European Journal of Social Psychology
Eur. J. Soc. Psychol. **38**, 231–245 (2008)
Published online 14 May 2007 in Wiley InterScience
(www.interscience.wiley.com) **DOI**: 10.1002/ejsp.440

Checkmate? The role of gender stereotypes in the ultimate intellectual sport

ANNE MAASS*, CLAUDIO D'ETTOLE
AND MARA CADINU
University of Padova, Italy

Abstract

Women are surprisingly underrepresented in the chess world, representing less that 5% of registered tournament players worldwide and only 1% of the world's grand masters. In this paper it is argued that gender stereotypes are mainly responsible for the underperformance of women in chess. Forty-two male–female pairs, matched for ability, played two chess games via Internet. When players were unaware of the sex of opponent (control condition), females played approximately as well as males. When the gender stereotype was activated (experimental condition), women showed a drastic performance drop, but only when they were aware that they were playing against a male opponent. When they (falsely) believed to be playing against a woman, they performed as well as their male opponents. In addition, our findings suggest that women show lower chess-specific self-esteem and a weaker promotion focus, which are predictive of poorer chess performance. Copyright © 2007 John Wiley & Sons, Ltd.

Chess is not only one of the oldest games but it is also, by many, considered the ultimate intellectual sport. Although chess is an intellectual pursuit not requiring physical strength, women are generally considered inferior and they represent less than 5% of registered tournament players worldwide. Currently, the best female player, Judit Polgar, is placed in position 17 of the FIDE ranking (Federation Internationale des Echecs, 2006) and she is also the only woman among the top 100 players of the world. Thus, women seem to be underrepresented as well as underperforming.[1]

Why should this be the case? A first step to understand gender differences in chess is to ask what characteristics are predictive of success and whether these characteristics are less common in females. We will only consider general cognitive and motivational factors here and ignore the specific tactical and strategic skills that develop as a function of chess training, including the striking ability of expert chess players to quickly capture the gist of highly complex chess positions (de Groot & Gobet, 1996; Ross, 2006).

*Correspondence to: Dr Anne Maass, DPSS, Universitò di Padova, Via Venezia, 8, 35139 Padova, Italy.
E-mail: anne.maass@unipd.it

[1]However, Charness and Gerchak (1996) have argued that women's underrepresentation among top ranks is simply a function of relative participation rates, since extreme scores tend to increase disproportionally as population size increases.

Received 11 November 2006
Accepted 2 April 2007

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The single most important key to success appears to be effort and engagement. According to Charness, Tuffiesh, Krampe, Reingold, and Vasyukova (2005), chess skill is best predicted by the number of hours a player allocates to deliberate practice, followed by number of hours of tournament play, and years of private instruction. It has been hypothesized that women may be less willing to devote their time mono-thematically to chess, leading to higher drop-out rates. However, this hypothesis has not found any support in a recent study conducted by Chabris and Glickman (2006) in the United States who have found equal drop-out rates in matched samples of males and females.

The second factor believed to play a major role in chess is memory. Chess players need to recall an impressive amount of theoretical knowledge from long-term memory, including a great number of openings, although they may not excel in mnemonic abilities outside of this specific domain. Less intuitive is the central role of working memory, including spatial-visual memory. Note that chess players have to calculate a great number of potential moves which implies an impressive working-memory capacity considering that positions of multiple pieces have to be memorized over a series of consecutive (imaginary) moves. Thus, memory for location is crucial in forward analysis. Indeed, expert chess players have a remarkable capacity to memorize positions (De Groot, 1965), although this memory advantage may be eliminated when chess positions are random and, hence, do not conform to intelligible schemes (e.g. Simon & Chase, 1973; Saariluoma, 1989; but see Gobet & Simon, 1996; Van der Maas & Wagenmakers, 2005). Are there reasons to expect that women are disadvantaged in terms of their mnemonic abilities? The literature argues against this hypothesis showing either no sex differences or better performance in women on memory tests in general (Jensen, 1998; Stumpf & Jackson, 1994; for an overview see Halpern & LaMay, 2000) and on memory for spatial location in particular (Eals & Silverman, 1994). Thus, memory—although heavily implicated in chess performance—is an unlikely candidate when trying to explain sex differences.

A third ability that appears critical in chess performance is mental imagery. Chess players seem to rely heavily on imagery and this capacity becomes decisive in 'blindfold' chess (Chabris & Hearst, 2003). Some authors even argue that players will be unable to ever reach top ranks, unless they have sufficient imagery ability (Howard, 2005). Interestingly, visual-spatial imaging is also one of the few facets of intelligence, where sex differences have emerged consistently, with females being at a clear disadvantage (for an overview see Halpern & LaMay, 2000). Among the spatial imaging tasks, two appear particularly relevant to chess, namely the generation and maintenance of spatial images and mental rotation, with gender gaps being particularly large on the latter (Voyer, Voyer, & Bryden, 1995). Mental rotation is crucial in chess because the board is rotated depending on the assigned color of pieces, black or white. For instance, a piece positioned in c6 will appear to the upper left or lower right, depending on the player's color, whereas chess books and magazines represent the board always from the position of the person playing white. Thus, mental imagery in chess necessarily involves some form of mental rotation. Considering the existence of pervasive gender differences, mental rotation appears a promising candidate for explaining the poorer chess performance of women.

