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Explaining male predominance at the apex of intellectual achievement

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ABSTRACT

One view attributes male predominance at the apex of intellectual achievement partly to some innate ability differences. Another view attributes it only to such social factors as socialization practices, lack of female role models, glass ceilings and male gatekeepers downplaying female achievement. The present study examined sex differences in performance at the top in international chess. This domain allows controls over the latter two social factors because chess has an objective performance measure based on game results and little of a glass ceiling as most tournaments are open to all and talent can rise quickly. The sex difference in performance in the top 10 and 50 of all international players is large at about one standard deviation and stayed roughly constant from 1975 to 2014. A large difference remained when examined over number of rated games played and also occurred, but not as strongly, with Georgian players, who have a high female participation rate. Male predominance in chess and related domains may be due partly to sex differences in innate abilities.

1. Introduction

Males predominate at the apex of intellectual achievement, securing more full professorships, chess grandmaster titles, and Nobel prizes (Deary, Thorpe, Wilson, Starr, & Whalley, 2003; Murray, 2003). Males particularly excel in mathematics-based fields such as physics and engineering (Ceci & Williams, 2010). Determining why is important to inform societal efforts to deal with it and to understand causes of sex differences.

One view imputes only such social factors as socialization practices, lack of female role models, media messages, and male gatekeepers downplaying female achievement and limiting female opportunity (Ayalon, 2003; Eklund, Lincoln, & Tansey, 2012; Lupart & Barva, 1998). Another view imputes some partly innate sex differences in abilities. IQ and visuospatial ability are good predictors of intellectual achievement (Gottfredsen, 1997; Robertson, Smeets, Lubinski, & Benbow, 2010) and more males score at both IQ extremes and males on average score higher in visuospatial ability (Deary et al., 2003; Halpern, 2012; Lynn & Irwing, 2004). Pesta, Bertsch, Poznanski, and Bonner (2008) argue that IQ tests are constructed to minimize sex differences and present evidence for small sex differences in elementary information-processing tasks such as inspection time.

Impacts of the above social factors apparently have diminished with recent changes in the role of women in industrial nations. If the male predominance is due only to social factors, it should have lessened. Female achievement in general indeed has soared. There were no female chess grandmasters in 1975 but there were 26 in January 2012. In many nations, females now outperform males on average in formal education and take an increasing majority of university places; 57% in the United States in 2007 (Halpern, 2012). In 1960, women secured only 5.9% of U.S. doctorates in mathematics but took 29.6% in 2006 (Ceci & Williams, 2010). But women still are under-represented at the apex in science and hold relatively few top leadership positions in business and politics (Halpern, 2012).

Perhaps glass ceilings and downplaying of female achievement are responsible. International chess is a useful real-world domain for testing this possibility. There is an objective performance measure, a numerical rating (Elo, 1978), and little of a glass ceiling. Most tournaments are open to all and unconnected talent can rise easily. Playing chess is a highly intellectual task and performance depends upon traits also important in science and other domains; high IQ, visuospatial ability, and competitiveness (Frydman & Lynn, 1992; Grabner, in press). There are female role models and useful population-level performance data are available from 1975.

Howard (2005) found large performance differences in the top 10 and 50 international chess players of each sex from 1975. But Howard examined data only until 2004 and did not control for differences in numbers of rated games, later shown to be important. Females on average play many fewer rated games and most players

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who play 900 games become grandmasters (Howard, 2009). International chess also has a much higher proportion of male players. Some researchers argue that this participation rate difference alone explains male predominance in chess. Chabris and Glickman (2006), using United States Chess Federation rating data spanning 13 years, concluded that the male predominance was due to greater numbers of males entering at the lower levels. But they did not study only highly skilled players, and gender differences are greatest at the extreme. Bilalic, Smallbone, McLeod, and Gobet (2009) examined the April, 2007 German Chess Federation rating list. They argued that male predominance at the top on this list mainly was because the greater percentage of males meant a greater likelihood of some having extreme scores. The implication was that the predominance would disappear with equal participation rates. However, Knapp (2010) argued that Bilalic et al.'s statistical approach was inappropriate. His analysis with another approach suggested that differing participation rates did not explain all of the male predominance. Howard (2014) provides empirical evidence against this participation rate hypothesis.

