MANKIND QUARTERLY 2019 59:3 394-405

Sex Differences in Intelligence on the Advanced Progressive Matrices among 15 to 18 Year-Old Students in Minya Governorate, Southern Egypt

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This study examines sex differences in reasoning ability assessed with Raven's Advanced Progressive Matrices among 2,206 (1001 male and 1205 female) school students aged between 15 and 18 from urban and rural secondary schools in the Minya region of southern Egypt. There are no statistically significant differences in intelligence between males and females up until the age of 15. However, males scored significantly higher than females at the ages of 16, 17 and 18, consistent with Lynn's developmental theory of sex differences in intelligence. In exploring the Egyptian education system and the social dynamics of the Minya region in more depth, we attempt to find various confounds which might offer explanations for this difference. However, we find that Lynn's model is the most persuasive.

Keywords: Intelligence; Advanced Progressive Matrices; Sex differences; Egypt

It has been almost invariably asserted from the early twentieth century up to the present that males and females have equal intelligence. Two of the first to advance this idea were Burt and Moore (1912) and Terman (1916). In the second half of the twentieth century it was frequently restated by leading authorities. For example: "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" (Cattell 1971, p. 131). Others who have repeated this assertion include Hutt (1972, p. 88), Court, (1983), Maccoby and Jacklin (1974, p. 65), Eysenck (1981, p. 40), Brody (1992, p. 323), Herrnstein and Murray (1994, p. 275), Mackintosh (1996), Gould (1996), Geary (1998, p. 310), Lubinski (2000), Loehlin (2000, p. 177), Lippa (2002), Jorm et al. (2004), Anderson (2004, p. 829), Spelke and Grace (2007, p. 65), Hines (2007, p. 103), Jung and Haier (2007), Halpern (2007, p. 123 and 2012, p. 233), Pinker (2008, p. 13), Mackintosh (2011, p. 380), Dunst et al. (2014), and Sternberg (2014, p. 178).

The contention that there is no sex difference in intelligence has been disputed in a series of papers by Lynn (1994, 1998a, 1998b, 1999, 2017), who proposed the developmental theory of sex differences in intelligence. This states that there is no sex difference in intelligence up until to the age of 15 years, but that at the age of 16 years, males begin to show a slightly higher average IQ than females and this increases to an advantage of 4 to 5 IQ points among adults. Evidence supporting this theory has been published for intelligence measured as the IQ derived as the average of cognitive abilities obtained in tests such as the Wechsler, the Stanford-Binet, the Cattell Culture Fair and numerous others (Lynn, 1994, 1998a, 1998b, 2017) and for abstract reasoning ability measured by the Progressive Matrices that have reported a male advantage from the age of 16 years into adulthood (Colom & Lynn, 2004; Lynn, Allik & Irwing, 2004; Lynn, Allik & Must, 2000; Lynn et al., 2002; Lynn & Tse-Chan, 2003; Pullmann, Allik & Lynn, 2004). The male advantage from the age of 16 years was confirmed in a meta-analysis of sex differences on the Progressive Matrices among general population samples that showed a 5 points higher average male IQ among adults (Lynn & Irwing, 2004), and in a meta-analysis of sex differences on the Progressive Matrices among college student samples that showed that males had an advantage of 4.6 IQ points (Irwing & Lynn, 2005). These results were further confirmed by a study of sex differences on the Progressive Matrices in Sudan in which 16, 17 and 18-year old males obtained higher average scores than females of 0.337*d*, equivalent to 5 IQ points (Bakhiet et al., 2015); and marginally in a study of sex differences on the Advanced Progressive Matrices in Yemen in which 16, 17 and 18-year-old males obtained higher average scores than females of 0.9

IQ points (Bakhiet et al., 2016). Interestingly, these results suggest that a similar pattern of sex differences emerges in rich and poor, traditional and modern societies, and create a problem for purely cultural explanations. Despite these studies, some authorities have continued to assert that there is no sex difference in intelligence. For instance, ". . . there are negligible gender differences in omnibus IQ assessments" (Ackerman 2018, p. 8). As it is therefore evident that there is no consensus on this issue, we present further data on it here.