Fourth, motivational factors such as aggressiveness may contribute to chess performance. Chess is a highly competitive activity, as evidenced by the war-like vocabulary used in periodicals and books in which terms like *battle, defeat, victory, attack, defense, destroy,* etc. appear with high frequency. Considering that women generally score lower than men both on aggressiveness and dominance (Bettencourt & Miller, 1996), it is plausible to assume that women encounter a disadvantage in chess. As the English grandmaster Nigel Short stated, women *'just don't have the killer instinct.'* The importance of motivational factors in chess has been demonstrated by Van der Maas and Wagenmakers (2005) who identified four major factors contributing to chess performance: general chess ability (tactical, positional as well as endgame knowledge), chess-specific verbal knowledge (opening-, middle-, endgame knowledge and imagery), memory (recall for positions), and motivation (including fear of failure and desire to win). Two findings are particularly relevant for the aims of the present study.

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First, general ability, knowledge, and memory emerged as the best predictors of chess ability, but motivation—although less predictive—contributed above and beyond these factors. Second, Van der Maas and Wagenmakers (2005, p. 50) found that women 'had lower Elo ratings than would be expected on the basis of their test scores'.[2] Since Elo ratings are earned in tournaments, this suggests that women encounter difficulties in competitive game situations that prevent them from performing at the level of their actual capacities.

This suggests yet another explanation of the underperformance of women in chess, namely gender stereotyping. The difficulty encountered by female chess players may mainly reside in their awareness that others expect them to perform poorly in a predominantly male domain. Not only are females often accused of inferior ('girl's') play but, when they perform exceptionally well, their femininity is also often doubted (Shahade, 2005). Although we are not aware of any systematic investigation of chess-related gender stereotypes, such stereotypes are easily visible in chess magazines and have been discussed in detail in Shahade's (2005) popular book. Applying the stereotype threat model (Steele & Aronson, 1995; Spencer, Steele, & Quinn, 1999), the activation of gender stereotypes during a tournament is likely to interfere with the chess performance of women, presumably due to their preoccupation to confirm negative expectations. The stereotype threat model has received considerable empirical support both in academic domains (Inzlicht & Good, 2006; Maass & Cadinu, 2003; Steele, Spencer, & Aronson, 2002) and sports (Stone, Lynch, Sjomeling, & Darley, 1999; for a review see Beilock & McConnell, 2004), but, to our knowledge, has never been investigated as a potential explanation of the gender gap in chess.

From a stereotype threat perspective, the investigation of chess appears interesting for a number of reasons. In the past, stereotype threat has been investigated in two broad domains, namely intellectual (e.g., math) and athletic activities (e.g., golf). Stereotype-related performance declines have been found in both domains, although distinct mechanisms seem to be implicated. Whereas performance declines in the academic domain are often attributable to thought intrusions and to a reduction of working-memory capacities (e.g., Cadinu, Maass, Rosabianca, & Kiesner, 2005; Schmader & Johns, 2003), sport performance seems to decline under stereotype activation because conscious attention is directed to motor processes that are usually performed in an automatic fashion (Beilock & McConnell, 2004). Chess and other competitive games (such as go or bridge) are located at the intersection between the academic and the sports domain, as they combine the intellectual demands of the former with the competitive nature of the latter. As a consequence, and different from physical sports, chess players may be particularly susceptible to stereotype threat, considering that chess requires a remarkable working-memory capacity that is already pushed to the limits by the competitive nature of the situation. However, there is an additional process through which stereotypes may affect quality of play, namely by making women less assertive and reducing the likelihood that they will play aggressively. One of the aims of the present study was to investigate this possibility.

From the perspective of gender stereotyping, chess also constitutes an interesting realm of inquiry for two additional reasons. First, it is one of the few sports in which men and women enter in direct competition. Second, chess tournaments satisfy a crucial precondition of stereotype threat, namely category salience, considering that women represent a miniscule percentage of players in practically all mixed-sex chess tournaments. Such minority or token status is known to produce performance deficits, decreased well-being, and a reduction of self-confidence (Inzlicht & Ben-Zeev, 2000; Inzlicht & Good, 2006). As the female chess champion of the U.S., Jennifer Shahade (2005, p. 6), states: *'the category of women's chess does not refer to some intrinsically female way of playing chess but rather to being a minority in the chess world, which can affect the way a woman plays'*. Interestingly, in line with this

[2] The Elo rating system allows to reliably calculate the strength of each player based on their past performance in tournaments, taking into account the strength of their opponents.

