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Sex differences in general knowledge in German and Northern Irish university students

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Abstract
Studies of sex differences in general knowledge have produced conflicting results with some investigators reporting no difference and others reporting greater general knowledge in men. This study was designed to determine whether the a male advantage in general knowledge found among university students in Northern Ireland could be replicated among students in Germany. The general knowledge questionnaire consisting of 17 domains of general knowledge was administered to 88 men and 145 women students at the University of Lüneburg. The sex differences were closely similar in the two countries. Men had significantly and substantially greater general knowledge than women ($d = 0.49$ standard deviation units) in Germany and in Northern Ireland ($d = 0.51$). In both countries, the domains of general knowledge in which males achieved significantly and substantially higher scores were sport, finance, games, geography, history, science, discovery and exploration, and politics. There were no substantial or significant sex differences in the domains of popular music, classical music, art, film, medicine, and fashion. Females achieved a significantly and substantially higher score on knowledge of nutrition in Northern Ireland and a non-significantly higher score in Germany. The product-moment correlation between the magnitudes of the sex differences in the two countries is 0.84. The sex differences in knowledge could be interpreted in terms of evolutionary psychology as a function of men's greater interest in inter-male competition and women's greater interest in nurturing.

Keywords: *General knowledge, sex differences*

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Introduction

There is a considerable research literature on sex differences in various cognitive abilities. Whole books have been devoted to this question, among which are those by Caplan, Crawford, Hyde and Richardson (1997), Kimura (1999), and Halpern (2000). Kimura (1999, 2002) lists five abilities in which males are on average better than females (spatial orientation, visualization, line orientation, mathematical reasoning, and throwing accuracy) and five abilities in which females are on average better than males (object location memory, perceptual speed, verbal memory, numerical calculation, and manual dexterity). To these should be added substantial female advantages in word fluency (Hyde & Linn, 1988), spelling (Feingold, 1988; Lynn, 1992) and foreign language ability (Lynn & Wilson, 1993), and a substantial male advantage in mechanical aptitude (Feingold, 1988; Lynn, 1992).

A number of these sex differences in abilities have been explained in terms of evolutionary psychology as having evolved as a result of the specialization of males for hunting and females for gathering during the evolution of the hominids (Buss, 1999; Kimura, 1999). The general theory is that hunting required spatial and visualization abilities for long distance navigation and tool making, with the result that these abilities have been selected for in males, while gathering required good perceptual abilities to scan foliage to identify fruit and distinguish it from other foliage, with the result that these abilities have been selected for in females. For instance, Kimura (1999, p. 14–15), writes: ''men most probably were selected for long distance navigation, which requires the ability to recognize a scene from various orientations, and for accurate targeting'' that would require spatial and visualization abilities.

In this paper we consider sex differences in general knowledge and whether these can also be plausibly explained in terms of evolutionary psychology. To do this it is first necessary to establish the nature of sex differences in general knowledge. This question has received relatively little attention. None of the books by Maccoby and Jacklin (1974), Caplanet et al. (1997), Kimura (1999), and Halpern (2000) reviewing sex differences in cognitive abilities has discussed whether there may be a sex difference in general knowledge. Nor has this question been considered in textbooks on intelligence such as those by Brody (1992), Mackintosh (1998), and Sternberg (2000). General knowledge has long been considered a cognitive ability and a component of general intelligence. A test of general knowledge has been present in all the Wechsler tests, where it is designated information (Wechsler, 1958). General knowledge is present as a component of intelligence in the two major taxonomies of cognitive abilities of Carroll (1994) and McGrew and Flanagan (1998). But the question of whether there may be sex differences in general knowledge has not been addressed by researchers in intelligence.

General knowledge can be defined as non-specialist information, some of which is acquired at school but much of which is picked up incidentally

from a variety of sources such as the media. People are exposed to a great deal of general information and most of it is forgotten (''much of our learning about the world occurs during episodes of incidental encoding, times during which we are not actively trying to encode information,'' Cherney & Ryalls, 1999, p. 305). People differ in the amount of general knowledge they acquire and retain in long-term memory. It might be thought that if there is a substantial sex difference in general knowledge this would be known and discussed by specialists in memory. There is, however, no mention of this issue in textbooks on memory such as that by Baddeley (1999).

General knowledge has been studied in cognitive psychology, where it has normally been equated with ''semantic memory.'' Some cognitive psychologists including Herlitz, Nilsson and Backman (1997) and Meinz and Salthouse (1998) have reported results showing that men and women perform about equally in tasks requiring the retrieval of stored information (semantic memory/general knowledge) but women perform better in situations that require the acquisition of new information and in ''episodic memory'' (autobiographical recollection of unique events). Stumpf and Jackson (1994) also found that in a sample of university students females were better at acquiring new information and interpret this as a function of better memory.

