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Sex Differences in Intelligence: The Developmental Theory

Richard Lynn*
University of Ulster, UK

*Address for correspondence: lynnr540@aol.com

It is a paradox that males have a larger average brain size than females, that brain size is positively associated with intelligence, and yet numerous experts have asserted that there is no sex difference in intelligence. This paper presents the developmental theory of sex differences in intelligence as a solution to this problem. This states that boys and girls have about the same IQ up to the age of 15 years but from the age of 16 the average IQ of males becomes higher than that of females with an advantage increasing to approximately 4 IQ points in adulthood.
Key Words: Sex differences, Intelligence, Developmental theory

There is an inconsistency between the assertion of numerous experts that there is no sex difference in general intelligence and the theoretical expectation that the larger average brain size of men should give them a higher average IQ than women. This paper presents the *Developmental Theory* of sex differences in intelligence as a solution to this problem. The term general intelligence is used in the sense defined by Johnson, Carothers and Deary (2009) "to mean the ability to use combinations of pre-existing knowledge and abstract reasoning to solve any of a variety of problems designed to assess the extent to which individuals can benefit from instruction or the amount of instruction that will be necessary to attain a given level of competence" and measured as the IQ derived as the average of cognitive abilities obtained in tests like the Wechsler, the Stanford-Binet, the Cattell Culture Fair and numerous others.

The equal intelligence of males and females has been almost invariably asserted from the early twentieth century up to the present. Two of the first to advance this conclusion were Burt and Moore (1912) and Terman (1916). In the second half of the century it was frequently restated. Typical conclusions by leading authorities are those of Cattell (1971, p. 131): "it is now demonstrated by countless and large samples that on the two main general cognitive abilities – fluid and crystallized intelligence – men and women, boys and girls, show no significant differences"; Brody (1992, p. 323): "gender differences in general intelligence are small and virtually non-existent"; Eysenck (1981, p. 40): "men and women average pretty much the same IQ"; Herrnstein and Murray (1994, p. 275): "the consistent story has been that men and women have nearly identical IQs"; Mackintosh (1996): "there is no sex difference in general intelligence worth speaking of "; and Hutt (1972, p. 88): "there is little evidence that men and women differ in average intelligence". Others who stated the same conclusion include Maccoby and Jacklin (1974, p. 65) and Geary (1998, p. 310).

The assertions that males and females have the same average IQ continued to be made in the twenty-first century. Lubinski (2000): "most investigators concur on the conclusion that the sexes manifest comparable means on general intelligence "; Colom et al. (2000): "we can conclude that there is no sex difference in general intelligence"; Loehlin (2000, p. 177): "there are no consistent and dependable male-female differences in general intelligence"; Lippa (2002): "there are no meaningful sex differences in general intelligence"; Jorm et al. (2004): "there are negligible differences in general intelligence"; Anderson (2004, p. 829): "the evidence that there is no sex difference in general ability is overwhelming"; Spelke and Grace (2007, p. 65): "men and women have equal cognitive capacity"; Hines (2007, p. 103): "there appears to be no sex difference in general intelligence; claims that men are more intelligent than women are not supported by existing data"; Haier (2007): "general intelligence does not differ between men and women"; Pinker (2008, p. 13): "the two sexes are well matched in most areas, including intelligence"; Halpern (2007, p. 123): "there is no difference in intelligence between males and females…overall, the sexes are equally smart"; Mackintosh (2011, p. 380): "the two sexes do not differ consistently in average IQ"; Halpern (2012, p. 233): "females and males score identically on IQ tests."

1. Sex Differences in Brain Size

It is well established that there is a positive association between brain size and intelligence and that males have a larger average brain size than females. The positive association between brain size and cognitive ability was first shown by Galton (1888) in a study of students at Cambridge University that reported a correlation of .11 between head size and examination results. This positive association was confirmed in a review of studies of head circumference and IQ giving a correlation of .30 (Van Valen, 1974). The first study of intelligence and brain size measured by MRI (Magnetic Resonance Imaging) was reported by Willerman et al. (1991), who estimated the correlation at .35. This association has been further confirmed in subsequent studies, e.g. at r = .43 (Raz et al., 1993), .40 for college students in Turkey (Tan et al., 1999), and .33 in a meta-analysis of 37 studies (McDaniel, 2005).

The larger average brain size of men than of women is also well-established. It was reported by Broca (1861) and confirmed when controlled for body size by Ankney (1992) and Rushton (1992). Thus, there is the paradox that brain size is positively associated with intelligence, that males have a larger brain size than females, that it appears to follow that males should have a higher average IQ than females, yet numerous experts have asserted that males and females have the same average intelligence.

There has been some acknowledgement of the paradox that men have a larger average brain size than women, that brain size is positively associated with intelligence, and yet males and females apparently have the same average intelligence. Butterworth (1999, p. 293) noted the problem, writing that “women's brains are 10% smaller than men's, but their IQ is on average the same” but did not offer a solution to the paradox. Gould (1996) wrote that since women with their smaller average brain size are just as intelligent as men, this disconfirms “the myth that group differences in brain size bear any relationship to intelligence”. Halpern (2012, p. 233) also asserted that “there is no evidence that larger brains are, in any way, better than smaller brains”, but the results of numerous studies do not support this contention.

An attempt to resolve the paradox was made by Jensen (1998), who suggested that females have the same number of neurons in the brain as males but these are smaller and more closely packed. This improbable hypothesis has been shown to be incorrect by Pakkenberg and Gundersen (1997), who reported that men have an average of four billion more neurons than women, a difference of 16 percent. Further data showing that men have more neurons than women have been given by Pelvig et al. (2008).

2. The Developmental Theory

In 1994 I presented the *Developmental Theory* as solution to the paradox that intelligence is positively associated with intelligence, that males have a larger average brain size than females and yet numerous experts have asserted that males and females have the same average intelligence (Lynn, 1994). This stated that boys and girls do have about the same IQ up to the age of 15 years but from the age of 16 the average IQ of males becomes higher than that of females with an advantage increasing to approximately 4 IQ points in adulthood. The reason for this is that the height, weight and crucially the brain size of males increases relative to that of females from the age of 16. One effect of the increasing brain size of males is that their intelligence increases relative to that of females. Data supporting this theory are shown in Table 1.