Method

The sample consisted of 1001 male and 1205 female school students aged 15 to 18 years from secondary schools in the Minya district of Egypt. The urban schools were: Malawi Secondary School for Girls, Malawi Secondary School for Boys, Minya New Secondary School for Boys, Minya New Secondary School for Girls, Al Salam Secondary School for Girls, Bani Mazar Secondary School for Boys, and Bani Mazar Secondary School for Girls. The rural schools were: Al-Ashmonain Secondary School, Al-Maharas Secondary School, Bani Ahmed Secondary Mixed School, Tenda Secondary Mixed School, Saif Pasha Secondary School, Al-Rawdha Secondary School and Naway Secondary Mixed School.

The sample was tested in the academic year 2014/2015 with the Raven's Advanced Progressive Matrices test (RAPM) (Raven, Raven & Court, 1993, 1998). The RAPM is a well-known measure of non-verbal reasoning ability that has been widely used both in applied and research settings (e.g. Arthur & Day, 1994; Carpenter, Just & Shell, 1990; Embretson, 1995; Jensen, 1987; Verguts & De Boeck, 2002). The total score provides a good measure of *g*, the general factor of intelligence (Jensen, 1980). The combined sets I (12 items) and II (36 items) of the APM were administered to the participants in groups in their classes. The time allowed for the test was 60 minutes. The average time taken to complete the test was 37.52 minutes (SD = 8.98). These data were analyzed using IBM SPSS Statistics Version 24.

Results

The reliability of the APM was calculated by Cronbach's Alpha as 0.72, which is considered acceptable. The results are given in Table 1 showing for the males and females the numbers, mean scores on the APM and standard deviations, the variance ratios (VR) calculated as the standard deviation of the boys divided by the standard deviation of the girls, the *d*s (difference between the scores of the boys and girls divided by the standard deviation), and the British-scaled IQ according to the British standardizations of 1979 (age 15) and 1992 (age 18). No Flynn effect corrections were applied because there is no indication that average

scores on Raven-type tests have increased for this age group in Britain since 1979 (Lynn, 2009).

Table 1. *Gender differences on the Advanced Progressive Matrices for secondary school students in Minya Governorate. VR, variance ratio; d, standardized sex difference. *** p<.001*

Age	*N* ♂/♀	Males Mean ± SD	Females Mean ± SD	VR	*d*	IQ
15	147/192	17.56 ± 5.74	17.04 ± 6.18	0.93	0.09	92
16	265/355	19.48 ± 6.26	16.40 ± 6.08	1.03	0.50***	-
17	277/339	21.69 ± 5.86	18.08 ± 5.99	0.98	0.61***	-
18	312/319	21.97 ± 6.31	19.82 ± 5.93	1.06	0.35***	86
Total	1001/1205	20.58 ± 6.30	17.88 ± 6.17	1.02	0.43***	89

Note: IQ is estimated from Raven, Raven & Court, 1998, Tables APM12 and APM14. Age 15 is from the 1979 standardization, and age 18 is from the 1992 standardization. No norms are available for the intervening ages.

The results show no statistically significant difference in intelligence between male and female 15 year olds, but statistically significantly higher scores by males among 16, 17 and 18 year olds. The average male advantage of the 16, 17 and 18 year olds is .49*d.* This is equivalent to 7.35 IQ points and is therefore greater than the 5 IQ points among adults reported by Lynn and Irwing (2004) in their meta-analysis of sex differences on the Progressive Matrices among general population samples. The sex differences in variance show that among the 15 and 17 year olds, females had greater variance than males, while among the 16 and 18 year olds, males had greater variance than females. For the total sample, males had slightly greater variance than females.

Discussion

To make sense of our findings and search for possible alternative explanations, an understanding of the nature of the Minya district and of the Egyptian education system are both highly germane. It may be that peculiarities of this region, of the Egyptian education system, or of a combination of the two offer a parsimonious explanation of the results we have presented.