The present study examined sex differences in international chess performance for 10 additional years from 2004 and looked at the possible impact of number of games played and different participation rates. The first was dealt with by considering sex performance differences over games played and the second by examining performance in the Caucasus nation of Georgia, where the female participation rate is high. Georgian women are strongly encouraged to play chess, there are local female role models, and Georgia has produced several women's world champions (but there never has been a female open world champion). In January 2012, 32.95% of Georgian international players were female versus only 8.51% for all nations. Any sex difference in performance at the top should be very much lower in Georgia if that for all players is due only to participation rate differences.

If, despite all the societal changes and with controls for games and participation rates, the sex difference in chess performance at the top remains large and constant, it probably is due partly to sex differences in abilities. Given the similarity of abilities needed to excel in chess and some sciences, this would be evidence that the male predominance at the top in some sciences also partly may be due to ability factors.

2. Materials and methods

2.1. Participants

These were international chess players selected as described below.

2.2. Materials

FIDE (the international chess federation) has issued rating lists from 1970. Pre-1975 lists have fewer than five females and were not used here. Each list gives a player's performance rating on a scale from 1200 to about 3000. A rating may change with game results. Wins against higher rated players will raise a rating and losses may lower it. Howard (2006) placed FIDE data into the database used here and gives more information about ratings. The database is available from the author. FIDE added 100 points to all female ratings in 1987, evidently to bring them more into line with male ratings, and 100 points were added to all pre-1987 female ratings here. The mean rating in January 2012 was 1956.66 (SD = 239.05, N = 139,000 with 11,835 females, and with 26 female and 1324 male grandmasters).

2.3. Procedure

The top 10 and top 50 male and top 10 and top 50 female ratings in each January list from 1975 to 2014 were determined and the mean difference (mean male − mean female rating) was calculated for each year.

Georgia first appears as a nation in a FIDE January list in 1993. Rating differences were calculated for the top 10 Georgian males and females from 1993. Only in 2001 did Georgia have 50 internationally-rated females and top 50 data were calculated only from then.

FIDE gives games counts in each rating period only from July 1985 and so only players who first entered the domain from then were included in the games analysis. All players who played at least 650 games from July 1985 to November 2013 were determined and the top 10 and 50 males and females of these by peak rating in the entire period were selected. All females used in this analysis entered the domain from January 1987 onwards. Only a few top ranked players did not play at least 650 games and needed to be dropped.

FIDE lists do not give ratings after each game played, only after the total played in the previous rating period. This total could vary from zero to over 100. Therefore, it is not possible to get a precise rating after say each 50 or 100 games. So, for each player, game totals from July 1985 to their latest list were divided into 50 game categories (starting with 0–49 games, and then 50–99, etc.) and the final rating of each player in each 50 game category was determined. For instance, say a player had the following data in successive lists; 2321 rating and 123 cumulative games and 2360 rating and 149 games. Only the value of 2360 was used for the 100–149 games category. Ratings were determined up until and including the 650–699 games category. About 1.8% of values were missing due to some players being very active (e.g. playing more than 50 games in a rating period) and were estimated by taking the mean value in adjacent categories for each player. The rating development of the top-rated male and female also were determined, to their latest games category.

To select the Georgian sample, for technical reasons the January 2012 list was used. For the games only analysis, ratings were used from a player's domain entry date, which could be under Soviet nationality before 1992. One Georgian male shifted to the United States from February 2013 and one female shifted to Spain from March 2012 but both were included in the present analysis. Both played their 700th game under Georgian nationality. Only 12 Georgian females played 650 games and so only top 10 differences were calculated. About 0.7% of values were missing and were estimated as for all players.

3. Results

Fig. 1 presents top 10 and top 50 rating differences for all players in each year from 1975. The sex difference is sizeable and fluctuates around about one SD (as mentioned, the population SD was 239.05 in January 2012). There is no clear trend downwards for the top 10 or 50 players since 1975 and certainly not for the past 10 years. A statistical analysis compared male and female ratings in each year from 1975. For the top 10, the effect of sex is highly significant ($F(1, 18) = 115.91$, $p < .001$) as is that of year ($F(39, 702) = 302.52$, $p < .001$) and the interaction ($F(39, 702) = 2.02$, $p < .001$). The interaction appears to be a varying difference over time but with no downwards trend. For the top 50, the effect of sex is significant ($F(1, 98) = 596.68$, $p < .001$) as is year with Greenhouse–Geisser correction ($F(4.95, 484.76) = 3940.95$, $p < .001$) and the interaction ($F(4.95, 484.76) = 41.31$, $p < .001$). (A Greenhouse–Geisser correction was used when the Mauchly Test