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idea, Chabris and Glickman (2006) have recently shown that girls have lower chess ratings than boys when entering competitions only in locales in which they are numerically underrepresented among the chess population.

AIMS OF THE PRESENT STUDY

The present study pursued four aims. The first and most important aim was to investigate the potential role of stereotype activation in chess performance of female players. In the control condition, the gender salience was reduced by having participants play through the Internet under false (gender-neutral) names. Players were unaware of the gender of their opponent and at no time during the experiment was there any reference to gender. In the experimental condition, we first activated the stereotype that females are poor chess players and then had males and females play two games against each other, but, critically, participants believed to play against a same-sex opponent in one game and against an opposite-sex opponent in the other. This allowed us to assess performance as a function of the presumed sex of the opponent, while keeping the actual (opposite-sex) opponent constant.

We predicted that women would perform close to chance level in the control condition. We expected the same in the experimental condition as long as females (falsely) believed that they were playing against another woman, because, in this case, gender stereotypes would be irrelevant. A below chance performance was only hypothesized in the condition in which the stereotype was activated *and* women were aware that they were playing against a man, presumably the condition that most closely resembles face-to-face tournaments in which gender is highly salient and women have an extremely high chance to be playing against a male opponent.

A second aim was to investigate whether women who were reminded of the stereotype and were aware that they were playing against a male opponent, would approach the game more defensively than those that believed that they were playing against another woman.

Third, if women are chronically exposed to chess-related gender stereotypes, as suggested by Shahade (2005), they may become less confident in their chess abilities (Inzlicht & Good, 2006) and generally approach games with a more cautious regulatory focus, trying to limit the likelihood of failure (prevention) rather than to maximize their gains (promotion; see Higgins, 1999). We therefore also assessed participants' chess-specific self-esteem as well as their promotion versus prevention-oriented regulatory focus, again, referring specifically to the way in which they approach chess competitions. Higgins (1999) distinguishes two motivational systems, one sensitive to gains (promotion), the other to losses (prevention). Although Higgins refers to two broad systems of goal pursuit that affect many facets of people's life, the aspect that is most relevant to the current study is how promotion versus prevention-oriented individuals approach achievement situations. Whereas promotion-orientated individuals strive to obtain positive outcomes (gains), prevention-oriented individuals are mainly concerned with avoiding negative outcomes (losses) and therefore are likely to approach competitive situations such as chess games with a more cautious, vigilant attitude. Considering the long history of stigmatization in the chess world, it is therefore reasonable to suspect that female players approach chess competitions with a more cautious prevention mindset, which may well hamper their performance and, in the long run, damage their chess careers.

Finally, we also assessed two spatial abilities that are potentially relevant in chess regardless of experimental condition, namely mental rotation and memory for location. Mental rotation not only represents a basic skill that is likely to be relevant in chess, but it is also a potential candidate for explaining gender differences in chess, considering that males reliably outperform females. Memory for

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location, although generally unrelated to gender, was included in this study because it appears particularly relevant in forward calculations and, to our knowledge, has not been investigated in the past.

METHOD

Pilot Study Investigating Chess-Related Gender Stereotypes

Prior to the main study, we tested whether chess players do indeed perceive women as less capable in chess, an issue frequently cited (Shahade, 2005), but—to our knowledge—not investigated systematically in the past. A sample of 22 registered chess players, including 12 males and 10 females, aged 17 to 61 (mean age = 37.5) were asked to indicate both their personal beliefs (stereotype endorsement: *In your opinion, on the average who is better at playing chess, men or women? In your opinion, who is more gifted for chess, men or women?*) and their perception of beliefs among chess players (stereotype awareness: *Regardless of your own opinion, what is the opinion among chess players? In general, do chess players believe that men or women are better at playing chess? In general, whom do chess players consider more gifted for chess, men or women?*). Participants responded on 7-point scales from 1 (*clearly males better* or *more gifted*) to 7 (*clearly females better* or *more gifted*), with 4 representing the neutral scale midpoint (*equal*).

As far as participant's personal *endorsement* of gender stereotypes is concerned, males were considered much better at chess ($M = 2.27$) and much more gifted ($M = 2.59$), with both means clearly below the neutral scale midpoint of 4, *one sample* $t(21) = -7.23$, $p < .001$, and *one sample* $t(21) = -6.56$, $p < .001$.

Ratings were even more extreme when considering the participants' *awareness* concerning socially shared stereotypes. Respondents agreed that other chess players consider males better at chess ($M = 1.80$) and more gifted ($M = 1.63$), with both means, again, clearly below the neutral scale midpoint of 4, *one sample* $t(21) = -10.68$, $p < .001$, and *one sample* $t(21) = -11.63$, $p < .001$.

Interestingly, no differences between male and female respondents emerged for any of the four items, suggesting that chess-related gender stereotypes are widely shared and by no means confined to male players. Stereotype awareness, a critical condition for stereotype threat to occur, did not vary with age, $r(22) = -.02$, n.s., whereas personal stereotype endorsement tended to decrease the younger the respondents were, $r(22) = -.42$, $p < .05$ (considering the average between the two endorsement and the two awareness scores, respectively).

