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MASTERS OF OUR TIME: IMPATIENCE AND SELF-CONTROL IN HIGH-LEVEL CHESS GAMES

by

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Abstract

This paper presents empirical findings on gender differences in time preference and inconsistency based on international, high-level chess panel data with a large number of observations, including a control for ability. Due to the time constraint in chess, it is possible to study performance and choices related to time preferences. The results suggest that men play shorter games on average and pay a higher price to end the game sooner. They also perform worse in shorter game compared to women but better in longer games. Furthermore, women perform worse in time pressure (the 40th move time control). The results are consistent with the interpretation that men are more impatient (with a lower discount factor) but also more inconsistent in the sense that they tend to be too impatient. Women, on the other hand, are more inconsistent as they tend to over-consume reflection time in the beginning, leading to time pressure later.

Keywords: Time preference, time inconsistency, impatience, gender, self-control problems

Classification codes: J16, D03, D91

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1. Introduction

We have all experienced moments of regret at leaving unpleasant tasks for later although we know we would be better off in the long run by doing them now. This is also true for pleasant tasks, or rewards, which we tend to carry out, or consume, earlier than we would prefer in the long run. Such acts are said to be due to self-control problems as we are just too tempted by the present utility to care sufficiently about the long-term utility. We also know that people differ in degrees of impatience as some people seem to be able to wait patiently for a higher reward while others want instant action although it will result in a lower payoff. Contrary to the concept of time preferences (impatience), time inconsistency (self-control problems) distinguishes between short- and long-term values. Angeletos et al. (2001) give a neat example. When we go to bed at night most of us set the alarm to wake us up at a certain time. Nevertheless, when the alarm sounds some of us just hit the snooze button, pull up the duvet and go back to sleep. We then tend to hit the snooze button repeatedly until we have to skip the healthy breakfast, have a swift cup of coffee and lock the door at the same time as we put our coat on. In this case, we consume too much time to the point where we experience subjective discomfort in the shape of stress. Such behavior is time inconsistent as our long-term preferences are not consistent with our short-term preferences. However, if we *intended* to snooze for a while before getting up then the behavior is time consistent as our preference did not change during the night. In practice, it may be difficult to observe whether there was an intention to snooze or not, which may be one explanation as to why there are so few empirical studies on time inconsistency.

The purpose of this paper is to examine potential gender differences in time preferences and time inconsistency by using an extensive panel dataset from international high-level chess games. Due to the time restriction in chess, a player can *consume* or *save* time for each move, where the move quality is a function of the time spent on that move. I investigate how eager women and men are to end the game although it implies a cost, how they perform in games shorter and longer than average, and also to what extent women and men end up in time pressure (approximated by performance at the 40th move time control, see section 2.4). I complement the data with unique survey data, collected at the world´s leading chess site, www.chessbase.com. In the survey, 235 expert chess players, with data from 18,000 games available, were asked to answer questions (rating answers from zero to ten) about impatience, performance under time pressure, risk taking and smoking habits (smoking is considered to be a typical self-control problem). The findings reveal that men are more impatient than women on average as they play shorter games and are willing to pay a higher price for ending the game earlier. Combined with the results of the survey, the findings suggest that both male and female players are time inconsistent but in different directions. Male players tend to be too impatient as they play too fast in the beginning of the game, while female players tend to over-consume reflection time in the beginning, leading to time pressure when approaching the 40th move time control. The fact that the survey consists of self-reported data suggests that the players are indeed aware of the inconsistency. The survey also shows that time preferences in chess are positively correlated with time preferences in real life, which strengthens the external validity of the findings. In addition, smokers are more impatient on average but are likely to be inconsistently impatient (as smoking is positively correlated with *being too impatient*).

Akerlof (1991) writes that time inconsistency could contribute to "poverty of the elderly due to inadequate savings for retirement, addiction to alcohol and drugs, criminal and gang activity, and the impact of corporate culture on firm performance." If one of the sexes is more impatient or time inconsistent than the other then consumption and savings could differ substantially during a lifetime.[1] With their empirical paper, Ashraf et al. (2006) showed that saving behavior can indeed be affected by time inconsistency. In detail, they find that women are, or at least consider themselves to be, more time inconsistent when studying savings among bank clients in the Philippines. The research results on time preference and gender diverge somewhat although there is some indication of male students being more impatient than female students. However, in an influential paper by Harison et al. (2002), no gender difference in discount factor was found when looking at a more representative (general) sample.

In experimental studies addressing discounting over time, it is common to include money as a means of measuring the degree of impatience. When doing so it is important to control for wealth, as a potential gender difference in impatience could otherwise be due to the fact that differences in wealth can lead to a different valuation of money. The time frame must typically be rather large as it would be difficult for most people to perceive a difference from one day to another. In a practical experiment \$100 now is the same for most people as \$100 a few hours later (the problem of *just perceptible differences*). For this reason, the

[1] In his theoretical paper, Strotz (1956) was the first researcher to suggest that people are more impatient in the short run than in the long run. Pollack (1968) and Phelps and Pollack (1968) gave an early formal model of time inconsistency which has later been extended and refined by Akerlof (1991), Laibson (1997), O´Donoghue and Rabin (1999), and Fischer (1999). For another paper on time inconsistency, see Ariely and Wertenbroch (2002). See also DellaVigna and Paserman (2005) for an empirical work on time preferences, Benzion et al. (2004) on time inconsistency and Croson and Gneezy (2009) for an overview of gender differences in economic preferences.

experiments are abstract, i.e., the participants are supposed to imagine an abstract time period of, for instance, one year. If the experiments were to last for a whole year it would be impossible to control for changing factors in the lives of the participants as they could not be isolated from the world for a year. In a chess game, that usually lasts for a few hours, no money is involved so any effect of wealth should be diminutive.[2] As a corollary, there is no need to study agents for a longer time period. The longer the time frame in an experiment, the higher the risk that external conditions will change, with obscure impact to follow. Consequently, when using chess data we do not have to worry about wealth, remaining lifetime or different perceptions of the interest rate when measuring discounting over time. The most obvious advantage with chess data, however, is the existence of the Elo rating which very accurately approximates the chess ability of a player on a metric scale. Moreover, the difference in Elo ratings between two players corresponds to a certain probability that a player will defeat the opponent.[3] This is further explained in section 2.