Table 1. *Sex differences in brain size (female as % of male) and intelligence (ds; positive signs denote boys score higher), ages 12-21. AR, abstract reasoning.*

	12	13	14	15	16	17	18	19	20	21	Reference
Female brain size	92.2	92.5	92.6	91.5	91.2	89.2	-	-	-	86.6	Roche & Malina, 1983; Rushton, 1992
IQ (AR)	-	-	0.00	0.04	0.09	0.10	0.16	-	-	-	Feingold, 1988
IQ (AR)	-	-	0.06	0.08	0.08	0.19	0.25	-	-	-	Lynn, 1992
IQ Spain	- 0.11	-0.12	0.10	0.00	0.09	0.26	0.28	-	-	-	Colom & Lynn, 2004
US:whites	-	-	-	-0.03	0.26	0.29	0.17	0.23	0.32	0.41	Meisenberg, 2009
US: blacks	-	-	-	-0.11	0.07	0.05	0.07	0.00	0.10	0.10	Meisenberg, 2009
US: whites	0.08	0.10	0.02	0.16	0.23	0.26	-	-	-	-	Nyborg, 2015
US: blacks	- 0.13	-0.18	-0.04	-0.19	-0.34	0.43	-	-	-	-	Nyborg, 2015
US: Hispanics	0.00	0.11	-0.08	0.24	-0.03	0.30	-	-	-	-	Nyborg, 2015

Row 1 gives the cranial capacity of females as a percentage of that of males calculated from the head width, length and height data given by Roche and Malina (1983, p. 483) and Rushton (1992) using the Lee and Pearson (1901) formula for converting these dimensions to cranial capacity. Note that the cranial capacity of females as a percentage of that of males declines from the ages of 15 to 17 (data from Roche and Malina, 1983) and declines further at age 21+ (data from Rushton, 1992).

Row 2 gives the American IQ (Abstract Reasoning) data from Feingold (1988) showing an increasing male advantage from ages 14 through 18. Row 3 gives the British-scaled IQ (Abstract Reasoning) data from Lynn (1992) also showing an increasing male advantage from ages 14 through 18. Row 4 gives the data from the Spanish DAT (Differential Aptitude Test) showing negligible differences from age 12 to 15, followed by increasing male advantages from ages 16 through 18, when the male advantage reaches 0.28*d* (4.2 IQ points). Row 5 gives results for 15 to 21 year old whites for the ASVAB (Armed Services Vocational Aptitude Battery) scored for *g* showing a female advantage at age 15 followed by increasing male advantages from age 16 reaching 0.41*d* (6.15 IQ points at age 21 (average of age 21-23). Row 6 gives results from the same data for blacks also showing a female advantage at age 15 followed by male advantages from age 16 but these are very small and not statistically significant. Rows 7, 8 and 9 give results for whites, blacks and Hispanics for the CAT (Cognitive Abilities Test) scored for *g* for 12 to 17 year olds. Row 7 shows that for whites there are negligible differences among 12-15 year olds followed by a male advantage among 16 and then among 17 year olds of 0.26*d.* Row 8 shows that for blacks there are female advantages among 12-16 year olds followed by a male advantage among 17 year olds of 0.43*d*. Row 9 shows that for Hispanics there are inconsistent results among 12-16 year olds followed by a male advantage among 17 year olds of 0.30*d*.

To calculate the magnitude of the higher adult male IQ that would be predicted from the larger male brain size I took Ankney's figure of the male-female difference in brain size expressed in standard deviation units of 0.78*d* and Willerman et al.'s (1991) estimate of the correlation between brain size and intelligence of 0.35. These figures would give adult males a higher average IQ of 0.78 multiplied by 0.35 = .27*d* = 4.0 IQ points. In my 1994 paper I presented data showing adult male advantages of 1.7 IQ points on verbal ability, 2.1 IQ points on verbal and non-verbal reasoning ability, and 7.5 IQ points on spatial, giving an average male advantage among adults of 3.8 IQ points and thus very close to the predicted advantage of 4.0 IQ points. I published further data for this male advantage in Lynn (1998, 1999). The male advantages given by Meisenberg (2009) given in Table 1 of 0.42*d* for whites and 0.30*d* for blacks are reasonably consistent with these results.

Further studies showing that a male IQ advantage begins to appear from the age of 16 years have been reported by Nyborg (2003, p. 212; 2005) giving a male advantage of 5.5 IQ points in a Danish adult sample; and by Jackson & Rushton (2006) who reported a male advantage of 3.6 IQ points in a sample of 100,000 17-18 year olds on the American Scholastic Assessment Test.

3. The Progressive Matrices

The great majority of scholars have ignored my solution to the sex difference in intelligence and brain size paradox and continued to assert that there is no sex difference in general intelligence. The only scholar who disputed my thesis was Mackintosh (1996, p. 567), who argued that Raven's Progressive Matrices is one of the best measures of *g* and that on this test "there is no sex difference in general intelligence worth speaking of …large scale studies of Raven's tests have yielded all possible outcomes, male superiority, female superiority and no difference… there appears to be no difference in general intelligence." He reiterated this conclusion in a subsequent paper contending that there is at most "only a very small difference consisting of no more than 1-2 IQ points among adults either way" (Mackintosh, 1998).

In response to this criticism, Irwing and I published a meta-analyses of sex differences on the Progressive Matrices among general population samples that showed that males obtain higher IQs than females from the age of 16 years reaching 5 IQ points among adults (Lynn & Irwing, 2004), and a meta-analysis of sex differences on the Progressive Matrices among college student samples that concluded that males have an advantage of 4.6 IQ points (Irwing & Lynn, 2005). These results have been confirmed in subsequent studies, e.g. by a higher male IQ of 4.35 points in a Scottish sample (Deary et al., 2004) and by a higher male IQ of 4.05 in a Serbian sample (Čvorović & Lynn, 2014).

4. The Wechsler Tests

Our meta-analyses showing an adult male advantage on the Progressive Matrices have been criticized by Cooper (2015, p. 207), who argues that sex differences in intelligence would be best examined by "averaging performance across a number of disparate tasks as with tests such as the WAIS". He seems to have been unaware that I had presented the results of fourteen studies of the sex differences on the Wechsler tests in my 1994 paper and showed that in eight studies of 6-16 year olds on the WISCs males obtained higher IQs than females by an average of 2.35 IQ points, and that in six studies of adults on the WAIS males obtained higher IQs than females by an average of 3.08 IQ points (Lynn, 1994, p. 259).

Cooper was right to suggest that the Wechsler tests provide some of the best data with which to evaluate the no-sex-difference theory and the male advantage theory because a number of them have been standardized on representative samples and they measure a wide range of verbal, spatial, perceptual, reasoning and memory abilities that are averaged to provide the Full Scale IQ as a measure of general intelligence. Advocates of the no IQ sex difference theory have asserted that males and females obtain the same IQs on these tests. Thus, it has been asserted by Halpern (2000, p. 91) that the WAIS Full Scale IQ "does not show sex differences". This assertion was repeated by Anderson (2004, p. 829): "The evidence that there is no sex difference in general ability is overwhelming. This is true whether general ability is defined as an IQ score calculated from an omnibus test of intellectual abilities such as the various Wechsler tests, or whether it is defined as a score on a single test of general intelligence, such as the Raven's Matrices". The same assertion has been made by Haier et al. (2004, p. 1): "Comparisons of general intelligence assessed with standard measures like the WAIS show essentially no differences between men and women." In the fourth edition of her textbook on sex differences in intelligence, Halpern (2012, p. 115) states that on the standardization sample of the American WAIS-IV "the overall IQ score does not show sex differences". We consider now how far the evidence supports these assertions that there is no sex difference in intelligence measured by the Wechsler tests.

