix of the sample was 69% Indian, 26% predominantly Creole (largely of mixed African and European descent), and 6% other (Chinese, English, French and others). This almost exactly matches the ethnic proportions of the population found in census returns.

At the age of 11 years the participants numbering 636 boys and 622 girls took seven subtests of the Wechsler Intelligence Scale for Children-Revised (WISC-R) (Wechsler, 1974). These were Similarities and Digit Span, from which a Verbal IQ was computed; and Picture Completion, Block Design, Object Assembly, Coding and Mazes, from which a Performance IQ was computed. The Verbal and Performance IQs were used to compute Full Scale IQs. The testing was done by a trained research assistant in a quiet room. It was conducted in English, the language in which the children are taught, although the instructions were given in Creole. Further details of the sample are given by Raine,Venables, Reynolds, and Mednick (2002).

3. Results

Sex differences on the seven subtests, the Verbal IQ, the Performance IQ and the Full Scale IQ are shown in Table 1. This gives for each test and IQ the means and standard deviations of the boys and the girls. This is followed by the *t* values for the statistical significance of the differences. In calculating the values of *t*, Levene's test for equality of variances was run and showed that the variances were not significantly different for any of the subtests and IQs except for Block Design, on which the variance for boys is significantly greater than that for girls. The *t*-tests were therefore computed assuming equality of variances for all subtests except Block Design for which equal variances were not assumed. Shown next are the differences between the mean scores of the boys and girls expressed as *d* (the differences between the means divided by the standard deviation). Positive *d*s denote higher means obtained by boys and

Table 1
Sex differences in 11 year olds on the WISC-R in Mauritius and the United States

Test	Boys	Girls	*t*	*d*	US*d*
	Mean (SD)	Mean (SD)			
Similarities	10.19 (3.05)	9.79 (2.93)	2.34*	.13	.07
Digit span	10.08 (3.03)	9.91 (2.98)	1.00	.06	−.10
Picture completion	10.71 (3.00)	9.27 (2.83)	8.74***	.44	.15**
Block design	10.63 (3.05)	9.34 (2.79)	7.80***	.44	.15**
Object assembly	10.75 (2.93)	9.20 (2.85)	9.55***	.54	.18**
Coding	9.64 (2.91)	10.33 (3.03)	4.14***	−.23	−.53***
Mazes	10.71 (2.81)	9.25 (3.01)	8.94***	.50	.19***
Verbal IQ	100.57 (15.52)	99.18 (14.58)	2.00*	.07	.19***
Perform IQ	103.33 (14.69)	96.48 (14.56)	8.43***	.46	.01
Full scale	102.81 (14.93)	97.00 (14.57)	7.01***	.39	.12*

*, **and *** denote statistically significant differences at $p<.05$, $p<.01$ and $p<.001$, respectively.

Table 2
Loadings of the subtests on the first principal component

Subtest	First PC
Picture completion	.638
Similarities	.658
Digit span	.658
Block design	.795
Object assembly	.750
Coding	.647
Mazes	.699

negative *d*s denote higher means obtained by girls. The final column gives the sex differences in the American standardization sample also expressed as *d*s given by Jensen and Reynolds (1983).

To ascertain whether the sex difference in the Full Scale IQ is a difference in Spearman's *g,* we have used the two methods proposed by Jensen (1998). First, following the methodology of Jensen and Reynolds (1983), the correlation matrix of the subtests was factor analyzed by Principal Components Analysis and the first Principal Component adopted as a measure of *g*. The loadings of the subtests on the first Principal Component are given in Table 2. The factor scores of the boys and girls were calculated to give scores on *g.* The factor scores are boys: 0.198 (.991) and girls −0.203 (.969) (the differences in the sds is not statistically significant by Levene's test, $p = .531$). The difference in the factor scores is statistically significant ($t = 7.206$, $p < .001$). The difference expressed in standard deviation units is $d = .41$ and is equivalent to 6.15 IQ points.

Second, we used the later and preferred method by Jensen (1998, p. 538) for measuring sex differences in *g* described thus: "represent the sex difference on each of the subtests of a battery in terms of a point-biserial correlation and include these correlations with the full matrix of subtest correlations for factor analysis. The results will reveal the factor loading of sex on each of the factors that emerges from the analysis, including g. The g factor loading of sex, therefore, is equivalent to the point biserial correlation between g and the sex variable (quantitized as male=1, female=0. This method is preferable to the use of g factor scores which I used in an earlier study". The correlation between sex, and *g* was found to be .224, which is equivalent to a sex difference of .46*d* in favour of males, equivalent to 6.9 IQ points. Thus both methods provide broadly consistent estimates of the boys' advantage in *g*.

4. Discussion

The results contain eight points of interest. First, the boys obtained significantly higher means on all the subtests except Coding, on which girls scored significantly higher, and Digit Span, on which girls scored higher, but not significantly. Boys also obtained significantly higher Performance and Full Scale IQs. These differences are generally consistent with those in other countries but the advantage obtained by the boys in this data set are greater than those typically found in other countries. The advantage of the boys on the Full Scale IQ in Mauritius was found to be 5.85 IQ points.

Second, the advantage of the boys on the Full Scale IQ ($d = .39$, standard deviation units, equivalent to 5.85 IQ points) is fractionally lower than their advantage on *g* ($d = .41$, equivalent to 6.15 IQ points) measured by the method of correlated vectors proposed by Jensen and Reynolds (1983). This result is

very similar to that obtained by Jensen and Reynolds (1983) in their analysis of sex differences on the American standardization sample of the WISC-R, on which boys had an advantage on the Full Scale IQ of $d = .112$, equivalent to 1.68 IQ points, fractionally lower than their advantage on g ($d = .12$, equivalent to 1.80 IQ points). Using the second method by Jensen (1998) for calculating the sex difference in g also produced a very similar result of .46d in favour of males, equivalent to 6.9 IQ points. The present result therefore confirms the conclusion by Jensen (1998) that the sex difference on the Wechsler full scale IQ is closely similar to that on g.