Why should economists bother to study high-level chess players? A frequently employed assumption in economics is the assumption of full rationality. However, most economists probably agree that full rationality is not very realistic and to obtain an image of how close we can expect people to be, it is important to study highly rational and competitive subgroups such as expert chess players. High-level chess players have been studied numerous times for this reason, for instance by Levitt et al. (2009) and Palacios-Huerta and Volij (2009) who focus on expert chess players in a lab experiment to investigate whether it is reasonable to test backward induction through the centipede game. Furthermore, compared to sports economics, chess has the advantage that different groups can be compared more easily as there is no requirement of physical strength. Indeed, chess is one of the few competitive events where men and women enter in direct competition.[4] Moreover, the rules in chess are globally homogenous which facilitates comparisons further.

This paper contributes to the literature by presenting empirical findings on two traditional economic topics, impatience and self-control problems, where focus is set on gender differences. Gender differences in time preferences and inconsistency have only been studied in a handful of papers and a consensus is still lacking. With the unexplored data used here together with the survey data, I am able to treat the topic from a new perspective.

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[2] The prize money in chess levels below the absolute world elite can be ignored as it is too small to be important in this context.

[3] For a second opinion on the qualities of the Elo ratings, see Moul and Nye (2009, p. 11) and Chabris and Glickman (2006, p. 1040)). For other studies of chess players, see Gobet (2005), Ross (2006) and Roring (2008). See also van Hareveld et al. (2007) for a study on time pressure in chess.

[4] For a discussion about women's situation in the chess world, see Shahade (2005).

The paper is organized as follows. The next section provides a theoretical background while section 3 discusses the data and statistics. Section 4 presents the results of the estimations and section 5 concludes.

2. Conceptual framework

2.1 Risk-taking in chess

In many games and sports there are only two outcomes: a win or a loss. In chess, however, there is also a third outcome: a draw (a tie). A win gives one point, a draw half a point and a loss zero points. Particularly interesting from a risk perspective, is that a draw can be offered and either accepted or rejected at *any* point of the game. These aspects make chess very suitable for the study of risk taking behavior. A risk-averse player will have a higher preference for a draw since it gives half a point with certainty rather than gambling by playing for a win or a loss. A risk-loving player will prefer to play for a win with the risk of losing. Expressed differently, a risk-averse player faces a concave utility function while a risk-loving player has a convex utility function.

The so called chess *openings* (the initial development schemes for the chess pieces) have been extremely well analyzed for more than a century. From analyses and real game history, probabilities of certain outcomes for certain openings are well known, i.e., the likelihood that a game ends in a win, draw and loss. This is easily demonstrated with an example: Suppose two equally good opening categories, A and B, have different probabilities of resulting in a draw. Opening A leads to a win in 40 percent of the cases, a loss in 40 percent, and a draw in 20 percent. Opening B leads to a win in 30 percent of the cases, a loss in 30 percent, and a draw in 40 percent. A risk-averse player will have a preference for opening B whereas a risk-loving player will have a preference for opening A.

All major opening categories have been classified into the so called ECO code system, consisting of 500 main categories. The database contains information about what ECO code was played in each game and by using the classification developed by Gerdes and Gränsmark (2010), I am able to control for the level of risk taking in each game and for each player.[5]

[5] The risk classification in Gerdes and Gränsmark (2010), was constructed by carrying out a survey among eight chess experts (with an Elo ranging from 2000 to 2600, three women and five men). They were asked to label each ECO code (from both white´s and black´s perspectives) as being either risky, neutral or risk-averse. Six out of eight experts had to agree to classify an opening code as being either risky or risk-loving, otherwise, it was denoted as neutral. Intuitively, the most straight-forward way to construct such a measure would be to just employ the outcomes of the games, however, such a measure would only supply one risk indicator per game. In addition, by studying the opening phase we get a clear indication of the actual intention that each player had in

When employing the survey data, I also include a self-reported risk measure, see section 3. We cannot be sure to what extent these risk indicators capture the true risk preferences. However, the results in Table 4 are the opposite to those expected had the gender difference been driven by risk preferences.

2.2 The Elo rating

An advantage with chess data is the existence of the Elo rating system, named after its creator Arpad Elo (1978). In this study only players with at least 2000 in Elo rating are included (with the maximum rating being the world record of 2851). When players win a game, they increase their Elo rating while the Elo rating of the defeated player decreases. An inferior player who wins a game wins more Elo points than a superior player. The difference in Elo between two players corresponds to an exact expected scoring probability and, since all Elo ratings are common knowledge, the expected score is known in advance. For instance, if a player has an Elo rating of 2300 and the opponent of 2100, the superiority measured in Elo difference is 200. This corresponds to an expected score, $\varphi \in (0,1)$, of .75. If the players are equally skilled, i.e. the Elo difference is zero, the expected score is .5.[6] By controlling for the Elo rating and the Elo difference in the econometric estimations, it is possible to reduce a potential bias occurring due to the fact that men and women may have different chess abilities.[7] By having information about the expected score in a certain game, it is possible to compare the performance in the game in focus with the expected score. I will take advantage of this as accepting a draw when being superior (i.e., $\varphi > .5$) means that the player is willing to pay a price for achieving the draw in the present. As both the result (a draw) and the expected score are available in the data, it is possible to calculate a potential gender difference in the cost men and women are willing to accept.

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the beginning of the game, which is not confounded by aspects occurring during the course of the game. Since it is not clear how the game outcome is affected when two extremes meet, it is preferable to have one risk indicator for each player, which was the motivation behind the expert survey. However, the two risk measures are positively and significantly correlated.

[6] In chess the player of the white pieces starts the game and has a first-mover advantage. I disregard that fact here for reasons of simplicity. However, since the color of the pieces is random (decided by a lottery before the 1st game in the event), there is no loss of generality.

[7] To see the usefulness of such a measure, we can compare it to the controls included in studies on gender wage gap comparisons where the researchers want to hold constant for gender differences in education, IQ and experience.