5. The WPPSI

The Wechsler Preschool and Primary Scale of Intelligence (WPPSI) was constructed in the United States in the mid-1960s by Wechsler (1967) and was designed for children aged between 4 and 7 years. It consists of five verbal subtests designated information, vocabulary, arithmetic, similarities and comprehension that are averaged to give the Verbal IQ, and five performance subtests designated animal house, picture completion, mazes, geometric design and block design that are averaged to give the Performance IQ. The Verbal IQ and Performance IQ are averaged to give the Full Scale IQ. Subsequent standardizations of the WPPSI designated the WPPSI-R and the WPPSI-III have been published in the United States.

Six studies of the sex differences on the WPPSI are summarized in Table 2. The data for the United States and Japan are for standardization samples. In the USA, Canada and Iran girls obtained slightly higher Full Scale and Verbal IQs than the boys while in China, England and Japan the boys obtained slightly higher Full Scale and Performance IQs but the girls obtained a higher Verbal IQ. All sex differences in the American, English, Canadian and Japanese samples are small. In the Iranian sample the girls obtained an appreciably higher Full Scale, Verbal and Performance IQ than the boys but the sample is very small at 54 and the sex differences are not statistically significant. The results as a whole suggests there is no significant sex difference at the age of 4 to 7 years.

Table 2. *Sex differences on the WPPSI: ds for Full Scale (FS), Verbal (V) and Performance IQ (P). Positive signs denote boys score higher.*

Country	N	FS	V	P	Reference
Canada	109	-0.03	-0.07	0.00	Miller & Vernon, 1996
China	1331	0.14	0.16	0.11	Liu & Lynn, 2011
England	150	0.14	0.10	0.14	Yule et al., 1969
Iran	54	-0.23	-0.42	-0.27	Ghaderpanah et al., 2015
Japan	599	0.06	-0.01	0.11	Hatttori, 2000
USA	1199	-0.06	-0.02	-0.01	Kaiser & Reynolds, 1985

6. The WISC

The Wechsler Intelligence Scale for Children (WISC) was constructed in the United States in the mid-1940s by Wechsler (1949) and was designed for children aged between 6 and 16 years. It consists of six verbal subtests designated Information, Vocabulary, Arithmetic, Similarities, Comprehension and Digit Span the first five of which are averaged to give the Verbal IQ, and six performance subtests designated Picture Completion, Picture Arrangement, Object Assembly, Coding, Block Design and Mazes, the first five of which are averaged to give the Performance IQ. The Verbal IQ and Performance IQ are averaged to give the Full Scale IQ. Subsequent standardizations of the WISC have been published in the United States and are designated the WISC-R, WISC-III and WISC-IV. The results of sex differences on the WISC tests are summarized in Table 3.

Table 3. *Sex differences on the WISCs, ds for Full Scale (FS), Verbal (V) and Performance IQ; positive signs denote boys score higher.*

Country	Test	N	FS	V	P	Reference
Bahrain	WISC-III	10	0.03	-0.10	0.04	Bakhiet & Lynn, 2015
Belgium	WISC-R	76	0.12	0.16	0.10	van der Sluis et al., 2008
China	WISC-R	223	0.28	0.30	0.21	Dai & Lynn, 1994
China	WISC-R	78	0.25	0.16	0.28	Liu & Lynn, 2015
Germany	WISC-IV	165	0.07	0.19	-	Goldbeck et al., 2010
Greece	WISC	40	0.21	0.19	0.27	Fatouros, 1972
Iran	WISC-R	140	0.04	-	-	Shahim, 1990, 1992
Israel: Jews	WISC-R	211	0.32	0.29	0.19	Lieblich, 1985
Israel: Arabs	WISC-R	63	0.41	0.43	0.43	Lieblich, 1985
Israel	WISC-R	110	0.19	0.20	0.01	Cahhan, 2005
Libya	WISC-R	21	0.10	-0.13	0.42	Al-Shahomee et al., 2016
Mauritius	WISC-R	125	0.60	0.16	0.70	Lynn, Raine et al., 2005
Netherlands	WISC-R	202	0.14	0.16	0.08	Born & Lynn, 1994
Netherlands	WISC-R	73	0.25	0.26	0.00	van der Sluis et al., 2008
New Zealand	WISC-R	89	0.06	0.09	0.00	Lynn, Fergusson et al., 2005
Romania	WISC-R	10	0.70	0.32	0.62	Dumitrascu, 1999
Scotland	WISC-R	136	0.18	0.31	0.01	Lynn & Mulhern, 1991
Sudan	WISC-III	121	0.23	0.26	0.13	Bakhiet et al., 2016
Taiwan	WISC-III	110	0.21	0.13	0.25	Chen et al., 20116
USA	WISC	220	0.17	0.25	0.06	Seashore et al., 1950
USA	WISC-R	186	0.12	0.19	0.01	Jensen & Reynolds, 1983
USA: whites	WISC	112	0.07	-	-	Jensen & Johnson, 1994
USA: blacks	WISC	81	-0.04	-	-	Jensen & Johnson, 1994
USA	WISC-R	10	0.53	-	-	Rushton, 1997
USA	WISC-R	85	0.29	-	-	Knopik & Defries, 1998

The WISC-III and the WISC-IV are also scored from the subtests to provide four Index IQs and a Full Scale IQ. The four Index IQs are Verbal Comprehension (the sum of the Vocabulary, Similarities and Comprehension subtests), Perceptual Reasoning (designated Perceptual Organization in the WISC-III, the sum of the Block Design, Matrix Reasoning and Picture Completion subtests), Working Memory (designated Freedom from Distractibility in the WISC-III, the sum of the Digit Span and Letter-Number Sequencing subtests), and Processing Speed (the sum of the Coding and Digit Symbol subtests). The Index IQs are averaged to give the Full Scale IQ. The results of these studies of sex differences on the WISC-III and IV tests are summarized in Table 4.

