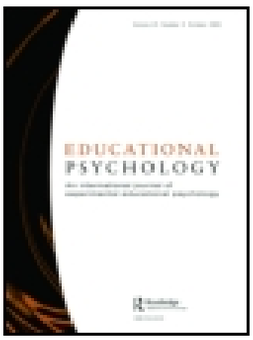

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Sex Differences on the Differential Aptitude Test in British and American Adolescents

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ABSTRACT *Sex differences on the eight tests of the Differential Aptitude Test are reported for approximately 10,000 13–18 year olds in Britain. Males obtained higher means in five of the tests and females obtained higher means in three. The sex differences in Britain are closely similar to those in the USA.*

The question of sex differences in cognitive abilities has attracted interest for at least 60 years. In an early study McCarthy (1930) found that preschool girls were ahead of boys in verbal ability. In the numerous subsequent studies, the sex differences most consistently reported are in spatial and mathematical abilities in which males typically obtain higher means than females, and in perceptual speed in which females typically obtain higher means than males. Thorough reviews of the literature are available in Maccoby and Jacklin (1974), Hyde and Linn (1986) and Halpen (1986).

There have been some reports that females obtain higher means on verbal ability (Maccoby & Jacklin, 1974; Vogel, 1990). Other studies have not confirmed these findings. For instance, in the American standardisation samples of the Wechsler tests males obtained higher means than females on the verbal scales of the WISC, WISC-R and WAIS-R (Seashore, Wesman and Doppelt, 1950; Jensen & Reynolds, 1983; Matarazzo *et al.*, 1986). This difference was also present in the standardisation sample of the Scottish WISC-R (Lynn & Mulhern, 1991). These results throw doubt on the claims sometimes made that females obtain higher means than males on verbal abilities.

A useful source of data to examine for sex differences in abilities is the Differential Aptitude Test (DAT) (Bennett *et al.*, 1982). This test consists of eight subtests, designated verbal reasoning (analogies), abstract reasoning (figural non-verbal reasoning), spelling, language usage (a test of grammar and punctuation), numerical ability (arithmetic), clerical speed and accuracy (perceptual speed), space relations (three-

dimensional spatial visualisation) and mechanical reasoning. The DAT has been standardised on four occasions in the United States on a total of 193,844 teenagers over the age range 13–18 years. The results have been analysed for sex differences by Feingold (1988), who showed that females obtained higher means on spelling, language, and clerical speed and accuracy, males obtained higher means on mechanical reasoning and space relations, while there were no sex differences on verbal reasoning, abstract reasoning and numerical ability. Feingold also found that the sex differences diminished over the years covered by the four standardisations which were made in 1947, 1962, 1972 and 1980. Nevertheless, statistically significant sex differences were still present in the last standardisation, although of smaller magnitude.

The interest of the sex differences on the DAT lies partly in the very large standardisation samples, which yield highly reliable results, and partly in the range of abilities covered in the eight tests. Four of the tests measure abilities similar to those in a number of other tests, i.e. verbal reasoning, abstract reasoning, numerical ability and space relations. For these there is a good deal of evidence from other tests with which comparisons can be made. The remaining four tests (spelling, language usage, clerical speed and accuracy and mechanical reasoning) provide data on sex differences for which there is not much comparable data elsewhere. To secure more data on sex differences in cognitive abilities, the present paper examines the sex differences in the standardisation sample of the DAT in Britain, with the objective of determining whether the same differences are present as in the American standardisation samples.

Method

The American DAT has appeared in different forms in successive standardisations. The first version of 1947 consisted of forms A and B, and the second (1966) of forms L and M, the third (1974) of forms S and T and the fourth (1982) of forms V and W. The successive pairs of the test are equivalent and have the same norms.

The third version of the test (S and T) was standardised in Britain in 1977–78, approximately five years after the American standardisation. The British standardisation was based on a sample of approximately 10,000 adolescents. The sample was drawn from six regions of the UK and matched approximately to the total numbers of children in these regions. The sample was also matched for school type (comprehensive, grammar and secondary modern) to the total numbers in these schools. The author of the test manual states that "it is considered that the sample is reasonably representative of the relevant UK secondary school population" (Hodgkiss, 1979, p. 12), and there seems no reason to question that this is the case. The test manual provides norm tables including means and standard deviations for boys and girls separately for five age groups spanning the years 13–14 to 17–18.