2.3 Impatience in chess

The quality of a chess move depends positively on the time of reflection allocated to that move, with decreasing returns. The quality of move *t* is the short-term utility of period *t* while the game quality (performance, i.e., a win, a loss or a draw) is the long-term utility. The available time is restricted and to maximize the long-term utility, the player wants to find the optimal allocation of time for each move. An impatient player prefers shorter games although this means performing worse. The time constraint in standard international chess implies that *each player* has a maximum of two hours for the first 40 moves and then an additional 60 or 90 minutes for the remainder of the game.[8] Under these conditions the maximum duration of a game would be six to seven hours. The two hours can be distributed among the 40 moves in the way the player wishes. Just as in exponential discounting, one can choose to *consume* or *save* time for each move. Time is the *good* that can be consumed or saved and each chess move represents a time period. It is possible to consume less time in the beginning of the game which can be used later in the game. If fewer than 40 moves have been played when the two hours end, the game is lost. Hypothetically, there may be players that over-consume reflection time in the beginning of the game but also players who, due to inconsistent impatience, under-consume reflection time. The former group is more likely to have to play under time pressure than the average player while the latter group is more likely to have to play under time pressure less than the average player. In the case of under-consumption of time, a player fails to reach the optimal move quality. Thus, both under- and over-consumption is an inconsistent behavior. However, a player may deliberately choose a suboptimal allocation (measured in mere score points) if the long-term utility is increased, i.e., a player can discount over time.

The typical question used in lab experiments when studying time preferences is ”Do you prefer $100 today or $110 a year from now?” By varying the amount and the time periods, it is possible to obtain a function and a discount factor. Implicitly, chess players have to ask themselves a similar question every time they are to move. They have to decide whether they prefer half a point (a draw) now or the expected score later in the game. If a superior player faces an expected score of .6, she has to ask herself whether she prefers .5 now to .6 later. Since .6 is the expected score, she doesn't know with certainty that she will have .6 later but given that we can remove the effect arising from risk preferences, this is the same questions as the one asked in the lab. Theoretically, to net out a potential risk taking

[8] A chess clock contains two clocks, one for each player.

effect from the impatience effect, we need to know that EU(.6) equals or exceeds U(.6). Empirically, I will study all games regardless of the outcome and control for the level of risk taking. However, I also test the sensitivity of the results by comparing the results with games that ended in draws and that were performed by players that chose a risk-loving opening. I will also analyze how men and women perform in games shorter and longer than average. In addition, I compare how they actually score relative to the expected score.

2.4 Self-control problems in chess

Regarding time inconsistency, there are two typical self-control issues in chess. The first is that some players spend too much time for reflection at each move, to the degree that they suffer from having to play under time pressure later in the game. The second is that some players are so eager to move that they tend to move without sufficient reflection and since the move quality is a function of the reflection time, this may lead to an inefficient time distribution. Almost a century ago the grandmaster Rudolf Spielmann stated that it is wrong to search for the best chess move in every position. You should only try to find a sufficiently good move.[9] By searching for the perfect move, you will over-consume the time you have at your disposal and also risk to exhaust your energy. Webb (2005) writes that:

> "…many leading grandmasters are so fascinated by chess that they cannot resist the challenge of finding the very best move in a position, even if this means spending up to an hour on a single move. Consequently they often end up having to make their last 10 or 15 moves in less than a minute." /:::/ "…[M]any experienced players, including some grandmasters, seem unable to avoid getting into time-trouble game after game. As a result they regularly throw away good positions and fail to achieve the results of which they are capable." (Webb 2005, p. 100-102)

The purpose of introducing a time control limit at the 40th move, is to force a commitment upon the players to reduce the over-consumption of time. To obtain a measure of potential time inconsistency in chess, I exploit the existence of the time control limit at the 40th move. The hypothesis is that those spending more time in the beginning of the game, will score better in games shorter than average and have a higher propensity to score worse at the 40th move and in longer games, compared to other moves and players.

[9] For an interesting discussion on the rational choice procedure of a chess player, see Simon (1955).

2.5 Econometric model and control variables

Two econometric models are used to estimate the coefficients of interest. The first is a regression framework which is estimated with OLS. The dependent variable in the main model is *the number of moves when the game ended*. The female dummies are the explanatory variables of interest. The second model is a difference-in-difference approach where I compare the performance for men and women at the 40th move time control *and* with the moves just before and after the 40th move. The dependent variable is then a ternary variable which takes on the value 1 if a win, ½ if a draw and 0 if a loss. The model is estimated with OLS but I also present results with ordered logit for the main model.

Each game counts as one observation. As there are two players in each game I only include a game once and I randomize which player to be the player in focus. Since a player usually plays many games in the dataset, I employ standard errors clustered at the individual level. There are two levels of control variables, game-specific and player-specific. Since the variable of interest is player-specific (i.e., it is constant over time), it is not possible to hold constant for individual fixed effects. The player-specific controls are: gender, nationality (regional dummies) and a female-opponent ratio (share of games played against a female opponent, see below). The game-specific (time-varying) control variables are: Elo rating (playing skill), Elo difference, age (age, age squared, age 0–20 years old and age difference), number of games played (log), piece color (to account for the first-mover advantage), arranged draws (a draw in less than 20 moves)[10], year dummies and risk taking. The data also include information about the names of the players, the ECO code and the score of the game.

To stimulate women's participation in chess, there are two types of competitive events, tournaments for both sexes and tournaments where only women may participate. It is possible that those women choosing to play in women's tournaments differ on average from those playing in mixed-sex tournaments. Since information about the type of tournament is not available in the dataset, it is not possible to distinguish games played in mixed-sex tournaments from those played in women's tournaments. However, in cases when at least one of the players is a man, we know with certainty that the game was played in a mixed-sex tournament. As the results are presented for all gender combinations, this should not have any decisive effect. Moreover, a control for the share of games played against female opposition is

[10] Professional players who play chess for a living, sometimes prefer to end a game quickly (by agreeing to an early draw). This is done to save energy and time. When doing this, they typically agree to a draw while the game is still in the theoretical opening phase, hence, in less than twenty moves; see also Moul and Nye (2009) for a discussion.

included which should capture most of the effect that occurs due to gender differences in the type of tournament.

3. Data and Statistics

3.1 Descriptive statistics

The main source of information used in this study comes from ChessBase 10, a database collection with 1.5 million chess games played by expert chess players in international chess events. It contains more than 30,000 players from 140 countries. I use games played by players with an Elo rating of at least 2000, above which a player is considered to be an expert chess player (i.e., either a master or a master candidate). The panel data of this study cover the years from 1997 to 2007. In addition to the Chessbase data, I have carried out an online survey at the leading internet chess site, www.chessbase.com, see below.