Table 4. *Sex differences on the WISC-III and WISC-IV for Full-Scale IQ (FS) and the four index IQs: Verbal Comprehension (VC), Perceptual Reasoning (PR), Working Memory (WM), and Processing Speed (PS). Differences expressed as d, positive signs denote boys score higher.*

Country	Test	N	FS	VC	PR	WM	PS	Reference
China	WISC-IV	1744	.12	.19	.26	-.08	-.19	Li et al., 2016
Germany	WISC-IV	1650	.06	.19	.13	.08	-.33	Goldbeck et al., 2010
Italy	WISC-IV	2200	-.03	.09	.04	.01	-.28	Pezzuti & Orsini, 2016
Sudan	WISC-III	1214	.23	.25	.29	.06	-.27	Bakhiet et al., 2017
Taiwan	WISC-III	1100	.21	.11	.36	.06	-.25	Chen et al., 2016
USA	WISC-III	2200	.11	.13	.08	.06	-.46	Chen et al., 2016

The studies of the WISCs for children aged between 6 and 16 years summarized in Table 3 give Full Scale IQs for 25 samples. In all of these studies boys obtained higher Full Scale IQs than girls except for American blacks. These results are confirmed by those for the six studies of WISC-III and WISC-IV given in Table 4 in five of which boys obtained higher Full Scale IQs than girls. Combining the results in Tables 3 and 4 gives 31 studies for which the median advantage of boys is .19*d,* equivalent to 2.85 IQ points. These results disconfirm the assertions cited in section 4 that there is no sex difference on the Wechsler tests and also my previous contention that there is virtually no sex difference in children up to the age of 15 years. It seems that we have all been wrong about this.

The studies of Verbal IQ in the WISCs for children aged between 6 and 16 years summarized in Table 3 give results for 20 samples. In two of these girls obtained a higher Verbal IQ than boys, namely in Bahrain and Libya. In the remaining 18 studies boys obtained higher Verbal IQs than girls. These results are confirmed by those for the six studies of the WISC-III and WISC-IV given in Table 4 in all of which boys obtained higher Verbal Comprehension IQs than girls.

Combining the results in Tables 3 and 4 gives 26 studies for which the median advantage of boys is .19*d,* equivalent to 2.85 IQ points, the same as for the Full Scale IQ. The studies of the Performance IQs on the WISCs summarized in Table 3 give results for 19 samples. In 17 of these boys obtained higher Performance IQs than girls and in two there was no difference. The median of the studies is a boys' advantage of .19*d*. The Performance IQ measures a mix of non-verbal abilities.

The results for six studies of the WISC-III and WISC-IV summarized in Table 4 show that in all of these males obtained a higher Verbal Comprehension IQ with a median advantage of .16*d,* confirming the male advantage in verbal ability shown in Table 3. Males obtained higher Perceptual Reasoning IQs with a median advantage of .16*d,* and in Working Memory IQ with a median advantage of .07*d.* On Perceptual Speed females obtained higher IQs with a median advantage of .28*d*.

7. The WAIS

The Wechsler-Bellevue Intelligence Scale (WBIS) was constructed in the United States in the mid-1940s by Wechsler and was designed for those aged 16 years into old age. It has been through four revisions designated the WAIS (Wechsler Adult Intelligence Scale), WAIS-R, WAIS-III and WAIS-IV. It consists of six verbal subtests designated Information, Vocabulary, Arithmetic, Similarities, Comprehension and Digit Span which are averaged to give the Verbal IQ, and five performance subtests designated Picture Completion, Picture Arrangement, Object Assembly, Block Design and Digit Symbol which are averaged to give the Performance IQ. The Verbal IQ and Performance IQ are averaged to give the Full Scale IQ. The results of studies of sex differences on the WAIS tests are summarized in Tables 5 and 6.

The WAIS-III and the WAIS-IV (like the WISC-III and the WISC-IV) are also scored from the subtests to provide four index IQs and a Full Scale IQ. The four index IQs are Verbal Comprehension (the sum of the Vocabulary, Similarities and Comprehension subtests), Perceptual Reasoning (the sum of the Block Design, Matrix Reasoning and Picture Completion subtests), Working Memory (the sum of the Digit Span and Letter-Number Sequencing subtests), and Processing Speed (the sum of the Coding and Digit Symbol subtests). The index IQs are averaged to give the Full Scale IQ. The results of studies of sex differences on the WAIS-III and the WAIS-IV tests are summarized in Table 6 and show that in the ten studies males obtained higher Full Scale IQs than females with a median advantage of 0.165*d* equivalent to 2.5 IQ points.

Table 5. *Sex differences of adults on the WAIS tests: Full scale (FS), Verbal (V) and Performance IQ (P) in d, positive signs denote males score higher.*

Country	Test	N	FS	V	P	Reference
China	WAIS-R	1979	0.33	0.36	-	Lynn & Dai, 1993
China	WAIS-R	120	0.43	0.42	0.44	Yao et al., 2004
Denmark	WAIS	62	0.21	-	-	Nyborg, 2005
Finland	WAIS-III	407	0.07	0.08	0.07	Finland Psych. Corp., 2006
Italy	WAIS-R	1168	0.45	0.43	0.35	Saggino et al., 2014
Japan	WAIS-R	1402	0.22	0.28	0.10	Hattori & Lynn, 1997
Netherlands	WAIS	2100	0.27	0.29	-	Stinissen, 1977
Romania	WAIS	100	0.44	0.25	0.52	Dumitrascu, 1999
Romania: Roma	WAIS	100	0.44	0.37	0.42	Dumitrascu, 1999
Russia	WAIS	296	0.13	-	-	Grigoriev et al., 2016
Russia	WAIS	1800	0.22	0.42	0.15	Grigoriev et al., 2016
Scotland	WAIS-R	200	0.39	0.43	0.28	Lynn, 1998
USA	W-Bell	235	0.59	0.63	0.35	Strange & Palmer, 1953
USA	W-Bell	153	0.20	0.52	-0.35	Norman, 1953
USA	W-Bell	392	0.29	0.34	0.22	Goolishian & Foster, 1954
USA	WAIS	1700	0.10	0.10	0.10	Matarazzo, 1972
USA	WAIS	279	0.40	0.14	0.26	Boor, 1975
USA	WAIS	588	0.17	0.21	-	Horn et al., 1979
USA	WAIS	521	0.13	-	-	Turner & Willerman, 1977
USA	WAIS	649	0.12	0.20	-0.08	Doppelt & Wallace, 1955
USA	WAIS-R	230	0.27	0.25	0.23	Arceneaux et al., 1996
USA	WAIS-R	206	0.28	0.37	-	Ilai & Willerman, 1989
USA	WAIS-R	1880	0.15	0.15	0.09	Matarazzo et al., 1986

The studies of the 23 WAIS IQs for adults summarized in Table 5 show that men obtained a higher Full Scale IQ than women in all samples. The studies of the 10 WAIS IQs for adults summarized in Table 6 again show that men obtained higher Full Scale IQs than women in all samples. The median male advantage for the 33 studies is .24*d*, equivalent to 3.6 IQ points. The median male advantage among adults of 3.6 IQ points is greater than the median advantage among children of 2.85 IQ points, confirming the thesis advanced in Lynn (1994).

Table 6. *Sex differences on the WAIS-III and WAIS-IV for Full-Scale IQ (FS) and the four index IQs: Verbal Comprehension (VC), Perceptual Reasoning (PR), Working Memory (WM), and Processing Speed (PS). Differences expressed as ds; positive signs denote males score higher*.