Results

Sex differences on the eight tests for the five age groups are shown in Table I. The table gives the means of the boys and girls for each age group, the standard deviation for both sexes combined and the Ds (the effect size, i.e. the sex difference in standard deviation units). The statistical significance of each sex difference has been tested by *t*-tests and the significance of the sex differences is indicated by asterisks against the Ds. It will be seen that girls obtain higher means on the tests of clerical speed and accuracy and spelling and language, while boys obtain higher means on the remaining

Table I. Mean scores of British boys and girls on the Differential Aptitude Test

	13–14-year-olds				14–15-year-olds				15–16-year-olds				16–17-year-olds				17–18-year-olds			
	Boys	Girls	SD	D	Boys	Girls	SD	D	Boys	Girls	SD	D	Boys	Girls	SD	D	Boys	Girls	SD	D
Verbal reasoning	23.2	21.7	10.0	0.15***	25.5	25.1	10.8	0.04^{NS}	28.0	26.9	11.3	0.10**	37.0	34.3	9.6	0.28***	41.4	39.6	7.2	0.25**
Abstract reasoning	30.0	29.3	11.0	0.06^{NS}	33.2	32.4	10.4	0.08*	34.3	33.5	10.1	0.08*	39.8	38.4	7.4	0.19**	42.2	40.8	5.5	0.25**
Numerical	13.6	12.0	6.6	0.24***	15.8	14.4	7.9	0.18***	18.1	16.3	8.8	0.20***	26.9	22.9	8.6	0.41***	30.2	25.8	8.2	0.54***
Clerical speed and accuracy	37.2	39.5	11.9	−0.19***	40.9	44.8	13.4	−0.29***	42.4	45.6	12.8	−0.25***	49.4	51.9	11.6	−0.22***	50.0	55.8	10.8	−0.54***
Mechanical reasoning	42.4	35.9	9.8	0.66***	46.1	38.0	10.4	0.72***	47.1	38.3	10.7	0.82***	52.5	42.4	10.6	0.95***	55.0	44.7	10.6	0.97***
Space relations	27.2	25.3	10.2	0.19***	31.8	28.6	11.4	0.28***	32.8	29.4	11.5	0.30***	39.7	34.9	11.5	0.43***	43.0	37.9	10.6	0.48***
Spelling	54.8	56.3	16.2	−0.09*	57.9	62.3	17.8	−0.25***	63.1	67.9	17.8	−0.27***	76.1	78.8	14.4	−0.19**	81.4	86.0	11.9	−0.39***
Language usage	25.0	26.9	9.6	−0.20***	27.1	30.6	10.5	−0.33***	29.9	32.9	10.9	−0.28***	38.8	40.9	8.9	−0.23***	42.9	44.9	7.2	−0.35***
N	1331	1063			1226	1159			1486	1335			524		489			309		244

*Statistical significance at 5% level; **at 1%; ***at 0.1%.
Minus signs indicate that girls obtain higher means than boys.

five tests. It is interesting to see whether the sex differences on the eight tests in the British sample resemble those in the United States. The sex differences show a high degree of consistency across the five age groups. Hence the simplest method of comparing the British and American differences is to combine the five age groups into single samples. The overall Ds for the British and for the four American samples given by Feingold (1988) are shown in Table II. It will be seen that there is a high degree of consistency in the results for the British and American samples. In both countries boys obtain higher means on verbal reasoning, abstract reasoning, numerical ability, mechanical reasoning and space relations, while girls obtain higher means on the remaining three tests. The correlation between the two sets of Ds is 0.98 ($p<0.01$) indicating a very close degree of similarity between the sex differences in these eight abilities in Britian and the United States.

