Personality and Individual Differences 86 (2015) 117–121

Contents lists available at ScienceDirect

Personality and Individual Differences

journal homepage: www.elsevier.com/locate/paid

Sex differences in chess performance: Analyzing participation rates, age, and practice in chess tournaments☆,☆☆

Angel Blanch [a,b,*], Anton Aluja [a,b], Maria-Pau Cornadó [c]

[a] Department of Psychology, University of Lleida, Spain
[b] Institute of Biomedical Research (IRB Lleida), University of Lleida, Spain
[c] Department of Catalan Philology and Communication, University of Lleida, Spain

ARTICLE INFO

Article history:
Received 13 February 2015
Received in revised form 29 May 2015
Accepted 1 June 2015
Available online 18 June 2015

Keywords:
Chess
Sex differences
Age
Practice

ABSTRACT

This study analyzed sex differences in chess Elo ratings with chess tournament data. We evaluated whether sex differences were due to differential participation rates of males and females, and whether age and practice were able to predict differences in chess ability. There were meaningful sex differences in Elo ratings unrelated to different participation rates. Age and practice predicted sex differences in Elo chess ratings for females, but not for males. The findings paralleled those concerning sex differences in cognitive ability research, and supported that biosocial factors (i.e., age and practice) rather than divergences in participation rates of males and females in the domain influenced the extreme sex differences in Elo ratings.

1. Introduction

The chess domain conveys a number of strengths for expertise and cognitive ability research. It involves a considerable amount of practice to reach expert levels, there is a wealth of available archival chess data, and there is an Elo rating indicator reflecting a player's chess skill (Gobet, 1998). The Elo chess rating allows the differentiation of chess players at diverse skill levels, and to studying individual differences in intellectual performance in a higher level cognitive function such as chess (Charness, 1992).

A core issue within this field is why males achieve higher chess performance than females. Sex differences in Elo ratings have been attributed to different participation rates of males and females in chess (Bilalic & McLeod, 2006; Bilalic, Smallbone, McLeod, & Gobet, 2009; Chabris & Glickman, 2006; Charness & Gerchak, 1996). From this approach, the huge disparity in chess performance between males and females originates in the underrepresentation of women in the domain, thus, higher Elo rating scores arise in the larger population (i.e., men). On the other hand, a variety of biological and cultural agents have also been proposed to accounting for the observed differences (de Bruin, Smits, Rikers, & Schmidt, 2008; Howard, 2005a, 2014a,b; Maass, D'Ettole, & Cadinu, 2008). With data from six chess tournaments, we examined this controversy and whether two intertwined factors related with the Elo rating (age and practice), contributed to explain sex differences in chess skill.

1.1. Age, practice, and chess skill

The relationship of intellectual performance with age is far from being simple. That cognitive abilities such as fluid intelligence or processing speed decrease along the life span is well-established, with some instances suggesting an inverted U-shaped relationship (Ackerman, 1996; Salthouse, 1996; Salthouse, Pink, & Tucker-Brob, 2008; Sturman, 2003; Verhaeghen & Salthouse, 1997). However, there are remarkable variations in several factors accounting for individual differences in ability deterioration, such as cohort effects or higher intelligence in young days that preserve intellectual decline in later life (Gow et al., 2011; Schaie, 1994). Performance declines in chess players are smaller than in other sports with peak ages occurring later in life (Fair, 2007; Roring & Charness, 2007).

Laboratory experimental studies indicate qualified levels of performance for older players (Charness, 1981; Jastrzembski, Charness, & Vasyukova, 2006). In contrast, aging has also been negatively related with the performance in chess move selection and position recall

☆ Acknowledgments: This research was done with the support of the Faculty of Education, Psychology and Social Work at the University of Lleida, and the County Council of Lleida (Diputació de Lleida).
☆☆ The authors express their appreciation to the referees for their helpful comments on an earlier version of this manuscript.

* Corresponding author at: Department Psychology, Faculty of Education, Psychology and Social Work, University of Lleida, Avda de l'Estudi General, 4, 25001 Lleida (Catalonia), Spain. Tel.: +34 973706529.
E-mail address: ablanch@pip.udl.cat (A. Blanch).

http://dx.doi.org/10.1016/j.paid.2015.06.004
0191-8869/

tasks (Moxley & Charness, 2013; Van der Maas & Wagenmakers, 2005). Furthermore, earlier studies with elite chess players suggest decrements in chess performance for players beyond forty years old. These decrements might be attributable to fatigue factors but also to the opponents' knowledge of their playing style and key playing attributes (i.e., conservative, aggressive, most used overtures and variants, or end games) that would be increasingly knowledgeable by potential opponents and constitute an opportunity to prepare a game in depth ahead in time (Draper, 1963; Rubin, 1960). In the past decades, however, higher levels of chess skill occur at earlier ages with younger players increasingly outperforming older players (Howard, 1999, 2005b) because of a better access to chess information in books and software, improved coaching methods, more opportunities to play chess tournaments, and new regulations regarding the thinking time in tournament games (Gobet, Campitelli, & Waters, 2002).