Country	Test	N	FS	VC	PR	WM	PS	Reference
Brazil	WAIS-III	3494	.07	-	-	-	-	Victora et al., 2015
Canada	WAIS-III*	1104	.11	-	-	-	-	Longman et al., 2007
Chile	WAIS-IV*	887	.20	.16	.26	.25	.03	Diaz & Lynn, 2016
Germany	WAIS-IV	137	.08	-	-	-	-	Lepach et al., 2015
Hungary	WAIS-IV*	1110	.08	.12	.18	.23	-.32	Rósza et al., 2010
Korea, South	WAIS-IV*	1228	.31	.36	.35	.46	-.33	Lynn & Hur, 2016
Netherlands	WAIS-III	519	.24	.30	.23	.26	-.45	van der Sluis, 2006
Spain	WAIS-III*	1369	.24	.13	.24	.24	.18	Colom et al., 2002
USA	WAIS-III*	2450	.18	.23	.22	.24	-.45	Irwing, 2012
USA	WAIS-IV*	2200	.15	.23	.24	.22	-.30	Piffer, 2016

*standardization samples

The Verbal IQs of adults summarized in the 20 studies given in Table 5 and in the 7 studies given in Table 6 show that in all samples men obtained a higher Verbal IQ than women. The median male advantage for the 27 studies is .23*d*, equivalent to 3.45 IQ points. This male advantage is greater than that of 2.85 IQ points among children and provides further confirmation that the male IQ advantage among adults is greater than among children. These results of the seven studies of the WAIS-III and WAIS-IV given in Table 6 show that in all of these males obtained higher Verbal Comprehension IQs with a median advantage of .23*d*. Males obtained higher Perceptual Reasoning IQs with a median advantage of .24*d*, and in Working Memory they had a median advantage of .24*d.* On Processing Speed females obtained higher IQs in 5 of the 7 studies with a median advantage of .32*d*.

The median male advantage of 3.6 IQ points on the WAIS Full Scale IQ in all 33 samples is a disconfirmation of the assertions by Halpern (2000, p. 91), Anderson (2004, p. 829) and Haier et al. (2004, p.1) that there is no sex difference on the WAIS Full Scale IQ. It is also a disconfirmation of Halpern's (2012, p. 115) assertion that in the standardization sample of the American WAIS IV “the overall IQ score does not show sex differences”. Contrary to this assertion, Piffer's (2016) study shows that men obtained a statistically significant higher Full Scale IQ of 2.25 IQ points than women.

The median male advantage of 3.6 IQ points on the 33 studies of the WAIS

Full Scale IQ is only slightly lower than the male advantage of 4 IQ points among adults that I estimated in my first paper on this issue (Lynn, 1994). It should be noted that this male advantage is consistently present despite efforts by test developers to construct tests on which males and females obtain the same IQs. Thus “From the very beginning test developers of the best known intelligence scales (Binet, Terman, and Wechsler) took great care to counterbalance or eliminate from their final scale any items or subtests which empirically were found to result in a higher score for one sex over the other” (Matarazzo, 1972, p. 352); and “test developers have consistently tried to avoid gender bias during the test development phase” (Kaufman & Lichtenberger, 2002, p. 98). The Wechsler tests have reduced the true male advantage by excluding measures of spatial perception and mental rotation on which males obtain higher scores than females by 9.6 and 10.9 IQ points, respectively (Voyer, Voyer & Bryden, 1995); and also by excluding tests of mechanical abilities on which 18 year old males have an advantage of .72*d* (10.2 IQ points) (Hedges & Newell, 1995). This has been noted by Eysenck (1995, p. 128), who adopted my estimate of a 4 IQ point male advantage: “Allowing for the fact that Wechsler made every effort to equalize IQ between the sexes... we may perhaps say that an IQ difference of four points would be a conservative estimate of the true difference.”

8. Sex Differences in Verbal and Spatial Abilities

Ritchie (2015, p. 105) stated in his recent textbook on intelligence that “Women tend to do better than men on verbal measures, and men tend to outperform women on tests of spatial ability; these small differences balance out so that the average general score is the same.” A similar assertion has been made in a recent textbook on intelligence by Cooper (2015, p. 207), who writes: “In adulthood...women tend to perform better than men in verbal tasks, whilst men outperform women slightly in spatial tasks.”

Contrary to these assertions, scholars who have examined the evidence accumulated over many decades have concluded that there is virtually no sex difference in verbal abilities but there is a large male advantage in the spatial abilities. Half a century ago the evidence was reviewed by Tyler (1965, p. 144), who concluded that "on vocabulary, the sex groups have turned out not to differ significantly" but "in spatial relationships, a consistent male superiority has been demonstrated." Subsequent research has confirmed this conclusion. A meta-analysis of sex differences in verbal abilities by Hyde and Linn (1988) concluded that there is no sex difference although a weighted mean of all studies gave a male advantage of .04*d*. A meta-analysis of sex differences in spatial abilities by Linn and Petersen (1985) concluded that there is a male advantage of .50*d*. The average of the two meta-analyses gives a male advantage of .27*d* equivalent to 4.05 IQ points as predicted in the Introduction to this paper. A later study by Hedges and Newell (1995) reported the results of the American High School and Beyond data for 25,069 18-year-olds collected in 1980 showing that females had a negligible advantage of .04*d* on verbal ability and males had an advantage of .25*d* on spatial ability, giving an average male advantage of .19*d.* These results therefore do not support the assertions by Ritchie (2015) and Cooper (2015) that females obtain higher verbal IQs than males and males obtain higher spatial IQs than females and these balance out to give no sex difference in general intelligence.

9. Other Tests of General Intelligence

Sex differences in 26 studies of subjects aged 16 years and above using other tests of general intelligence are summarized in Table 7.

Table 7. *Sex differences in general intelligence (ds; positive signs denote males score higher).*