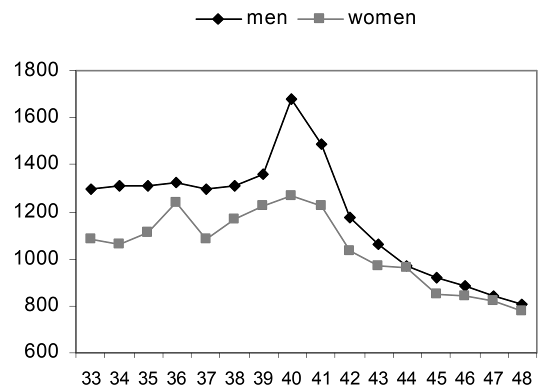
Table 1 gives the mean duration of the games measured in moves. Column (1) shows that women´s games last 42.0 moves on average while men´s games last 39.3 moves on average. Table 1 also gives the mean game duration for two subgroups with different chess ability and for different game outcomes. Roughly, the group with an Elo rating lower than 2300 are expert amateurs and the higher-rated group with an Elo rating higher than or equal to 2300 are professionals or semi-professionals. For the professionals, the female games last about four moves longer than the male games, on average. For the amateurs the difference is smaller, about 2.5 moves.

Table 1
Descriptive statistics for game durations in moves for different subgroups.

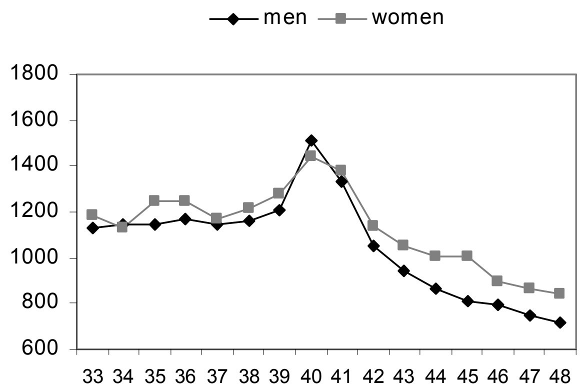
Duration in moves	(1) All players		(2) Amateurs, Elo<2300		(3) Professionals Elo>2300	
	men	women	men	women	men	women
All games, mean	39.31	41.99	38.99	41.55	39.07	42.96
Stand dev	(16.77)	(16.83)	(15.98)	(16.34)	(17.34)	(17.84)
Wins, mean	41.48	43.39	41.07	42.99	41.71	44.03
Draws, mean	34.76	39.32	35.61	39.11	34.22	39.68
Losses, mean	41.45	43.08	40.14	42.27	43.40	46.05

Figure 1 displays the pattern around the critical 40th move time control for wins, losses and draws, and for men and women. It reflects the effect of the time constraint. Although players can be short of time also before reaching the 40th move, the effect tends to concentrate at the 40th move.[11]

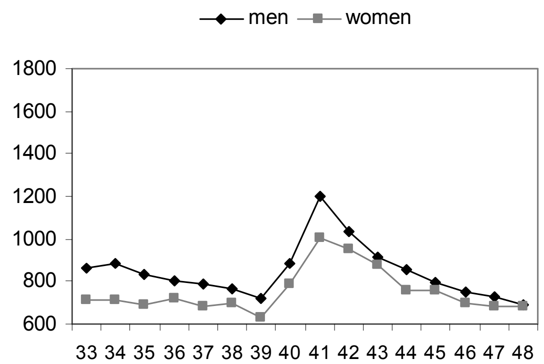
Figure 1
a) the number of wins, b) the number of losses, c) the number of draws. The number of male games has been divided by 10.



a) No. of wins at each game length (in moves)



b) No. of losses at each game length (in moves)



c) No. of draws at each game length (in moves)

3.2 The survey data

To obtain additional data on time preferences and time inconsistency, a survey was carried out among expert chess players. A questionnaire was posted at the world's leading internet chess site, www.chessbase.com. The survey was run between the 30th of September and the 4th of October in 2011 and obtained 1,620 respondents. The questionnaire contained five questions where the respondents could rate between zero and ten, and one question where they answered whether they were smokers or not (yes or no). In addition, they were asked to

[11] Some of the effect is expected to spill over to the 41st period as it is not uncommon that the last moves before the time control are played so quickly that the player in time trouble does not have time to properly evaluate the position. Once the time control is passed, the player realizes that the position is lost (given that it is) and resigns. For this reason, some of the games won/lost when playing under time pressure are registered as won/lost in period 41.

give their names and email address. A lottery prize of 500 USD as a value check at www.amazon.com was given to a winner. By using the names of the players participating in the survey, it was possible to match 235 players out of the 1,620 respondents to the ChessBase dataset used in this paper.[12]

The questions asked in the survey are given in Table 2 and concern impatience in chess, performance under time pressure in chess, patience in general, risk in general and whether the player smokes regularly. Table 2 also gives the Spearman correlation between any two questions with the significance, p-values, in brackets.

Table 2
Spearman correlation matrix between the answers of the survey questions. Ratings between 0 and 10, smoking either 0 or 1(smoker).

	Do you consider yourself an **impatient** player when playing a chess game?(0=not at all, 10=very much)	Do you think you would perform better in chess if you could **avoid time pressure**? (0=not at all, 10=very much)	Do you think you tend to be **too impatient** when playing chess? (0=not at all, 10=very much)	Do you **smoke** regularly? (yes/no)	In life **in general,** do you consider yourself a **patient** person or do you consider yourself to be impatient? (0=very impatient, 10=very patient)
Do you think you would perform better in chess if you could **avoid time pressure**? (0=not at all, 10=very much)	-0.0873 (0.0005)				
Do you think you tend to be **too impatient** when playing chess? (0=not at all, 10=very much)	0.8016 (0.0000)	-0.0294 (0.2404)			
Do you **smoke** regularly? (yes or no)	0.0857 (0.0006)	-0.0128 (0.6116)	0.0859 (0.0006)		
In life **in general,** do you consider yourself a **patient** person or do you consider yourself to be impatient? (0=very impatient, 10=very patient)	-0.2267 (0.0000)	0.0862 (0.0005)	-0.2267 (0.0000)	-0.0664 (0.0080)	
In life in **general,** are you fully prepared to take **risks** or do you try to avoid risks? (0=minimum risk, 10=maximum risk)	0.0972 (0.0001)	-0.0207 (0.4071)	0.0644 (0.0099)	0.0309 (0.2182)	-0.0249 (0.3182)

[12] The survey participants were required to have at least an Elo of 2000. The reason for not finding more matches is because a substantial part of the players have improved between 2007 and 2011. Since the survey was carried out in 2011, and the ChessBase data end in 2007, some players who had an Elo of at least 2000 in 2011, had an Elo below 2000 in 2007. Also, some players have spelled their names slightly different (using short names, dropping initials etc) and the ChessBase requires an exact match. Some players may also be missing in the data.