This small-scale pilot study suggests that gender stereotyes are very pronounced in the chess world and that both male and females players are perfectly aware of these stereotypes.[3]

Participants of Main Study

Forty-two male and 42 female chess players volunteered to participate via Internet in this study (mean age 33.54). They were contacted at tournaments, through the Italian Chess Federation, and through local chess clubs throughout the entire national territory. Each dyad was composed of a male and a

[3] These findings are in line with those recently obtained by Luciana Carraro [personal communication] on *non*-chess players. Carraro asked a sample of Italian students (age 21–22) not involved in chess whether they considered chess (together with a list of other sports) a typically masculine or feminine activity. On a scale from −9 (typically masculine activity) to +9 (typically feminine activity), chess was rated more typical of males, $M = -2.46$, a value that differed from the neutral point of zero, $t(17) = -3.56$, $p < .01$.

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female player of comparable strength. Considering the small number of female players, we first contacted the female participants and then identified for each a male player of comparable strength.

Since not every player was ranked according to the Elo rating system[2], we also accepted three additional systems (Yahoo, Chessbase, Scacchisti) that were then converted into Elo-equivalent rankings.[4] Female and male players of each pair were matched so that the maximum difference between players was 30 points.

Procedure

The entire experiment (preliminary assessment and main experiment) was run on-line, using a different nickname and password for each participant and for each game. During preliminary testing, we assessed the player's individual ranking (Elo or equivalent), two cognitive abilities (mental rotation and memory for location), and two motivational factors (trait-prevention/promotion, chess-specific self-esteem). During the experimental phase, we first assessed state-promotion/prevention and then had each participant play two games with an opposite-sex partner matched for chess ability. Before each game, we also assessed aggressive intent. At the end, participants were fully debriefed.

Preliminary Assessment

Trait Prevention/Promotion Focus

Most existing scales of regulatory focus (e.g., Higgins, Friedman, Harlow, Chen Idson, Ayduk, & Taylor, 2001; Semin, Higgins, Gil de Montes, Estourget, & Valencia, 2005) rely heavily on childhood experiences, especially in the assessment of prevention focus (e.g., 'Growing up, would you ever ''cross the line'' by doing things that your parents would not tolerate?' 'Did you get on your parents' nerves often when you were growing up?'). For the scope of our experiment, we were less interested in the origins of regulatory focus than in its current manifestation, characterized by either a focus on gain and advancement (promotion) or on avoiding mistakes, being vigilant, and assuring safety and non-losses (prevention). Moreover, we wanted the questionnaire to be specific to chess.

We therefore developed a 7-item scale ($\alpha = .75$) assessing the promotion/prevention orientation that players *generally* experience when playing chess. We were interested to see whether they were mainly motivated to obtain a good result (promotion) or to avoid poor outcomes (prevention). Examples of promotion items are *I care a lot about winning when I play chess* and *I want to perform better than anybody else.* Examples of prevention items (reverse scoring) are: *When playing chess I mainly try to prevent poor outcomes by avoiding to make errors, I work hard not to lose the game, 'In chess, I rather keep the errors to a minimum than to pursue an attack.'* Responses were provided on a 6-point scale (from 'totally disagree' to 'totally agree'). Prevention items were reversed-scored so that high values correspond to high promotion focus.

Chess-Specific Self-Esteem

A 7-item scale ($\alpha = .89$) assessed participant's domain-specific self-esteem, using a modified version of Rosenberg's (1965) scale (item examples: *As a chess player I don't think I have much to be proud of, I am able to play at least as good as other chess players, In general, I am satisfied with myself as a chess player).*

[4] Eight players had no official ranking and were therefore asked to obtain a ranking by playing 15 games (free of charge) either through Scacchisti or Yahoo chess Internet sites.

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Mental Rotation

We developed an electronic version of the mental rotation test (MRT, Vandenberg & Kuse, 1978), in which participants were instructed to identify two geometrical figures out of four that match a standard figure. Responses were coded as hit only when both figures were correctly identified. Participants were given 8 minutes to resolve a maximum of 20 problems (scores ranging potentially from 0 to 20).[5]

Memory for Location

We developed an electronic version of Reynolds and Bigler's (1994) Memory for Location subtest. Participants observed a set of large dots on 3×4 or 4×4 matrices and then had to recall their positions, in any order they wanted, on an empty matrix. The procedure was repeated 24 times, with increasing difficulty of the dot pattern, until the participant erred three times on five consecutive problems. The score corresponds to the total number of correct responses.

Experimental Session

For the experimental session, participants were asked to connect to a computer platform at a pre-established time, using an assigned gender-neutral nickname.