Estimations to reach expert chess performance range from a minimum of 3000 h (Campitelli & Gobet, 2011) to an average of 10,000 h of total practice (Simon & Chase, 1973), including activities such as group practice, specialized coaching, book reading, and persistence within the domain (Campitelli & Gobet, 2008, 2011; Gobet & Campitelli, 2007). However, recent meta-analytic findings suggest that game practice explained only a 26% of variance in game performance, and that age could also account for part of the unexplained variation (Macnamara, Hambrick, & Oswald, 2014). Chess practice activities stream along with age into the progression towards adult expertise, with early involvement in the aforementioned chess practice activities improving latter expertise in a greater extent. This supports the conception of a critical period around 12 years old or younger, in which a higher brain plasticity to environmental stimuli would enable a more refined learning and organization of chess knowledge than at older ages (Campitelli & Gobet, 2008, 2011; Gobet & Campitelli, 2007; Macnamara et al., 2014).

1.2. The present study

To the best of our knowledge, there is a paucity of research addressing explicitly whether age and practice relate with sex differences in chess performance with data from chess tournaments, with recent work focusing instead on archival data (Howard, 2014a,b). Because both factors are important in determining chess performance, they should relate with sex differences in Elo ratings. Practice activities at early ages, which eventually improve later chess performance, may be equally available to males and females. In contrast, the achievement of the critical period for optimal brain plasticity may occur earlier for females than for males, even though fewer women may enter competitive chess at the lowest rating level, when they are likely to be younger (Chabris & Glickman, 2006). First, we evaluated whether sex differences in Elo ratings were due to different participation rates, or whether it could be attributed to biological or cultural factors. Second, we studied whether age, practice, and the age × practice interaction, were able to predict sex differences in Elo ratings. Earlier starting ages imply more available time for studying in depth and playing serious competition more frequently (Roring & Charness, 2007), and more importantly, a crucial period to optimally select and integrate chess knowledge (Gobet & Campitelli, 2007; Macnamara et al., 2014). Females may be playing a lower amount of games during their chess career than males, and be more prone to dropout from the domain (Howard, 2005a, 2009, 2014b). Thus, if age relates non-linearly in an inverted U-shaped relationship with chess performance, then sex differences in chess performance should relate with age in a U-shaped relationship, with higher sex differences arising for the youngest and oldest players. The amount of practice should also relate negatively with sex differences in the Elo rating, and interact with age such as the association of age with sex differences in Elo ratings should vary significantly for different levels of practice.

2. Method

2.1. Participants and measures

Participants in rated chess tournaments hold an Elo rating that ranges approximately from 500 to about 2880 points, depending on the country or chess federation. Higher ratings characterize higher levels of chess expertise. Moreover, the Elo rating indicates a higher probability of winning against a weaker player, and a lower probability of wining against a stronger player (Elo, 1978; Glickman, 1995), while it updates periodically in accordance with the outcomes from official rated tournaments. Wins against stronger players' increase the Elo rating in a greater extent, loses against weaker players decrease the Elo rating in a greater extent.

The data for the current study were obtained from the Swiss manager database (http://swiss-manager.at) that contains information of chess tournaments from all over the world. There was a random selection of tournaments held in Spain from 2010 to 2013, because the popularity of chess tournaments in this country attracting players from all over the world. We selected six tournaments with at least 80 participants and 9 rounds, the regular parameters typically found in this kind of chess contests: Balaguer 2012 ($n = 85$), Figueres 2010 ($n = 100$), Gran Canaria 2012 ($n = 109$), Montcada 2012 ($n = 107$), Sanxenxo 2012 ($n = 108$), and Sitges 2013 ($n = 81$).

Each tournament spreadsheet contained information about the participant's FIDE Elo rating at the tournament date. Player's age and the number of games played 18 months prior to the tournament were obtained from the International Chess Federation database (FIDE, http://www.fide.com). The data from the latter tournament only were considered for players that had participated in more than one tournament, resulting in two lists in descending Elo rating with 511 males and 42 females. Elo sex differences were found by matching the ranks in the two lists and obtaining the Elo rating male–female difference. There were 42 data points in three measures: Elo sex differences, age, and number of games.

2.2. Data analyses

Sex differences in Elo ratings were examined with a negative hypergeometric distribution, a sampling without replacement from a finite population where a binary observation (i.e., male or female) is made on each sampling unit (Zhang & Johnson, 2011). This distribution describes more adequately the upper tail of chess ratings than a normal distribution, while it allows comparing the real differences with differences attributable to different participation rates (Knapp, 2010). With n_f females and n_m males, R_k is the rank of the k_{th} best female player in the combined ordered list of all participants. We calculated the 5% and 95% quantiles ($r_{k0.05}$, $r_{k0.95}$) for the distribution (R Development Core Team, 2014). Without a sex effect in chess performance, the rank R_k of the k_{th} best female player should fall between $r_{k0.05}$ and $r_{k0.95}$.

The association of the study variables with sex differences in chess performance was examined with regression analyses for males and females, with the Elo sex differences as the dependent variable. Centered age, number of games, and the age × games interaction were the independent variables in two models (Aiken & West, 1991): 1) Age and games; and 2) the variables in model 1), the age quadratic term, and the age × games interaction term.

3. Results

When comparing the list of 42 females with the list of 511 males, there were higher mean Elo ratings ($t = 2.96$, $p < 0.01$), and higher mean age ($t = 5.45$, $p < 0.001$) for males than for females, and played a similar mean amount of games ($t = 1.22$). When compared with the top 42 males, however, apart of higher mean Elo ratings ($t = 12.33$, $p < 0.001$) and higher mean age ($t = 3.67$, $p < 0.001$), males also had a