Norms and Gender Differences on the Progressive Matrices in Sudan

Omar Khaleefa*, Mohamed A. Khatib,
University of Khartoum, Sudan
Mohied M. Mutwakkil
Omdurman Islamic University, Sudan
Richard Lynn
University of Ulster, Coleraine, Northern Ireland

A standardization of the Progressive Matrices in Sudan for the ages 9 through 25 years is analysed for sex differences in means and variability. There are no sex differences in means at the ages 9, 11, 12, 13 and 19 years. At age 14 through 18 years females obtain higher means than males, while at ages 10 and 20-25 years males obtain higher means than females. There are no consistent sex differences in variability.

Key Words: Sex Differences; Progressive Matrices; Sudan; Variability.

Introduction

It has been frequently asserted that there is no difference between males and females in general intelligence but that males have greater variability, such that there are more males at both the high and low end of the intelligence distribution, while females cluster around the mean. These contentions were advanced in the early years of the twentieth century by Havelock Ellis (1904), Thorndike (1910) and Terman (1916). These early writers drew this conclusion from the observations that there is no average sex difference in general intelligence measured by a variety of intelligence tests, but men are greatly over-represented among geniuses and among the mentally retarded. The theory was advanced by Thorndike (1910) as follows: "The trivial difference between the central tendency of men and that of women which is a common finding of psychological tests and school experience may seem at variance with the patent fact that in the great achievements of the world in science, art, invention, and

* Address correspondence to Omar Khaleefa, Ph.D., PO Box 12718 Khartoum, Sudan; e-mail: okhaleefa@hotmail.com

management, women have been by far excelled by men. One who accepts the equality of typical representatives of the two sexes must assume the burden of explaining this great difference in the high ranges of achievement. The probably true explanation is to be sought in the greater variability within the male." Thorndike examined test data on variability and concluded that men are about one twentieth more variable than women.

There has been a good deal of subsequent research on these two propositions. Many scholars have endorsed them (e.g. Hedges & Nowell, 1995; Deary, Irwing, Der, & Bates, 2007). There has however been some dissent. Lynn (1994, 1999) has proposed a developmental theory to the effect that there is no sex difference in intelligence up to the age of 9 years, from the age of 10 through 13 girls obtain slightly higher average IQs than boys as a result of the earlier growth spurt occurring in girls accelerating both physical and mental development; at ages 14 and 15 years there is again no difference as the growth rate of girls decelerates, while at the age of 16 years males obtain a slightly higher mean than females, and this advantage increases in size into adulthood where it reaches about 5 IQ points.

One of the most widely used tests of general intelligence, reasoning ability and Spearman's *g* is the Progressive Matrices constructed in Britain in the 1930s by John Raven (1939). Numerous studies have been published on the test during the last seventy years. It has been widely asserted that there is no sex difference in the average scores obtained by males and females on the test. Raven (1939) reported that in his initial standardization on children up to the age of 14 years that there was no difference in the average scores obtained by males and females. This conclusion was affirmed for adults as well as children in a review of numerous studies by Court (1993). It has however been shown in a meta-analysis of sex differences on the test that sex differences conform to the developmental theory (Lynn & Irwing, 2004), and that at the age of 16 years males obtain a slightly higher mean than females, and this advantage increases in size into adulthood where it reaches about 5 IQ points. This

conclusion was confirmed in a meta-analysis of sex differences on the Progressive Matrices among university students on the Progressive Matrices (Irwing & Lynn, 2005). This conclusion has been confirmed in a developmental study of the Naglieri Nonverbal Ability Test (Rojahn & Naglieri, 2006). The question of whether males have greater variability than females on the Progressive Matrices has received less attention. No difference in variability was found in the meta-analysis of sex differences on the Progressive Matrices among university students, but as these are not representative samples of the population this result is not conclusive.

Nearly all the research on sex differences in means and variability has been carried out in economically developed countries. It would be useful to examine these issues in developing countries to ascertain whether they are consistent with those with the existing research. As a contribution to this research program we present some data from Sudan.

Method

The data were collected as a standardisation of the Standard Progressive Matrices (Raven, Raven & Court, 2000) carried out in 1999 in Khartoum, the capital city of Sudan and the surrounding regions. The sample size was 6,202 and the age range from 9-25 years. The children up to the age 18 years were tested in representative schools, and the older adolescents and young adults were selected in representative universities in Khartoum State. A full account of the methodology is given by Khatib & Mutwakkil (2001).

Results

The results are given in Table 1. This shows for each age group the numbers, means and standard deviations of males and females, the differences between the means of the males and females expressed in standard deviation units (*d*, obtained by dividing the difference between the means by the pooled standard deviation, i.e. the average of the two standard deviations; minus signs denote higher scores obtained by females); the t values for the statistical significance of the sex differences; and the VRs (variance

ratios), obtained by dividing the males' variance by the females' variance. VRs greater than 1.0 indicate that males had greater variance than females, while VRs less than 1.0 indicate that females had greater variance than males.