State Prevention/Promotion Focus

At the beginning of the experimental phase, we assessed state prevention/promotion, this time referring to the participants' *current* mindset as they were to play the two games. Different from the trait scale, the 6-item scale had a bipolar format with one pole representing the prevention, the other the promotion pole (counterbalanced for right vs. left positioning of prevention responses). Item examples: *My aim is to win* (promotion) versus *my aim is not to lose* (prevention); *In order to obtain a good result, I would run the risk of making errors* (promotion) versus *In order to avoid unnecessary errors, I would settle for a draw* (prevention). Note that this bipolar format violates the assumption that prevention and promotion are orthogonal dimensions. However, it does resolve the common problem of positive correlations between prevention and promotion, by imposing a forced choice between 'striving to win' and 'avoiding to lose'. After the exclusion of one item, the internal consistency was 0.82.

Since trait and state scales were highly correlated, $r(84) = .59$, $p < .001$, we averaged the two scores and analyzed them as a single measure of promotion/prevention.

Experimental Manipulation

Each participant then played two rapid chess games (15 minutes per player) against the same opposite-sex opponent, but was led to believe that they were playing with two different opponents.[6]

[5] A pretest of the electronic MRT version on 31 non-chess players showed that performance was very similar to the national norms of the classical paper-and-pencil version and that males ($M = 9.25$) outperformed females ($M = 6.76$) reliably as is generally the case, $t(29) = 2{,}89$, $p < .01$. Thus, the electronic version corresponded perfectly to the standard version of the test.

[6] To make participants believe that they were playing with different opponents, they had to lock out after the first game and then lock back into the chess platform for the second game with a new nickname. None of the participants voiced any suspicion about this or any other aspect of the procedure.

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They were aware that they were playing against an opponent of similar strength, but did not necessarily know the opponent's sex. In the *control condition*, players were informed that, for reasons of privacy, no further information was going to be provided about the opponent. Nowhere during the experiment were gender stereotypes or sex of player mentioned. In the *experimental condition*, the stereotype was explicitly activated by reminding participants 'that recent studies had shown that men earn clearly superior scores than women in chess games. The aim of this study is to provide further tests for these findings.' In addition, we systematically varied the alleged sex of the opponent across the two games ('for reasons of privacy, no further information is going to be provided about the opponent, except for the fact that you are going to play against a woman [man]'). In one game, both players were told that they were playing with a same-sex opponent, in the other game they were told that they were playing with an opposite-sex opponent (which corresponded to reality). We counter-balanced color (black vs. white pieces) as well as order of same- versus opposite-sex opponent across participants (first same sex then opposite sex, or *vice versa*).

Performance

For each participant, we coded the outcome of each game with 0, loss; 1, draw; 2, win. Scores varied from 0 to 2 for each game and from 0 (player lost both games) to 4 (player won both games) when considering both games together.

Aggressive Intent

Before each game, aggressive intent was assessed by two 6-point items: '*I intend to impose my type of game and play an attack game*' and '*I intend to play defensively against my opponent.*' The two items were highly correlated, $r(84) = .84$, $p < .001$, and therefore averaged.

Manipulation Check

At the end of the second game, experimental participants were asked to recall what kind of sex differences had been found in previous research. All participants recalled the information correctly.

RESULTS

Performance

Since the performance of males and females in each pair was perfectly interdependent, we analyzed only the results obtained by female participants. We had predicted that female players in the control condition would, on the average, total about 1 point per game, thus showing approximately the same performance level as their male opponents. Considering their mean performance per game (which could vary from 0 to 2), female players in the control condition ($M = 0.88$) performed close to what would be expected by chance. Indeed, their performance did not deviate from the neutral value of 1, *one-sample* $t(19) = -0.63$, n.s., although it remained slightly below the expected performance, possibly due to the fact that some of these women may, by default, have imagined to be playing with males.

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In the experimental condition,[7] where the gender stereotype had been activated, we predicted similar performance levels when female players believed to be playing against females, but below chance performance when they believed to be playing against males. As can be seen in Figure 1, this prediction was supported. When women (falsely) believed to be playing against another woman, they won about one game out of two ($M = 0.95$), *one-sample* $t(21) = -0.21$, n.s. However, these same women performed below chance when they knew that they were playing against a male opponent ($M = 0.50$), *one-sample* $t(21) = -2.73$, $p < .05$. Indeed, they performed more poorly against the same opponent when they knew that they were playing against a male than when they thought they were playing against a female, *within-participants* $t(21) = -1.56$, *p (one-tailed)* $< .05$.

Also, comparing the performance of women in the stereotype threat condition with the control condition, it becomes clear that threatened women who believed to be playing against a male opponent performed worse than women in the control condition, *between-participants* $t(40) = -1.39$, *p (one-tailed)* $< .05$. Women who believed to be playing against other women did not differ from those in the control condition.

Together, these findings suggest that women players showed a remarkable drop in performance when the stereotype was salient *and* when they knew that they were playing against a male opponent. Yet, they had good chances of beating the same (male) opponent when they were misled into believing that they were playing against a woman.