Contrary to the two studies by Herlitz et al. (1997) and Meinz and Salthouse (1998), finding that men and women perform about equally in tasks of semantic memory and general knowledge, it has recently been reported by Lynn, Irwing and Cammock (2002) and by Lynn and Irwing (2002) that there is a substantial sex difference favouring males in general knowledge. Two studies were reported on sex differences in general knowledge among university students in Northern Ireland. In the first, in a sample of 636 university students it was found that men obtained a higher mean score on a test of general knowledge ($d = 0.51$; standard deviation units, i.e., approximately half a standard deviation or 7.5 IQ points; Lynn et al., 2002). This result was confirmed in the second study of 1047 students using a shorter version of the general knowledge test, in which men obtained a higher mean than women ($d = 0.48$), virtually identical to the result obtained in the first study (Lynn & Irwing, 2002).

As the results of our studies, our object in this paper is to ascertain whether the Northern Ireland results can be replicated. It is possible that there is a selective gender bias among the samples of students in Northern Ireland on which these results were obtained and the findings may not generalize to other populations. For instance, many young people in Northern Ireland opt to attend universities in England and Scotland, and there could be a gender bias among those who attend the universities in Northern Ireland. For a variety of reasons, the greater general knowledge of men obtained in the Northern Ireland samples could be an idiosyncratic result. We have therefore carried out a study of sex differences in general knowledge among university students in Germany to see whether similar differences are present.

Method

The first stage of the study was to translate into German the General Knowledge Test (GKT) constructed by Irwing, Cammock and Lynn (2001) and used in Lynn et al. (2002). This consisted of 216 items on 19 domains of general knowledge such as politics, sport, history, literature, classical and popular music, jazz, film, fashion, nutrition, and medicine (see Table I for the complete list). A pilot study was carried out at the University of Lüneburg in which the German translation was administered to a group of 35 men and 40 women, mostly students and employees of the university. The administration of the test took about 60 minutes. Items of extremely low (<20) and extremely high (>80) difficulty and of low discriminatory power (<0.30; i.e., items which were only slightly related to the total score) were eliminated. This left 95 items for 17 domains of general knowledge identified in Tables I and II. The domains of popular music and jazz in the two Northern Ireland studies were combined, and general science and history of science were also combined. The test is designated the GKT-G test (General Knowledge Test-German). The test therefore consists of 17 subtests of general knowledge which can be summed to give an overall score.

The sample for the study consisted of 88 men and 145 women students in the departments of Education and Economics at the University of Lüneburg. The ages ranged from 19 to 45 years, with a mean age of 24.7 years. Participation in the study was voluntary. The students took the questionnaire in the last 20–30 minutes of different lectures or seminars and during break times, in groups of 5 to 50.

Table I. Cronbach's alpha reliability coefficients for the subtests.

Subtest	Number of items	Alpha
Popular music	6	0.28
Discovery and exploration	11	0.66
Sport	5	0.37
Politics	5	0.58
History	6	0.56
Classical music	5	0.39
Art	4	0.13
Literature	5	0.46
Physics and chemistry	5	0.33
Geography	5	0.33
Nutrition	5	0.35
Medicine	6	0.54
Games	6	0.49
Biology	4	0.41
Finance	5	0.53
Fashion	6	0.50
Film	7	0.56
GKT-G total	95	0.87

Results

The reliabilities of the scores on the subtests and of the total score were calculated by Cronbach's coefficient alpha. The coefficient of internal consistency was 0.87 for the complete test of 95 items. The number of items in the subtests and reliability coefficients for the subtests are given in Table I.

The mean scores and standard deviations of the men and women on the 17 domains of general knowledge and on the total score are given in Table II. Column 6 gives the results of univariate *F*-tests as measures of the statistical significance of the sex differences on the 17 subtests and the total score. The multivariate *F*-test is statistically significant ($F_{17,278} = 14.25$; $p < 0.001$). This result shows a highly significant effect of sex in regard to the scores on the 17 GKT-G subtests. The last row gives the means and standard deviations of the total scores and shows that males obtained a higher mean score than females. Columns 7 and 8 give the effect sizes (d) for the present German sample and for the Northern Irish sample reported by Lynn et al. (2002).

To explore the similarities and differences between the German and Irish samples in more detail, we have run a two way multivariate analysis of variance using the variables of sex and country to examine whether the main effect of country and sex-by-country interaction are significant overall and on each domain. To do this the following steps were taken:

(1) Each of the 17 subtests was recoded in order to give individual scores between 0 and 1 (e.g., the score in *sport* in the German data set

Table II. Sex differences in the GKT-G subtests by sex; effect sizes for the mean differences in the German sample and in the Northern Irish sample of Lynn et al. (2002).