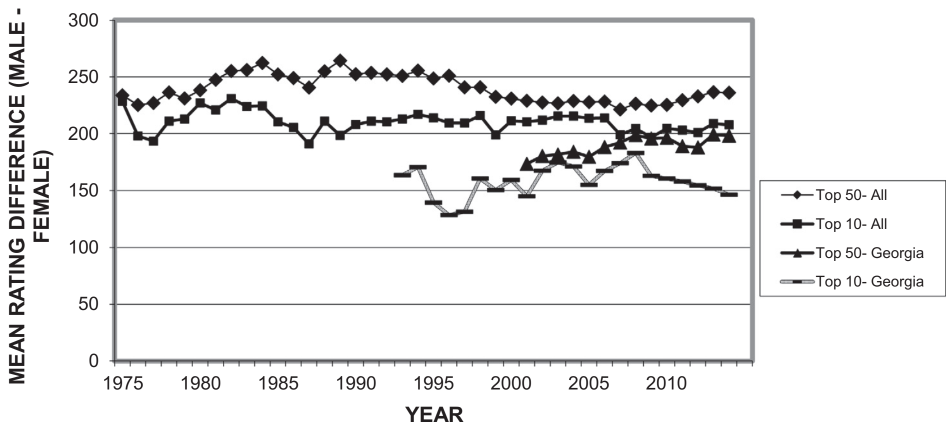

Fig. 1. Mean sex differences in ratings in top players in each year since 1975.

of Sphericity indicated that a key ANOVA assumption was violated. The test adjusts degrees of freedom. The Mauchly test was not significant in some comparisons and so a Greenhouse–Geisser correction was not needed.)

Fig. 2 presents data over games. Here the top 10 and 50 shows an apparent steadily-rising difference from the 0 to 49 games category to a difference of about one SD by the 650–699 games category. For the top 10, the sex difference is significant ($F(1, 18) = 21.1$, $p < .001$) and with Greenhouse–Geisser correction so is the effect of games category ($F(2.84, 51.09) = 106.8$, $p < .001$) and the interaction ($F(2.84, 51.09) = 4.82$, $p < .01$). The pattern is the same for the top 50. The sex difference is significant ($F(1, 98) = 279.61$, $p < .001$) and with Greenhouse–Geisser correction so is the effect of games category ($F(3.8, 372.82) = 529.04$, $p < .001$) and the interaction ($F(3.8, 372.82) = 17.55$, $p < .001$).

Fig. 3 presents development over games of the highest-ever rated male and female. Both entered the international domain at about 10.5 years old. The female actually had an initially higher rating but took up the game seriously much younger (at age five versus age eight for the male) and was hot-housed, studying 5–10 h a day (Forbes, 1992). By later career the rating difference is sizeable.

Fig. 1 presents data over years for Georgia and the overall pattern is similar as for all players. The sex difference for the top 10 and 50 is sizeable and shows no downwards trend but is numerically smaller than that for all players. For the top 10 in 2012, the difference between data for all players and Georgians was about 0.19 SDs (0.84 and 0.65 SDs respectively for each) and for the top 50 was about 0.18 SDs (0.97 and 0.79 SDs respectively). For the top 10 Georgians, the sex difference is significant ($F(1, 18) = 43.34$, $p < .001$) as is the effect of year ($F(21, 378) = 70.18$, $p < .001$) and the interaction ($F(21, 378) = 2.95$, $p < .001$). For the top 50 Georgians, the sex difference is significant ($F(1, 98) = 89.6$, $p < .001$) and with Greenhouse–Geisser correction so is the effect of year ($F(3.82, 374.34) = 227.36$, $p < .001$) and the interaction ($F(3.82, 374.34) = 11.87$, $p < .001$).

Examining performance over games for the top 10 Georgians, the sex difference is significant ($F(1, 18) = 63.52$, $p < .001$) and with Greenhouse–Geisser correction so is the effect of games category ($F(5.18, 93.2) = 97.18$, $p < .001$) but the interaction is not significant ($F(5.18, 93.2) = 1.79$, $p = 0.12$, power = 0.6). The sex difference is numerically larger than that for all players in the initial games categories.