Aggressive Intent

Aggressive intent was assessed at the beginning of each game and, in the experimental condition, after participants knew the alleged opponent sex. This allowed us to investigate (a) whether aggressive intent varied as a function of stereotype activation and presumed sex of opponent and (b) whether aggressive intent predicted performance. As expected, male and female players did not differ in aggressive intent in the control condition in which opponent sex was unknown (males: $M = 4.49$, females: $M = 4.35$, $t(38) = 0.46$, n.s.) and in the experimental condition when allegedly playing against a 'same-sex' opponent (males: $M = 4.68$, females: $M = 4.52$, $t(38) = 0.65$, n.s.). Sex differences emerged *only* when players were made aware that they were playing against an opposite-sex opponent, with females

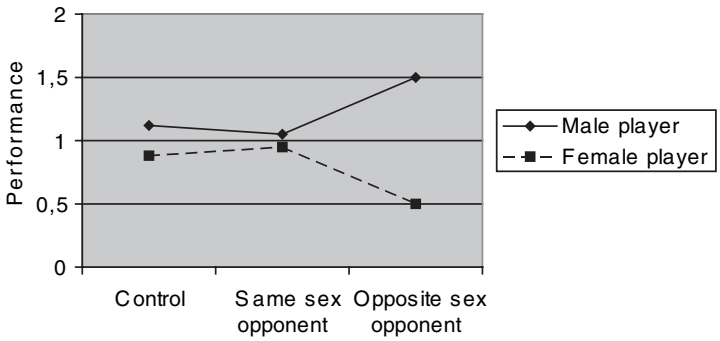

Figure 1. Performance of male and female players in the control condition and when believing to play against same- versus opposite-sex opponents in the experimental condition

[7] In the experimental condition, a preliminary 2 (presumed sex of opponent) × 2 (order) ANOVA tested for order effects in the gender—composition manipulation. Order did not interact with presumed gender ($F < 1$), suggesting that it was irrelevant whether participants believed to be first playing against a same or an opposite-sex opponent.

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($M = 4.31$) intending to play less aggressively than males ($M = 4.70$), $t(42, \text{one-tailed}) = 1.60$, $p < .05$. Females reported a more defensive attitude when approaching a male ($M = 4.31$) than a female opponent ($M = 4.52$), $t(22, \text{one-tailed}) = 1.82$, $p < .05$, whereas opponent sex did not affect males ($M = 4.68$ vs. $M = 4.70$, n.s.).

Also, using the single games as unit of analysis, the aggressive intent of women prior to each game was reliably correlated with their performance, $r(84) = .28$, $p = .01$, suggesting that this variable may at least in part account for gender differences of chess performance under stereotype threat.[8]

Self-Esteem and Prevention/Promotion Focus

Assuming that female chess players are chronically exposed to situations in which their minority status is salient and in which stereotypes are likely to operate, we also hypothesized that they may, in general, show lower confidence in their chess abilities and a more cautious, prevention-oriented approach to chess. In support of this hypothesis (see Table 1), women showed lower chess-specific self-esteem than men, despite the fact that they had objectively the same capacities, as they had been matched for their Elo ratings. As far as regulatory focus is concerned, women tended to approach chess games in a more cautious way, trying to avoid losses, whereas men were more promotion-oriented, focusing primarily on potential gains.

Interestingly, both low self-esteem and a prevention focus may constitute a handicap for women in chess. Looking at the control condition, in which no manipulation took place and in which the 'pure' effect of our variables on performance can be assessed, the more promotion-oriented women were, the better they performed, $r(20) = .46$, $p < .05$. Also, as a tendency, the more confident women were in their chess abilities, the better they tended to play, although this correlation was far from significant, $r(20) = .29$, n.s.[9]

We also were interested to see whether regulatory focus and self-esteem would vary across ability levels. As ability level (Elo) increased, female players not only became more self-confident in their abilities, $r(42) = .52$, $p < .05$, but they also displayed a greater promotion-orientation, $r(42) = .62$, $p < .05$.[10] However, our correlational design does not allow to test whether the regulatory focus of these women changed as a function of their chess training or whether only those women that start their chess training with high levels of promotion-orientation are able to proceed into higher ranks.

Table 1. Sex differences in memory for location, mental rotation, prevention/promotion, and self-esteem

	Males	Females	*t*	*p*
Promotion/Prevention	4.42 (SD = 0.70)	3.94 (SD = 0.73)	3.11	< 0.01
Self-esteem	3.81 (SD = 0.57)	3.21 (SD = 0.82)	3.89	<0.001
Memory for location	17.69 (SD = 6.17)	19.17 (SD = 4.26)	−1.28	n.s.
Mental rotation	8.93 (SD = 2.79)	6.50 (SD = 1.90)	4.66	<0.001

Note: Higher values indicate greater promotion-orientation, greater self-esteem, better memory for location and better rotation performance.