As Table 2 shows, the players interpret *impatient* and *too impatient* as basically the same question (the correlation is .8 and highly significant), which indicates that impatience is a rather negative attribute in chess. Since these two answers correlate so highly, I will address only *impatient* in the remainder of the paper. Moreover, *impatience* in chess is negatively correlated with *performing better without time pressure*, positively correlated with being a *smoker*, negatively correlated with *patience in life in general*, and positively correlated with being *risk-loving in life in general*. In addition, *performing better without time pressure* is positively correlated with *patience in life in general*. Thus, the questions are correlated as expected. The rater characteristics and survey statistics are to be found in Tables A.1 and A.2 in the Appendix.

4. Results

In column (1) of Table 3, I present the coefficients when all games are included. We see that the coefficients of interest, *opposite-sex players* and *both are female players*, are significantly positive. Opposite-sex players play about .3 moves longer games than two males. Two female players play about 2.1 moves longer games than two males. Column (2) and (3) give the results for amateur and professional players, respectively. The gender difference for professionals is larger than for amateurs. Column (4) shows the coefficients when only including drawn games in the regression. The gender difference remains and is about 1.1 moves for two women and about .5 moves for opposite-sex players compared to two men. The conclusion is that women tend to increase the game duration in moves and since games played by two women are even longer than mixed-sex games, this is not likely to be due to a change in the male behavior (due to the opponent being a woman) but is rather a female preference.

Table 3
Game duration in moves regressed with OLS on *opposite-sex players* and *both are female players*, where the comparison group is *both are male players*.

Dep var: game length in moves	*All players and games*	*Amateurs Elo<2300*	*Professionals Elo>2300*	*Including only draws*[13]
	(1)	(2)	(3)	(4)
Opposite-sex players	**.2948**	**.1113**	**.5606**	**.5144**
	(.1182)**	(.1309)	(.2255)**	(.2050)**
Both are female players	**2.1311**	**1.6008**	**2.8093**	**1.0729**
	(.2240)***	(.2534)***	(.4291)***	(.3962)**
Elo	.0035	.0044	.0032	-.0011
	(.0003)***	(.0004)***	(.0006)***	(.0004)**
Elo difference	-.0025	.0003	-.0058	.0001
	(.0002)***	(.0002)*	(.0002)***	(.0003)
Age	-.0582	-.0084	-.0931	-.0414
	(.0130)***	(.0151)	(.0231) ***	(.0192)**
Age-squared	.0006	.0002	.0007	.0001
	(.0001)***	(.0002)	(.0003)***	(.0002)
Teenage	-.0197	.0403	.0186	.0901
	(.0966)	(.1223)	(.1439)	(.1512)
Age difference	.0057	-.0086	.0244	.0177
	(.0014)***	(.0019)***	(.0021)***	(.0024)***
Arranged draws[14]	-28.9749	-28.3357	-29.5044	-28.9678
	(.0482)***	(.0545)***	(.0699)***	(.0742)***
White pieces (1st mover adv.)	.0023	.2598	-.2235	-.0234
	(.0349)	(.0503)***	(.0491)***	(.0592)
Share of female opponents, player	.3322 (.1924)*	.1539 (.2140)	.2713 (.4150)	.8877 (.3471)
Share of female opponents, opponent	.3744 (.1815)**	.7224 (.2154)**	.2619 (.3378)	.4858 (.3281)
Number of games (log)	.2360	.4014	.0780	.1202
	(.0339)***	(.0378)***	(.0595)	(.0531)**
Risk-loving player[15]	-.6622	-.7444	-.6062	-.0690
	(.0461)***	(.0633)***	(.0643)***	(.0790)
Risk-loving opponent	-.5773	-.6226	-.5358	.0072
	(.0443)***	(.0622)***	(.0632)***	(.0770)
Constant	33.5613	30.5672	36.1150	45.2535
	(.6192)***	(.9363)***	(1.3459)***	(.9219)***
Regional dummies, both pl.	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
R-squared	.247	.202	.283	.423
Number of players	32,148	28,548	7,302	25,257
Number of observations	738,989	340,132	396,917	269,773

Notes: Western Europe is used as the comparison group for the regional dummies. Robust standard errors in parentheses, clustered at player level. *** significant at 1%, ** significant at 5%, * significant at 10%.

The results in Table 3, show that women play longer games than men on average. Since I include controls for risk taking in the opening, these differences are not likely to arise due to differences in risk preferences. Moreover, since women have been found to be more risk-

[13] Conditioning on both players being risk-loving (choosing risky openings) and the result being a draw produces similar results as in column (4).
[14] Excluding the control for arranged draws, *increases* the gender differences. Male players are more prone to accept arranged draws, also when controlling for Elo, Elo difference, number of games played etc, which is interesting per se.
[15] Risk-loving is a dummy variable taking on the value one if risk-loving, zero otherwise (including neutral or risk-averse).

averse, see Gerdes and Gränsmark (2010), the risk taking effect is likely to affect the results in the opposite direction, i.e., women should play *shorter* games on average. This is particularly true for draws since accepting a draw rather than playing for a win with the risk of losing is a risk-averse behavior. Later in this section, I also include a second risk control based on a player´s self-reported risk taking in real life.[16]

To establish how the gender differences in game duration affect performance, Table 4 presents the results when the Elo difference between two players is regressed on the female dummies, when conditioning on the game outcome being a draw. Thus, column (1) of Table 4 tells us how women perform, relative to men, when agreeing to draws, compared to the expected score. By conditioning on a draw, we know that the actual performance was .5. An Elo difference of +30 corresponds to approximately +8 percentage points difference, i.e. .54 vs. .46 in expected score. To accept .5 when your expected score is .54 can be seen as the player being willing to pay a price to achieve a draw in the present period rather than continuing the game with an expected score of .54, given that we can hold constant for risk-aversion. We see that when the player in focus is a woman playing against a man, the Elo difference is negative compared to the comparison group (man vs. man), indicating that, on average, women perform better than their expected score (which is smaller than .5 since the Elo difference is negative). A coefficient of -11 should be interpreted as the expected score being roughly .485. When a man plays against a female opponent, the Elo difference is 30 points larger than for the comparison group (man vs. man), meaning that the expected score is roughly .54. Thus, the conclusion from Table 4 is that men are willing to pay a higher price than women to end the game sooner when playing against a woman. Note that any given game where the players agree to a draw would have been ended later had they not agreed to a draw.