Minya is in Upper Egypt (that is, southern Egypt), a region which is, in general, poorer and less educated than Lower Egypt (that is, northern Egypt) (Dutton et al., 2018a). According to official statistics for 2015, 56.7% of households in Minia Governorate were below the national poverty line compared to 27.8% nation-wide (UN Population Fund, 2018), with 36% of the poorest

villages in Egypt being situated in the Minya district (El Nour, 2012). Minya also has the highest rate of illiteracy of any region in Egypt, with the most recent estimate being 36.7% (Habib, 2017, p. 301). Schooling is only compulsory in Egypt between the ages of 4 and 14. Schooling is divided into Kindergarten (4-6), Primary (7-11) and Preparatory (12-14). After this comes (non-compulsory) Secondary (15-17). Nationwide, among Egyptians aged 20 to 24, 70% of males and 68% of females had completed secondary school in 2008 (Egypt Policy Data Centre, 2008). The main reason for this sex difference is the higher percentage of females who never attend school, an issue we will explore further below, because dropout rates from school show little difference between sexes (Lloyd et al., 2003). In addition, urban and rural pupils in Upper Egypt were more likely to drop out of school than pupils in urban and rural Lower Egypt (controlling for whether urban or rural) in 2006, a year for which data are available (Ersado & Gignoux, 2014, Table 4).

The estimated IQ in the last column of Table 1 fits a pattern of results that had been obtained in earlier studies, as shown in Table 2. Briefly, during the 90s, the scores of adults recruited from the general Egyptian population on Raven-type tests were well below the range of the British test norms. For university students, there appears to be a rising trend from the 1980s to the 2010s suggesting systematic rises of intelligence (Flynn effects) during this period (Flynn, 2012).[1] This rising trend is not evident in school-based samples, most of which have produced IQs in the 80s from the first SPM standardization in 1986 to the present. A possible reason for this apparent lack of a Flynn effect is that school enrollment was far less universal in the 1980s than it is today, with the result that those attending school tended to be an elite group. The present results are therefore consistent with evidence of Flynn effects during this period in many other developing countries.

Concerning the present study, we are dealing with an elite sample from a poor area of Egypt. Therefore, the result is likely to overestimate the average IQ of all young people in Minya Province including those who do not attend secondary school. However, it is likely that average cognitive development is less in Minya Province than in the more prosperous parts of Egypt. Therefore, the results obtained with the present sample are likely to be a reasonable approximation of the average IQ of this age group in Egypt as a whole.

[1] For an up-to-date summary of the proposed causes of the Flynn Effect, see Dutton and Woodley of Menie (2018).

Table 2. *Summary of British-scaled IQs obtained from Raven tests in Egypt. APM, Advanced Progressive Matrices; CPM, Coloured Progressive Matrices; SPM, Standard Progressive Matrices.*

Year	Age	Test	*N*	IQ	Sample	Reference
1986±	23.5±	SPM	452	79.5	Students	Abdel-Khalek, 1988
1986	7-15	SPM	4,733	89.5	School	Bakhiet & Lynn, 2015
1993±	7-10	CPM	110	69	Population	Wachs et al., 1995
1994±	18-63	SPM	155	<65	Population	Wachs et al., 1996
1994-95	24-60	SPM	30	<65	Population	von der Lippe, 1999
2000	20.5	SPM	2147	90.5 (science) 79 (arts)	Students	Abdel Khalek et al., 2014
2000	20.5	APM	2147	102.5	Students	Abdel Khalek et al., 2015
2010±	9-11	CPM	300	74	School	Eissa & Alsayed, 2012
2011-13	5-10	CPM	11,284	84.2	School	Bakhiet & Lynn, 2014
2014-15	20±	APM	1,502	102.4	Students	Essa et al., 2016
2014/15	15-18	APM	2,206	89	School	This study
2015	19.6±	SPM+	423	98	Students	Abdel Khalek & Lynn, 2016a
2015/16	10-18	SPM	722	89	School	Abdel Khalek & Lynn, 2016b
2017	5-11	CPM	1,756	85	School	Ziada et al., 2017