Third, to put the present results in international context the sex differences on the WISC and WISC-R are shown for the Full Scale, Verbal and Performance IQs in nine countries including Mauritius are given in Table 3. The sex differences are expressed in conventional IQ points (d can be converted to conventional IQ points by multiplying by 15) and represent the advantage of boys over girls. It will be seen that the advantage of boys in Mauritius is consistent with that in the other countries in so far as boys obtain higher average Full Scale IQs than girls, but the advantage of boys in Mauritius is greater than in the other eight countries. This is not because the Mauritius sample consists of 11 year olds whereas the other samples are for 6–16 year olds. There do not appear to be any age differences in the magnitude of the boys' advantage on the WISC and WISC-R (see, e.g. Lynn & Mulhern, 1991).

Fourth, on the Verbal IQ the advantage of boys is less in Mauritius at 1.0 IQ points than in any of the other eight countries except the Netherlands. The reason for this is that the Verbal IQ is calculated from only two subtests, Similarities and Digit Span. In the samples in the other countries where the six verbal subtests were given, girls typically do relatively well on Digit Span (and in some data sets better than boys, including the United States, as shown in Table 1) while the advantage of boys on Information is greater than on the other subtests.

Fifth, on the Performance IQ the advantage of boys in Mauritius is greater at 6.8 IQ points than in any of the other eight countries and is similar to the boy's Full Scale IQ advantage of 5.8 IQ points. The Picture Arrangement subtest was not included in the study but this is unlikely to have made any appreciable difference to the boys' advantage because in the other data sets the boy's advantage on Picture Arrangement is similar to that on the other performance subtests.

Sixth, looking now in more detail at the sex differences on the subtests in Mauritius compared with those in the United States shown in Table 1, it will be seen that the pattern of the differences is quite similar. In both data sets girls do significantly better than boys on Coding. This is consistent with results in other countries and with other tests of perceptual speed (Kimura, 1999, 2002). In both Mauritius and

Table 3
Sex differences on the WISC and WISC-R in nine countries

Country	Test	*N*	Full scale	Verbal	Perform	Reference
USA	WISC	2200	1.7	2.5	0.6	Seashore, Wesman, and Doppelt (1950)
Greece	WISC	403	2.1	1.9	2.7	Fatouros (1972)
USA	WISC-R	2200	1.8	2.8	0.2	Jensen and Reynolds (1983)
China	WISC-R	2236	2.8	3.0	2.1	Dai and Lynn (1994)
Scotland	WISC-R	1361	1.8	3.1	0.1	Lynn and Mulhern (1991)
Israel: Jews	WISC-R	2111	3.2	2.9	1.9	Leiblich (1985)
Israel: Arabs	WISC-R	639	4.1	4.3	4.3	Leiblich (1985)
Netherlands	WISC-R	2027	1.4	1.6	0.8	Born and Lynn (1994)
Mauritius	WISC-R	1258	5.8	1.0	6.5	Present study

the United States boys do significantly better than girls at the four visual–spatial subtests (Picture Completion, Block Design, Object Assembly and Mazes). This is consistent with other data sets and, more generally, with other tests of visual–spatial abilities found in many studies as shown in the meta-analyses carried out by Linn and Peterson (1985) and Voyer, Voyer, and Bryden (1995). The correlation between the sex differences in *d*s in Mauritius and the United States is 0.932 and is statistically significant at $p < .002$. The similarity between the pattern of sex differences in cognitive abilities in Mauritius and in economically developed western nations and China is generally consistent with the position that these are to some degree genetically determined.

Seventh, it may be useful to note finally that the variances in abilities in this study in Mauritius are slightly greater for boys than for girls. This also is consistent with the results obtained in the other data sets and with the conclusion that has been frequently advanced that the variance of cognitive abilities is greater in males than in females. For instance: "the consistent story has been that men and women have nearly identical IQs but that men have a broader distribution. . .the larger variation among men means that there are more men than women at either extreme of the IQ distribution" (Herrnstein and Murray, 1994, p. 275); "males are more variable than females" (Lehrke, 1997, p. 140); "males' scores are more variable on most tests than are those of females" (Jensen, 1998, p. 537). However, the sex difference in variances are very small in the present and other Wechsler samples and in the Mauritius sample the differences are not statistically significant except for Block Design.

Eighth, it was suggested in the introduction that the pattern of sex differences in the different cultures has a bearing on the question of whether these are culturally or genetically determined. If there are considerable differences across cultures, the cultural theory is supported. A strong version of this theory has been articulated by Hutt and Hughes (2004, p. 828) who write of "the overwhelming importance of cultural influences in shaping sex-typed behaviour. . .the biological dichotomy of the sexes should not be seen as necessarily implying an equally rigid dichotomy of abilities". The present results do not support the view that sex differences in cognitive abilities differ in an economically developing country like Mauritius as compared with economically developed western nations. The results are more consistent with the position adopted by Kimura (1999, p. 181) that "there are substantial sex differences in cognitive functions and we can state with certainty that most of these are strongly influenced by early and/or current hormonal environments" and therefore that they will be similar in all cultures. It may however be argued that the culture of Mauritius is sufficiently similar to that of economically developed western nations to produce the same pattern of sex differences.

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