[8] Unfortunately, our design does not allow to test for mediation.
[9] A similar, but weaker pattern emerged for male players who became more self-confident, $r(42) = .31$, $p < .05$, and slightly more promotion-oriented, $r(42) = .29$, n.s., as their ability level increased.
[10] For males, neither self-esteem, $r(20) = .14$, n.s., nor regulatory focus, $r(20) = .24$, n.s., were predictive of performance.

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Mental Rotation and Memory for Location

As expected, men outperformed women on mental rotation but not on memory for location (see Table 1). Looking again at the control condition in which no manipulation had taken place, neither mental rotation, $r(20) = .07$, n.s., nor memory for location, $r(20) = .04$, n.s., were correlated with performance of our female players.[11]

DISCUSSION

The striking underrepresentation of women in the chess world in general, and among top ranks in particular, has attracted much attention over the past decades and various hypotheses have been advanced to explain the gender gap, including different distributions of relevant cognitive abilities and differential drop-out rates (see Chabris & Glickman, 2006, for an overview). Our research offers a very different explanation, suggesting that women entering the male-dominated chess world encounter great difficulties due to widespread stereotypes (for concrete examples, the interested reader is referred to Shahade's 2005, popular book on women and chess). Not only has chess remained an almost exclusively male sport over the centuries, but even nowadays female role models are rare and most chess books and periodicals feature mainly male players. Our pretest investigating gender stereotypes among Italian chess players confirm the pervasiveness of this bias, suggesting that males are not only considered better at chess, but also seen as more gifted. Sadly, even female players seem to share this idea. Since women are a highly salient minority in any chess competition, from local school tournaments all the way up to the World Championship or the Chess Olympiad, gender stereotypes are likely to be activated in such competitions, a condition that is known to hamper performance as well as self-confidence (Inzlicht & Good, 2006).

Our Internet method allowed us to disguise the sex of opponent and hence to investigate to which degree performance in mixed-sex pairs is determined by real versus presumed sex of opponent. In the control condition, where players were unaware of the sex of opponent, women won almost half of the games as would be expected for Elo-matched opponents. In the experimental condition, performance was reduced by about 50% when women were reminded of the stereotype *and* when they were aware of the fact that they were playing against a male opponent. In this case, they won only one fourth of the games. Yet, these same women were able to win half of the games when they were misled into believing that the opponent was female. The difference in performance is particularly impressive, if one considers that the opponent was exactly the same.

Our study also provides suggestive evidence for *why* women may have played more poorly when knowing the sex of their opponent. Looking at the aggressive intent measure that was assessed at the beginning of each game, women intended to play in a more defensive way when knowing that they were playing against a male opponent than when thinking that their opponent was female, whereas male players did not modify their aggressive intent. Apparently, the experimental manipulation mainly affected women, but not men. Although the interdependence of the performance data in our study did not allow to test for mediation, it is plausible to hypothesize that the more defensive attitude of women when playing against a male opponent may, at least in part, account for gender differences in performance in mixed-sex play. Interestingly, chat-line comments of our male participants tend to confirm this idea, as in the case of a participant who commented that the female opponent was easy to beat whereas the second opponent

[11] For male players, mental rotation, $r(20) = .25$, n.s., was not predictive of performance, and memory for location, $r(20) = -.47$, $p < .05$, was negatively correlated with performance.

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(allegedly a man, but in reality the same woman) was a much tougher opponent. Although these unsystematic observations should not be over-interpreted, it may be worthwhile to investigate the mutual perception of players in mixed-sex competitions in a more systematic way.

Unfortunately, our design has two limits. First, since the performance of male and female players within each competing pair was perfectly interdependent and since both were exposed to the same manipulation, it is difficult to know with certainty whether females suffered a performance decline under stereotype threat or whether their male opponent profited from the same manipulation, experiencing a 'stereotype lift', or both. We are inclined to give more credence to the first interpretation, considering that women also reported a more defensive approach when confronting a male opponent under stereotype threat, whereas the aggressiveness versus defensiveness of male players did not vary as a function of experimental condition. Although our findings seem to suggest that stereotype activation is more harmful to females than it is helpful to males, more systematic research is needed before definite conclusions can be drawn.

Second, our design did not allow us to test whether women would suffer a performance decline also when confronted with male opponents, but without being reminded of the stereotype. We suspect that mixed-sex chess play is sufficient in and of itself to activate the stereotype, especially in chess tournaments in which women are a salient minority. However, the small number of female players in Italy made it impossible to include a third condition in which players were made aware of opponent sex without explicitly activating the stereotype. A more extensive study will need to be run in a different country, since we have exhausted the pool of female chess players in Italy.

Our findings also suggest that, independent of experimental condition, women tend to approach chess games more cautiously and with lesser self-confidence, possibly because they are stigmatized in a male-dominated field (Inzlicht & Good, 2006). If chess-specific self-esteem and goal regulatory processes are implicated in performance (as our data suggest), this may constitute a relevant handicap for women. However, we caution against drawing general conclusions about the role of regulatory focus and self-confidence in chess without longitudinal research on larger samples of chess players of different ability level.