Turning to the ways in which the dynamics of Minya and the Egyptian education system may have impacted our results, there is an extent to which these factors might artificially reduce the sex difference. In southern Egypt, girls are more likely to not pursue secondary education than boys. In 2012, 8% of rural Upper Egyptian girls aged between 10 and 17 had never attended school at all, constituting 50% of children in that age range nationwide who had never attended school. Among Upper Egyptian rural boys only around 3% had never attended school. It is among poorer Egyptians that school non-attendance is more prevalent (Elbadawy 2014, p. 7). This means that the females in our sample are likely to be relatively intellectually elite compared to the males. There are other factors which might reduce male IQ scores relative to female. In Islamic societies we would expect females to be subject to considerably greater restrictions than males, leaving them with a less stimulating social life and thus fewer distractions from studying, something which might elevate female IQ relative to male. This hypothesis has been advanced elsewhere as a means of explaining regional differences in male-female IQ score differences in Saudi Arabia (Dutton et al., 2018b). However, even in spite of this realistic possibility, males score higher in our sample. This information would imply that our finding underestimates the male

advantage.

There are also factors which can potentially increase the sex difference. Although girls drop out of school at the same rate as boys, dropping out of school in Egypt is predicted by low socioeconomic status among boys but *not* among girls (Lloyd et al., 2003). Low SES is robustly negatively associated with IQ in Western societies (Lynn & Vanhanen, 2012). If this is also the case in Egypt, we would expect this to ameliorate the various factors which cause the females to be a more elite sample because this factor would, instead, elevate the IQ of the males relative to the females. Our results indicate greater IQ variance among females aged 15. In general, it has been found that IQ variance is greater among males (Arden & Plomin, 2006; Deary, Penke & Johnson, 2010). Thus, if female variance is greater at the age of 15, it might mean either that the greater propensity for low SES males to drop out has reduced the male relative to the female IQ variance and/or that female variance in puberty onset is a factor, because puberty is associated with brain growth and thus rising intelligence. However, by the age of 18, we find pronounced greater variation *and* higher IQ score among males, despite the process of attrition among low-SES males continuing. Most females likely have completed puberty at this age, as females begin and end puberty earlier than males (Dutton & Madison, 2016). Accordingly, it seems reasonable to posit that delayed male development is the simplest explanation for our findings and that greater male variance at this stage may also be due to variation in the timing of puberty.

It can be seen that there exists no statistically significant male-female difference in IQ score at the age of 15, but that the difference can consistently be found thereafter. This would be congruous with Lynn's theory that the difference only shows up at around the age of 16 because girls enter puberty earlier than boys. In general, we might expect that the difference would show up even later than 16 in Egypt due to the evidence that as countries modernize, children tend to enter puberty earlier. For example, the age of menarche in mid-nineteenth century Europe was roughly 17 compared to less than 13 in 2014 (Jones & Lopez 2014, p. 112). However, the relatively elite nature of our sample may at least partly explain this anomaly as their lifestyle may be more 'Western' than would be the Egyptian norm. We would, however, expect the male-female difference to increase with age after the age of 16, but it does not, even despite evidence that less intelligent males are continuously dropping out of school.

References

Abdel-Khalek, A.M. (1988). Egyptian results on the Standard Progressive Matrices. *Personality and Individual Differences* 9: 193-195.

Abdel-Khalek, A.M. & Lynn, R. (2016a). Sex differences in the intelligence of students at Alexandria University, Egypt. *Mankind Quarterly* 57: 87-90.

Abdel-Khalek, A.M. & Lynn, R. (2016b). A study of sex differences in intelligence in Egypt. *Mankind Quarterly* 57: 82-86.

Abdel-Khalek, A.M., Nour-Eddin, A.S. & Lynn, R. (2014). A study of the intelligence of university students in Egypt. *Mankind Quarterly* 55: 121-127.

Abdel-Khalek, A.M., Nour-Eddin, A.S. & Lynn, R. (2015). A study of the performance of Egyptian college students on the Advanced Progressive Matrices. *Personality and Individual Differences* 72: 141-142.

Ackerman, P. (2018). Intelligence as potentiality and actuality. In: R.J. Sternberg (ed.), *The Nature of Human Intelligence.* Cambridge: Cambridge University Press.