	Test	Country	N	Age	*d*	Reference
1	IUIS	USA	5748	17	0.15	Book, 1922
2	SB	USA	419	15-18	0.13	McNemar, 1942
3	AH4	Britain	4243	50-69	0.22	Rabbitt et al., 1995
4	AH4	Britain	900	50	0.08	Deary et al., 2001
5	AH4	Iran	3120	17-18	0.29	Mehryar et al., 1972
6	AH5	N. Ireland	1436	17	0.32	McEwen et al., 1986
7	IST	Germany	227	17	0.30	Amelang & Steinmayr, 2006
8	IST	Germany	207	34	0.40	Amelang & Steinmayr, 2006
9	IST	Germany	977	17	0.77	Steinmayr et al., 2015
10	IST	Austria	449	21	0.41	Pietschnig et al., 2011
11	Dureman	Norway	3064	18-65	0.51	Nystrom, 1983
12	DAT	Britain	653	17-18	0.12	Lynn, 1992
13	DAT	Ireland	2600	18	0.17	Lynn, 1996
14	DAT	Spain	703	16-18	0.21	Colom & Lynn, 2004
15	DAT	USA	692	16-17	0.12	Keith et al., 2011
16	Tiki-T	Indonesia	936	18-24	0.16	Drenth et al., 1977
17	SAT	Israel	1778	24	0.40	Zeidner, 1986
18	SAT	Sweden	31342	18	0.38	Stage, 1988
19	RIT	Portugal	1519	16	0.17	Lemos et al., 2013
20	Test QI	France	222000	21-70	0.25	Société Anxa, 2004
21	KAIT	USA	1146	17-94	0.22	Kaufman et al., 1995
22	KAIT	USA	1500	17-94	0.10	Kaufman & Horn, 1996
23	KBIT	USA	2022	4-90	0.16	Kaufman & Wang, 1992
24	WJIII	USA	441	19-79	0.57	Camarata & Woodcock, 2006
25	CET	USA	1394	16-20	0.14	Roalf et al., 2014
26	HCP	Netherlands	900	28	0.28	van der Linden et al., 2017

In all these studies males obtained higher IQs than females. There is a wide range of results from the male advantage of .08*d* to .77*d* with a median of .22*d.* Note that the male advantage of .15*d* among 17 year olds reported in 1922 and given in row 1 is virtually identical to that of .14*d* reported in 2014 for the same age group by Roalf et al. (2014) disconfirming the thesis advanced by Feingold (1988), Flynn (2012) and Mackintosh (2011) that a male advantage in former years had disappeared by the twenty-first century. The tests are identified in the Appendix.

10. Sex Differences in *g*

Spearman (1923) asserted that there is no sex difference in *g*, the common factor that accounts for about half the variance in intelligence assessed in tests like the Wechsler's, e.g. Colom et al. (2002). Studies that have addressed the question of whether there is a sex difference in *g* are summarized in Table 8. Row 1 gives the results of Jensen and Reynolds (1983) for the American WISC-R standardization sample of whites; a Schmid-Leiman principal factor analysis was carried out to obtain factor scores on *g* and on independent second stratum factors of verbal, performance and memory abilities. The first two of these correspond approximately to Carroll's second-stratum factors 2C and 2V; the third is more problematical and appears to be approximately Carroll's first stratum Perceptual Speed factor. The sex differences on the factor scores were calculated. The results were that males obtained a higher mean score on *g* of .161*d*, on the verbal and performance factors of .175*d* and .144*d,* while females obtained a higher mean score on the memory factor of .256*d*.

Jensen returned to this problem in his book *The g Factor* (1998, p. 538). Here he argued that his use of *g* factor scores in his first study was not the best method for analyzing sex differences in *g* because "*g* factor scores are not a pure measure of the *g* factor … it is somewhat contaminated by including small bits of other factors and test specificity measured by the various subtests." To overcome this problem he proposed the method of correlated vectors (CV), described as follows: "the sex difference in *g* is calculated by including the sex difference on each of the sub-tests of a battery in terms of a point-biserial correlation and including these correlations with the full matrix of inter-correlations for factor analysis; the results of the analysis will reveal the factor loading of sex on each of the factors that emerge from the analysis, including *g*" (Jensen, 1998, p. 538). His results for the WISC-R standardization sample are shown in Table 8. It will be seen that this method produced a similar but slightly greater male advantage of .189*d,* as compared with the male advantage of .161*d* obtained from the principal factor method shown in row 1.

Table 8. *Studies of sex differences in g (d, positive signs denote males higher).*

	Country	Age	N	Test	Method	*d*	Reference
1	USA	6-16	1868	WISC-R	PF	0.161	Jensen & Reynolds, 1983
2	USA	6-16	1868	WISC-R	CV	0.189	Jensen, 1998
3	USA	18-23	-	ASVAB	CV	0.366	Jensen, 1998
4	USA	25-34	-	WAIS	CV	0.012	Jensen, 1998
5	USA	18	-	GATB	CV	-0.527	Jensen, 1998
6	USA	17-17	-	BAS	CV	-0.002	Jensen, 1998
7	USA	18	2584	AFQT	CFA	0.06	Deary et al., 2007
8	USA	17-18	102516	SAT	CV	0.24	Jackson & Rushton, 2006
9	USA	18-79	436	Various	MIMIC	0.14	Johnson & Bouchard, 2007
10	USA	16	2100	KABC	MIMIC	-0.15	Reynolds et al., 2008
11	USA	17-18	275	KABC	MIMIC	-0.12	Reynolds et al., 2008
12	USA	16-59	3884	W-J III	MIMIC	0.08	Keith et al., 2008
13	USA	16-59	3086	W-J III	MIMIC	-0.17	Keith et al., 2008
14	USA-blacks	23	1383	ASVAB	PC	0.16	Meisenberg, 2009
15	USA-whites	23	3797	ASVAB	PC	0.45	Meisenberg, 2009
16	USA	16-89	2450	WAIS-III	MGCFA	0.20	Irwing, 2012
17	USA-blacks	16-17	472	ASVAB	PC	-0.30	Nyborg, 2015
18	USA-Hisp.	16-17	327	ASVAB	PC	0.04	Nyborg, 2015
19	USA-whites	16-17	913	ASVAB	PC	0.24	Nyborg, 2015
20	Denmark	11	52	Various	HOFA	0.18	Nyborg, 2005
21	Denmark	16	52	Various	HOFA	0.27	Nyborg, 2005
22	Germany	18-21	187110	TMS	PC	0.50	Stumpf & Jackson, 1994
23	Estonia	18	1201	Various	PC	0.65	Allik et al., 1999
24	Netherlands	Adults	519	WAIS-III	MGCFA	0.30	van der Sluis et al., 2006
25	Portugal	13	1714	RTB	MGCFA	0.13	Lemos et al., 2013
26	Portugal	16	1519	RTB	MGCFA	0.29	Lemos et al., 2013
27	Scotland	11	70000	CAT	PA	-0.01	Deary, Irwing et al., 2007
28	Spain	13	678	Various	PF	-0.19	Aluja-Fabregat et al., 2000
29	Spain	13	887	Various	PF	-0.15	Aluja-Fabregat et al., 2000
30	Spain	23	6879	Various	CV	0.49	Colom et al., 2000
31	Spain	23	3596	Various	CV	0.38	Colom et al., 2000
32	Spain	16-94	1369	WAIS-III	CV	0.16	Colom et al., 2002
33	Spain	16-34	588	WAIS-III	MGCMSA	0.03	Dolan et al., 2006

CFA: confirmatory factor analysis
CV: correlated vectors
HOFA: hierarchical oblique factor analysis (Schmid-Leiman transformation)
MGCFA: multi-group confirmatory factor model with mean structures
MGCMSA: multi-group covariance and mean structures analysis
MIMIC: multiple indicator-multiple cause
PA: principal axis
PC: principal components
PF: principal factor

Jensen (1998, p. 538) used the same method to analyze four further data sets. His results are summarized in rows 3-6. The results were that males obtained a higher *g* of .366*d* on the ASVAB (Armed Services Vocational Aptitudes Battery) and of .12*d* on the American standardization sample of the WAIS; females obtained a higher *g* of .527*d* on the GATB (General Aptitude Test Battery); while there was no sex difference (.002*d*) on the BAS (British Ability Scales). These results are highly inconsistent and Jensen (1998, p. 40) concluded that "the sex difference in psychometric *g* is either totally non-existent or is of uncertain direction and of inconsequential magnitude".