[16] The differences could arise from a potential gender difference in the intensity of tournament participation (playing many games might affect how long games you want to play), but there is no significant gender difference in intensity and I also control for the number of games played.

Table 4
Elo difference (cost) for ending the game, conditional on the outcome being a draw. The Elo difference is defined as Elo (player) – Elo (opponent).

Dep. Var. Elo diff. conditional on result=draw	*Draw=1*	*Stand. error*
	(1)	(2)
Female vs. male opponent	**-11.2090**	**(3.2972)*****
Male vs. female opponent	**30.9286**	**(2.1230)*****
Female vs. female opponent	-21.2569	(2.7769)***
Elo	.3660	(.0051)***
Age	-.2659	(.2117)
Age-squared	.0086	(.0025)***
Teenage	-.7143	(1.4548)
Age difference	.5360	(.0240)***
Share of female opponents, player	-5.2281	(3.9907)
Share of female opponents, opponent	89.7461	(3.2035)***
Number of games (log)	-10.6175	(.5093)***
Risk-loving player	-.0618	(.6230)
Risk-loving opponent	6.8732	(.5946)***
White pieces (first-mover adv.)	-20.7119	(.4291)***
Constant	-808.8361	(10.0483)***
Year and regional dummy	Yes	
R-squared	.214	
Number of players/observations	25,336 / 269,773	

Notes: Western Europe is used as the comparison group for the regional dummies. Robust standard errors in parentheses, clustered at player level. *** significant at 1%, ** significant at 5%, * significant at 10%.

A potential explanation for these findings is that men have a lower discount factor and want to end the game sooner. Another explanation could be that men spend less time in the beginning of the game and fail to achieve the position they have the capacity of, with the consequence that they tend to accept a draw against an inferior opponent more often.

In Table 5, I turn to the survey subsample. From column (1), we see that players who have reported that they are impatient in chess play significantly shorter games, about .9 moves shorter games. The magnitude of the coefficient is obtained by multiplying the mean rating for impatience which is 3.55, see Table A2 in Appendix, with the coefficient .237 in Column (1). Players who smoke play significantly *shorter* games, about 1.1 moves, see column (2). Players who have reported that they are patient in life in general, play about .6 moves *longer* games (6.4*.10), although this coefficient is not significantly different from zero. Note that the number of players in this subsample is substantially lower which produces larger standard errors. As an extra control I also include risk-taking in life in general.

Table 5
Survey data. Game duration in moves regressed with OLS on *impatience in chess*, being a *smoker* and *patience in life in general*.[17]

Dep var: game length in moves	*Impatience*	*Smoker*	*Patience in general*
	(1)	(2)	(3)
Impatience in chess (0-10)	**-.2373**	-	-
	(.0766)***		
Smoker (0 or 1)	-	**-1.1331**	-
		(.6565)*	
Patience in general (0-10)	-	-	**.1005**
			(.0775)
Risk-loving in general (0-10)	-.0816	-.0199	-.0764
	(.0784)	(.0873)	(.0769)
The same controls as in Table 3	…	…	…
R-squared	.207	.207	.206
Number of players/observations	231 / 18,224	230 / 18,214	230 / 18,208

Notes: Western Europe is used as the comparison group for the regional dummies. Robust standard errors in parentheses, clustered at player level. *** significant at 1%, ** significant at 5%, * significant at 10%.

If women prefer to use more time in the beginning of the game, resulting in a higher initial move quality, then they are likely to have to settle with a lower move quality later in the game (due to the time constraint). In Table 6, I regress the game result on a short-game/long-game dummy (1 if less or equal to 38 moves, zero if more than 38). The median game duration in moves is 38, and due to the right-skewed distribution (one is the lower limit but there is no upper limit), I choose the median as a cut-off value rather than the mean.[18] In the four columns of Table 6, I regress on four different variables, *female*, *impatience*, *patience in general* and *performance without time pressure*. As the regression is a difference-in-difference approach, the variables of interest are the interaction coefficients. These coefficients reveal whether the player in focus (indicated by A/B/C/D, where each letter denotes one of the studied groups) performs better in shorter games compared to longer games *and* compared to the comparison group. We see that women (A) perform comparably, and significantly, better in games lasting less than or equal to 38 moves compared with longer games and the comparison group (male players). Impatient players (B), in column (2), are expected to play (too) quickly in the beginning of the game and, hence, score worse in shorter games compared to longer. This pattern is confirmed by the empirical findings as the coefficient is highly significant. In column (3) and (4), I find weak support for patience in general (C) and performance without time pressure (D) leading to better performance in shorter games. However, although these coefficients have the expected sign, they are far from

[17] It would have been interesting to compare how men and women answered the survey questions. Unfortunately, only eleven players were identified as females which is not sufficient to be used for inference.

[18] However, the results in Table 6 are not sensitive to either the mean, median or other close values as 30, 35 or 40. Neither does a dummy denoting 1-39 and 42-upwards, excluding the critical 40th and 41st move, affect the findings more than marginally.

significant. These findings give support to the hypothesis that impatient players perform worse in the beginning of a game.

Table 6
Performance for four different categories for games shorter than 38 and longer or equal to 38 moves, estimated with a diff-in-diff. model (=1 if 1-37, =0 otherwise).