	Male $n = 88$		Female $n = 145$		Effect sizes		
Subtest	Mean	SD	Mean	SD	*F*	German *d*	Northern Irish *D*
Popular music	4.2	1.1	4.0	1.2	1.9	0.18	−0.15
Discovery and exploration	2.7	2.3	1.8	1.7	10.9	0.44***	0.69***
Sport	2.8	1.2	2.1	1.2	19.4	0.57***	0.84***
Politics	1.4	1.5	0.8	1.0	11.7	0.45***	0.69***
History	2.6	1.4	1.7	1.4	20.0	0.58***	0.72***
Classical music	0.9	1.0	0.7	0.9	3.4	0.25	0.08
Art	1.1	0.9	1.2	1.2	1.2	0.15	0.07
Literature	1.6	1.1	1.3	1.1	4.4	0.28*	0.49***
Physics and chemistry	2.9	1.1	2.4	1.1	10.9	0.44***	0.63***
Geography	2.3	1.1	1.8	1.2	12.4	0.58***	0.41***
Nutrition	2.9	1.3	3.1	1.0	3.9	−0.26	−0.48***
Medicine	4.8	1.4	4.6	1.3	0.6	0.10	−0.32***
Games	4.0	1.5	3.6	1.4	5.9	0.32**	0.54***
Biology	2.1	1.1	2.0	1.2	0.4	0.09	0.42***
Finance	3.7	1.0	3.2	1.2	12.8	0.47***	0.69***
Fashion	3.5	1.5	3.7	1.4	1.4	−0.16	−0.05
Film	2.8	1.7	2.9	1.4	0.2	−0.01	0.13
Total score	46.1	9.9	40.7	11.2	13.9	0.49***	0.51***

Note: Significance levels: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

was divided with 5 and the score in *sport* in Irish data set was divided with 10).

(2) The percentages of male and female in both the German and Irish subsamples were calculated for each cell given the number of German male students $n = 88 = 100\%$.

(3) The subsamples of Irish males and both subsamples of females were examined using the SPSS procedure for chance number generator. The data set consisted now of $N = 368$ students as compared with the former numbers of VP (in brackets): female G 94 (of 145 = ca. 61%) female IR 94 (of 469 = ca. 19%) male G 88 (of 88 = 100%) male IR 92 (of 167 = ca. 53%). The SPSS procedure takes approximately x% of a given N by chance.

(4) The mean age of the German students = 24.67 ($SD = 4.1$) and of the Irish = 20.22. Both samples had the same SD (= 4.1). This age mean difference was significant ($t = 9.9$). The age variable influenced scores on the domains of film, classical music, politics, and discovery and exploration.

(5) The 2 (sex) × 2 (country) multivariate analysis of variance (MANOVA) with age as covariate gave the following results: *age* $F\ (17, 347) = 13.9$; $\text{eta}^2 = 0.41$ *sex* $F\ (17, 347) = 12.9$; $\text{eta}^2 = 0.39$ *country* $F\ (17, 347) = 38.7$; $\text{eta}^2 = 0.66$ *sex* × *country* $F\ (17, 347) = 2.4$; $\text{eta}^2 = 0.11$.

(6) To interpret the effects of the main factors *sex* and *country* univariate 2 x 2 ANOVAs were calculated with age as a covariate. This gave the following pattern of effects (estimated for age of 22.5): Interaction: no significant interaction *sex* × *country* in any domain except medicine. Country: no effect of *country* in two domain (games, biology). In four domains Irish students had greater knowledge than German students (popular music, sport, politics, fashion). In the remaining 11 domains, German students obtained the higher scores. Sex: no effect of *sex* for the domains of popular music, classical music, art, fashion, and film. Women students obtained higher scores than men students in the domains of literature and nutrition; in the remaining nine domains men obtained higher scores than women.

Discussion

It is evident from inspection of the sex differences in the domains of general knowledge shown in Table II that the differences in the German university students are closely similar to those in the university students in Northern Ireland reported by Lynn et al. (2002). It may be useful to note that the sample of German students reported in the present study are closely matched to those in the studies in Northern Ireland, in so far as they came from similar academic disciplines (education and economics in Germany) as those from Northern Ireland (education and general social sciences). In both samples, men have significantly and considerably more general knowledge of politics, finance, history, discovery and exploration, geography, games, literature,

and science. In both samples, there are no statistically significant differences in general knowledge of fashion, popular music, classical music, art, and film.