This conclusion cannot be accepted. The major inconsistency in these results is the large female advantage of .527*d* on the GATB. This is attributable, as Jensen points out (p. 543), to the presence in the battery of five perceptual motor tests on which females perform well. When these are removed and the analysis is carried out on the three cognitive tests of verbal, numerical and spatial abilities, the sex difference becomes .021*d* (a negligible difference in favor of males). This shows that the sex difference in *g* obtained by the method of correlated vectors depends on the nature of the tests from which the *g* factor is extracted and that the method of correlated vectors is flawed as a technique for measuring *g* independent of the nature of the tests in the battery from which it is extracted.

A number of criticisms of this method have been made by Dolan and Hamaker (2001), Lubke et al. (2003), Nyborg (2003) and Ashton and Lee (2005). These have argued that the method of correlated vectors is invalid on a number of grounds including (1) the correlations calculated using the method are dependent on the combination of subtests used to measure *g*; (2) the correlations between the sex and non-*g* sources of variance in the battery of tests; Ashton and Lee (2005) demonstrate that, due to these sources of contamination, the method of correlated vectors can yield a correlation of zero even when a variable has a strong relation with *g*, leading to the erroneous conclusion of no sex difference in *g*; (3) the method of correlated vectors lacks power even in large samples, because the degrees of freedom equal the number of subtests minus 1. Thus, the degrees of freedom were 4 and 5 in the two studies in the Colom et al. (2000) study, and 13 in the Colom et al. (2002) study, producing non-significant sex differences in *g* even though the differences are appreciable. This conclusion is elaborated by Nyborg (2003, p. 206), who also discusses the principal axis (PA) and principal components (PC) methods of measuring *g* and considers both unsatisfactory. He prefers hierarchical oblique factor analysis (HOFA, Schmid-Leiman transformation) on which he reported a male advantage on *g* of .27*d* in a sample of 16-year-olds.

Meisenberg (2009) reported that there was no significant sex difference on *g* among 15-year-olds among either blacks or whites. Among whites a significant male advantage of 4 IQ points was present among 16-year-olds, and this increased to an advantage of 6.5 points among 22-year-olds. For blacks there was a male advantage of 1 IQ point at age 16 that increased to an advantage of 2.15 points at age 22.

In more recent studies the preferred method for measuring differences in *g* has been the multi-group confirmatory factor model with mean structures (MGCFA) as described and used by Irwing (2012). Three studies have been published using this method for samples aged 16 and above with the results given in rows 16, 24 and 26 in Table 8, with male advantages of .20*d*, .30*d* and .29*d*. These give an average of .26*d*, almost the same as Nyborg's .27*d* estimate. This is equivalent to 3.9 IQ points, the same as my estimate of the adult male IQ advantage and thus suggesting that the male IQ advantage is wholly attributable to an advantage in *g*. We have therefore reached the opposite of Jensen's (1998, p. 540) conclusion that "the sex difference in psychometric *g* is either totally non-existent or is of uncertain direction and of inconsequential magnitude; the generally observed sex difference in variability of tests scores is attributable to factors other than *g*", and also contrary to the conclusion reached by Colom et al. (2000, p. 65) that there is "a negligible sex difference in *g.*"

A further method for estimating the sex difference in *g* is to adopt the Raven's Progressive Matrices as a proxy for *g* as proposed by Mackintosh (1996) and Jensen (1998, p.38) because its *g* loading is approximately .80. As noted in Section 3, the meta-analysis of the sex difference among adults showed a higher male average of .33*d* (Lynn & Irwing, 2004) giving a further confirmation of a male advantage in *g*.

11. Sex Differences in High Achievement

It is a notorious fact that there are many more men than women at the top of all professions, except of course the oldest. This has frequently been attributed to "the glass ceiling", an invisible and hypothetical barrier that men in senior positions impose to prevent women from rising to the top. Ceci and Williams (2007) have edited a book in which 15 experts discuss this phenomenon in connection with the question of why there are so many more men than women who are high achievers in science. None of these experts described as "top researchers" acknowledge that this is partly attributable to men having a higher average IQ than women and hence a greater proportion at the high end of the IQ distribution. Two of these experts, Spelke and Grace (2007), mention this as a possibility but dismiss it citing evidence that there are no sex differences in ability among infants on the basis of which they assert that “men and women have equal cognitive capacity” (p. 65).

None of the 15 experts discuss the explanation advanced by Eysenck (1995, p. 128) for the larger numbers of men than of women at the top of science and other professions and among geniuses. Eysenck accepted my thesis that men have a 4 points higher IQ than women and calculated that this advantage combined with the greater male variance of a standard deviation of 15 for men and 14 for women would produce 55 men and 5 women per 10,000 with an IQ of 160 and above, a ratio of 10:1. The same point has been made more recently by Nyborg (2015, p. 51), who presents data for a male advantage of 3.9 IQ points among American white 17 year olds and calculates that this advantage gives men a ratio of 5:1 to women at an IQ of 145 (approximately one per 300 males). He shows that this is about the ratio of men to women in senior positions in academia and business in a number of countries. In addition to the IQ advantage, it has been shown in a number of countries that men are more competitive than women and hence more motivated to reach top positions (Lynn, 1993). The higher average male IQ, greater male IQ variance and greater male competitiveness are sufficient to explain the greater numbers of men than of women in top positions. The construct of a glass ceiling barrier calls for William of Ockham's (1281-1347) razor: "Hypothetical entities should not be unnecessarily multiplied".

12. The Pietschnig, Penke, Wicherts et al. (2015) Study

The recent meta-analysis of the relation between brain size and intelligence by Pietschnig et al. (2015) makes an important contribution to the sex differences paradox. The study confirms the positive association and concludes from an analysis of 88 studies that the correlation is .24. Pietschnig et al. (2015) acknowledge their result may imply that males should have a higher average IQ but state that "careful analyses of datasets not limited by range restriction clearly indicate the absence of sex differences in IQ (Dykiert, Gale & Deary, 2009; Flynn, 2012; Johnson, Carothers & Deary, 2009)”.