Anderson, M. (2004). Sex differences in general intelligence. In: R.L. Gregory (ed.), *The Oxford Companion to the Mind*. Oxford: Oxford University Press.

Arden, R. & Plomin, R. (2006). Sex differences in variance of intelligence across childhood. *Personality and Individual Differences* 41: 39-48.

Arthur, W.J.R. & Day, D.V. (1994). Development of a short form for the Raven Advanced Progressive Matrices test. *Educational and Psychological Measurement* 54: 394-403.

Bakhiet, S.F.A. & Lynn, R. (2014). A note on a new study of intelligence in Egypt. *Psychological Reports* 115: 810-812.

Bakhiet, S.F.A. & Lynn, R. (2015). Standardization of the Standard Progressive Matrices in Egypt. *Mankind Quarterly* 56: 70-78.

Bakhiet, S., Haseeb, B., Seddieg, I., Cheng, H. & Lynn, R. (2015). Sex differences on Raven's Standard Progressive Matrices among 6 to 18 year olds in Sudan. *Intelligence* 50: 10-13.

Bakhiet, S.F.A., Essa, Y.A.S., Albursan, I.S., Abdelrasheed, N.A.G. & Lynn, R. (2016). Sex differences in high school students on Raven's Advanced Progressive Matrices in Yemen. *Mankind Quarterly* 57: 99-103.

Brody, N. (1992). *Intelligence*, 2nd ed. San Diego, CA: Academic Press.

Burt, C.L. & Moore, R.C. (1912). The mental differences between the sexes. *Journal of Experimental Pedagogy* 1: 355-388.

Carpenter, P.A., Just, M.A. & Shell, P. (1990). What one intelligence test measures: A theoretical account of processing in the Raven Progressive Matrices test. *Psychological Review* 97: 404-431.

Cattell, R.B. (1971). *Abilities: Their Structure, Growth, and Action*. Boston, MA: Houghton Mifflin.

Colom, R. & Lynn, R. (2004). Testing the developmental theory of sex differences in intelligence on 12–18 year olds. *Personality and Individual Differences* 36: 75-82.

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., Penke, L. & Johnson, W. (2010) The neuroscience of human intelligence differences. *Nature Reviews Neuroscience* 11: 201-211.

Dunst, B., Benedek, M., Koschutnig, K., Jauk, E. & Neubauer, A.C. (2014). Sex differences in the IQ-white matter microstructure relationship: A DTI study. *Brain and Cognition* 91: 71-78.

Dutton, E. & Madison, G. (2016). Life history and race differences in puberty length: A test of differential-*K* theory. *Mankind Quarterly* 56: 546-561.

Dutton, E. & Woodley of Menie, M.A. (2018). *At Our Wits' End: Why We're Becoming Less Intelligent and What It Means for the Future.* Exeter: Imprint Academic.

Dutton, E., Bakhiet, S., Ziada, K., Essa, Y., Ali, H. & Alqafari, S. (2018a). Regional differences in intelligence in Egypt: A country where upper is lower. *Journal of Biosocial Science,* doi:10.1017/S0021932018000135.

Dutton, E., Bakhiet, S., Madison, G., Essa, Y. & Rageh, M. (2018b). Sex differences on Raven's Standard Progressive Matrices within Saudi Arabia and across the Arab world. *Personality and Individual Differences* 134: 66-70.

Egypt Policy Data Centre (2008). Untitled. https://www.epdc.org/sites/default/files/documents/Egypt_coreusaid.pdf (Accessed 17th December 2018).

Eissa, M.A. & Alsayed, A.F. (2012). The Raven's Colored Progressive Matrices test: A normative data for gifted students in Egypt aged 10-17. *International Journal of Psychoeducational Sciences* 1: 103-110.

El Nour, S. (2012). National geographical targeting of poverty in Upper Egypt. In: R. Bush & H. Ayeb (eds.), *Marginality and Exclusion in Egypt.* London: Zed Books.