4. Discussion

Social, ability and personality factors all may affect high achievement and may interact in complex ways but social factors alone and participation rate differences cannot easily explain male preponderance at the top in chess. An ability explanation is much more plausible. Males score higher on average in visuospatial ability and many more males score at the upper IQ extreme and increments in these abilities yield continually higher achievement (Robertson et al., 2010). Both abilities partly are innate and so

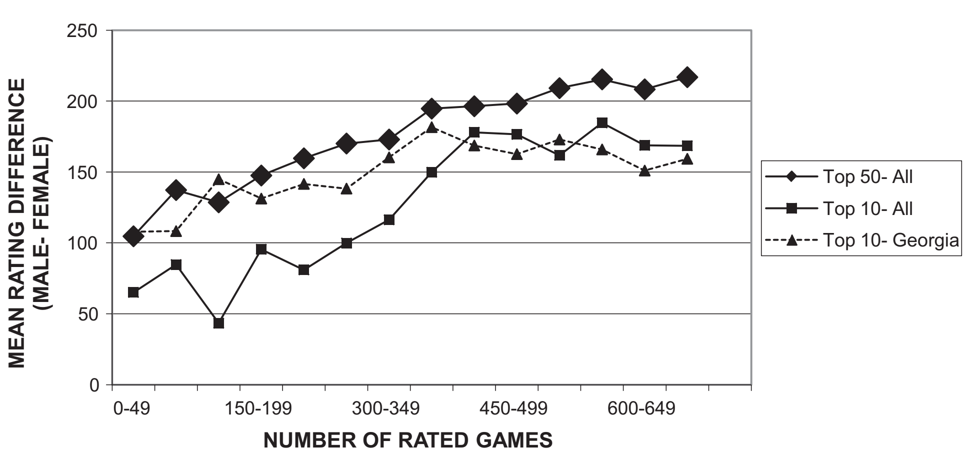

Fig. 2. Mean sex differences in ratings in 50 game categories from domain entry for top players.

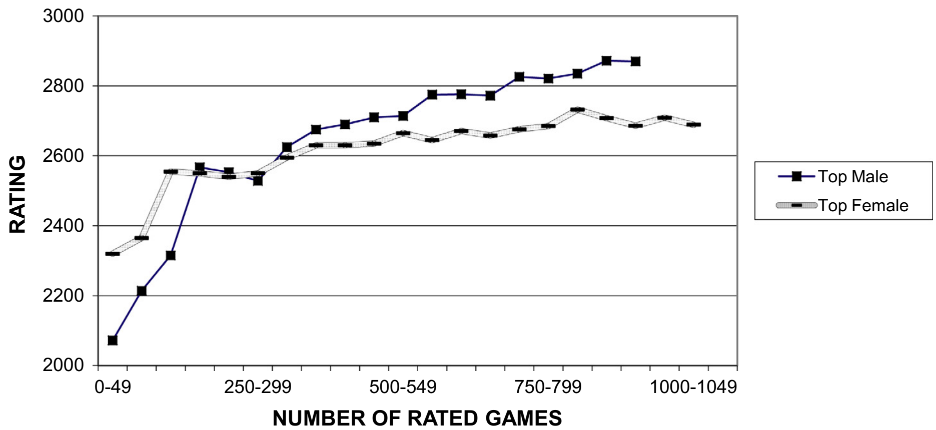

Fig. 3. Rating development from domain entry in 50 game categories for the top-rated male and female.

the male predominance in chess also probably partly is innate. Given the similarity between abilities needed to succeed in chess and in physics and engineering and the similar pattern of male predominance in these disciplines, the male predominance there also partly may be innate. However, in other intellectual domains, on average females may some innate advantages.

The present study has some limitations. Sample size for the Georgians is not large but includes all the Georgian players who met the criteria used. It also would be useful to examine sex differences in a nation with 50% females, but unfortunately no such nation exists.

A dominant societal view in some Western nations is that only social factors create later sex differences in psychological traits. Although some researchers provide evidence that complex interactions between nature and nurture actually may determine many psychological sex differences (Eagly & Wood, 2013), stating an alternative view still can provoke controversy. In 2005, then Harvard University president Larry Summers mused over whether the under-representation of women at the top in some fields of science and engineering might be due to some partly innate factors, which elicited much protest (Halpern, 2012). Research findings can be very unpalatable but societal beliefs should not constrain interpretation of results. And, social policy best is informed by how the world actually is rather than by how it ought to be.

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