Dep. var. Result	A.. Female	B. Impatience	C. Patience in gen	D. No time pressure
	(1)	(2)	(3)	(4)
Move dummy (1-37)	-.0007	.0249	-.0178	-.0234
	(.0009)	(.0122)***	(.0178)	(.0146)
A/B/C/D	-.0378	.0015	-.0001	-.0027
	(.0036)***	(.0022)	(.0022)	(.0016)
Move dummy * A/B/C/D	**.0082**	**-.0078**	**.0015**	**.0024**
	(.0030)***	(.0026)***	(.0026)	(.0027)
Control var. as in Table 3				

If women spend more time in the first 38 moves, they are more likely to fall short of time (and move quality) later in the game, in particular when approaching the 40th move time control. In Table 7, I present the coefficients for a difference-in-difference (or, rather, a triple-diff.) regression. Games ended in 35 to 45 moves are included, where move 40 is the critical point. Players in time pressure are expected to perform worse at the 40th move compared to other game lengths (35 to 45) and compared to the comparison group. The dependent variable is the result of the game (i.e., performance). The variable of interest is the *Female * 40th move coefficient*. (not the Female * Female opponent * 40th move, since two women are not expected to perform differently than two men). Column (1) gives the result for the whole population and it shows that women perform 2.9 percent worse in the 40th move. Column (2) and (3) reveal that this finding originates from gender differences at the amateur level. There is no significant gender difference for professional players. Column (4) strengthens the credibility of the results as a similar pattern is found when estimating with an ordered logit model. The conclusion from Table 7 is that women perform worse than men at the critical 40th move time control. This is consistent with the hypothesis that women spend more time in the beginning and are more likely to be short of time later in the game.

Table 7
Performance at the critical 40th move with female dummies. The dep. var. is either 1, ½ or 0 (win, draw or loss). The model is estimated by OLS in a diff-in-diff. approach where the 40th move dummy is 1 if move 40, zero if move 35-39 or 41-45.[19]

Dep. var. Results (1, ½, 0) ,for moves 35-45	*All players, OLS*	*Amateurs, Elo<2300, OLS*	*Professionals, Elo>2300, OLS*	*All players Ordered Logit*
	(1)	(2)	(3)	(4)
Female	-.0340	-.0447	-.0071	-.1782
	(.0069)***	(.0079)***	(.0141)	(.0376)***
40th move	-.0013	-.0061	.0029	-.0091
	(.0029)	(.0045)	(.0039)	(.0157)
Female opponent	.0157	.0168	.0087	.0876
	(.0064)**	(.0089)*	(.0092)	(.0345)**
Female * 40th move	**-.0286**	**-.0482**	**.0147**	**-.1489**
	(.0138)**	(.0173)***	(.0234)	(.0773)*
Female opponent * 40th move	-.0112	-.0270	.0071	-.0497
	(.0149)	(.0226)	(.0196)	(.0829)
Female * female opponent	.0035	.0018	.0193	.0211
	(.0080)	(.0106)	(.0128)	(.0433)
Female * female opp. * 40th	.0618	.0964	.0126	.3000
move	(.0228)***	(.0307)***	(.0384)	(.1252)**
White pieces	.0857	.0699	.0995	.4441
	(.0017)***	(.0025)***	(.0022)***	(.0090)***
Elo	-.0002	-.0002	-.0001	(-.0010)
	(.00001)***	(.00002)***	(.00002)***	(.00005)
Elo difference[20]	.0012	.0012	.0013	.0067
	(0.0001)***	(0.0001)***	(0.0001)***	(.00004)
Age	.0009	-.0006	.0019	.0063
	(.0005)*	(.0006)	(.0007)***	(.0025)**
Age squared	-0.0001	0.0001	-.00001	-.00005
	(0.0001)	(0.0001)	(0.0001)	(.00003)*
Age difference	-.0023	-.0023	-.0022	-.0125
	(.0001)***	(.0001)***	(.0001)***	(.0004)***
Teenager <20 years old	.0131	.0013	.0192	.0790
	(.0036)***	(.0054)	(.0050)***	(.0189)***
Risk-loving player	-.0022	-.0010	-.0033	-.0120
	(.0021)	(.0031)	(.0028)	(.0111)
Risk-loving opponent	.0023	.0049	0.0001	.0134
	(.0021)	(.0031)	(.0028)	(.0111)
Share of female opponents,	-.0250	-.0050	-.0843	-.1367
player	(.0095)***	(.0104)	(.0221)***	(.0514)***
Share of female opponents,	.0181	.0064	.0322	.0964
opponent	(.0089)**	(.0117)	(.0135)**	(.0484)**
number of games (log)	.0312	.0330	.0274	.1668
	(.0011)***	(.0015)***	(.0018)***	(.0063)***
Constant	.7190	.8598	.5824	-
	(.0228)***	(.0421)***	(.0395)***	
R squared	.236	.195	.227	.126
Number of players/games	25,633/203,673	22,006/95,539	6,438/107,579	25,633/203,673

Notes: Western Europe is used as the comparison group for the regional dummies. Robust standard errors in parentheses, clustered at player level. * significant at 10%; ** significant at 5%; *** significant at 1%

[19] Without the move restriction of games ended in 35 to 45 moves, i.e., when all games are included, the coefficient of interest is -.03001 (.0135)***.
[20] The Elo difference is highly correlated with the result. However, removing the variable Elo difference from the regressions only affects the results marginally.

In Table 8, I return to the survey subsample where I focus on patience in general, performance without time pressure, smokers and impatience in chess. The variables of interest are the coefficients of the interaction term. In line with the hypothesis and earlier results of this study, we see that players who are patient in life in general tend to end up in time pressure (perform worse) at the critical 40th move, compared to other moves and groups. Multiplied by the mean rating, see Table A.2 in Appendix, I obtain a magnitude of about 7.5 percent lower performance at the 40th move. The coefficient is significantly different from zero. A similar pattern is found for performance without time pressure although the coefficient is smaller and insignificant. The results in column (3) suggest that smokers perform 8.3 percent better at the 40th move. The result for impatience in chess is approximately zero and insignificant.