Elbadawy, A. (2014). Education in Egypt: Improvements in attainment, problems with quality and inequality. Working Paper 854. Economic Research Forum, Dokki, Egypt.

Embretson, S.E. (1995). The role of working memory capacity and general control processes. *Intelligence* 20: 175-186.

Ersado, L. & Gignoux, J. (2014). Inequality of educational opportunities in Egypt. PSE Working Papers 2014-28. 2014. <halshs-01064510>.

Essa, Y.A.S., Abdelrasheed, N.S.G., Bakhiet, S.F.A., Cheng, H., Dwieb, A.M.M. & Lynn, R. (2016). Sex differences in the intelligence of students at an Egyptian university. *Personality and Individual Differences* 95: 183-184.

Eysenck, H.J. (1981). *Intelligence: The Battle for the Mind*. London: Pan.

Flynn, J.R. (2012). *Are We Getting Smarter? Rising IQ Scores in the Twenty First Century.* Cambridge: Cambridge University Press.

Geary, D.C. (1998). *Male, Female: The Evolution of Human Sex Differences.* Washington, DC: American Psychological Association.

Gould, S.J. (1996). *The Mismeasure of Man*. Revised and expanded edition. New York: W.W. Norton.

Habib, S. (2017). Arab Republic of Egypt. In: M. Wehmeyer & J. Patton (eds.), *The Praeger International Handbook of Special Education*, Vol. I. Santa Barbara, CA: Praeger.

Halpern, D.F. (2007). The nature and nurture of critical thinking. In: R.J. Sternberg, H.L. Roediger III & D.F. Halpern (eds.), *Critical Thinking in Psychology*, pp. 1-14. Cambridge: Cambridge University Press.

Halpern, D.F. (2012). *Sex Differences in Cognitive Abilities*, 3rd ed. New York: Psychology Press.

Herrnstein, R.J. & Murray, C. (1994). *The Bell Curve: Intelligence and Class Structure in American Life.* New York: Free Press.

Hines, S. (2007). *Transforming Gender: Transgender Practices of Identity, Intimacy and Care*. Bristol: Policy Press.

Hutt, C. (1972). Neuroendocrinal behaviour and intelligence aspects of sexual differentiation in human development. In: C. Ounsted & D. Taylor (eds.), *Gender Differences: Their Ontogeny and Significance*. Edinburgh: Churchill Livingstone.

Irwing, P. & 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.

Jensen, A.R. (1980). *Bias in Mental Testing*. New York: Free Press.

Jensen, A.R. (1987). Process differences and individual differences in some cognitive tasks. *Intelligence* 11: 107-136.

Jones, R. & Lopez, K. (2014). *Human Reproductive Biology.* London: Academic Press.

Jorm, A., Anstey, K., Christensen, H. & Rogers, B. (2004). Gender differences in cognitive abilities: The mediating role of health state and health habits. *Intelligence* 32: 7-23.

Jung, R.E. & Haier, R.J. (2007). The parieto-frontal integration theory (P-FIT) of intelligence: Converging neuroimaging evidence. *Behavioral and Brain Sciences* 30: 135-154.

Lippa, R.A. (2002). *Gender, Nature, and Nurture.* Mahwah, NJ: Lawrence Erlbaum.

Lloyd, C., El Tawila, S., Clark, W. & Mensch, B. (2003). The impact of educational quality on school exit in Egypt. *Comparative Education Review* 47: 444-467.

Loehlin, J.C. (2000). Group differences in intelligence. In: R.J. Sternberg (ed.), *Handbook of Intelligence*, pp. 176-193. New York: Cambridge University Press.

Lubinski, D. (2000). Scientific and social significance of assessing individual differences: "Sinking shafts at a few critical points." *Annual Review of Psychology* 51: 405-444.

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

Lynn, R. (1998a). Sex differences in intelligence: A rejoinder to Mackintosh. *Journal of Biosocial Science* 30: 529-532.

Lynn, R. (1998b). Sex differences in intelligence: Data from a Scottish standardization of the WAIS-R. *Personality and Individual Differences* 24: 289-290.

Lynn, R. (1999). Sex differences in intelligence and brain size: A developmental theory. *Intelligence* 27: 1-12.