Table 1.
Sex Differences on the Progressive Matrices in Sudan

	Males			Females					
Age	N	Mean	SD	N	Mean	SD	*d*	t	VR
9	102	22.38	10.25	97	21.23	10.56	.11	0.78	0.94
10	183	25.63	10.95	130	22.13	10.83	.32	2.80**	1.02
11	182	27.10	11.29	143	27.29	13.55	-.02	0.13	0.69
12	236	29.03	12.67	190	28.05	14.67	.07	0.73	0.75
13	262	33.98	10.21	206	34.65	12.17	-.06	0.59	0.70
14	188	37.58	10.41	214	40.45	10.65	-.27	2.73**	0.96
15	186	39.10	10.93	181	41.66	10.85	-.23	2.25*	1.01
16	181	40.45	10.19	135	44.02	8.18	-.39	3.46***	1.55
17	214	40.45	9.90	145	44.23	11.23	-.32	3.34***	0.78
18	169	40.80	11.26	141	43.34	8.50	-.26	2.26**	1.75
19	185	44.95	8.79	223	43.14	9.83	.19	1.19	0.80
20-25	1047	40.76	10.91	1937	39.83	10.59	.09	2.02*	1.06

Note: *, **, *** denote statistically significant differences at p<.05, .01 & .001

Discussion

The results provide evidence on both the developmental theory of sex differences in intelligence, and the theory of greater male variability, discussed in the introduction. As far as the developmental theory is concerned, the general trend of the sex differences is that there are no differences at the ages 9 through 13 years (with the exception of a significantly higher mean for girls among 10 year olds). From 14 through 18 years females obtain significantly higher means than males. At age 19 years males obtain a non-significantly higher mean (.19*d* = 2.85 IQ points) and among 20-25 years males obtain a significantly higher mean than females (.09*d* =1.35 IQ points). At first sight, these results appear to give little support to the developmental theory. However, they are consistent with the developmental theory once it is understood that maturation is delayed in economically developing countries as compared with economically developed countries (Eveleth & Tanner, 1990). Maturation has accelerated by about three years in economically developing countries during the nineteenth and twentieth centuries, largely as a result of improvements in nutrition, resulting in the growth spurt occurring an younger ages. The effect of delayed maturation in economically developing countries like Sudan is that the growth spurt of girls takes place in mid-adolescence and gives an IQ advantage over the age range 14-18 years, rather than the 10 through 13 years found in economically developed countries. The IQ advantage of males is likewise delayed until the age of 19 years and adulthood.

The results show no consistent sex difference in variability. In 7 of the age groups, males have greater variability than females, but in 5 of the age groups, females have greater variability than males. There is no consistent trend for the sex difference in variability to vary with age. Thus, in the two youngest age groups, females have greater variability at age 9 while males have greater variability at age 10. In the two oldest age groups, females have greater variability at age 19 while males have greater variability at ages 20-25. Despite the frequent contention that males have greater variability than females, the present results

show that this is a "now you see it, now you don't" phenomenon.

References

Court, J.H.
(1983) Sex differences in performance on Raven's Progressive Matrices: A review. *Alberta Journal of Educational Research*, 29, 54-74.

Deary, I.J., Irwing, P., Der, G. & Bates, T.C.
(2007) Brother-sister differences in the g factor in intelligence: analysis of full, opposite-sex siblings from the NLSY 1970. *Intelligence*, 35, 451-456.

Ellis, H.
(1904) *Man and Woman: A Study of Human Secondary Sexual Characteristics*. London: Walter Scott.

Eveleth, P.B. and Tanner, J.M.
(1990) *Worldwide Variation in Human Growth*. Cambridge, UK: University Press.

Hedges, L. V. & Nowell, A.
(1995) Sex differences in mental test scores, variability, and numbers of high-scoring individuals. *Science*, 269, 41-45.
Irwing, P. and Lynn, R (2005). Sex differences in means and variability on the Progressive Matrices in university students: A meta-analysis. *British Journal of Psychology*, 96, 505–524.

Khatib, M., & Mutwakkil, M.
(2001) *Manual for Standard Progressive Matrices to the Sudanese environment* (in Arabic). Khartoum: Khartoum Press.

Lynn, R.
(1994) Sex differences in brain size and intelligence: a paradox resolved. *Personality and Individual Differences*, 17, 257-271.

Lynn, R. and Irwing, P.
(2004) Sex differences on the Progressive Matrices: a meta-analysis. *Intelligence*, 32, 481-498.

Raven, J.C.
(1939) The RECI series of perceptual tests: An experimental survey. *British Journal of Medical Psychology*, 18, 16-34.

Raven, J., Raven, J.C. & Court, J.H.
(2000) *Standard Progressive Matrices*. Oxford: Oxford Psychologists Press.

Rojahn, J. & Naglieri, J.
(2006) Developmental gender differences on the Naglieri Nonverbal Ability Test in a nationally normed sample of 5-17 year olds. *Intelligence*, 34, 253-260.

Terman, L.M.
(1916) *The Measurement of Intelligence*. New York: Houghton Mifflin.

Thorndike, E.L.
(1910) *Educational Psychology.* New York: Houghton Mifflin.