The three citations in the last of these papers do not support the authors' assertion that there is no sex difference in IQ. The paper by Dykiert, Gale & Deary (2009) showed that in 10 year olds tested in the 1970 British Cohort Study boys had a significantly higher IQ of .081*d.* In a subsequent follow up at age 26 the attrition rate was 43% and was greater for males and the male advantage had increased to .124*d.* The authors conclude that "a proportion of the apparent male advantage in general cognitive ability reported by some researchers might be attributable to the combination of greater male variance and sample restriction..." (p. 42). All this paper showed was that in longitudinal studies the follow-up samples are no longer representative because of attrition and cannot be relied on to give accurate data on sex differences. In no way does it support the assertion that it "clearly indicates the absence of sex differences in IQ." The authors' citation of Flynn (2012) refers to a study of young adults in Argentina in which there was no sex difference on the Progressive Matrices, but the authors chose to ignore the meta-analysis of sex differences on the Progressive Matrices in general population samples that gave the results of ten studies of adults in all of which males obtained higher scores with an average advantage of 0.33*d* equivalent to 5 IQ points (Lynn & Irwing, 2004). The authors' third citation (Johnson, Carothers & Deary, 2009) gives the results of two studies of 10-12 year olds in which there was no sex difference in IQ. They do not acknowledge my theory that the male advantage only appears from the age of 16 years or the large number of studies supporting this theory. They conclude that males and females have the same IQ and "thus large brains and neuron numbers do not need to translate into higher intelligence among humans", but they do not offer any explanation for this exception to the numerous studies showing a positive association between brain size and intelligence.

13. Evolutionary Psychology of the Higher Male IQ

We turn now to the evolutionary explanations of the higher male IQ. There are three problems that require consideration: (1) why males have evolved greater spatial abilities; (2) why males have evolved greater reasoning abilities; and (3) why females mature more rapidly than males. The likely explanation of the evolution of greater spatial abilities of males is that during the last several million years hominids became hunter-gatherers in which males specialized in hunting and females specialized in gathering plant foods (Lovejoy, 1981; Watson and Kimura, 1991). Hunting large animals requires spatial abilities to enable males to throw stones and spears accurately, at which males are better than females (Watson & Kimura, 1991), to plan group hunting strategies such as driving potential prey into the loops of rivers, and to make weapons such as spears and bows and arrows with which to kill prey. Females had less need for spatial abilities and so did not evolve them so strongly. The female specialization of gathering plant foods is less cognitively demanding.

The likely evolutionary explanation of the greater reasoning ability of males is that in most mammalian group-living species males compete for high status in dominance hierarchies in order to secure access to females and reproduction (Wilson, 1975; Wynne-Edwards, 1962). During the evolution of the hominids greater reasoning ability would have contributed to success in this intra-male competition enabling males with greater intelligence to form useful alliances, display leadership qualities in hunting and warfare, and out-talk other males with lesser intelligence. This advantage is present in contemporary societies where intelligence is a significant determinant of rank indexed by socio-economic status with which it is correlated at 0.46 (Jencks, 1972).

The likely evolutionary explanation of the more rapid maturation of females is that it is advantageous for them to begin reproducing in puberty as soon as they are sufficiently mature to have babies and look after them. It is advantageous for males to continue maturing beyond the age of 16 years because it takes longer for them to acquire the experience and skills required to work their way up the dominance hierarchies and obtain sufficient status to secure access to females.

14. Conclusion

I began this paper by stating the problem of the inconsistency between the assertions of numerous experts that "females and males score identically on IQ tests" (Halpern, 2012, p. 233) and the theoretical expectation that the larger average brain size of males should give them a higher average IQ than females. I presented as a solution to this problem the developmental theory of sex differences in intelligence stating that boys and girls have about the same IQ up to the age of 15 years but from the age of 16 the average IQ of males becomes higher than that of females with an advantage increasing to approximately 4 IQ points in adulthood. The magnitude of the adult male advantage cannot be precisely quantified and will vary according to the definition of intelligence but whatever definition is adopted the data reviewed in this paper show that among adults men do have a higher average IQ than women. Thus the theoretical expectation that males should have a higher average IQ than females is correct for adults. As Einstein is said to have observed, "When the data and the theory are in conflict, it is generally the data that are wrong."

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Appendix

Description of the tests given in Table 7:

AH4 and AH5: These tests consist of two parts designated verbal-numerical and diagrammatic (consisting of spatial and non-verbal reasoning). These are summed to give a total representing general intelligence (Heim, 1968).

CET: The Conditional Exclusion Test of a number of mental abilities. The data shown are for the Abstraction and Mental Flexibility test.

DAT: The Differential Ability Test contains 8 tests covering verbal, reasoning, spatial, memory and perceptual speed averaged to give an IQ. Keith et al. (2011) aggregate these from the American standardization sample into four ability factors identified as visual memory (Gv), free recall memory (Gfr), working memory (Gwm) and perceptual speed (Gs) and give the average of these as a male advantage of .12*d*.

Dureman-Salde: A Norwegian test of verbal (.047*d*), reasoning (.77*d*) and spatial (.770*d)* abilities averaged to give general intelligence. Male advantages are given in parentheses. Note the marginally higher male verbal ability and much higher male spatial ability confirming the Wechsler results and contrary to assertions of Cooper (2015) and Ritchie (2015) that higher female verbal ability and higher male spatial ability balance out to produce no difference in general intelligence.

IST: Intelligenz-Struktur-Test. A German test of general intelligence measuring a number of abilities that are averaged to give an IQ.

KAIT: Kaufman Adult Intelligence Test. A test of general intelligence measuring a number of abilities that are averaged to give crystallized and fluid IQs. There were higher male IQs on these of 0.7 and 2.3 IQ points, respectively, and are averaged to 1.5 equivalent to .10*d* given in Table 7.

KBIT: Kaufman Brief Intelligence Test. A short form of the KAIT.

RIT: A Portuguese test of general intelligence.

SAT: Scholastic Aptitude Test (Sweden) consists of verbal (.04*d*), reasoning (.54*d*) and spatial (.56*d*) abilities averaged to give general intelligence. Male advantages are given in parentheses. Note the marginally higher male verbal ability and much higher male spatial ability confirming the Wechsler results and contrary to assertions of Cooper (2015) and Ritchie (2015) that higher female verbal ability and higher male spatial ability balance out to produce no difference in general intelligence.

SAT: Scholastic Aptitude Test (United States) consists of verbal and mathematical abilities taken for entry to university.

SB: Stanford-Binet. A test of general intelligence.

Test de QI: A French test of general intelligence administered over the internet.

Tiki-T: An Indonesian test of verbal (.11*d*), reasoning (.15*d*) and spatial (.29*d*) abilities averaged to give general intelligence. Male advantages are given in parentheses. Note that the sex differences on the three abilities are similar to those in western countries with the greatest male advantage in spatial ability and the least in verbal ability.

WJ III: The Woodcock-Johnson Test of general intelligence measuring a number of abilities including fluid IQ given in Table 7.