Table 8
Survey data. Performance at the 40th move and for patience in general, performance without time pressure, smoker and impatience. The model is estimated by OLS in a diff-in-diff. approach where the 40th move dummy is 1 if move 40, zero if move 35-39 or 41-45.[21]

Dep var: Result (1, ½, 0)	*Patience*	*No time pres.*	*Smoker*	*Impatience*
	(1)	(2)	(3)	(4)
40th move	.088649	.0618	-.0025	.0180
	(.0410)**	(.0350)*	(.0231)	(.0322)
Patience in general	.0023	-	-	-
	(.0028)			
Performance without time pressure (hypothetically)	-	-.0025	-	-
		(.0020)		
Smoker	-	-	.0032	-
			(.0147)	
Impatience in chess	-	-	-	.0032
				(.0027)
Patience in gen * 40th move	**-.0130**	-	-	-
	(.0064)**			
Performance without time pressure * 40th move	-	**-.0085**	-	-
		(.0061)		
Smoker * 40th moves	-	-	**.0830**	-
			(.0306)***	
Impatience * 40th move	-	-	-	**.0006**
				(.0075)
Risk-loving in general	-.0004	.0001	-.0010	-.0002
	(.0027)	(.0026)	(.0029)	(.0026)
Controls as in Table 3	…	…	…	…
R-squared	.250	.244	.244	.244
Number of players/obs.	210 / 5,115	211 / 5,118	210 / 5,115	211 / 5,118

[21] The corresponding coefficients of the variables of interest estimated by ordered logit are similar. The coefficients are:: smoker*40th move: .4251 (.1669)**, no-time-pressure*40th move: -.0421 (.0329), impatience*40th move: .0015 (.0394) and patience in general*40th move: -.0802 (.0360)**.

5. Conclusion

This paper finds that male players play shorter games than their female peers on average, and that they are willing to pay a price in the shape of reduced performance to shorten the game. As a consequence, female players perform relatively better in the beginning of the game while male players perform better in the second half. Moreover, women perform worse than men at the 40th move time control. A plausible interpretation is that women spend more time in the beginning of the game and thereby obtain a higher move quality in the beginning. In the second half women are forced, to a higher extent than men, to play with less time for reflection due to the time constraint.

The complementary small-scale survey shows that impatient players play shorter games. The fact that the questions about impatience and being-too-impatient correlate so highly, suggests that this behavior is partly inconsistent. The fact that the data is self-reported indicates that the players are aware of the behavior. This implies that they tend to make a move faster than they would like to do in the long run. Smokers show a similar behavior and since smoking is a notorious example of inconsistency, it seems reasonable to interpret this as a self-control problem. Furthermore, the fact that patient players and players who reported that they would perform better without time pressure, actually perform worse at the 40th move, gives further support to the interpretation.

In economic terms, the findings suggest that male players are more impatient than female players. As to potential self-control problems, men are more inconsistent in the sense that they tend to be too impulsive whereas women are inconsistent in the sense that they tend to over-consume reflection time. It is possible that women are more indecisive and strive for perfectionism to a larger extent than male players. Nevertheless, given that you are aware of the indecisiveness or perfectionism, this is still a self-control problem.

Alternative explanations to the results could be that men and women differ in their perception of effort or that they have different planning abilities or degree of awareness. In psychological research, women, not men, are generally found to be better at planning, see for instance Naglieri and Rojahn (2001) and references given therein. Whatever the underlying explanation to the findings, there *is* a gender difference which may be important to help us understand gender differences and interactions in daily life.[22]

[22] Furthermore, the fact that the gender differences survive nationality controls makes it tempting to conclude that the behavior is universal. However, this does not necessarily mean that the difference is genetic, see, for example, Lundborg and Stenberg (2010) for a discussion.

One objection that could be raised against this study is that it focuses on a non-representative selection of people. For this reason we should be careful not to generalize the results too far. Nonetheless, in light of the opinion that expert chess players are highly rational and act in a highly competitive environment, we would expect their behavior to be a lower bound as regards gender differences in impatience and self-control problems. The accumulated picture of the results is that the magnitude of the gender difference in impatience and inconsistency is about 2 to 5 percent. However, since we do not know with certainty whether these findings really constitute a lower bound or not, some measure of cautiousness when interpreting the results is called for. It is also possible that the data suffer from sample selection, not least because the female share is about 10 percent.

There are particularly three aspects that could be highlighted in future research on this topic and data. Thanks to the panel structure of the data it is possible to follow a player over time to study the development of the inconsistent behavior as a player develops in playing skill. A player that improves in self-control would be expected to improve in Elo rating. It would also be possible to construct a quasi-experiment by exploiting the so called Fischer time (possible with digital clocks). With Fischer time a player receives an additional 30 seconds (usually) for every move and therefore the 40th move time constraint is substantially relaxed in practical play. By comparing the gender differences in tournaments played with and without Fischer time it should be possible to create a reasonably counter-factual control group. Finally, with the increasing popularity of online chess tournaments on the Internet, it should be possible to collect data on the exact amount of time spent on each single move. That could give rise to some interesting further research which would be more precise than in the present study.

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Appendix

Table A.1
Rater characteristics

Rater characteristics		
Smoker	No: 198 (85%)	Yes: 35 (15%)
Mean Elo	2167.047	St. dev. 128.709
Mean age	36 (in 2011)	St. dev. 12.337
Gender	Male: 224 (95.2%)	Female: 11 (4.8 %)

Table A.2
Survey statistics

Survey characteristics								
	Impatient, 0=not at all, 10=very much		Patient in gen., 0=very imp., 10=very pat.		Risky in gen., 0=min risk, 10=max risk		No time pressure, 0=not at all, 10=very much	
No. of players	234		233		233		234	
Mean rating	3.555 (2.520)		6.377 (2.479)		4.519 (2.515)		5.948 (3.152)	
rate	*answers*	*%*	*answers*	*%*	*answers*	*%*	*answers*	*%*
0	27	11.54	1	0.43	8	3.43	15	6.41
1	25	10.68	5	2.15	17	7.30	7	2.99
2	39	16.67	16	6.87	34	14.59	25	10.68
3	45	19.23	19	8.15	42	18.03	25	10.68
4	18	7.69	17	7.30	16	6.87	4	1.71
5	27	11.54	22	9.44	30	12.88	19	8.12
6	15	6.41	17	7.30	21	9.01	12	5.13
7	15	6.41	39	16.74	34	14.59	28	11.97
8	18	7.69	54	23.18	21	9.01	46	19.66
9	2	0.85	23	9.87	4	1.72	17	7.26
10	3	1.28	20	8.58	6	2.58	36	15.38