Lynn, R. (2009). Fluid intelligence but not vocabulary has increased in Britain, 1979–2008. *Intelligence* 37: 249-255.

Lynn, R. (2017). Sex differences in intelligence: The developmental theory. *Mankind Quarterly* 58: 9-42.

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

Lynn, R. & Tse-Chan, P.W. (2003). Sex differences on the Progressive Matrices: Some data from Hong Kong. *Journal of Biosocial Science* 35: 145-150.

Lynn, R. & Vanhanen, T. (2012). *Intelligence: A Unifying Construct for the Social Sciences.* London: Ulster Institute for Social Research.

Lynn, R., Allik, J. & Irwing, P. (2004). Sex differences on three factors identified in Raven's Standard Progressive Matrices. *Intelligence* 32: 411-424.

Lynn, R., Allik, J. & Must, O. (2000). Sex differences in brain size, stature and intelligence in children and adolescents: Some evidence from Estonia. *Personality and Individual Differences* 29: 555-560.

Lynn, R., Allik, J., Pullmann, H. & Laidra, K. (2002). Sex differences on the Progressive Matrices among adolescents: Some data from Estonia. *Personality and Individual Differences* 34: 669-679.

Maccoby, E.E. & Jacklin, C.N. (1974). *The Psychology of Sex Differences*. Stanford, CA: Stanford University Press.

Mackintosh, N.J. (1996). Sex differences and IQ. *Journal of Biosocial Science* 28: 559-

572.

Mackintosh, N.J. (2011). *IQ and Human Intelligence*, 2nd edition. Oxford: Oxford University Press.

Pinker, S. (2008). *The Sexual Paradox: Men, Women and the Real Gender Gap*. New York: Scribner.

Pullmann, H., Allik, J. & Lynn, R. (2004). The growth of IQ among Estonian school children from ages 7 to 19. *Journal of Biosocial Science* 36: 735-740.

Raven, J., Raven, J.C. & Court, J.H. (1993). *Raven Manual Section 1: General Overview*. Oxford: Oxford Psychologists Press.

Raven, J., Raven, J.C. & Court, J.H. (1998). *Manual for Raven's Advanced Progressive Matrices*. Oxford: Oxford Psychologists' Press.

Spelke, E.S. & Grace, A.D. (2007). Sex, math, and science. In: S.J. Ceci & W.M. Williams (eds.), *Why Aren't More Women in Science? Top Researchers Debate the Evidence*, pp. 57-67. Washington, DC: American Psychological Association.

Sternberg, R.J. (2014). Teaching about the nature of intelligence. *Intelligence* 42: 176-179.

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

UN Population Fund (2018). *Localizing the targets of the Sustainable Development Goals at governorate level*. UNFPA. https://egypt.unfpa.org/sites/default/files/pub-pdf/edited_Localizing%20SDGs-%20Report-%20Engish.pdf

Verguts, T. & de Boeck, P. (2002). The induction of solution rules in Raven's Progressive Matrices test. *European Journal of Cognitive Psychology* 14: 521-547.

von der Lippe, A.L. (1999). The impact of maternal schooling and occupation on child-rearing attitudes and behaviours in low income neighbourhoods in Cairo, Egypt. *International Journal of Behavioral Development* 23: 703-729.

Wachs, T.D., McCabe, G., Moussa, W., Yunis, F., Kirksey, A., Galal, O., ... & Jerome, N. (1996). Cognitive performance of Egyptian adults as a function of nutritional intake and sociodemographic factors. *Intelligence* 22: 129-154.

Wachs, T.D., Bishry, Z., Moussa, W., Yunis, F., McCabe, G., Harrison, G., ... & Shaheen, F. (1995). Nutritional intake and context as predictors of cognition and adaptive behaviour of Egyptian school-age children. *International Journal of Behavioral Development* 18: 425-450.

Ziada, K.E., Metwaly, H.A.M., Bakhiet, S.F.A., Cheng, H. & Lynn, R. (2017). A new study of intelligence in Egypt. *Mankind Quarterly* 58: 307-311.