Table II. Sex differences on the Differential Aptitude Test expressed in Ds* (SD units) for US and British teenagers

	Ds	
	US	Britain
Verval reasoning	05	16
Abstract reasoning	08	13
Numerical	05	31
Clerical speed and accuracy	−48	−30
Mechanical reasoning	98	82
Space relations	24	34
Spelling	−50	−24
Language usage	−43	−28

*Decimal points omitted. Minus signs indicate that girls obtain higher mean than boys.

Discussion

The results of British standardisation of the DAT provide new data which clarify and extend existing knowledge on the problem of sex differences in cognitive abilities. There are six principal points of interest in the results.

(1) The high level of consistency of the sex differences in the United States and Britain on the eight abilities measured by the DAT ($r=0.98$) indicates the stability of the differences in these two cultures. These sex differences are also similar to those on the subtests of the WISC-R, which are also highly consistent in the US and Britain (Lynn & Mulhern, 1991). On the WISC-R standardisation samples in the US and Scotland, boys obtain slightly higher means on the similarities, arithmetic and visuospatial subtests, comparable to the verbal reasoning, numerical and space relations test in the DAT. Girls obtain higher means on coding in the WISC-R and on clerical speed and accuracy in the DAT, both tests of the perceptual speed primary (Cronbach, 1990).

(2) The consistency of the sex differences from the USA to Britain on the tests of the DAT and the subtests of the WISC-R can be interpreted as lending support to the hypothesis that there is some element of biological determination of these differences, as argued by Benbow (1988) for the sex difference in mathematic ability. If the consistency were not present, the hypothesis of biological determination would be

strongly disconfirmed, so it can be argued that the biological hypothesis has survived an attempt at falsification. On the other hand, it could be argued that similar socialisation pressures operate on boys and girls in the USA and in Britain, producing a similar profile of sex differences in the two countries. Hence the consistency phenomenon is not decisive for the nature–nurture debate.

(3) Possibly more persuasive evidence on the biological determinants question comes from the details of male and female advantage on these tests. It may seem intrinsically implausible that social pressures operate to make girls better at language, spelling and perceptual speed abilities, but to make boys better on verbal and abstract reasoning, numerical, spatial and mechanical ability. If there is stronger social pressure on boys for the acquisition of cognitive skills, the first expectation would be that this would operate across the whole range of abilities rather than in the selective way which is so consistently present in the USA and Britain.

(4) Much of the interest in the results on the sex differences in the DAT lies in the variable size and direction of the differences in the eight primary abilities measured in the test. There has been a tendency in discussions of sex differences in cognitive abilities to focus on broad abilities as the datum requiring explanation. For instance, there has been much interest in Benbow's (1988) work showing that 12–13-year-old boys greatly outnumber girls in obtaining high scores on the mathematical test of the SAT. But this mathematical test probably involves the verbal reasoning, abstract reasoning, numerical and space relations abilities which are measured independently in the DAT. To answer the question of why boys perform better than girls on the math-SAT it is useful to examine sex differences in the primary abilities utilised in performance of the test.

(5) The same point applies to the problem of sex differences in verbal ability. This is often treated as if it were a single ability, yet the DAT contains four tests of verbal ability, namely verbal reasoning, clerical speed and accuracy, language usage and spelling. On one of these (verbal reasoning) boys obtain significantly higher means, while on the other three (clerical speed and accuracy, spelling and language usage) higher means are obtained by girls. It seems clear that verbal ability is too broad a category for the analysis of sex differences and that it is necessary to break the ability down into micro-abilities, on some of which males show superiority while females show superiority on others.

(6) For some of the tests in the DAT, the British results confirm that sex differences obtained in many studies in the USA are also present in Britain. This applies particularly to higher male means on space relations and the higher female means on clerical speed and accuracy. For some of the other DAT tests, data on sex differences are quite sparse. The greatest sex differences in the DAT is in the mechanical reasoning, where much higher means are obtained by boys (Ds for the USA=0.98; Britain=0.82). This ability receives no mention in two recent books on sex differences in cognitive abilities (Halpen, 1986; Hyde & Linn, 1986). The considerable sex difference in mechanical reasoning may go some way towards explaining the greater proportion of males in engineering schools in universities and in the engineering profession.

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