There are some minor discrepancies between the two samples. In medicine, women have significantly more knowledge in Northern Ireland [$d = -0.32$] but not in Germany [$d = 0.10$]. In biology, men have significantly more knowledge in Northern Ireland [$d = 0.42$] but not in Germany [$d = 0.09$]. In both samples, women have the most knowledge of nutrition (this includes food and cooking) and this advantage is statistically significant in Northern Ireland [$d = -0.48$] but not in Germany [$d = -0.26$]. The effect size for the total score of the present German sample is $d = 0.49$. This is the approximately equivalent to half a standard deviation and is normally considered as a medium size effect. In the Northern Irish sample, men obtained a higher mean on the total test of $d = 0.51$. Thus the magnitude of the men's advantage in total general knowledge is closely similar in the German and Irish samples. The product-moment correlation of the d values in the two samples is 0.84 ($p < 0.01$), indicating a high degree of similarity in the sex differences in general knowledge in the two samples.

The results showing that in both Germany and Northern Ireland men have on average more general knowledge than women differs from the findings of Herlitz et al. (1997) and of Meinz and Salthouse (1998), cited in the Introduction (both studies reported that men obtained a small but non-significantly higher score). The following possible explanations for the discrepancies between the results are suggested. In the Herlitz et al. (1997) study of a Swedish sample of 1000 adults, the measure of general knowledge consisted of only 20 questions, whereas the measure of general knowledge in our study in Northern Ireland contained 182 questions and the measure of general knowledge in the present study in Germany contained 95 questions. A short scale is likely to produce smaller differences than a long scale. Another possibility is that the domains of general knowledge tested in the Swedish study may have been those in which there is little or no sex difference, or the questions in the domains in which men have greater general knowledge than women may have been counterbalanced by those in which women have greater general knowledge than men (Herlitz, Nilsson, and Backman do not publish their questions). A possible explanation for the result in the Meinz and Salthouse (1998) study, of a sample of 1380 American adults, is that the measure of general knowledge included vocabulary as well as general knowledge as ordinarily understood. It has generally been found there is no sex difference in vocabulary or possibly a slight difference favouring women (Hyde & Linn, 1988), so the conflation of general knowledge and vocabulary into a single score is likely to reduce the sex difference in general knowledge.

We believe that the confirmation in the present study of German students of the results initially obtained on Northern Ireland students establishes that it is unsatisfactory to report sex differences in general knowledge as if this is a unitary construct. On the contrary, we have shown that in some domains men have more general knowledge than women, in other domains women have more general knowledge than men,

while in further domains men and women have equal amounts of general knowledge.

This conclusion raises the question of why there should be these sex differences in general knowledge of different domains and whether they can be explained in terms of evolutionary psychology. The results show that: men in both samples have significantly more general knowledge of politics, finance, history, discovery and exploration, geography, games, literature, and science; there are negligible sex differences in general knowledge of fashion, popular music, classical music, art, and film; and women have more knowledge of nutrition (although this female advantage is not statistically significant in Germany). We propose that these differences can be understood in terms of evolutionary psychology as follows. Throughout virtually all species, males are biologically programmed to compete with other males for status and territory (Buss, 1999; Geary, 1998; Wynne-Edwards, 1962). It has been shown that this difference is present in humans in a study of 20 countries in all of which it has been found that men are more competitive than women (Lynn, 1993). An examination of the domains in which men have greater general knowledge than women shows that these are largely concerned with competition between men for status or territory. These are sport and games (largely concerned with which men or group of men can win), history (much of which is concerned with which men become leaders and which group of men win wars), finance (which men can make the most money as a symbol of status), politics (which men and group of men can secure power), and discovery, exploration, and science (which men can be the first to make discoveries and secure the status of having done so). The greater knowledge of men of geography may be explicable in terms of greater male concern with territory and its possession. While women participate in all these competitive activities, they do so to a much lesser extent than men. The domains in which there are negligible sex differences in general knowledge (fashion, popular music, classical music, art, and film) are not much concerned with competition between men. The domain for which women in both samples have more knowledge than men is nutrition, which may likewise be explicable in terms of evolutionary psychology as an expression of a greater female concern with the gathering and preparation of food and the feeding of families.

We propose that the sex differences in different domains of general knowledge are largely determined by their different interests. Men are more interested in domains concerned with inter-male competition. Thus, it has been found by Lubinski and Humphreys (1990) that men are more interested than women in sport ($d = 0.70$), finance ($d = 0.70$), and science ($d = 0.70$), while women are more interested than men in music ($d = 0.70$) and art ($d = 0.70$). Hence, we suggest that the principal reason why men have more knowledge than women in the domains concerned with inter-male competition is that men are more competitive than women, this makes men more interested in the domains concerned with inter-male competition, and this in turn leads to men acquiring greater general knowledge in these domains.

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