Finally, turning to the cognitive factors considered in this research, as predicted, male players reliably outperformed female players on mental rotation but not on memory for location. However, neither mental rotation nor memory for location were related to performance, confirming the idea that *general* mnemonic or spatial abilities are not predictive of chess performance (Waters, Gobet, & Leyden, 2002; Ross, 2006).

Together, our study suggests that gender stereotypes play a major role in mixed-sex chess competitions. Female players in this situation approached games more defensively and lost an over-proportional number of games against male opponents, yet they played as well as their male opponents when they falsely believed that they were playing against a woman. This suggests that female players may be intimidated by playing against male opponents, despite the fact that our players knew that they were matched for ability level (Elo). This may explain why women tend to earn lower Elo ratings in competitions than their chess test scores, obtained in non-competitive test situations, would suggest (Van der Maas & Wagenmakers, 2005). Our findings also speak to the much-debated issue of whether it is useful to have all women's tournaments to help girls build a solid confidence in their own abilities and to encourage them 'to stay with the game.'

Implications for Stigma and Stereotype Threat Research

Although the main aim of our study was to offer a new perspective on chess by extending chess research beyond a purely cognitive approach, our results may also have some implications for research on

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stigma and stereotype threat. First of all, concerning the applicability of the model to sports, our results suggest that stereotype threat not only operates in physical but also in intellectual sports. Recently, a number of studies have shown that stereotypes may impair athletic performance (Stone, 2002; Stone et al., 1999, Beilock & McConnell, 2004) but, to our knowledge, this is the first study demonstrating such performance declines in an intellectual sport. Note that chess is similar to the academic domain in terms of its intellectual demands, but closer to physical sports in terms of the highly competitive nature of the game. From the perspective of gender stereotypes, this is an interesting realm of inquiry considering that it is one of the few sports in which men and women enter in direct competition.

Second, the systematic variation of alleged sex of opponent allowed us to test whether stereotype activation in itself interferes with performance or whether the stereotype has to be relevant to the specific competition. Our findings suggest that stereotype activation is not sufficient to hamper performance, but that the stereotype has to be relevant to the test situation, quite in line with the stereotype threat model as originally proposed by Steele and collaborators. When playing against another woman, the gender stereotype—even when explicitly activated—simply becomes irrelevant and, hence, has no debilitating effects.

Third, our study may contribute to the ongoing discussion concerning the underlying mechanisms of stereotype threat. Whereas thought intrusion and reduction of working-memory capacities (Cadinu et al., 2005; Schmader & Johns, 2003) figure among the most promising accounts of stereotype threat in the academic domain, self-handicapping (Stone, 2002) and explicit monitoring of otherwise automatic behaviors (choking under pressure, see Beilock & McConnell, 2004; Beilock, Jellison, Rydell, McConnel, & Carr, 2006) have been discussed as mechanisms interfering in the sports domain. Being an intellectual sport, the reduction of working-memory capacities due to interfering thoughts (although not investigated in this study) seems to offer a plausible explanation for our findings on chess. However, our study suggests yet another possibility, namely that women play more defensively under stereotype threat, which, in turn, decreases their chance of winning. Our aggressive intent data, collected at the beginning of each game, are in line with this idea. Interestingly, a similar mechanism has been proposed by Seibt and Forster (2004) in the academic domain, who found that people exposed to stereotype threat shifted toward greater caution, adopting a prevention focus that, depending on the task, may either be beneficial or harmful to performance. Our study suggests that a similar process may be operating in the sports domain, although it remains to be seen whether the more vigilant focus adopted under stereotype threat may always have negative effects in competitive situations (as suggested by our data) or whether there are situations in which it may be beneficial.

CONCLUSION

A number of novel findings emerge from the present study that complement cognitively-oriented research on chess. Most importantly, gender stereotypes can have a greatly debilitating effect on female players leading to a 50% performance decline when playing against males. Interestingly, this disadvantage is completely removed when players are led to believe that they are playing against a woman. This may, in part, occur because women choose a more defensive style when playing with men. A second and more general message of our study is that self-confidence and a win-oriented promotion motivation contribute positively to chess performance. Since women show lower chess-specific self-esteem and a more cautious regulatory focus than males, possibly as a consequence of widely held gender stereotypes, this may at least in part explain their worldwide underrepresentation and underperformance in chess. Thus, women seem disadvantaged not because they are lacking cognitive or spatial abilities, but because they approach chess competitions with lesser confidence and with a

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more cautious attitude than their male opponents. Hence, a motivational perspective may be better suited to understand (and prevent) the underperformance of women in the 'ultimate intellectual sport.'

ACKNOWLEDGEMENTS

We are grateful to Antonio Rosino and Michele Pavon for their expert advice on chess that was critical for the development of this research program and to Gün Semin for his comments on an earlier version of this paper. We also thank Luciana Carraro for making the pretest data on non-chess players available to us.

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